MITSUBISHI ELECTRIC

Programmable Automation Controllers

MELSEC MX Controller

MELSEC MX Controller MX-R Model User's Manual

-MXR300-16
-MXR300-32
-MXR300-64
-MXR500-128
-MXR500-256

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using Mitsubishi Electric programmable automation controllers, please read the manuals for the products used and the relevant manuals carefully and pay full attention to safety to handle the products correctly. If products are used in a different way from that specified by manufacturers, the protection function of the products may not work properly.

In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

⚠ **WARNING**	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ **CAUTION**	Indicates that incorrect handling may cause hazardous conditions, resulting in minor or moderate injury or property damage.

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.

Observe the precautions of both levels because they are important for personal and system safety.

Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠ WARNING

- Configure safety circuits external to the programmable controller to ensure that the entire system operates safely even when a fault occurs in the external power supply or the programmable controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  (1) Emergency stop circuits, protection circuits, and protective interlock circuits for conflicting operations (such as forward/reverse rotations or upper/lower limit positioning) must be configured external to the programmable controller.
  (2) When the programmable controller detects an abnormal condition, it stops the operation and all outputs are:
    • Turned off if the overcurrent or overvoltage protection of the power supply module is activated.
    • Held or turned off according to the parameter setting if the self-diagnostic function of the controller detects an error such as a watchdog timer error.
  (3) All outputs may be turned on if an error occurs in a part, such as an I/O control part, where the controller cannot detect any error. To ensure safety operation in such a case, provide a safety mechanism or a fail-safe circuit external to the programmable controller. For a fail-safe circuit example, refer to "General Safety Requirements" in the MELSEC iQ-R Module Configuration Manual.
  (4) Outputs may remain on or off due to a failure of a component such as a relay and transistor in an output circuit. Configure an external circuit for monitoring output signals that could cause a serious accident.
- In an output circuit, when a load current exceeding the rated current or an overcurrent caused by a load short-circuit flows for a long time, it may cause smoke and fire. To prevent this, configure an external safety circuit, such as a fuse.
- Configure a circuit so that the programmable controller is turned on first and then the external power supply. If the external power supply is turned on first, an accident may occur due to an incorrect output or malfunction.
- Configure a circuit so that the external power supply is turned off first and then the programmable controller. If the programmable controller is turned off first, an accident may occur due to an incorrect output or malfunction.
- For the operating status of each station after a communication failure, refer to manuals for the network used. For the manuals, please consult your local Mitsubishi representative. Failure to do so may result in an accident due to an incorrect output or malfunction.
- When connecting an external device with a controller or intelligent function module to modify data of a running programmable controller, configure an interlock circuit in the program to ensure that the entire system will always operate safely. For other forms of control (such as program modification, parameter change, forced output, or operating status change) of a running programmable controller, read the relevant manuals carefully and ensure that the operation is safe before proceeding. Improper operation may damage machines or cause accidents.

[Design Precautions]

⚠ WARNING

- Especially, when a remote programmable controller is controlled by an external device, immediate action cannot be taken if a problem occurs in the programmable controller due to a communication failure. To prevent this, configure an interlock circuit in the program, and determine corrective actions to be taken between the external device and programmable controller in case of a communication failure.
- Do not write any data to the "system area" and "write-protect area" of the buffer memory in the module. Also, do not use any "use prohibited" signals as an output signal from the controller to each module. Doing so may cause malfunction of the programmable controller system. For the "system area", "write-protect area", and the "use prohibited" signals, refer to the user's manual for the module used.
- If a communication cable is disconnected, the network may be unstable, resulting in a communication failure of multiple stations. Configure an interlock circuit in the program to ensure that the entire system will always operate safely even if communications fail. Incorrect output or malfunction due to a communication failure may result in an accident.
- To ensure that the entire system operates safely, configure interlock circuits external to the programmable controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  (1) OPR (Homing) is controlled by two kinds of data: an OPR direction and an OPR speed. Deceleration is performed when the proximity dog signal turns on. If an incorrect OPR direction is set, motion control may continue without deceleration.
  (2) When the controller detects an error, the operation decelerates and stops or suddenly stops, depending on the parameter settings. Set the parameters to meet the specifications of the system used.
- If safety standards (such as robot safety rules) apply to the system using the controller, drive unit, and servo motor, ensure that the safety standards are satisfied.
- Configure a safety circuit external to the module or drive unit if the abnormal operation of the controller or drive unit differs from the safety directive operation in the system.

[Design Precautions]

⚠ CAUTION

- Do not install the control lines or communication cables together with the main circuit lines or power cables. Doing so may result in malfunction due to electromagnetic interference. Keep a distance of 100mm or more between those cables.
- During control of an inductive load such as a lamp, heater, or solenoid valve, a large current (approximately ten times greater than normal) may flow when the output is turned from off to on. Therefore, use a module that has a sufficient current rating.
- After the programmable controller is powered on or is reset, the time taken for the controller to enter the RUN status varies depending on the system configuration, parameter settings, and/or program size. Design circuits so that the entire system will always operate safely, regardless of the time.
- Do not power off the programmable controller or reset the controller while the settings are being written. Doing so will make the data in the flash ROM and SD memory card undefined. The values need to be set in the buffer memory and written to the flash ROM and SD memory card again. Doing so also may cause malfunction or failure of the module.
- When changing the operating status of the controller from external devices (such as the remote RUN/STOP functions), select "Do Not Open by Program" for "Opening Method" of "Module Parameter". If "Open by Program" is selected, an execution of the remote STOP function causes the communication line to close. Consequently, the controller cannot reopen the line, and external devices cannot execute the remote RUN function.
- The base unit and modules mounted on the base unit must be powered by a power supply that complies with Safety Extra-Low Voltage (SELV) and Limited Energy Circuit (LIM) or one that complies with UL 1310 Class 2.

[Security Precautions]

⚠ WARNING

- To maintain the security (confidentiality, integrity, and availability) of the programmable controller and the system against unauthorized access, denial-of-service (DoS) attacks, computer viruses, and other cyberattacks from external devices via the network, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.

[Installation Precautions]

⚠ WARNING

- Shut off the external power supply (all phases) used in the system before mounting or removing the module. Failure to do so may result in electric shock or cause the module to fail or malfunction.

[Installation Precautions]

⚠ CAUTION

- Use the programmable controller in an environment that meets Page 208 GENERAL SPECIFICATIONS in this manual. Failure to do so may result in electric shock, fire, malfunction, or damage to or deterioration of the product.
- To mount a module, place the concave part(s) located at the bottom onto the guide(s) of the base unit, and push in the module until the hook(s) located at the top snaps into place. Incorrect interconnection may cause malfunction, failure, or drop of the module.
- To mount a module with no module fixing hook, place the concave part(s) located at the bottom onto the guide(s) of the base unit, push in the module, and fix it with screw(s). Incorrect interconnection may cause malfunction, failure, or drop of the module.
- When using the programmable controller in an environment of frequent vibrations, fix the module with a screw.
- Tighten the screws within the specified torque range. Undertightening can cause drop of the component or wire, short circuit, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. For the specified torque range, refer to the MELSEC iQ-R Module Configuration Manual.
- When using an extension cable, connect it to the extension cable connector of the base unit securely. Check the connection for looseness. Poor contact may cause malfunction.
- When using an SD memory card, fully insert it into the SD memory card slot. Check that it is inserted completely. Poor contact may cause malfunction.
- Beware that the module could be very hot while power is on and immediately after power-off.
- Do not directly touch any conductive parts and electronic components of the module, SD memory card, or connector. Doing so can cause malfunction or failure of the module.

[Wiring Precautions]

⚠ WARNING

- Shut off the external power supply (all phases) used in the system before installation and wiring. Failure to do so may result in electric shock or cause the module to fail or malfunction.
- After installation and wiring, attach a blank cover module (RG60) to each empty slot before powering on the system for operation. Also, attach an extension connector protective cover[*1] to each unused extension cable connector as necessary. Directly touching any conductive parts of the connectors while power is on may result in electric shock.
  *1 For details, please consult your local Mitsubishi Electric representative.

[Wiring Precautions]

⚠ CAUTION

- Individually ground the FG and LG terminals of the programmable controller with a ground resistance of 100 ohms or less. Failure to do so may result in electric shock or malfunction.
- Use applicable solderless terminals and tighten them within the specified torque range. If any spade solderless terminal is used, it may be disconnected when the terminal screw comes loose, resulting in failure.
- Check the rated voltage and terminal layout before wiring to the module, and connect the cables correctly. Connecting a power supply with a different voltage rating or incorrect wiring may cause fire or failure.
- Connectors for external devices must be crimped or pressed with the tool specified by the manufacturer, or must be correctly soldered.
- Securely connect the connector to the module. Poor contact may cause malfunction.
- Do not install the control lines or communication cables together with the main circuit lines or power cables. Doing so may result in malfunction due to noise. Keep a distance of 100mm or more between those cables.
- Place the cables in a duct or clamp them. If not, dangling cables may swing or inadvertently be pulled, resulting in malfunction or damage to modules or cables.
  In addition, the weight of the cables may put stress on modules in an environment of strong vibrations and shocks.
  Do not clamp the extension cables with the jacket stripped. Doing so may change the characteristics of the cables, resulting in malfunction.
- Check the interface type and correctly connect the cable. Incorrect wiring (connecting the cable to an incorrect interface) may cause failure of the module and external device.
- Tighten the terminal screws or connector screws within the specified torque range. Undertightening can cause drop of the screw, short circuit, fire, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- When disconnecting the cable from the module, do not pull the cable by the cable part. For the cable with connector, hold the connector part of the cable. For the cable connected to the terminal block, loosen the terminal screw. Pulling the cable connected to the module may result in malfunction or damage to the module or cable.
- Prevent foreign matter such as dust or wire chips from entering the module. Such foreign matter can cause a fire, failure, or malfunction.
- When a protective film is attached to the top of the module, remove it before system operation. If not, inadequate heat dissipation of the module may cause a fire, failure, or malfunction.
- Programmable controllers must be installed in control panels. Connect the main power supply to the power supply module in the control panel through a relay terminal block. Wiring and replacement of a power supply module must be performed by qualified maintenance personnel with knowledge of protection against electric shock. For wiring, refer to the MELSEC iQ-R Module Configuration Manual.
- For Ethernet cables to be used in the system, select the ones that meet the specifications in the user's manual for the module used. If not, normal data transmission is not guaranteed.

[Startup and Maintenance Precautions]

⚠ WARNING

- Do not touch any terminal while power is on. Doing so will cause electric shock or malfunction.
- Correctly connect the battery connector. Do not charge, disassemble, heat, short-circuit, solder, or throw the battery into the fire. Also, do not expose it to liquid or strong shock. Doing so will cause the battery to produce heat, explode, ignite, or leak, resulting in injury and fire.
- Shut off the external power supply (all phases) used in the system before cleaning the module or retightening the terminal screws, connector screws, or module fixing screws. Failure to do so may result in electric shock.

[Startup and Maintenance Precautions]

⚠ CAUTION

- When connecting an external device with a controller or intelligent function module to modify data of a running programmable controller, configure an interlock circuit in the program to ensure that the entire system will always operate safely. For other forms of control (such as program modification, parameter change, forced output, or operating status change) of a running programmable controller, read the relevant manuals carefully and ensure that the operation is safe before proceeding. Improper operation may damage machines or cause accidents.
- Especially, when a remote programmable controller is controlled by an external device, immediate action cannot be taken if a problem occurs in the programmable controller due to a communication failure. To prevent this, configure an interlock circuit in the program, and determine corrective actions to be taken between the external device and controller in case of a communication failure.
- Do not disassemble or modify the modules. Doing so may cause failure, malfunction, injury, or a fire.
- Use any radio communication device such as a cellular phone or PHS (Personal Handy-phone System) 25cm or more away in all directions from the programmable controller. Failure to do so may cause malfunction.
- Shut off the external power supply (all phases) used in the system before mounting or removing the module. Failure to do so may cause the module to fail or malfunction.
- Tighten the screws within the specified torque range. Undertightening can cause drop of the component or wire, short circuit, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- After the first use of the product, do not perform each of the following operations more than 50 times (IEC 61131-2/JIS B 3502 compliant).
  Exceeding the limit may cause malfunction.
  - Mounting/removing the module to/from the base unit
  - Mounting/removing the terminal block to/from the module
  - Connecting/disconnecting the extension cable to/from the base unit
- After the first use of the product, do not insert/remove the SD memory card to/from the controller more than 500 times. Exceeding the limit may cause malfunction.
- Do not touch the metal terminals on the back side of the SD memory card. Doing so may cause malfunction or failure of the module.
- Do not drop or apply shock to the battery to be installed in the module. Doing so may damage the battery, causing the battery fluid to leak inside the battery. If the battery is dropped or any shock is applied to it, dispose of it without using.

[Startup and Maintenance Precautions]

⚠ CAUTION

- Startup and maintenance of a control panel must be performed by qualified maintenance personnel with knowledge of protection against electric shock. Lock the control panel so that only qualified maintenance personnel can operate it.
- Before handling the module, touch a conducting object such as a grounded metal to discharge the static electricity from the human body. Wearing a grounded antistatic wrist strap is recommended. Failure to discharge the static electricity may cause the module to fail or malfunction.
- Use a clean and dry cloth to wipe off dirt on the module.
- Before starting the operation, check if the brake function operates correctly.
- Before testing the operation, set a low speed value for the speed limit parameter so that the operation can be stopped immediately upon occurrence of a hazardous condition.
- Confirm and adjust the program and each parameter before operation. Unpredictable movements may occur depending on the machine.
- When using the absolute position system, on starting up, and when the module or absolute position motor has been replaced, always perform a homing.
- After maintenance and inspections are completed, check that the positions detected in the absolute position detection are correct.

[Operating Precautions]

⚠ CAUTION

- When changing data and operating status, and modifying program of the running programmable controller from an external device such as a personal computer connected to an intelligent function module, read relevant manuals carefully and ensure the safety before operation. Incorrect change or modification may cause system malfunction, damage to the machines, or accidents.
- Do not power off the programmable controller or reset the controller while the setting values in the buffer memory are being written to the flash ROM in the module. Doing so will make the data in the flash ROM and SD memory card undefined. The values need to be set in the buffer memory and written to the flash ROM and SD memory card again. Doing so also may cause malfunction or failure of the module.
- Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.
- When the reference axis speed specification is used in interpolation operation, the speed of the partner axis (2nd, 3rd, or 4th axis) may exceed the set speed and ultimately the speed limit value.

[Computer Connection Precautions]

⚠ CAUTION

- When connecting a personal computer to a module having a USB interface, observe the following precautions as well as the instructions described in the manual for the personal computer used. Failure to do so may cause the module to fail.
  (1) When the personal computer is AC-powered
  When the personal computer has a 3-pin AC plug or an AC plug with a grounding wire, connect the plug to a grounding receptacle or ground the grounding wire. Ground the personal computer and the module with a ground resistance of 100 ohms or less.
  When the personal computer has a 2-pin AC plug without a grounding wire, connect the computer to the module by following the procedure below. For power supplied to the personal computer and the module, using the same power source is recommended.
  1. Unplug the personal computer from the AC receptacle.
  2. Check that the personal computer is unplugged. Then, connect the personal computer to the module with a USB cable.
  3. Plug the personal computer into the AC receptacle.
  (2) When the personal computer is battery-powered
  The personal computer can be connected to the module without taking specific measures.

[Disposal Precautions]

⚠ CAUTION

- When disposing of this product, treat it as industrial waste.
- When disposing of batteries, separate them from other wastes according to the local regulations. For details on battery regulations in EU member states, refer to the MELSEC iQ-R Module Configuration Manual.

[Transportation Precautions]

⚠ CAUTION

- When transporting lithium batteries, follow the transportation regulations. For details on the regulated models, refer to the MELSEC iQ-R Module Configuration Manual.
- The halogens (such as fluorine, chlorine, bromine, and iodine), which are contained in a fumigant used for disinfection and pest control of wood packaging materials, may cause failure of the product. Prevent the entry of fumigant residues into the product or consider other methods (such as heat treatment) instead of fumigation. The disinfection and pest control measures must be applied to unprocessed raw wood.

INTRODUCTION

Thank you for purchasing the Mitsubishi Electric programmable automation controllers.
This manual describes the procedures before operation, specifications, functions, devices, parameters, and troubleshooting of the relevant products listed below.
Before using this product, please read this manual and the relevant manuals carefully and develop familiarity with the functions and performance of the controller to handle the product correctly.
When applying the program examples provided in this manual to an actual system, ensure the applicability and confirm that it will not cause system control problems.
Note that the menu names and operating procedures may differ depending on an operating system in use and its version. When reading this manual, replace the names and procedures with the applicable ones as necessary.
Please make sure that the end users read this manual.

Point

The MELSEC MX Controller MX-R Model is used in combination with the MELSEC iQ-R series modules. This manual describes detailed information on the MELSEC MX Controller MX-R Model. For details on the MELSEC iQ-R series modules, refer to their user's manuals.

Relevant products

- MXR300-16, MXR300-32, MXR300-64
- MXR500-128, MXR500-256

Structure of this manual

This section describes the MELSEC MX Controller MX-R Model in the following structures.

- PART 1 to PART 3 describe the contents to be read first.
- PART 4 to PART 6 describe the contents to be referred to when constructing a system.
- PART 7 to PART 15 describe the contents such as the functions and operations of this module.
- PART 16 and PART 17 describe the contents of the required measures for maintenance and troubleshooting.

Item	Description
PART 1 OVERVIEW	What can be achieved with this module
PART 2 PART NAMES	External appearance and LED indications
PART 3 PROCEDURES BEFORE OPERATION	Procedures before operation such as installation, wiring, and the basic parameter settings. The procedure for the program creation is also included.
PART 4 SYSTEM CONFIGURATION	Modules and software that can be used. For the system configuration of the network, refer to Part 5 (COMMUNICATION WITH DEVICES).
PART 5 COMMUNICATION WITH DEVICES	A system configuration of CC-Link IE TSN and Ethernet. Their setting methods are also included.
PART 6 SPECIFICATIONS	General specifications and performance specifications. The motion control and CC-Link IE TSN specifications are also included.
PART 7 CONTROLLER OPERATION	Sequence control scans, program execution, and memory configuration. CC-Link IE TSN communication cycle and motion operation are also included.
PART 8 DEVICES, LABELS, AND CONSTANTS	Devices and labels. A setting method for a device that is required to be set in advance and backup power (latch) for a device is also included.
PART 9 FUNCTIONS	Function overview of the motion control, CC-Link IE TSN, Ethernet, data collection, and security. For details on these functions, refer to each part.
PART 10 MOTION CONTROL	The settings, functions, operation cycle, and each control for performing the motion control
PART 11 CC-Link IE TSN	The cyclic transmission, transient transmission, and other functions of CC-Link IE TSN. For the system configuration and setting procedures to connect with CC-Link IE TSN, refer to "COMMUNICATION WITH DEVICES".
PART 12 Ethernet	Each communication using Ethernet. For the system configuration and setting procedures to connect with Ethernet (SLMP, communication protocol, FTP, OPC UA, and others), refer to "COMMUNICATION WITH DEVICES".
PART 13 DATA COLLECTION	How to collect device values at a specified interval or at a desired timing
PART 14 SECURITY	How to prevent unauthorized access and data outflow
PART 15 ONLINE OPERATION	Online change, remote operation, and monitor performed from the engineering tool
PART 16 MAINTENANCE AND INSPECTION	Daily inspection and periodic inspection. Backup for the various data and firmware update methods
PART 17 TROUBLESHOOTING	Troubleshooting procedure. Error codes and event codes are also included.

CONTENTS

SAFETY PRECAUTIONS 1
INTRODUCTION 10
RELEVANT MANUALS 39
TERMS 40
GENERIC TERMS AND ABBREVIATIONS 43

PART 1 OVERVIEW

CHAPTER 1 MELSEC MX CONTROLLER 46

PART 2 PART NAMES

CHAPTER 2 CONTROLLER 50

2.1 MX-R Model 50

PART 3 PROCEDURES BEFORE OPERATION

CHAPTER 3 START-UP PROCEDURE 54

3.1 Connection Example 55
3.2 Mounting the Controller 56
Installing a battery 56
Inserting and removing an SD memory card 57
Mounting/removing the controller on/from a main base unit 58
3.3 Wiring 62
Wiring products 62
Ethernet cable wiring method 64

CHAPTER 4 CONNECTION BETWEEN THE PERSONAL COMPUTER AND CONTROLLER 66

4.1 Engineering Tool Setting 66
Creating a project 66
Connection between the personal computer and controller 68
Initializing the controller 70

CHAPTER 5 PARAMETER SETTINGS 71

5.1 Creating a Module Configuration 71
5.2 Network Settings 73
Setting a network configuration 73
5.3 Motion Setting 75
PDO mapping 75
Servo parameter settings 76
Axis parameter settings 79
Driver unit conversion (electronic gear) 86
Reflecting axis parameters 91
Axes group settings 92

5.4 **Saving a Project** 95
5.5 **Writing to the Controller** 96

CHAPTER 6 PROGRAM EXAMPLES 97

6.1 **Creation Procedure for Controller Programs** 98
Creating a program block 98
Program execution types 99
How to input an FB 100
6.2 **Labels** 106
Naming rules for labels 106
Global label list 107
6.3 **Motion Program Example** 110
6.4 **Checking Operation** 111
Conversion and writing of programs 111
Axis monitor 112
Program monitor 113
Watch 114
Event history 115

PART 4 SYSTEM CONFIGURATION

CHAPTER 7 CONTROLLER SYSTEM CONFIGURATION 118

7.1 **Overall Configuration** 118
Single CPU system 119
7.2 **Lists of Configuration Devices** 120
7.3 **System Configuration Specifications** 123
Modules having restrictions on the number of mountable modules 124
7.4 **Applicable Software** 125
7.5 **Access Range** 126
When the connected station is a controller 126
When the connection destination is a controller 127
7.6 **Precautions for System Configuration** 128

CHAPTER 8 ASSIGNMENT FOR MODULES 129

8.1 **Slot Numbers on a Base Unit** 130
8.2 **I/O Numbers of Modules** 133

PART 5 COMMUNICATION WITH EQUIPMENT

CHAPTER 9 CC-Link IE TSN SYSTEM CONFIGURATION 142

9.1 **Required Settings** 144
9.2 **Basic Settings** 147
9.3 **Application Settings** 151
9.4 **"CC-Link IE TSN Configuration" Window (Network Configuration Settings)** 153
Parameter setting of a device station 153
Device station parameter automatic setting 157
Detection of connected/disconnected devices 158
Parameter processing of a device station 161
Command execution to device stations 164

PDO mapping setting . . . 165
Change of module . . . 168
Device number reassignment . . . 169
Object name display . . . 170
9.5 Structure with CC-Link IE TSN Class B Devices Only . . . 171
Structure of unicast mode . . . 172
Structure with modules on CC-Link IE TSN only . . . 173
Structure with modules on CC-Link IE TSN and Ethernet devices . . . 176
9.6 Structure with CC-Link IE TSN Class B/A Devices . . . 178
Structure of unicast mode . . . 179
Structure with modules on CC-Link IE TSN only . . . 180
Structure with modules on CC-Link IE TSN and Ethernet devices . . . 187
9.7 Structure of the CC-Link IE TSN and CC-Link IE Field Network . . . 188
9.8 Precautions for System Configuration . . . 189

CHAPTER 10 Ethernet SYSTEM CONFIGURATION 190

10.1 Required Settings . . . 190
10.2 Basic Settings . . . 191
10.3 Application Settings . . . 192
10.4 "Ethernet Configuration" Window (External Device Configuration Setting) . . . 194
Setting method . . . 194
Setting items . . . 196
10.5 Connection with MELSOFT Product and GOT . . . 200
Direct connection . . . 201
Specifying IP address . . . 204
Searching modules on the network . . . 206

PART 6 SPECIFICATIONS

CHAPTER 11 GENERAL SPECIFICATIONS 208

CHAPTER 12 PERFORMANCE SPECIFICATIONS 210

12.1 Controller . . . 210
Hardware specifications . . . 210
Programming specifications . . . 212
Motion control specifications . . . 214
Network specifications . . . 215

PART 7 CONTROLLER OPERATION

CHAPTER 13 SCAN CONFIGURATION 218

13.1 Initial Processing (When Powered On or Switched to RUN) . . . 220
13.2 I/O Refresh . . . 220
13.3 Program Operation . . . 220
13.4 END Processing . . . 221
13.5 Scan Time . . . 222
Initial scan time . . . 222
Constant scan . . . 224
Device/label access service processing setting . . . 226

13.6 **Data Communication and I/O Processing** . . . 233
Data communication . . . 233
I/O processing and response delay . . . 233
Refresh mode . . . 234
Direct mode . . . 241

CHAPTER 14 RUNNING A PROGRAM 243

14.1 **Program Flow** . . . 243
14.2 **Program Setting** . . . 244
14.3 **Program Execution Type** . . . 246
Initial execution type program . . . 246
Scan execution type program . . . 247
Fixed scan execution type program . . . 248
Event execution type program . . . 252
Standby type program . . . 257
Execution type change . . . 258
Group setting for refresh . . . 259
14.4 **Subroutine Program** . . . 260
14.5 **Interrupt Program** . . . 261
Operation upon occurrence of an interrupt factor . . . 262
Varying operation depending on the interrupt factor . . . 263
Interrupt period setting . . . 268
Processing at interrupt program startup . . . 269
Multiple interrupt . . . 274
Precautions . . . 277

CHAPTER 15 OPERATING STATUS OF THE CONTROLLER 279

15.1 **Operating Statuses** . . . 279
15.2 **Operation When Operating Status Is Changed** . . . 280
Output mode at operating status change (STOP to RUN) . . . 281
15.3 **Operation during a Momentary Power Failure** . . . 283
15.4 **Operation When an Error Occurs** . . . 283

CHAPTER 16 CC-Link IE TSN COMMUNICATION CYCLE AND MOTION OPERATION 284

16.1 **Network Synchronous Communication** . . . 286
Communication cycle coexistence . . . 292
16.2 **Program Execution Synchronized with Communication Cycle** . . . 295
16.3 **Communication Cycle Adjustment** . . . 306
Adjustment by "Communication Period Interval Setting" and "Cyclic Transmission Time" . . . 306
Adjustment by reviewing immediately before processing . . . 308
Cyclic transmission distribution . . . 310
CC-Link IE TSN Class A group send . . . 312
Device number reassignment . . . 314

CHAPTER 17 CONTROLLER MEMORY CONFIGURATION 315

17.1 **Memory Configuration** . . . 315
Program memory/program cache memory . . . 316
Data memory . . . 318
Device/label memory . . . 319

Motion data memory . . . 322
Function memory . . . 322
Refresh memory . . . 322
Buffer memory . . . 322
Signal flow memory . . . 323
SD memory card . . . 324
17.2 Memory Capacity . . . 330
17.3 File Size Unit in Memory . . . 330
17.4 Number of Storable Files . . . 330
17.5 Number of Storage Folders . . . 331
17.6 Drive Number Definition for Memory . . . 331
17.7 Memory Operation . . . 332
Initialization and value clear . . . 332
17.8 Memory Access Control . . . 334
17.9 Target Memory for All Information Initialization . . . 334
17.10 Files . . . 335
File/folder specifications . . . 335
File types and storage memory . . . 336
File operation available . . . 340
17.11 Specifying Path for Motion Control . . . 342
Drive configuration . . . 342
Specifying path . . . 342
Working folder . . . 344
Precautions . . . 344

PART 8 DEVICES, LABELS, AND CONSTANTS

CHAPTER 18 DEVICES AND CONSTANTS 346

18.1 Device List . . . 346
18.2 Device Setting . . . 347
Range of use of device points . . . 348
18.3 User Device . . . 349
Input (X) . . . 349
Output (Y) . . . 350
Internal relay (M) . . . 350
Latch relay (L) . . . 350
Link relay (B) . . . 350
Annunciator (F) . . . 351
Link special relay (SB) . . . 353
Edge relay (V) . . . 354
Timer . . . 356
Counter . . . 365
Data register (D) . . . 368
Link register (W) . . . 368
Link special register (SW) . . . 368
18.4 System Device . . . 369
Function device (FX/FY/FD) . . . 369
Special relay (SM) . . . 370
Special register (SD) . . . 370

18.5 Link Direct Device . . . 371
Specification method . . . 371
Specification range . . . 371
Difference from link refresh . . . 372
How to access CC-Link IE TSN link device . . . 372
18.6 Module Access Device . . . 373
Buffer memory specification method . . . 374
How to access CC-Link IE TSN link device . . . 374
Precautions . . . 374
18.7 CPU Buffer Memory Access Device . . . 375
Buffer memory specification method . . . 375
How to access CC-Link IE TSN link device . . . 375
18.8 Index Register (Z/LZ) . . . 376
16-bit index modification . . . 376
32-bit index modification . . . 376
Device for which index modification can be performed . . . 377
Index register setting . . . 377
Combination of index modification . . . 378
Precautions . . . 379
18.9 File Register (R/ZR) . . . 380
Specification method . . . 380
Setting file registers . . . 381
Clearing file registers . . . 382
18.10 Refresh Data Register (RD) . . . 382
Refresh memory setting . . . 383
18.11 Nesting (N) . . . 384
18.12 Pointer (P) . . . 385
Global pointer . . . 385
Local pointer . . . 386
Pointer setting . . . 387
18.13 Interrupt Pointer (I) . . . 388
Interrupt factors of the interrupt pointer numbers . . . 388
Priority for the interrupt pointer numbers and interrupt factors . . . 389
18.14 Network No. Specification Device (J) . . . 390
18.15 I/O No. Specification Device (U) . . . 390
18.16 Global Device . . . 390
18.17 Local Device . . . 390
18.18 Device Indirect Specification . . . 395
18.19 Constants . . . 396
Decimal constant (K) . . . 396
Hexadecimal constant (H) . . . 396
Real constant (E) . . . 396
Character string constant . . . 397
Notation of constants . . . 397

CHAPTER 19 LABELS 399

19.1 Global Labels . . . 400
Module label . . . 400
19.2 Local Labels . . . 400
19.3 Classes . . . 401

19.4 Data Types . . . 402
19.5 Arrays . . . 406
19.6 Structures . . . 410
19.7 Label Access Setting from External Device . . . 412
Configuration procedure . . . 414
Global label assignment information . . . 414
Auto-tracking when the label assignment is changed . . . 414
19.8 Precautions . . . 415

CHAPTER 20 LATCH FUNCTION 418

20.1 Device/Label Latch . . . 418
Types of latch . . . 418
Applicable devices and labels . . . 418
Setting latch on devices . . . 419
Setting latch on labels . . . 422
Clearing latch range data . . . 422
Number of points that can be latched . . . 423
When SD memory card is specified . . . 424
Related special relay/special register areas . . . 424
Precautions . . . 425

CHAPTER 21 DEVICE/LABEL INITIAL VALUE SETTINGS 426

21.1 Setting Device/Label Initial Values . . . 426
Setting device initial values . . . 426
Setting initial label values . . . 428
21.2 Applicable Devices/Labels . . . 431
21.3 Device/Label Initialization After Writing . . . 431
21.4 Device/Label Initial Value Reflection After Device/Label Clear Operation Is Executed . . . 431
21.5 Precautions . . . 432

PART 9 FUNCTIONS

CHAPTER 22 FUNCTION LIST 434

22.1 Motion Control . . . 434
22.2 CC-Link IE TSN . . . 437
22.3 Ethernet . . . 438
22.4 Data Collection . . . 439
22.5 Security . . . 439

PART 10 MOTION CONTROL

CHAPTER 23 AXIS SETTING 443

23.1 Axis . . . 443
Relevant variable . . . 443
Maximum number of controlled axes . . . 444
Required settings for axes . . . 444
Axis variables . . . 444
Axis variable initialization timing . . . 445
How to specify in a user program . . . 446

Axis status . . . 446
Precautions . . . 448
23.2 Axis Type . . . 449
Relevant variables . . . 449
Real drive axis . . . 453
Real encoder axis . . . 455
Virtual drive axis . . . 461
Virtual encoder axis . . . 461
Virtual linked axis . . . 465
23.3 Axis Assignment . . . 466
Relevant variables . . . 468
Object data settings . . . 469
PDO mapping setting . . . 470
Setting procedure . . . 470
Memory usage . . . 471
Object data list . . . 472
Motion system function and object data . . . 477
Precautions . . . 477
23.4 Axes Group . . . 478
Relevant variables . . . 478
Relevant FBs . . . 479
Settings required for axes group . . . 479
Axes group variables . . . 479
Axes group variable initialization timing . . . 480
How to specify in a user program . . . 480
Axes group status . . . 480
Axes group enabled . . . 482
Axes group disabled . . . 484
Precautions . . . 486
23.5 Axes Group Assignment . . . 487
Relevant variables . . . 487
Setting with engineering tool . . . 488
Precautions . . . 489

CHAPTER 24 AXIS MANAGEMENT FUNCTIONS 490

24.1 Units . . . 490
Relevant variables . . . 490
Setting methods . . . 491
Precautions . . . 495
24.2 Positioning Range . . . 496
Relevant variables . . . 496
Set position . . . 497
Combination with other functions . . . 498
Precautions . . . 498
24.3 Velocity Range . . . 499
Relevant variables . . . 499
Velocity command range . . . 500
Precautions . . . 500
24.4 Servo ON/OFF . . . 501
Relevant variables . . . 501

Relevant FBs . . . 501
Control details . . . 502
Precautions . . . 503
24.5 Follow Up . . . 504
Relevant variables . . . 505
Disabling follow up . . . 506
Precautions . . . 509
24.6 Absolute Position Control . . . 510
Relevant variables . . . 511
Current position restoration . . . 512
Absolute position data backup . . . 515
Current position restoration for each axis type . . . 517
Required object data . . . 521
Precautions . . . 521

CHAPTER 25 OPERATION CYCLE 522

25.1 Relevant Variables . . . 522
25.2 Motion Operation Cycle Setting . . . 524
25.3 Operation Cycle Assignment . . . 527
25.4 Motion Operation Processing Time Monitor . . . 528
Relevant Variables . . . 528
Control details . . . 528
Precautions . . . 529
25.5 Specifications of Modules on CC-Link IE TSN Configuration Controlled by the Motion System . . . 530
25.6 Send/Receive Data Refresh of Network Connected Devices . . . 531
25.7 Send/Receive Data Refresh of I/O Modules and Intelligent Function Modules . . . 534
25.8 Operation Cycle Coexistence . . . 535
25.9 Precautions for Programming . . . 542

CHAPTER 26 START AND STOP 543

26.1 Start . . . 543
Relevant variables . . . 543
Starting conditions . . . 545
26.2 Retrigger/Continuous Update . . . 546
26.3 Multiple Start (Buffer Mode) . . . 547
Relevant variables . . . 551
Multiple start during single axis operation . . . 552
Multiple start during multiple axes operation . . . 561
Options of buffering FB . . . 569
Near pass . . . 570
Combination with retrigger/continuous update . . . 571
Precautions . . . 576
26.4 Stop . . . 578
Relevant variables . . . 579
Relevant FBs . . . 583
Stop cause lists . . . 584
Types of stop processes . . . 586
Order of priority for stop process . . . 590
Overrun at stop cause occurrence . . . 591
Stop during single axis operation . . . 592

Stop during axes group operation . . . 600
Precautions . . . 608
26.5 Forced Stop . . . 609
Relevant variables . . . 610
Operation at the forced stop occurrence . . . 613
Operation at the forced stop release . . . 615
Check method . . . 616
Precautions . . . 616

CHAPTER 27 HOMING 617

27.1 Overview . . . 617
Relevant variables . . . 618
Relevant FB . . . 618
Homing request . . . 619
Driver homing method . . . 620
Data set homing method . . . 623
Precautions . . . 624
27.2 Operation Setting for Incompletion of Homing . . . 625
Relevant variables . . . 625
FBs that can be started when homing is incomplete . . . 626
Homing request clear . . . 626
Precautions . . . 626

CHAPTER 28 AXIS CONTROL FUNCTIONS 627

28.1 Single Axis Positioning Control . . . 627
Relevant FBs . . . 627
Absolute value positioning control . . . 627
Relative value positioning control . . . 628
28.2 Single Axis Speed Control . . . 629
Relevant FBs . . . 629
Control details . . . 629
BufferMode . . . 630
Required object data . . . 630
28.3 Single Axis Manual Control . . . 631
Relevant variables . . . 631
Relevant FB . . . 631
Types of manual control . . . 631
JOG operation . . . 632
28.4 Multiple Axes Positioning Control . . . 636
Relevant variables . . . 636
Relevant FB . . . 636
Multiple axes positioning control types . . . 637
Operation in multiple axes positioning control . . . 637
Positioning speed in multiple axes positioning control . . . 638
Command unit in the multiple axes positioning control . . . 645
Acceleration/deceleration processing . . . 648
State transition in the multiple axes positioning control . . . 648
Linear interpolation control . . . 649
Circular interpolation control . . . 655
Required object data . . . 664

28.5 Multiple Axes Positioning Data Operation 665
Overall block diagram 666
Relevant variable 666
Relevant FB 666
Control details 667
Positioning data setting 668
Auxiliary function 693
Precautions 708

CHAPTER 29 DIRECT CONTROL 710

29.1 Absolute Position Follow-up Control 712
Relevant variables 712
Relevant FB 712
Control details 713
Relevant object data 714
Precautions 714
29.2 Velocity Control 715
Relevant variables 715
Relevant FB 715
Control details 715
Buffer mode (BufferMode) 717
Relevant object data 725
Precautions 725
29.3 Torque Control 726
Relevant variables 726
Relevant FB 726
Control details 727
Buffer mode (BufferMode) 731
Relevant object data 741
Precautions 741
29.4 Pressure Control 742
Relevant variable 742
Relevant FB 742
Overall block diagram 743
Control details 744
Pressure ramp function 747
Velocity limit acceleration/deceleration processing function 748
Pressure control process 749
Limit position / final position (forward end position) 750
Multiple start (buffer mode) 754
Precautions 757
29.5 Precautions on Direct Control 759

CHAPTER 30 MOTION CYCLIC CONTROL 760

30.1 Motion Cyclic Positioning Control 761
Relevant variables 761
Relevant FB 762
Control details 763
Relevant object data 766
Precautions 766

Program example . . . 767
30.2 Motion Cyclic Velocity Control . . . 768
Relevant variables . . . 768
Relevant FBs . . . 769
Control details . . . 770
Relevant object data . . . 772
Precautions . . . 772
Program example . . . 773
30.3 Motion Cyclic Torque Control . . . 774
Relevant variables . . . 774
Relevant FB . . . 774
Control details . . . 775
Relevant object data . . . 777
Precautions . . . 777
Program example . . . 778
30.4 Precautions on Motion Cyclic Control . . . 779

CHAPTER 31 SYNCHRONOUS CONTROL 780

31.1 Overview of Single Axis Synchronous Control FBs . . . 780
31.2 Axis Configuration . . . 781
31.3 Master Axis Data Source Selection . . . 782
31.4 Stop Operation . . . 783
31.5 Required Object Data . . . 783
31.6 Restrictions . . . 784
31.7 Cam Operation . . . 784
Relevant variable . . . 784
Relevant FB . . . 784
Control details . . . 785
Precautions . . . 815
31.8 Gear Operation . . . 816
Relevant FB . . . 816
Control details . . . 816
Precautions . . . 818
31.9 Addition/Subtraction Positioning . . . 819
Relevant FB . . . 819
Control details . . . 819
31.10 Precautions . . . 821

CHAPTER 32 OPERATION PROFILE DATA FUNCTION 824

32.1 Operation Profile Data . . . 824
Overall block diagram . . . 824
Relevant variables . . . 825
Relevant FBs . . . 825
Operation profile data types . . . 826
Creating operation profile data . . . 861
Operating operation profile data . . . 863
Control of operation profile data . . . 869
Start mode . . . 869
Sub function of operation profile data . . . 871
Precautions . . . 874

32.2 Operation Profile Data Format . . . 875
Operation profile data details. . . . 875
Notation for each setting format . . . 888

CHAPTER 33 ADVANCED SYNCHRONOUS CONTROL 889

33.1 Overview of Advanced Synchronous Control . . . 889
Relevant variables . . . 890
Relevant FBs . . . 894
33.2 Control Details for Advanced Synchronous Control . . . 895
Procedure for executing advanced synchronous control. . . . 896
Starting/stopping for advanced synchronous control. . . . 900
Advanced synchronous control precautions . . . 906
33.3 Input Axis Function . . . 911
Input axis initialization timing . . . 913
Input axis position command unit . . . 913
Input axis positioning range . . . 913
Input axis relevant variables . . . 914
Precautions . . . 919
33.4 Output Axis Function . . . 920
Output axis initialization timing . . . 921
Output axis positioning range . . . 921
Output axis relevant variables . . . 922
Main shaft module . . . 924
Auxiliary shaft module . . . 935
Clutch . . . 947
Speed change gear . . . 960
Output axis module . . . 964
Cam function . . . 972
Synchronous control change function . . . 985
Precautions . . . 989
33.5 Synchronous Control Initial Position . . . 990
Backup data management for advanced synchronous control . . . 991
Restoration method for current position after composite main shaft gear, current position per cycle after main shaft gear, and current position per cycle after auxiliary shaft gear at start of synchronous control . . . 992
Cam axis position at synchronous control start . . . 995
Synchronous control analysis mode . . . 1003
Variables related to synchronous control initial position . . . 1005
Precautions . . . 1008
33.6 Cam Position Calculation Function . . . 1009
Control details . . . 1009
Precautions . . . 1015
33.7 Application Function . . . 1016
Phase compensation function . . . 1016
33.8 Example Programs . . . 1019
Flying shear . . . 1019
Filling machine . . . 1029

CHAPTER 34 FUNCTIONS RELATED TO POSITION 1054

34.1 Current Position Change Function . . . 1054
Relevant FB . . . 1054

Current position change 1055
Cancel 1058
34.2 Command In-position 1059
Relevant variables 1059
Command in-position range check 1060
34.3 Software Stroke Limit 1061
Relevant variables 1061
Definition of movable range 1062
Specifications of the software stroke limit check 1068
Precautions 1068
34.4 Hardware Stroke Limit 1069
Relevant variables 1070
Hardware stroke limit check details 1073
Returning from outside the hardware stroke limit range 1074
Checking whether the hardware stroke limit is enabled/disabled 1075
Precautions 1075

CHAPTER 35 FUNCTIONS RELATED TO VELOCITY 1078

35.1 Acceleration/Deceleration Processing Function 1078
Relevant variables 1080
Acceleration/deceleration method 1084
Acceleration/deceleration waveform adjustment when specifying jerk 1092
Operation when specifying acceleration/deceleration 0 1094
Acceleration limit value/deceleration limit value 1096
Jerk limit value 1097
Limit of acceleration time/deceleration time 1098
Automatic deceleration 1099
Changing control of jerk acceleration/deceleration 1100
Acceleration/deceleration method and multiple start 1106
Velocity bias 1108
Precautions 1110
35.2 Velocity Limit 1112
Relevant variables 1112
How to set the velocity limit function 1112
Operation when the velocity limit value is exceeded 1113
Operation Setting at Velocity Limit Value Exceeded 1115
35.3 Override Function 1116
Relevant variables 1117
Relevant FBs 1118
How to change control data 1118
Precautions 1123

CHAPTER 36 FUNCTIONS RELATED TO TORQUE 1124

36.1 Torque Limit 1124
Relevant variables 1124
Object data settings 1125
Torque limit value setting range 1125
Torque limit maximum value setting range 1126
Precautions 1126

36.2 Torque Limit Value Change Function 1127
Relevant variables 1127
Relevant FB 1127
How to change control data 1128

CHAPTER 37 COMPENSATION FUNCTION 1129

37.1 Relevant Variables 1129
37.2 Driver Unit Conversion Function 1130
Control details 1131
Precautions 1132

CHAPTER 38 COMMAND FILTER 1133

38.1 Relevant FBs 1133
38.2 Smoothing Filter 1134
Program example 1135
Precautions on smoothing filter 1136
Required object data 1136
38.3 Moving Direction Restriction Filter 1137
Program example 1137
Required object data 1137
38.4 Speed Limit Filter 1138
Program example 1138
Required object data 1138
38.5 Backlash Compensation Filter 1139
Procedure to enable the backlash compensation filter 1142
Program example 1142
Precautions on backlash compensation filter 1145
Required object data 1145
38.6 Precautions on Command Filter 1145

CHAPTER 39 INPUT VARIABLE CHANGE IN EXECUTION 1146

39.1 Relevant Variables 1146
39.2 Target Position/Movement Distance Change 1147
Target position change 1147
Movement distance change 1148
The deceleration distance is not kept by the target position/movement distance change 1149
When an operation is reversed by changing the target position/movement distance 1150
39.3 Command Velocity Change 1151
Command velocity sign inversion during speed control 1151
Combination with override 1151
Operation during interpolation control 1152
39.4 Acceleration/Deceleration and Acceleration/Deceleration Time Change 1153
39.5 Precautions 1153

CHAPTER 40 EXTERNAL SIGNAL SELECTION 1154

40.1 Overall Block Diagram 1154
40.2 Relevant Variables 1155
40.3 SIGNAL_SELECT Structure 1156
40.4 TARGET_REF Structure 1158
40.5 External Signal High-Accuracy Input 1164

40.6 External Signal High-Accuracy Output . . . 1164
40.7 Precautions . . . 1165

CHAPTER 41 TOUCH PROBE 1166

41.1 Overall Block Diagram . . . 1166
41.2 Relevant FBs . . . 1166
41.3 Touch Probe Enabled . . . 1167
Control details . . . 1167
Precautions . . . 1171
41.4 Touch Probe Disabled . . . 1172
Control details . . . 1172
41.5 Precautions . . . 1174

CHAPTER 42 DIGITAL CAM SWITCH 1175

42.1 Overall Block Diagram . . . 1175
42.2 Relevant Variables . . . 1176
42.3 Relevant FB . . . 1176
42.4 Control Details . . . 1177
Switch settings . . . 1179
Time compensation . . . 1182
Signal output timing . . . 1183
42.5 Precautions . . . 1185

CHAPTER 43 AXIS EMULATION 1186

43.1 Relevant Variables . . . 1187
43.2 Setting Procedure . . . 1187
43.3 Operation During Emulate Function . . . 1187
43.4 Specifications of the Emulated Device Station . . . 1188
Feedback data specifications . . . 1188
43.5 Precautions . . . 1189

CHAPTER 44 AXIS CONTROL WAIT 1190

44.1 Overall Block Diagram . . . 1190
44.2 Relevant Variables . . . 1190
44.3 Relevant FBs . . . 1191
44.4 Axis Control Start Wait . . . 1191
Timing chart . . . 1192
Execution permission signal . . . 1196
44.5 Axis Group Control Start Wait . . . 1197
Timing chart . . . 1198
Execution permission signal . . . 1199
44.6 Program Example . . . 1200
44.7 Precautions . . . 1202

CHAPTER 45 PROGRAM EXAMPLES 1203

45.1 Project Structure . . . 1203
Program name . . . 1203
45.2 PLC READY (Program Name: ServoON_Jog) . . . 1204
45.3 Servo ON (Program Name: ServoON_Jog) . . . 1204
45.4 JOG Operation (Program Name: ServoON_Jog) . . . 1205

45.5 Homing (Program Name: Homing) . . . 1209
45.6 Single Axis Positioning Control (Program Name: Positioning) . . . 1211
45.7 Single Axis Continuous Positioning (Program Name: ContinuousPositioning) . . . 1213
45.8 Interpolation Control (Program Name: LinearInterpolation) . . . 1217
Procedure for interpolation control . . . 1217
Enabling/disabling an axes group . . . 1217
Interpolation control . . . 1217
Program example for linear interpolation . . . 1218
45.9 Synchronous Control (Program Name: Synchronous) . . . 1223
Procedures for executing synchronous control . . . 1223
Operation profile data . . . 1224
Single axis synchronous control FBs . . . 1226
Axes configuration . . . 1226
Program example for synchronous control . . . 1227
45.10 Error Reset (Program Name: ErrorReset) . . . 1232

PART 11 CC-Link IE TSN

CHAPTER 46 CYCLIC TRANSMISSION 1234

46.1 Communications Using RX, RY, RWr, and RWw . . . 1235
46.2 Link Refresh . . . 1236
Setting method . . . 1237
Transmission delay time shortening method . . . 1239
46.3 Direct Access to Link Devices . . . 1241
46.4 Cyclic Data Assurance . . . 1244
46.5 I/O Maintenance Settings . . . 1247
Output settings during STOP or error . . . 1248
Data link error station setting . . . 1250
46.6 CANopen Communications . . . 1251
PDO communication using cyclic transmission . . . 1251
SDO communication using transient transmission . . . 1253

CHAPTER 47 TRANSIENT TRANSMISSION 1254

47.1 Communications Using the SLMP . . . 1254
47.2 Routing . . . 1255
Dynamic routing setting . . . 1255
Routing setting . . . 1255

CHAPTER 48 OTHERS 1257

48.1 Reserved Station Setting . . . 1257
48.2 Error Invalid Station Setting . . . 1257
48.3 Time Synchronization . . . 1257

PART 12 Ethernet

CHAPTER 49 SLMP COMMUNICATION 1260

49.1 Applications . . . 1260
49.2 Difference Between Ports for CC-Link IE TSN and Ports for Ethernet . . . 1261
49.3 Communication Structure . . . 1261

49.4 Data Communication Procedures 1262
49.5 List of Valid Commands 1264

CHAPTER 50 SIMPLE CPU COMMUNICATION FUNCTION 1266

50.1 Setting Method. 1269
Setting for each communication destination 1270
Encrypted communication settings 1278
Import/export of settings 1279
Executing simple CPU communication 1281
50.2 Checking the Simple CPU Communication Status 1287
How to check using the buffer memory 1287
Checking with "simple CPU communication diagnostics" 1289
50.3 Precautions 1289

CHAPTER 51 PREDEFINED PROTOCOL COMMUNICATIONS 1291

51.1 Applicable Connections 1292
51.2 Data Communication Procedures 1293
51.3 Protocol Communication Type. 1300
51.4 Packet Elements 1301
51.5 Execution Conditions of Predefined Protocol Communications 1307
51.6 Example of Predefined Protocol Communications 1308

CHAPTER 52 SOCKET COMMUNICATIONS 1318

52.1 Setting Method. 1320
52.2 Dedicated Instructions 1321
52.3 Applicable Connections 1321
52.4 Communication Structure 1322
52.5 Communications Using TCP 1323
52.6 Communications Using UDP 1326
52.7 Broadcast Communications. 1326
52.8 Precautions 1327
52.9 Communication Example 1328
Socket communication example 1328
Communication example of re-open processing 1342

CHAPTER 53 FTP FUNCTIONS 1345

53.1 FTP Server 1345
Supported communication modes 1346
FTP server settings 1347
Data communication procedures 1349
Files that can be transferred with FTP. 1352
FTP commands 1353
Precautions 1361
53.2 FTP Client. 1367
Encrypted communication settings 1368
Transferable files 1375
FTP client settings 1375
Procedure for executing the file transfer function (FTP client) 1376
Precautions 1378

CHAPTER 54 WEB SERVER FUNCTION 1379

54.1 Web Server Function Specifications 1381
54.2 System Configuration 1382
54.3 Operation Method/Procedure 1383
Downloading the system Web page library 1383
Module parameter setting 1384
Writing the system Web page 1387
How to access the Web server 1388
Logon/logoff 1389
54.4 Function Details 1390
Detailed Module Information (Module Information) 1391
Device Monitor 1392
Watch 1394
CPU Diagnostics 1395
Event history 1396
Program monitor 1397
User Web page 1399
System Web page update 1399
Display update interval 1399
Language switcher 1400
54.5 User Web Page 1401
Accessing User Web Page 1402
54.6 Error message 1403
54.7 PRECAUTIONS 1404

CHAPTER 55 OPC UA COMMUNICATION FUNCTION 1405

55.1 OPC UA Communication Function 1405
Specifications 1406
Procedure of OPC UA server startup 1415
OPC UA server startup/stop 1421
OPC UA server function list 1424
Precautions 1427

CHAPTER 56 OTHERS 1430

56.1 Network Setting Change Function 1430
IP address of the controller 1431
How to use 1432
Checking the IP address 1435
Checking the operating status 1435
Precautions 1436
56.2 DNS Client Function 1437
DNS settings 1437
56.3 Discard Received Data at CPU STOP 1438
Setting method 1438
Precautions 1438

PART 13 DATA COLLECTION

CHAPTER 57 DATA LOGGING FUNCTION 1440

57.1 Data Logging Procedure . . . 1441
57.2 Specifications . . . 1442
57.3 Data to Be Collected . . . 1444
Number of data points . . . 1444
Data type and output format . . . 1444
Data to be collected . . . 1446
57.4 Data Collection Conditions . . . 1448
Each scan . . . 1448
Time specification . . . 1448
Condition specification . . . 1449
Network communication cycle synchronization . . . 1451
After the execution of specified program . . . 1452
57.5 Logging Types . . . 1453
Operating procedure for continuous logging . . . 1453
Operating procedure for trigger logging . . . 1454
57.6 Data Logging File . . . 1460
Storage format of data logging files . . . 1460
Binary file output format . . . 1461
Unicode text file output type . . . 1465
CSV file output format (Shift-JIS) . . . 1471
CSV file output format (Unicode) . . . 1477
JSON file output format . . . 1483
Output content details . . . 1497
57.7 States of the Data Logging Function . . . 1499
Data logging states . . . 1499
57.8 Steps Until the Collected Data Is Saved . . . 1500
Internal buffer . . . 1501
Switching to a storage file . . . 1503
57.9 Missing Data . . . 1509
Conditions under which missing data occurs . . . 1509
57.10 Data Logging File Transfer to Data Memory . . . 1510
57.11 Logging Start Condition Setting . . . 1511
57.12 Auto Logging . . . 1512
57.13 SD Memory Card Replacement . . . 1517
57.14 SD Memory Card Life When the Data Logging Function Is Used . . . 1519
57.15 Special Relay and Special Register Areas Used by the Data Logging Function . . . 1520
57.16 Precautions to Take When Using the Data Logging Function . . . 1521

CHAPTER 58 SEQUENCE SCAN SYNCHRONIZATION SAMPLING FUNCTION 1531

PART 14 SECURITY

CHAPTER 59 LIST OF SECURITY FUNCTIONS 1534

CHAPTER 60 PROTECTION OF INFORMATION ASSETS IN THE CONTROLLER 1536
60.1 User Authentication Function 1536
User authentication 1537
Management information (user management information and user group management information) 1538
User group 1539
Access to the controller 1542
How to operate the user authentication function 1544
Restrictions on using the user authentication function 1552
Precautions 1554
60.2 File Tamper Check Setting 1555
Target files 1555
60.3 All Information Initialization of Controller 1556
Setting method 1556
LED indicator 1557
CHAPTER 61 PROTECTION OF THE NETWORK CONNECTED TO THE CONTROLLER 1558
61.1 Encrypted Communication Function 1558
Digital certificate 1559
"Certificate Management" window 1564
Operation procedure for the encrypted communication 1571
Certificate expiration check 1580
Closing connections for encrypted communication 1580
Precautions 1581
61.2 IP Filter Function 1582
Setting procedure 1582
Operation 1584
Precautions 1584
61.3 Default Open Port Usage Setting Function 1585
Setting method 1585
61.4 Band Limit Function Against DoS Attacks 1588
Setting method 1588
Precautions 1590
CHAPTER 62 PROTECTION OF CONTROLLER OPERATION 1591
62.1 Operation Settings 1591
PART 15 ONLINE OPERATION
CHAPTER 63 WRITING DATA TO THE CONTROLLER 1594
63.1 Writing Data to the Programmable Controller 1594
63.2 Online Change 1594
Convert + Online change 1594
File batch online change 1598
63.3 Precautions 1599
CHAPTER 64 REMOTE OPERATION 1606
64.1 Remote RUN/STOP 1606
Executing method 1606

Operation at device/label memory clear 1607
Precautions 1607
64.2 Remote PAUSE 1608
Executing method 1608
64.3 Setting RUN-PAUSE Contacts 1609
64.4 Remote RESET 1610
Remote reset setting 1610
Executing method 1610

CHAPTER 65 MONITOR FUNCTION 1611

65.1 Performance Monitor 1611
65.2 Real-time Monitor 1612
65.3 Position Data History 1613

PART 16 MAINTENANCE AND INSPECTION

CHAPTER 66 MAINTENANCE FUNCTION LIST 1616

CHAPTER 67 DAILY INSPECTION 1618

CHAPTER 68 PERIODIC INSPECTION 1620

68.1 Battery Replacement Procedure 1621

CHAPTER 69 CONTROLLER DATA BACKUP/RESTORATION FUNCTION 1622

69.1 Backup 1630
Backup using engineering tool 1632
Backup processing triggered by turning on SM1351 1633
Automatic backup using engineering tool 1634
Automatic backup using SD944 1636
Precautions 1639
69.2 Restoration. 1643
Automatic restoration using engineering tool 1644
Automatic restoration using SD955 1646
Checking restoration errors 1646
Precautions 1647

CHAPTER 70 SOFTWARE UPDATE OF THE CONTROLLER 1650

70.1 Firmware Update Function 1650
70.2 Add-on Function 1663
Add-on type 1663
Memory specifications 1663
Operating procedure 1664
Safe mode 1668
Label list 1669
Precautions 1670

PART 17 TROUBLESHOOTING

CHAPTER 71 TROUBLESHOOTING FUNCTION LIST 1672

CHAPTER 72 TROUBLESHOOTING PROCEDURE 1674

72.1 Troubleshooting with LED Indicators . . . 1674
When the READY LED or PROGRAM RUN LED turns off . . . 1674
When the ERROR LED turns on or is flashing . . . 1675
When the D LINK LED turns off or is flashing . . . 1676
When the L ER LED turns on . . . 1677
When the LINK LED turns off . . . 1678
When the dot matrix LED is alternately repeating the station number display and ERR display . . . 1679
When S-ERR is displayed on the dot matrix LED . . . 1679

72.2 Checking the Module Status . . . 1680
System monitor . . . 1680
Module diagnostics . . . 1681
Event history . . . 1683

72.3 Checking Status of Motion Function . . . 1684
Checking errors and warnings . . . 1684
Error and warning reset . . . 1686

72.4 Checking the Network Status . . . 1697
CC-Link IE TSN/CC-Link IE Field diagnostics . . . 1697
Ethernet diagnostics . . . 1707
OPC UA server diagnostics . . . 1712
Communication test . . . 1713
Station information list . . . 1714
Remote operation . . . 1715
Monitoring link special relay (SB) and link special register (SW) . . . 1716

CHAPTER 73 TROUBLESHOOTING BY SYMPTOM 1717

73.1 Programmable Controller Function Troubleshooting . . . 1717
When data cannot be written to the controller . . . 1717
When data cannot be read from the controller . . . 1717
When the operating status of the controller cannot be changed . . . 1717

73.2 CC-Link IE TSN Troubleshooting . . . 1718
When cyclic transmission failed . . . 1718
When transient transmission failed . . . 1721
When a station is disconnected from the network . . . 1723
When a station is repeatedly disconnected and reconnected . . . 1723
When communications are unstable . . . 1725
When communications using the SLMP cannot be performed . . . 1725
When communications with Ethernet devices failed . . . 1726
When communications for the link device failed although the data link is normal . . . 1726
When the network map or selected station communication status monitor is not displayed correctly . . . 1727
When communications cannot be performed with the external device while the default open port is used . . . 1727
When CC-Link IE TSN Class A device does not perform data link . . . 1728
When invalid information is displayed in the event history or detailed information of the module diagnostics window . . . 1730
When a synchronous communication error is detected in a device station . . . 1730

73.3 Ethernet Troubleshooting . . . 1731
When communications cannot be performed with the external device . . . 1731
When communications cannot be performed with the external device during encrypted communication . . . 1732
When communications cannot be performed with the external device while the default open port is used . . . 1732
When a message sent from the external device cannot be received frequently . . . 1732

When communications using the Ethernet port are slow . . . 1733
When direct connection to the engineering tool is not possible. . . . 1733
When the CPU module or CC-Link IE TSN-equipped module search on the network cannot be performed . . . 1733
When communications using the SLMP cannot be performed . . . 1734
When communications using the predefined protocol cannot be performed. . . . 1734
When socket communications cannot be performed. . . . 1735
When access using the file transfer function (FTP server) cannot be performed . . . 1735
When access using the file transfer function (FTP client) cannot be performed . . . 1736
When using the Web server function. . . . 1737
When the simple CPU communication function is used . . . 1739
When communications cannot be performed with the OPC UA server . . . 1740
When the time setting function (SNTP client) cannot be performed normally . . . 1741
When the access cannot be allowed/denied correctly by the IP filter . . . 1741
73.4 Motion Function Troubleshooting . . . 1742
When Servo ON failed. . . . 1742
When a motor does not rotate . . . 1742
When motion control cannot be used . . . 1742

CHAPTER 74 RAS FUNCTIONS RELATED TO TROUBLESHOOTING 1743

74.1 RAS Functions of Programmable Controller . . . 1743
Scan monitoring function . . . 1743
Self-diagnostic function . . . 1745
Error clear . . . 1751
Event history function . . . 1754
74.2 CC-Link IE TSN RAS Functions . . . 1767
Device station disconnection . . . 1767
Automatic return . . . 1767
Master station duplication detection . . . 1767
IP address duplication detection . . . 1768
Module communication test. . . . 1769
LED display of data link faulty station . . . 1770
74.3 Ethernet RAS Functions . . . 1771
Timer settings for data communication . . . 1771
Ethernet communication load monitor function . . . 1775
IP address duplication detection . . . 1775

CHAPTER 75 ERROR CODES 1776

75.1 Error Code System . . . 1776
75.2 How to Clear Errors. . . . 1777
75.3 Codes of Errors Detected by Self-diagnostic Function (1000H to 3FFFH) . . . 1778
75.4 Error Codes Returned to Request Source During Communications (4000H to 4FFFH). . . . 1850
75.5 Codes of Errors Detected by Other Than the Self-diagnostic Function (C000H to DFFFH). . . . 1871

CHAPTER 76 EVENT LIST 1887

76.1 How to Read the Event List . . . 1887
76.2 System (00000H to 03FFFH) . . . 1890
76.3 Security (10000H to 1FFFFH) . . . 1906
76.4 Operation (20000H to 2FFFFH). . . . 1907

CHAPTER 77 RESPONSE CODE (SDO ABORT CODE) 1912

CHAPTER 78 FTP SERVER FUNCTION REPLY LIST 1914

APPENDICES 1922

Appendix 1 External Dimensions **1922**
Appendix 2 EMC and Low Voltage Directives **1923**
Measures to comply with the EMC Directive 1923
Measures to comply with the Low Voltage Directive 1929
Appendix 3 General Safety Requirements **1930**
System design circuit examples 1930
Fail-safe measures for controller failure 1934
Appendix 4 Clock Data **1935**
Time setting 1935
SNTP client 1937
Setting time zone 1940
Daylight saving time function 1941
System clock 1944
Appendix 5 I/O Signals **1945**
List of input signals 1945
List of output signals 1945
Details of input signals 1946
Details of output signals 1948
Appendix 6 List of Special Relay (SM) Areas **1949**
Diagnostic information 1950
System information 1952
System clock 1953
Fixed scan function information 1955
Drive information 1956
Instruction related 1957
Latch area 1959
Data logging function 1961
Controller data backup/restoration function 1963
iQ Sensor Solution data backup/restoration function 1964
File transfer function (FTP client) 1966
Event history function 1966
User authentication function 1966
Ethernet function 1967
Add-on function 1967
Appendix 7 List of Special Register (SD) Areas **1968**
Diagnostic information 1969
System information 1986
System clock 1989
Fixed scan function information 1990
Drive information 1992
Instruction related 1994
Latch area 1996
Data logging function 1997
Controller data backup/restoration function 1999
Data backup/restoration function of iQ Sensor Solution 2002

Interrupt pointer mask pattern . . . 2005
Event history function . . . 2005
Program monitor function . . . 2006
User authentication function . . . 2006
Communication enable setting function . . . 2006
Real-time monitor function . . . 2006
FUNCTION LED indication function . . . 2007
Debug function . . . 2007
Ethernet function . . . 2008
Open completion signal function . . . 2010
Open request signal function . . . 2010
Socket communications receive status signal function . . . 2010
Data logging setting function . . . 2011
Label allocating information management function . . . 2012
Appendix 8 List of Link Special Relay (SB) . . . 2013
Appendix 9 List of Link Special Register (SW) . . . 2017
Appendix 10 Buffer Memory . . . 2028
List of buffer memory addresses . . . 2028
Details of buffer memory addresses (CPU function part) . . . 2041
Details of buffer memory addresses (CC-Link IE TSN function part) . . . 2062
Details of buffer memory addresses (motion function part) . . . 2076
Appendix 11 Parameter List . . . 2077
System parameters . . . 2077
CPU parameters . . . 2078
Module parameters . . . 2080
Memory card parameters . . . 2084
Appendix 12 Processing Time of CPU Function Part . . . 2085
Program execution time . . . 2085
END processing time . . . 2088
END processing extension time . . . 2096
Synchronous station refresh execution time . . . 2099
Execution time of data logging function . . . 2100
Controller data backup/restoration function execution time . . . 2105
Real-time monitor execution time . . . 2106
File operation execution time . . . 2107
Firmware update execution time . . . 2109
Appendix 13 CC-Link IE TSN Processing Time . . . 2110
Transmission delay time . . . 2110
Shortening method of the communication cycle interval and cyclic transmission time . . . 2116
Appendix 14 Ethernet Processing Time . . . 2117
Processing time of the simple CPU communication function . . . 2117
Processing time of the Web server function . . . 2119
Processing time of the OPC UA server function . . . 2120
Appendix 15 Service Processing . . . 2122
Target list and operation details of the device/label access service processing setting . . . 2122
Motion service processing . . . 2128
Appendix 16 Connection of CC-Link IE TSN Class B/A Devices . . . 2129
Configuration with CC-Link IE TSN Class B/A devices (Protocol version 2.0/1.0) . . . 2129
Configuration with CC-Link IE TSN Class B/A devices (Protocol version 1.0 only) . . . 2132
Appendix 17 Operation Image and Data Structure of Predefined Protocol . . . 2143
Operation image of each communication type of protocol . . . 2143

Verification operation of receive packet . . . 2148
Example of packet element data . . . 2149
Appendix 18 Connection to Servo Amplifier That Supports CC-Link IE TSN . . . 2152
MR-J5(W)-G (cyclic synchronous mode) connection method . . . 2152
MR-J5(W)-G (other than cyclic synchronous mode) connection method . . . 2161
MR-JET-G connection method . . . 2165
Relevant functions . . . 2165
Precautions . . . 2190
Appendix 19 Port Numbers Used by the System . . . 2191
Ports for CC-Link IE TSN . . . 2191
Ports for Ethernet . . . 2191
Appendix 20 Password Policy . . . 2192
Appendix 21 Software Licenses and Copyright . . . 2194
Other software . . . 2194
Appendix 22 Procedures Before Disposal . . . 2195
Appendix 23 Added or Enhanced Functions and Supported Versions . . . 2196

INDEX 2197

REVISIONS . . . 2201
CONDITIONS OF USE FOR THE PRODUCT . . . 2202
WARRANTY . . . 2203
INFORMATION AND SERVICES . . . 2204
TRADEMARKS . . . 2204
COPYRIGHTS . . . 2204

RELEVANT MANUALS

The following manuals and guidelines are relevant to this product.

Manuals

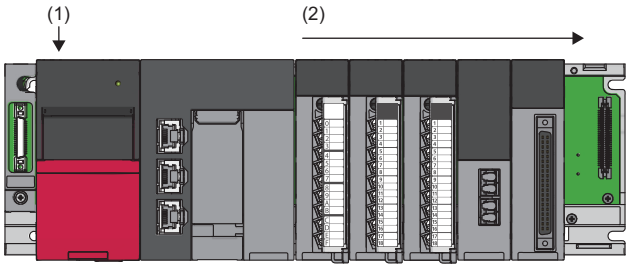
Manual name [Manual number]	Description
MELSEC MX Controller MX-R Model User's Manual [SH-082641ENG] (this manual)	Procedures before operation, specifications, devices, memory, functions, parameters, and troubleshooting of the controller
MELSEC MX Controller MX-R Model Programming Manual [SH-082644ENG]	Program language specifications, controller instructions, standard functions/function blocks, and specifications of motion control function blocks
GX Works3 Operating Manual [SH-081215ENG]	System configuration, parameter settings, and online operations of GX Works3
CPU Module Logging Configuration Tool Version 1 Operating Manual [SH-082478ENG]	System configuration and operation/setting procedures when using CPU Module Logging Configuration Tool
SLMP Reference Manual [SH-080956ENG]	A protocol used to access an SLMP-compatible device from an external device (such as a personal computer or HMI (Human Machine Interface)) or an SLMP-compatible module (such as the Ethernet-equipped module or modules on CC-Link IE TSN)
iQ Sensor Solution Reference Manual [SH-081133ENG]	Operation methods of the online functions for iQ Sensor Solution

Guidelines

Guideline name [Guideline number]	Description
FA SYSTEM SECURITY GUIDELINE -SEPARATE VOLUME [MELSEC]- [BCN-P5999-1474]	Mitsubishi Electric approach to security for the MELSEC series and information for using the MELSEC series safely and securely in an FA system

MELSEC iQ-R series manuals

Since the MELSEC MX Controller MX-R Model is used in combination with the MELSEC iQ-R series modules, refer to the MELSEC iQ-R series manuals.



(1) MELSEC iQ-R series main base unit and power supply module
(2) MELSEC iQ-R series intelligent function modules and I/O modules

Item		Reference manual
(1)	Base unit and power supply module	MELSEC iQ-R Module Configuration Manual [SH-081262ENG]
(2)	Procedures before operation, connections, functions, and troubleshooting of the intelligent function modules and I/O modules	User's manuals for the MELSEC iQ-R series modules
	Dedicated instructions for the intelligent function modules and I/O modules	MELSEC iQ-R Programming Manual (Module Dedicated Instructions) [SH-081976ENG]
	Module FBs for the intelligent function modules and I/O modules	Function block references for the MELSEC iQ-R series modules

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Actual position	A position obtained by rounding a position address returned by a device with a ring counter. It is affected by a current position change.
Actual pressure	The actual value of pressure
Actual velocity	A value obtained by converting the actual value received from the device on the real axis to the unit of the axis
Axes group variable	An AXES_GROUP type variable instance including parameters and data related to the axes group
Axis	A target to perform the motion control
Axis variable	An AXIS_* type variable instance including parameters and data related to the axis
Axis warning	An error or a warning related to an axis
Basic core	A core that executes a program
Buffer memory	A memory to store data such as setting values and monitored values.
Buffering	Standby status of a motion control FB when multiple start is performed
Buffering FB	A motion control FB that is in a pending status (Busy is TRUE) when multiple start is performed
Cam table	An operation profile data used for cam control (Example) Operation profile data of cam data format or operation profile data of cam data format for rotary cutter
CC-Link IE TSN Class	A group of devices and switching hubs compatible with CC-Link IE TSN, ranked according to the functions and performance by the CC-Link Partner Association. For CC-Link IE TSN Class, refer to the CC-Link IE TSN Installation Manual (BAP-C3007ENG-001) published by the CC-Link Partner Association.
CC-Link IE TSN function part	A part used for Ethernet communications and CC-Link IE TSN communications through the CC-Link IE TSN port (P1, P2)
CC-Link IE TSN Protocol version 1.0	This protocol is used to perform communications by using the time sharing method defined by IEEE 802.1AS or IEEE 1588 for time synchronization.
CC-Link IE TSN Protocol version 2.0	This protocol is used to perform communications by using the time sharing method defined by IEEE 802.1AS and time-managed polling method for time synchronization. Supporting this protocol version mitigates restrictions when "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" is set in the system configuration, and increases the number of connectable devices.
Command limit velocity	Set value for limit velocity
Command pressure	Set value for pressure
Commanded limit velocity	A specified value for limit velocity
Commanded position	A command position address that is specified in the motion FB
Commanded pressure	A specified value for pressure
Commanded velocity	Velocity that is specified in the motion FB
Continuous update	Continuous reflection of input values to the control while the ContinuousUpdate input of the motion control FB is TRUE
Core	An operation circuit of the controller. The controller has multiple cores.
CPU function part	A part used for sequence control and Ethernet communications through the Ethernet port (P3)
CPU Module Logging Configuration Tool	Software to configure data logging settings and to manage collected data
Cumulative current position	A command position address that is not rounded by the ring counter. It is affected by a current position change.
Cyclic data transfer processing	Processing of a cyclic transmission from its start to finish, performed by all the stations on a single network. The processing is performed asynchronously with the sequence scan of the CPU function part. The cyclic data transfer processing time varies depending on data volume and the number of transient transmission requests.
Dedicated instruction	An instruction that simplifies programming for using functions of intelligent function modules
Device	A memory of the controller to store data. Devices such as X, Y, M, and D are provided depending on the intended use.
Device station	A station other than a master station: a local station, a remote station
Disconnection	A process of stopping data link for relevant stations if a data link error occurs
Extension core	A core to which functions to be executed can be assigned
External signal high-accuracy input	An input signal linked with the signal detection time of the device station
FB instance	A function block that is inserted to a sequence program
First point of cam table	The meaning is different depending on the interpolation method specification for the cam data • Section interpolation or spline interpolation: Point of Table No.1 • Linear interpolation: Point of No.1

Term	Description
Forward-side position	Data to be sent to the drive unit as object data "Forward-side stop function (2E56H)". The limit position to which an axis can move in the pressure increase direction at feed/dwell, or the last position at pressure release.
Global label	A label that is valid for all the program data when multiple program data are created in the project. There are two types of global label: a module specific label (module label), which is generated automatically by GX Works3, and an optional label, which can be created for any specified device.
Grandmaster	A source device or station to synchronize clocks in the time synchronization via PTP (Precision Time Protocol)
GX LogViewer	Software to display data collected by data logging
GX Works3	The product name of the software package for the MELSEC programmable controllers
Industrial switch (CC-Link IE TSN certified)	A switching hub authorized by CC-Link Partner Association (☞ Page 63 Industrial switch)
Input variable	An input argument of FB
Intelligent function module	A module that has functions other than input and output, such as an A/D converter module and D/A converter module
iQSS	iQ Sensor Solution. Cooperation of sensors, programmable controllers, HMI (Human Machine Interface), and engineering tool to facilitate the start-up or maintenance of sensors. (📖iQ Sensor Solution Reference Manual)
Jerk	Chronological change rate of acceleration or deceleration
Label	A variable consisting of a specified string used in I/O data or internal processing
LB	A link relay of a link device. Bit data sent from each station of the network.
Link device	A device (RX, RY, RWr, RWw, LB, or LW) in the CC-Link IE TSN function part or a network module
Local station	A station that performs cyclic transmission and transient transmission with the master station and other local stations
LW	A link register of a link device. Word data (16-bit data) sent from each station of the network.
Machine feed value	A command position address that is not rounded by the ring counter. It is based on the home position, and it is not affected by a current position change.
Master axis (input) absolute coordinate	Another term for the Master axis absolute coordinate (MasterAbsolute) for input variables of MC_CamTableSelect (Cam Table Selection)
Master station	A station that controls the entire network. This station can perform cyclic transmission and transient transmission with all stations. Only one master station can be used in a network.
Module label	A label that represents one of memory areas (I/O signals and buffer memory areas) specific to each module in a given character string. For the module used, GX Works3 automatically generates this label, which can be used as a global label.
Motion control FB	An FB that is related to motion control. Its name starts with MC_ or MCv_.
Motion FB	A motion control FB that takes an axis or an axes group for the argument and changes the axis status or the axes group status when executed
Motion function part	A part of the controller used for motion control
Motion system	A system that realizes motion control constructed with the CPU function section, CC-Link IE TSN function section, and the motion function section of the controller
MR Configurator2	A product name of the servo setup software
Multicast filter	A filter function that selects whether to send cyclic data of multicast mode received by the own station to the subsequent stations. Setting parameters for this function are not required because the master station automatically sets the parameters according to the system configuration.
Multicast mode	A communication mode used to send cyclic data to multiple stations
Multiple axes interpolation control	Control in which multiple axes work together such as linear interpolation and circular interpolation. Axes to be cooperated are specified in an axes group.
Multiple start	Executing another motion control FB to the same axis to which the other motion control FB is being executed
Object	Data of a device compatible with CANopen
Output variable	An output argument of FB
POU	A unit that configures a program. Units are categorized and provided in accordance with functions. A program that is composed of POUs (program organization units) allows the lower-layer processing, when the program is multi-layered, to be divided into several units by processing and function, enabling the creation of programs based on each unit.
Predefined protocol support function	A function of GX Works3. This function sets protocols appropriate to each external device and reads/writes protocol setting data.
Program block	A group of POUs that configure a program
Real axis	An axis that is linked with a device on the network
Real drive axis	An axis that is linked with a CC-Link IE TSN compatible device that supports csp/csv/cst mode (sequential command) of the CiA402 drive profile

Term	Description
Real encoder axis	An axis that generates a commanded position from the current position of the encoder connected with a device. It is used as the master axis of the single axis synchronous control.
Reconnection	A process of restarting data link for relevant stations when the faulty station recovers from an error
Relay station	A station that relays data link to other station with mounting more than one network modules on one programmable controller.
Remote station	A station that exchanges I/O signals (bit data) and I/O data (word data) with another station by cyclic transmission. This station can perform transient transmission.
Reserved address	An IP address reserved for special purposes, defined by RFC 6890. This IP address cannot be used when the programmable controller is connected via the global IP network.
Routing	A process of selecting paths for communication with other networks. There are two types of routing: dynamic routing that auto-selects the communication routes, and static routing where communication routes are arbitrarily set.
RWr	A remote register of the link device. Word data (16-bit data) input from a device station to the master station. (For some areas in a local station, data are input in the opposite direction.)
RWw	A remote register of the link device. Word data (16-bit data) output from the master station to a device station. (For some areas in a local station, data are output in the opposite direction.)
RX	Remote input of the link device. Bit data input from a device station to the master station. (For some areas in a local station, data are input in the opposite direction.)
RY	Remote output of the link device. Bit data output from the master station to a device station. (For some areas in a local station, data are output in the opposite direction.)
SB	An abbreviation for a link special relay. Bit data that indicates the operating status and data link status of a module on CC-Link IE.
Set position	A commanded position address rounded by the ring counter. It is affected by a current position change.
Set velocity	The current control value that is generated by motion operation
Signal flow	The execution status that the last time an operation of a program or an FB is executed in each step.
Single axis synchronization	A control to output the position information (command) of one Slave (slave axis) that is synchronized with Master (master axis)
Slave axis (output) absolute coordinate	Another term for the Slave axis absolute coordinate (SlaveAbsolute) for input variables of MC_CamTableSelect (Cam Table Selection)
SLMP	A SeamLess Message Protocol. This protocol is used to access an SLMP-compatible device or a programmable controller connected to an SLMP-compatible device from an external device.
Soft LED	An LED that is not mounted as the hardware, but is controlled by software only Check by using the module diagnostics.
SW	An abbreviation for a link special register. Word data that indicates the operating status and data link status of a module on CC-Link IE.
Switching speed	• The set velocity of the on-going motion control FB when Aborting is specified • The command velocity when the on-going motion control FB reached the target position when Blending is specified
System error	An error or a warning not related to an axis. When Axis information (Axis) and Axes Group Information (AxesGroup) of the motion control FBs are not correct, the system error will occur.
Target position	A command position address that is specified in the motion FB
Transient transmission group number	Number that is assigned for transient transmission to any given stations. By specifying a group of stations as transient transmission target, data can be sent to the stations of the same group No.
TSN hub	Notation of industrial switches (CC-Link IE TSN Class B certified) on an engineering tool
Unicast mode	A communication mode used to send cyclic data to one station
Virtual axis	An axis that is not linked with a device on network
Virtual drive axis	A virtual axis that can generate a command virtually
Virtual encoder axis	An axis that generates a commanded position from a variable. It is used as the master axis of the single axis synchronous control.
Virtual linked axis	An axis that connects FBs and transmits commands in the single axis synchronous control

GENERIC TERMS AND ABBREVIATIONS

Unless otherwise specified, this manual uses the following generic terms and abbreviations.

Generic term/abbreviation	Description
Base unit	A generic term for main base units and extension base units
CC-Link IE	A generic term for the following items: • CC-Link IE TSN • CC-Link IE Controller Network (MELSEC iQ-R CC-Link IE Controller Network User's Manual (Application)) • CC-Link IE Field Network (MELSEC iQ-R CC-Link IE Field Network User's Manual (Application))
CC-Link IE Controller Network-equipped module	An RJ71GP21-SX CC-Link IE Controller Network module, an RJ71GP21S-SX CC-Link IE Controller Network module, and the following modules when the CC-Link IE Controller Network function is used: • RJ71EN71
CC-Link IE TSN master/local module	RJ71GN11-T2, RJ71GN11-SX, RJ71GN11-EIP (CC-Link IE TSN part)
CC-Link IE TSN-equipped module	A generic term for the RJ71GN11-T2, RJ71GN11-SX, and RJ71GN11-EIP
Controller	A generic term for the MXR300-16, MXR300-32, MXR300-64, MXR500-128, and MXR500-256
csp	An abbreviation for cyclic synchronous position mode (one of the control modes on the drive unit side)
cspr	An abbreviation for cyclic synchronous pressure mode (one of the control modes on the drive unit side)
cst	An abbreviation for cyclic synchronous torque mode (one of the control modes on the drive unit side)
csv	An abbreviation for cyclic synchronous velocity mode (one of the control modes on the drive unit side)
ct	An abbreviation for continuous operation to torque control mode (one of the control modes on the drive unit side)
Data link	A generic term for cyclic transmission and transient transmission
Device supporting iQSS	A device which supports iQ Sensor Solution. iQ Sensor Solution Reference Manual
Drive unit	A generic term for motor drive devices such as a servo amplifier
Engineering tool	A tool used for setting up controllers or servo amplifiers, programming, debugging, and maintenance
Ethernet device	A generic term for the devices supporting IP communication (such as a personal computer, a vision sensor, and a bar code reader)
Ethernet-equipped module	A generic term for the following modules: • Controller (when the Ethernet function is used) • RJ71EN71 (when the Ethernet function is used)
GOT	A generic term for Mitsubishi Electric Graphic Operation Terminal GOT1000 and GOT2000 series
hm	An abbreviation for homing mode (one of the control modes on the drive unit side)
I/O module	An input module, an output module, an I/O combined module, and an interrupt module
ICMP	An abbreviation for Internet Control Message Protocol. This protocol is used to exchange messages of errors in an IP network or other information related to an Ethernet network.
MCFB	An abbreviation for motion control FB
MR-J5(W)-G	A generic term for the MR-J5-_G/MR-J5-_G_-RJ/MR-J5-_G_-LL/MR-J5W_-_G/MR-J5D_-_G_ model servo amplifiers
Operation profile data	A generic term for waveform data used for each control
PDO	An abbreviation for Process Data Object. Aggregation of application objects transferred periodically between multiple CANopen nodes.
Power supply module	A MELSEC iQ-R series power supply module
PTP	An abbreviation for Precision Time Protocol. A predefined protocol for time synchronization between devices on a network.
RJ71GN11	A generic term for the RJ71GN11-T2 and RJ71GN11-SX
SDO	An abbreviation for Service Data Object. A message to access an object entry in the object dictionary of a CANopen node. Data is sent/received between the stations aperiodically.
SLMP	An abbreviation for Seamless Message Protocol. This protocol is used to access an SLMP-compatible device from an external device (such as a personal computer or HMI (Human Machine Interface)) or an SLMP-compatible module (such as the Ethernet-equipped module or modules on CC-Link IE TSN).
Station sub ID number	An ID number of a sensor connected to a CC-Link-compatible communication module

MEMO

PART 1 OVERVIEW

This part consists of the following chapter.

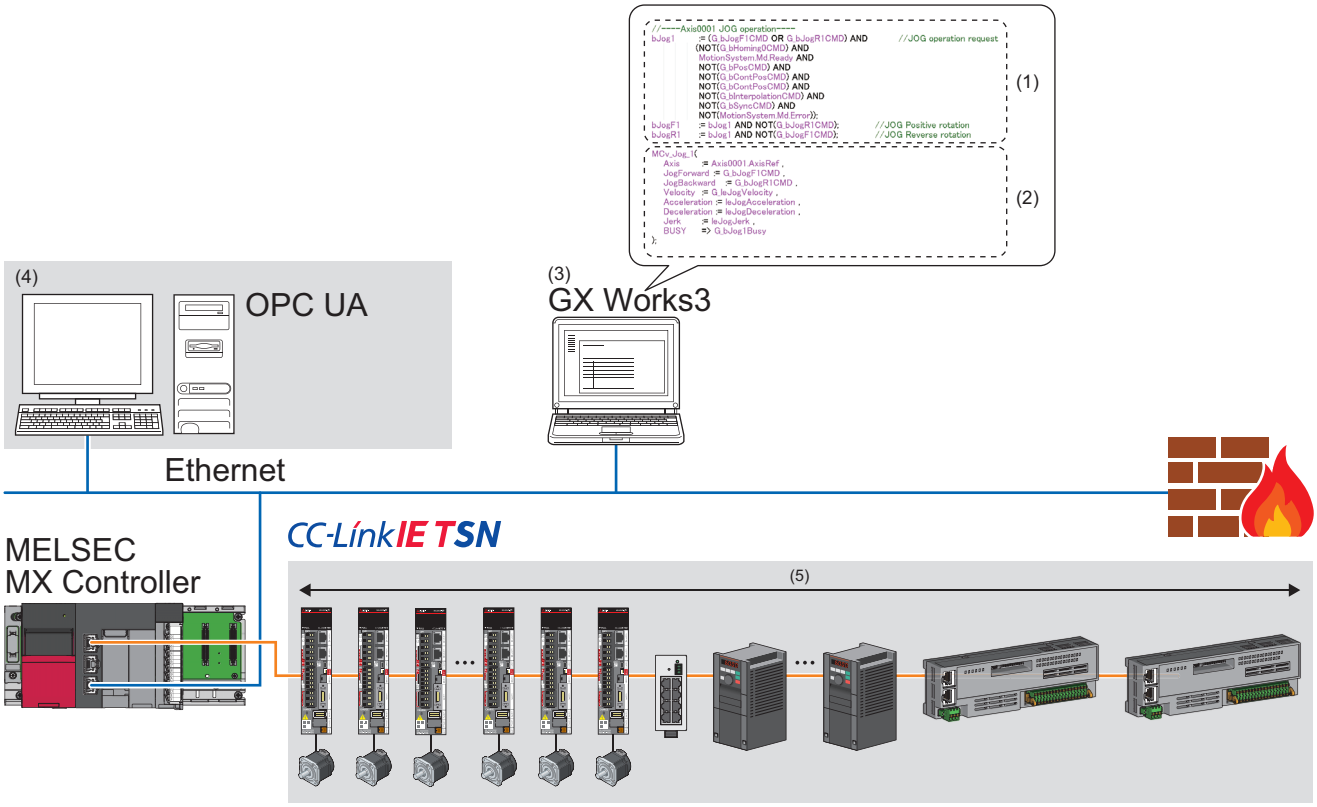
1 MELSEC MX CONTROLLER

1 MELSEC MX CONTROLLER

A MELSEC MX Controller (referred to as the controller in this manual) can achieve the following:

Integration of sequence control, motion control, and network

A system with a network that can execute the sequence control and motion control by a single controller can be constructed.



(1) Sequence control program
(2) Motion control program
(3) Engineering tool
(4) Upper system
(5) Up to 256 axes used for motion control (with multi-axis servo amplifiers)/Up to 253 device stations connected

■Controlling the entire line by a single controller

- Servo amplifiers, inverters, and remote I/O modules can be connected on CC-Link IE TSN.
- The controller can be connected to CC-Link IE TSN and Ethernet simultaneously using three LAN ports.
- Data sharing and linking with the upper system can be performed with OPC UA communications.

■Improving efficiency by a single tool

- Sequence control and motion control can be set and programmed with a single tool.
- The primary judgment at an occurrence of trouble can be quickly determined using each monitor or diagnostic window.

■Protecting information assets by security measures

- The controller complies with the international standard IEC 62443-4-2.
- User authentication and communication encryption can prevent data leakage and unauthorized access.
- Data tampering is detected, and the execution of unauthorized programs is prevented.

Point

For the pages described in this manual, refer to the following.

☞ Page 11 Structure of this manual

MEMO

MEMO

PART 2 PART NAMES

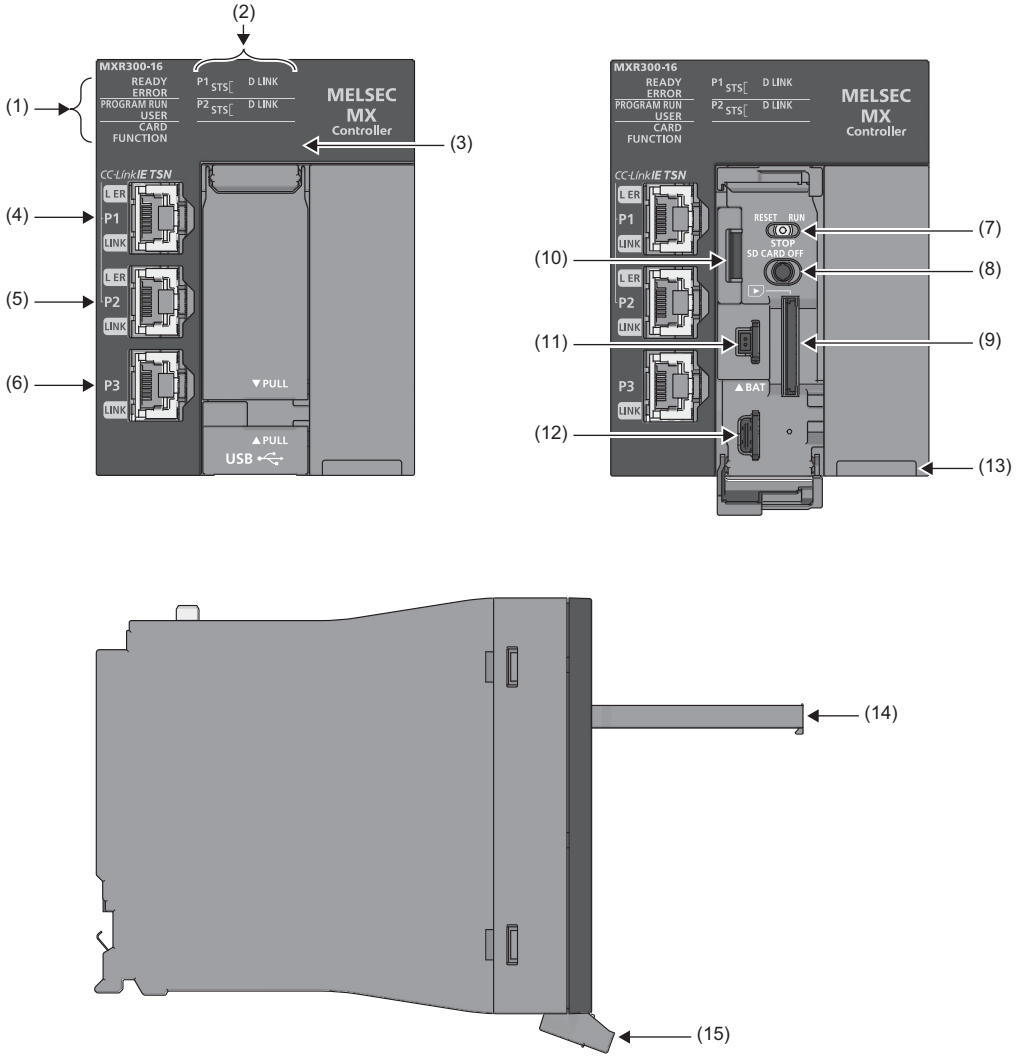
This part consists of the following chapter.

2 CONTROLLER

2 CONTROLLER

This chapter describes the part names of the controller.

2.1 MX-R Model



No.	Name	Description
(1)	READY LED	Indicates the operating status of the hardware and the error level. (☞ Page 1674 Troubleshooting with LED Indicators) ● READY LED—ERROR LED status • On—off: Normal operation • On—on: Minor error • On—flashing: Moderate error • Flashing (every 1s)—off: Initial processing • Flashing (every 200ms)—on/flashing/off: All information initialization in progress • Off—on/flashing: Major error
	ERROR LED	
	PROGRAM RUN LED	Indicates the operating status of the program. • On: Being executed (RUN state) • Flashing: Being suspended (PAUSE state) • Off: Stopped (STOP state) or stop error
	USER LED	Indicates the status of the annunciator (F). (☞ Page 351 Annunciator (F)) • On: Annunciator ON
	CARD LED	Indicates the status of the SD memory card. • On: SD memory card available • Flashing (every 50ms): Accessing the SD memory card • Slow flashing (every 200ms): Preparing the SD memory card • Off: Card not inserted or can be removed
	FUNCTION LED	Indicates the program restoration information write status. • Flashing: Program restoration information not written
(2)	STS LED	The LED is always off.
	D LINK LED	Indicates the data link status of P1 and P2. The D LINK LED of P2 is always off. • On: Cyclic transmission being performed • Flashing: Cyclic transmission stopped • Off: Disconnected
(3)	Dot matrix LED	Displays the station number set for the controller. Parameter not set: "— — —" Master station: 0 ■When a data link faulty station is detected, or when an error is detected in all stations The station number and ERR are displayed in alternating repetition. ■At error detection Displays S-ERR and the error number. ■In module communication test mode Displays the module communication test result. (☞ Page 1769 Module communication test)
(4)	P1	Port for CC-Link IE TSN. Connect an Ethernet cable. For wiring methods and wiring precautions, refer to the following. (☞ Page 64 Ethernet cable wiring method)
	L ER LED	Indicates the port status. • On: Abnormal data received • Off: Normal data received
	LINK LED	Indicates the link status. • On: Link-up • Flashing: Data being sent or received • Off: Link-down
(5)	P2	Same as P1
	L ER LED	
	LINK LED	
(6)	P3	Port for Ethernet. Connect an Ethernet cable. For wiring methods and wiring precautions, refer to the following. (☞ Page 64 Ethernet cable wiring method)
	LINK LED	Same as P1
(7)	RUN/STOP/RESET switch	A switch for controlling the operating status of the controller • RUN: Executes the program. • STOP: Stops the program. • RESET: Resets the controller. (Keep the switch in the RESET position for approximately one second.) Operate the RUN/STOP/RESET switch with your fingers. To prevent the switch from being damaged, do not use any tool such as a screwdriver.
(8)	SD CARD OFF button	A switch for stopping card access when the SD memory card is removed (☞ Page 57 SD memory card removal procedure)
(9)	SD memory card slot	A slot where an SD memory card is inserted
(10)	Battery compartment	A compartment for storing the body of the battery (FX3U-32BL) when the battery is connected

No.	Name	Description
(11)	Battery connector	A connector for connecting to the battery (FX3U-32BL)
(12)	USB port*1	A port for connecting to a USB-compatible device (Connector type: Type-C)
(13)	Serial number marking	Indicates the serial number (16 digits) of the module.
(14)	Switch cover	A cover for the switch. Open this cover and set the switch. Otherwise, keep the cover closed to prevent entry of foreign matter such as dust.
(15)	USB cover	A cover for the USB port. When not using the USB port, keep the cover closed to prevent entry of foreign matter such as dust.

*1 When a cable is connected to the USB port at all times, clamp the cable to prevent a poor connection, moving, and disconnection by unintentional pulling.

PART 3 PROCEDURES BEFORE OPERATION

This part consists of the following chapters.

3 START-UP PROCEDURE

4 CONNECTION BETWEEN THE PERSONAL COMPUTER AND CONTROLLER

5 PARAMETER SETTINGS

6 PROGRAM EXAMPLES

3 START-UP PROCEDURE

This chapter describes the procedures before operation.

Procedure	Description
1. Installing a battery	Install a battery to the controller.*1 ☞ Page 56 Battery installation procedure
2. Inserting an SD memory card	Insert an SD memory card to the controller as needed. ☞ Page 57 SD memory card installation procedure
3. Mounting modules and connecting cables	Mount the controller on the base unit, and connect cables. ☞ Page 58 Controller installation procedure
4. Powering on the system	Check the following before powering on the system. • A cable is correctly connected to the power supply. • Power supply voltage is within the specified range. • The controller is in the STOP state. • The controller is connected to a personal computer on which the engineering tool has been installed.
5. Starting up the engineering tool	Start up the engineering tool that has been installed on the personal computer connected to the controller.
6. Registering user information (user authentication function)	Register a user name and password used to log in to the project. Then, write the user information to the controller. 📖 GX Works3 Operating Manual
7. Initializing the controller	Initialize the controller using the engineering tool. ☞ Page 70 Initializing the controller
8. Setting parameters	Set parameters using the engineering tool. ☞ Page 71 PARAMETER SETTINGS
9. Creating programs	Create a program using the engineering tool. ☞ Page 97 PROGRAM EXAMPLES
10. Writing to the controller	Write the parameters set and the program created by using the engineering tool to the controller. ☞ Page 111 Conversion and writing of programs
11. Resetting the controller	Restart the system in either of the following ways. • Power off and on the system. • Reset the controller.
12. Checking for errors	Check the status of the READY LED and ERROR LED of the controller. If an error is detected, identify the error using the engineering tool, and eliminate the error cause. ☞ Page 1674 Troubleshooting with LED Indicators
13. Network diagnostics	Using network diagnostics, check if the cables are connected properly and communications are performed normally with the parameters. ☞ Page 1697 Checking the Network Status
14. Parameter setting of a device station	Set parameters of the device station used. 📖Manual for the device station used
15. Test operation	Check whether the created program was executed properly.
16. Executing the program	Set the controller to the RUN state and check that the PROGRAM RUN LED turns on.
17. Monitoring the program	Check that the program operates normally using the engineering tool. ☞ Page 113 Program monitor

*1 The controller does not need a battery for holding data. Use the battery (FX3U-32BL) to save clock data in the event of a long-term (10 days or more) power failure.

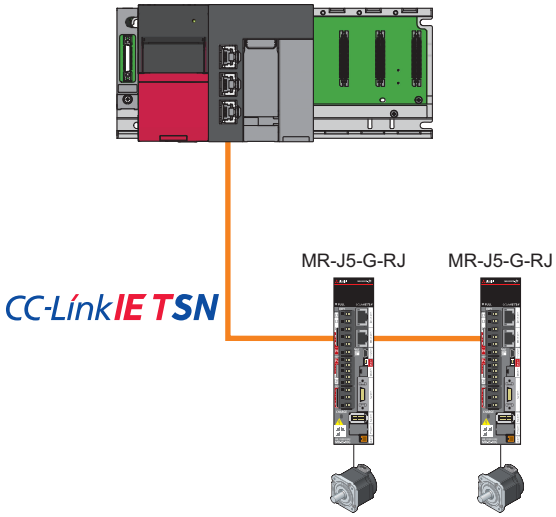
Precautions

When multiple device stations are powered on simultaneously, the startup time of the device stations may vary. In such a case, the networks are connected in turn, resulting in the possibility of the longer time to complete data links at all stations. Starting up the master station after all device stations have started prevents the time required for data links at all stations from increasing.

3.1 Connection Example

A connection example using the following devices is shown.

- Main base unit: R35B
- Power supply module: R61P
- Controller: MXR500-256
- Servo amplifier: MR-J5-G-RJ
- Servo motor (HK-KT series)

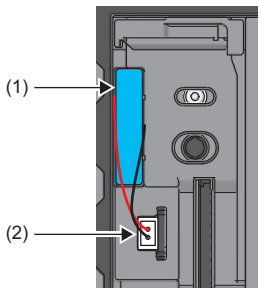


3.2 Mounting the Controller

Installing a battery

Battery installation procedure

To use the battery, connect the battery, following the procedure below.



1. Open the switch cover on the front of the controller.
2. Connect the lead connectors to the battery connector (2) in the right orientation. Insert the battery in the battery compartment (1).
3. Close the switch cover on the front of the controller.

Point

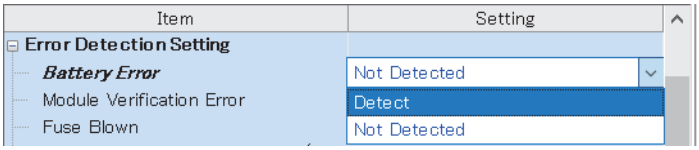
For the battery replacement procedure, refer to the following.

☞ Page 1621 Battery Replacement Procedure

■Battery error detection setting in the engineering tool

The following setting is required to use the battery.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Error Detection Setting] ⇨ [Battery Error]



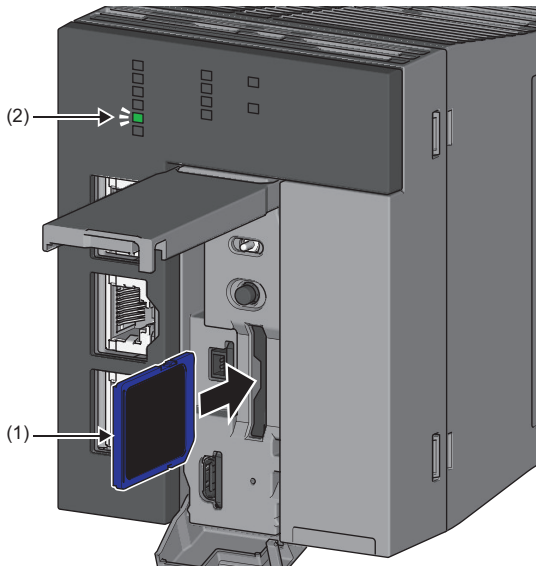
The default is "Not Detected", so change it to "Detect".

Inserting and removing an SD memory card

Insert an SD memory card to the controller as needed.

SD memory card installation procedure

Check the direction and insert an SD memory card, following the procedure below.

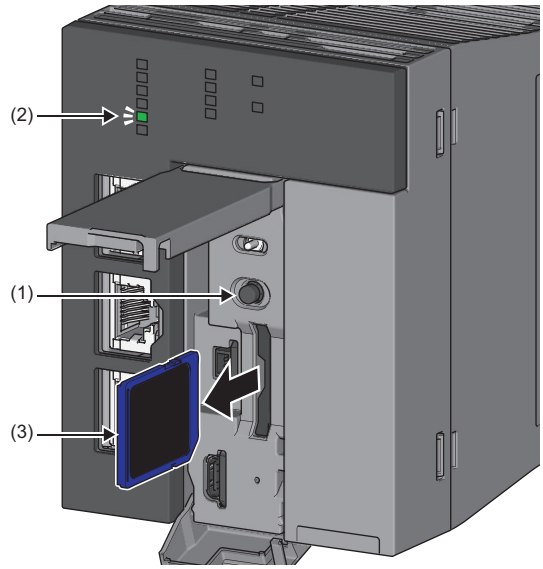


1. Insert an SD memory card (1) into the card slot until it clicks with the notched edge in the direction as illustrated. After inserting the card, check that it is inserted completely. Poor contact may cause malfunction.
2. The CARD LED (2) flashes until the SD memory card can be used. When the CARD LED is on, the SD memory card can be used.

Point

If the CARD LED does not turn on even after the card is inserted, use the engineering tool to check that SM606 (SD memory card forced disable instruction) and SM607 (SD memory card forced disable status flag) are off.

SD memory card removal procedure



1. Press the SD CARD OFF button (1) for one second or longer to disable access to the SD memory card.*1
2. The CARD LED (2) flashes during the access stop processing, and turns off upon completion of the processing.
3. Push in and release the SD memory card (3), and then pull the card out of the slot.

*1 SM606 (SD memory card forced disable instruction) can also disable access to an SD memory card. For details, refer to the following.
☞ Page 324 How to forcibly disable the SD memory card with a special relay

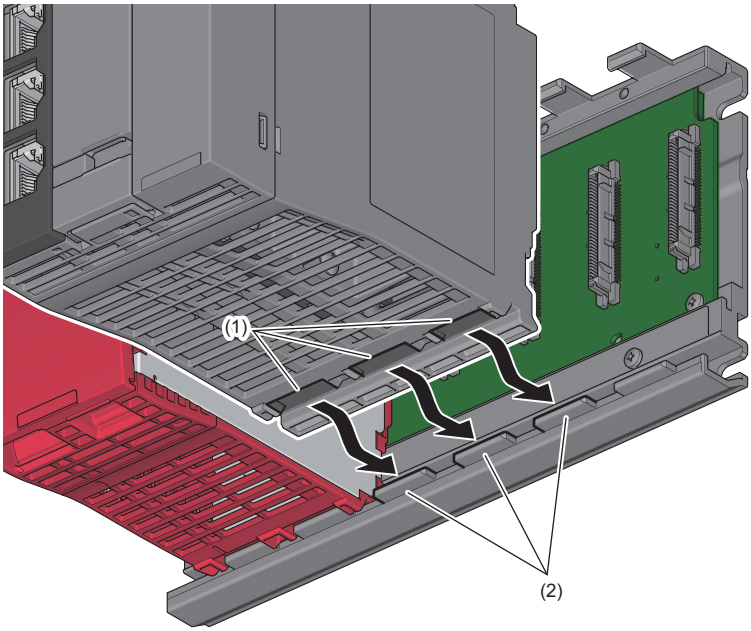
Precautions

- Do not drop or apply strong shock to the controller and SD memory cards.
- Follow the procedure above when inserting or removing the SD memory card while the system is powered on. If not, the data on the SD memory card may corrupt.
- If any function that accesses the SD memory card is being executed when removing the card, the CARD LED turns off after the processing of the function is completed. For this reason, the time required from when the CARD LED flashes slowly until when it turns off differs depending on the function being executed.
- If SM605 (Memory card remove/insert prohibit flag) is on, the CARD LED does not turn off even if the SD CARD OFF button is pressed. If not, turn on SM606 (SD memory card forced disable instruction) to forcibly disable the card.

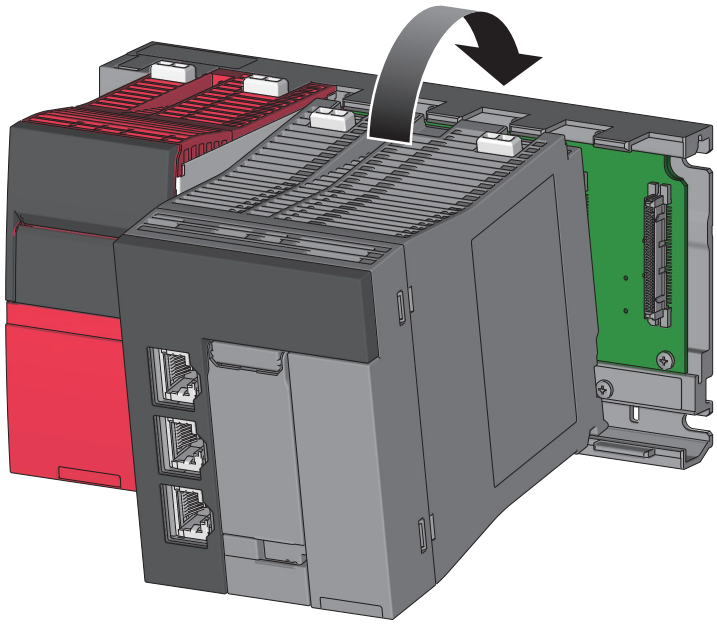
Mounting/removing the controller on/from a main base unit

This section describes the procedure for mounting/removing the controller on/from the main base unit.
Power off a system when mounting/removing the controller. Attach a blank cover module (RG60) to each connector where no controller is mounted to prevent entry of foreign matter such as dust.

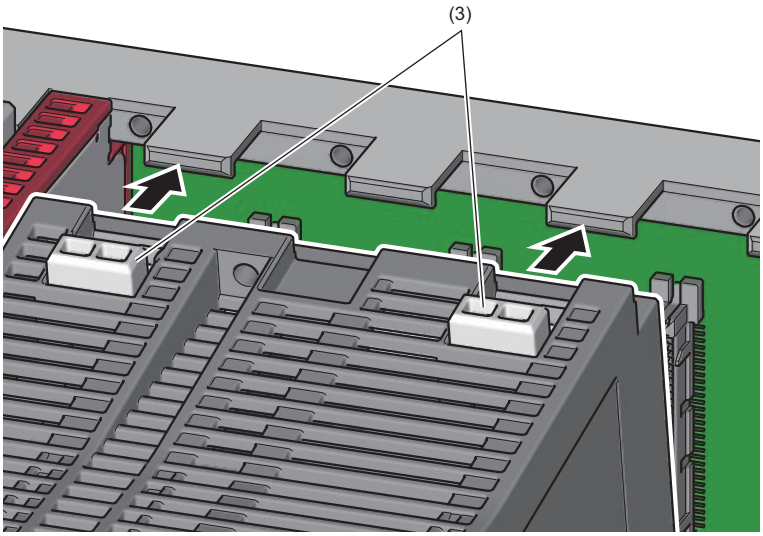
Controller installation procedure



1. If a cap is attached to the module connector of the base unit, remove it.
2. Place the concave part (1) of the controller onto the guide (2) of the base unit.



3. Using the guide (2) as a pivot point, push in the controller until the module fixing hook (3) snaps into place.
4. Check that the controller's module fixing hook (3) hangs the base unit and the controller is mounted on the base unit securely.



Point

When using the controller in environments in which it is subject to strong vibrations and shocks, take the following measures:

- Fix the controller to the base unit using screws. (Module fixing screw: M3×12 (sold separately))
- Place the cables connected to the controller in a duct or clump them to prevent the weight of the cables from putting stress on the controller.

■Precautions for installation

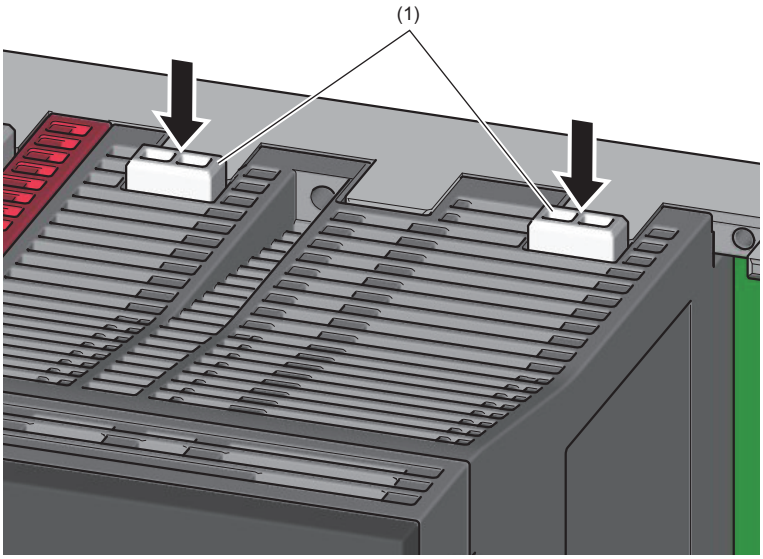
- Correctly place the concave part of the controller onto the guide of a base unit before mounting the controller. Failure to do so may damage the controller.
- When mounting the controller on the base unit in the control panel, keep a certain distance from the control panel for installation. For information on the installation position when a controller is used and the side dimensions for installation on the DIN rail, refer to the following.

Safety Guidelines (IB-0800726)

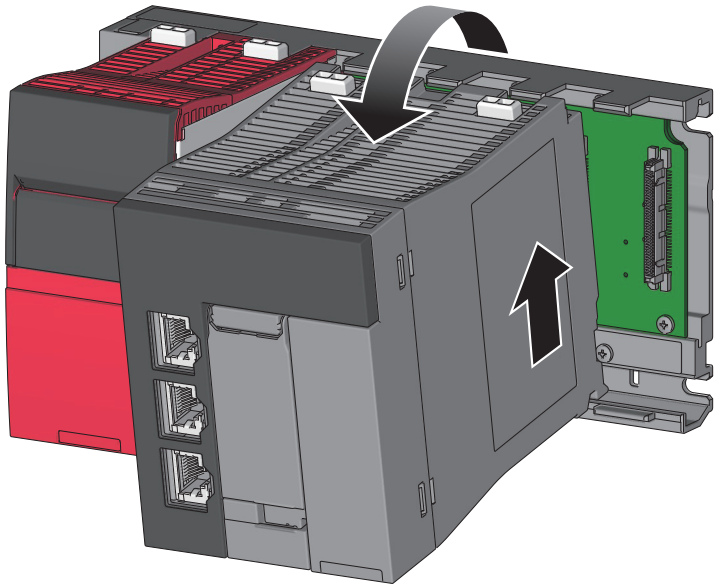
- When installing devices other than the controller, refer to the following.

MELSEC iQ-R Module Configuration Manual

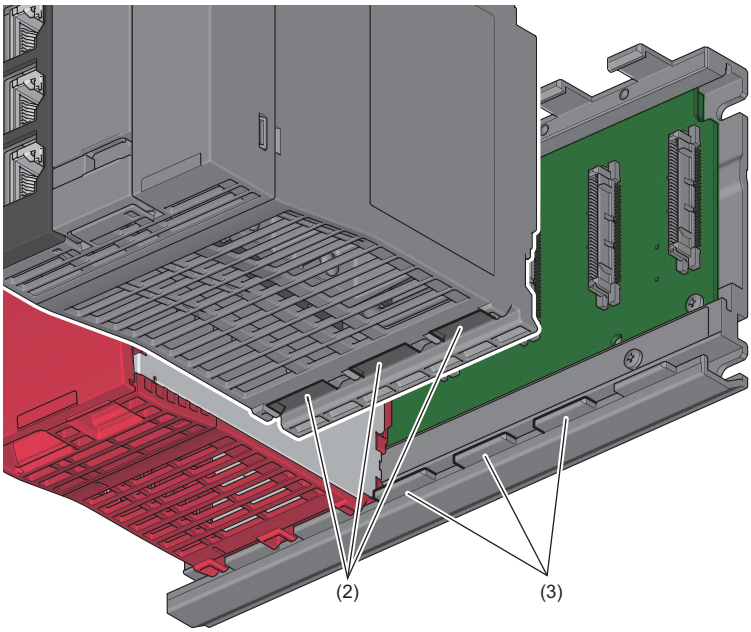
Controller removal procedure



1. Support the controller with both hands and firmly press the module fixing hooks (1) on the top of the controller with your fingers.



2. Pull the controller straight while pressing the module fixing hooks (1), using the bottom of the controller as a fulcrum.
3. While lifting the controller, remove its concave part (2) from the guide (3) of the base unit.



Point

- When module fixing screws are used, remove the screws first and then the controller. Failure to do so may damage the controller.
- The controller surface temperature may be high immediately after power-off. When the controller is removed, pay attention to the burn injury.

3.3 Wiring

This section describes wiring products, wiring methods, and wiring precautions.

Wiring products

The following describes the devices used for the network.

Ethernet cable

Use an Ethernet cable that meets the following standards.

Communication speed	Ethernet cable	Connector	Type
1Gbps	Category 5e or higher, straight cable (shielded, STP)	RJ45 connector	The following conditioning cables: • IEEE 802.3 (1000BASE-T) • ANSI/TIA/EIA-568-B (Category 5e)
100Mbps	Category 5 or higher, straight cable (shielded, STP)		The following conditioning cables: • IEEE 802.3 (100BASE-TX) • ANSI/TIA/EIA-568-B (Category 5)

Cables for CC-Link IE TSN are available from Mitsubishi Electric System & Service Co., Ltd. (Catalogs for cable are also available.)
In addition, the connector processing of cable length is available for your preference. Please contact your local Mitsubishi representative.

Communication speed	Type	Model (Manufacturer)
1Gbps	Category 5e or higher, straight cable (double shielded, STP)	SC-E5EW series (Mitsubishi Electric System & Service Co., Ltd.)

Point

A communication error may occur due to high-frequency noise from other devices in a given connection environment.
The following are the measures to be taken with the wiring to avoid high-frequency noise influence.
- Use a duplex shield type cable.
- Do not bundle the cable with the main circuit or power cable or do not place it near those lines.
- Place the cable in a duct.

■Hubs

Use hubs that support the transmission speed of communication for use in the Ethernet.

Point

The controller determines whether to use 1000BASE-T/100BASE-TX and the full-duplex/half-duplex communication mode based on the hub. For connection to the hub with no auto-negotiation function, set the half-duplex communication mode on the hub side.

USB cable

Wire with a USB cable whose connector type is Type-C.

Industrial switch

Use the following industrial switches when using CC-Link IE TSN.

- Industrial switch (CC-Link IE TSN Class B certified)*1
- Industrial switch (CC-Link IE TSN Class A certified)

Point

- For the models and usage methods of the industrial switch, refer to the CC-Link Partner Association website (www.cc-link.org).
- Industrial switches can be used for cascade connection, but check the specifications of the industrial switch used.

*1 For the industrial switch (CC-Link IE TSN Class B certified), the NZ2MHG-TSNT☐ (Mitsubishi Electric Corporation) is recommended.

Precautions

Since there are different restrictions for a system configuration using industrial switch (CC-Link IE TSN Class B certified) and for a system configuration using industrial switch (CC-Link IE TSN Class A certified), setting with the engineering tool is required. (☞ Page 142 CC-Link IE TSN SYSTEM CONFIGURATION)

Ethernet cable wiring method

The following describes connection and disconnection of the Ethernet cable.

Installation method

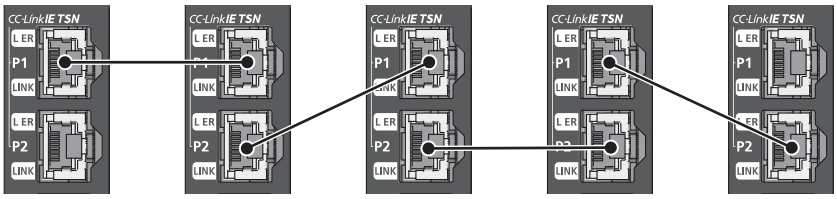
1. Push the Ethernet cable connector into the controller until it clicks. Pay attention to the direction of the connector.
2. Lightly pull it to check that it is securely connected.
3. Check that the LINK LED of the Ethernet port where the Ethernet cable is connected is on.*1

*1 The time between the Ethernet cable connection and the LINK LED turning on may vary. The LINK LED usually turns on in a few seconds. Note, however, that the time may be extended further if the link-up processing is repeated depending on the status of the device on the line. If the LINK LED does not turn on, refer to the following and take corrective actions.
☞ Page 1678 When the LINK LED turns off

Point

CC-Link IE TSN devices can be connected to both P1 and P2.

- When only one port is used in a star topology, either P1 or P2 is applicable.
- When both ports are used in a line topology, P1-P1, P2-P2, and P1-P2 are acceptable.



Disconnecting the cable

1. Press the latch down and unplug the Ethernet cable.

Precautions

Be sure to follow the precautions for wiring. Otherwise, some functions may not operate normally. (It may operate normally temporarily.)

- Place the Ethernet cable in a duct or clamp them. If not, dangling cable may swing or inadvertently be pulled, resulting in damage to the module or cables or malfunction due to poor contact.
- Do not touch the core of the cable-side or module-side connector, and protect it from dirt or dust. If oil from your hand, dirt or dust is attached to the core, it can increase transmission loss, arising a problem in a data link.
- Check that the Ethernet cable is not disconnected or not shorted and there is no problem with the connector connection.
- Before connecting the Ethernet cables, check also the CC-Link IE TSN Installation Manual available on the CC-Link Partner Association website (www.cc-link.org). Failure to follow the instructions in the manual may cause malfunctions.
- Do not use Ethernet cables with broken latches. Doing so may cause the cable to unplug or malfunction.
- Hold the connector part when connecting and disconnecting the Ethernet cable. Pulling the cable connected to the module may result in damage to the module or cables or malfunction due to poor contact.
- For connectors without an Ethernet cable, the attached connector cover should be placed to prevent foreign matter such as dirt or dust and to prevent failure or malfunction caused by static electricity.
- The maximum station-to-station distance of the Ethernet cable is 100m. However, the distance may be shorter depending on the operating environment of the cable. For details, contact the manufacturer of the cable used.
- The bending radius of the Ethernet cable is limited. For details, check the specifications of the Ethernet cable to be used.
- In a line topology, do not connect the device station with no IP address setting between the master station and device stations, or between device stations. A data link may not be established with the device stations connected from the device station with no IP address setting onwards. However, if the device station with no IP address setting is connected at the end of the line topology, the device stations between the master station and the device station at the end perform a data link.
- Communication with the Ethernet device may not be possible depending on the specifications of the connected Ethernet device or industrial switch. If communication is not possible, reduce the communication data volume of the Ethernet device.
- When setting "Communication Speed" of the master station to 100Mbps to connect a device with a communication speed of 100Mbps, enable auto-negotiation of the device.

4 CONNECTION BETWEEN THE PERSONAL COMPUTER AND CONTROLLER

4.1 Engineering Tool Setting

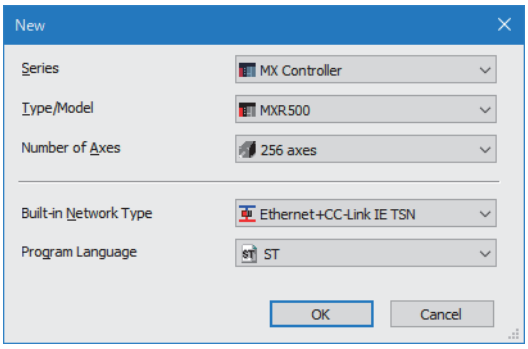
Creating a project

Create a new project.

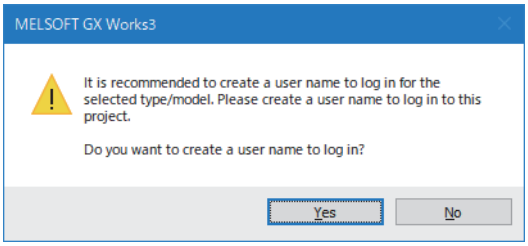
Operating procedure

1. Start the engineering tool.
2. Set the controller as follows.

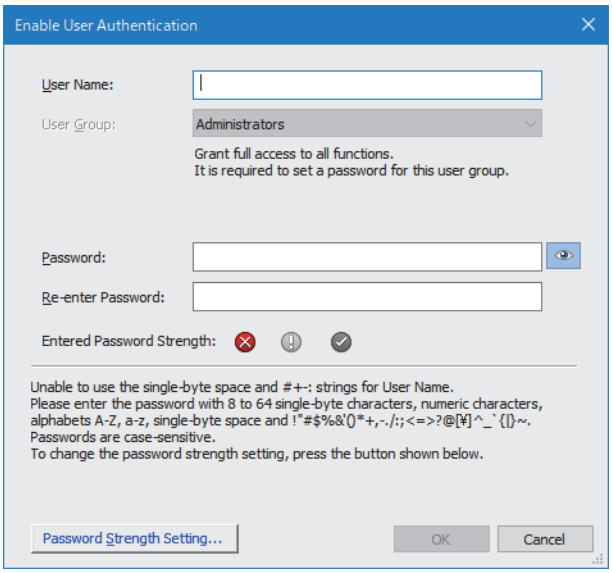
[Project] ⇨ [New]



3. Click the [Yes] button.



4. Configure each item and click the [OK] button.

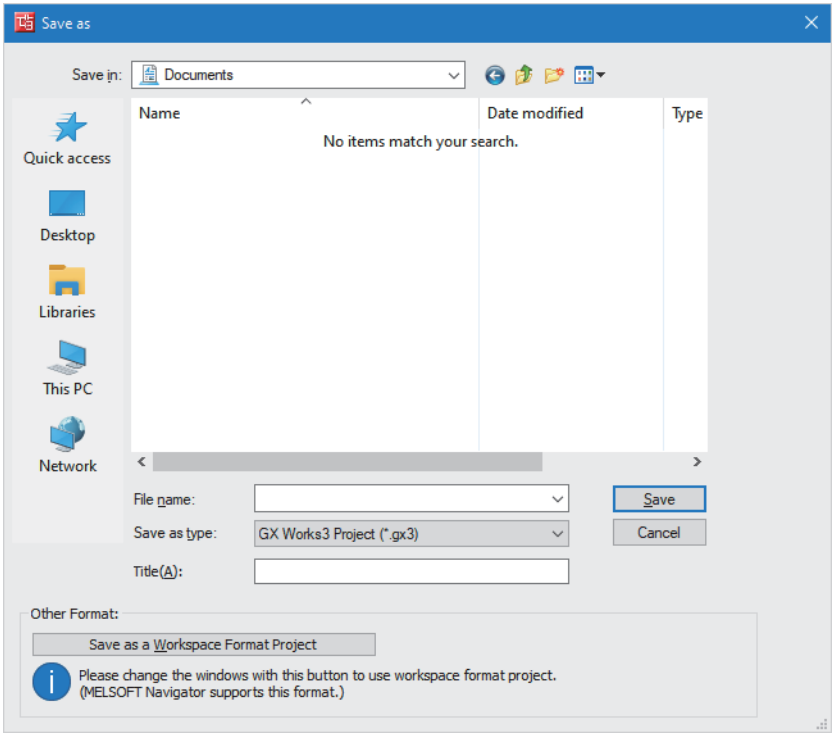


Point

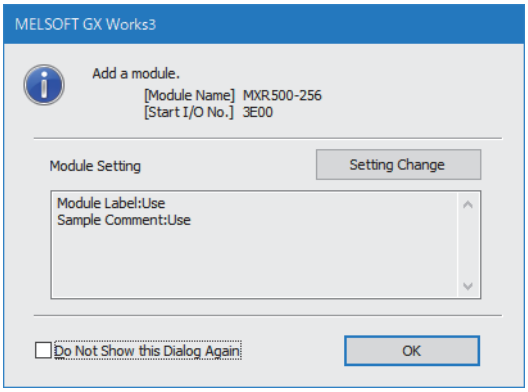
For details on characters that can be used in passwords, refer to the following.

☞ Page 2192 Password Policy

5. Configure each item and click the [Save] button.



6. Click the [Setting Change] button and set "Module Label" to "Use".



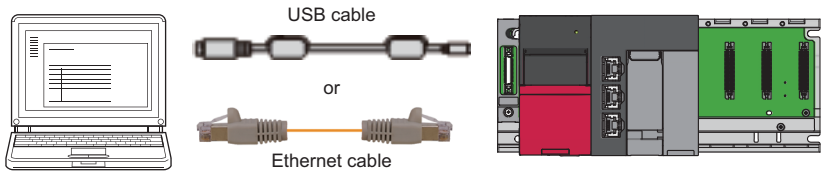
7. Click the [OK] button to create the project.

Connection between the personal computer and controller

Check the connection between the personal computer and the controller.

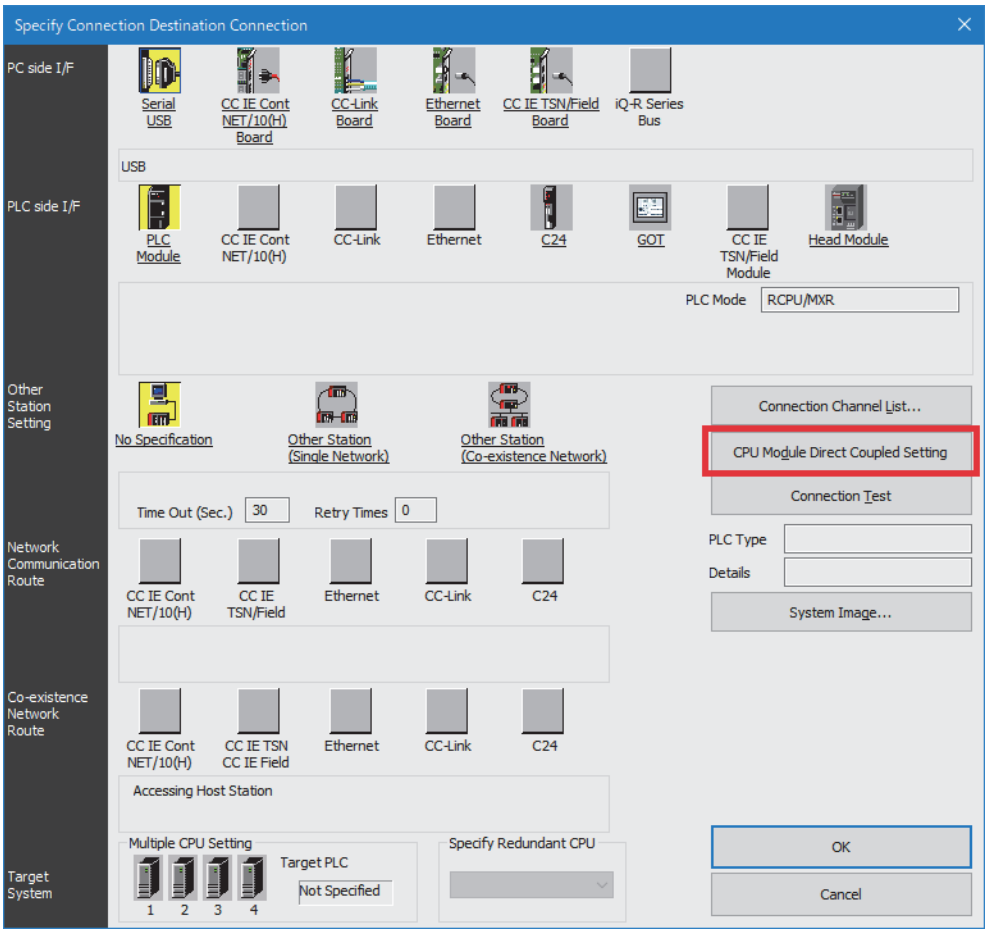
Operating procedure

1. Connect the personal computer to the controller with a USB cable or an Ethernet cable.

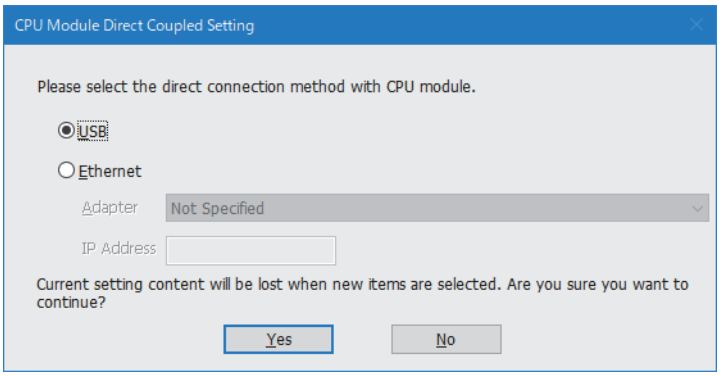


2. Click the [CPU Module Direct Coupled Setting] button on the "Specify Connection Destination Connection" window.

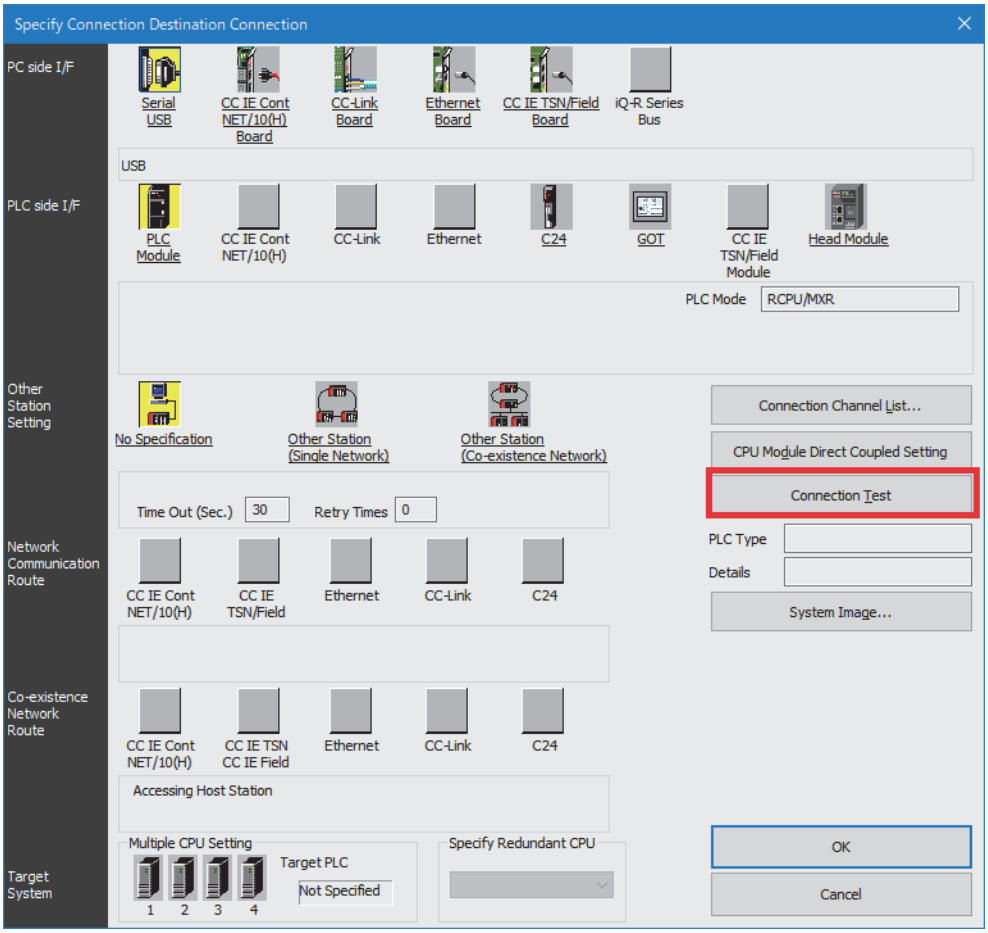
[Online] ⇨ [Current Connection Destination] on the menu bar



3. Select the connection method, and click the [Yes] button. (When selecting "Ethernet", specify the adapter.)



4. Click the [Connection Test] button on the "Specify Connection Destination" window to perform a connection test with the personal computer.



5. If the connection was successful, the successfully connected message appears. Click the [OK] button.

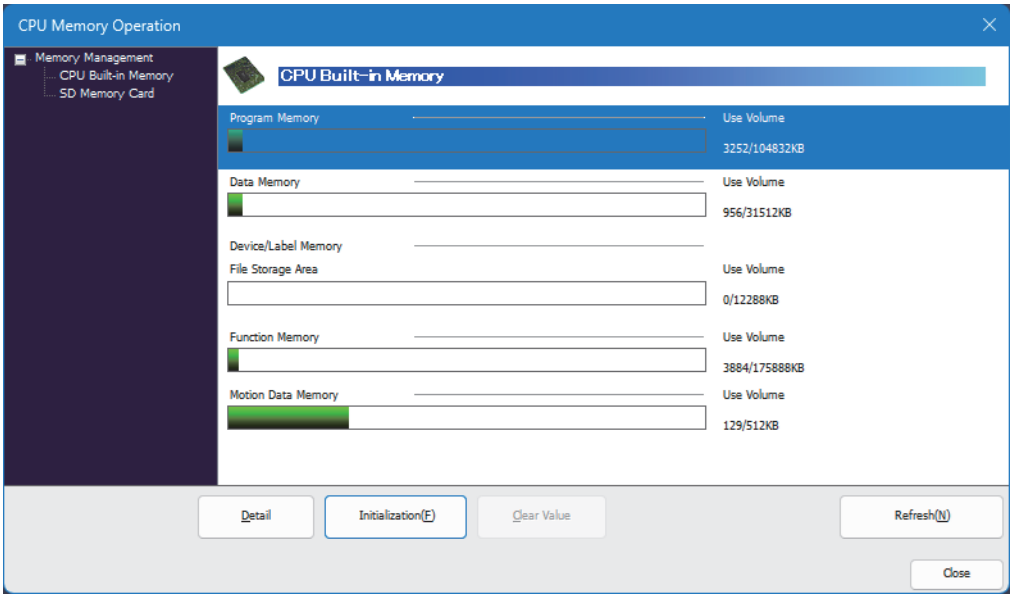
Initializing the controller

Initialize the controller.

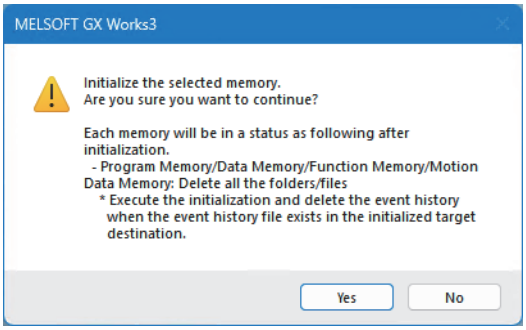
Operating procedure

1. Click the [Initialization] button on the "CPU Memory Operation" window.

[Online] ⇨ [CPU Memory Operation] on the menu bar



2. When the confirmation message appears, click the [Yes] button to start initialization.



3. When initialization is complete, the completed message is displayed. Click the [OK] button.

5 PARAMETER SETTINGS

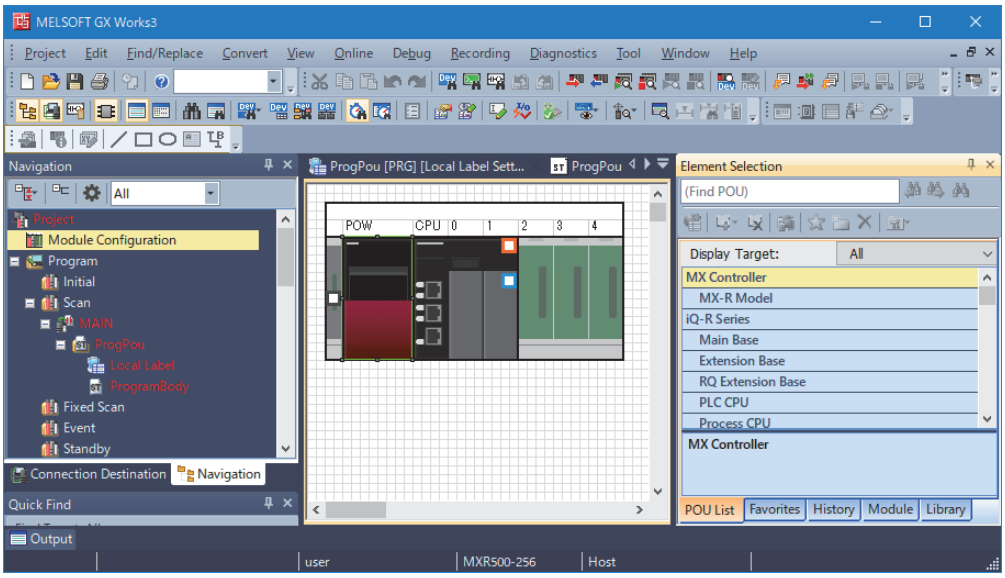
5.1 Creating a Module Configuration

Create a module configuration.

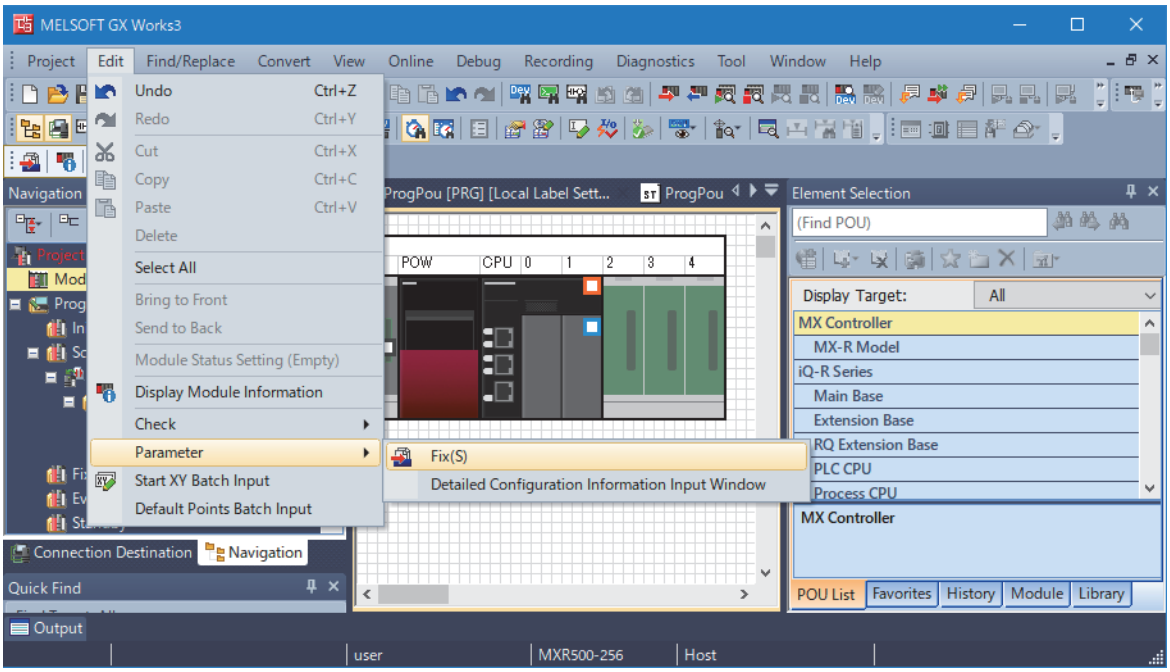
Operating procedure

1. Click the [POU List] tab in the Element Selection window. Select the modules to be used (main base unit and power supply module). Then, drag and drop them into position on the module configuration.

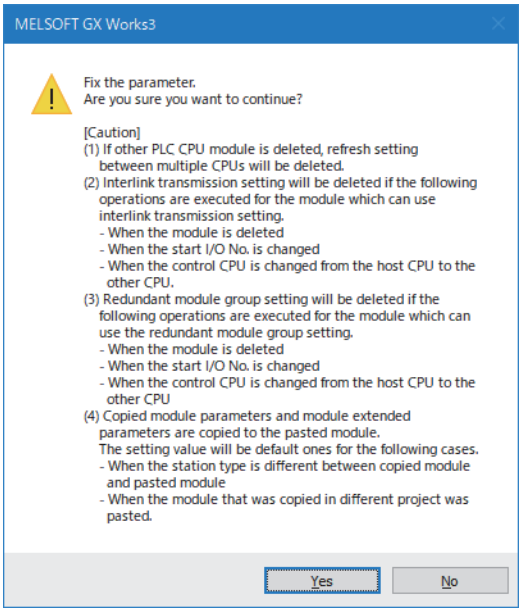
Navigation window ⇨ Double-click [Module Configuration].



2. Select [Edit] ⇨ [Parameter] ⇨ [Fix] on the menu bar.



3. When the confirmation message appears, click the [Yes] button.



5.2 Network Settings

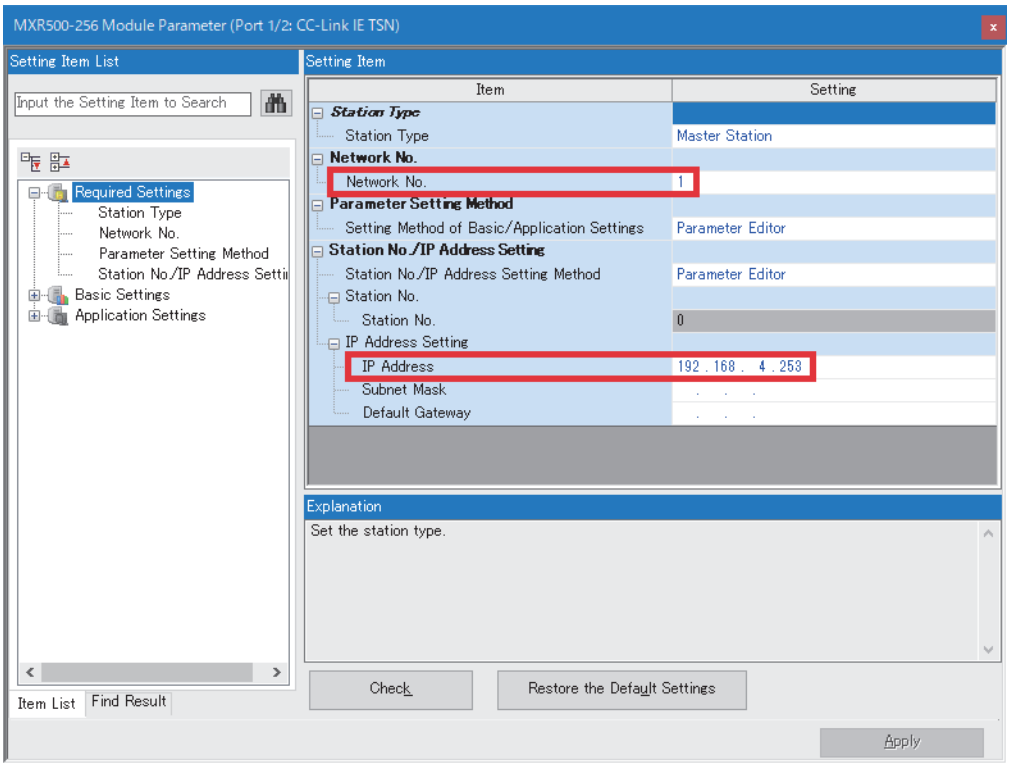
Set device stations, such as servo amplifiers, to be connected to CC-Link IE TSN.

Setting a network configuration

Operating procedure

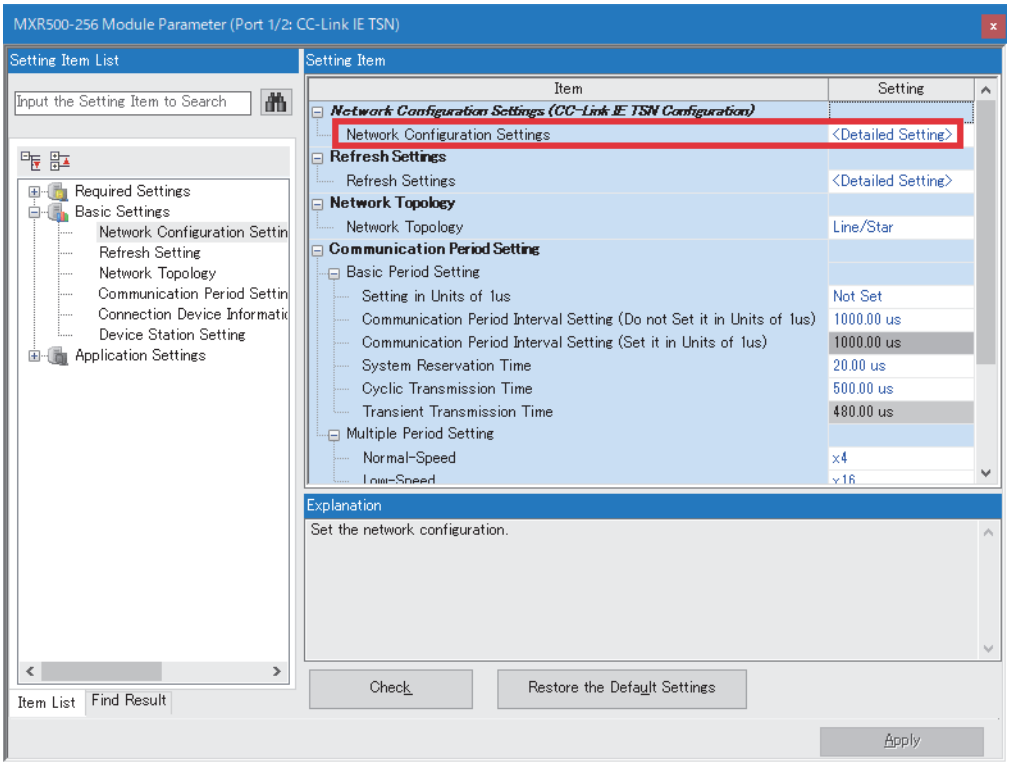
1. Set "Network No." and "IP Address". The example in this procedure uses the initial value.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Required Settings]



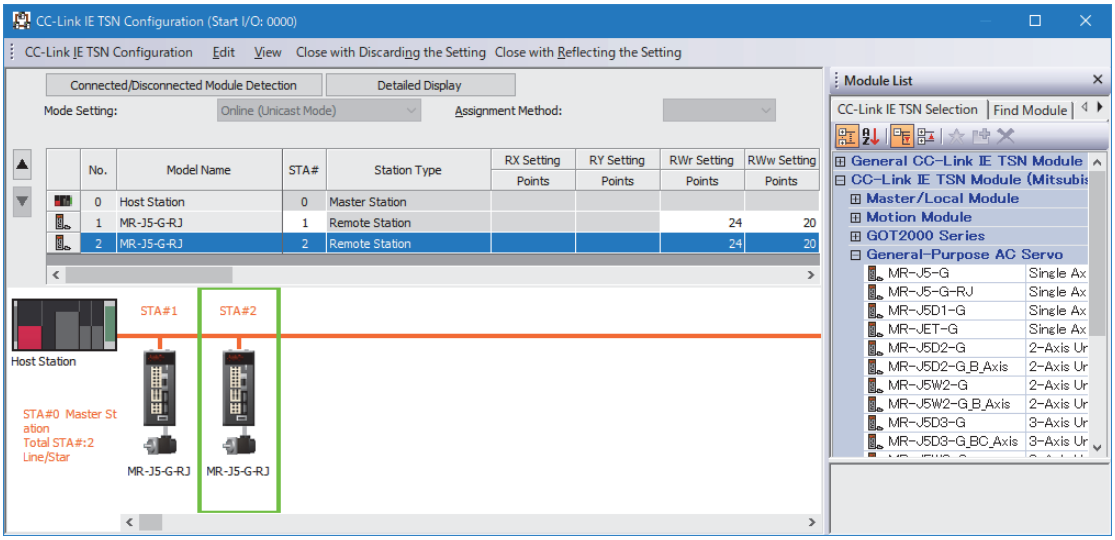
2. Double-click "<Detailed Setting>" in "Network Configuration Settings".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings]



3. Select the devices to be used, and drag and drop them into their assigned position.

[CC-Link IE TSN Selection] tab in the module list ⇨ [General-Purpose AC Servo] in [CC-Link IE TSN Module (Mitsubishi Electric)]



Point

The initial values are displayed in the station No. and the number of I/O points.
The IP address is assigned automatically based on the master station setting, the master station No., and the order the module is dropped.

5.3 Motion Setting

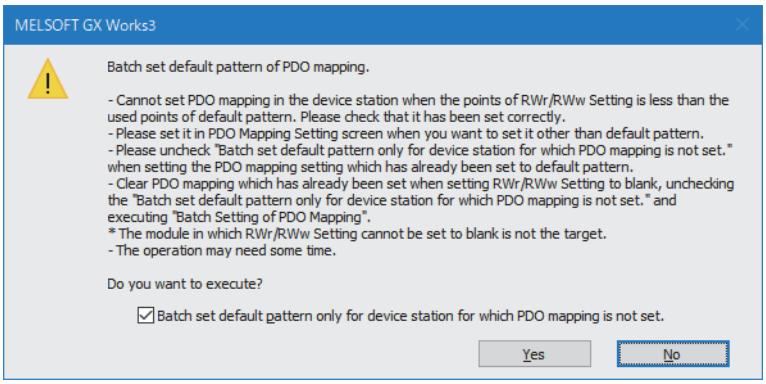
PDO mapping

Set default data of the PDO mapping in a batch.

Operating procedure

1. From the menu on the "CC-Link IE TSN Configuration" window, select "Batch Setting of PDO Mapping" and then click the [Yes] button.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ Double-click <Detailed Setting> ⇨ [CC-Link IE TSN Configuration] ⇨ [Batch Setting of PDO Mapping]



2. When the PDO mapping batch setting completes, the completed message appears. Click the [OK] button.

Point

PDO is an abbreviation for Process Data Object.
PDO communication is equivalent to the conventional CC-Link cyclic transmission.
PDO mapping performs mapping (associating) of data (objects) sent/received between the controller and the devices in cyclic transmission (PDO communication).

Servo parameter settings

There are two methods for writing parameters to servo amplifiers.

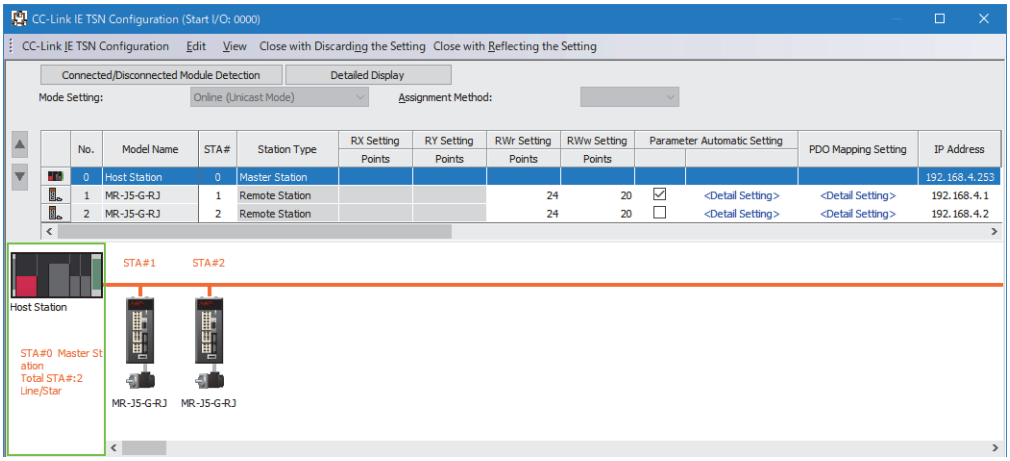
Writing method	Advantage	Disadvantage
Writing from the engineering tool to the controller	• Batch-management of parameters • Setting parameters without connecting servo amplifiers	Taking time at the initial communication
Writing parameters from MR Configurator2 to servo amplifiers	Quick startup of servo amplifiers since transmission of parameters is not necessary at power-on	Necessary to write parameters to each servo amplifier

This section describes the procedure for writing from the engineering tool to the controller.

Procedure for writing from the engineering tool to the controller

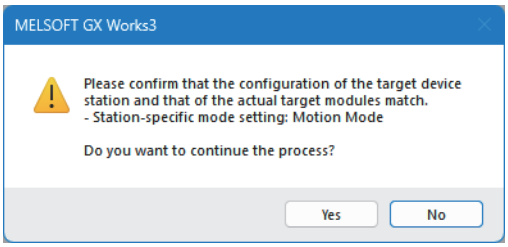
Operating procedure

1. Place a check in the "Parameter Automatic Setting" checkbox in the "CC-Link IE TSN Configuration" window to write parameters to the device stations from the master station at the initial communication.

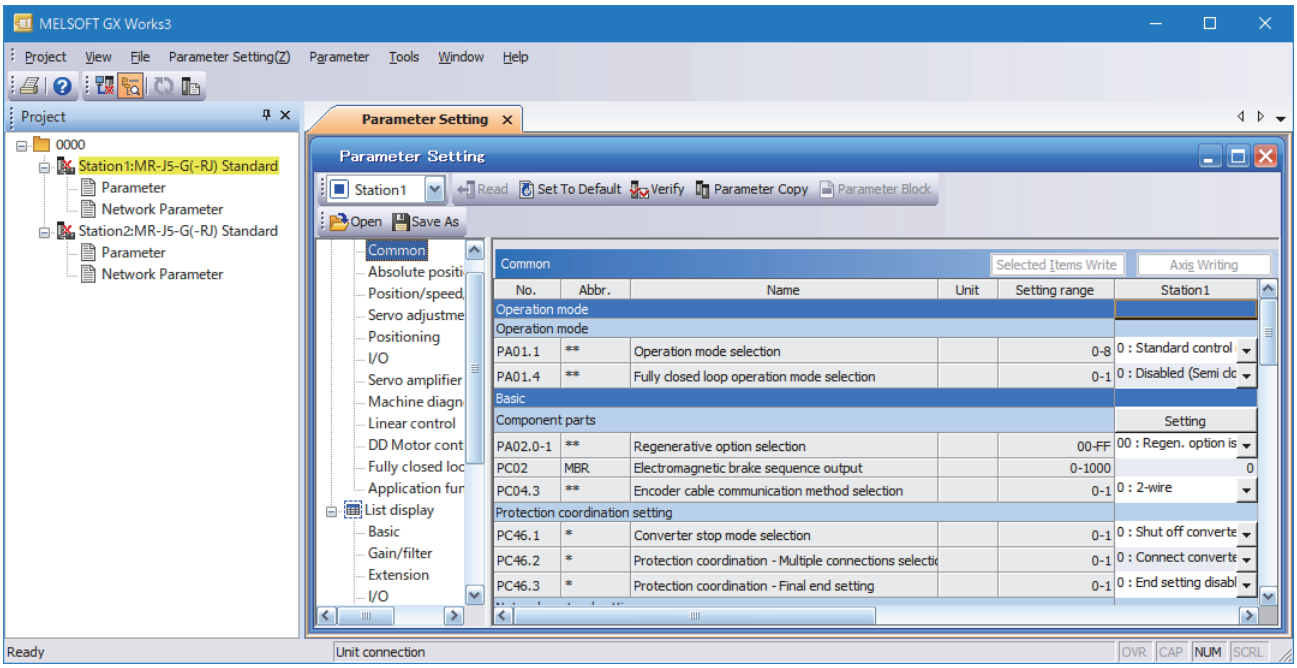


2. Double-click the illustration of the servo amplifier to be set.

3. When the confirmation message appears, click the [Yes] button.



4. On the "Parameter Setting" window, set the servo parameters.

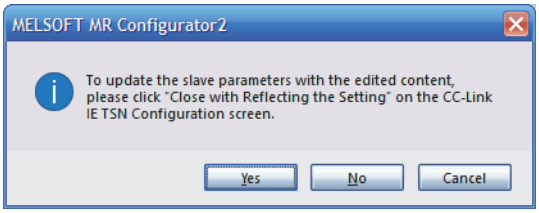


Change the following parameters.

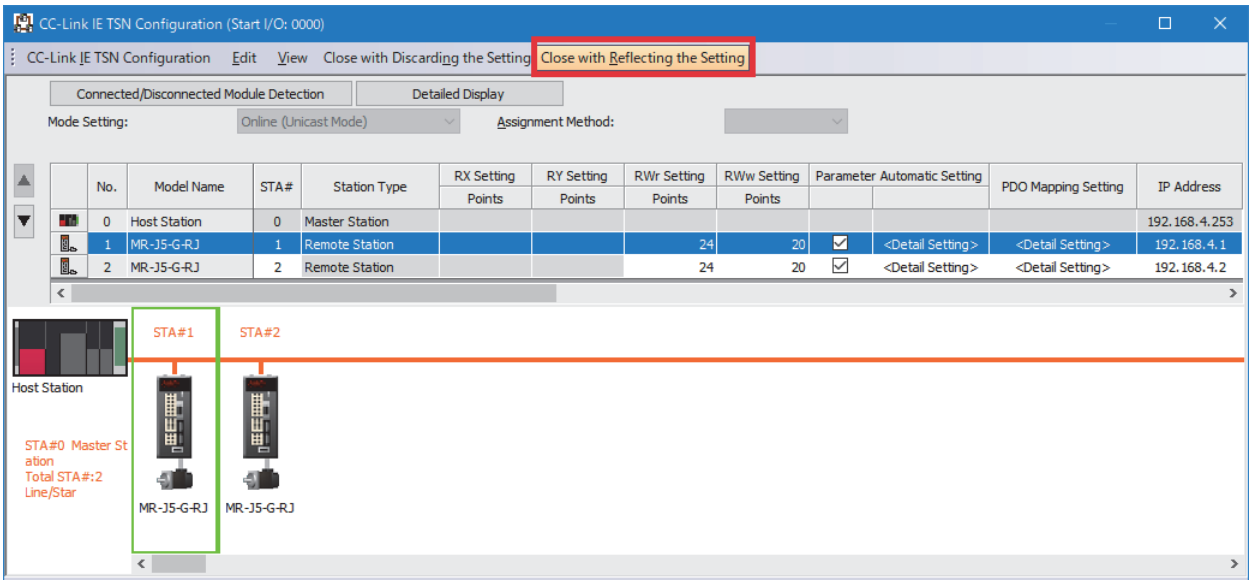
Operation	No.	Parameter	Setting value
[Common] ⇨ [Basic] ⇨ [Forced stop]	PA04.2	Servo forced stop selection	0: Enabled (Use forced stop input EM1 or EM2.) → 1: Disabled (The forced stop input EM1 and EM2 are not used.)
[I/O] ⇨ [Stroke limit function] ⇨ [Stroke limit function]	PC19.0	[AL.099 Stroke limit warning] selection	0: Enabled → 1: Disabled
	PD41.2	Limit switch enabled status selection	0: Limit switch always enabled → 1: Enabled only for homing mode

5. When the setting is complete, click the [×] button in the upper right corner of the "Parameter Setting" window.

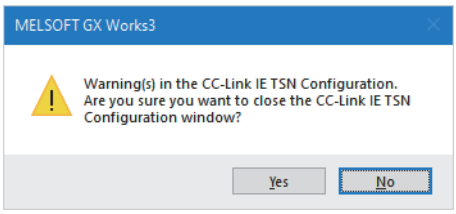
6. When the confirmation message appears, click the [Yes] button to update the parameters.



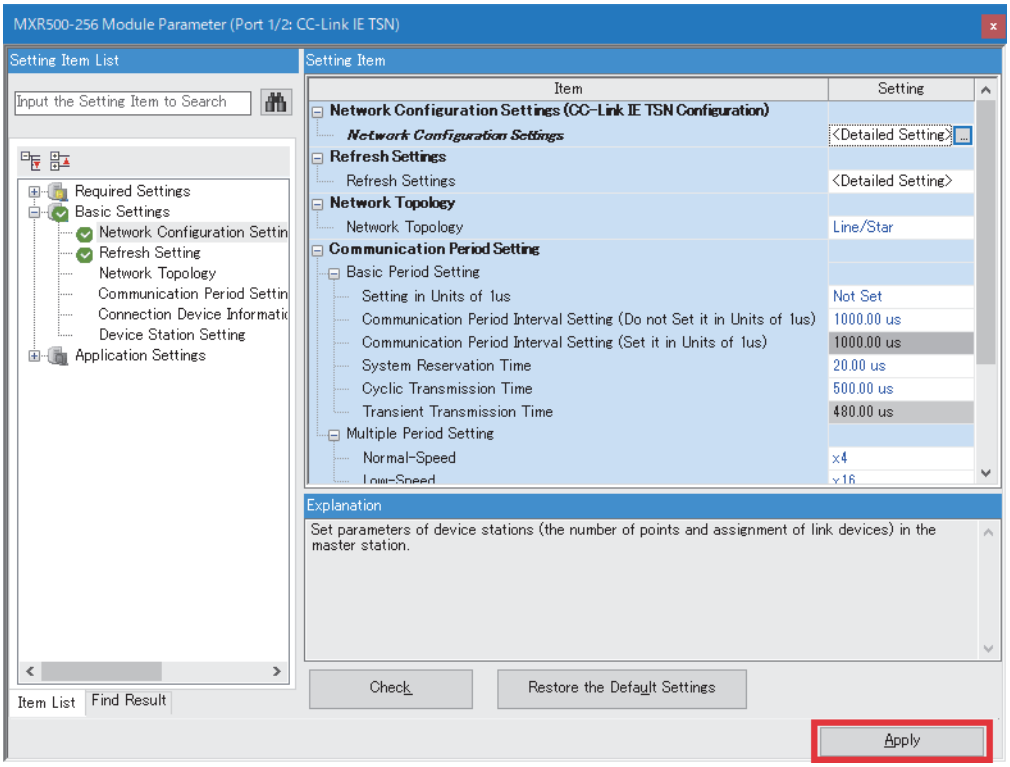
7. From the menu on the "CC-Link IE TSN Configuration" window, click the "Close with Reflecting the Setting" button.



If the following warning message appears, click the [Yes] button.



8. In the module parameters, click the [Apply] button to reflect the parameters of the controller.



Point

Changes made to parameters will be reflected only after the [Apply] button is clicked.

Axis parameter settings

Setting a station address and an axis type

There are five axis types.

Axis type	Description
Real drive axis	Outputs commands using a servo amplifier connected to CC-Link IE TSN.
Real encoder axis	Generates the current position from the output pulses of the synchronous encoder which is connected to a servo amplifier on CC-Link IE TSN.
Virtual drive axis	Virtually generates commands.
Virtual encoder axis	Virtually generates the current position from the variables.
Virtual linked axis	Virtually connects the single axis synchronous control FBs.

The example in this section registers two real drive axes, one virtual drive axis, and two virtual linked axes.

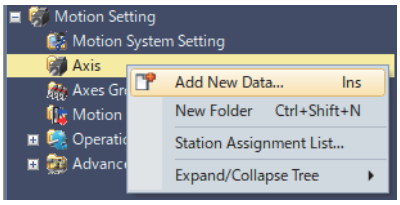
Real drive axis

Set the station address to link the axis information in the axis parameter to the servo amplifier set in the network configuration.

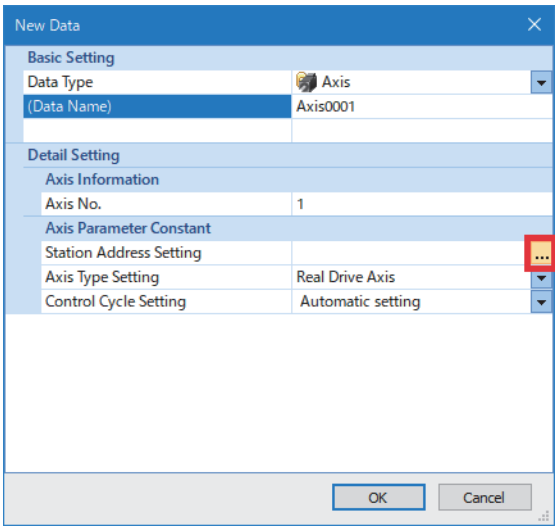
Operating procedure

1. Right-click "Axis" in the navigation window, and select "Add New Data".

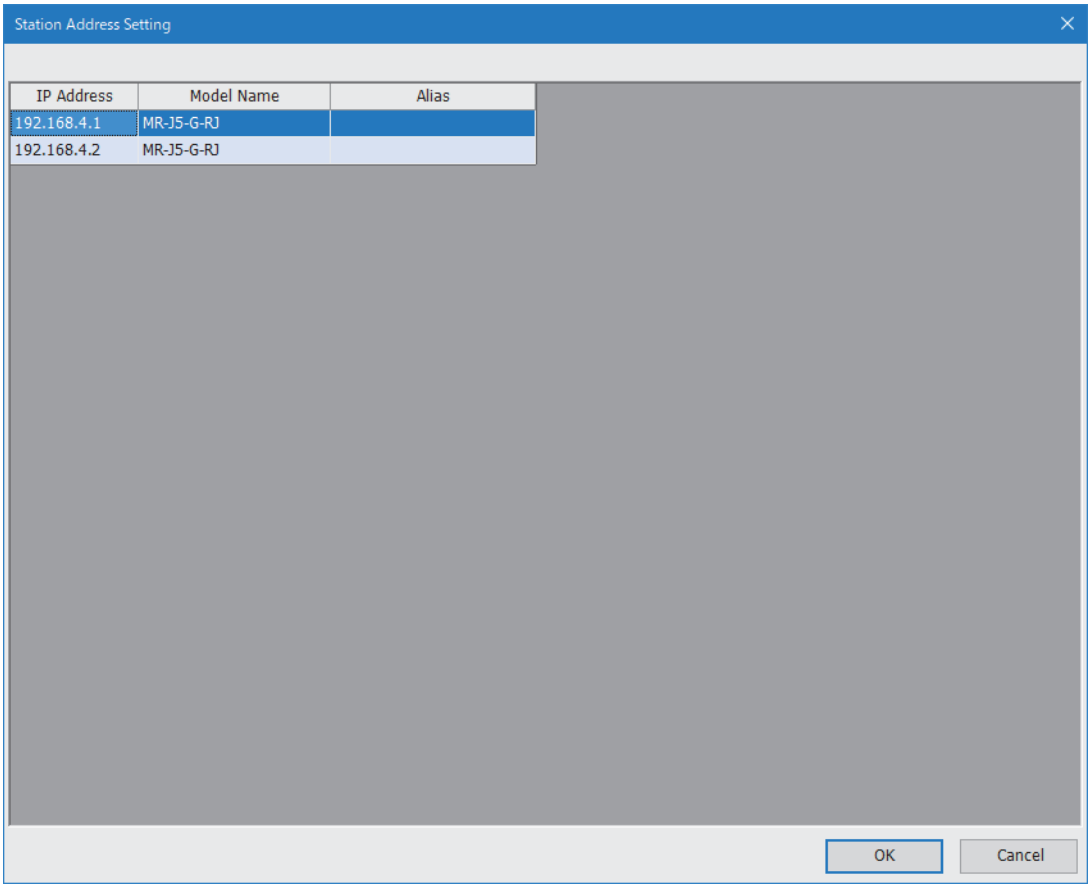
Navigation window ⇨ [Motion Setting] ⇨ [Axis]



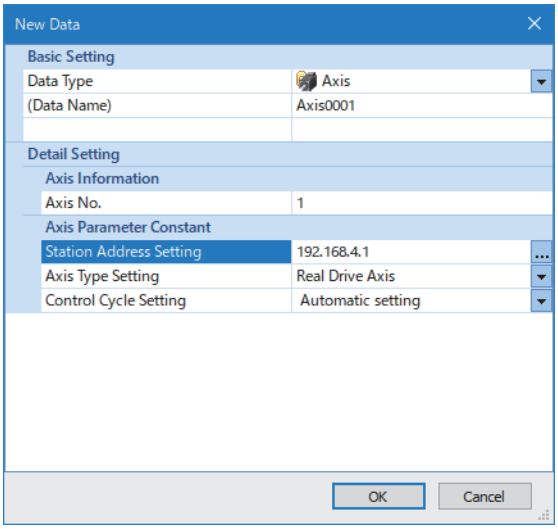
2. Click the [...] button on "Station Address Setting" to display the "Station Address Setting" window.



3. The station address can be set by selecting one of the IP addresses displayed on the "Station Address Setting" window and clicking the [OK] button.



4. Enter "Data Name", "Axis No.", "Station Address Setting", and "Axis Type Setting", and click the [OK] button.

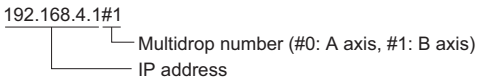


■Real drive axis setting description

Item	Setting value (1st axis)	Setting value (2nd axis)
Data Name	Axis0001	Axis0002
Axis No.	1	2
Station Address Setting	192.168.4.1	192.168.4.2
Axis Type Setting	Real Drive Axis	Real Drive Axis

Point

For the station address setting, use the IP address set in the "CC-Link IE TSN Configuration" window.
A multi-drop No. is shown when the station address for axes other than the first axis of a multi-axis servo amplifier is specified.
(Example) For B-axis of the MR-J5-W3 with "IP address: 192.168.4.1"



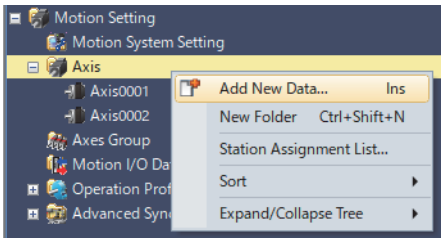
Virtual drive axis

Set a virtual drive axis.

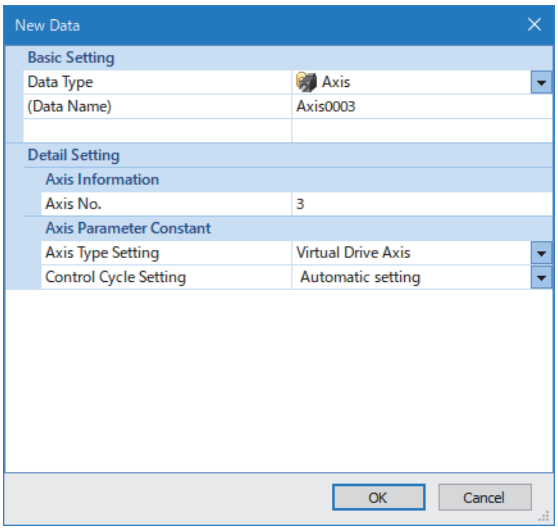
Operating procedure

1. Right-click "Axis" in the navigation window, and select "Add New Data".

Navigation window ⇨ [Motion Setting] ⇨ [Axis]



2. Enter "Data Name", "Axis No.", and "Axis Type Setting", and click the [OK] button.



■Virtual drive axis setting description

Item	Setting value
Data Name	Axis0003
Axis No.	3
Axis Type Setting	Virtual Drive Axis

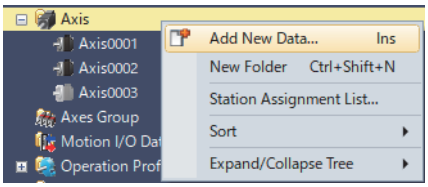
Virtual linked axis

Set a virtual linked axis.

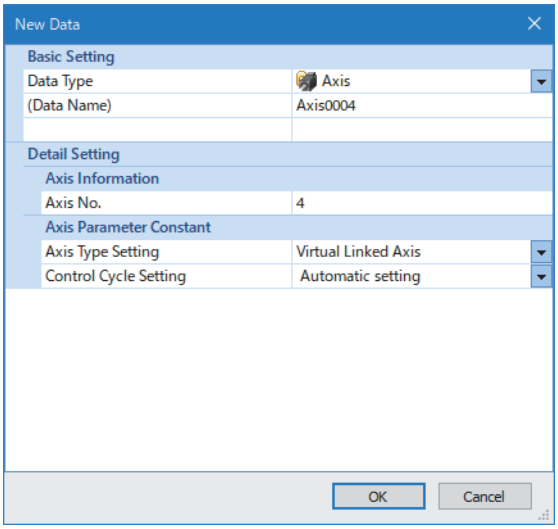
Operating procedure

1. Right-click "Axis" in the navigation window, and select "Add New Data".

Navigation window ⇨ [Motion Setting] ⇨ [Axis]



2. Enter "Data Name", "Axis No.", and "Axis Type Setting", and click the [OK] button.



■Virtual linked axis setting description

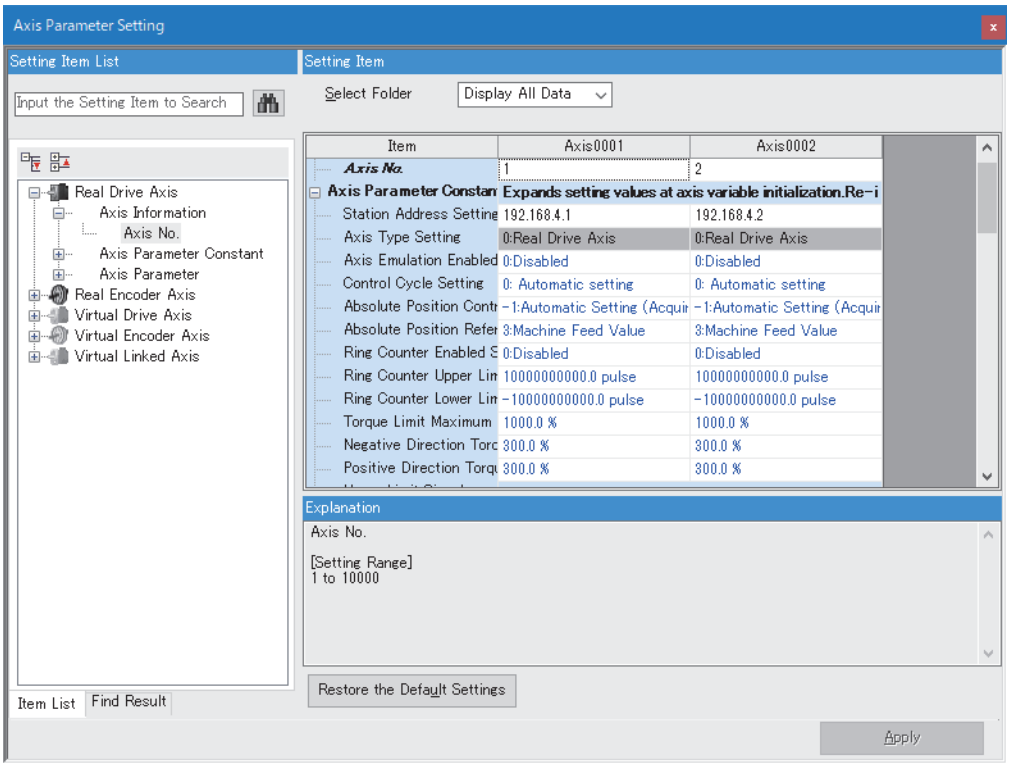
Item	Setting value (1st axis)	Setting value (2nd axis)
Data Name	Axis0004	Axis0005
Axis No.	4	5
Axis Type Setting	Virtual Linked Axis	Virtual Linked Axis

Setting each item

■Real drive axis

1. In the "Axis Parameter Setting" window, set the axis parameters for Axis0001 and Axis0002.

Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Double-click Axis0001 (Axis0002).



Set the real drive axes (Axis0001 and Axis0002) as shown below.

Item				Description	Setting value	
					Axis0001	Axis0002
Axis Parameter Constant	Station Address Setting			Set the IP address of the driver.	192.168.4.1	192.168.4.2
	Upper Limit Signal			Set the hardware stroke limit switches at the upper/lower limit of the movable range by assigning external signals.	Initial value	
	Lower Limit Signal					
Axis Parameter	Driver Unit Conversion Numerator			Convert units of the target position and the actual position between the controller and the driver. For details on the setting method, refer to the following. ☞ Page 86 Driver unit conversion (electronic gear)	67108864	
	Driver Unit Conversion Denominator				5000	
	Forced Stop Signal			Set the forced stop signal.	Initial value	
	Stop Signal	Signal	Target	Set the stop signal.	[VAR]G_bStopSignalX*1	[VAR]G_bStopSignalY*1
		Signal Detection Method			Initial value	
		Compensation Time				
		Filter Time				
	Start Permission at Homing Uncompleted			Set whether axis start is allowed or not for when the homing request is TRUE.	Initial value	
	Software Stroke Limit Lower Value			Set the range and the target of the software stroke limit.	Initial value	
	Software Stroke Limit Target					
	Software Stroke Limit Upper Value					
	Position Command Unit			Set the position command unit and the velocity command unit used for the motion control.	um*2	
	Velocity Command Unit				U/s	

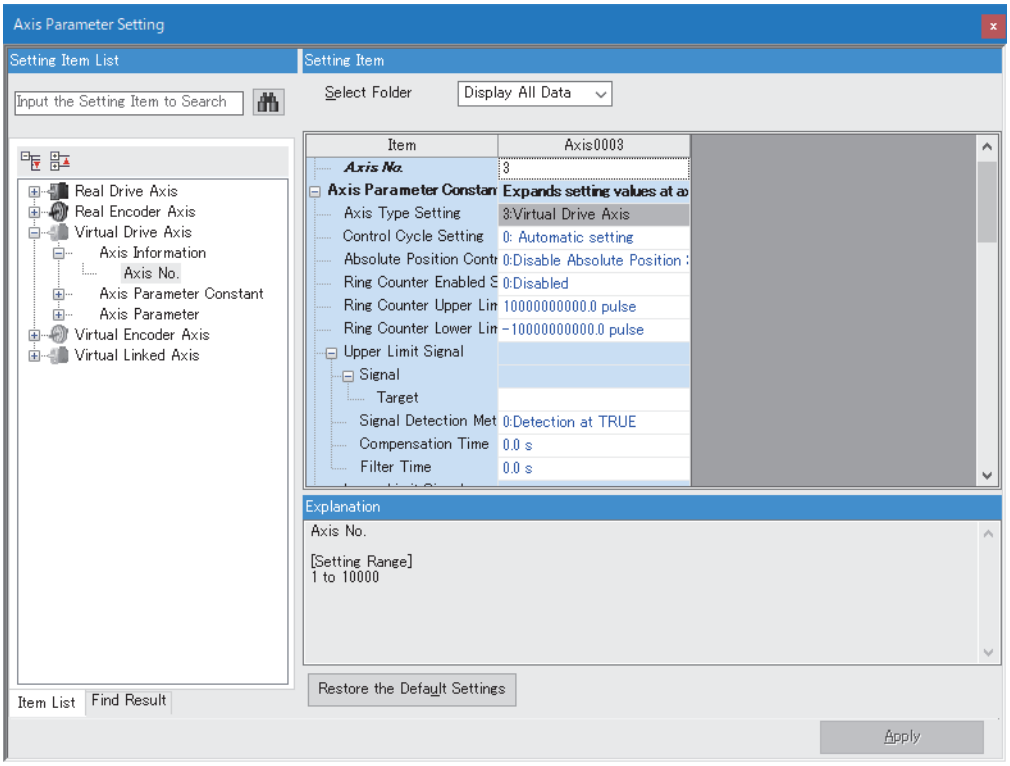
*1 A global label is registered for the stop signal. For setting the global labels, refer to the following.
☞ Page 107 Global label list

*2 um indicates micrometer (μm).

■Virtual drive axis

1. In the "Axis Parameter Setting" window, set the axis parameters for Axis0003.

Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Double-click Axis0003.



Set the virtual drive axis (Axis0003) as shown below.

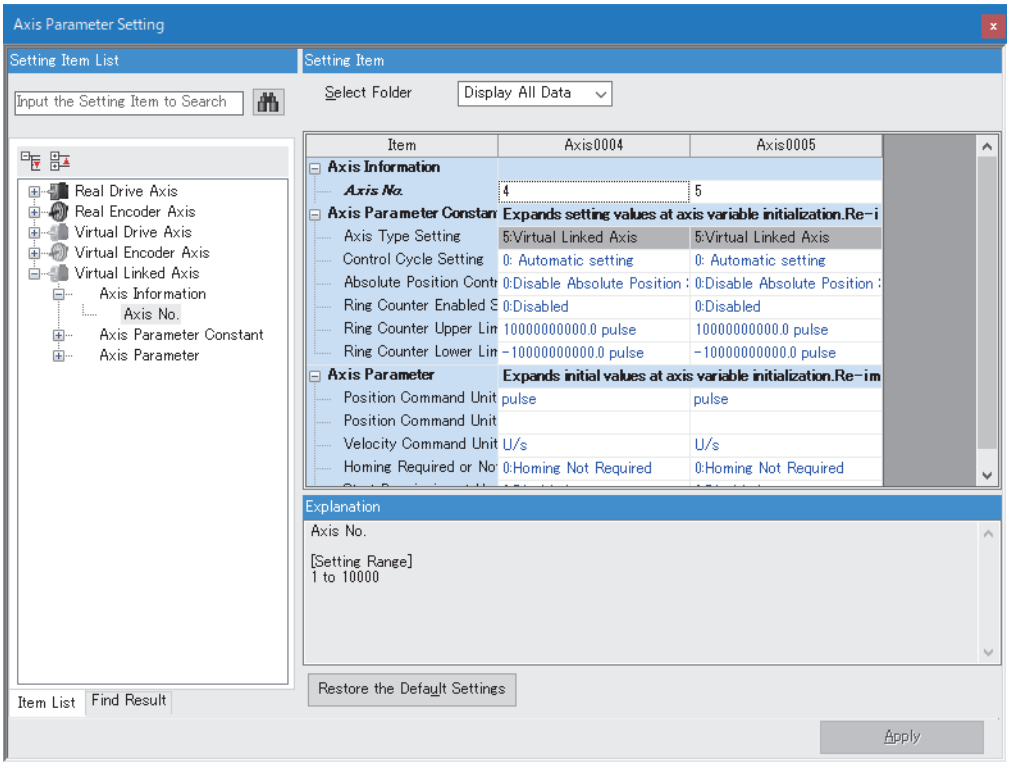
Item		Description	Setting value
			Axis0003
Axis Parameter	Position Command Unit	Set the position command unit and the velocity command unit used for the motion control.	um*1
	Velocity Command Unit		U/s

*1 um indicates micrometer (μm).

■Virtual linked axis

1. In the "Axis Parameter Setting" window, set the axis parameters for Axis0004 and Axis0005.

Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Double-click Axis0004 (Axis0005).



Set the virtual linked axes (Axis0004 and Axis0005) as shown below.

Item		Description	Setting value	
			Axis0004	Axis0005
Axis Parameter	Position Command Unit	Set the position command unit and the velocity command unit used for the motion control.	um*1	um*1
	Velocity Command Unit		U/s	U/s

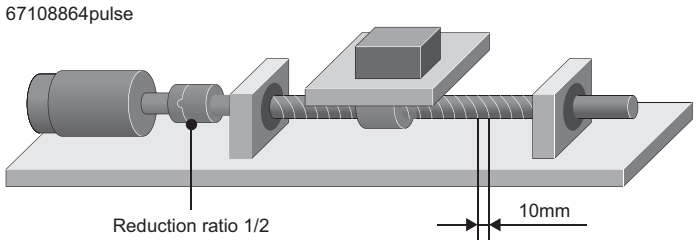
*1 um indicates micrometer (μm).

Driver unit conversion (electronic gear)

A setting example of the driver unit conversion numerator/driver unit conversion denominator is shown below.

About the electronic gear

■Ball screw



Item	Setting value
Servo motor encoder resolution	67108864 pulse (26 bits)
Lead of the ball screw	10mm (10000μm)
Reduction ratio	1/2 (load side [NL]/motor side [NM]) Each time the servo motor rotates twice, the ball screw of the load side rotates once.

$$\frac{\text{Driver unit conversion numerator}}{\text{Driver unit conversion denominator}} = \frac{\text{Number of encoder pulses}}{\text{Movement amount} \times \text{Reduction ratio}} = \frac{67108864}{10000 \times 1/2} = \frac{67108864}{5000}$$

- Driver unit conversion numerator = Number of pulses per rotation 67108864
- Driver unit conversion denominator = Movement amount per rotation 5000

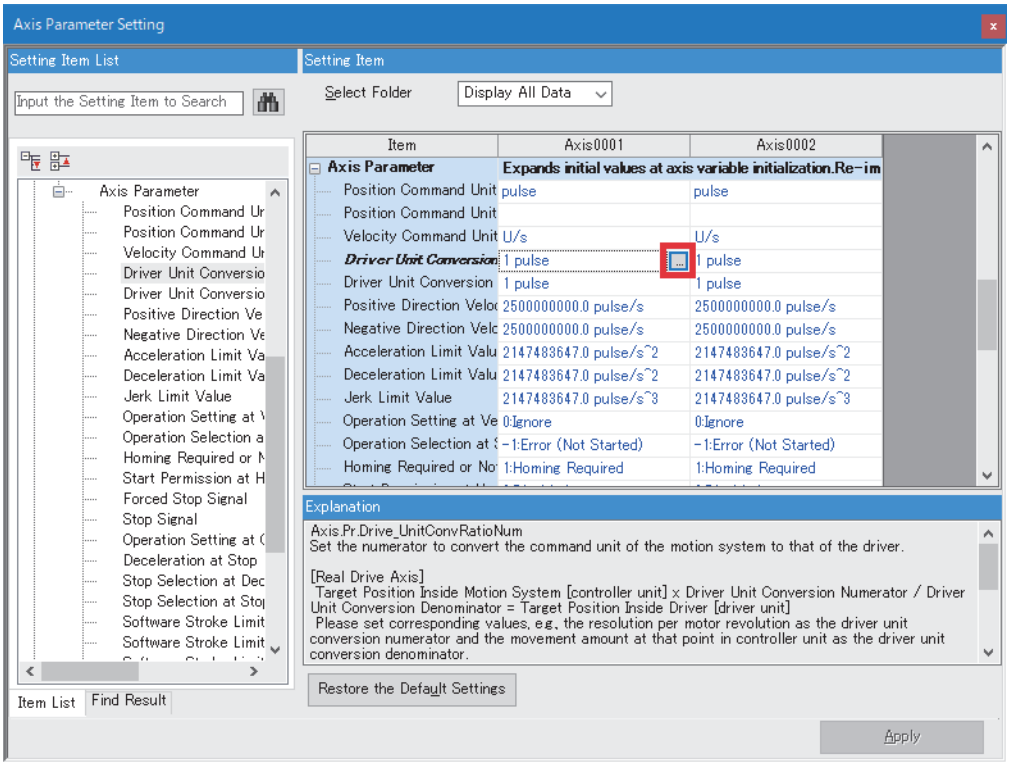
Electronic gear setting

The procedure for setting the electronic gear is shown below.

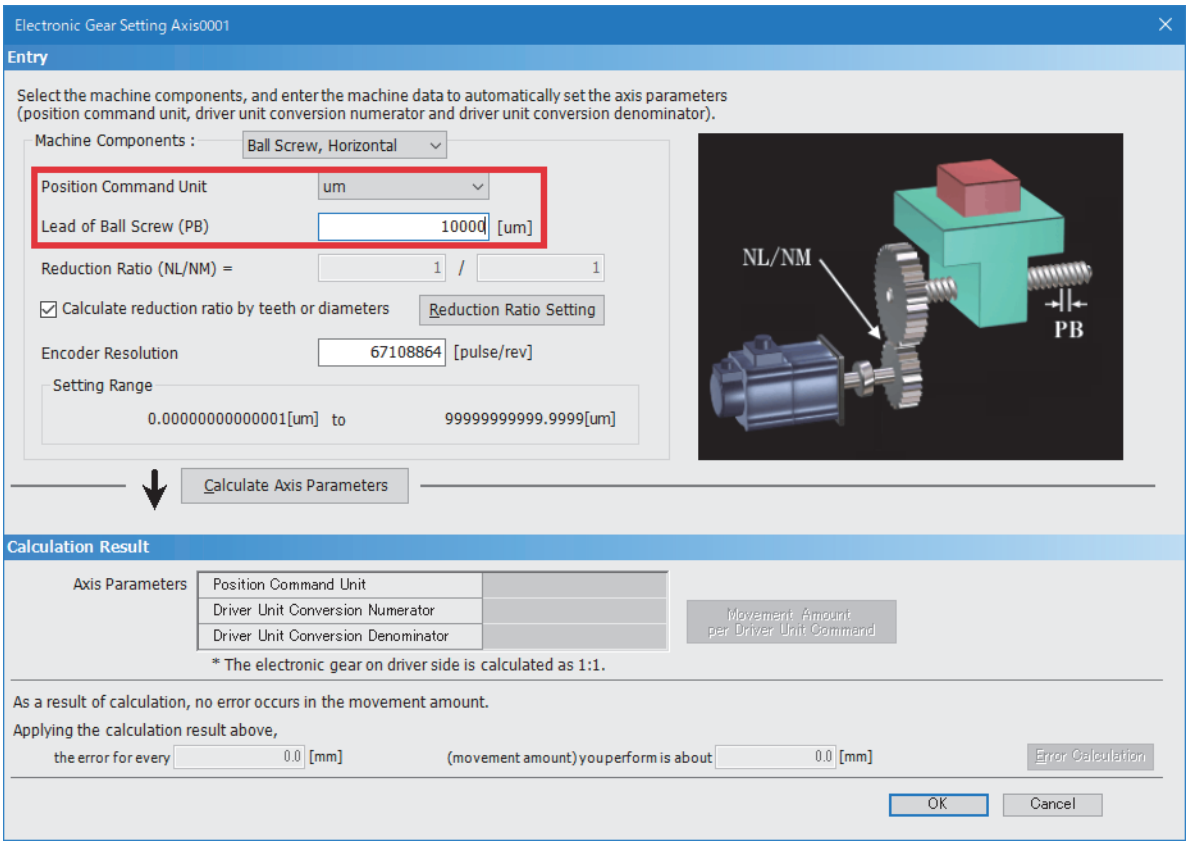
Operating procedure

1. In the "Axis Parameter Setting" window, click "Axis Parameter" ⇨ [...] button for "Driver Unit Conversion Numerator" to display the "Electronic Gear Setting" window.

Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Double-click Axis0001.



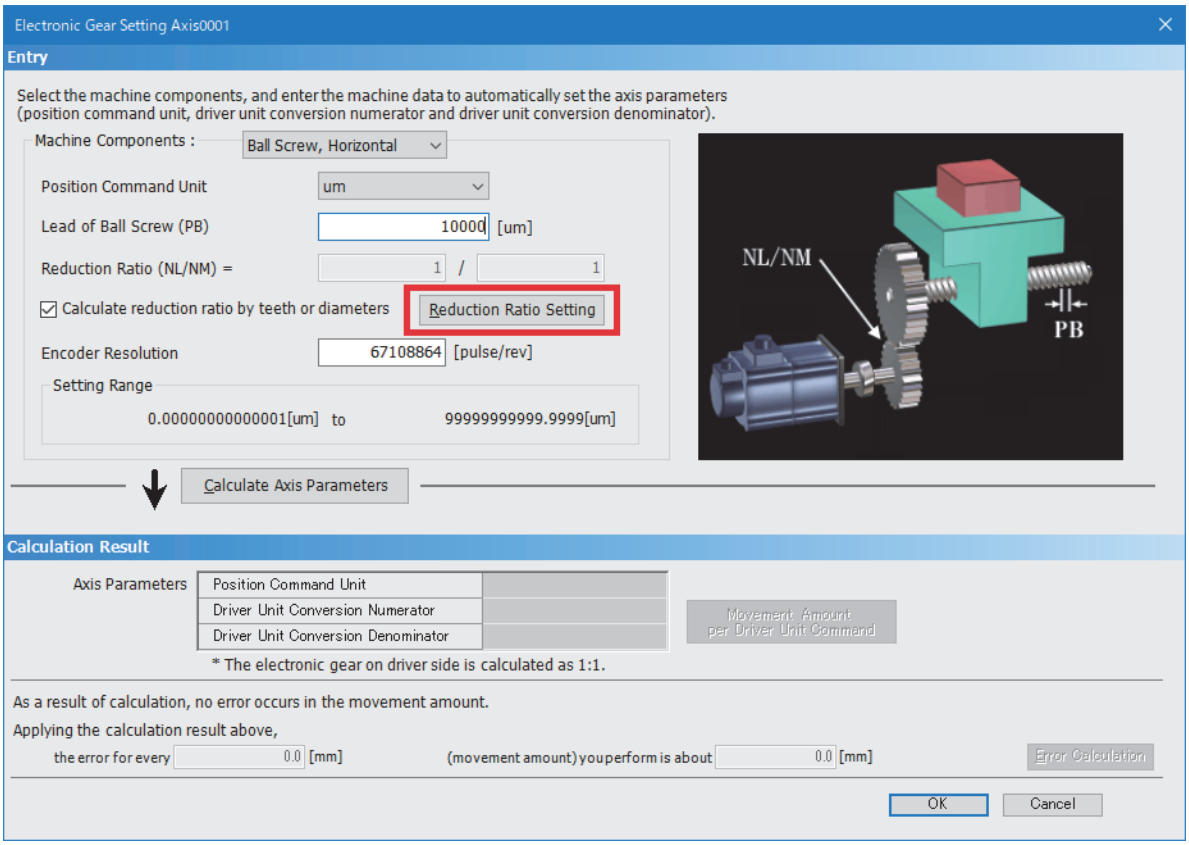
2. Enter each item of the machine components.



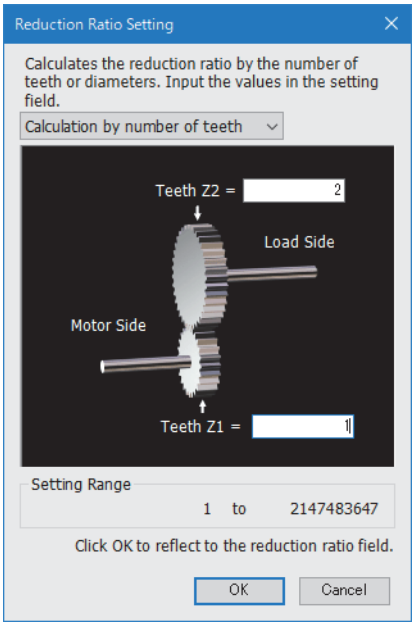
The following table lists the settings to change.

Item	Setting value
Position Command Unit	um
Lead of Ball Screw (PB)	10000.0

3. Click the "Reduction Ratio Setting" button to open the "Reduction Ratio Setting" window.



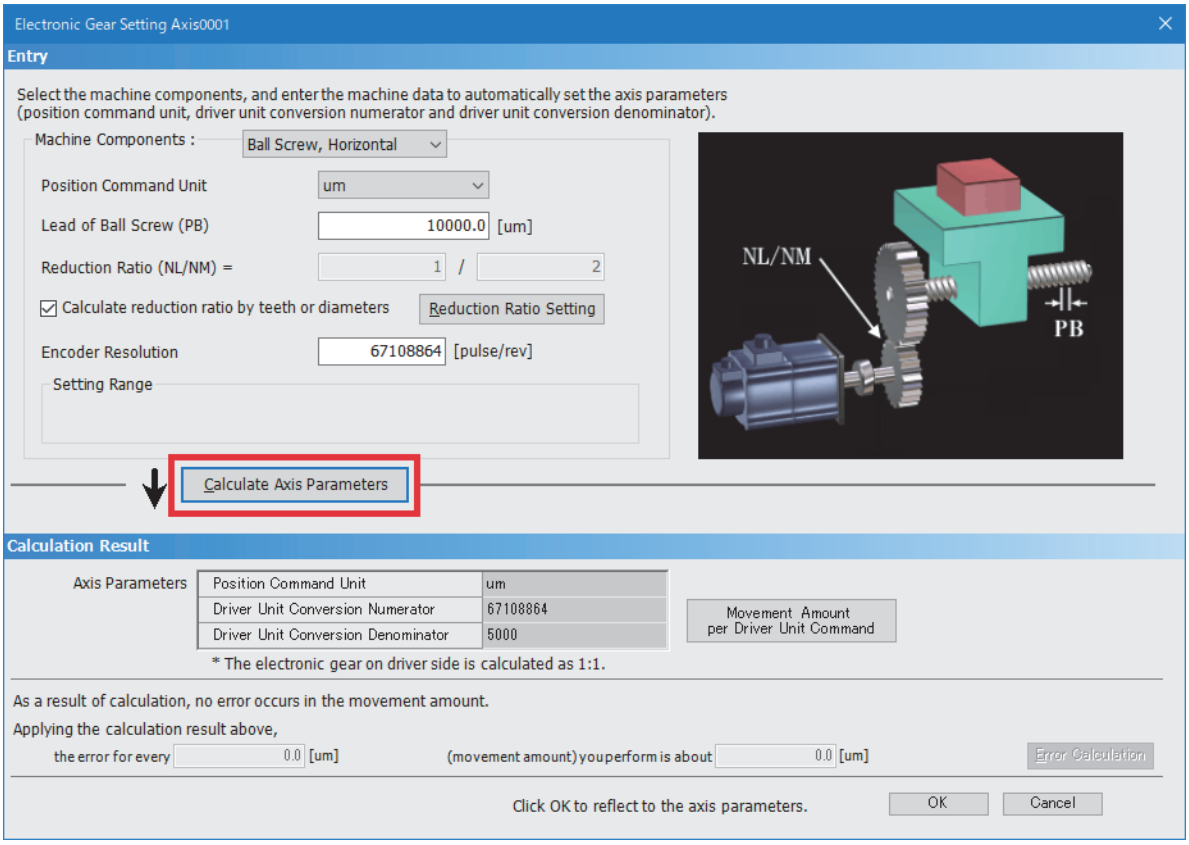
4. Set the number of teeth and click the [OK] button.



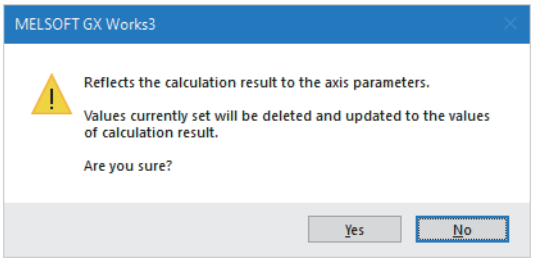
The following table lists the settings.

Item	Setting value
Teeth Z2	2
Teeth Z1	1

5. Click the [Calculate Axis Parameters] button to display the calculation result. Check the calculation result, and click the [OK] button.

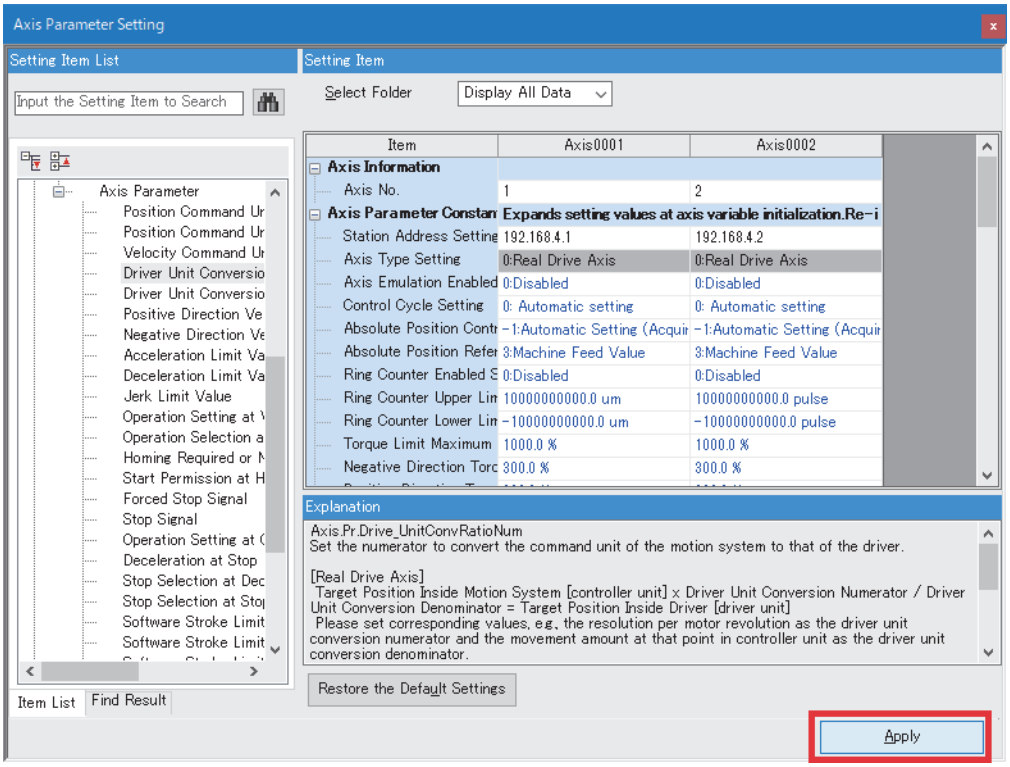


6. When the confirmation message appears, click the [Yes] button. The calculation result is reflected in the axis parameters.



Reflecting axis parameters

After setting each item, click the [Apply] button to fix the parameters.



Point

Changes made to parameters will be reflected only after the [Apply] button is clicked.

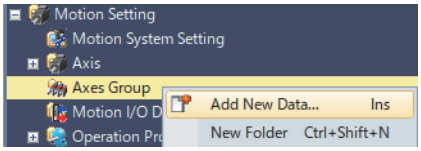
Axes group settings

An axes group is used for multiple axes control such as linear interpolation and circular interpolation.
An axes group does not need to be created for axes used for synchronous control.
This section describes the procedure for registering the X axis (Axis0001) and Y axis (Axis0002) in an axes group.

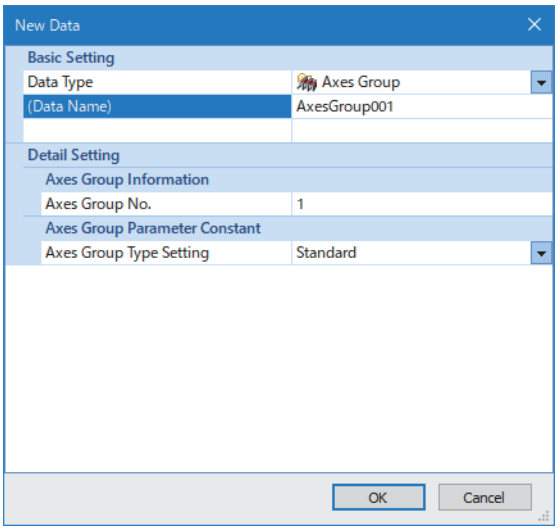
Axes group

1. Right-click "Axes Group" in the navigation window, and select "Add New Data".

Navigation window ⇨ [Motion Setting] ⇨ [Axes Group]



2. Enter "Data Name", the "Axes Group No.", and click the [OK] button.



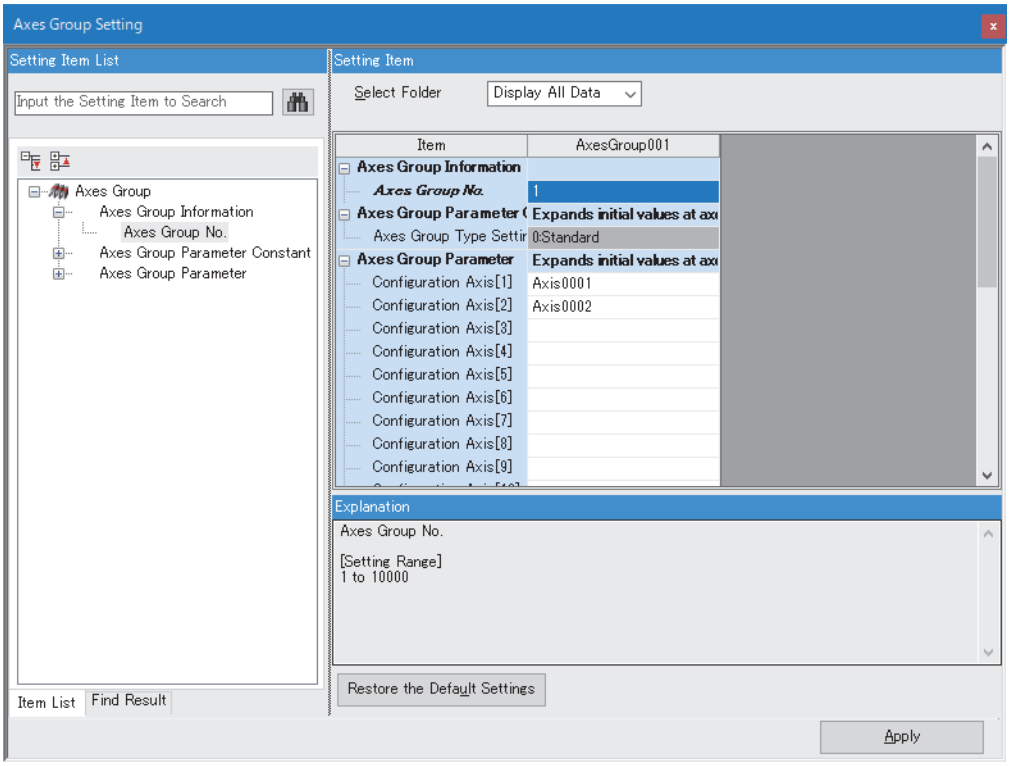
The following table lists the settings.

Setting item	Setting value
Data Name	AxesGroup001
Axes Group No.	1

3. Display the "Axes Group Setting" window. Set the axes group parameters of AxesGroup001.

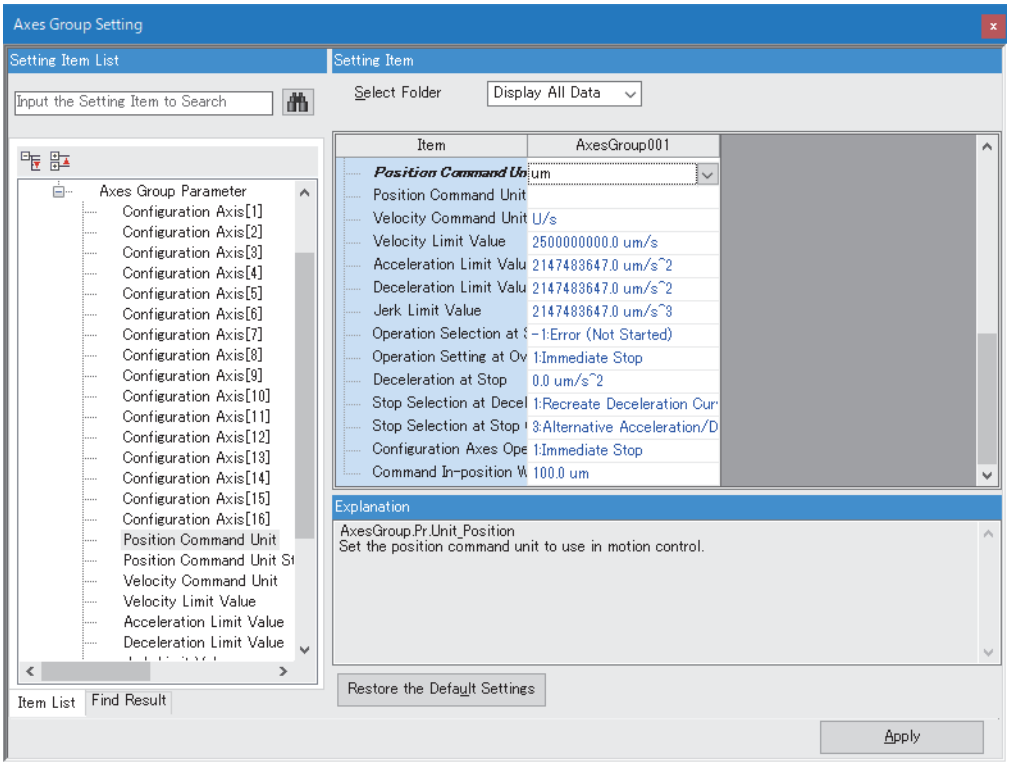
Navigation window ⇨ [Motion Setting] ⇨ [Axes Group] ⇨ Double-click AxesGroup001.

• Axes group configuration axis setting example



Item	Setting value
Configuration Axis[1]	Axis0001
Configuration Axis[2]	Axis0002

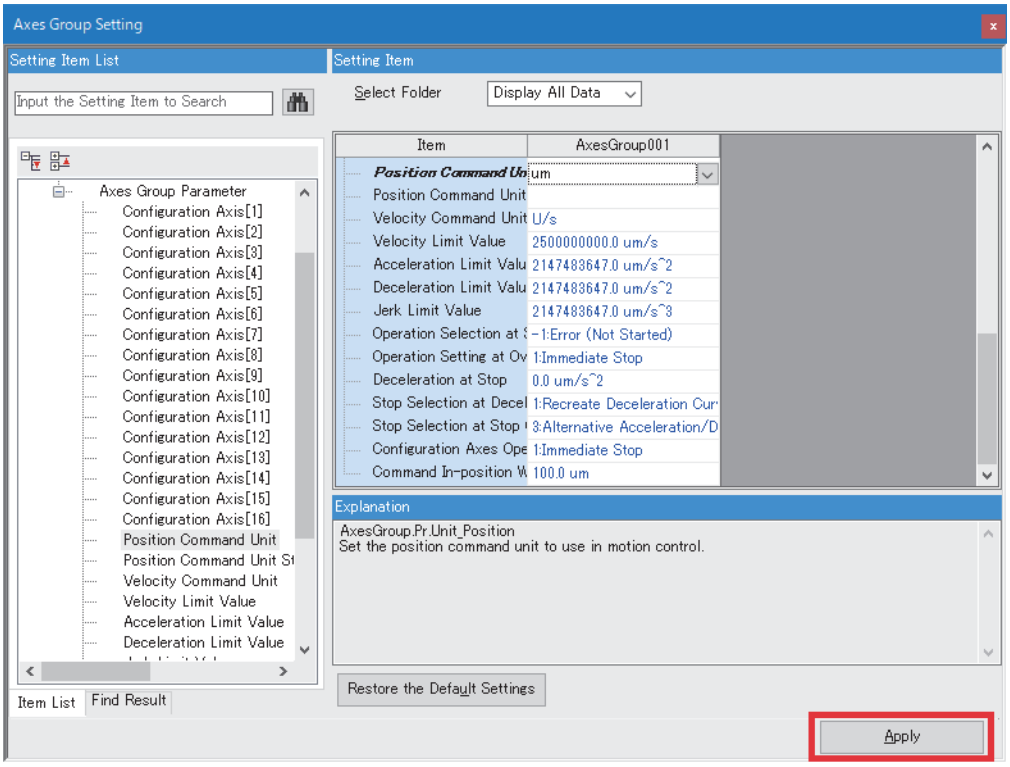
• Axes group units setting example



Item	Setting value
Position Command Unit	um*1

*1 um indicates micrometer (μm).

4. After setting the items for each axes group, click the [Apply] button to fix the axes group parameter setting.



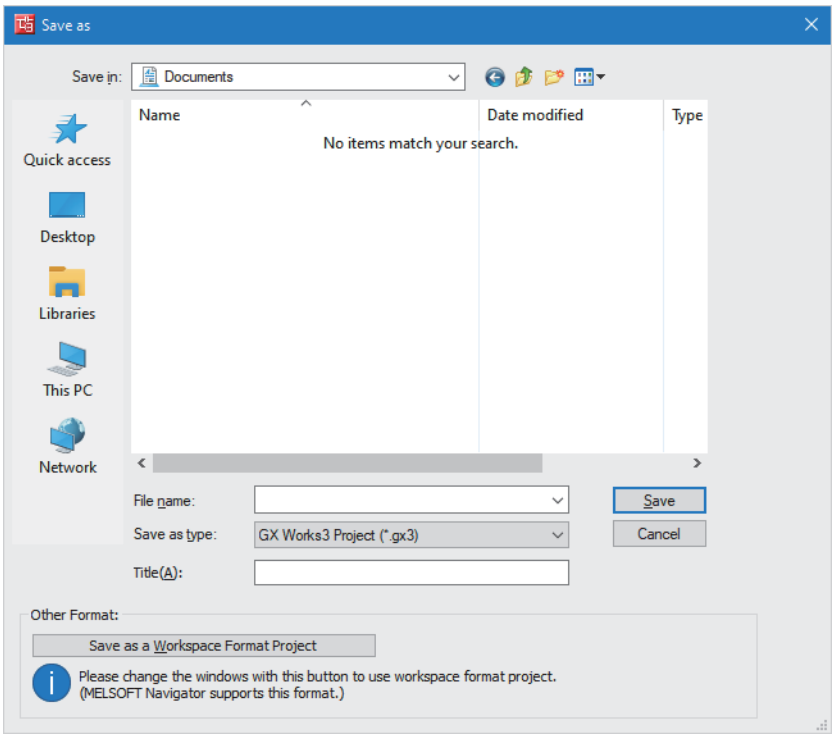
Point

Changes made to parameters will be reflected only after the [Apply] button is clicked.

5.4 Saving a Project

Save the created project.

1. In the engineering tool, select [Project] ⇨ [Save as] on the menu bar to display the "Save as" window. Enter a file name, and click the [Save] button.

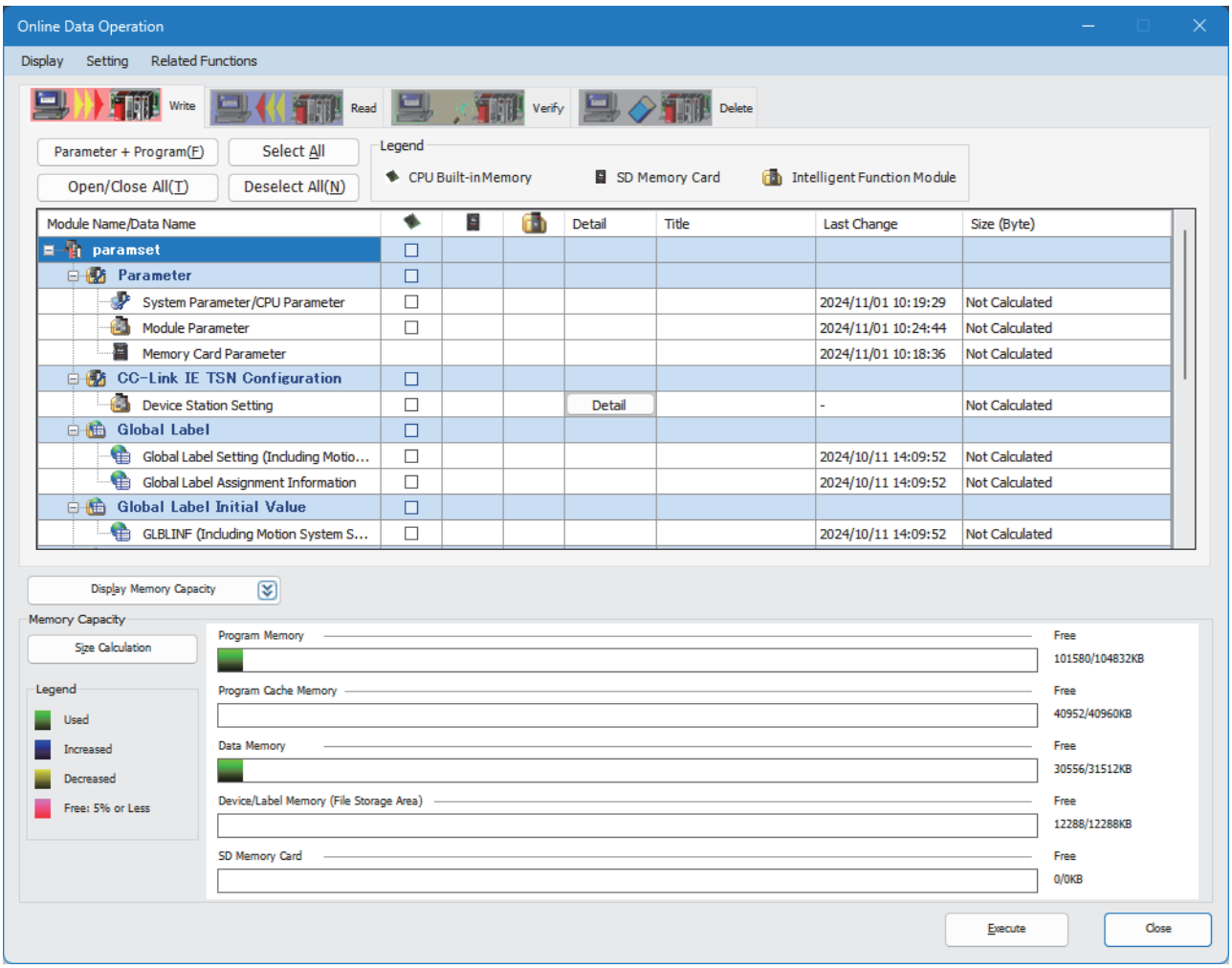


5.5 Writing to the Controller

After writing the module parameters to the controller, reset it or turn the power off and on.

Operating procedure

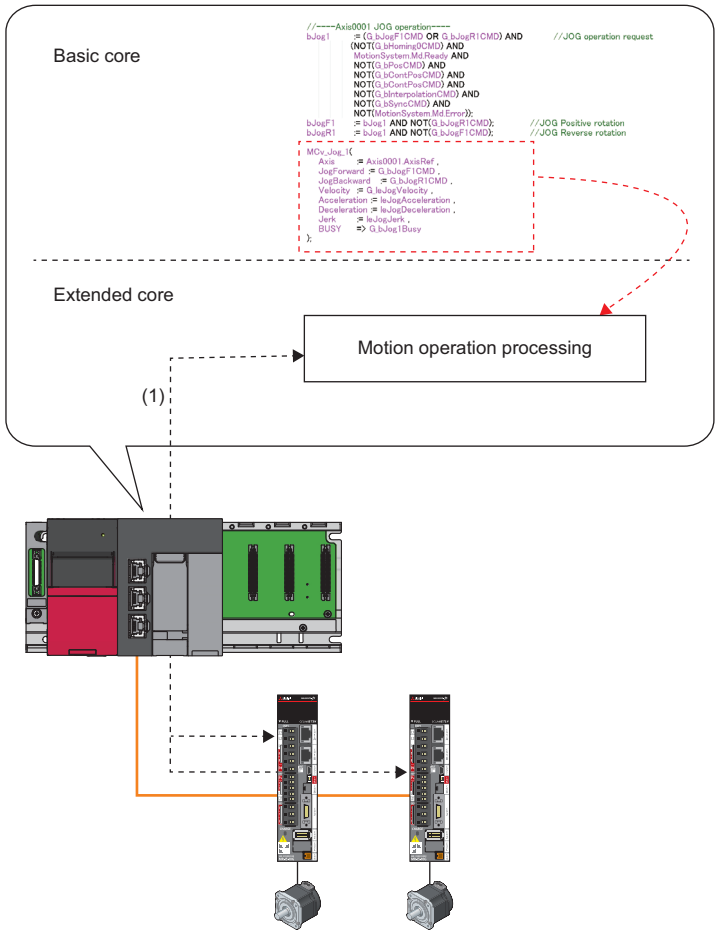
1. Select [Online] ⇨ [Write to PLC] on the menu bar to display the "Online Data Operation" window. Check the items to be written on the window, and click the [Execute] button.



2. The parameters are written to the controller.
3. When the writing is complete, a completed message is displayed. Click the [OK] button.
   Reset the controller or turn the power off and on again to check that no error occurs. Errors can be checked on the LED indicator of the controller or the system monitor of the engineering tool.

6 PROGRAM EXAMPLES

The example in this chapter uses the structured text language.



(1) I/O processing of motion operation

Point

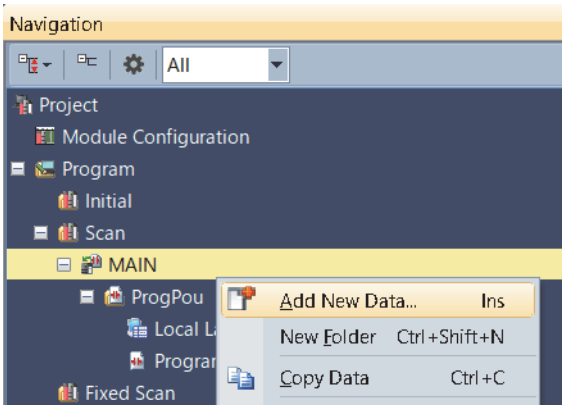
When applying the sample program to an actual system, ensure the applicability and check that it will not cause system control problems.
Consider and add interlock conditions according to the user's system.

6.1 Creation Procedure for Controller Programs

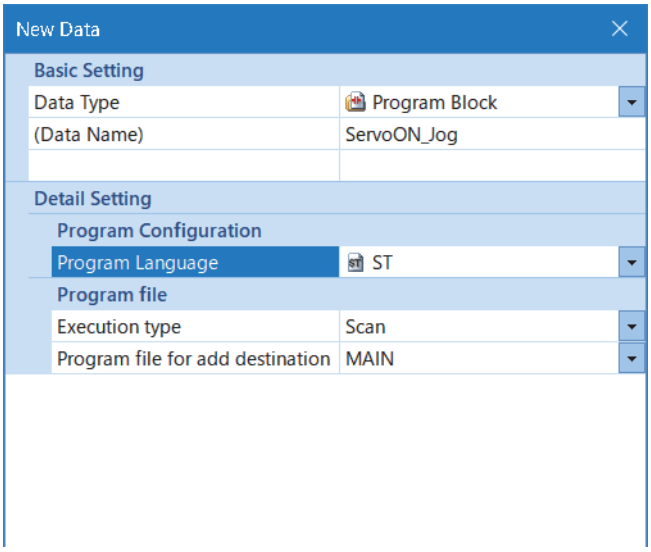
The engineering tool is used to create a program for a controller.

Creating a program block

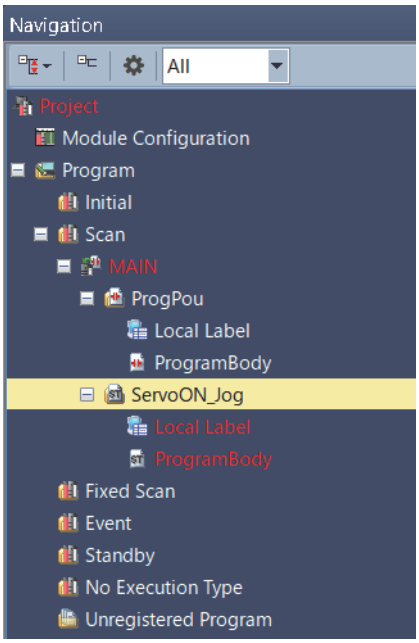
1. In the navigation window of the engineering tool, right-click "Program" ⇨ the program execution type ("Scan" in this example), and select "Add New Data".



2. The "New Data" window is displayed. Set the data name, the program language, and the program file for add destination. Then, click the [OK] button. (Setting example: ServoON_Jog)



3. A program block is added to the navigation window.



Program execution types

The following table lists the five program execution types available.

Execution type	Description
Initial	This program is executed only once when the controller status is changed from the power-on to RUN or from STOP (PAUSE) to RUN.
Scan	This type of program is executed only once per scan. The execution starts from the next scan right after the initial execution type program is executed.
Fixed scan	This is an interrupt program which is executed at a specified time interval. Different from a normal interrupt program, this type of program does not require the interrupt pointer (I) or IRET instruction and is executed for each program file unit.
Event	This type of program starts execution when triggered by a specified event.
Standby	This type of program is executed only when its execution is requested.

To set the execution type, perform the following operations in the navigation window.

The set execution type will be applied to "Program Setting" in "CPU Parameter".

- Right-click on a target program in the navigation window, and select [Register Program] from the shortcut menu.
- Drag and drop the program onto the target execution type.

How to input an FB

This section describes the procedure for creating a program using the JOG operation FB (MCv_Jog) as an example.

Preparing labels

Prepare labels for input/output signals of the FB. This example uses labels for the Velocity, Acceleration, Deceleration, and Jerk inputs of MCv_Jog. When registering a new label, consider whether the label is registered as a global label or a local label.

Ex.

The labels for JOG command and JOG velocity are registered as global labels, considering that JOG velocity will be operated from an external device such as a GOT (HMI).

The labels for JOG acceleration, JOG deceleration, and JOG jerk are registered as local labels of the ServoON_Jog program created in Creating a program block (☞ Page 98 Creating a program block) since these labels are only used within this program.

For naming rules for labels, refer to the following.

☞ Page 106 Naming rules for labels

■Global labels

	Label Name	Data Type		Class
1	G_bJogF1CMD	Bit	...	VAR_GLOBAL
2	G_bJogR1CMD	Bit	...	VAR_GLOBAL
3	G_bJog1Busy	Bit	...	VAR_GLOBAL
4	G_leJogVelocity	FLOAT [Double Precision]	...	VAR_GLOBAL
5			...	

■Local labels

	Label Name	Data Type		Class
1	leJogAcceleration	FLOAT [Double Precision]	...	VAR
2	leJogDeceleration	FLOAT [Double Precision]	...	VAR
3	leJogJerk	FLOAT [Double Precision]	...	VAR
4			...	

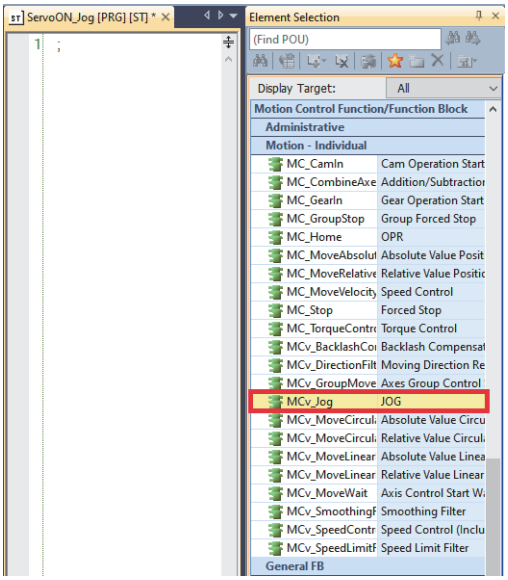
Inputting an FB

1. Click the [POU List] tab in the Element Selection window and select "Motion Control Function/Function Block" ⇨ "Administrative", "Motion - Individual", or "General FB" to display the FB library list.
The FB for JOG operation (MCv_Jog) is located in the "Motion - Individual" tree.

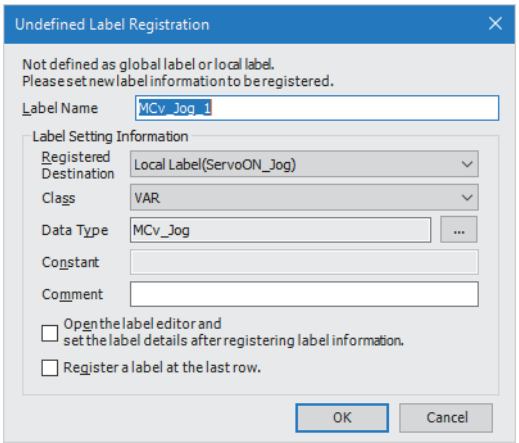
FBs are classified into the following three groups.

Group	Description
Administrative	A motion control FB that takes an axis or an axes group for the argument and does not change the axis status or the axes group status by execution (There are some exceptions.)
Motion - Individual	A motion control FB that takes an axis or an axes group for the argument and changes the axis status or the axes status by execution
General FB	A motion control FB that does not take an axis or an axes group for the argument

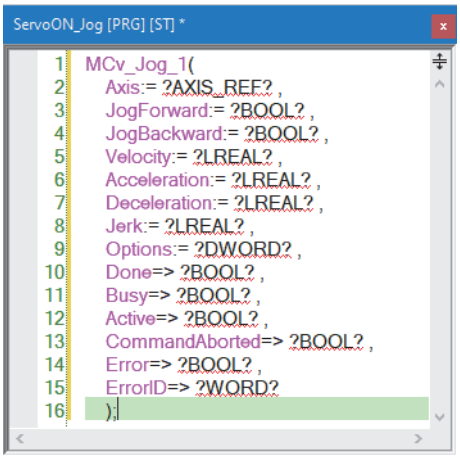
2. Drag and drop the FB to use (MCv_Jog) onto the program editor.



3. Enter the FB label name, registered destination, and comments if necessary, and click the [OK] button. This example uses all the initial settings.



4. Delete the leading semicolon because it is unnecessary. (Depending on the drag-and-drop position, there will be two semicolons at the end of the FB. In this case, delete one of them.)



Point

From the menu of the engineering tool, select [Tool] ⇨ [Options] ⇨ [Program Editor] ⇨ [ST Editor] ⇨ [Edit Operation] ⇨ set [Vertically Align Arguments for Displaying Template] to "Yes" to automatically input line breaks and indents.

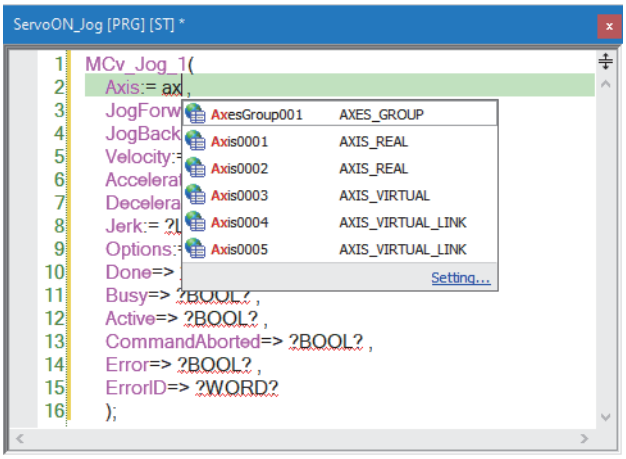
Inputting I/O signals

Rewrite strings such as ?AXIS_REF? and ?BOOL? to the labels.

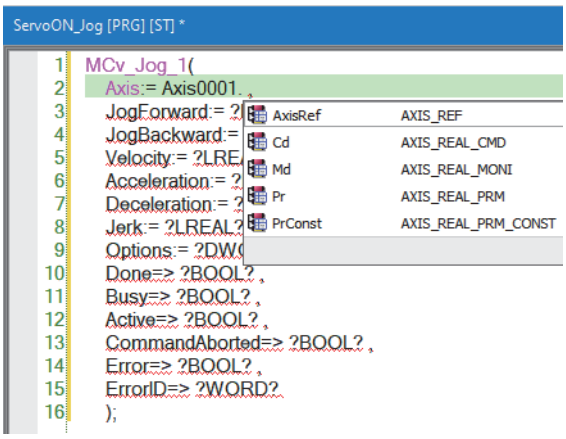
■AxisRef type structure

This section describes how to input the AxisRef type structure, which is axis information for axis 1, into the input variable Axis.

1. Enter "ax" in "Axis := " to display the registered labels.



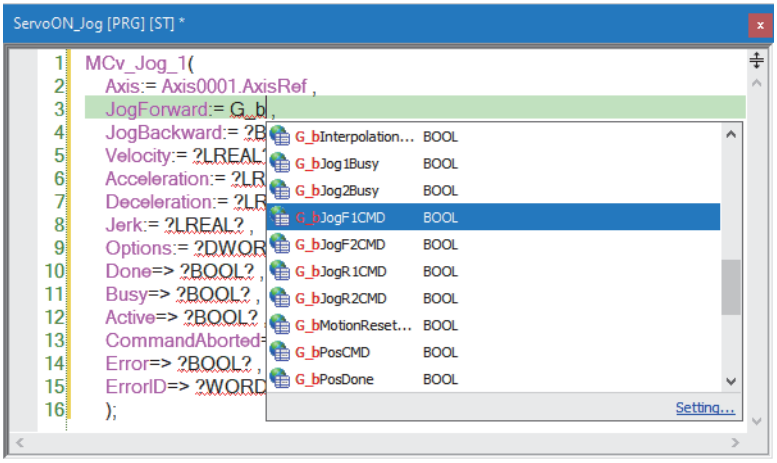
2. When "Axis0001" is selected and "." is entered, the structure members of Axis0001 will be displayed. Select "AxisRef".



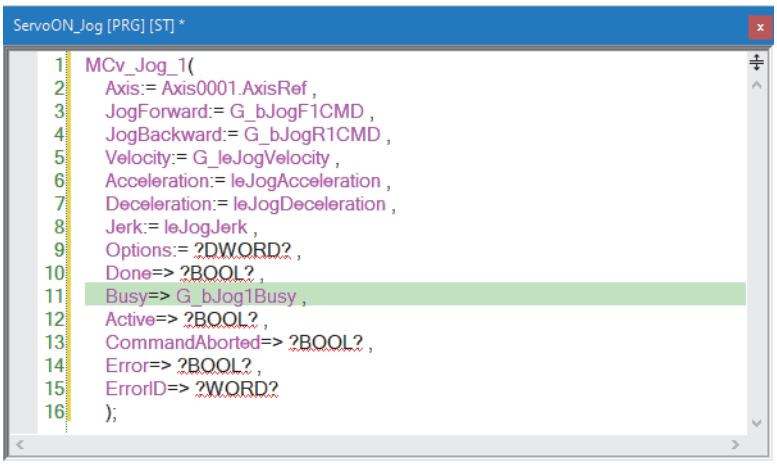
■Global label and local label

Enter the global label "G_bJogF1CMD" into the "JogForward" input.

1. When "G_b" is entered in "JogForward := ", the registered labels will be displayed. Select "G_bJogF1CMD".



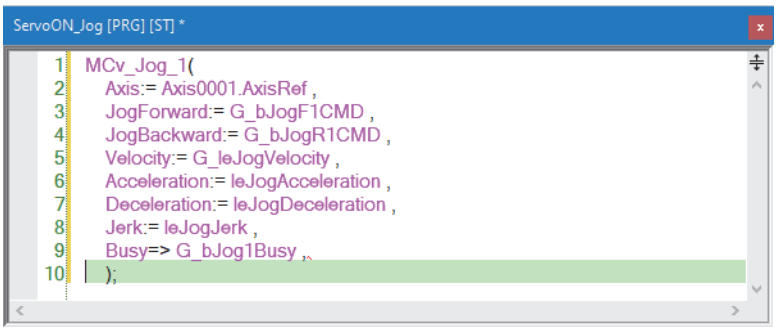
2. Using the same procedure, enter labels for the JogBackward, Velocity, Acceleration, Deceleration, Jerk, and Busy signals.



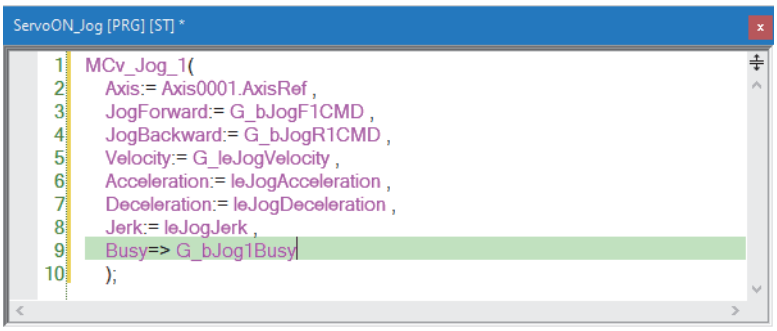
■Omitting I/O signals

Input signals using an initial value and input signals of unused FB can be omitted.

1. In the following example, the "Options" input remains unchanged from its initial value (0), and the output signals "Done", "Active", "CommandAborted", "Error", and "ErrorID" are deleted because they are not used.

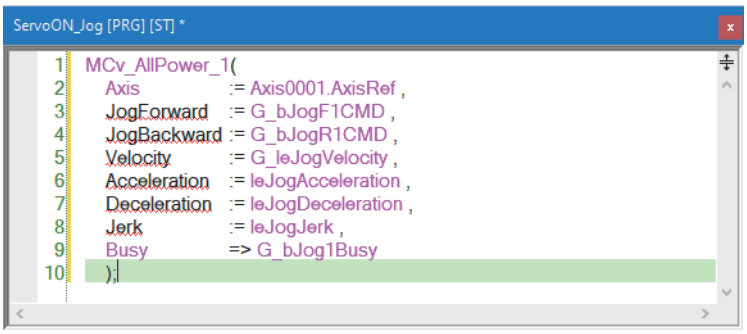


2. Delete the "," at the end of the FB because it is unnecessary.



■Organizing format

Organize the program by adding comments and indents as necessary.



6.2 Labels

Naming rules for labels

This manual uses the following prefix rules for labels to distinguish their data type.

Data type		Value range	Prefix	
			Local	Global
Bit	BOOL	FALSE, TRUE	b	G_b
Word [unsigned]/bit string [16 bits]	WORD	0 to 65535	u	G_u
Double word [unsigned]/bit string [32 bits]	DWORD	0 to 4294967295	ud	G_ud
Word [signed]	INT	-32468 to 32767	w	G_w
Double word [signed]	DINT	-2147483648 to 2147483647	d	G_d
Single-precision real number	REAL	-2^{128} to -2^{-126}, 0, 2^{-126} to 2^{128}	e	G_e
Double-precision real number	LREAL	-2^{1024} to -2^{-1022}, 0, 2^{-1022} to 2^{1024}	le	G_le
Time	TIME	T#-24d20h31m23s648ms to T#24d20h31m23s647ms	tm	G_tm
Timer	TIMER	TIMER structure • S: contact • C: coil • N: current value	td	G_td

Ex.

For local labels

Data type	Label
Bit	bMoveCMD
Double-precision real number	lePosition
Word [signed]+array	wAxes[16]
Timer	tdTimer1

Ex.

For global labels

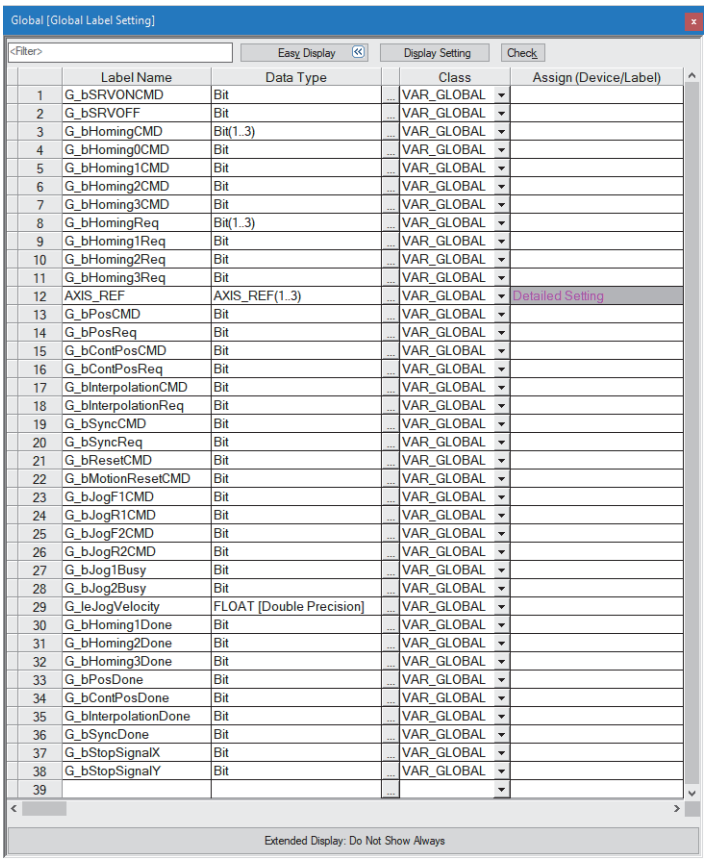
Data type	Label
Bit	G_bJogF1
Double-precision real number	G_leVelocity

Global label list

The following shows setting examples for the global labels in the sample program.
For the local labels, refer to each program.

Global label setting

The following table lists the global label settings.



	Label Name	Data Type	Class	Assign (Device/Label)
1	G_bSRVONCMD	Bit	VAR_GLOBAL	
2	G_bSRVOFF	Bit	VAR_GLOBAL	
3	G_bHomingCMD	Bit(1..3)	VAR_GLOBAL	
4	G_bHoming0CMD	Bit	VAR_GLOBAL	
5	G_bHoming1CMD	Bit	VAR_GLOBAL	
6	G_bHoming2CMD	Bit	VAR_GLOBAL	
7	G_bHoming3CMD	Bit	VAR_GLOBAL	
8	G_bHomingReq	Bit(1..3)	VAR_GLOBAL	
9	G_bHoming1Req	Bit	VAR_GLOBAL	
10	G_bHoming2Req	Bit	VAR_GLOBAL	
11	G_bHoming3Req	Bit	VAR_GLOBAL	
12	AXIS_REF	AXIS_REF(1..3)	VAR_GLOBAL	Detailed Setting
13	G_bPosCMD	Bit	VAR_GLOBAL	
14	G_bPosReq	Bit	VAR_GLOBAL	
15	G_bContPosCMD	Bit	VAR_GLOBAL	
16	G_bContPosReq	Bit	VAR_GLOBAL	
17	G_bInterpolationCMD	Bit	VAR_GLOBAL	
18	G_bInterpolationReq	Bit	VAR_GLOBAL	
19	G_bSyncCMD	Bit	VAR_GLOBAL	
20	G_bSyncReq	Bit	VAR_GLOBAL	
21	G_bResetCMD	Bit	VAR_GLOBAL	
22	G_bMotionResetCMD	Bit	VAR_GLOBAL	
23	G_bJogF1CMD	Bit	VAR_GLOBAL	
24	G_bJogR1CMD	Bit	VAR_GLOBAL	
25	G_bJogF2CMD	Bit	VAR_GLOBAL	
26	G_bJogR2CMD	Bit	VAR_GLOBAL	
27	G_bJog1Busy	Bit	VAR_GLOBAL	
28	G_bJog2Busy	Bit	VAR_GLOBAL	
29	G_leJogVelocity	FLOAT [Double Precision]	VAR_GLOBAL	
30	G_bHoming1Done	Bit	VAR_GLOBAL	
31	G_bHoming2Done	Bit	VAR_GLOBAL	
32	G_bHoming3Done	Bit	VAR_GLOBAL	
33	G_bPosDone	Bit	VAR_GLOBAL	
34	G_bContPosDone	Bit	VAR_GLOBAL	
35	G_bInterpolationDone	Bit	VAR_GLOBAL	
36	G_bSyncDone	Bit	VAR_GLOBAL	
37	G_bStopSignalX	Bit	VAR_GLOBAL	
38	G_bStopSignalY	Bit	VAR_GLOBAL	
39				

Network labels

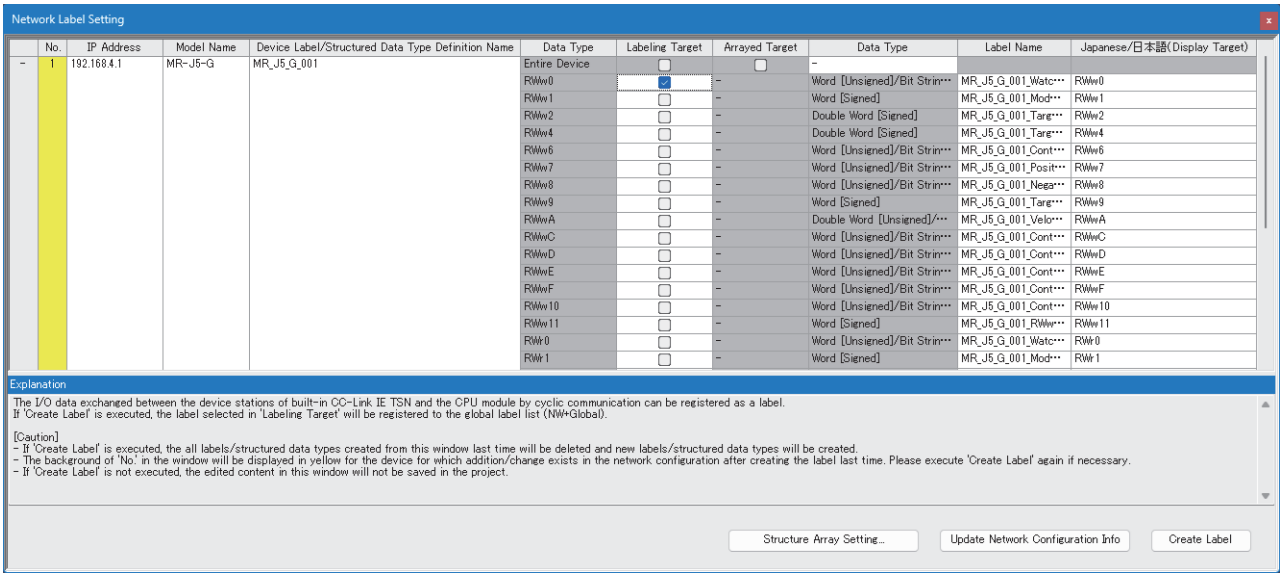
Creating a network label enables label access to other modules on the network that are not on the same base unit.
Network labels target remote stations and are registered as global labels.

■Creation procedure for network labels

Operating procedure

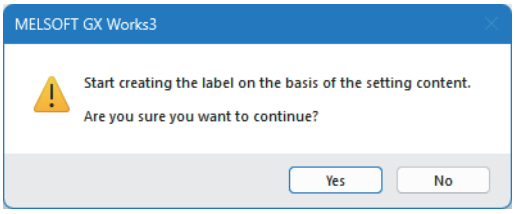
1. Display the "Network Label Setting" window, and insert a check in "Labeling Target" for "Data Type" to be labeled.

Navigation window ⇨ "Parameter" ⇨ Controller ⇨ "Module Parameter (Port 1/2: CC-Link IE TSN)" ⇨ "Network Label Setting"



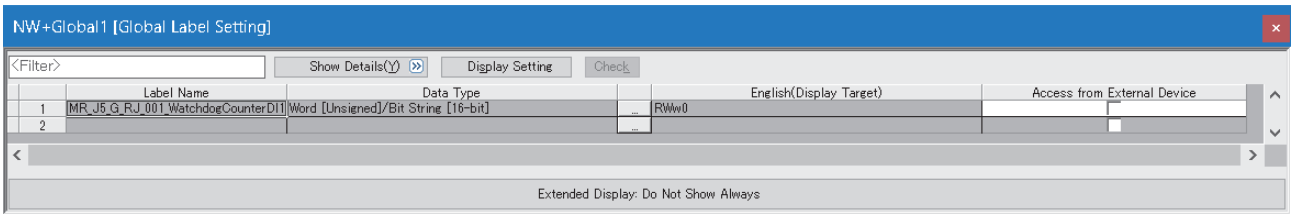
2. Click the [Create Label] button.

3. Click the [Yes] button.



4. A list of the created network labels is displayed in Global Label.

Navigation window ⇨ "Label" ⇨ "Global Label" ⇨ "NW+Global1"



Point

- Set the remote station in advance in the "CC-Link IE TSN Configuration" window.
- Right-click in the "Network Label Setting" window and execute "Add Prefix" or "Delete Prefix" to add or delete a device label to/from the label names.

Precautions

- When the network number or network configuration setting has been changed, open the "Network Label Setting" window again or click the [Update Network Configuration Info] button and then the [Create Label] button.
- Network labels will be refreshed regardless of whether the network label checkbox is selected in the network configuration setting. Therefore, the network labels that are already created will be refreshed even if the network label checkbox in the network configuration setting is not selected. If no network label is used, delete the network labels.
- When using the network labels assigned to RY and another RY in the same word boundary, use network label.

6.3 Motion Program Example

For program examples to use motion control, refer to the following.

☞ Page 1203 PROGRAM EXAMPLES

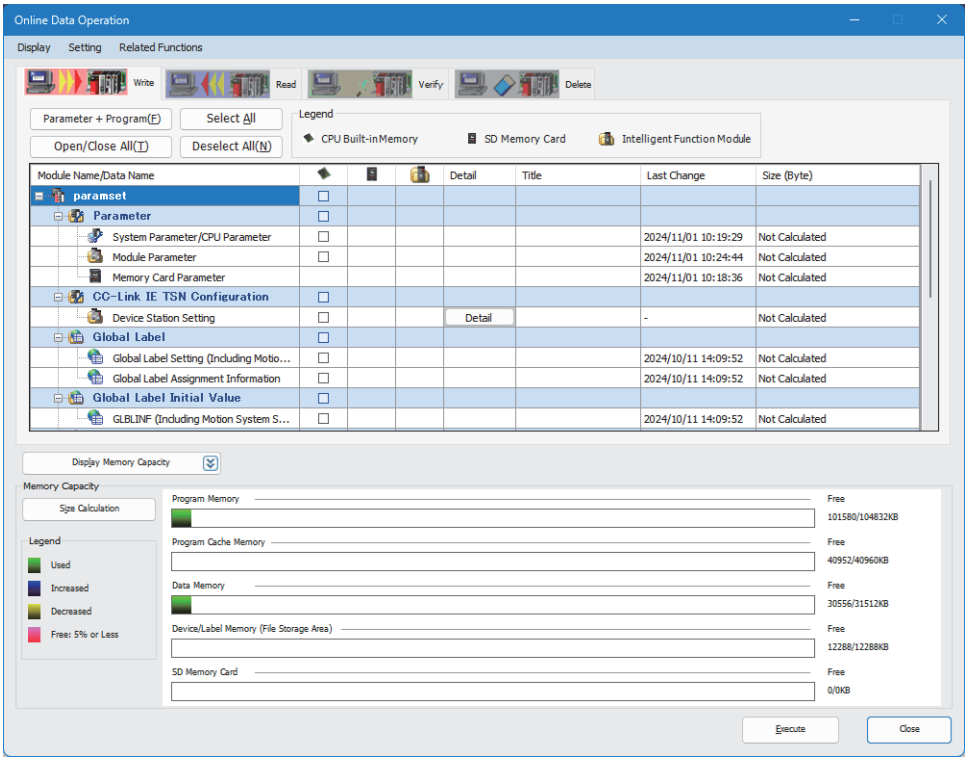
6.4 Checking Operation

Conversion and writing of programs

Write the program to the controller.

Operating procedure

1. After creating the programs, select [Convert] ⇨ [Rebuild All] from the menu to convert all the programs.
2. Check that no error occurs after executing "Rebuild All". Select [Online] ⇨ [Write to PLC] in the menu, and write the programs to the controller.



Axis monitor

The axis monitor displays the current values and the error codes of all axes in operation all at once.
Users can check the current values and whether any error occurs during the operation.

Displaying the axis monitor window

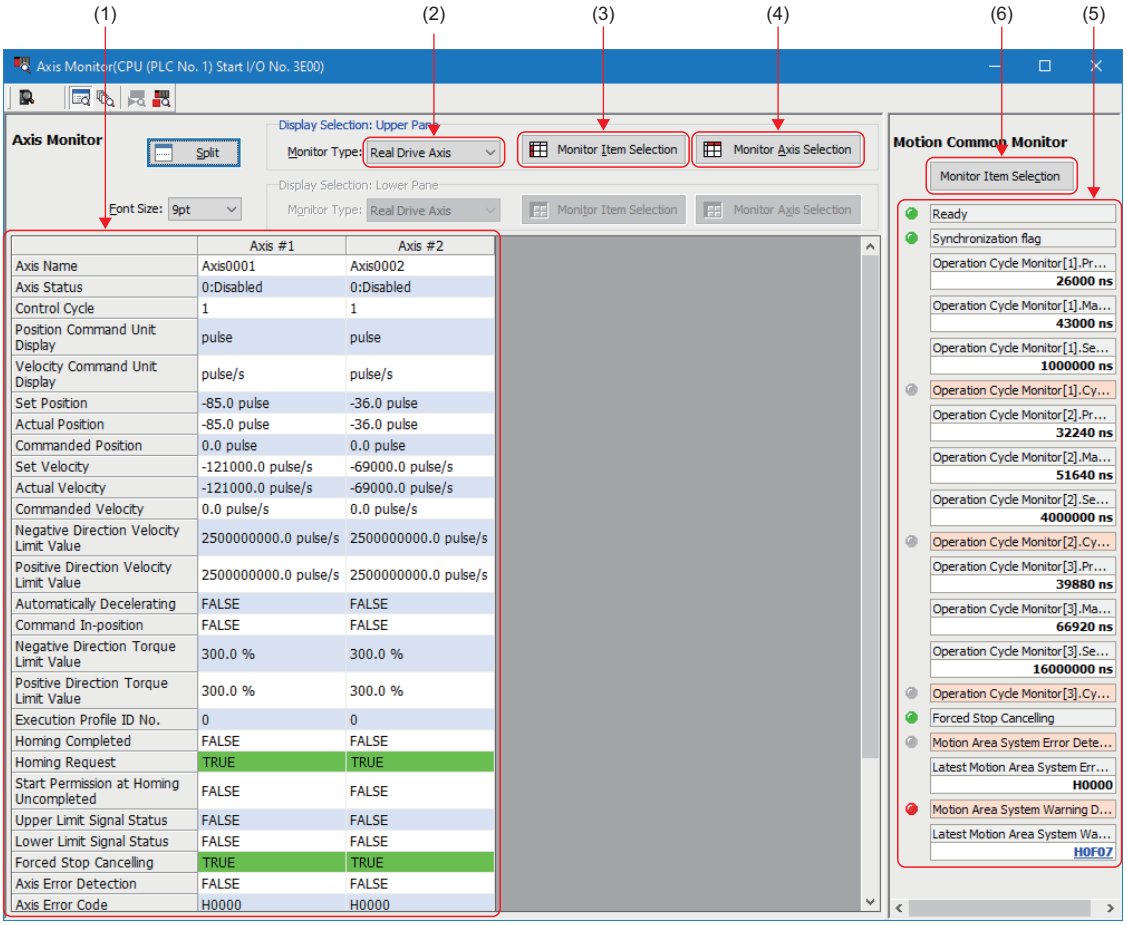
The axis monitor window can be displayed by following the steps below.

Operating procedure

1. Select [Online] ⇨ [Motion Monitor] ⇨ [Axis Monitor] from the menu bar of the engineering tool.

Displayed contents

The following contents are displayed on the axis monitor.



No.	Name	Description
(1)	Axis monitor display items	The monitor items for each axis selected in monitor type are displayed.
(2)	Monitor type	The axis type to monitor can be selected.
(3)	Monitor item selection	Add/delete items to monitor in the axis monitor display items.
(4)	Monitor axis selection	Add/delete axes to monitor in the axis monitor display items.
(5)	System monitor display items	The system monitor items are displayed.
(6)	Monitor item selection	Add/delete items to monitor in the system monitor display items.

Program monitor

The program monitor enables the user to check the current status of the program in execution on the program editor.

Displaying the program monitor window

The program monitor window can be displayed by following the steps below.

- Select [Online] ⇨ [Monitor] ⇨ [Start Monitoring] from the menu bar of the engineering tool.
- Click the "Start Monitoring (All Windows)" icon on the tool bar of the engineering tool.

Watch

The watch function enables the user to check the current values of registered devices and labels.
Register the devices and labels to be monitored to a watch window.

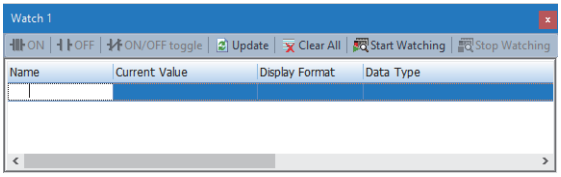
Displaying the watch window

Select [View] ⇨ [Docking Window] ⇨ [Watch 1] to [Watch 4] from the menu in the engineering tool.

Registration of devices/labels/structures to a watch window

Register devices/labels/structures by using the following methods.

- Select the label or structure to register on the program editor, right-click the label or structure, and select [Register to Watch Window] ⇨ [Watch 1] to [Watch 4].
- Enter the device number, label, or structure in the "Name" column of a watch window.



Watching start

Select [Online] ⇨ [Watch] ⇨ [Start Watching] from the menu in the engineering tool.

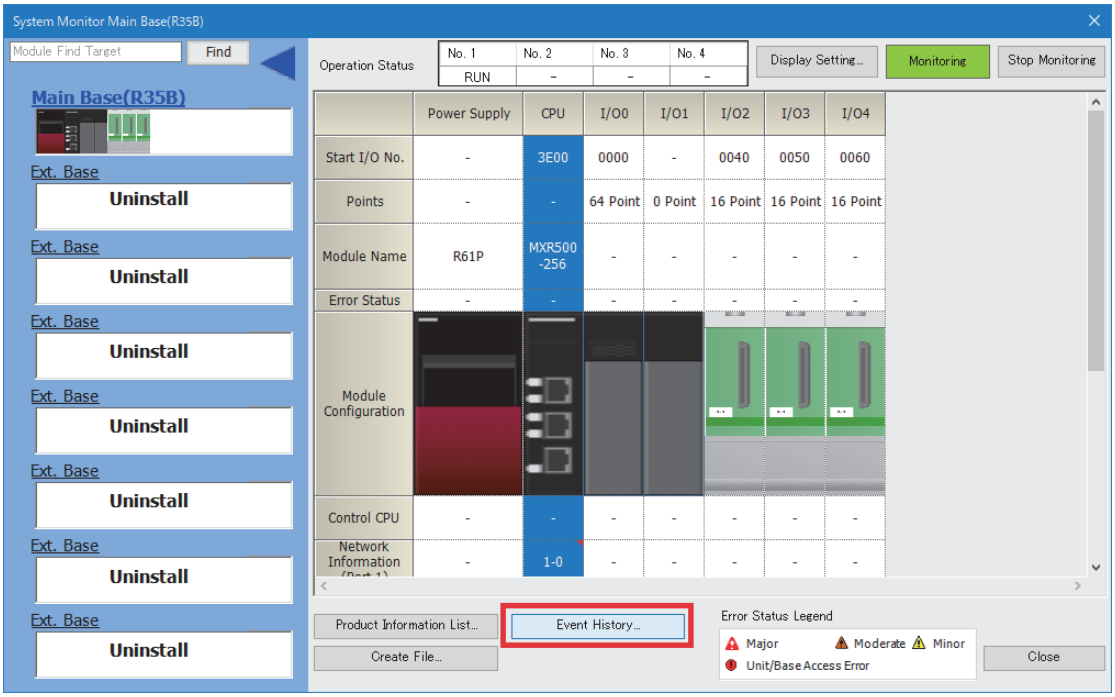
Changing current values

Directly enter a value in "Current Value" during watching.
To switch the on/off (TRUE/FALSE) of bit devices or bit type labels, select the row and double-click it with Shift pressed, or select the row and press both Shift and Enter.

Event history

To check the event history, click [Diagnostics] ⇨ [System Monitor] in the menu of the engineering tool, and then click "Event History" on the "System Monitor" window. If an error occurs, check the details of the error.

The error occurrence time in the event history of the controller synchronizes with those recorded. Check the error details of the event history together with the data in the servo amplifier.



MEMO

PART 4 SYSTEM CONFIGURATION

This part consists of the following chapters.

7 CONTROLLER SYSTEM CONFIGURATION

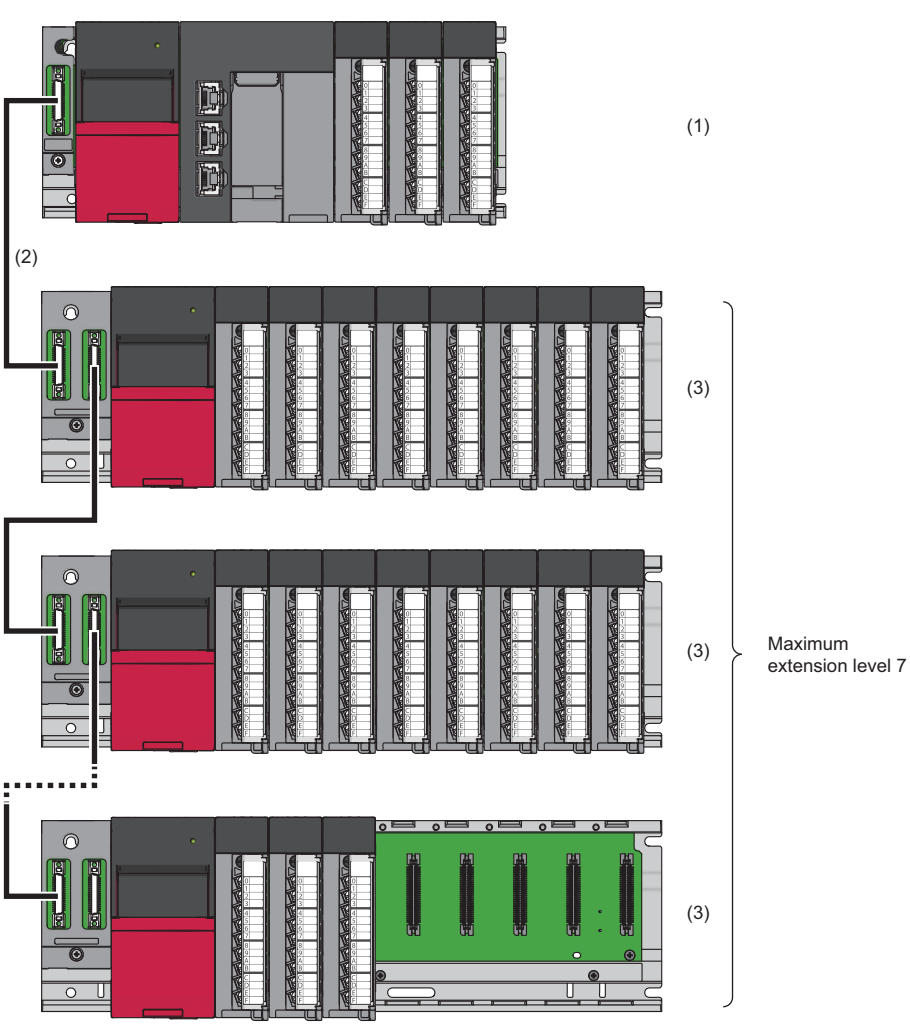
8 ASSIGNMENT FOR MODULES

7 CONTROLLER SYSTEM CONFIGURATION

This chapter describes the system configuration of a controller.

7.1 Overall Configuration

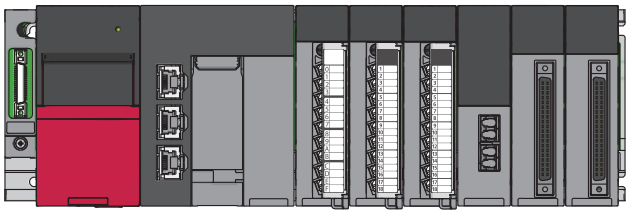
A power supply module is mounted on the power supply slot located on the left end of a main base unit, and a controller is mounted on the CPU slot located on the right side of the power supply slot. Modules other than the power supply module are mounted on the slots located on the right side of the CPU slot.



(1) Main base unit
(2) Extension cable
(3) Extension base unit

Single CPU system

This single CPU system controls I/O modules and intelligent function modules with a single controller mounted on a main base unit.



7.2 Lists of Configuration Devices

The following tables show the system configuration devices of a controller.

For the modules that are not described in this section, refer to the manuals for each module used.

Manuals for each module used

Main base unit

Item	Model
Main base unit	R33B, R35B, R38B, R312B

Extension base unit and extension cable

Item	Model
Extension base unit	R65B, R68B, R612B
Extended temperature range extension base unit	R610B-HT
Extension cable	RC06B, RC12B, RC30B, RC50B, RC100B

Power supply module

Item	Model
Power supply module	R61P, R62P*1, R63P, R64P, R69P
Redundant power supply module	R63RP, R64RP, R69RP

*1 When the MXR500-128 or MXR500-256 is used, the R62P cannot be used in combination with the main base unit because the current consumption exceeds the rated output current of the R62P. When the MXR300-16, MXR300-32, or MXR300-64 is used, the R62P can only be used in combination with the R33B or R35B.

Point

- For the internal current consumption of the controller, check the performance specifications. (Page 210 Hardware specifications)
- For the rated output current of the power supply module, refer to the following.

MELSEC iQ-R Module Configuration Manual

SD memory card

Item	Model
SD memory card	NZ1MEM-2GBSD, NZ1MEM-4GBSD, NZ1MEM-8GBSD, NZ1MEM-16GBSD

Battery

Item	Model
Battery	FX3U-32BL

I/O module

Item	Model
AC input module	RX10
	RX10-TS
	RX28
DC input module	RX40C7, RX41C4, RX42C4
	RX40C7-TS, RX41C4-TS, RX70C4, RX71C4, RX72C4
DC high-speed input module	RX40PC6H, RX40NC6H
	RX41C6HS, RX61C6HS
Input module with diagnostic functions	RX40NC6B*1
Contact output module	RY10R2
	RY10R2-TS
	RY18R2A
Triac output module	RY20S6
Transistor output module	RY40NT5P, RY41NT2P, RY42NT2P, RY40PT5P, RY41PT1P, RY42PT1P
	RY40NT5P-TS, RY41NT2P-TS, RY40PT5P-TS, RY41PT1P-TS
Transistor high-speed output module	RY41NT2H, RY41PT2H
Output module with diagnostic functions	RY40PT5B*1
I/O combined module	RH42C4NT2P

*1 SIL2 mode is not supported.

Analog module

Item	Model
Analog-digital converter module	R60AD4, R60ADI8, R60ADV8
High speed analog-digital converter module	R60ADH4
Channel isolated analog-digital converter module	R60AD8-G*1, R60AD16-G
Channel isolated analog-digital converter module (with signal conditioning function)	R60AD6-DG
Digital-analog converter module	R60DA4, R60DAI8, R60DAV8
High speed digital-analog converter module	R60DAH4
Channel isolated digital-analog converter module	R60DA8-G, R60DA16-G

*1 SIL2 mode is not supported.

Temperature input module, temperature control module

Item	Model
Channel isolated thermocouple input module	R60TD8-G
Channel isolated RTD input module	R60RD8-G
Temperature control module	R60TCTRT2TT2, R60TCTRT2TT2BW, R60TCRT4, R60TCRT4BW
	R60TCTRT2TT2-TS, R60TCRT4-TS

High-speed counter, isolated pulse input, flexible high-speed I/O control modules

Item	Model
High-speed counter module	RD62P2, RD62D2, RD62P2E
Channel isolated pulse input module	RD60P8-G
Flexible high-speed I/O control module	RD40PD01

Positioning module

Item	Model
Positioning module	RD75P2, RD75P4, RD75D2, RD75D4

Information module

Item	Model
Ethernet interface module with built-in CC-Link IE	RJ71EN71
Serial communication module	RJ71C24, RJ71C24-R2, RJ71C24-R4
MES interface module*1	RD81MES96N
GP-IB interface module	RJ71GB91

*1 Before using, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

Network module

Item	Model
CC-Link IE TSN-equipped module	RJ71GN11-T2
	RJ71GN11-SX
	RJ71GN11-EIP
CC-Link IE Controller Network module	RJ71GP21-SX
	RJ71GP21S-SX
CC-Link IE Field Network module	RJ71GF11-T2
CC-Link system master/local module	RJ61BT11
AnyWireASLINK master module	RJ51AW12AL
DeviceNet master/slave module	RJ71DN91
CANopen module*1	RJ71CN91
BACnet module	RJ71BAC96

*1 The parameters cannot be set with the configuration tool. Set them with the buffer memory.

Energy measuring module

Item	Model
Energy measuring module	RE81WH

Blank cover module

Item	Model
Blank cover module	RG60

GOT

Item		Model
GOT2000	GT27 model	GT27□□-□
	GT25 model	GT25□□-□
	GT21 model*1	GT21□□-□
SoftGOT		GT SoftGOT2000 (Multi)

*1 This model cannot be connected by using the motion function because it does not support global labels and 64-bit labels.

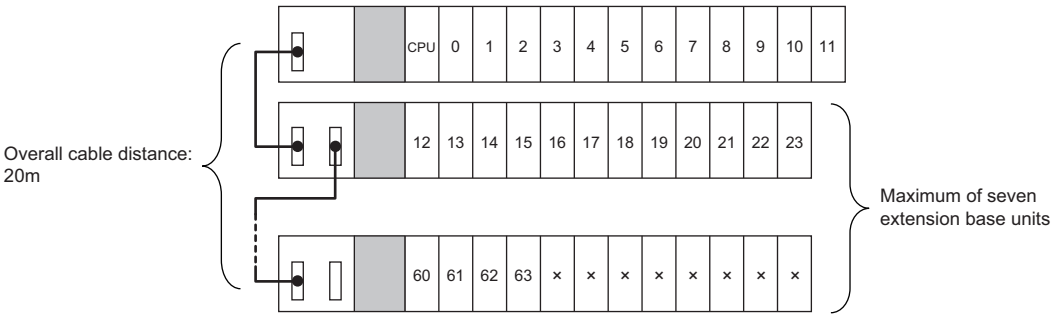
7.3 System Configuration Specifications

This section provides an overview of the system configuration of a controller.

Controller

The following table shows the system configuration when a controller is mounted on the CPU slot of a main base unit.

Item	Description
Maximum number of mountable modules	62
Maximum number of extension base units	7
Overall extension cable distance	20m



- Shaded areas are for the power supply modules.
- "CPU" is the CPU slot, and the numbers are slot numbers.
- Modules cannot be mounted on the slots marked ×.

Modules having restrictions on the number of mountable modules

This section describes modules having restrictions on the number of mountable modules.

MELSEC iQ-R series modules

The following table shows the restrictions when a controller is mounted on the CPU slot of a main base unit.

Item	Model	Maximum number of mountable modules
CC-Link IE TSN-equipped module	• RJ71GN11-T2 • RJ71GN11-SX • RJ71GN11-EIP	8*2*3
CC-Link IE Controller Network-equipped module	• RJ71GP21-SX • RJ71GP21S-SX • RJ71EN71*1	8
CC-Link IE Field Network-equipped master/local module	• RJ71GF11-T2 • RJ71EN71*1	8*2*3
CC-Link system master/local module	• RJ61BT11	8*2

*1 When using ports as CC-Link IE Controller Network and CC-Link IE Field Network, do not exceed the maximum number for each connection. When using ports as Ethernet, there is no restriction on the number of mountable modules.

*2 There is no restriction on the number of mountable modules when parameters are set using the dedicated instruction after "Program" in "Module Parameter" is selected.

*3 Indicates the number of modules including a controller.

7.4 Applicable Software

The following table lists software that can be used.

Item	Function	Application	Version
GX Works3	Software for a system design, programming, debug, and maintenance of a programmable controller	Used for setting the controller.	"1.115V" or later
CPU Module Logging Configuration Tool	Software for data logging setting and maintenance	Used for logging.	"1.166Y" or later
GX LogViewer	An easy-to-use tool for displaying and analyzing large-capacity data collected by modules with the data collection function		"1.166Y" or later
CommDTM (Communication DTM) for IO-Link module	A software module for configuring the settings of communication with field devices, from the personal computer via the IO-Link master	Used for setting the CC-Link IE Field Network remote IO-Link module.	"1.05F" or later
MR Configurator2	A configuration tool for the servo amplifier	Used for setting the motion function.	"1.165X" or later
OPC UA data collector	A software for data collection compatible with Edgecross	Used for executing the collection function, read function, and write function for the device connected to the OPC UA server.	"1.06G" or later

7.5 Access Range

This section describes the range when accessed via a network from an engineering tool connected to the controller or CPU module.

Point

The following networks can be accessed.

- Ethernet
- Serial communication
- CC-Link IE TSN
- CC-Link IE Field
- CC-Link IE Control
- CC-Link

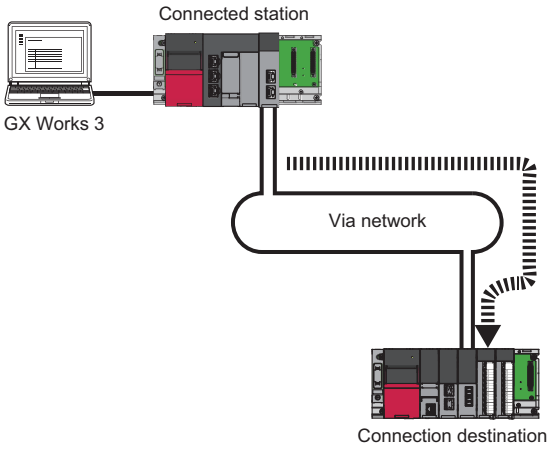
When the connected station is a controller

The engineering tool connected to the controller can access the following connection destinations via the network.

Ex.

Below is a configuration example using the following modules.

- Controller
- MELSEC iQ-R series CPU module
- Remote head module (RJ72GF15-T2)



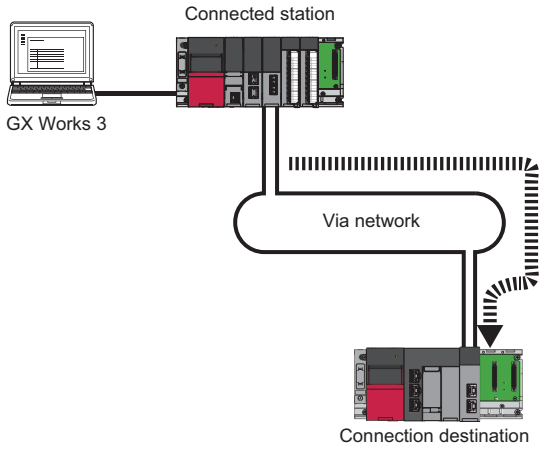
When the connection destination is a controller

The engineering tool connected to the following connection stations can access the controller via the network.

Ex.

Below is a configuration example using the following modules.

- Controller
- MELSEC iQ-R series CPU module
- Remote head module (RJ72GF15-T2)



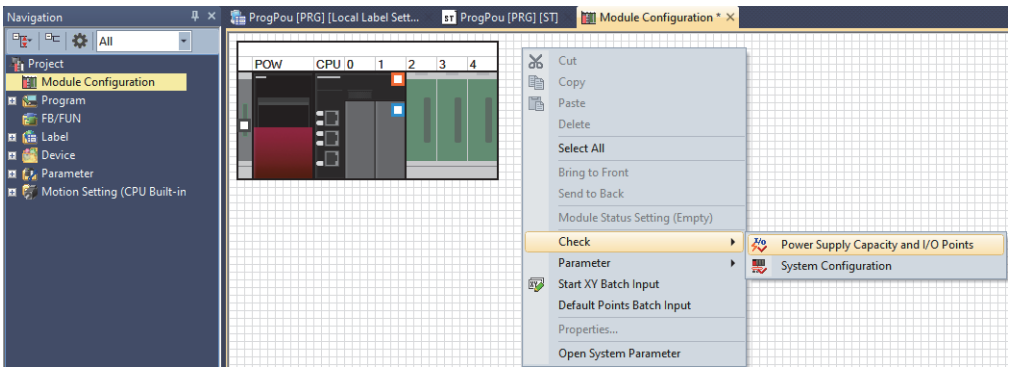
7.6 Precautions for System Configuration

This section describes precautions for configuring a system.

Consideration for internal current consumption

Configure the system so that the internal current consumption of the entire system will be equal to or less than the rated output current of the power supply module.

The internal current consumption can be checked by using the engineering tool as follows.



The following window shows the check result.

Result of Power Supply Capacity and I/O Points Check

Base/C...	Slot	Model Name	Consumption Current	Total Consumption Current	Total Voltage Drop	Total I/O Points
R35B	-	R35B	0.58A	4.88A / 6.5A	-	112 Point / 4096 Point
	[Power S...	R61P	-			
	[CPU]	MXR500-256	4.3A			
	[0]	Network/Motion	-			
	[1]	Empty (3 Slot(s) Occupy)	-			

Restrictions for use together with MELSEC iQ-R series modules

For restrictions other than those described below, refer to the manual for each module.

Model	Function	Restriction
RJ71EN71	File transfer function (FTP server)	The following subcommands usable for the quote command are not supported. • passwd-rd • passwd-wr • password-lock • password-unlock • pm-write
	SLMP	The following commands are not supported. • Remote Password Lock (command: 1631) • Remote Password Unlock (command: 1630)
RJ71C24(-R2/R4)	MC protocol	The following commands are not supported. • Remote Password Lock (command: 1631) • Remote Password Unlock (command: 1630)
• RJ71GN11-T2 • RJ71GN11-SX • RJ71GN11-EIP	SLMP	The following commands are not supported. • Remote Password Lock (command: 1631) • Remote Password Unlock (command: 1630)

8 ASSIGNMENT FOR MODULES

This chapter describes how to assign slot numbers and I/O numbers to modules.
These assignments can be set by placing the same modules in the actual system on the "Module Configuration" window using the engineering tool.
These assignments can also be set by reading system parameters or actual system configuration. (GX Works3 Operating Manual)
The following table lists the setting availability on the module configuration window or system parameters for each item.

Item	Module configuration window	System parameter
Base unit model	○	○
Power supply module model	○	○
Extension cable model	○	○
Module model	○	○
Module order	○	○
I/O numbers of modules (☞ Page 133 I/O Numbers of Modules)	○	○
Module status setting (☞ Page 139 Module status setting)	○	○
Number of points of an empty slot (☞ Page 138 I/O numbers of an empty slot)	○	○
Number of slots on a base unit (☞ Page 130 Setting the number of slots)	×	○
Number of points of a module	×	○

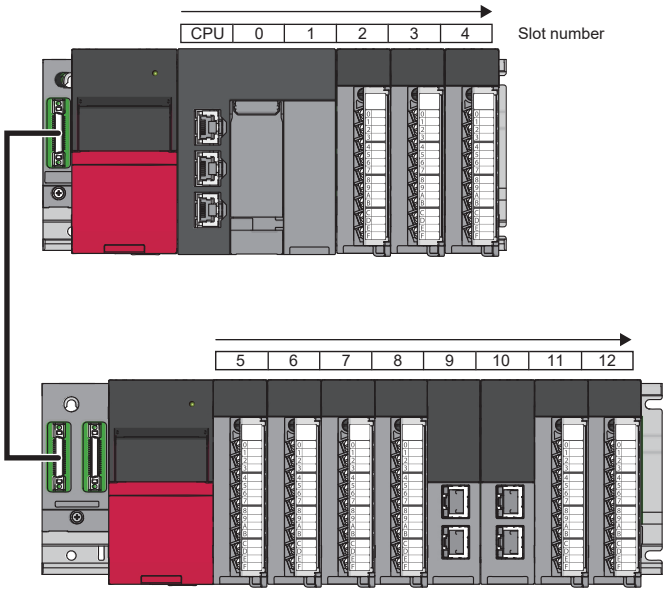
Point

Set assignments either on the module configuration window or in the system parameters depending on the application.

- Module configuration window: To use information unique to each module, such as the number of occupied points, as it is
- System parameter: To change the number of slots on a base unit or the number of occupied points of a module

8.1 Slot Numbers on a Base Unit

Slot numbers are sequentially assigned starting from the slot on the right side of the CPU slot.
When extension base units are connected, slot numbers are assigned to the main base unit first, and successively to the extension base units (1st level to 7th level).



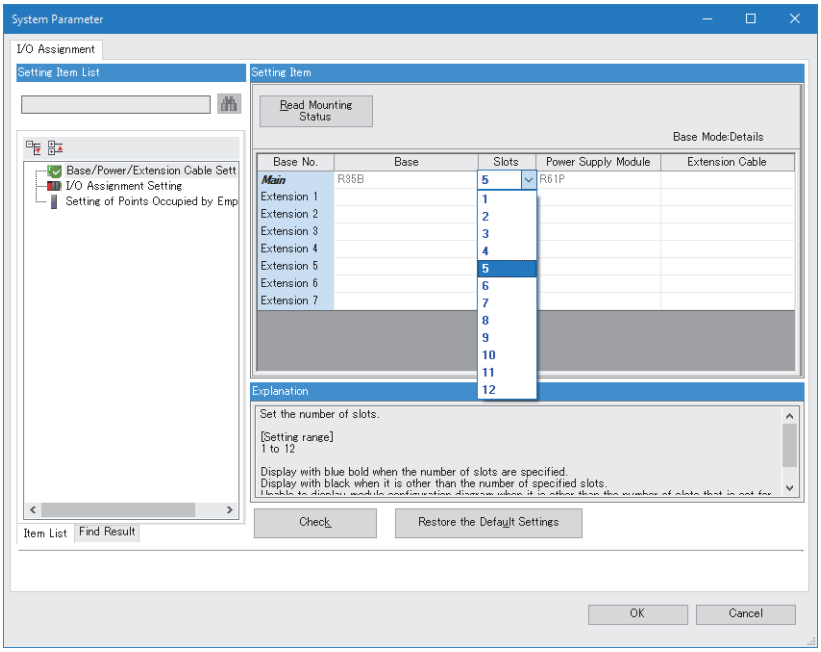
If a module which occupies two slots is mounted, slot numbers for two modules are assigned.

Setting the number of slots

The number of slots for each base unit can be set within the range of 1 to 12. Set the number of slots for the following purposes.

- To secure slots so that the base unit can be changed to the one having the different number of slots in the future
- To keep the same number of slots even after the base unit used in the existing system is changed

Navigation window ⇨ [System Parameter] ⇨ [I/O Assignment] ⇨ [Base/Power/Extension Cable Setting]

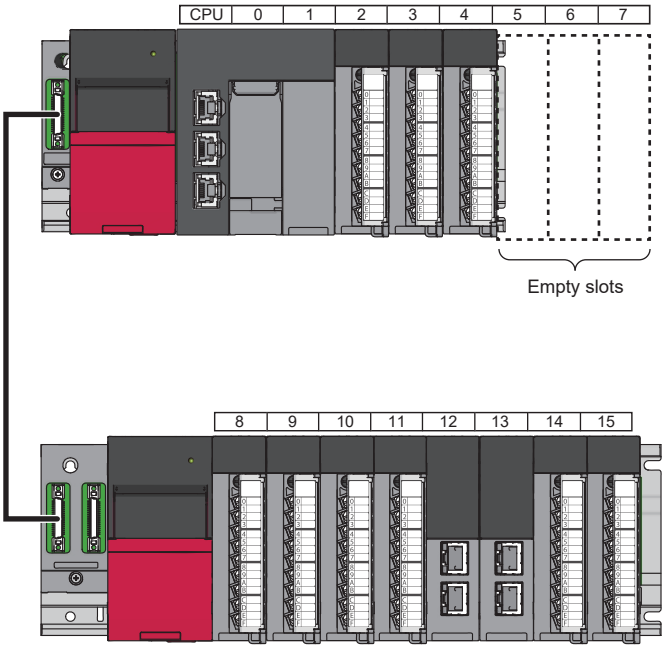


■When the number of set slots is more than the number of actual slots

Slots corresponding to the set number are occupied, where the slots exceeding the actual number are regarded as empty slots.

Ex.

When the number of slots is set to eight for the base unit with five slots, three slots are regarded as empty slots.



Point

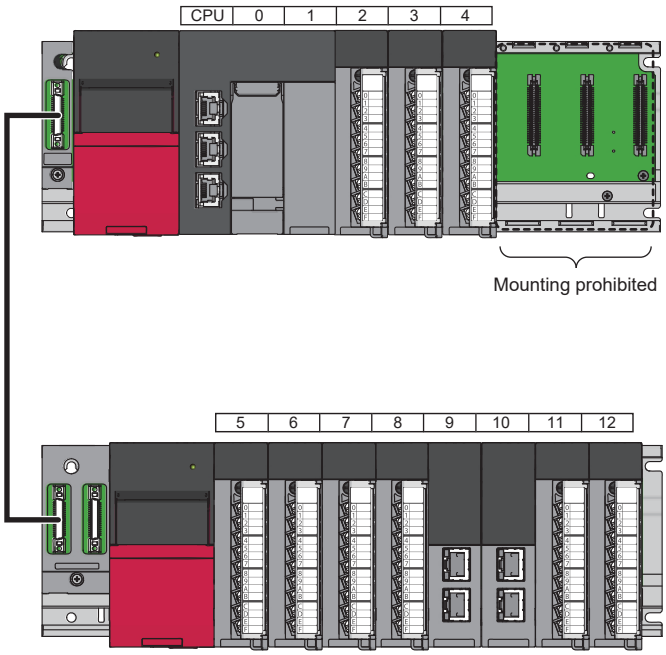
The number of points for empty slots can be changed on the "Module Configuration" window, or in "Setting of Points Occupied by Empty Slot" of the [I/O Assignment] tab on the "System Parameter" window. (☞ Page 138 I/O numbers of an empty slot)

■When the number of set slots is less than the number of actual slots

Slots corresponding to the set number are occupied, where slots that are out of the set range are prohibited from mounting a module, and the slot number is not assigned.

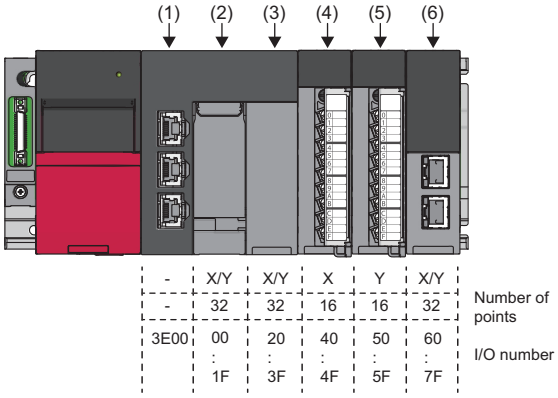
Ex.

When the number of slots is set to five for the base unit with eight slots, three slots will be use-prohibited.



8.2 I/O Numbers of Modules

An I/O number is a number (hexadecimal) assigned to I/O modules and intelligent function modules to communicate data with the controller. On/off data are classified into two types: input and output, and the symbol, "X" for input, and "Y" for output, is added in front of the I/O number.



(1) CPU function part of the controller
(2) CC-Link IE TSN function part of the controller
(3) Motion function part of the controller
(4) Input module
(5) Output module
(6)Intelligent function module

Point

- The CPU function part performs sequence control and Ethernet communications through the Ethernet port (P3).
- In the CC-Link IE TSN function part, CC-Link IE TSN and Ethernet communications are performed through the CC-Link IE TSN port (P1, P2).
- For details on how to specify the buffer memory areas of each function part, refer to the following.

☞ Page 375 Buffer memory specification method

Automatic setting of I/O numbers

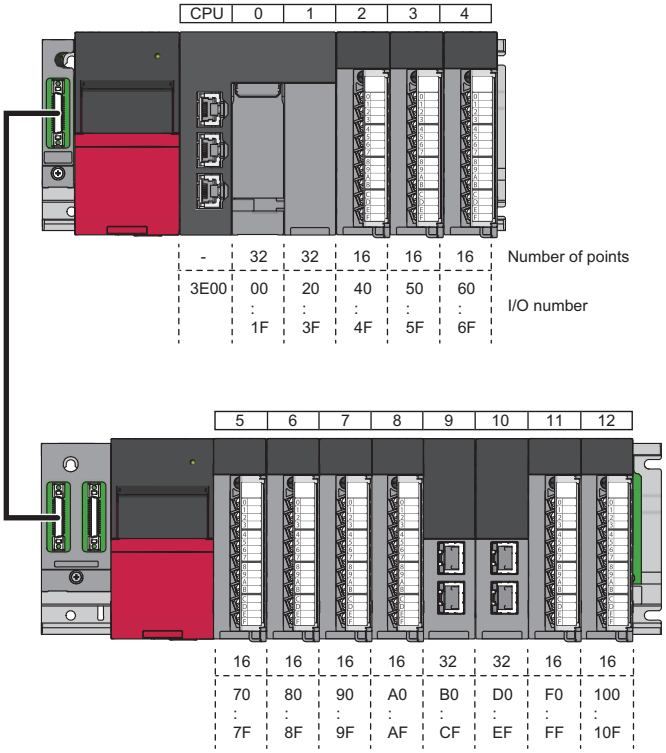
I/O numbers are automatically assigned in sequential order. On the main base unit, the I/O number assignment starts with the module on the right side of the controller.

On the extension base unit, the I/O number starts from the next number of the last I/O number on the main base unit.

Each slot on the base unit occupies I/O numbers corresponding to the number of points of the module mounted.

Ex.

When the I/O number starts from 40H in sequential order

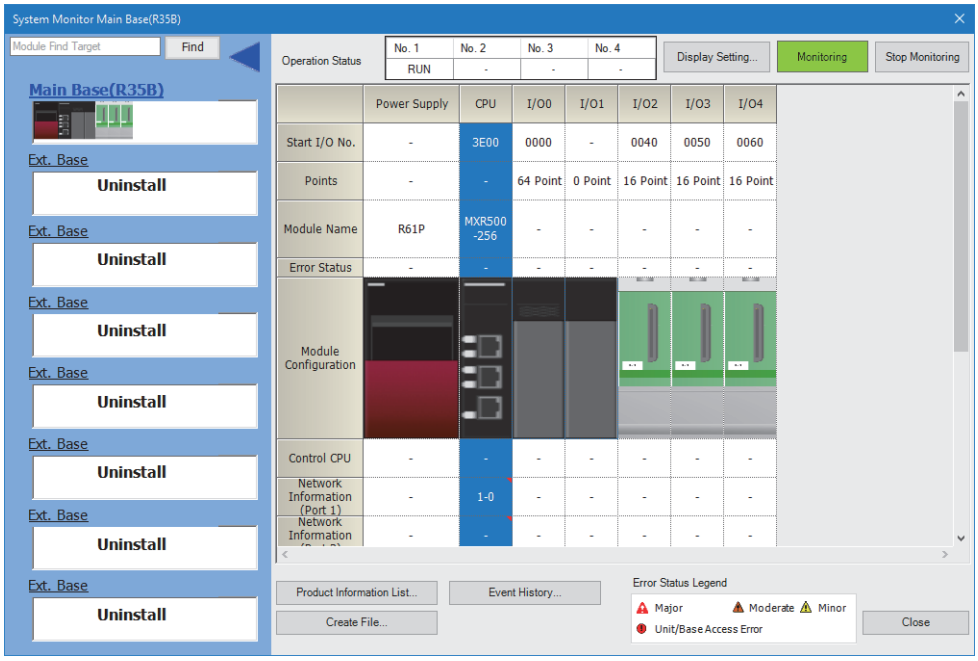


Upon placing a module on the "Module Configuration" window using the engineering tool, the I/O numbers are automatically assigned according to the number of occupied points of the module.

Even though the mounting position of the module is changed, the I/O numbers once assigned remain unchanged.

Point

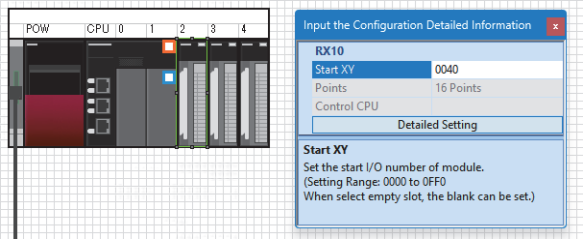
The mounted modules and their I/O numbers can be checked on the "System Monitor" window using the engineering tool. (GX Works3 Operating Manual)



Changing I/O numbers

Upon placing a module on the "Module Configuration" window, the I/O numbers are automatically assigned according to the number of occupied points of the module. The assigned I/O numbers, however, can be changed for each module.

- To eliminate the need of modification due to an overlap of I/O numbers after the module is changed to a module having a different number of occupied points
- To reduce the program modifications when using an existing program by assigning modules according to the I/O numbers that have already been used in the program



Point

The I/O number of the CC-Link IE TSN function part can also be changed.
If the I/O number of the CC-Link IE TSN function part is changed, 32 points from the next I/O number for which 32 points from "Start XY" assigned to the CC-Link IE TSN function part are occupied will automatically be assigned to the I/O number of the motion function part.

■Precautions

- Set the same model as the one actually mounted.
- The module that is not set as actually mounted denies access.
- The number of I/O points of a module can be changed in "I/O Assignment Setting" of the [I/O Assignment] tab on the "System Parameter" window.
- If the number of I/O points set in the parameters differs from that of the module actually mounted, the number of I/O points will be as follows:

Setting	Operation	Remarks
The number of I/O points set in the parameters is less than that of the module actually mounted.	The available number of points for the mounted I/O modules is reduced to the set number of points.	Intelligent function modules do not permit the setting of a fewer number of I/O points.
The number of I/O points set in the parameters is more than that of the module actually mounted.	The number of I/O points exceeding the actual number of I/O points is not used in the mounted I/O modules and intelligent function modules.	—

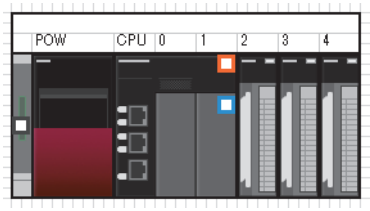
- Set same modules as in the actual system on the "Module Configuration" window. Because the settings of the engineering tool control the module operation, a setting that is different from the actual configuration may result in unintended operation.
- When changing the default I/O numbers, setting the I/O numbers to all the modules is recommended. I/O numbers of a module that is not set in the engineering tool are assigned following the I/O numbers of the module already set, which may cause an overlap of I/O numbers.

Ex.

I/O numbers overlap as a result of setting the I/O numbers up to the module on slot No.4.

• I/O numbers set by using the engineering tool

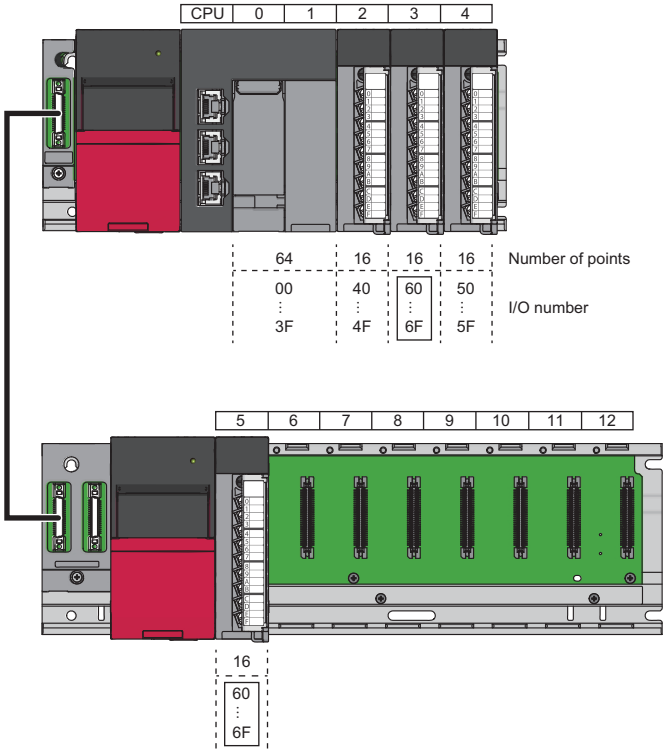
Set the start I/O number 60 to the module on slot No.3, and 50 to the module on slot No.4.



Slot	Module Name	Module Status Setting	Points	Start XY
Main				
CPU	MXR500-256(Host Station)			3E00
CPU	Network/Motion		64 Points	0000
CPU	3 Slots Occupy [Empty]		0 Points	
2(0-2)	RX10	No Setting	16 Points	0040
3(0-3)	RX10	No Setting	16 Points	0050
4(0-4)	RX10	No Setting	16 Points	0060

• I/O numbers in the actual system

I/O numbers of the module on slot No.5, which is not set in the engineering tool, are assigned following the I/O numbers of the module on slot No.4. This results in an overlap of I/O numbers.



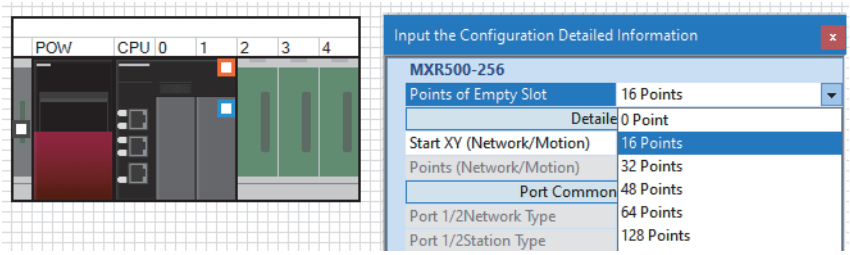
Set the I/O numbers of the module on slot No.5 in the parameter so that they do not overlap.

Slot	Module Name	Module Status Setting	Points	Start XY
Main				
CPU	MXR500-256(Host Station)			3E00
CPU	Network/Motion		64 Points	0000
CPU	3 Slots Occupy [Empty]		0 Points	
2(0-2)	RX10	No Setting	16 Points	0040
3(0-3)	RX10	No Setting	16 Points	0050
4(0-4)	RX10	No Setting	16 Points	0060
Extension 1				
5(1-0)	RX10	No Setting	16 Points	0070

• To set the module reserved for future use, or when an already set module is not to be mounted, perform the module status setting. (☞ Page 139 Module status setting)

I/O numbers of an empty slot

An empty slot is a slot where a module is not mounted, and occupies 16 points by default.
I/O numbers and the number of points can be set to empty slots for future use.
The number of I/O points can be changed for all empty slots at once by selecting the controller on the "Module Configuration" window as shown below.



Module status setting

The module status setting makes it possible to set the module status such as reserved status and disabled status, interpreting a configured module in the engineering tool as an empty slot.

The following table summarizes the application of the module status setting.

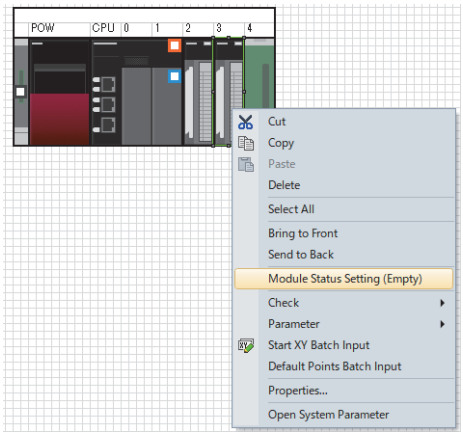
Status	Application
Reserved status	• To operate the system while a module is allocated in the engineering tool but not actually mounted • To reserve the I/O numbers of a module for future use
Disabled status	• To disable operation of an actually mounted module

The change of the parameter settings is not reflected in the module where the module status setting has been performed.

In addition, the following operations have no effect on the module where the module status setting has been performed:

- Setting a remote password
- Executing a program that accesses the set target module

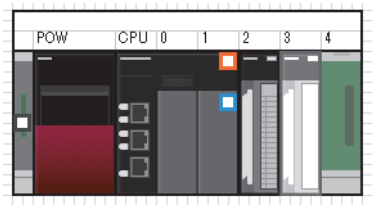
Set the module status as shown below. (GX Works3 Operating Manual)



Ex.

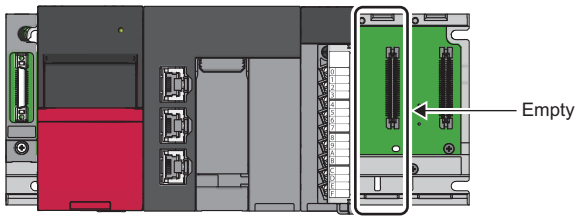
To operate the system while a module is allocated in the engineering tool but not actually mounted

- Module configuration window



When the module status is set, the set target module is high-lighted, and regarded as an empty slot.

- Actual system



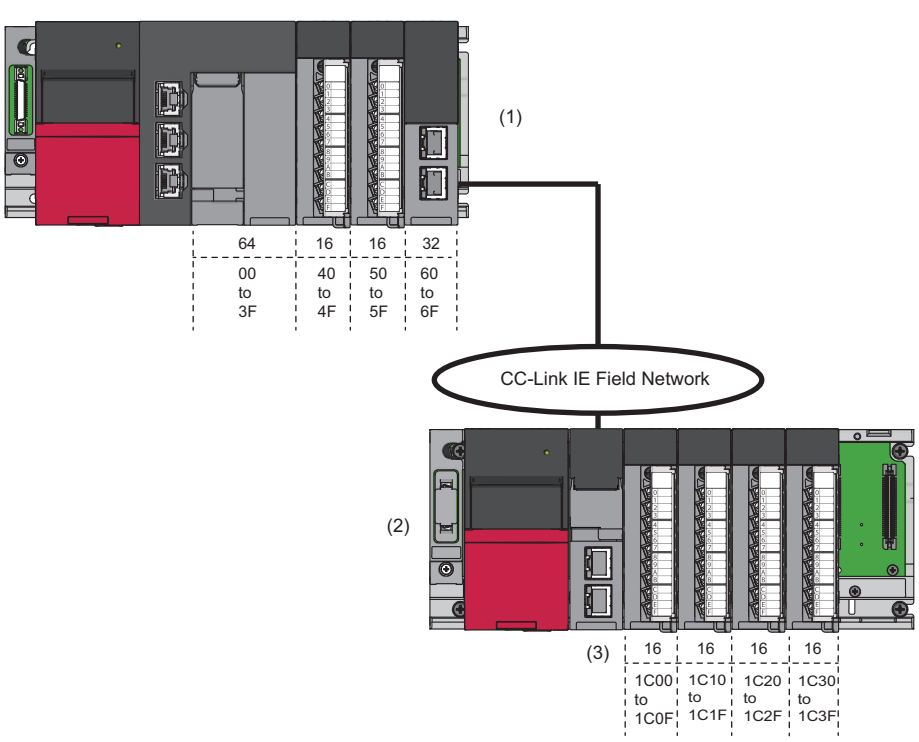
Writing the module configuration to the controllers allows operation even without mounting modules actually.

Assigning I/O numbers in the device station

Network systems such as CC-Link IE Field Network can be controlled by assigning input "X" and output "Y", which are the devices of the controller, to the I/O modules and intelligent function modules in the device station.

Ex.

Controlling a module connected to the remote head module on CC-Link IE Field Network

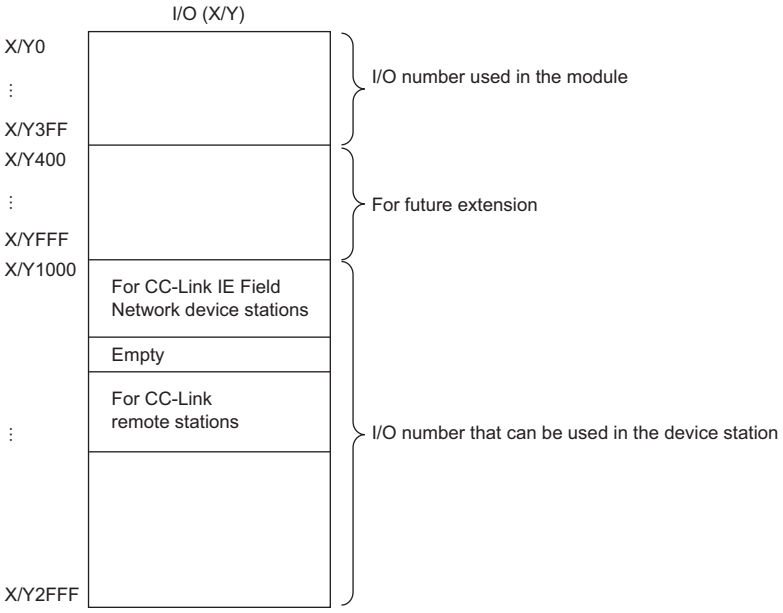


■Available I/O numbers

In the device station, assign the I/O numbers following the I/O numbers assigned to the modules in the master station.

■Precautions

- The same I/O numbers cannot be used for the refresh destination (device on the controller side) on CC-Link IE Field Network and for the CC-Link remote station.
- When intending to connect more I/O modules and intelligent function modules to the controller later, reserve I/O numbers for modules to be added.



PART 5 COMMUNICATION WITH EQUIPMENT

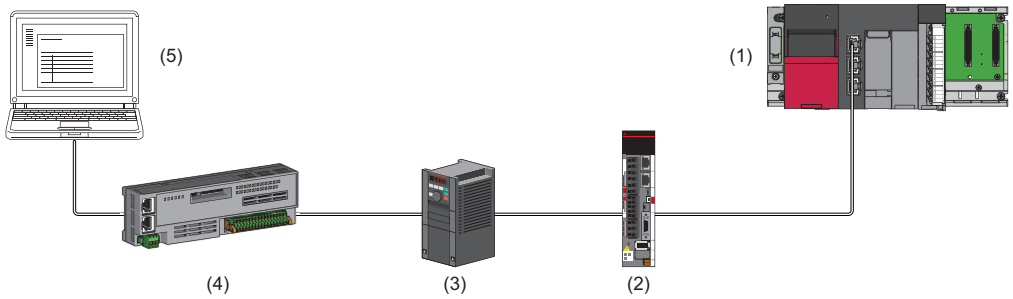
This part consists of the following chapters.

9 CC-Link IE TSN SYSTEM CONFIGURATION

10 Ethernet SYSTEM CONFIGURATION

9 CC-Link IE TSN SYSTEM CONFIGURATION

The controller becomes a master station and controls the entire network.
CC-Link IE TSN is configured using Ethernet cables. (☞ Page 62 Ethernet cable)
Use the port for CC-Link IE TSN. When only one of the connectors is used, either P1 or P2 is applicable.
For the specifications of connectable devices, refer to the manual for each device used.



(1) Controller
(2) Drive unit
(3) Inverter device
(4) Remote I/O module and other modules
(5) Ethernet device

Restriction

Among CC-Link IE TSN compatible devices, the following modules cannot be connected to the controller.

- CC-Link IE TSN-CC-Link IE Field Network bridge module: NZ2GN-GFB
- CC-Link IE TSN-AnyWireASLINK bridge module: NZ2AW1GNAL
- CC-Link IE TSN FPGA module: NZ2GN2S-D41P01, NZ2GN2S-D41D01, NZ2GN2S-D41PD02

Restriction

If a parameter where the following settings in CC-Link IE TSN are set is written to the controller, an error occurs.

- Ring topology*1
- Local station setting*2
- "LB Setting" and "LW Setting"*3
- Multicast*4
- Setting values 1 to 32 for "Transient Transmission Group No."*5

*1 If a parameter where the ring topology is set is written to the controller, an error (error code 3A32H) occurs.
*2 If a parameter where a local station is set is written to the controller, an error (error code 3A6EH) occurs.
*3 If a parameter where "LB Setting" and "LW Setting" are set is written to the controller, an error (error code 3A6EH) occurs.
*4 If a parameter where the multicast is set is written to the controller, an error (error code 3A6EH) occurs.
*5 If a parameter where any of the setting values 1 to 32 is set for "Transient Transmission Group No." is written to the controller, an error (error code 3A6EH) occurs.

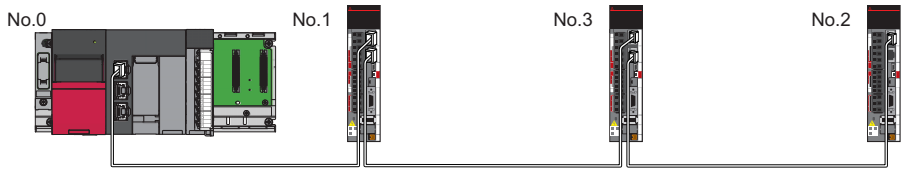
System configuration list

The following table lists the system configuration references by connection device.

Connection device	Reference
Modules on CC-Link IE TSN (CC-Link IE TSN Class B only), Ethernet devices	Page 171 Structure with CC-Link IE TSN Class B Devices Only
Modules on CC-Link IE TSN (mixture of CC-Link IE TSN Class B/A or Class A only), Ethernet devices	Page 178 Structure with CC-Link IE TSN Class B/A Devices
Modules on CC-Link IE TSN, modules on CC-Link IE Field Network, Ethernet devices	Page 188 Structure of the CC-Link IE TSN and CC-Link IE Field Network
Modules on CC-Link IE TSN (protocol version 2.0/1.0 mixed), Ethernet devices	Page 2129 Configuration with CC-Link IE TSN Class B/A devices (Protocol version 2.0/1.0)
Modules on CC-Link IE TSN (protocol version 1.0 only), Ethernet devices	Page 2132 Configuration with CC-Link IE TSN Class B/A devices (Protocol version 1.0 only)

Point

Modules can be connected in any order regardless of the station number. A No.☐ shown in the figure below represents a station number.



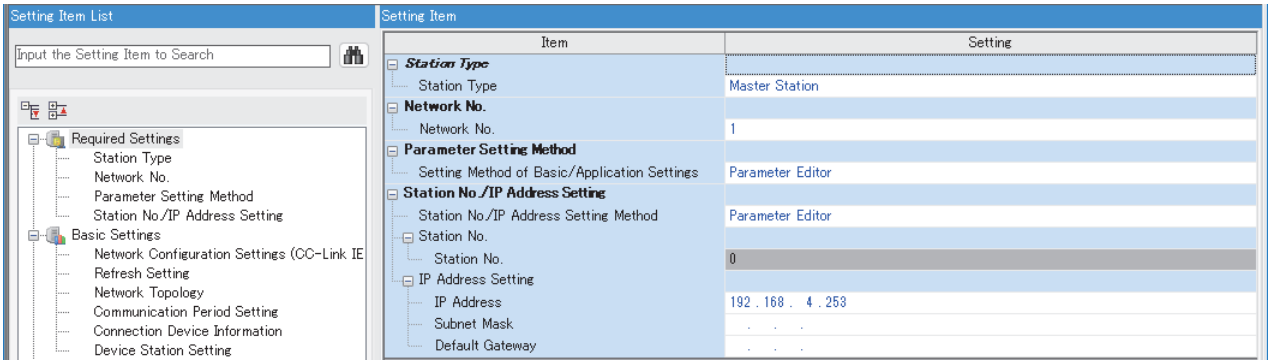
Precautions

A dedicated industrial switch (CC-Link IE TSN Class B certified) may be required depending on the parameter settings or the network topology used to connect modules on CC-Link IE TSN.

9.1 Required Settings

Set the parameters such as the IP address of the controller.

Navigation window ⇨ [Parameter] ⇨ Controller model ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Required Settings]

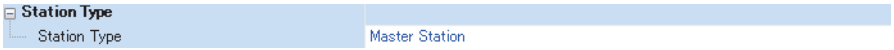


Item	Description	Reference
Station Type	Set the station type of the controller.	Page 144 Station Type
Network No.	Set the network number of the own station of the controller.	Page 145 Network No.
Parameter Setting Method	Select the setting methods for "Basic Settings" and "Application Settings".	Page 145 Parameter Setting Method
Station No./IP Address Setting	Set the parameters such as the station number and IP address of the own station of the controller.	Page 146 Station No./IP Address Setting

Station Type

Set the station type of the controller.

"Module Parameter (CC-Link IE TSN)" ⇨ "Required Settings" ⇨ "Station Type"



Item	Description	Setting range
Station Type	The controller is used as a master station. Only one master station can be set in a network.	Master Station

Network No.

Set the network number of the own station of the controller.

"Module Parameter (CC-Link IE TSN)" ⇨ "Required Settings" ⇨ "Network No."



Item	Description	Setting range
Network No.	Set the network number of the controller.	1 to 239 (Default: 1)

Precautions

Set a network number that does not overlap any other network numbers.

In particular, when using an Ethernet port of the controller at default, the IP address is 192.168.3.39 and the network number is the third octet of the IP address, thus 3. Because setting the network number of the port for CC-Link IE TSN to 3 causes an overlap, set another network number.

Parameter Setting Method

Select the method for setting "Basic Settings" and "Application Settings" items.

"Module Parameter (CC-Link IE TSN)" ⇨ "Required Settings" ⇨ "Parameter Setting Method"

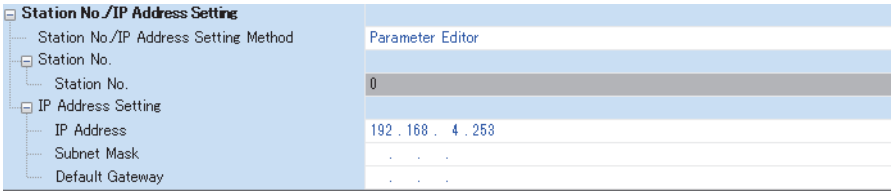


Item	Description	Setting range
Setting Method of Basic/ Application Settings	■Parameter Editor Select this item to set the parameter using the engineering tool. The following are advantages. • All parameters can be easily set in the window without creating a program for setting. • The data will be automatically transferred from SB, SW, and link devices of the CC-Link IE TSN function part to the devices or module label of the CPU function part.	Parameter Editor

Station No./IP Address Setting

Set the parameters such as the station number and IP address of the own station of the controller.

"Module Parameter (CC-Link IE TSN)" ⇨ "Required Settings" ⇨ "Station No./IP Address Setting"

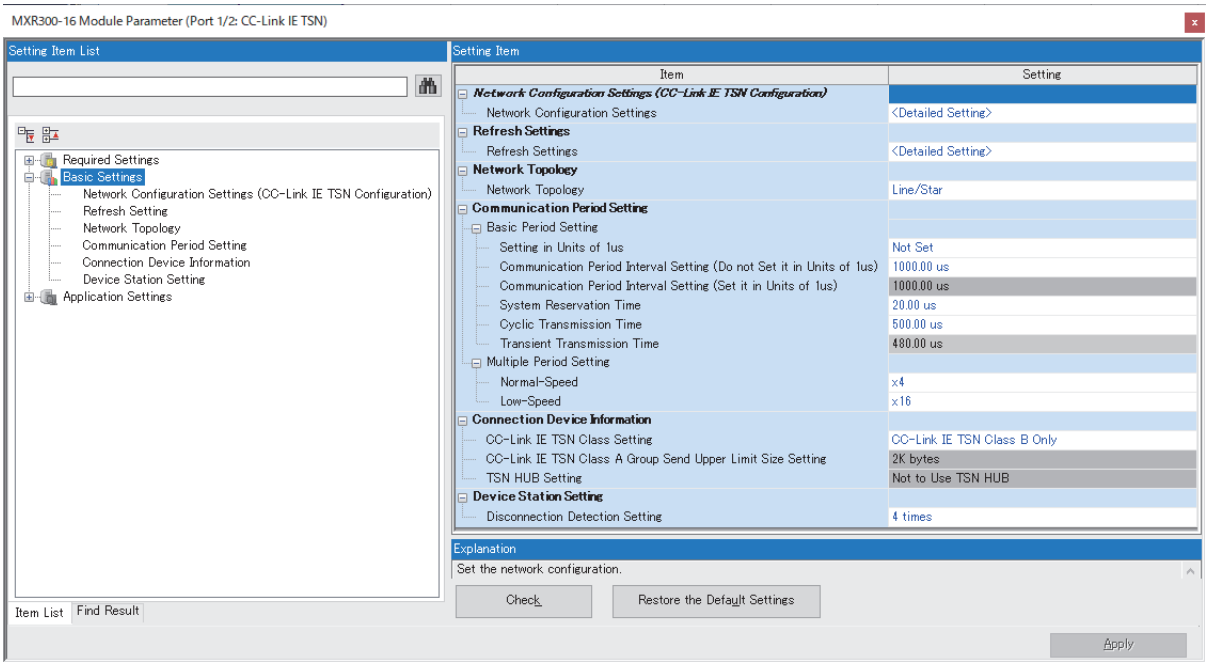


Item	Description	Setting range
Station No./IP Address Setting Method	The method is fixed to "Parameter Editor".	Parameter Editor
Station No.	The master station is fixed to station No.0.	0
IP Address	Set the IP address of the own station. Set an IP address different from those used in other stations. Do not set the following values. • The third and fourth octets are all 0 or all 1. • The host address bits are all 0 or all 1 • Reserved address Also, set the IP address to be in a different segment from the IP address set for the Ethernet port.	0.0.0.1 to 223.255.255.254 (Default: 192.168.4.253)
Subnet Mask	Set the subnet mask. Set the same value for the master station and device station. If the subnet mask is empty, the address class (class A, class B, class C) is determined from the setting of "IP Address", and operation is done with the subnet mask according to the address class. The subnet mask for each class is as follows. • Class A: 255.0.0.0 • Class B: 255.255.0.0 • Class C: 255.255.255.0 The IP address for each class is as follows. • Class A: 0.x.x.x to 127.x.x.x • Class B: 128.x.x.x to 191.x.x.x • Class C: 192.x.x.x to 223.x.x.x The host address for each class is the 0 section shown below. • Class A: 255.0.0.0 • Class B: 255.255.0.0 • Class C: 255.255.255.0	• Empty • 0.0.0.1 to 255.255.255.255 (Default: Empty)
Default Gateway	Set the default gateway.	• Empty • 0.0.0.1 to 223.255.255.254 (Default: Empty)

9.2 Basic Settings

Configure settings such as the refresh setting of the controller.

Navigation window ⇨ [Parameter] ⇨ Controller model ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings]

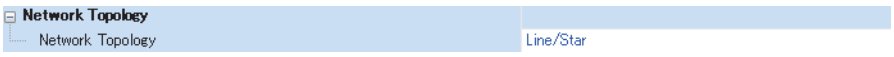


Item	Description	Reference
Network Configuration Settings (CC-Link IE TSN Configuration)	Perform the parameter settings of device stations, the detection of connected/disconnected devices, or others.	Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings)
Refresh Setting	Assign link refresh ranges between the devices described below. • SB, SW, link devices of the CC-Link IE TSN function part ↔ Devices of the CPU function part • SB, SW of the CC-Link IE TSN function part ↔ Module label	Page 1236 Link Refresh
Network Topology	Select the network topology type according to the actual network configuration.	Page 147 Network Topology
Communication Period Setting	Set the basic cycle setting and multiple cycle setting.	Page 287 Basic period setting Page 293 Multiple period setting
Connection Device Information	Set the information of the connected device.	Page 148 Connection Device Information
Device Station Setting	Set the number of consecutive communication failures until a device station is considered disconnected.	Page 150 Device Station Setting

Network Topology

Select the network topology type according to the actual network configuration.

"Module Parameter (CC-Link IE TSN)" ⇨ "Basic Settings" ⇨ "Network Topology"

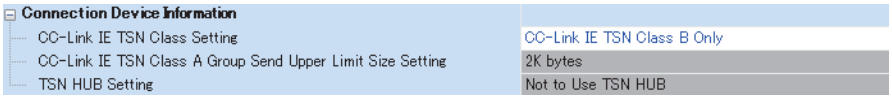


Item	Description	Setting range
Network Topology	Select the network topology type according to the actual network configuration. If a parameter where the ring topology is set is written to the controller, an error (error code 3A32H) occurs.	(Default: Line/Star)

Connection Device Information

Set the information of the connected device.

"Module Parameter (CC-Link IE TSN)" ⇨ "Basic Settings" ⇨ "Connection Device Information"



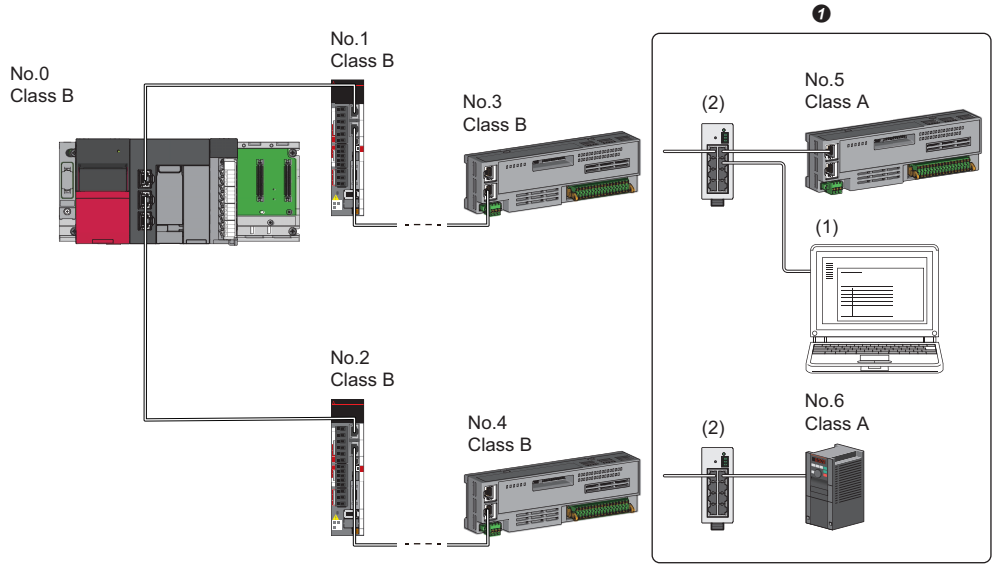
Item	Description	Setting range
CC-Link IE TSN Class Setting	Set the CC-Link IE TSN Class of the connected device.	• CC-Link IE TSN Class B Only • Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only (Default: CC-Link IE TSN Class B Only)
CC-Link IE TSN Class A Group Send Upper Limit Size Setting	Set the upper limit size of CC-Link IE TSN Class A group send. (☞ Page 312 CC-Link IE TSN Class A group send) The setting is available when "CC-Link IE TSN Class Setting" is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".	• 2K bytes • 8K bytes (Default: 2K bytes)
TSN HUB Setting	Set whether to use an industrial switch (CC-Link IE TSN Class B certified). The setting is available when "CC-Link IE TSN Class Setting" is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" and "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" is set to "8K bytes".	• Not to Use TSN HUB • Use TSN HUB (Default: Not to Use TSN HUB)

■CC-Link IE TSN Class setting

From "Connection Device Information" under "Basic Settings" of the engineering tool, select either of the following items according to devices to be connected.

Connection device information	System configuration	Supported standard
CC-Link IE TSN Class B Only	Select this if the system is to be configured without connecting the CC-Link IE TSN Class A device. • ☞ Page 173 Connection with modules on CC-Link IE TSN only • ☞ Page 176 Connection with modules on CC-Link IE TSN and Ethernet devices	IEEE 802.1AS
Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only	Select this information if connecting a CC-Link IE TSN Class A device or Ethernet device to a configuration consisting only of CC-Link IE TSN Class B devices. (☞ Page 187 Connection with modules on CC-Link IE TSN and Ethernet devices)	IEEE 802.1AS or IEEE 1588

When "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" is set in the "Connection Device Information" setting, connection is possible even in the configuration consisting of CC-Link IE TSN Class B devices only as shown below. Select this setting when connecting (2) Ethernet switch to the end of a CC-Link IE TSN Class B device-only configuration to connect CC-Link IE TSN Class A devices or Ethernet devices.



No.0: Master station
No.1 to 6: Remote stations
(1) Ethernet device
❶ When connecting CC-Link IE TSN Class A devices or Ethernet devices

■Precautions

When "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" is set to "8K bytes" in a configuration with mixed CC-Link IE TSN Class B devices and CC-Link IE TSN Class A devices, set "TSN HUB Setting" to "Use TSN HUB" when connecting the TSN HUB.

Device Station Setting

Set items related to the device station.

"Module Parameter (CC-Link IE TSN)" ⇨ "Basic Settings" ⇨ "Device Station Setting"

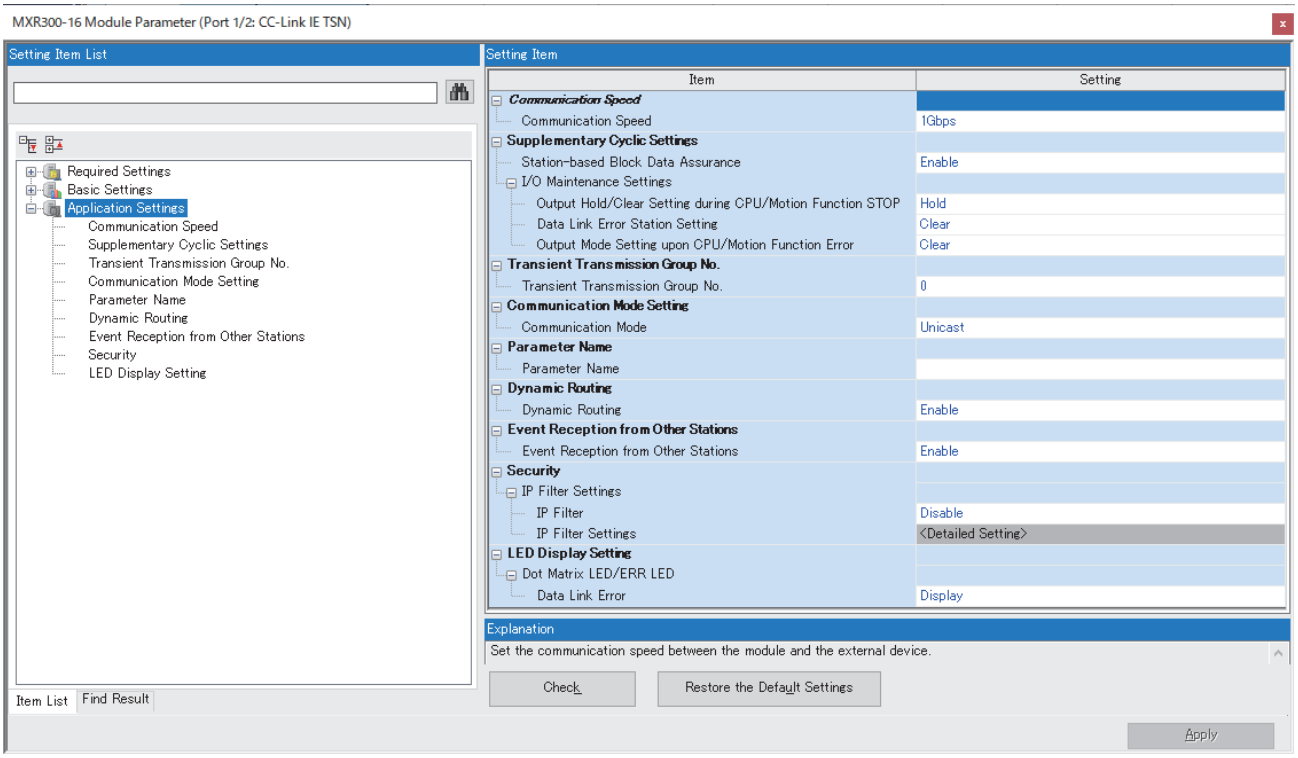


Item	Description	Setting range
Disconnection Detection Setting	Set the number of consecutive communication failures until a device station is considered disconnected.	• 2 times • 4 times • 8 times (Default: 4 times)

9.3 Application Settings

Set the parameters such as the communication speed setting of the controller.

Navigation window ⇨ [Parameter] ⇨ Controller model ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings]



Item	Description	Reference
Communication Speed	Set the communication speed with the external device.	Page 152 Communication Speed
Supplementary Cyclic Settings	Set the station-based block data assurance and I/O maintenance settings.	Page 1246 Station-based block data assurance Page 1247 I/O Maintenance Settings
Transient Transmission Group No.	Set the transient transmission group number. Do not change the number. If a parameter where any of the setting values 1 to 32 is set for "Transient Transmission Group No." is written to the controller, an error (error code 3A6EH) occurs.	—
Communication Mode	Set the communication mode.	Page 152 Communication Mode Setting
Parameter Name	Set a name for the module parameter if desired.	Page 152 Parameter Name
Dynamic Routing	Select whether to enable the dynamic routing function.	Page 1255 Dynamic routing setting
Event Reception from Other Stations	Select whether to obtain the events occurring in the other stations.	Page 1757 Event Reception from Other Stations
Security	Set the security measures for access to the Ethernet device.	Page 1582 IP Filter Function
LED Display Setting	Set the LED display.	Page 1770 LED display setting

Communication Speed

Set the communication speed with the external device.

"Module Parameter (CC-Link IE TSN)" ⇨ "Application Settings" ⇨ "Communication Speed"



Item	Description	Setting range
Communication Speed	Set the communication speed with the external device.	• 1Gbps • 100 Mbps (Default: 1Gbps)

For details on the connection of modules or devices based on the communication speed setting, refer to the following.

☞ Page 171 Structure with CC-Link IE TSN Class B Devices Only

☞ Page 178 Structure with CC-Link IE TSN Class B/A Devices

Communication Mode Setting

Set the communication mode.

Item	Description	Setting range
Mode	Set the communication mode. If a parameter where the multicast is set is written to the controller, an error (error code 3A6EH) occurs.	Unicast (Default: Unicast)

Parameter Name

Set a name for the module parameter if desired.

Item	Description	Setting range
Parameter Name	Set a name for the module parameter if desired.	Up to 8 one-byte or two-byte characters (Default: Empty)

9.4 "CC-Link IE TSN Configuration" Window (Network Configuration Settings)

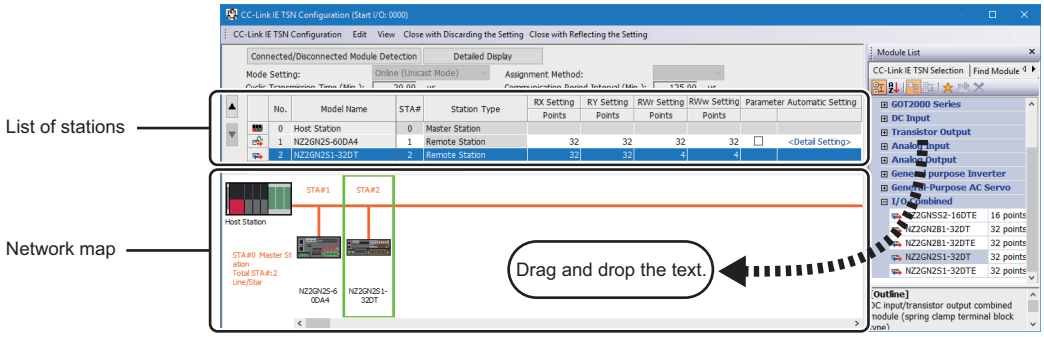
Perform the parameter setting of device stations, the detection of connected/disconnected devices, or others.

Navigation window ⇨ "Parameter" ⇨ "Controller model name" ⇨ Module Parameter (Port 1/2: CC-Link IE TSN) ⇨ Module Parameter (CC-Link IE TSN) ⇨ "Basic Settings" ⇨ "Network Configuration Settings"

Parameter setting of a device station

Set parameters of device stations (such as the number of points and assignment of link devices) in the master station.

1. Select the module in "Module List" and drag it to the list of stations or the network map.



2. Set the required items.
3. Check the system configuration.

[CC-Link IE TSN Configuration] ⇨ [Check] ⇨ [System Configuration]

An error or a warning message appears on the output window, refer to the following.

MELSOFT Navigator MessageNo.

4. Select [Close with Reflecting the Setting] and close the "CC-Link IE TSN Configuration" window.

Setting items

- Simple Display: Click the [Simple Display] button to display a narrow portion of items. Use for operation with default settings or the minimum required settings. (Default)
- Detailed Display: Click the [Detailed Display] button to display all items.

Item (Detailed display)		Description	Setting range
Mode Setting		The settings for "Module Operation Mode" and "Communication Mode" is displayed. For details on the settings, refer to the following. • Module Operation Mode: ☞ Page 1769 Module communication test • Communication Mode: ☞ Page 152 Communication Mode Setting	—
Assignment Method		Select a link device assignment method. • Points/Start: Enter the number of link devices and the start number. • Start/End: Enter the start and end numbers of link devices.	• Points/Start • Start/End (Default: Start/End)
No.		The total number of device stations set in the "CC-Link IE TSN Configuration" window is displayed.	—
Model Name		The module model name is displayed. To set a module where the profile is not registered, select it from the "General CC-Link IE TSN Module" list or register the profile before setting the model name. For how to register a profile, refer to the following. 📖GX Works3 Operating Manual	—
STA#		Enter the station number of each device station connected to the network. Station numbers do not need to be set consecutively, but must be unique.	• Master Station: Fixed to "0" • Device station: 1 to 253 (Default: Serial number of added stations)
Station Type		Set the station types. Select the station types same as those of the modules connected to the network. If a parameter where the connection to a local station is set is written to the controller, an error (error code 3A6EH) occurs.	• Remote Station (Default: Varies depending on the set module)
Network Label		Set this item to enable the network label generation. ☞ Page 108 Network labels	—
Number of input/output bit points[*1]	RX Setting	Assign RX/RY points in increments of 16. (☞ Page 1235 Communications Using RX, RY, RWr, and RWw) For modules for which the settings are provided by the device profile, this item is automatically set through selected models. (Excluding modules with a number of points that is not fixed)	• Points: None, 16 to 16384 • Start: 0000H to 3FF0H • End: 000FH to 3FFFH (Default: Varies depending on the set module)
	RY Setting		
Number of input/output word points[*1]	RWr Setting	Assign RWr/RWw points in increments of 4. (☞ Page 1235 Communications Using RX, RY, RWr, and RWw) For modules for which the settings are provided by the device profile, this item is automatically set through selected models. (Excluding modules with a number of points that is not fixed)	• Points: None, 4 to 8192 • Start: 0000H to 1FFCH • End: 0003H to 1FFFH (Default: Varies depending on the set module)
	RWw Setting		
—	LB Setting	If a parameter where "LB Setting" and "LW Setting" are set is written to the controller, an error (error code 3A6EH) occurs.	—
	LW Setting		—
Parameter Automatic Setting		Set whether to set the parameters of each device station automatically. This cannot be set for extension modules. However, the parameter automatic setting of extension modules is interlocked with the settings of the connected main module. ☞ Page 157 Device station parameter automatic setting	• Checked: Distribute parameters • Not checked: Do not distribute parameters. (Default: Not checked)
PDO Mapping Setting		Set the PDO mapping to the station that supports CANopen communications. (☞ Page 165 PDO mapping setting)	—
IP Address		Set the IP address of a station that performs cyclic transmission.	0.0.0.1 to 223.255.255.254 (Default: The first to third octets have the same values as the master station, the fourth octet has a serial number from 1 to 254.)
Subnet Mask		Set a subnet mask to identify a network address. Set the same value for the master station and device station. Even if a device station has a different subnet mask from the master station, it does not result in an input error. If 255.255.255.255 is set, leave it empty.	• 0.0.0.1 to 255.255.255.255 (00.00.00.01 to FF.FF.FF.FF) • Empty (Default: Empty[*2])
Default Gateway		Set the default gateway address to connect to the external network.	• 0.0.0.1 to 223.255.255.254 (00.00.00.01 to DF.FF.FF.FE) • Empty (Default: Empty)

Item (Detailed display)	Description	Setting range
Reserved/Error Invalid Station	Set the device station as a reserved station or error invalid station. • No Setting: The device station is connected to the network. • Reserved Station: The device station is reserved in the parameters for future expansion. By using a reserved station, link device assignment will not change even if the device station is added (reservation is canceled). Therefore, modification of the program is not required. Physical connection of the device station is not required. • Error Invalid Station: Even if a device station is disconnected during a data link, the master station will not detect the device station as a faulty station.	• No Setting • Reserved Station • Error Invalid Station (Default: No setting, master station is fixed as empty)
Network Synchronous Communication	Set whether to synchronize each device station with network synchronous communication. (☞ Page 286 Network Synchronous Communication) When "PDO Mapping Setting" is provided for the set device station, the default is "Synchronous". If a module controlled by the motion system is set to "Asynchronous", an error code (3407H) occurs. For modules controlled by the motion system, refer to the following. ☞ Page 530 Specifications of Modules on CC-Link IE TSN Configuration Controlled by the Motion System	• Synchronous • Asynchronous (Default: Varies depending on the set module)
Communication Period Setting	When multiple communication cycles are set, set the cycle of each device station. (☞ Page 292 Communication cycle coexistence)	• Basic Period Setting (default) • Normal-Speed • Low-Speed
Station Information	■Alias Enter the name of a device if required. The name entered is displayed in "Network Status" of the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window. For the extension module of the remote station, the name is not displayed in the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window, even if entered.	Up to 32 one-byte characters (one-byte or two-byte) (Default: Empty)
	■Comment Information entered in "Comment1" on the "Properties" window displayed by right-clicking the module in the list of stations or the network map is displayed.	Up to 32 one-byte characters (one-byte or two-byte) (Default: Empty)
	■Station-specific mode setting Set the station-specific mode of the device station. (Only when the device station supports the station-specific mode.)	The setting varies depending on the set device station.
CC-Link IE TSN Class Setting	Select the CC-Link IE TSN Class of the device for each device station.	• CC-Link IE TSN Class B • CC-Link IE TSN Class A (Default: Automatically judged based on the profile)
Cyclic Transmission Distribution Setting	Set whether or not to perform cyclic transmission distribution. For details on cyclic transmission distribution, refer to the following. ☞ Page 310 Cyclic transmission distribution	• Do not distribute • Distribute (Default: Do not distribute)

*1 If the number of link device points assigned to a station whose CC-Link IE TSN Class is CC-Link IE TSN Class A exceeds the number of points that can be assigned, a link device number of points error (error code: 3AD8H) occurs. For the number of points that can be assigned to CC-Link IE TSN Class A device stations, refer to the following.
☞ Page 156 Number of link devices that can be assigned to a CC-Link IE TSN Class A device station

*2 If "Subnet Mask" is set in "Station No./IP Address Setting" of "Required Settings", the same value is set as default.

Point

- Because a portion of the setting items are not displayed in simple display, when there are deficiencies in setting items that are not displayed, the "Output" window may display a warning or error by selecting [Close with Reflecting the Setting].
  If a warning is displayed, switch to detailed display and correct the items.
- Up to 253 stations with station numbers can be set, and up to 256 stations can be set for network configuration. When using extension modules that support CANopen communication, each module is counted as one station.

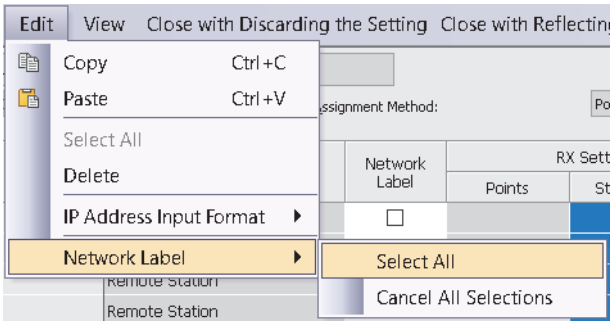
■Network labels

Device stations with "Network Label" selected are target stations for network label generation. (☞ Page 108 Network labels)

	No.	Model Name	Station Type	Network Label
	0	Host Station	Master Station	☐
	1	MR-J5-G	Remote Station	☑
	2	NZ2GN2S1-16D	Remote Station	☑
	3	NZ2GN2S1-16D	Remote Station	☑

Point

When [Edit] ⇨ [Network Label] ⇨ [Select All] is selected, all remote stations can be targeted.



■Number of link devices that can be assigned to a CC-Link IE TSN Class A device station

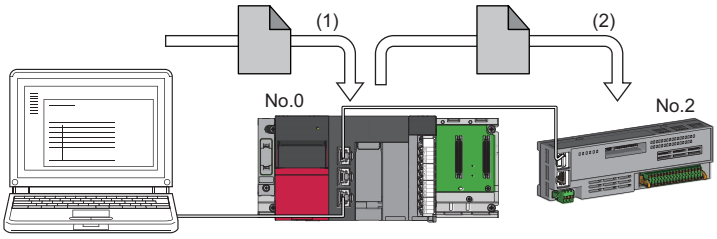
The number of points of link devices assigned to a CC-Link IE TSN Class A device station must satisfy the following two conditional formulas.

- (Number of points of "RY Setting" ÷ 8) + (Number of points of "RWw Setting" × 2) ≤ 1912
- (Number of points of "RX Setting" ÷ 8) + (Number of points of "RWr Setting" × 2) ≤ 1872

Device station parameter automatic setting

This function uses parameters of the device station saved to the master station to set the parameters automatically when the device station is connected or returned to the network.

1. Save parameters of the device station set using the engineering tool to the controller memory or the SD memory card by writing them.
2. When the device station is connected/returned by an operation such as power-on, saved parameters are automatically set from the master station.



(1) Save the parameters of the device station to the controller of the master station.
(2) When the device station is connected/returned, saved parameters are automatically set from the master station to the device station.

Point

- The master station starts data link with the device station after parameters of the device station are automatically set.
- The device station parameter automatic setting is also executed for device stations set as reserved stations.

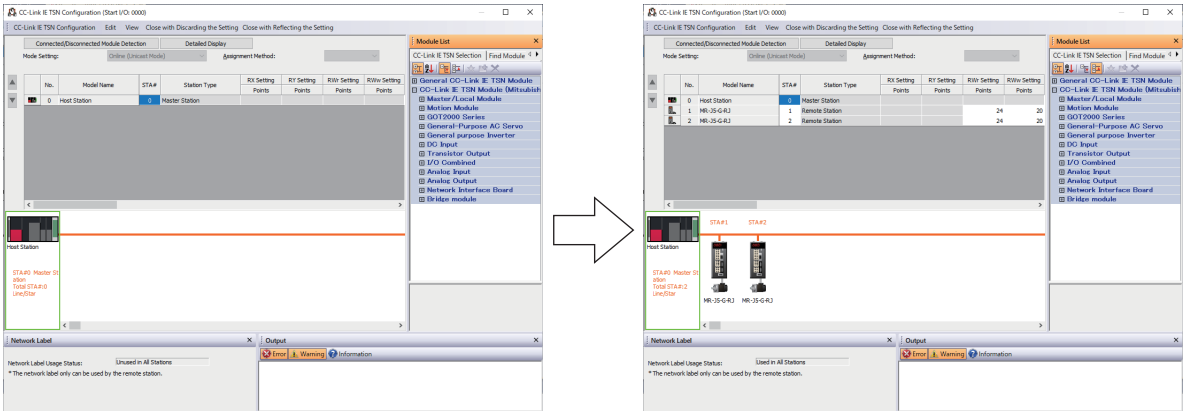
Precautions

- A device station where the device station parameter automatic setting abnormally ended does not start data link, and 'Execution result of device station parameter automatic setting function (station numbers 1 to 253)' (SW0200 to SW020F) turns on. Check 'Detailed execution result of device station parameter automatic setting' (SW0194) and the event history and perform corrective actions according to Action of the error codes list.
- Use 'Execution result of device station parameter automatic setting function (station numbers 1 to 120)' (SW0160 to SW0167) when the station number of the device station to be connected is 120 or less and an existing program is used.
- Check if the checkbox of "Parameter Auto-setting" of the device station is selected in the "CC-Link IE TSN Configuration" window.
- Check if the IP address of the device station in the "CC-Link IE TSN Configuration" window matches the actual IP address of the device station.
- When communication speeds are different between the master station and the station where the device station parameter automatic setting is performed, the device station parameter automatic setting may end abnormally. If the setting ends abnormally, check if the communication speeds are matched.
- When saving the parameters of a device station in the SD memory card, set "Use" for "Device Station Parameter" in "Setting of File/Data Use or Not in Memory Card" in "Memory Card Parameter" of the controller.
- In the "CC-Link IE TSN Configuration" window of all master stations controlled by the controller, ensure that the total number of files for the device station parameter automatic setting targets including extension modules is 2048 or less.
- If the device station parameter automatic setting is completed with an error, connect/return the device station and perform the device station parameter automatic setting again. Or write the device station parameters.

Detection of connected/disconnected devices

Connected device stations are detected and displayed on the "CC-Link IE TSN Configuration" window.

1. Click the [Connected/Disconnected Module Detection] button.
2. When the [Execute] button is clicked according to the instruction on the window, connected device stations are detected and displayed on the "CC-Link IE TSN Configuration" window.



3. Check items in the list of stations and change them as necessary. (☞ Page 154 Setting items)
4. Select [Close with Reflecting the Setting] and close the "CC-Link IE TSN Configuration" window.

Point

Detection of connected/disconnected devices cannot be executed in the following cases.

- The controller is not in the online mode. (☞ Page 1769 Module communication test)
- The actual system configuration is incorrect. (An overlapping IP address or others)
- In "Setting to Use or Not to Use Default Open Port", "CC-Link IE TSN Connection" is set to "Close". (☞ Page 1585 Default Open Port Usage Setting Function)

Connection/Disconnection/Replacement

When the [Connected/Disconnected Module Detection] button is clicked while the saved CC-Link IE TSN configuration is displayed, IP addresses of detected device stations are compared with the saved IP addresses of device stations and displayed as follows by connection/disconnection/replacement.

IP address verification result	Operation	Display	When station numbers of detected device stations are not set
Detected device stations are not in the saved CC-Link IE TSN structure.	Connect	Detected device stations are added. (Settings other than "IP Address", "STA#", and "Station Type" are default) When adding a device, the settings other than IP address, station number, and station type are set to the defaults. (However, if the station number of the detected device has not been set, the station number is also set to the default.*1) Added device stations are displayed in the list of stations in the following order. • Modules other than extension modules: In the order of IP addresses, following disconnected device stations. • Extension modules: In the order of sub-IDs, following connected main modules and extension modules.	A station number is automatically numbered as the youngest unused station number in the range from 1 to 253. The order of automatic numbering is the same as the displayed order in the list of stations (see left).
Device stations in the saved CC-Link IE TSN structure are not detected.	Disconnect	• Modules other than extension modules: Setting of "Reserved/Error Invalid Station" is changed to "Reserved Station". • Extension modules: Are deleted.	—
Detected device stations are in the saved CC-Link IE TSN structure.	Replace	When parameters between a detected device station and a saved CC-Link IE TSN structure mismatch, the parameters are replaced with the parameters of the detected device station. When the model name, model version, and station type are mismatched, the following settings are inherited. • "RX Setting", "RY Setting", "RWr Setting", "RWw Setting", "LB Setting", "LW Setting" • "IP Address" of the master station • "Subnet Mask" • "Default Gateway" • "Reserved/Error Invalid Station" (Note that if "Reserved Station" is set, the setting will change to the default.) • "Network Synchronous Communication" • "Communication Period Setting" If only the station number is mismatched, only the station number is reflected, and all the settings are inherited. (Note that if the station number of the detected device has not been set, the station number of the device before replacement is inherited.)	The station number takes over the station number of the saved CC-Link IE TSN structure.

*1 A station number is automatically numbered as the youngest unused station number in the range from 1 to 253. If the numbers do not match between the automatically numbered station and the station numbered by the detected device station, take either of the following actions.

· Change the station number in "Network Configuration Settings" of the master station to the same value as the station number set by the device station.

· Change the station number of the device station to the same value as the station number set in "Network Configuration Settings" of the master station.

Precautions

- When the station number is set in the device station using the CC-Link IE TSN structure and parameters are written in the controller, the station number of the device station is held in the master station. When parameters are not to be written in the controller, they are saved in the CC-Link IE TSN structure as device stations with the station number not set.
- In "Setting to Use or Not to Use Default Open Port", when "CC-Link IE TSN Connection" is set to "Close", even if this function is executed, device stations cannot be detected and the network configuration settings are not automatically configured.
- If the actual system configuration is incorrect, executing this function may not automatically set some or all device stations. Check that nothing is incorrect in the system configuration before executing.

Point

Register the profile of the target device to detect in advance.
If the profile is not registered, the following may be displayed.
- "Model Name" is "General Remote Station" or "General Extension Module".
- "Station Type" is "Remote Station" or "Extension Module".

For how to register a profile, refer to the following.
GX Works3 Operating Manual

Restriction

Even when the profile is registered, if modules that are not available for detection of connected/disconnected devices are used, "Model Name" and "Station Type" are not displayed correctly.

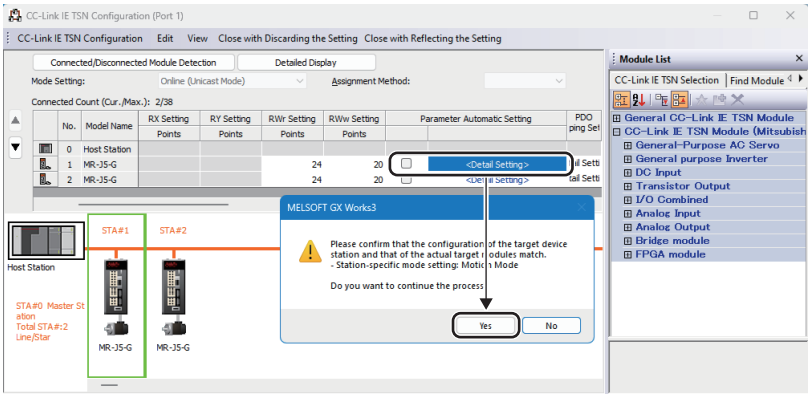
Parameter processing of a device station

The processing is to read and save the parameters from the device station, and to write the saved parameters to the device station.

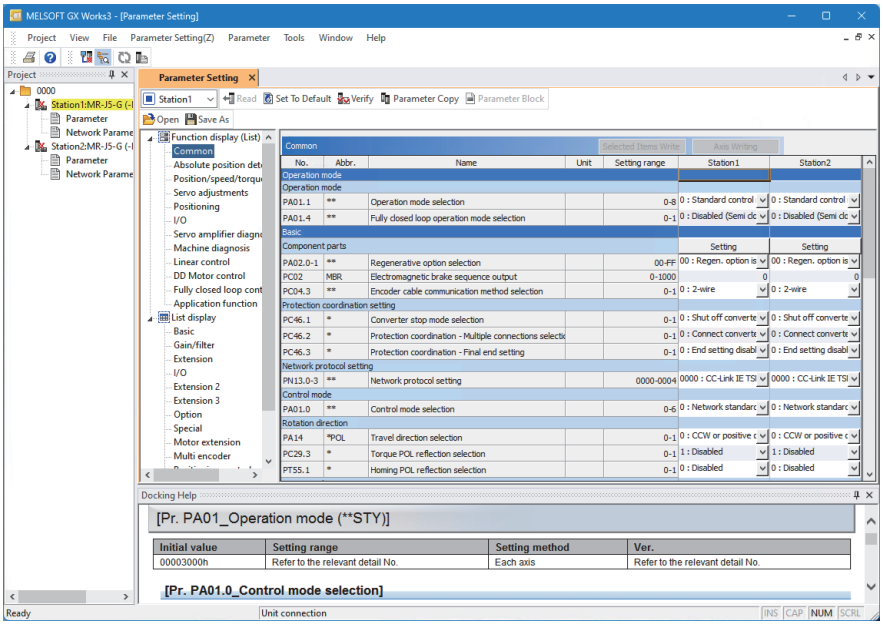
Also, it automatically sets parameters of the device station from the master station. (☞ Page 157 Setting items)

For the MR-J5(W)-G

[Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



Select "Parameter Automatic Setting" ⇨ <Detailed Setting> to display the "Parameter Setting" window.



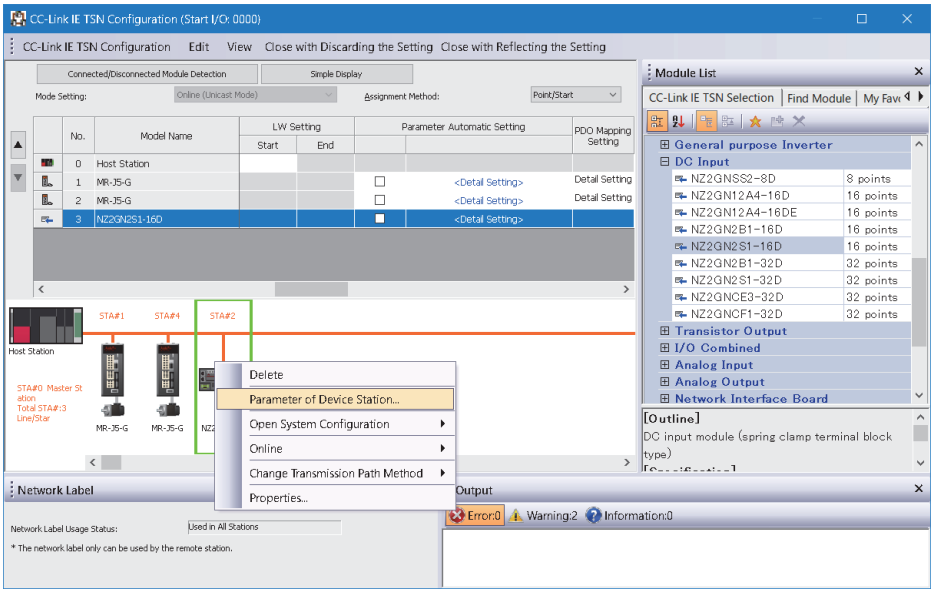
In addition to setting device station parameters, the following can be performed. For details on the window, refer to [Help].

- Reading and writing parameters for the MR-J5(W)-G during data link (during online)
- Saving the MR-J5(W)-G parameters to a separate file/Reading them from the file where they have been saved

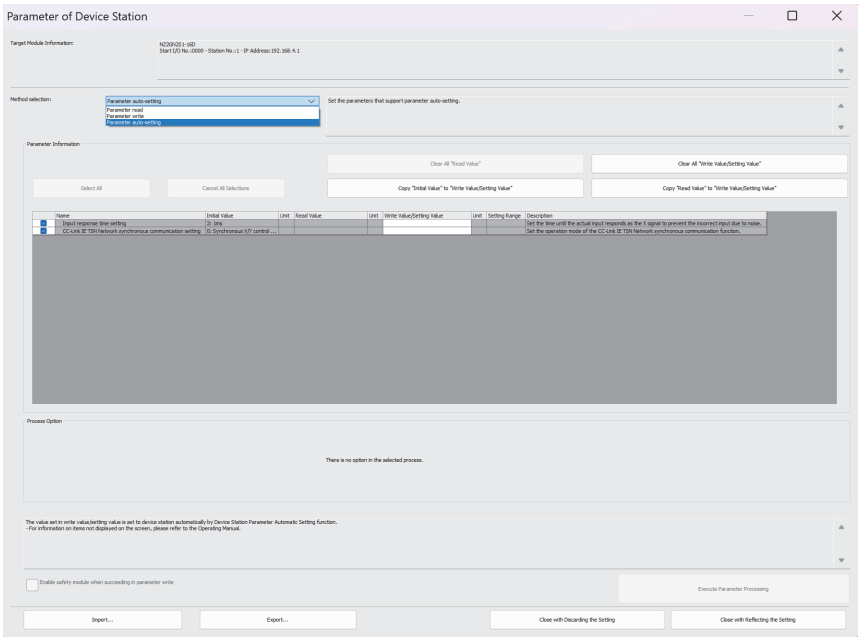
When the settings are completed, close the "Parameter Setting" window by selecting [Project] ⇨ [Exit MR Configurator2] or clicking the [Close] button in the upper right corner of the window.

For modules other than the MR-J5(W)-G

Navigation window ⇨ "Parameter" ⇨ "Module Information" ⇨ Target module ⇨ "Basic Settings" ⇨ "Network Configuration Settings"



Select and right-click the device station, and select "Parameter of Device Station" to display the "Parameter of Device Station" window.



Item		Description
Target Module Information		Information for the selected device stations is displayed.
Method selection		Select processing to be executed for selected device stations. • Parameter auto-setting: Automatically set contents of "Write Value/Setting Value" to the device station. (☞ Page 157 Setting items) • Parameter read: Read parameters from the selected device station. • Parameter write: Write parameters to the selected device station.
Parameter Information	[Clear All "Read Value"] button	Click to clear all setting details that were read using "Parameter read".
	[Clear All "Write Value/Setting Value"] button	Click to clear all setting details that are written using "Parameter write".
Processing Option		When there are options for processing selected by "Method selection", setting items are displayed.
[Import] button		Read contents of parameter processing created in a CSV file.
[Export] button		Output contents of parameter processing set in this window to a CSV file.

Clearing a saved parameter

■Procedure

When returning the saved parameters of a not-required device station to the not-set status, perform the following procedure.

1. If the saved parameters are to be saved, output them in a CSV file using the [Export] button.
2. Delete not-required device stations from the list of stations.
3. Select the same module as the deleted device station in "Module List", and drag it to the list of stations or the network map.

■Conditions

Saved parameters of a device station can be cleared under the following conditions.

When saved parameters are cleared, execute "Parameter auto-setting" or "Parameter read" in the "Parameter of Device Station" window and read the parameters of the device station.

Item	Operation	Description
"CC-Link IE TSN Configuration" window	Open the "CC-Link IE TSN Configuration" window.	When there is no device station with a station number that matches the saved parameter information in the "CC-Link IE TSN Configuration" window, the saved parameters of the relevant device station are skipped. Skipped parameters of the device station are deleted.
	Reflect the setting and close the window.	Saved parameters of a device station that is not in the actual system configuration are cleared.
	Execute detection of connected/disconnected devices.	All saved parameters are cleared.
	Change the function version in the "Properties" window.	When the "Properties" window is closed, saved parameters are cleared.
"Parameter of Device Station" window	Open the "Parameter of Device Station" window.	Saved parameters that mismatch the relevant device station are skipped. Clicking the [Close with Reflecting the Setting] button in the above state clears the skipped saved device station parameters.
Module Parameter	Manually delete "Network Configuration Settings" to apply.	Parameters of "Network Configuration Settings" return to default.
	Change "Station Type" or set parameters that do not exist.	
System Parameter	Divert system parameters from another project.	Parameters of the device station are not diverted.
Module Configuration	Delete a module and check.	Parameters are deleted together with the module.
Navigation window	Delete a module.	
Read from PLC	Read module parameters that have a different network configuration and the same start I/O number.	Parameters are overwritten.
Navigation window	Import the data of the controller to take network settings.	
MELSOFT Navigator	Reflect the parameters.	Saved parameters are cleared.

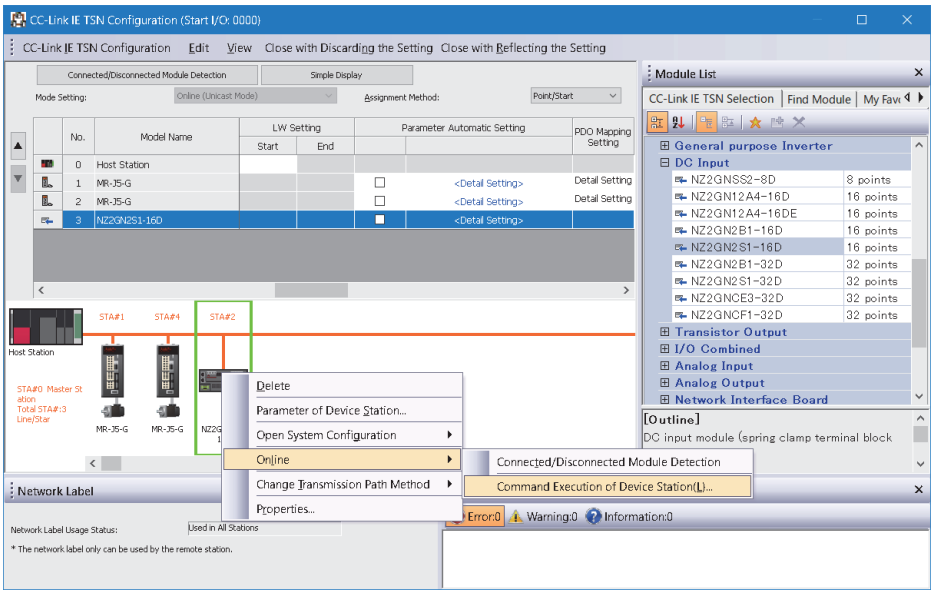
Precautions

If writing parameters to the device station is completed with an error, write the parameters to the device station again.

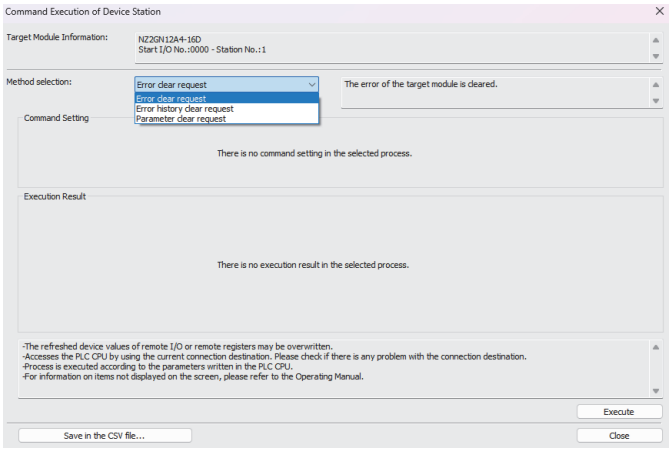
Command execution to device stations

Commands to a device station (Error clear request, Error history clear request) are executed.

Navigation window ⇨ "Parameter" ⇨ "Module Information" ⇨ Target module ⇨ "Basic Settings" ⇨ "Network Configuration Settings"



Select and right-click the device station, and select "Command Execution of Device Station" from "Online" to display the "Command Execution of Device Station" window.



Item	Description
Target Module Information	Information for the selected device stations is displayed.
Method selection	Select the processing to be executed for the selected device stations. • Error clear request • Error history clear request
Command setting	When there are command settings for the processing selected by "Method selection", setting items are displayed.
Execution Result	Execution results of the processing selected in "Method selection" are displayed.
[Save in the CSV file] button	Outputs the contents of this window to a CSV file.

Precautions

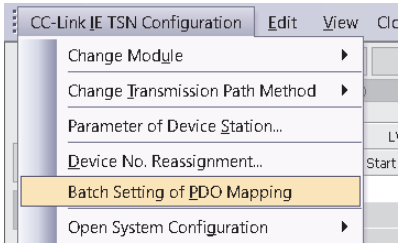
If the command execution to the device station is completed with an error, execute the command to the device station again.

PDO mapping setting

Set the PDO mapping to the station that supports CANopen communications.
When an extension module such as the multi-axis servo amplifier having PDO mapping information is connected, the maximum number of connectable modules varies depending on the number of axes.

"Batch Setting of PDO Mapping"

Set the default PDO mapping to the target device stations at once.



1. Click "Batch Setting of PDO Mapping".

   "Basic Settings" ⇨ "Network Configuration Settings" ⇨ [CC-Link IE TSN Configuration] ⇨ [Batch Setting of PDO Mapping]

2. Check the confirmation message appeared, then click the [OK] button.
3. When the completion window of "Batch Setting of PDO Mapping" appears, click the [OK] button.

Restriction

The PDO mapping is not set to the target device stations in the following cases:

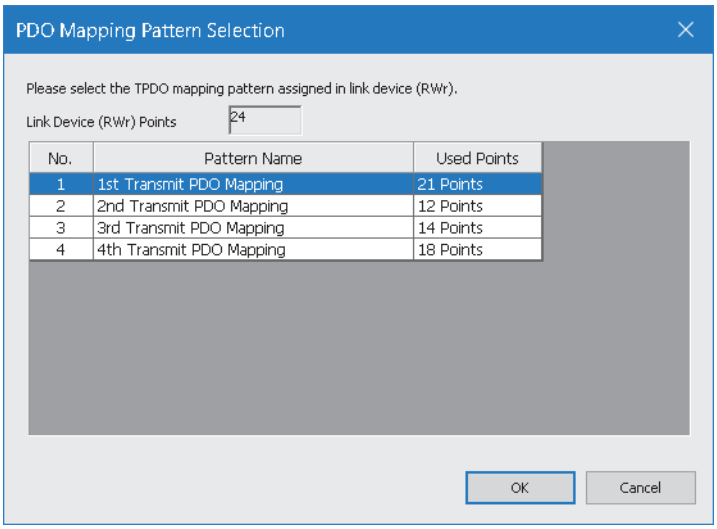
- A station that the PDO mapping can be set does not exist.
- The numbers of points of "RWr Setting" and "RWw Setting" are less than the points used in the default pattern.
- The setting is performed when "RWr Setting" and "RWw Setting" are blanks, and the checkbox of "Batch set default pattern only when PDO mapping is unset device station" is not selected.

"PDO Mapping Setting"

Set the PDO mapping of the target device stations individually.

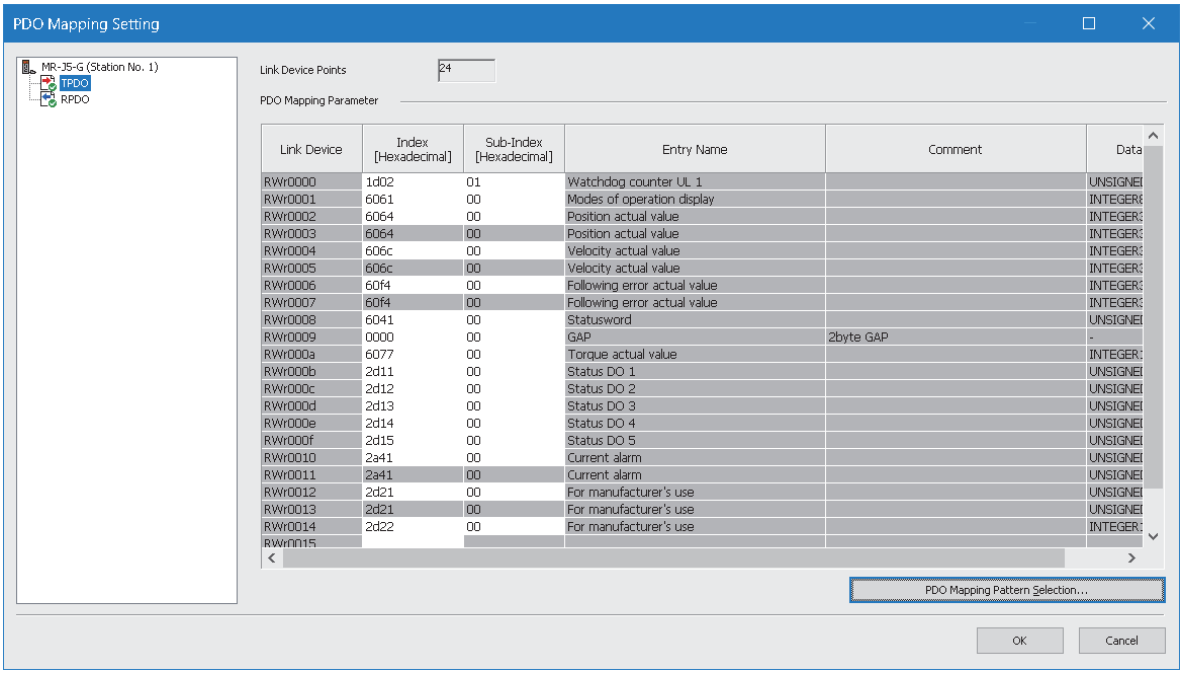
"Basic Settings" ⇨ "Network Configuration Settings" ⇨ "PDO Mapping Setting" ⇨ Double-click <Detailed Setting> of the target device station.

1. Select a PDO mapping pattern of TPDO assigned in the link device (RWr). Click the [OK] button.



2. Select a PDO mapping pattern of RPDO assigned in the link device (RWw). Click the [OK] button.

3. Check the selected PDO mapping pattern.



4. Click the [OK] button to close "PDO Mapping Setting".

Restriction

The PDO mapping is not set to the target device stations in the following cases:

- The number of points in "RWr Setting" is one or more points and an entry is not assigned in TPDO.
- The number of points in "RWw Setting" is one or more points and an entry is not assigned in RPDO.
- A line where "Sub-Index" is blank though a value has been entered in "Index" exists.
- Entries are assigned out of the link device range.
- The same entry is assigned to the multiple link devices.

Precautions

- Ensure that the number of set entries does not exceed 64.
- The number of link devices to which one entry is assigned varies depending on the data length (data type) of the entry. Data length of one entry ÷ 16 bits = Number of link devices (The operation result is rounded up to the nearest integer). For the GAP for 2-byte alignment, assign one entry to one link device.
- When using the watchdog counter, set an object of the watchdog counter for both TPDO and RPDO. If the watchdog counter is not used, delete any objects of the watchdog counter from both TPDO and RPDO. (☞ Page 289 Watchdog counter)
- When writing is performed to objects assigned to a link device in the PDO mapping setting using SDO communication, the written value is overwritten by PDO communication. To write the value using SDO communication, delete the setting of the corresponding object from the PDO mapping setting.

Ex.

In the following case, 4 entries are assigned to 5 link devices.

PDO Mapping Parameter

Link Device	Index [Hexadecimal]	Sub-Index [Hexadecimal]	Entry Name	Comment	Data Type
RWw001e	1d01	01	Watchdog counter DL 1		UNSIGNED16
RWw001f	6060	00	Modes of operation		INTEGER8
RWw0020	607a	00	Target position		INTEGER32
RWw0021	607a	00	Target position		INTEGER32
RWw0022	0000	00	GAP	2byte GAP	-

Entry 1: 16 ÷ 16 = 1 link device (RWw0030)
Entry 2: 8 ÷ 16 = 0.5 rounded up → 1 link device (RWw0031)
Entry 3: 32 ÷ 16 = 2 link devices (RWw0032, RWw0033)
Entry 4: GAP = 1 link device (RWw0034)

- For a multi-axis servo amplifier, up to eight axes can be set to a single module. If nine or more axes are set, an error occurs, and a parameter error (multidrop number) (error code: D658H) is stored in SW004C (parameter setting status).

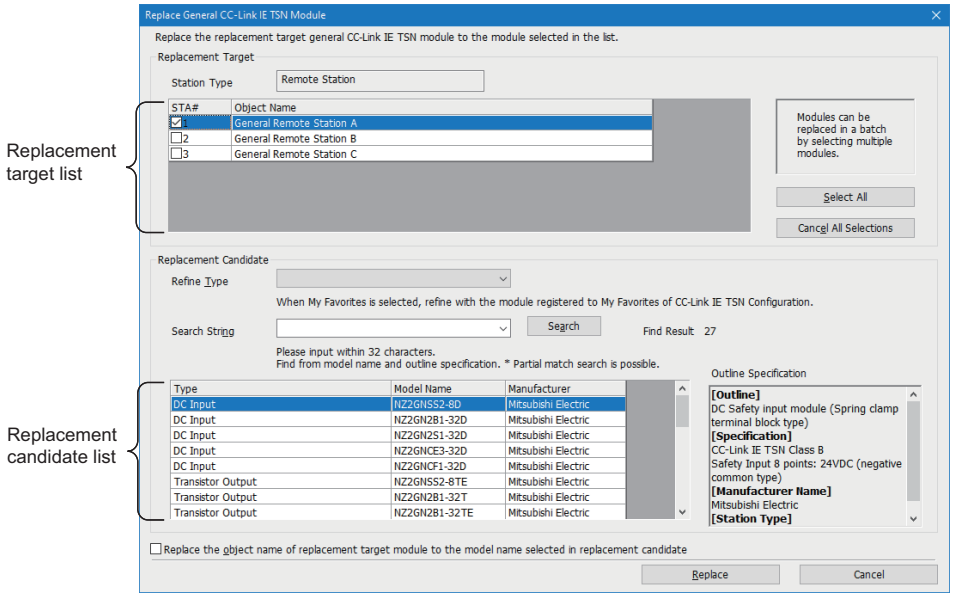
Change of module

This section describes how to replace a general CC-Link IE TSN module with a module (device station) and vice versa.

A general CC-Link IE TSN module → A module (device station)

Replace a general CC-Link IE TSN module with a module (device station).

Right-click a general CC-Link IE TSN module from the list of stations on the "CC-Link IE TSN Configuration" window. ⇨ [Change Module] ⇨ Click [Replace General CC-Link IE TSN Module].



Item		Description
Replacement Target	Station Type	Displays the station type of the general CC-Link IE TSN module selected from the list of stations on the "CC-Link IE TSN Configuration" window.
	Replacement target list	Displays general CC-Link IE TSN modules whose station types are the same as the general CC-Link IE TSN modules selected from the list of stations on the "CC-Link IE TSN Configuration" window. By selecting the checkboxes, multiple general CC-Link IE TSN modules can be replaced.
	[Select All] button	Selects all checkboxes in the replacement target list.
	[Cancel All Selections] button	Deselects all checkboxes in the replacement target list.
Replacement Candidate	Refine Type	Narrows the replacement candidates in the list by types.
	Search String	Searches the input string from models and outline specifications.
	[Search] button	Displays the replacement candidate list based on the conditions that was set in "Refine Type" and "Search String".
	Replacement candidate list	The modules to be replaced are displayed.
	Outline Specification	The outline specifications of the module selected in the replacement candidate list are displayed.
	Replace the object name of replacement target module with the model name selected from replacement candidate	By selecting the checkbox, the object name of the replacement target module is replaced with the module model name selected from the replacement candidate.
	[Replace] button	Replaces the module selected in the replacement target list with the module selected in the replacement candidate list.
	[Cancel] button	Cancels the replacement processing and close the window.

A module (device station) → A general CC-Link IE TSN module

Replace a module (device station) with a general CC-Link IE TSN module of the same station type.

Right-click a device station in the list of stations on the "CC-Link IE TSN Configuration" window. ⇨ [Change Module] ⇨ Click [Change to General CC-Link IE TSN Module].

Device number reassignment

Assign the device numbers successively to the link device of the specified target station.

Point

This setting shortens the communication cycle interval by assigning device numbers by selecting "Communication Period Interval Shortening Assignment" in "Assignment Method". This setting also allows consecutive refresh devices to be more easily set in the refresh settings, creating a good potential of improvement in refresh performance.

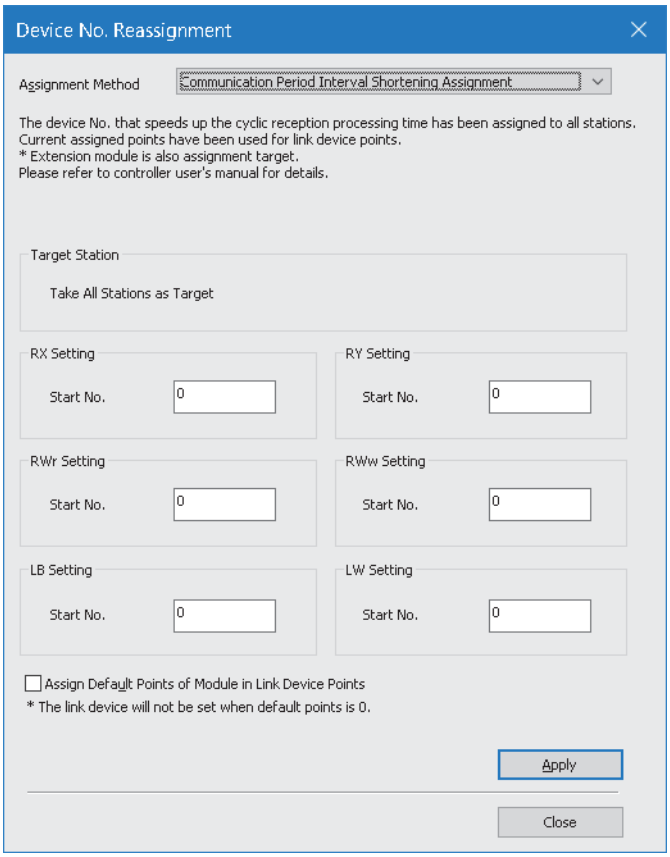
If "Communication Period Interval Shortening Assignment" is selected in "Assignment Method", the device numbers for the RX setting, RY setting, RWr setting, and RWw setting of the device station set in the network configuration settings are assigned consecutively in the following order.

Assignment order	"Network Synchronous Communication"	"Communication Period Setting"
1	"Asynchronous"	"Basic Period"
2	"Asynchronous"	"Normal-Speed"
3	"Asynchronous"	"Low-Speed"
4	"Synchronous"	"Basic Period"
5	"Synchronous"	"Normal-Speed"
6	"Synchronous"	"Low-Speed"

Operating procedure

1. Display "Device No. Reassignment".

[CC-Link IE TSN Configuration] ⇨ [Device No. Reassignment]



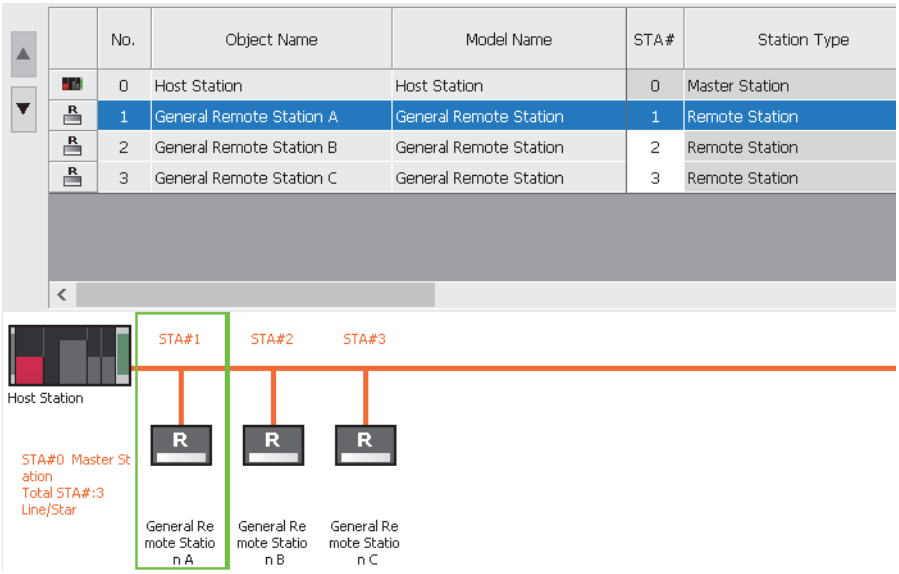
2. Check that "Communication Period Interval Shortening Assignment" is selected in "Assignment Method", and click the [Apply] button.

When the [Apply] button is clicked with the checkbox of "Assign Default Points of Module in Link Device Points" selected, the default points of each module are reassigned. However, if a default number of points is 0, the number of points of corresponding link device is not assigned.

Object name display

The object name of the module displayed in the list of stations on the "CC-Link IE TSN Configuration" window is displayed.

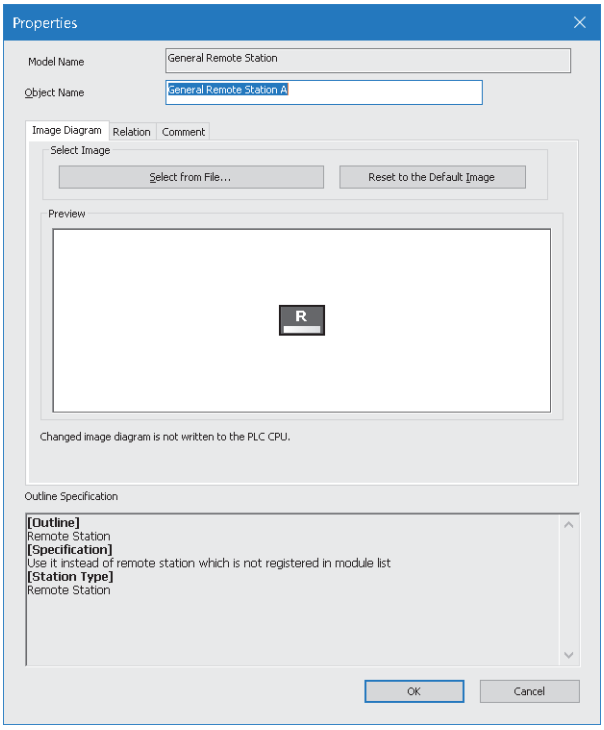
[View] ⇨ [Object Name Display]



Change of object name

Changing object names helps users to identify each module on the "CC-Link IE TSN Configuration" window.

1. In the network map on the "CC-Link IE TSN Configuration" window, right-click the module whose object name is changed and click "Properties".

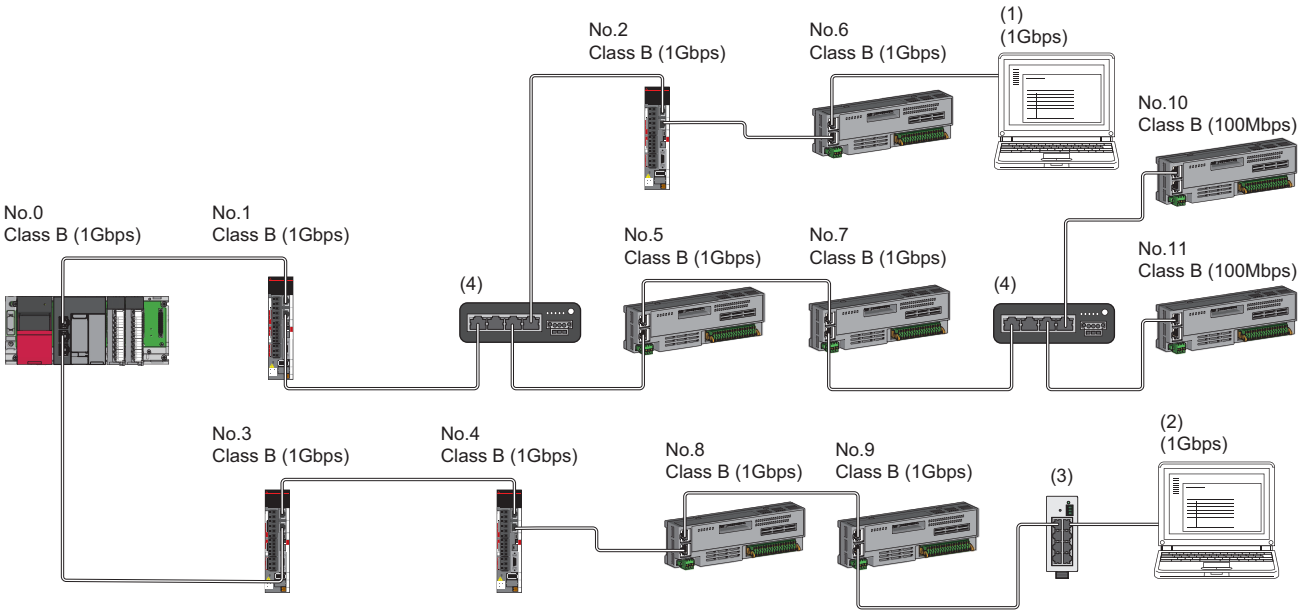


2. Change "Object Name".

3. Click the [OK] button.

9.5 Structure with CC-Link IE TSN Class B Devices Only

This section describes the system configuration when "Connection Device Information" under "Basic Settings" of the engineering tool is set to "CC-Link IE TSN Class B Only".
When "Connection Device Information" under "Basic Settings" of the master station is set to "CC-Link IE TSN Class B Only", up to 254 stations (one master station and 253 device stations) can be connected.



No.0: Master station
No.1 to 11: Remote stations
(1), (2): Ethernet devices
(3) Ethernet switch
(4) Industrial switch (CC-Link IE TSN Class B certified)
Class B: CC-Link IE TSN Class B device

Point

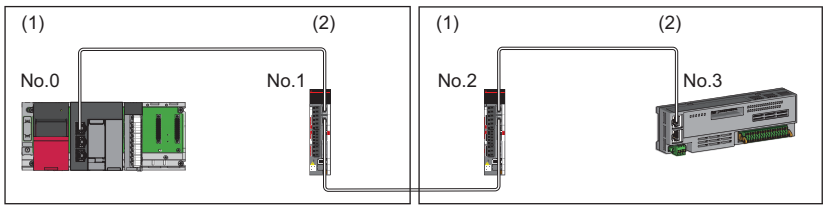
For the parameter settings related to CC-Link IE TSN system configuration, refer to the following.
☞ Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings)

The availability of connection of network configuration devices varies depending on the communication mode and communication speed.

- Unicast mode

☞ Page 172 When the communication speed for the master station is set to 1Gbps
☞ Page 172 When the communication speed for the master station is set to 100Mbps

The following terms are used to describe the terms in the tables referenced.



No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Device on the master station side (The master station or a device near the master station)
(2) Device on the end side (A device far from the master station)

Structure of unicast mode

The following table lists the availability of connection with a network configuration device when "Communication Mode" under "Application Settings" is set to "Unicast".

When the communication speed for the master station is set to 1Gbps

The following table lists the availability of connection with a network configuration device when "Communication Speed" for the master station is set to "1Gbps".

○: Connection available, △: Connection available via an Ethernet switch, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)			
		Remote station (CC-Link IE TSN Class B device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1	○SH	△SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1*2	○SH	△SH
	100Mbps	×	○S*1*2	×	○SH

*1 For a device station with a communication speed of 100Mbps, set "Communication Period Setting" to "Low-Speed".

*2 A connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps. (☞ Page 189 Calculation of the total cyclic data size)

Precautions

When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

When the communication speed for the master station is set to 100Mbps

The following table lists the availability of connection with a network configuration device when "Communication Speed" for the master station is set to "100Mbps".

○: Connection available, △: Connection available via an Ethernet switch, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)			
		Remote station (CC-Link IE TSN Class B device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	100Mbps	×	○S*1	×	○SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	×	×	×	×
	100Mbps	×	○S*1	×	○SH

*1 For a device station with a communication speed of 100Mbps, set "Communication Period Setting" to "Basic Period" or "Normal-Speed".

Precautions

When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

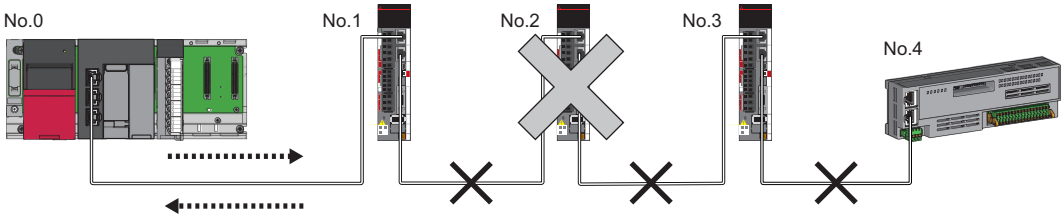
Structure with modules on CC-Link IE TSN only

Connection with modules on CC-Link IE TSN only

■Line topology

The network is configured in a line topology. An industrial switch (CC-Link IE TSN Class B certified) is not required for connection.

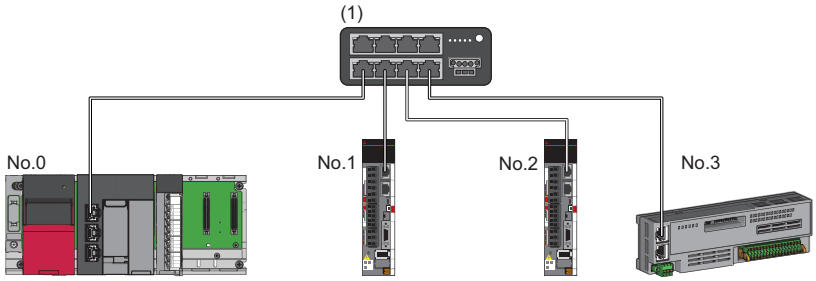
When an error occurs in a device station, the stations connected after the faulty station will be disconnected.



No.0: Master station
No.1 to 4: Remote stations

■Star topology

The modules are connected in a star topology via an industrial switch (CC-Link IE TSN Class B certified). This allows devices to be added easily.

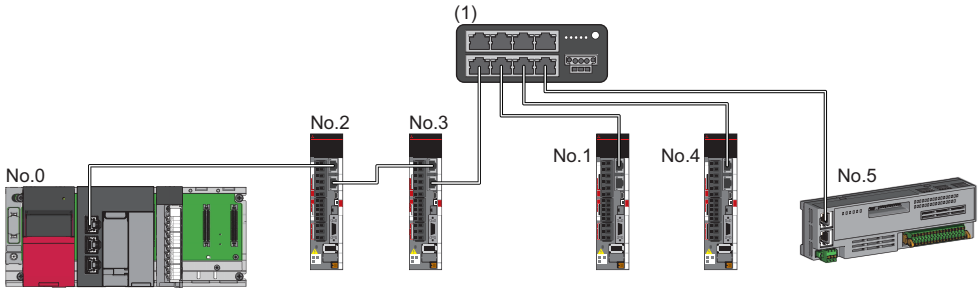


No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)

Even when an error occurs in a device station, a data link can be continued with the stations that are operating normally.

■Coexistence of line and star topologies

Line and star topologies are mixed.



No.0: Master station
No.1 to 5: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)

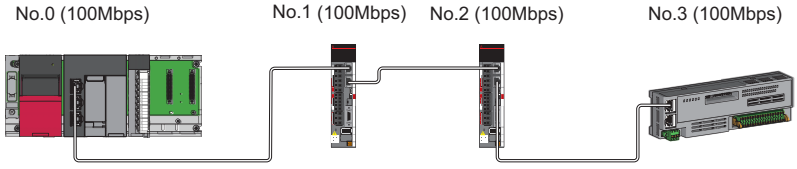
Connection with modules on CC-Link IE TSN with a communication speed of 100Mbps

This section describes the network topology when "Communication Speed" under "Application Settings" is set to "100Mbps".

■Line topology

The network is configured in a line topology.

- Ensure that the communication speed of each module is the same when connecting them.
- When connecting modules with different communication speeds, connect the modules via an industrial switch (CC-Link IE TSN Class B certified).

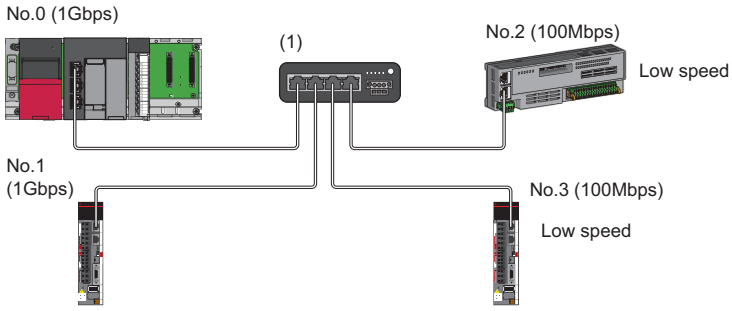


No.0: Master station
No.1, No.2, and No.3: Remote stations

■Star topology

The modules are connected in a star topology via an industrial switch (CC-Link IE TSN Class B certified).

- When the master station with a communication speed of 1Gbps and a remote station with a communication speed of 100Mbps exist in the structure, set "Communication Period Setting" to "Low-Speed" for the remote station with a communication speed of 100Mbps.

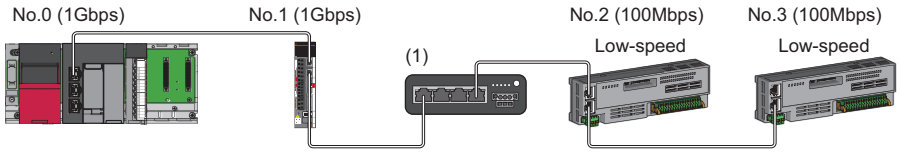


No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)

■Coexistence of line and star topologies

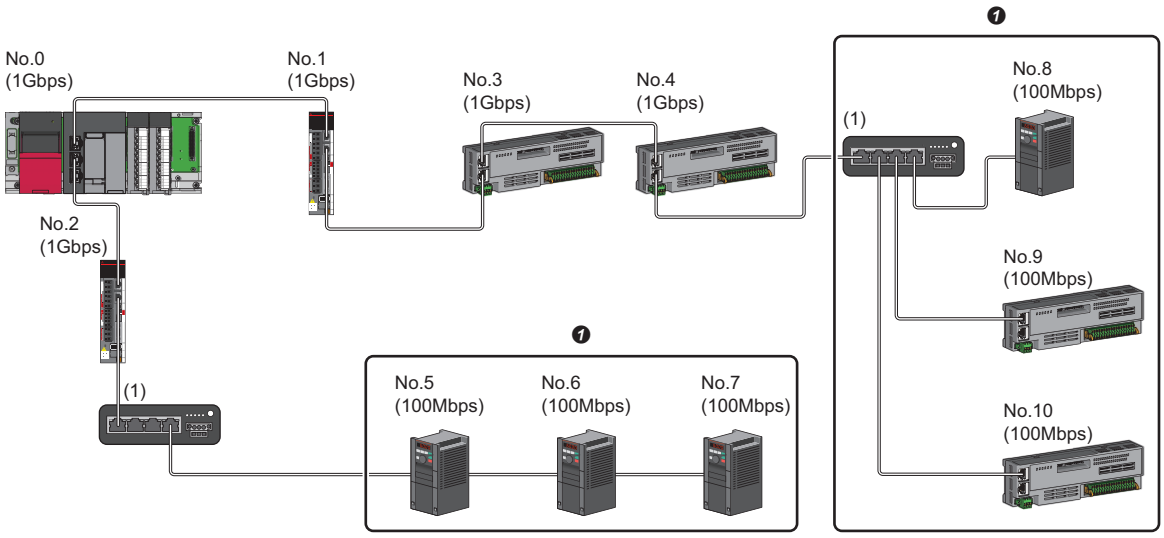
Line and star topologies can be mixed in the same network configuration.

- When the master station with a communication speed of 1Gbps and a device station with a communication speed of 100Mbps exist in the structure, set "Communication Period Setting" to "Low-Speed" for the device station with a communication speed of 100Mbps.



No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)

- When the communication speed of the master station is 1Gbps, a connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps.



No.0: Master station
No.1 to 10: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
❶ Set the total cyclic data size within 2K bytes.

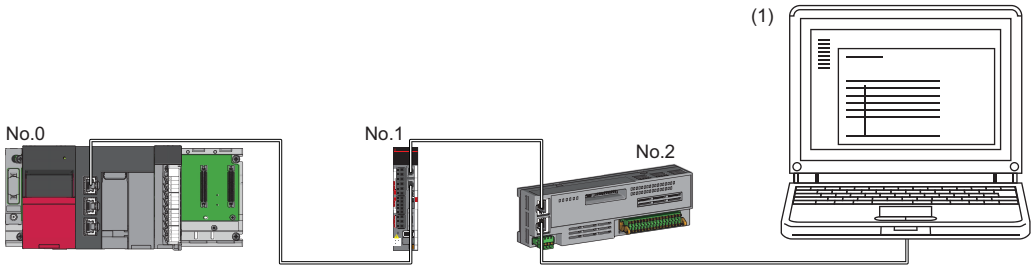
Structure with modules on CC-Link IE TSN and Ethernet devices

Connection with modules on CC-Link IE TSN and Ethernet devices

■Line topology

The network with modules and devices is configured in a line topology. An industrial switch (CC-Link IE TSN Class B certified) is not required for connection.

Connect Ethernet devices to the end of the network.



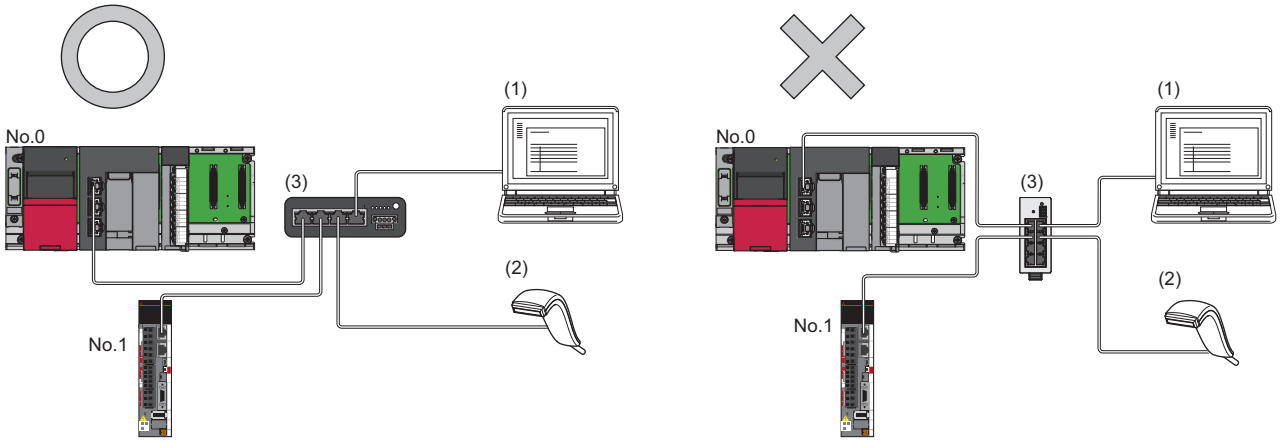
No.0: Master station
No.1 and No.2: Remote stations
(1) Ethernet device (such as a personal computer)

When an error occurs in a device station, the stations connected after the faulty station will be disconnected.

■Star topology

The modules are connected in a star topology via an industrial switch (CC-Link IE TSN Class B certified).

Device stations cannot be connected with an Ethernet switch other than (3) industrial switch (CC-Link IE TSN Class B certified). Line and star topologies should be mixed in the same network configuration.

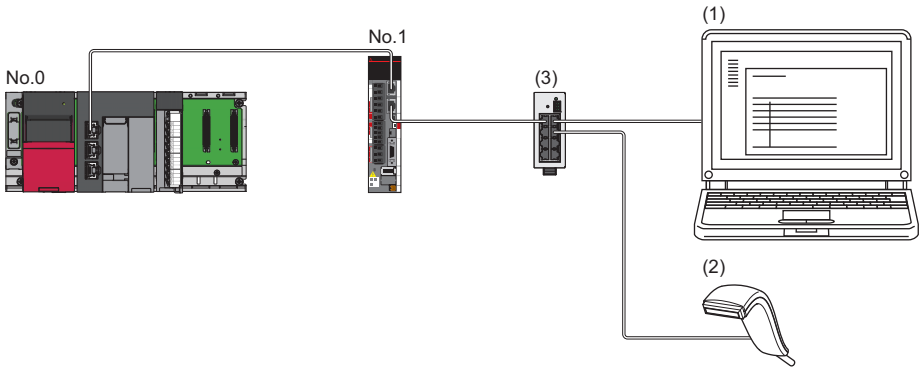


No.0: Master station
No.1: Remote station
(1), (2): Ethernet devices
(3) Industrial switch (CC-Link IE TSN Class B certified)

■Coexistence of line and star topologies

Line and star topologies can be mixed in the same network configuration.

Connect Ethernet devices to the end of the network.



No.0: Master station
No.1: Remote station
(1), (2): Ethernet devices
(3) Ethernet switch

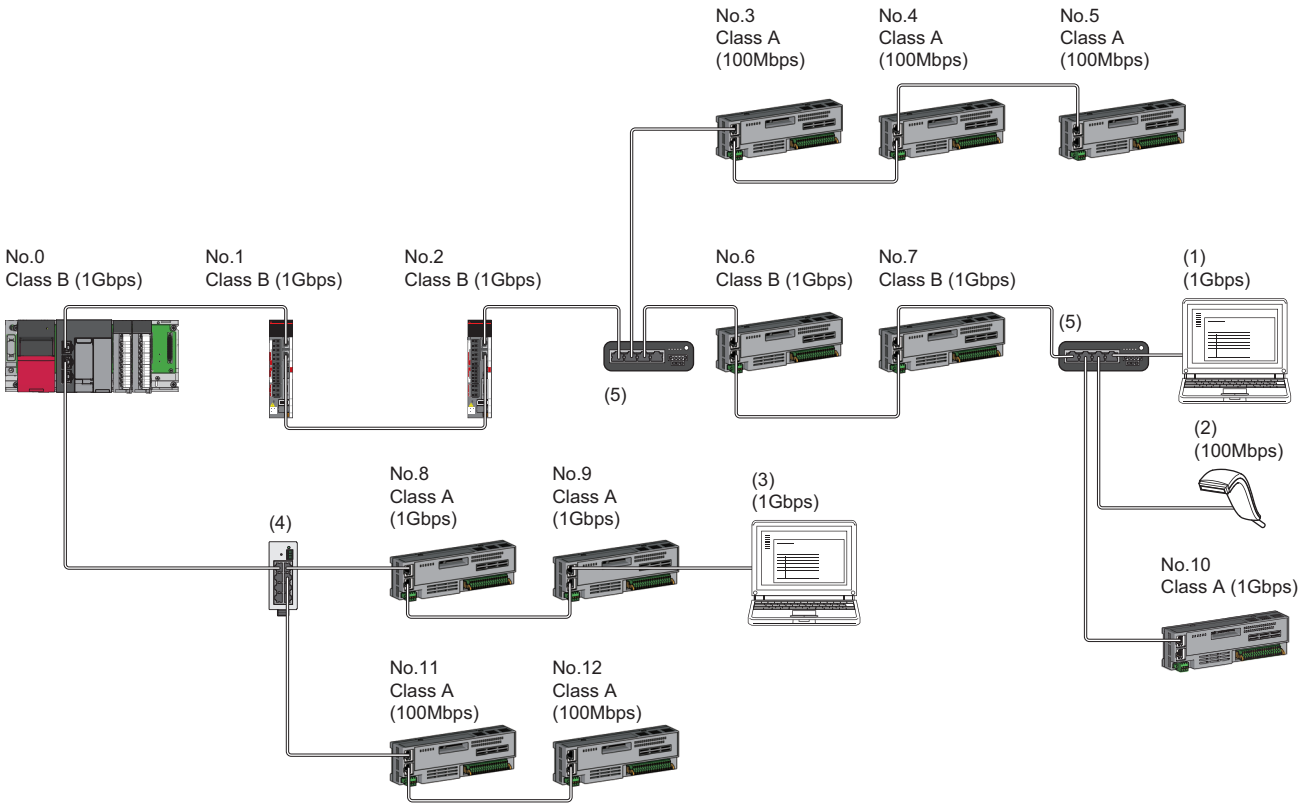
9.6 Structure with CC-Link IE TSN Class B/A Devices

The following diagram shows the system configuration under the conditions below:

- CC-Link IE TSN module is protocol version 2.0 only.
- "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" is set for "Connection Device Information" under "Basic Settings" in the engineering tool

If there is a CC-Link IE TSN module that is not protocol version 2.0, refer to the following.

☞ Page 2129 Connection of CC-Link IE TSN Class B/A Devices



No.0: Master station
No.1 to 12: Remote stations
(1), (2), and (3): Ethernet devices
(4) Industrial switch (CC-Link IE TSN Class A certified)
(5) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

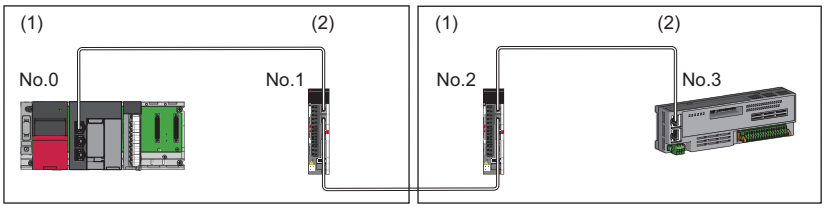
The availability of connection of network configuration devices varies depending on the communication mode and communication speed.

- Unicast mode

☞ Page 179 When the communication speed for the master station is set to 1Gbps

☞ Page 179 When the communication speed for the master station is set to 100Mbps

The following terms are used to describe the terms in the tables referenced.



No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Device on the master station side (The master station or a device near the master station)
(2) Device on the end side (A device far from the master station)

Structure of unicast mode

The following table lists the availability of connection with a network configuration device when "Communication Mode" under "Application Settings" is set to "Unicast".

When the communication speed for the master station is set to 1Gbps

The following table lists the availability of connection with a network configuration device when "Communication Speed" for the master station is set to "1Gbps".

○: Connection available, △: Connection available via an Ethernet switch, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)					
		Remote station (CC-Link IE TSN Class B device)		Remote station (CC-Link IE TSN Class A device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1	○SH	△SH*1	○SH	△SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1*2	○SH	△SH*1	○SH	△SH
	100Mbps	×	○S*1*2	×	○SH*1*2	×	○SH
Remote station (CC-Link IE TSN Class A device)	1Gbps	×	×	○SH	△SH*1	○SH	△SH
	100Mbps	×	×	×	△SH*1	×	○SH

*1 For a device station with a communication speed of 100Mbps, set "Communication Period Setting" to "Low-Speed".

*2 A connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps. (☞ Page 189 Calculation of the total cyclic data size)

Precautions

When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

When the communication speed for the master station is set to 100Mbps

The following table lists the availability of connection with a network configuration device when "Communication Speed" for the master station is set to "100Mbps".

○: Connection available, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)					
		Remote station (CC-Link IE TSN Class B device)		Remote station (CC-Link IE TSN Class A device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	100Mbps	×	○S*1	×	○SH	×	○SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	×	×	×	×	×	×
	100Mbps	×	○S*1	×	○SH	×	○SH
Remote station (CC-Link IE TSN Class A device)	1Gbps	×	×	×	×	×	×
	100Mbps	×	×	×	○SH	×	○SH

*1 Set "Communication Period Setting" to "Basic Period" or "Normal-Speed".

Precautions

When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

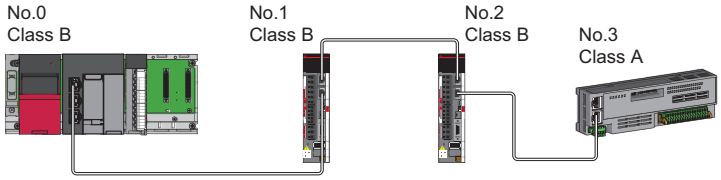
Structure with modules on CC-Link IE TSN only

Connection with modules on CC-Link IE TSN only

■Line topology

The network is configured in a line topology.

- When connecting a CC-Link IE TSN Class A device, connect to the end of the CC-Link IE TSN Class B device.

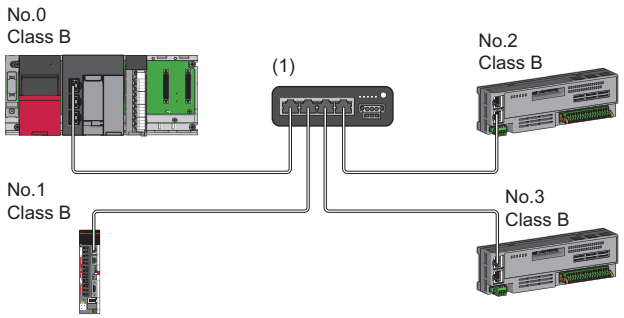


No.0: Master station
No.1, No.2, and No.3: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Star topology

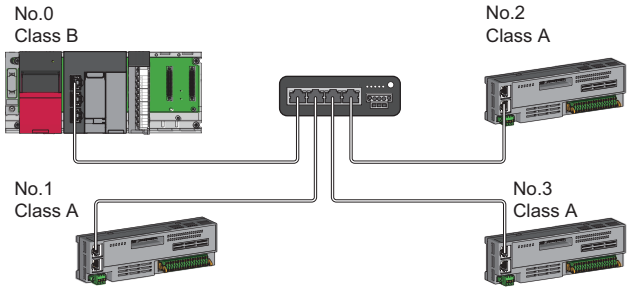
Modules are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

- When connecting a CC-Link IE TSN Class B device in a star topology, use an industrial switch (CC-Link IE TSN Class B certified).



No.0:Master station
No.1, No.2, and No.3: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
Class B: CC-Link IE TSN Class B device

- When connecting a CC-Link IE TSN Class A device to a CC-Link IE TSN Class B device or a CC-Link IE TSN Class A device to another CC-Link IE TSN Class A device in a star topology, connect them via an industrial switch (CC-Link IE TSN certified).

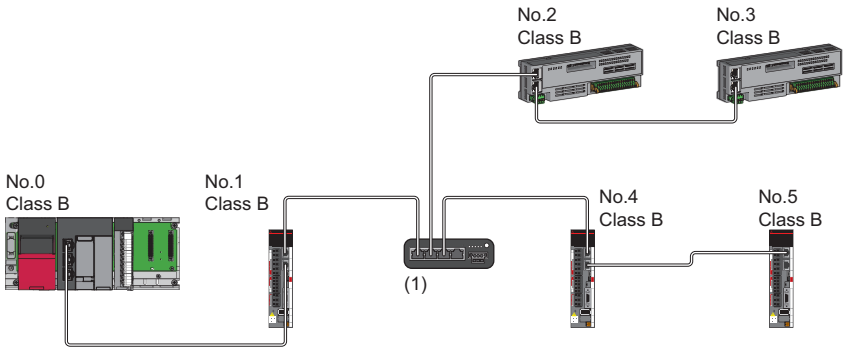


No.0:Master station
No.1, No.2, and No.3: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

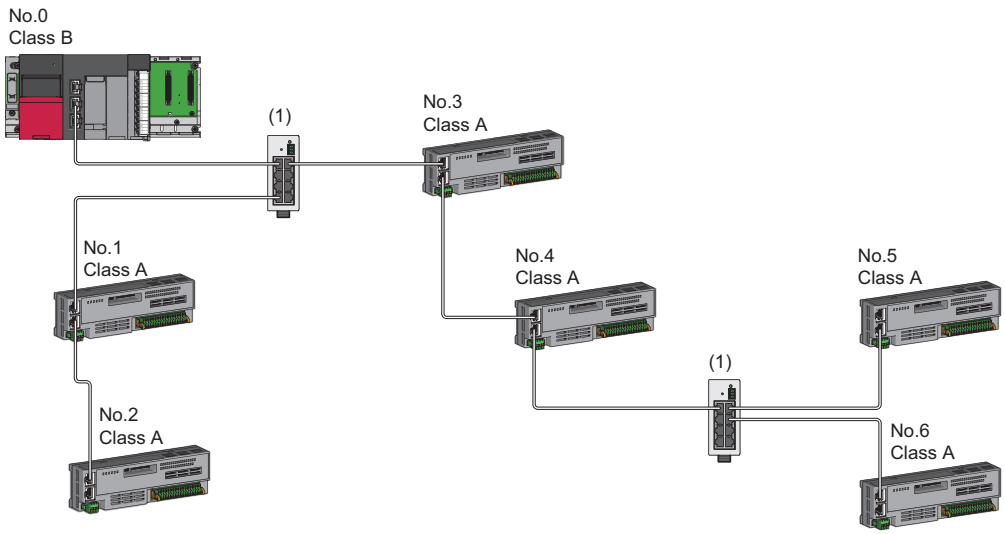
Line and star topologies can be mixed according to the following connection requirements.

- When connecting a CC-Link IE TSN Class B device in a star topology, use an industrial switch (CC-Link IE TSN Class B certified).



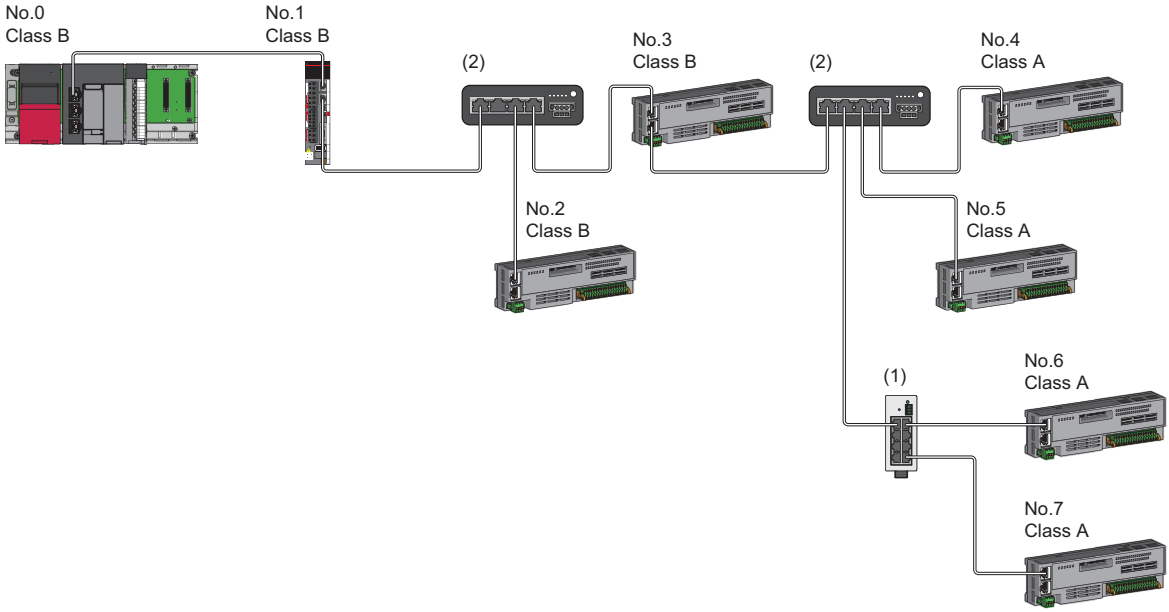
No.0: Master station
No.1 to 5: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
Class B: CC-Link IE TSN Class B device

- When connecting CC-Link IE TSN Class A devices only in a star topology, use (1) industrial switch (CC-Link IE TSN Class A certified).



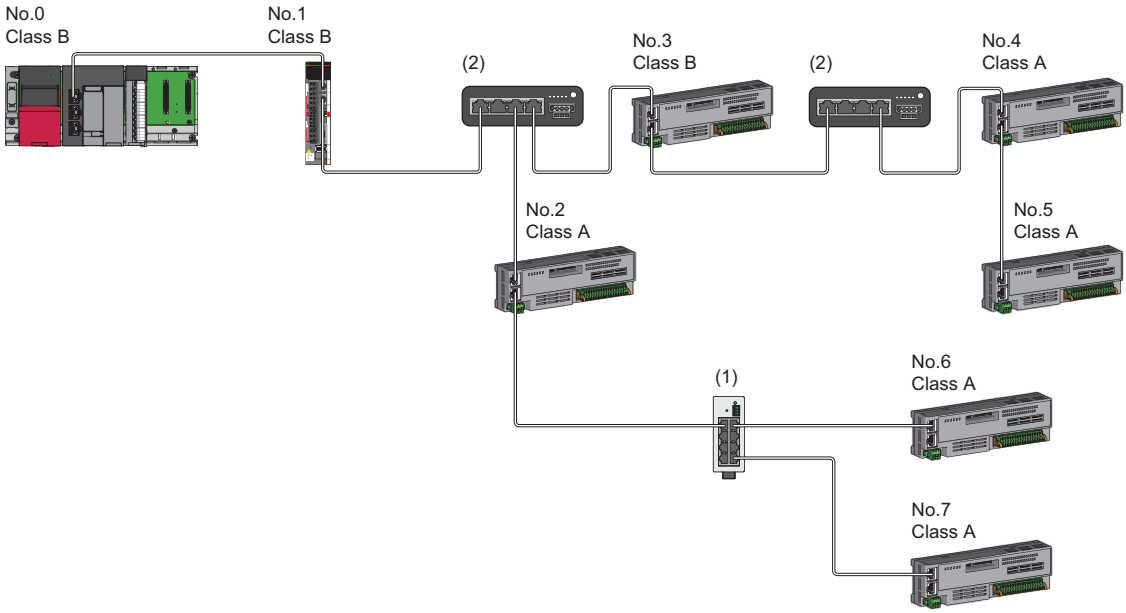
No.0: Master station
No.1 to 6: Remote stations
(1) Industrial switch (CC-Link IE TSN certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

• In a CC-Link IE TSN Class B/A mixed structure, when connecting a CC-Link IE TSN Class B device in a star topology, connect a CC-Link IE TSN Class A device via an industrial switch (CC-Link IE TSN Class B certified).



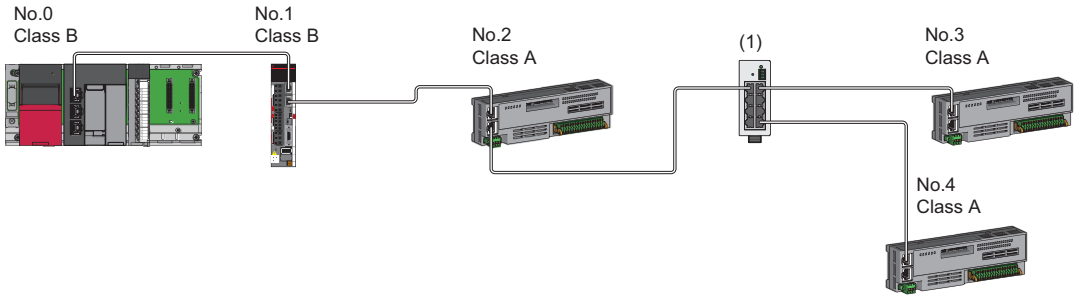
No.0: Master station
No.1 to 7: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1) Industrial switch (CC-Link IE TSN certified)
(2) Industrial switch (CC-Link IE TSN Class B certified)

• In a CC-Link IE TSN Class B/A mixed structure, the CC-Link IE TSN Class A device can be connected from the industrial switch (CC-Link IE TSN Class B certified) between the CC-Link IE TSN Class B devices.

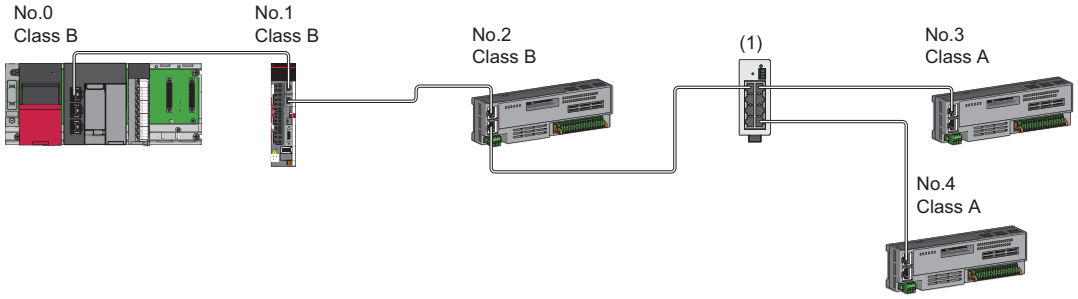


No.0: Master station
No.1 to 7: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1) Industrial switch (CC-Link IE TSN certified)
(2) Industrial switch (CC-Link IE TSN Class B certified)

- In a CC-Link IE TSN Class B/A mixed structure, when connecting a CC-Link IE TSN Class B device in the line topology, connect the CC-Link IE TSN Class A device directly or via (1) industrial switch (CC-Link IE TSN certified).

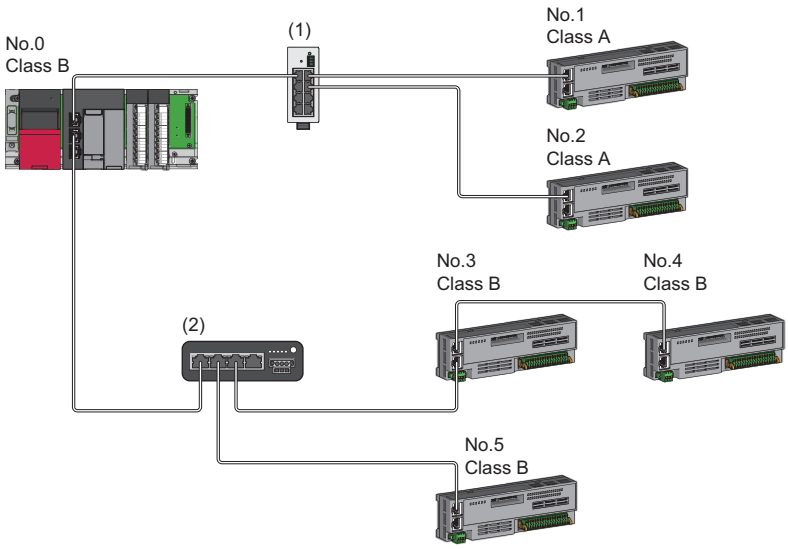


No.0: Master station
No.1 to 4: Remote stations
(1) Industrial switch (CC-Link IE TSN certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device



No.0: Master station
No.1 to 4: Remote stations
(1) Industrial switch (CC-Link IE TSN certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- In a CC-Link IE TSN Class B/A mixed structure, when a CC-Link IE TSN Class B device is connected in the star topology using an industrial switch (CC-Link IE TSN Class B certified), the CC-Link IE TSN Class A device station can be connected to another port of the master station directly or via (1) industrial switch (CC-Link IE TSN certified). (Example: P1 to a CC-Link IE TSN Class A device, and P2 to a CC-Link IE TSN Class B device.)



No.0: Master station
No.1 to 5: Remote stations
(1) Industrial switch (CC-Link IE TSN certified)
(2) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

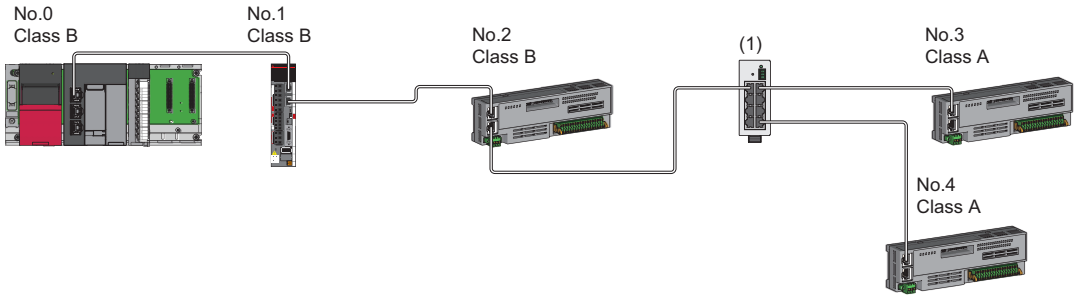
Precautions

In a CC-Link IE TSN Class B/A mixed structure, set whether to use an industrial switch (CC-Link IE TSN Class B certified) in "TSN HUB Setting" of "Connection Device Information" under "Basic Settings". If "TSN HUB Setting" and the system structure differ in whether an industrial switch (CC-Link IE TSN Class B certified) is used, the CC-Link IE TSN Class A device may not perform a data link.

Ex.

Connecting CC-Link IE TSN Class B devices in line topology

- Set "TSN HUB Setting" of "Connection Device Information" under "Basic Settings" to "Not to Use TSN HUB".
- CC-Link IE TSN Class B and CC-Link IE TSN Class A devices are connected using (1) industrial switch (CC-Link IE TSN certified).

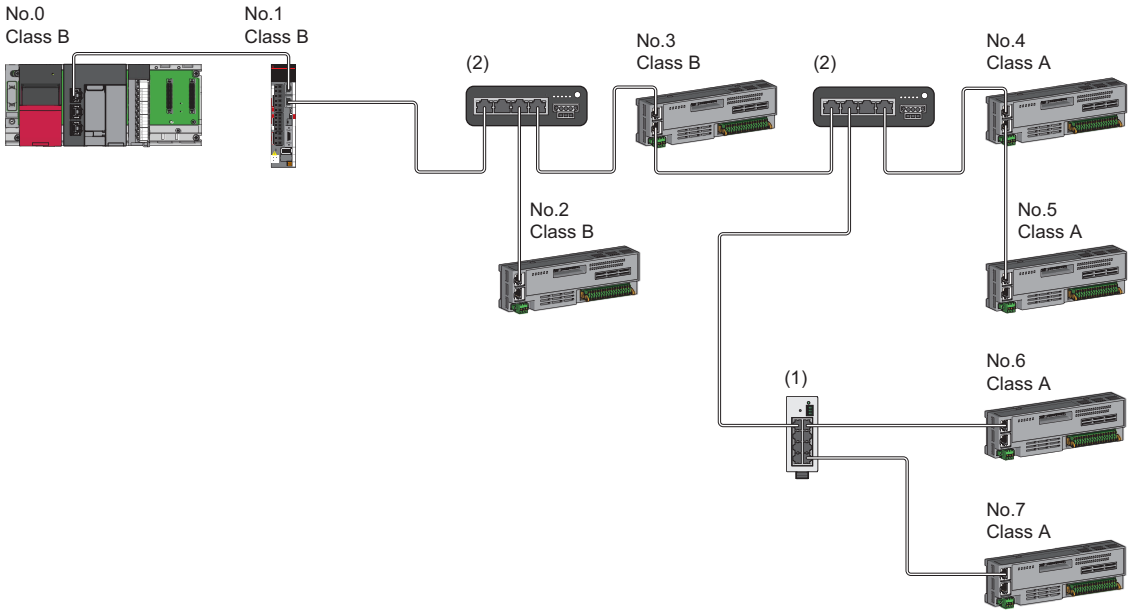


(1) Industrial switch (CC-Link IE TSN certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

Ex.

Connecting CC-Link IE TSN Class B devices in a star topology

- Set "TSN HUB Setting" of "Connection Device Information" under "Basic Settings" to "Use TSN HUB".
- CC-Link IE TSN Class B and CC-Link IE TSN Class A devices are connected by an industrial switch (CC-Link IE TSN Class B certified).



(1) Industrial switch (CC-Link IE TSN certified)
(2) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

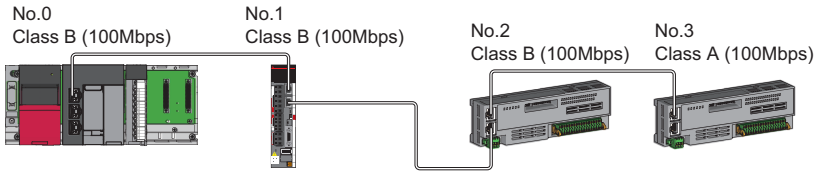
Connection with modules on CC-Link IE TSN with a communication speed of 100Mbps

This section describes the network topology when "Communication Speed" under "Application Settings" is set to "100Mbps".

■Line topology

The network is configured in a line topology.

- Adjust the communication speed of the module.
- When connecting modules with different communication speeds, connect the modules via an industrial switch (CC-Link IE TSN certified).

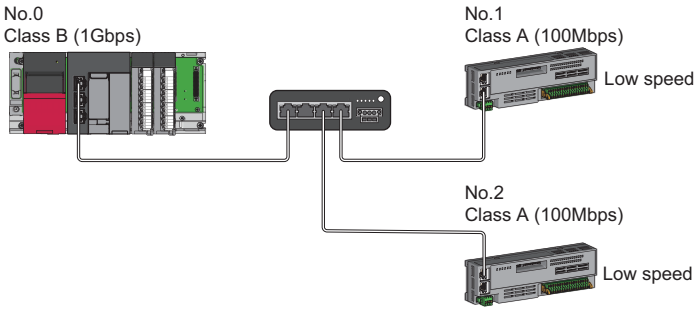


No.0: Master station
No.1, No.2, and No.3: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Star topology

Modules are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

- When the master station with a communication speed of 1Gbps and a device station with a communication speed of 100Mbps exist in the structure, set "Communication Period Setting" to "Low-Speed" for the device station with a communication speed of 100Mbps.

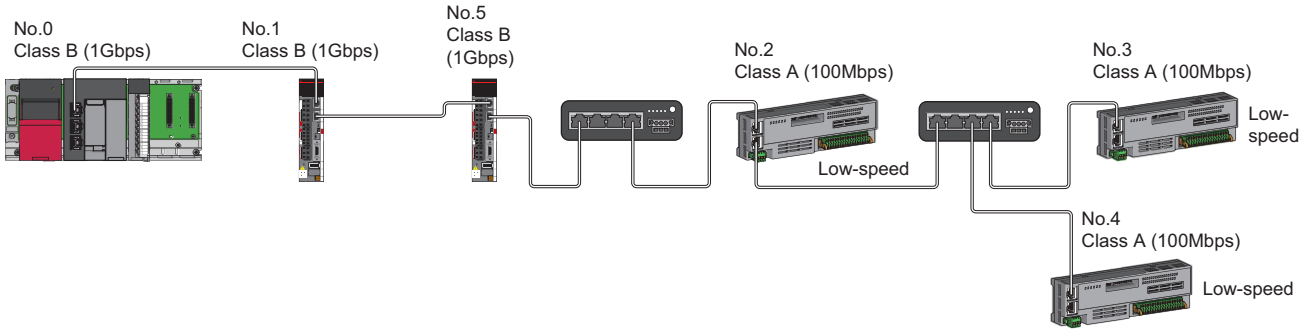


No.0: Master station
No.1 and No.2: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

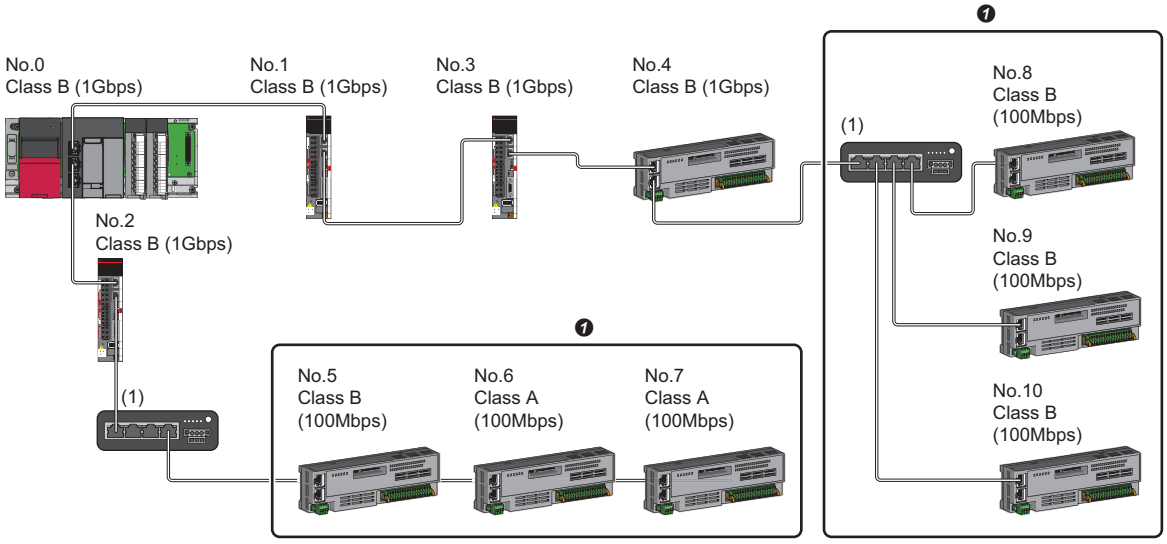
Line and star topologies can be mixed in the same network configuration.

- When the master station with a communication speed of 1Gbps and a device station with a communication speed of 100Mbps exist in the structure, set "Communication Period Setting" to "Low-Speed" for the device station with a communication speed of 100Mbps.



No.0: Master station
No.1 to 5: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- When the communication speed of the master station is 1Gbps, a connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps.



No.0: Master station
No.1 to 10: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
❶ Set the total cyclic data size within 2K bytes.

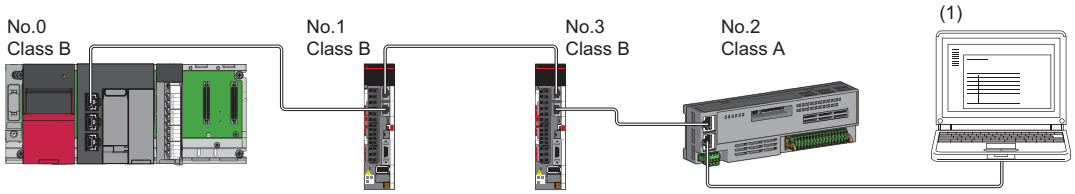
Structure with modules on CC-Link IE TSN and Ethernet devices

Connection with modules on CC-Link IE TSN and Ethernet devices

■Line topology

The network with modules and devices is configured in a line topology. An Ethernet switch is not required for connection.

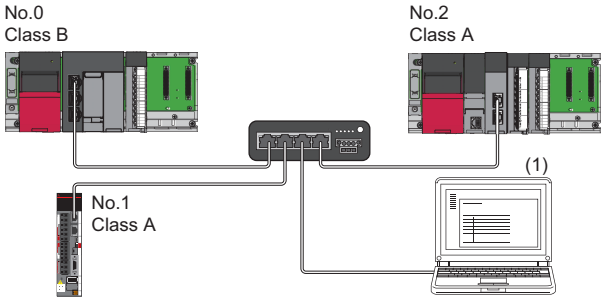
Connect Ethernet devices to the end of the network.



No.0:Master station
No.1, No.2, and No.3: Remote stations
(1) Ethernet device
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Star topology

Modules or Ethernet devices are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

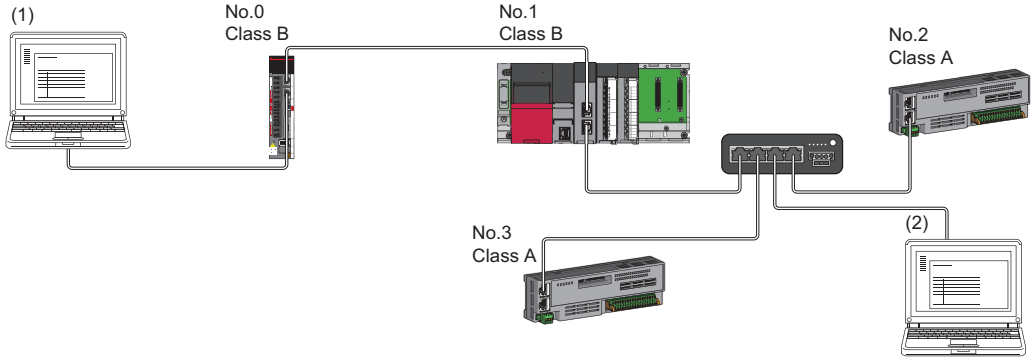


No.0: Master station
No.1 and No.2: Remote stations
(1) Ethernet device (such as a personal computer, vision sensor, and bar code reader)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

Line and star topologies can be mixed according to the following connection requirements.

- Connect Ethernet devices at the end of line topology.
- When connecting the Ethernet devices in a star topology, connect them to an industrial switch (CC-Link IE TSN certified).



No.0:Master station
No.1, No.2, and No.3:Remote stations
(1), (2): Ethernet devices
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

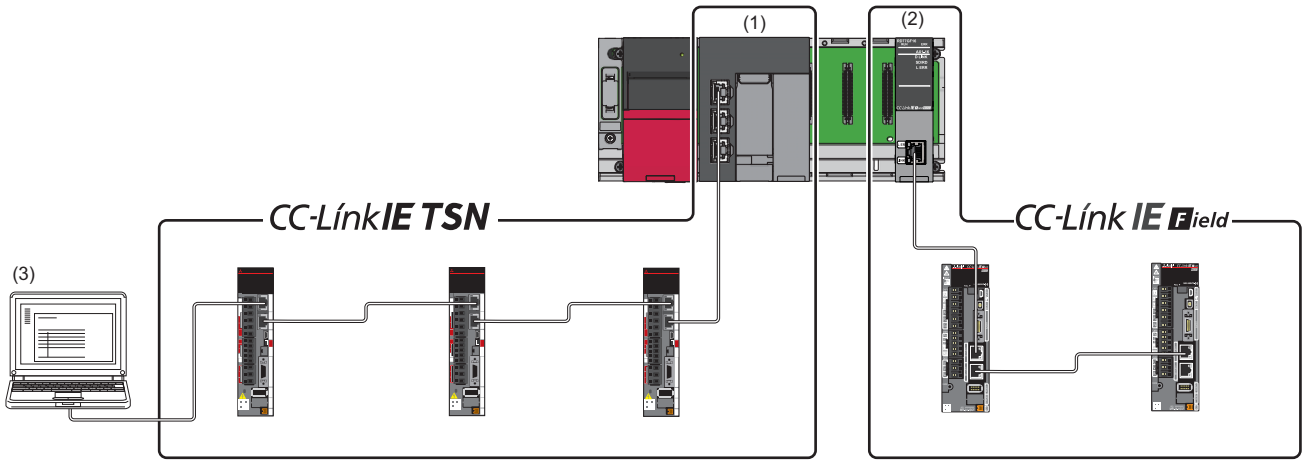
9.7 Structure of the CC-Link IE TSN and CC-Link IE Field Network

Set different network numbers to the controller and the CC-Link IE Field compatible network module, and mount the master stations of each network on the same base unit.

Connect Ethernet devices to the end of the network.

For details on CC-Link IE Field Network, refer to the following.

- MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup)
- MELSEC iQ-R CC-Link IE Field Network User's Manual (Application)



(1) Master station (Network No.1)
(2) Master station (Network No.3)
(3) Ethernet device

Point

The communication data of the CC-Link IE TSN and CC-Link IE Field Network are transferred between master stations.

9.8 Precautions for System Configuration

Devices connected to the same network

Do not connect the devices as described below. Doing so may cause the disconnection of all stations.

- A module on CC-Link IE TSN and a device having different network types (such as CC-Link IE Controller Network or CC-Link IE Field Network) other than an Ethernet device are connected to the same network.
- A module on CC-Link IE TSN and an Ethernet device (such as a personal computer), both of which are on different networks, are connected to one Ethernet switch.

Adding a device station with no IP address setting

In a line topology, do not connect the device station with no IP address setting at a place other than the end of the network. A data link may not be performed in the device stations after the device station with no IP address setting.

CC-Link IE TSN/CC-Link IE Field diagnostics

If the following operations are performed, the actual network configuration and the network map of the CC-Link IE TSN/CC-Link IE Field diagnostics may be different.

Network configuration	Operation
Star topology	• Powering off and on a device station or Ethernet switch • Connecting/disconnecting an Ethernet cable connected to the Ethernet switch • Disconnecting an Ethernet cable and connecting it to another device station or an Ethernet switch • Disconnecting 10 or more stations, or half or more the number of device stations in the system • Changing the network topology when adding a device station
Line topology	• Simultaneously powering off or on multiple stations • Simultaneously connecting/disconnecting Ethernet cables to/from multiple stations (When a data link faulty station returns, a data link error will occur in all the stations.) • Disconnecting 10 or more stations, or half or more the number of device stations in the system • Changing the network topology when adding a device station

Point

The actual network configuration and network map can be matched by executing the network map update of the CC-Link IE TSN/CC-Link IE Field diagnostics. For details, refer to the following.

☞ Page 1697 CC-Link IE TSN/CC-Link IE Field diagnostics

Calculation of the total cyclic data size

The following shows the calculation formula of the total cyclic data size. The part of the variable surrounded by double quotes (" ") is the setting value of "Network Configuration Settings" under "Basic Settings".

Total cyclic data size = 256 + (106 × Number of remote stations) + (Number of "RX Setting" points ÷ 8) + (Number of "RWr Setting" points × 2) [byte]

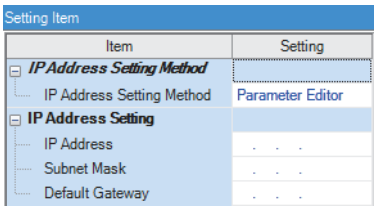
10 Ethernet SYSTEM CONFIGURATION

This chapter describes the system configuration for connecting the devices using Ethernet with the controller.

10.1 Required Settings

This section describes the parameter settings required for communications with other stations.
Set the parameters such as the IP address of the controller.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings]



Item	Description	Reference
IP Address Setting Method	Select the method for setting the IP address of own station.	Page 1432 IP Address Setting Method
IP Address Setting	Set the IP address of the own station. Set the IP address class within the range of classes A, B and C.	Page 190 IP Address Setting

IP Address Setting

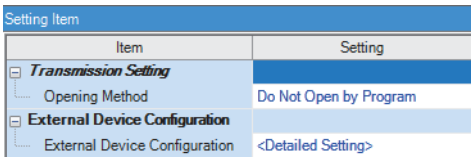
Set the IP address of the own station.

Item		Description	Setting range
IP Address Setting	IP Address	Set the IP address of the own station. Set the IP address class within the range of classes A, B and C. Set the external device to the same class and subnet address of the controller of the own station for communications. Consult with the network manager for the IP address setting. When the parameters are written without setting the IP address, the address 192.168.3.39 is set.	• Blank • 0.0.0.1 to 223.255.255.254 (Default: Blank)
	Subnet Mask	Set the subnet mask pattern of the default gateway when setting the IP address of the default gateway and communicating with an external device on another network via a router. All the devices on a subnetwork must have the same subnet mask. This setting is not required when communicating in single network.	• Blank • 0.0.0.1 to 255.255.255.255 (Default: Blank)
	Default Gateway	Set the IP address of the default gateway (the device which the own node passes through to access a device of another network). Set the value that satisfies the following conditions. • The IP address class is any of A, B, and C. • The subnet address of the default gateway is the same as the subnet address of the controller of the own station. • The host address bits are not all "0" or all "1".	• Blank • 0.0.0.1 to 223.255.255.254 (Default: Blank)

10.2 Basic Settings

Set the connection with the external device.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings]



Item	Description	Reference
Transmission Setting	Configure the settings for Ethernet communications.	Page 191 Transmission Setting
External Device Configuration	Configure the settings for communications with external devices.	Page 194 "Ethernet Configuration" Window (External Device Configuration Setting)

Transmission Setting

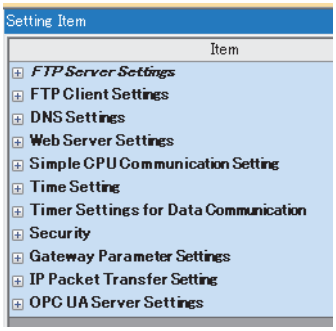
Configure the settings for Ethernet communications.

Item	Description	Setting range
Opening Method	Select how to open the connection.	• Do Not Open by Program • Open by Program (Default: Do Not Open by Program)

10.3 Application Settings

Configure the settings for communications with external devices.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings]



Item	Description	Reference
FTP Server Settings	Configure settings related to the FTP server.	Page 1347 FTP server settings
FTP Client Settings	Configure settings related to the FTP client.	Page 1375 FTP client settings
DNS Settings	Configure settings related to the DNS server.	Page 1437 DNS settings
Web Server Settings	Configure settings related to the Web server function.	Page 1384 Web server settings
Simple CPU Communication Setting	Configure settings related to simple CPU communications.	Page 193 Simple CPU Communication Setting
Time Setting	Automatically performs time setting of the controller by collecting clock data from the time information server (SNTP server) on the LAN.	Page 1935 Clock Data
Timer Settings for Data Communication	Set the timer to be used by each function.	Page 1771 Timer settings for data communication
Security	Configure settings related to security.	Page 1534 LIST OF SECURITY FUNCTIONS
Gateway Parameter Settings	Set gateway parameters to communicate with an external device connected to other Ethernet via a router.	Page 193 Gateway Parameter Settings
IP Packet Transfer Setting	Configure settings related to the IP packet transfer function.	Page 193 IP Packet Transfer Setting
OPC UA Server Settings	Configure settings related to the OPC UA server function.	Page 1416 OPC UA Server Settings

Simple CPU Communication Setting

Configure settings related to simple CPU communications.

Item	Description	Setting range
To Use or Not to Use Simple CPU Communication	Select whether to use the simple CPU communication or not.	• Not to Use • Use (Default: Not Use)
Simple CPU Communication Setting	Configure settings for simple CPU communications.	—

Gateway Parameter Settings

Set gateway parameters to communicate with an external device connected to other Ethernet via a router.

Item			Description	Setting range
Gateway Other Than Default Gateway			Set whether or not to use a gateway other than the default gateway.	• Not Use • Use (Default: Not Use)
Gateway Information	No.1 to No.8	Gateway IP Address	Set the IP address of the gateway other than the default gateway.	• Blank • 0.0.0.1 to 223.255.255.254 (Default: Blank)
		Subnet Address	Set the network address or subnet address of the external device when communicating with it through a gateway other than the default gateway.	• Blank • 0.0.0.1 to 223.255.255.254 (Default: Blank)

IP Packet Transfer Setting

Configure settings related to the IP packet transfer function.

Item	Description	Setting range
IP Packet Transfer Function	Select whether to use the IP packet transfer function.	• Not Use • Use (Default: Not Use)

10.4 "Ethernet Configuration" Window (External Device Configuration Setting)

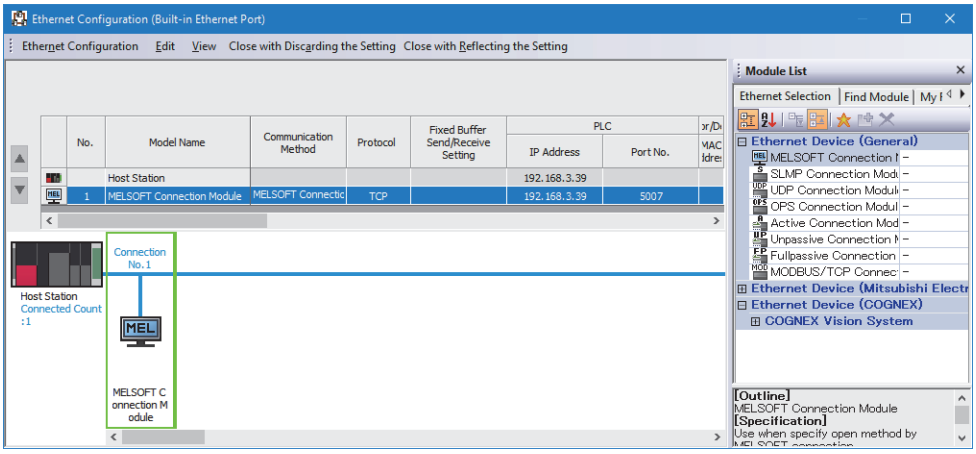
Set the method and protocol used for communicating with external devices.
This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)

Setting method

The procedure for setting the external device to be connected is shown below.

1. Select the external device to be connected in "Module List" and drag it to the list of devices or device map area.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]



2. Set the required items. The required items vary depending on the selected external device.

3. Select [Close with Reflecting the Setting] to finish the "External Device Configuration" settings.

Point

Since encrypted communications need the protocol (TLS, DTLS) and port number to be set, apply the external device configuration settings. In addition, the same port number cannot be used for multiple connections.

For unencrypted communications, the system dedicated connection can be used to connect to MELSOFT products and GOT. The number of connectable modules by protocol is listed below.

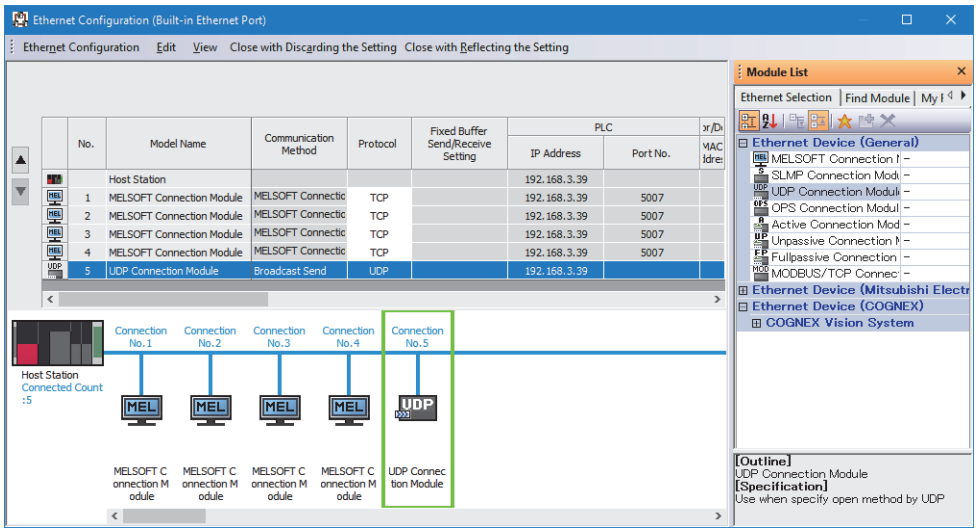
- TCP connection: (Maximum number of connectable modules in "External Device Configuration") - (Number set for a communication means other than "MELSOFT connection") + 1
- UDP connection: Simultaneous communication is possible for up to 120 modules by Ethernet port and up to 8 modules by CC-Link IE TSN port.

Restriction

Set external devices from the connection No.1.

To use specific connection number, set "MELSOFT Connection Module" in the connection number not used. (Set "Protocol" to "TCP".)

• When only the connection No.5 is used.



Setting items

Item		Description	Setting range
No.		Connection number for distinguishing settings for each user connection.	The number is set in the range in order from 1 up to 64.
Model Name		The name of the external device is displayed.	—[*1]
Communication Method		Set the method for communications with the external device. • Broadcast Send: Sends the same data to an unspecified number of devices all at once. • Broadcast Receive: Receives data sent by broadcast. • Predefined Protocol: Communications according to the protocol of the external device • Socket Communication: Send and receive arbitrary data. • MELSOFT Connection: Communicate with MELSOFT products and a GOT. Set it to reserve a connection for MELSOFT. • SLMP: Communications that use SLMP (MC protocol) commands to access controller files and read/write data from external devices	• Broadcast Send • Broadcast Receive • Predefined Protocol • Socket Communication • MELSOFT Connection • SLMP
Protocol		Select the communication protocol for the external device. • TCP: Secures a connection that allows one-to-one communication with the external device. Data arrival is checked. • UDP: Secures a connection that allows one-to-many communications with the external device. Data arrival is not checked. • TLS: Secures a connection for encrypted communications with the external device. Data arrival is checked. • DTLS: Secures a connection for encrypted communications with the external device. Data arrival is not checked.	• TCP • UDP • TLS • DTLS (Default: TCP)
PLC	IP Address	The IP address of the own node, which is set in "IP Address" of "Required Settings", is displayed.	0.0.0.1 to 223.255.255.254
	Port No.	Set the port number for each connection on the controller.	1 to 4999, 5010 to 65534 (Default: Blank)[*2]
Sensor/ Device	MAC Address	The MAC address of the device supporting iQSS is displayed when using the automatic detection of connected devices.	—
	Host Name	Set the name for identifying the device supporting iQSS. This setting is available only for the devices supporting iQSS which were detected by automatic detection of connected devices.	63 characters maximum The following one-byte characters can be used. • Number (0 to 9) • Alphabetical character (a to z, A to Z) • Hyphen (-) • Period (.) • Colon (:) • Underscore (_) (Default: Blank)[*2]
	IP Address	Set the IP address of the external device.	0.0.0.1 to 223.255.255.254 (Default: Blank)[*2]
	Port No.	Set the port number of the external device. Set "65535" to set all the port numbers as the target of data receive.	1 to 65534, 65535 (Default: Blank)[*2]
	Subnet Mask	Set the subnet mask of the device supporting iQSS. This setting is available only for the devices supporting iQSS which were detected by automatic detection of connected devices.	192.0.0.0 to 255.255.255.252 (Default: Blank)[*2]
	Default Gateway	Set the default gateway of the device supporting iQSS. This setting is available only for the devices supporting iQSS which were detected by automatic detection of connected devices.	0.0.0.1 to 223.255.255.254 (Default: Blank)[*2]
Existence Confirmation		Select the method of alive check which is performed when the controller has not communicated with the external device for a certain period of time. When the controller cannot communicate with the external device, the connection will be closed. (☞ Page 198 Existence confirmation)	• KeepAlive • UDP • Do not confirm existence

Item		Description	Setting range
Connection Monitoring Timer	Setting	Set the watch time when closing a connection in TCP or TLS communications. If a communication request is not made from the external device within the set time after the connection is established, a timeout error will occur and the connection will be closed. (☞ Page 199 Connection monitoring timer)	• — • Disable • Enable
	Time	Set the time for the connection monitoring timer.	• — • ms: 100 to 16383000 (in increments of 100ms) • s: 1 to 16383
	Unit	Select a unit of measurement for the connection monitoring timer.	• — • s • ms

*1 OPS connected devices and MODBUS/TCP connected devices cannot be set.

*2 When the automatic detection of the connected devices is executed, the values read from the connected devices will be the default.

Point

Comment can be set on the "Properties" window displayed by right-clicking the module in the list of devices or device map area and selecting "Properties". The following can be performed depending on the selected device.

- Changing the image
- Creating association with a file or application

Encrypted communication protocol

Select TLS or DTLS for encrypted communications with an external device.

The combinations of "Model Name" and "Communication Method" for which TLS or DTLS can be selected are shown below.

○: Selectable, ×: Not selectable

Model name	Communication method	Selectable protocol	
		TLS	DTLS
MELSOFT Connection Module	MELSOFT Connection	○	○
SLMP Connection Module	SLMP	○	○
UDP Connection Module	Broadcast Send	×	×
	Broadcast Receive	×	×
	Socket Communication	×	×
	Predefined Protocol	×	×
Active Connection Module	Socket Communication	○	○
	Predefined Protocol	×	×
Unpassive Connection Module	Socket Communication	○	○
	Predefined Protocol	×	×
Fullpassive Connection Module	Socket Communication	○	○
	Predefined Protocol	×	×

For precautions on encrypted communications, refer to the following.

☞ Page 1558 Encrypted Communication Function

Point

Right-click the SLMP connected device item. From the menu displayed, select "Change Module" to change "Model Name".

If the "Protocol" before change is TLS or DTLS, TLS is changed to TCP and DTLS to UDP.

Existence confirmation

When the controller has not communicated with the external device for a certain period of time while the connection is open, this function checks whether the external device is alive by sending an alive check message to the device and waiting for the response.

The following table lists the details on alive check.

Item	Applicable protocol	Description
KeepAlive	• TCP • TLS	This method is used for a connection opened using TCP. The controller performs an alive check by sending an ACK message for alive check to the external device with which communications have not been performed for a certain period of time and waiting to check whether the response is received. The connection will be automatically closed when the open state is not continued.*1
UDP	• UDP*3 • DTLS	This method is used for a connection opened using UDP. The controller performs an alive check by sending the PING command (ICMP echo request/response function) to the external device with which communications have not been performed for a certain period of time and waiting to check whether the response is received.*2
Do not confirm existence	• TCP • UDP • TLS • DTLS	Alive check is not performed.

*1 The connection may be disconnected if the external device does not support the TCP KeepAlive function (response to a KeepAlive ACK message).

*2 The controller automatically sends an echo response packet when it receives a PING echo request command. (It sends a response to the received PING command even if the connection used in the data communications with the external device is closed.)

*3 When "Protocol" of the SLMP connection device is set to "UDP" in the "Ethernet Configuration" window, the destination cannot be specified. Therefore, the alive check will not be executed even if "Existence Confirmation" is set to "UDP".

Point

If a response message cannot be received from the external device (or if an error has been detected) using the alive check function, the following are performed.

- The corresponding connection will be forcibly closed. (The line is disconnected.) Open the connection again using a user program.
- Open completion signal is turned off, and the error code is stored in the buffer memory areas.

Connection monitoring timer

Set the watch time when closing a connection in TCP or TLS communications where the controller is the server.

If a communication request or communication response is not made within the set time while the connection is established, a timeout error will occur and the connection will be closed.

The combinations for which the connection monitoring timer can be set are shown below.

○: Selectable, ×: Not selectable

Model	Communication method	Selectable protocol	
		TCP	TLS
MELSOFT Connection Module	MELSOFT Connection	×*1	○
SLMP Connection Module	SLMP	○	○
Unpassive Connection Module*2	Socket Communication	○	○
	Predefined Protocol	○	×
Fullpassive Connection Module*2	Socket Communication	○	○
	Predefined Protocol	○	×

*1 If TCP is set for the MELSOFT connection, use the system dedicated connection.
The controller can connect to MELSOFT products and GOT using the system dedicated connection without configuring the external device connection configuration setting.

*2 When the communication method is socket communication or communication protocol connection, the connection is closed when a timeout error occurs in the connection monitoring timer. Therefore, to accept the connection again, the connection needs to be opened.

Point

DTLS communications operate with a watch time of 900 seconds.

■Precautions

Set the connection monitoring timer to a value greater than the send/receive interval of communication requests and communication responses.

If a value smaller than the send/receive interval is set, the connection monitoring timer may close the connection during communication, resulting in communication failure. If the connection is closed by the connection monitoring timer, extend the time.

Ex.

For MELSOFT connection:

- Connection monitoring timer setting value > Communication time check setting value

10.5 Connection with MELSOFT Product and GOT

Programming and monitoring of the programmable controller with the engineering tool, and monitoring and testing of the programmable controller from the GOT can be performed via Ethernet. This function enables remote operations using Ethernet's long-distance connection and high-speed communications.
This section describes the methods of connecting the controller to MELSOFT products (such as engineering tool and MX Component) and a GOT.
○: Supported, ×: Not supported

Port*1	Direct connection	Specifying IP address	Searching the CPU module on the network*2
Port for CC-Link IE TSN	×	×	×
Port for Ethernet	○	○	○

*1 For the port allocation, refer to the following.
☞ Page 50 MX-R Model
*2 Encrypted communications are not supported.

Point

- Encrypt communications whose communication route crosses the trust boundary.
- For the procedures to connect the controller and a GOT, refer to the following.

📖 Manual for the GOT used

Restriction

The following functions cannot be used when the controller and an engineering tool are connected via an industrial switch. To use the functions, connect them directly or with a USB cable.

- Ethernet diagnostics
- CC-Link IE TSN/CC-Link IE Field diagnostics
- CC-Link IE Control Diagnostics

Direct connection

The controller and engineering tool can be directly connected with a single Ethernet cable without using an industrial switch. When direct connection is made, communications are possible without setting the IP address or host name in the "Specify Connection Destination Connection" window. (Communicate using broadcast communications)

The availability of unencrypted/encrypted communications with MELSOFT products and GOT are shown below.

○: Available, ×: Not available

Connection device*1	Whether unencrypted communications are available		Whether encrypted communications are available	
	Port for CC-Link IE TSN	Port for Ethernet	Port for CC-Link IE TSN	Port for Ethernet
MELSOFT products	×	○	×	×
GOT	×	×	×	×

*1 For the port allocation, refer to the following.
☞ Page 50 MX-R Model

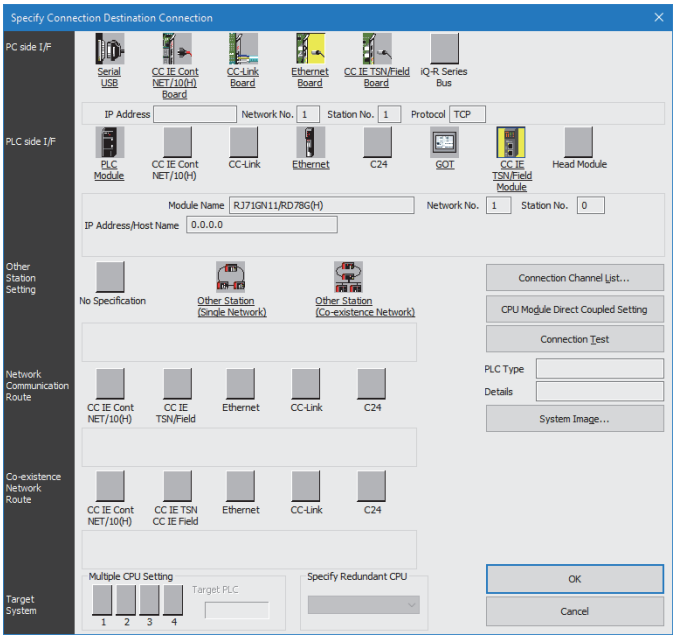
Point

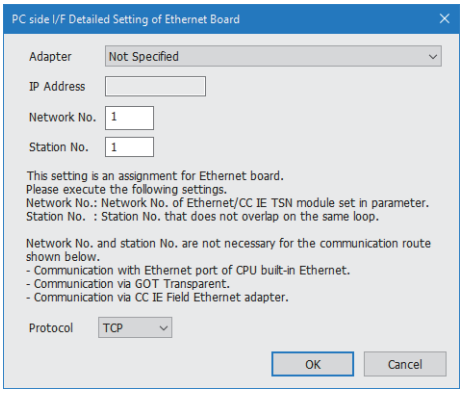
To prohibit direct connection via Ethernet cable, set "MELSOFT Direct Connection Port" in "Security" of "Basic Settings" under "Module Parameter (Common Setting)" to "Close".

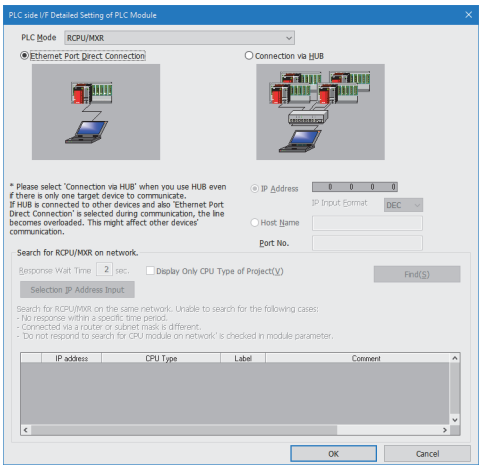
Setting method

Set in the "Specify Connection Destination Connection" window.

[Online] ⇨ [Current Connection Destination]







1. Select "Ethernet Board" for "PC side I/F".
2. Double-click "Ethernet Board" to display the "PC side I/F Detailed Setting of Ethernet Board" window.
3. Set the operating protocol. Set the protocol according to the settings for the controller.

4. Set "PLC side I/F" to "PLC Module".
5. Double-click "PLC Module" to display the detailed setting window.
6. Select "Ethernet Port Direct Connection" for the connection method.

Point

It can also be set with the [CPU Module Direct Coupled Setting] button on the "Specify Connection Destination Connection" window.

Precautions

■Connection with LAN line

Do not connect with a LAN line and set direct connection. Data will be sent to all external devices on the LAN line, so this setting will cause the line load to increase and will affect communications with other external devices.

■Connections that are not direct connections

- Do not use a configuration in which the controller and the external device are connected to an industrial switch. A direct connection is not established if an industrial switch is used.
- When creating a network connection on the personal computer side, communications with a direct connection is not possible if two or more Ethernet ports are set to "Enable". Review the personal computer settings so that only the Ethernet port for the direct connection is set to "Enable", and the other Ethernet ports are set to "Disable".
- Use only one engineering tool for the personal computer.

■Conditions that disable communications using direct connection

Communications with a direct connection may be disabled if the following conditions apply. If communications are not possible, review the controller and personal computer settings.

- When all the bits of the controller IP address that correspond to 0 part of the personal computer subnet mask are on or off:

Ex.

Controller IP address: 64.64.255.255

IP address for the personal computer: 64.64.1.1

Subnet mask for the personal computer: 255.255.0.0

- When all the bits of the controller IP address that correspond to the host address of each class of the personal computer IP address are on or off:

Ex.

IP address for the personal computer: 192.168.0.1 ← 192.x.x.x., class C and the host address is the fourth octet.

Subnet mask for the personal computer: 255.0.0.0

IP address for the controller: 64.255.255.255 ← Each bit turns on because the fourth octet is 255.

Point

The IP address for each class are as follows.

- Class A: 0.x.x.x to 127.x.x.x
- Class B: 128.x.x.x to 191.x.x.x
- Class C: 192.x.x.x to 223.x.x.x

The host address for each class is the 0 section shown below.

- Class A: 255.0.0.0
- Class B: 255.255.0.0
- Class C: 255.255.255.0

Specifying IP address

It is used to connect to an Ethernet-equipped module that has no network number and station number settings or no settings, or to connect multiple MELSOFT products.

The availability of unencrypted/encrypted communications with MELSOFT products and GOT are shown below.

○: Available, ×: Not available

Connection device*1	Whether unencrypted communications are available		Whether encrypted communications are available	
	Port for CC-Link IE TSN	Port for Ethernet	Port for CC-Link IE TSN	Port for Ethernet
MELSOFT products	×	○	×	○
GOT	×	○	×	×

*1 For the port allocation, refer to the following.
☞ Page 50 MX-R Model

Precautions

When UDP or DTLS is used as the communication protocol, problems such as loss of data and data arrival order interchange may occur. If such a problem occurs, consider using the TCP or TLS protocol.

Ethernet port setting method

■Controller settings

Set the IP address of the controller in "Required Settings" in "Module Parameter (Ethernet)".

The controller can be connected to MELSOFT products and GOTs using the system dedicated connection without setting in "External Device Configuration" of "Basic Settings" under "Module Parameter (Ethernet)".*1

*1 When using a TCP/IP connection with the system dedicated connection, up to ((maximum number of connected modules in "External Device Configuration") - (set number) + 1) modules can be connected.
When using a UDP/IP connection, up to the maximum number of connectable modules can be connected.

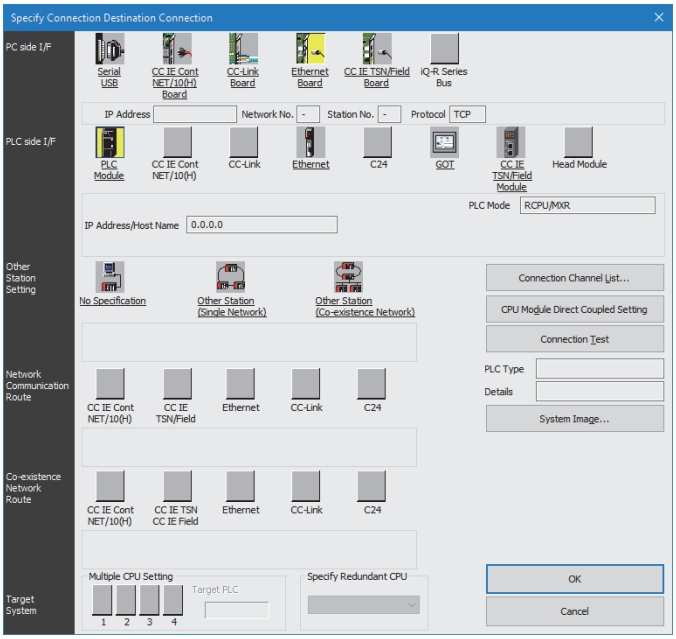
Point

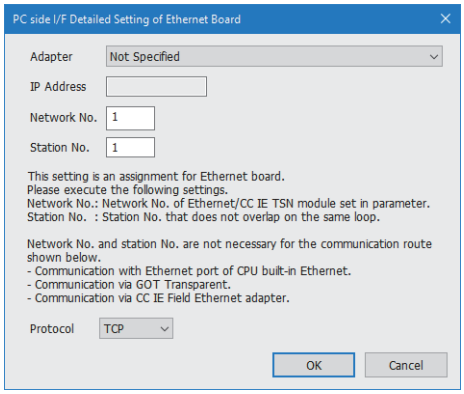
When connecting multiple MELSOFT products with TCP/IP, drag "MELSOFT Connection Module" from the "Module List" in "External Device Configuration" under "Basic Settings" of "Module Parameter (Ethernet)".
(☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

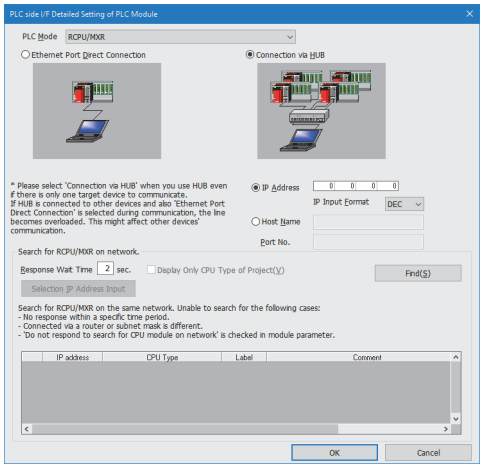
■Settings on the engineering tool side

Set in the "Specify Connection Destination Connection" window.

[Online] ⇨ [Current Connection Destination]







1. Select "Ethernet Board" for "PC side I/F".
2. Double-click "Ethernet Board" to display the "PC side I/F Detailed Setting of Ethernet Board" window.
3. Set the adapter and protocol of the personal computer. Set the protocol according to the settings for the controller.

4. Set "PLC side I/F" to "PLC Module".
5. Double-click "PLC Module" to display the detailed setting window.
6. Select "Connection via HUB" for the connection method, and enter the IP address or host name of the controller.

7. Set "Other Station Setting" to "No Specification".

Searching modules on the network

For a connection using an industrial switch, a list of the following modules that can be searched for will appear by clicking the [Find] button on the detailed setting window.

- The controller connected to the same industrial switch as the engineering tool
- The controller connected to a cascade-connected industrial switch

Restriction

Not available for the CC-Link IE TSN port.

When module does not appear after search

If the connected controller does not appear in the list after searching the modules on the network, check the following items.

- Search cannot be performed if it is disabled with the IP filter.
- Modules connected via a router cannot be searched.
- If the module is connected via a wireless LAN, packet loss can prevent the Ethernet communications from stabilizing, and may inhibit the module search.
- If there are modules with the same IP address in the list, review the IP address parameter settings for the controller.
- If the service processing load of the search-target CPU module is high, it may not be possible to search for the corresponding module. If the search cannot be performed, increase the response wait time in the search dialog, and perform the search again.

PART 6 SPECIFICATIONS

This part consists of the following chapters.

11 GENERAL SPECIFICATIONS

12 PERFORMANCE SPECIFICATIONS

11 GENERAL SPECIFICATIONS

This chapter describes general specifications such as the usage environment.

Item	Specifications					
Operating ambient temperature	0 to 55℃					
Storage ambient temperature	-25 to 75℃					
Operating ambient humidity	5 to 95%RH, non-condensing					
Storage ambient humidity	5 to 95%RH, non-condensing					
Vibration resistance	—	Frequency	Constant acceleration	Half amplitude	Sweep count	IEC 61131-2: 2007/JIS B 3502: 2011
	Under intermittent vibration	5 to 8.4Hz	—	3.5mm	10 times each in X, Y, and Z directions	
		8.4 to 150Hz	9.8m/s²	—		
	Under continuous vibration	5 to 8.4Hz	—	1.75mm	—	
		8.4 to 150Hz	4.9m/s²	—		
Shock resistance	Three shocks in each direction per axis, on 3 mutually perpendicular axes (total of 18 shocks)					
Operating atmosphere	No corrosive gases*4 and flammable gases, less conductive dust					
Operating altitude*1	0 to 2000m					
Installation location	Inside a control panel intended for indoor use					
Overvoltage category*2	Ⅱ or less					
Pollution degree*3	2 or less					

*1 Do not use or store the controller under pressure higher than the atmospheric pressure of altitude 0m. Doing so may cause malfunction.

*2 This indicates the section of the power supply to which the equipment is assumed to be connected between the public electrical power distribution network and the machinery within premises. Category Ⅱ applies to equipment for which electrical power is supplied from fixed facilities. The surge voltage withstand level for up to the rated voltage of 300V is 2500V.

*3 This index indicates the degree to which conductive material is generated in terms of the environment in which the equipment is used. Pollution degree 2 is when only non-conductive pollution occurs. A temporary conductivity caused by condensing must be expected occasionally.

*4 When using the controller in the environment with the corrosive gases, use the special coated products having improved resistance to the environment of a certain degree of corrosive gas concentration specified in IEC 60721-3-3: 1994 3C2. For details on the special coated products, please contact your local Mitsubishi representative.

MEMO

12 PERFORMANCE SPECIFICATIONS

12.1 Controller

This section describes the specifications of the MX-R models.

Hardware specifications

Item			MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Operation control method			Stored program cyclic operation	
I/O control mode			Refresh mode (The direct access input/output is available by specifying the direct access input/output (DX, DY).)	
Processing speed	Instruction processing time	LD instruction	0.38ns minimum	0.28ns minimum
Memory capacity	Program memory		100M bytes	150M bytes
	Program cache memory		40M bytes	80M bytes
	SD memory card*1		The capacity differs depending on the SD memory card used. (SD/SDHC memory card)	
	Device/label memory		131072K bytes	262144K bytes
	Signal flow memory		512K bytes (fixed)	
	Data memory		30M bytes	60M bytes
	Function memory		172032K bytes	
	Buffer memory		36864K bytes (18432K words)	
	Refresh memory		8M bytes	
	Motion data memory		512K bytes	1024K bytes
Number of storable files	Program memory		Number of program files: 252 Number of FB files: 128	Number of program files: 380 Number of FB files: 192
	SD memory card*2		Number of files that can be stored in the root directory of the SD memory card/Number of files that can be stored in the subdirectory of the SD memory card • 2GB: 511/65534 • 4GB, 8GB, 16GB: 65535/65534	
	Device/label memory		324	
	Data memory*3		7616	15244
	Function memory*3		LOGGING: 10172, motion: 8129, other: 8129 (☞ Page 322 Function memory)	
	Motion data memory		512	1024
USB port			USB2.0 High Speed (Type-C) × 1	
Ethernet port	Number of ports		3	
	Interface		RJ45 connector (Auto MDI/MDI-X)	
Clock function	Display		Year, month, date, hour, minute, second, and day of the week (automatic leap year adjustment)	
	Accuracy		-1.00 to +1.00s/d at 0 to 55℃	
Number of occupied I/O points			64 points (CC-Link IE TSN function part: 32 points, motion function part: 32 points)	
Backup power	Backup method		Capacitor	
	Backup power time		10 days (under an ambient temperature of 25℃)	
	Data retained		Clock data	
Allowable momentary power failure time			The time differs depending on the power supply module used. (📖MELSEC iQ-R Module Configuration Manual)	
Internal current consumption (5VDC)			2.83A	3.22A
External dimensions	Height		110mm (base unit mounting side: 98mm)	
	Width		84.2mm	
	Depth		131mm	
Weight			0.72kg	

*1 The memory capacity of an SD memory card used for the system may be additionally consumed by the file operation processing speed enhancement. (The consumed capacity varies depending on the usage environment.)
To free up the consumed capacity, turn on the controller power while the SD memory card is inserted, or eject and insert the SD memory card.

*2 If the number of characters in a file name is 12 characters or less (including single-byte alphanumeric characters and the extension), the total number of files and folders shown in the above table can be stored in the root directory and each subdirectory. If a file name exceeds 12 characters or one includes lower-case characters, the number of files that can actually be stored may be reduced compared to the values shown in the above table.
When the temporary file creation setting at file transfer is set to 0: Create by the GP.FTPCGET and SP.FTPGET instructions, the extension .TMP (4 characters) is automatically provided for the file name of the temporary file to be created. Therefore, if a file name exceeding 8 characters (including the extension) is specified, the maximum number of the files that can actually be stored may be reduced.

*3 This is a total number of files and folders that can be stored in the root directory when the number of characters in a file name is 9 (including the extension). Note that the number of files that can actually be stored may increase or decrease depending on the usage status.

Programming specifications

Item			MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Programming language			• Ladder diagram (LD) • Structured text (ST) • Function block diagram (FBD/LD)	
Programming supporting function			• Function block (FB) • Label programming	
Program operation	Execution type		• Initial execution type • Scan execution type • Fixed scan execution type • Event execution type • Standby type	
	Type of interrupt		• Interrupt using the internal timer (I28 to I31) • High-speed internal timer interrupt 1 (I49) • High-speed internal timer interrupt 2 (I48) • Network communication cycle synchronous interrupt • Interrupt by a module	
Number of executable programs			252	380
Number of FB files			128	192
Tact performance	Constant scan		0.2 to 2000ms (The value can be set in increments of 0.1ms.)	
	Fixed scan interrupt	Interrupt using the internal timer (I28 to I31)	0.5 to 1000ms (The value can be set in increments of 0.5ms.)	
		High-speed internal timer interrupt 1 (I49)	0.05 to 1000ms (The value can be set in increments of 0.05ms.)	
		High-speed internal timer interrupt 2 (I48)	0.05 to 1000ms (The value can be set in increments of 0.05ms.)	
Timer performance	Low-speed timer		1 to 10000ms (Default: 100ms)	
	High-speed timer		0.01 to 100ms (Default: 10ms)	
	Long timer		0.001 to 1000ms (Default: 0.001ms)	
Number of I/O points			4K points (4096 points)*3	
Number of user device points (default)	Input (X)		12K points (12288 points (fixed))*4	
	Output (Y)		12K points (12288 points (fixed))*4	
	Internal relay (M)		64K points (65536 points)*1	
	Latch relay (L)		8K points (8192 points)*1	
	Link relay (B)		32K points (32768 points)*1	
	Link special relay (SB)		2K points (2048 points)*1	
	Annunciator (F)		2K points (2048 points)*1	
	Edge relay (V)		2K points (2048 points)*1	
	Timer device	Timer (T)	1K points (1024 points)*1	
		Long timer (LT)	4K points (4096 points)*1	
	Retentive timer device	Retentive timer (ST)	0 points*1	
		Long retentive timer (LST)	0 points*1	
	Counter device	Counter (C)	512 points*1	
		Long counter (LC)	512 points*1	
	Data register (D)		64K points (65536 points)*1	
	Link register (W)		32K points (32768 points)*1	
	Link special register (SW)		2K points (2048 points)*1	
Number of system device points	Special relay (SM)		4496 points (fixed)	
	Special register (SD)		4496 points (fixed)	
	Function input (FX)		16 points (fixed)	
	Function output (FY)		16 points (fixed)	
	Function register (FD)		5 points × 4 words (fixed)	
Number of file register points (default)	File register (R/ZR)		0 points*1	

Item		MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Number of index register points (default)	Index register (Z)	24 points (fixed)	
	Long index register (LZ)	12 points (fixed)	
Number of pointer points	Pointer (P)	8192 points (16384 points maximum)*1	16384 points (32768 points maximum)*1
	Interrupt pointer (I)	1024 points (fixed)	
Number of link direct device points*2	Link input (J□\X□)	160K points maximum	
	Link output (J□\Y□)	160K points maximum	
	Link relay (J□\B□)	640K points maximum	
	Link register (J□\W□)	2560K points maximum	
	Link special relay (J□\SB□)	5120 points maximum	
	Link special register (J□\SW□)	5120 points maximum	
Number of module access device points	Intelligent function module device (U□\G□)	268435456 points maximum	
Number of CPU buffer memory access device points	Buffer memory (U3E□\G□)	512K points maximum (Up to 268435456 points can be input by using the engineering tool.)	
Number of refresh data register points (default)	Refresh data register (RD)	1024K points (4096K points maximum)	
Number of nesting points	Nesting (N)	15 points	

*1 The points can be changed by using the parameter. For the setting range, refer to the following.
☞ Page 347 Device Setting

*2 These are the maximum points that can be handled in the controller. The number of points actually used differs depending on the module (network) used.
X: 16K points, Y: 16K points, B: 32K points, W: 16K points, SB: 4K points, SW: 4K points when CC-Link IE TSN is used
X: 8K points, Y: 8K points, B: 32K points, W: 128K points, SB: 512 points, SW: 512 points when CC-Link IE Controller Network is used

*3 When a module such as an I/O module and intelligent function module is mounted, allocate I/O points based on the number of I/O points of each module as set in the I/O assignment. (X/Y0 to FFF) (☞ Page 133 I/O Numbers of Modules)

*4 The number of points that can be used in the program.

Motion control specifications

This section describes the performance specifications of motion control.

Item			MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Number of controlled axes	Real drive axis		MXR300-16: 16 axes MXR300-32: 32 axes MXR300-64: 64 axes	MXR500-128: 128 axes MXR500-256: 256 axes
	Real drive axis + the other axes		10000 axes maximum The number of axes that can be set varies depending on the system memory capacity setting. (Depends on the amount of system memory that is set.)	
Operation cycle			1000.00μs: 64 axes	500.00μs: 64 axes
Operation cycles mixed			3 groups	
Control unit system			Double-precision real number (LREAL type), any unit string	
System memory size			256MB	
Size of built-in ROM for user data			30MB (Data memory is used.)	60MB (Data memory is used.)
Number of connectable motion control FBs			256	
Electronic cam	Number of registrations		60000 maximum	
	Cam data	Zone division, spline interpolation (resolution)	8 to 65535	
		Linear interpolation (coordinate number)	2 to 65535	
	Area sizes available		Parameter setting (The sizes depend on the amount of system memory that is set.)	

Network specifications

This section describes the network specifications.

Performance specifications of CC-Link IE TSN

The following table lists the performance specifications of CC-Link IE TSN.

Item			MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Maximum number of link points per network[*1]		RX/RY	16K points (16384 points, 2K bytes) for each	
		RWr/RWw	8K points (8192 points, 16K bytes) for each	
Maximum number of link points per station	Master station	RX/RY	16K points (16384 points, 2K bytes) for each	
		RWr/RWw	8K points (8192 points, 16K bytes) for each	
Transient transmission capacity			1920 bytes maximum (259 bytes maximum for the send data size)	
Communication speed			• 1Gbps • 100Mbps	
Minimum synchronization cycle			125.00μs	
CC-Link IE TSN Class			CC-Link IE TSN Class B device	
CC-Link IE TSN Protocol version			2.0/1.0	
Maximum number of connectable stations per network			254 stations (master station: 1, device stations: 253[*2*3])	
Communication cable			☞ Page 62 Ethernet cable	
Overall cable distance		Line topology	25300m (when 254 stations are connected)	
		Others	Depends on the system configuration.	
Maximum station-to-station distance			100m	
Maximum number of networks			239	
Network topology			Line topology, star topology, coexistence of line and star topologies	
Communication method			Time sharing method	
Multicast filter			Not available	
Number of extension modules per main module			7	

*1 All link devices may not be able to use its maximum number of points simultaneously depending on the number of device stations, or the number of points and assignments of the link devices that are set in "Network Configuration Settings" of "Basic Settings".

*2 The maximum number of connectable stations becomes 256 when modules that operate as extension modules, such as a multiple-axes drive unit, are included in the number.

*3 Depending on the device station used, the number of connectable stations varies on the trunk line of one port of the master station. Refer to the manual for the device station to check the maximum number of connectable stations. Then, ensure that the maximum number of connectable stations is not exceeded for each device station on the trunk line of one port of the master station.
Also, when using 121 or more device stations, check the following.
· For information on the device stations manufactured by Mitsubishi Electric, refer to the Line Topology with 121 or More Device Stations (CC-Link IE TSN Products) (FA-A-0451).
· Device stations not manufactured by Mitsubishi Electric are considered incompatible with line topology with 121 or more stations.

Performance specifications of Ethernet

The following table lists the performance specifications of Ethernet.

Item			MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Transmission specifications	Data transmission speed		• 1Gbps • 100Mbps	
	Communication mode	100BASE-TX	Full-duplex/half-duplex	
	Transmission method		Base band	
	Maximum frame size		1518 bytes	
	Jumbo frame		Not available	
	Maximum distance between an industrial switch and a node		100m (For the distance between industrial switches, consult the manufacturer of the industrial switches used.)	
	IP version		Compatible with IPv4	
	Maximum nodes connection	100BASE-TX	Cascade connection, 2 levels maximum	
Sending/receiving data storage memory	Number of simultaneous open connections (maximum number of connections)		■Port for Ethernet 64 connections	
	Socket communications		5K words × 64	
Number of connections	TCP		■Port for Ethernet • Total of MELSOFT connections, SLMP, and socket communications ≤ 64 connections • FTP: 1 connection	
	UDP			
	TLS			
	DTLS			

Point

The operation of commercial devices used for the following applications is not guaranteed. Check the operation before using the controller.

- Internet (general public line) (Internet-access service offered by an Internet service provider or a telecommunications carrier)
- Firewall device(s)
- Broadband router(s)
- Wireless LAN

PART 7 CONTROLLER OPERATION

This part consists of the following chapters.

13 SCAN CONFIGURATION

14 RUNNING A PROGRAM

15 OPERATING STATUS OF THE CONTROLLER

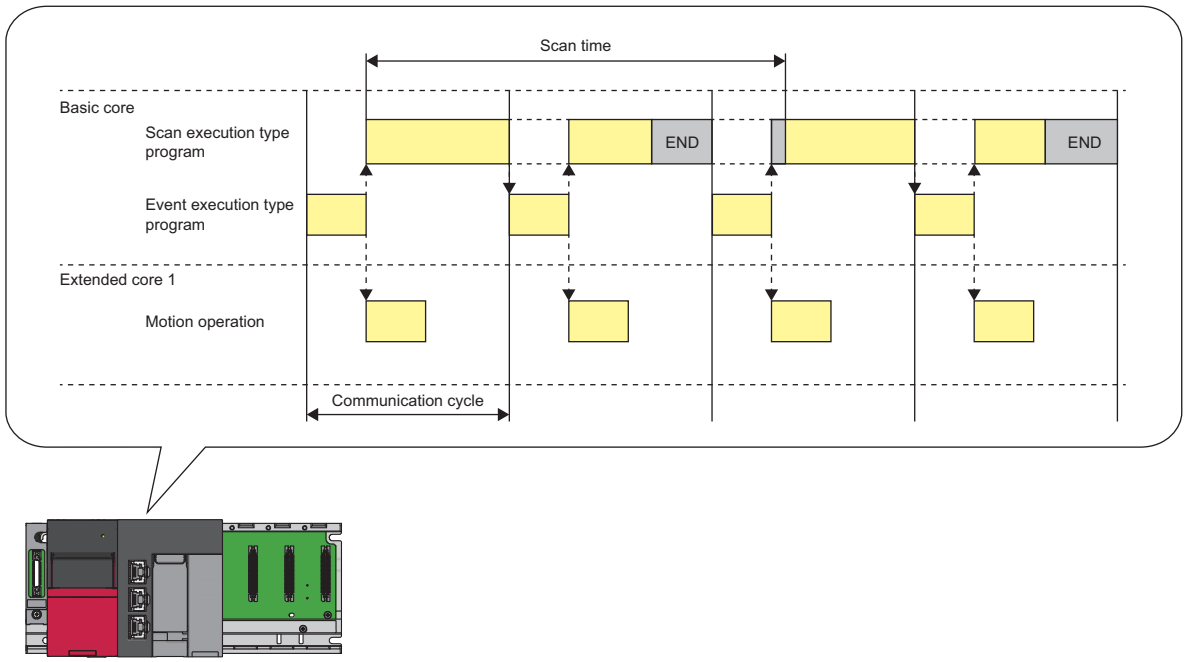
16 CC-Link IE TSN COMMUNICATION CYCLE AND MOTION OPERATION

17 CONTROLLER MEMORY CONFIGURATION

13 SCAN CONFIGURATION

The controller has multiple cores to execute programs or perform motion operation.
Multiple cores can perform operation simultaneously. For instance, the basic core executes programs and the extended core performs motion operation simultaneously.

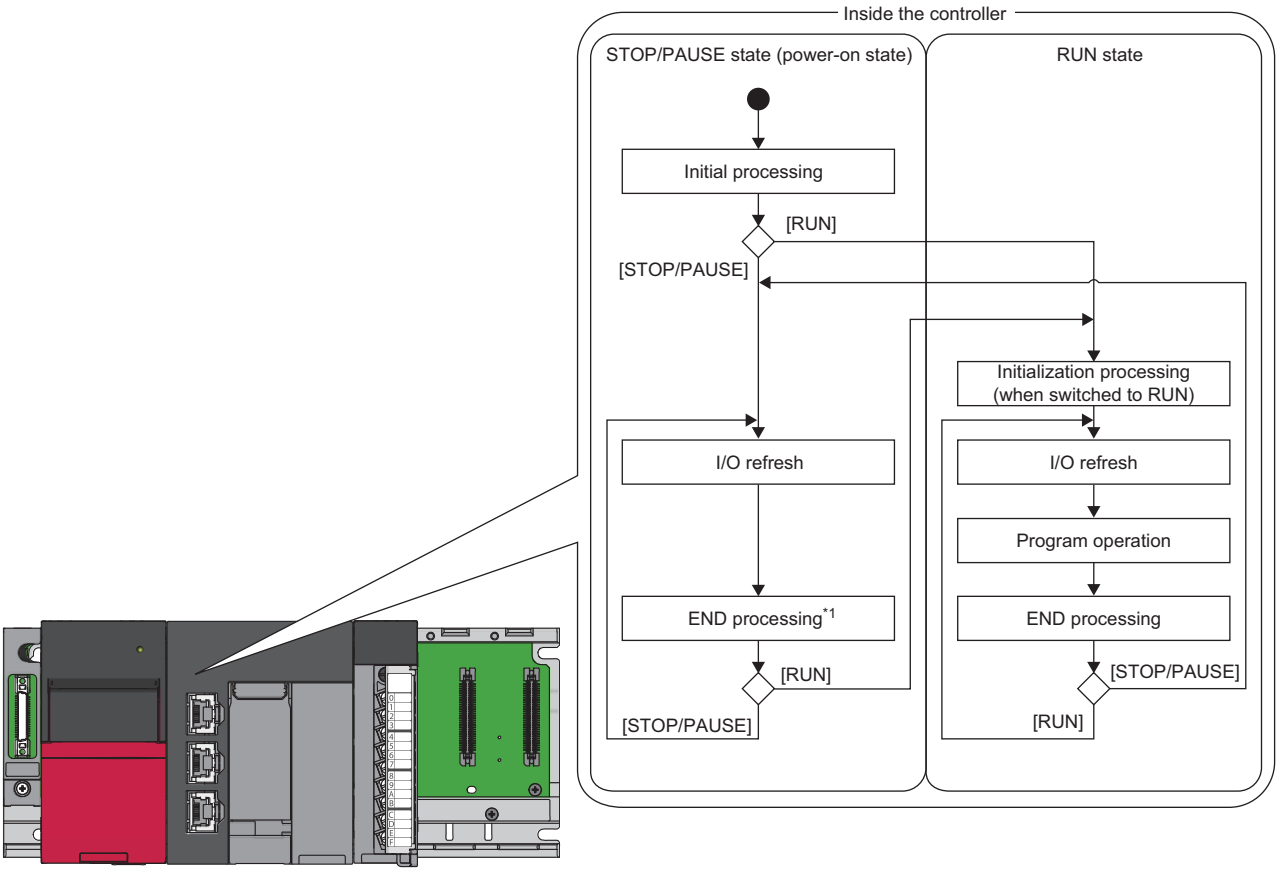
Ex.



Point

For the program execution type, refer to the following.
☞ Page 246 Program Execution Type
For the execution of a program synchronized with the communication cycle of CC-Link IE TSN/motion operation, refer to the following.
☞ Page 284 CC-Link IE TSN COMMUNICATION CYCLE AND MOTION OPERATION

The following shows the scan configuration of the controller.



*1 The END processing differs between STOP and PAUSE.

13.1 Initial Processing (When Powered On or Switched to RUN)

For the initial processing (when powered on or switched to RUN), the following processes are performed:

Item	Initial processing	Initial processing (when switched to RUN)
Booting from an SD memory card	Executed	Not executed
Checking each parameter and program*1	Executed	Executed
Assigning the I/O number to the mounted module	Executed	Not executed
Initializing and setting the information of each module	Executed	Not executed
Restoring latch data after initializing a device/label (Bit device: Off, Others: 0)	Executed	Not executed
Setting the device/label initial value	Executed	Executed*2

*1 In the following cases, the initial processing may take time, and it may take time to respond to peripherals.
· The SD memory card has too many files, or the SD memory card is close to the end of life or it has reached the end of life.
· It takes time to check each parameter and program depending on the parameter settings and the number of programs.

*2 The operation may vary depending on the parameter settings. For details, refer to the following.
☞ Page 427 Initial value setting

13.2 I/O Refresh

The module performs the following before starting program operation.

- ON/OFF data input from the input module/intelligent function module to the controller
- ON/OFF data output from the controller to the output module/intelligent function module

Point

While constant scan is in progress, I/O refresh is performed after the waiting time for constant scan expires.

13.3 Program Operation

According to the program settings, the module executes from step 0 through the END/FEND instruction for each program. This program is referred to as a main routine program. A main routine program can be divided into subroutine programs. (☞ Page 260 Subroutine Program)

Point

Interrupts are enabled at power-on or reset or at transition to RUN. When an initial execution type program is registered, interrupts are disabled during the execution of the initial execution type program in the first scan after the status is changed to RUN. However, interrupts are enabled at the execution of the program in the second and subsequent scans.

13.4 END Processing

The controller performs the following processing.

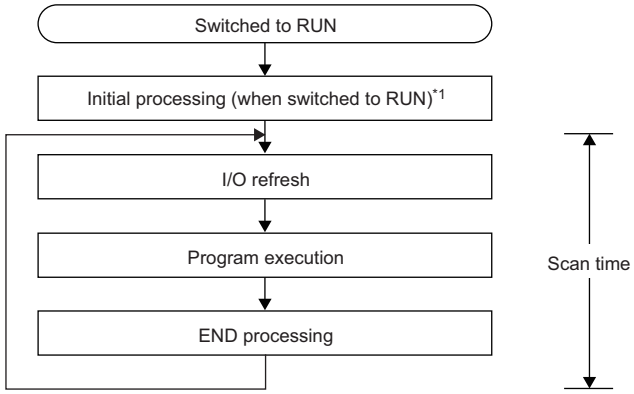
- Network module link refresh
- Intelligent function module refresh
- Instruction end processing (including dedicated instruction for the module)
- Device/label latch processing
- Service processing such as read and write of devices, labels, and program access files (☞ Page 2122 Service Processing)
- Watchdog timer reset (☞ Page 1743 Watchdog timer reset)
- Data collection by the data logging function (when the collection interval is set to "Each scanning cycle" or "Sample data at the next END processing after the specified time has elapsed")
- Self-diagnostics processing
- Sets a value to the special relay/special register (for those with the set timing specified as the END processing timing)
- Sequence scan synchronization sampling function

Point

Even during the END processing, an interrupt program, fixed scan execution type program, or event execution type program (when the trigger type is set to at interrupt occurrence or network communication cycle synchronization) is executed. To prevent the execution of an interrupt program during the END processing, disable an interrupt by the DI instruction immediately before the END processing, and enable an interrupt by the EI instruction at the head of the interrupt program.

13.5 Scan Time

The controller repeats the following processing. The scan time is the sum of the following processing and execution time.



*1 The initial scan time includes this processing.

Initial scan time

The first scan time when the controller is in the RUN state

How to check the initial scan time

See below.

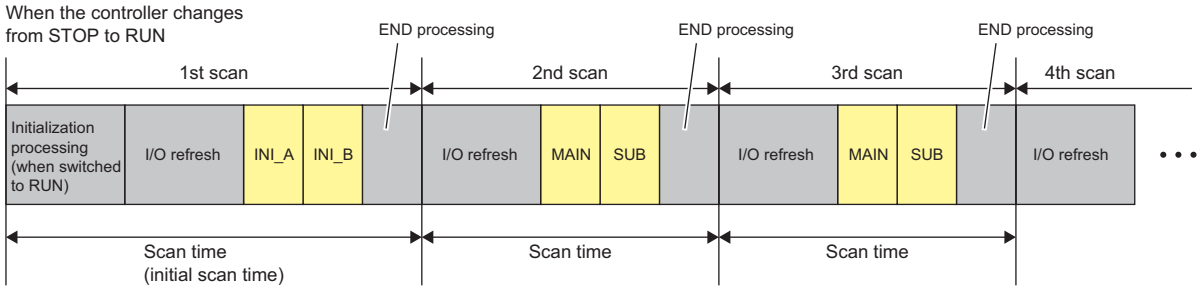
- Values stored in SD518 (Initial Scan Time) and SD519 (Initial Scan Time)

For single core execution

■When an initial execution type program exists

The following figure shows the initial scan time when there is an initial execution type program.

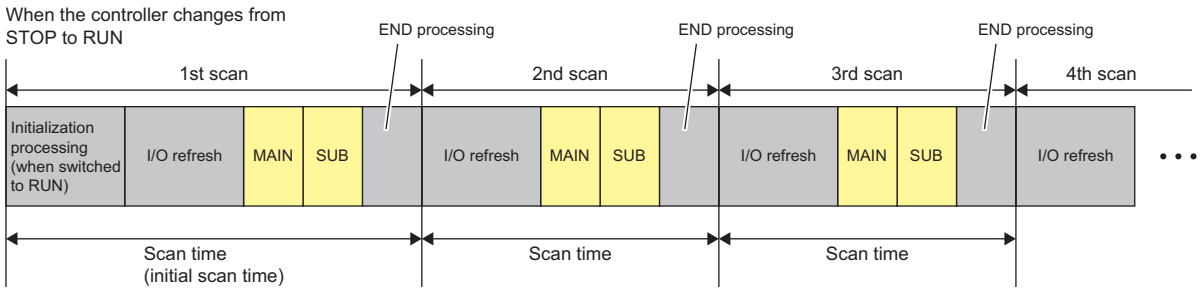
Program name	Execution type
INI_A	Initial
INI_B	Initial
MAIN	Scan
SUB	Scan



■When no initial execution type program exists

The following figure shows the initial scan time when there is no initial execution type program.

Program name	Execution type
MAIN	Scan
SUB	Scan



Initial scan time monitoring

Monitoring is performed with the initial scan time monitoring time. (☞ Page 1743 Scan Time Monitoring Time (WDT) Setting)

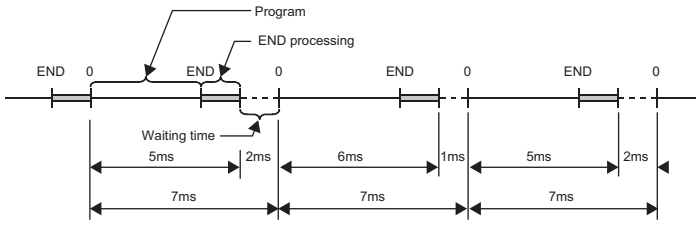
■Precautions on the initial scan time monitoring time

- Set the initial scan time monitoring time longer than the execution time of the initial scan time.

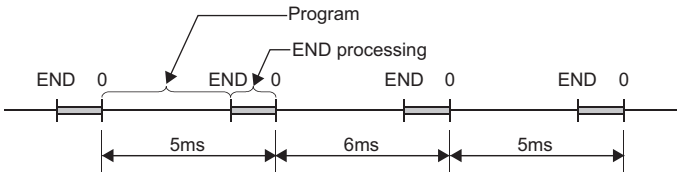
Constant scan

Scan time is different for each scan because its processing time varies depending on whether instructions used in a program are executed or not. By setting constant scan, the I/O refresh interval can be kept constant even when the program execution time varies because the program can be executed repeatedly by keeping the scan time constant.

- When constant scan is set (Setting value = 7ms)



- When constant scan is not set

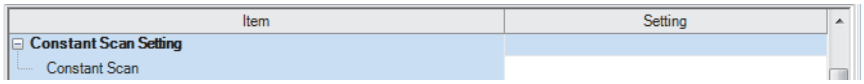


Constant scan setting

Constant scan can be set.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Contact Scan Setting]

Window



Displayed items

Item	Description	Setting range	Default
Constant Scan	Sets the constant scan time.	0.2 to 2000ms (in increments of 0.1ms)	—

Point

The setting time for the constant scan must be a value that satisfies the relational expression below.
Watchdog timer setting time > Constant scan setting time > Maximum scan time of the program
If the execution time until constant scan wait (the time period from the start of a scan to the completion of an END processing) is longer than the constant scan setting time, a constant scan time error (error code: 1818H) is detected.

Accuracy of constant scan

The accuracy of the constant scan is 0.03ms. However, if processing, which should be executed during the waiting time from the completion of the END processing to the start of the next scan, is being executed, the constant scan cannot finish even if the constant scan time is reached. The constant scan may increase by the program execution time of the interrupt factor. (☞ Page 225 Precautions)

Precautions

Processing of the program is stopped during the waiting time from the time the END processing is completed for the program until the next scan starts. If any of the following processing requests is received during the waiting time, the corresponding processing is executed.

- Interrupt program
- Fixed scan execution type program
- Event execution type program which uses an interrupt occurrence or network communication cycle synchronization as a trigger
- Data logging function
- Realtime monitor function
- Refresh synchronized with the network communication cycle (performing only the I/O refresh processing of the synchronous station)
- Device/label access service processing
- Count processing (system interruption) after executing the special counter instruction (UDCNT1/UDCNT2)
- Label access from an add-on
- Continuation error notification at error detection by the self-diagnostic function
- Device access from an add-on whose add-on type is GI/RI

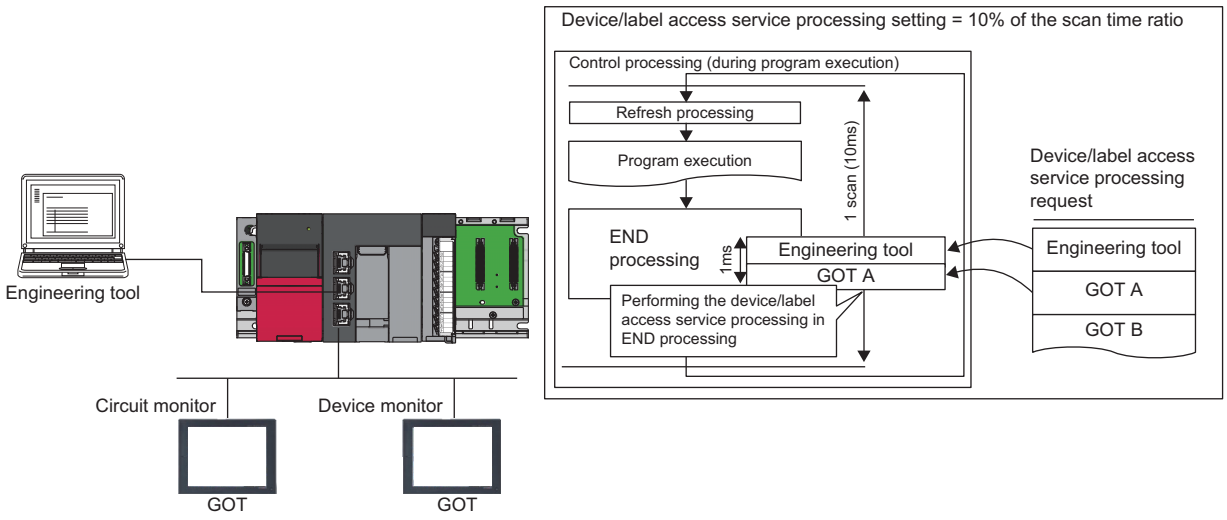
Device/label access service processing setting

The user can specify the time or the execution timing of the device/label access service processing which is performed during the END processing.

A request to the controller from a peripheral is processed by the device/label access service processing. A communication response to a request from a peripheral varies depending on the scan time and the state of communication load. To create the service processing environment suitable for the system, change the device/label access service processing setting as shown below.

- Set a longer time for the device/label access service processing to improve a communication response to a peripheral.
- Set a shorter time for the device/label access service processing to reduce a scan time extension due to service processing.

Note that communications to the controller from multiple peripherals may lower a communication response to each peripheral. Thus, consider the performance of communication responses and the extension of scan time, and adjust the service processing environment according to the system by methods such as setting a longer time for the device/label access service processing or changing the parameter settings of peripherals so that the timeout time becomes longer.



Point

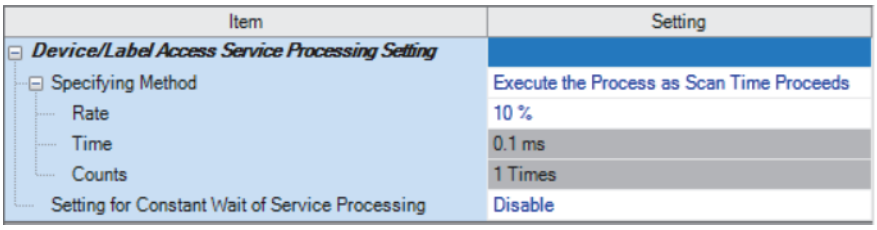
For functions to which the device/label access service processing setting can be applied, refer to the list targeted for device/label access service processing setting. (☞ Page 2122 Target list and operation details of the device/label access service processing setting)

Setting method

The device/label access service processing can be configured as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Service Processing Setting] ⇨ [Device/Label Access Service Processing Setting]

Window



Displayed items

Item	Description		Setting range	Default
Specifying Method	Select a method for specifying the service processing for access to devices/labels.		• Execute the Process as Scan Time Proceeds • Set Processing Time • Set Processing Counts • Execute END Processing between Programs	Execute the Process as Scan Time Proceeds
	Rate	Set the ratio of the device/label access service processing to execute during a single scan when "Execute the Process as Scan Time Proceeds" is enabled. The device/label access service processing time is determined based on the scan time.	1 to 99% (unit: 1%)	10%
	Time	Set the device/label access service processing time per scan when "Set Processing Time" is enabled.	0.1 to 1000ms (unit: 0.1ms)	0.1ms
	Counts	Set the number of executions of the device/label access service processing per scan when "Set Processing Counts" is enabled.	1 to 10 times (unit: 1 time)	1 time
Setting for Constant Wait of Service Processing	Specify whether to enable or disable the device/label access service processing constant wait setting.		• Disable • Enable	Disable

Operations enabled by setting details

Operations enabled by setting details of the device/label access service processing setting are as follows.

Item	Scan performance		Device/label access service process performance		Inter-program monitoring *5	Application
	Increase *1	Stability *2	Response time *3	Stability *4		
Execute the Process as Scan Time Proceeds	Medium	Medium	Medium	Medium	None	This setting is useful to execute the device/label access service processing in a way commensurate with the system size. It allows the system to be designed without considering the device/label access service processing time because it is determined based on the scan time. Multiple requests are processed until the specified ratio is exceeded. If exceeded, the remaining requests are processed in the END processing of the next scan. When no request data is received in the current scan, the scan time is shortened by the specified ratio as the controller proceeds to the next scan without waiting for requests.
Set Processing Time	Medium	High	Medium	High	None	This setting is useful to give priority to the device/label access service processing. It allows for stable communication because the controller can always process a constant amount of the device/label access service processing without affecting the scan time. Multiple requests are processed until the specified processing time is exceeded. If exceeded, the remaining requests are processed in the END processing of the next scan. When no request data is received in the current scan, the scan time is shortened by the specified processing time as the controller proceeds to the next scan without waiting for requests.
Set Processing Counts	Large	Low	Medium	High	None	This setting is useful to stably execute the device/label access service processing in a system where requests come from multiple peripherals. It provides stable communication in a system where multiple peripherals exist because the controller can execute the device/label access service processing based on the number of request sources. Multiple requests are processed until the specified number of executions of the service processing is reached. When no request data is received in the current scan, the controller proceeds to the next scan without waiting for requests.
Execute END Processing between Programs	Large	Medium	Quick	High	Yes	This setting is useful to give priority to the device/label access service processing in a system with a large number of programs. It improves the communication response as it enables the device/label access service processing to be executed multiple times during a single scan. When no request data is received between program executions and/or during the END processing, the controller proceeds to the next program or scan without waiting for requests.

*1 This term indicates how long the scan time will be extended at its maximum due to the device/label access service processing.

*2 This term indicates how much the scan time will be varied due to the device/label access service processing.

*3 This term indicates how long the response time will take after a request for the device/label access service processing is received from an engineering tool or other devices.

*4 This term indicates how much the response time will be varied depending on the contents of requests for the device/label access service processing from engineering tools or other devices.

*5 When this function is enabled, monitoring is performed between execution of programs, and therefore values of ongoing operation may be read out. (☞ Page 232 When "Execute END Processing between Programs" is enabled)

For what operation is enabled by setting each item, refer to the following.

☞ Page 2124 Target list and operation details of the device/label access service processing setting

Service processing constant wait setting

This function improves the communication response of device/label access service processing requests.
By setting "Setting for Constant Wait of Service Processing" to "Enable", device/label access service processing requests are accepted until the time and ratio set in "Device/Label Access Service Processing Setting" of the CPU parameter is reached.
Even if there is no request during device/label access service processing, the function waits until the set time is reached to allow any request accepted while waiting to be processed in the same scan and its response to be returned, thereby improving the communication response for device/label access service processing requests.

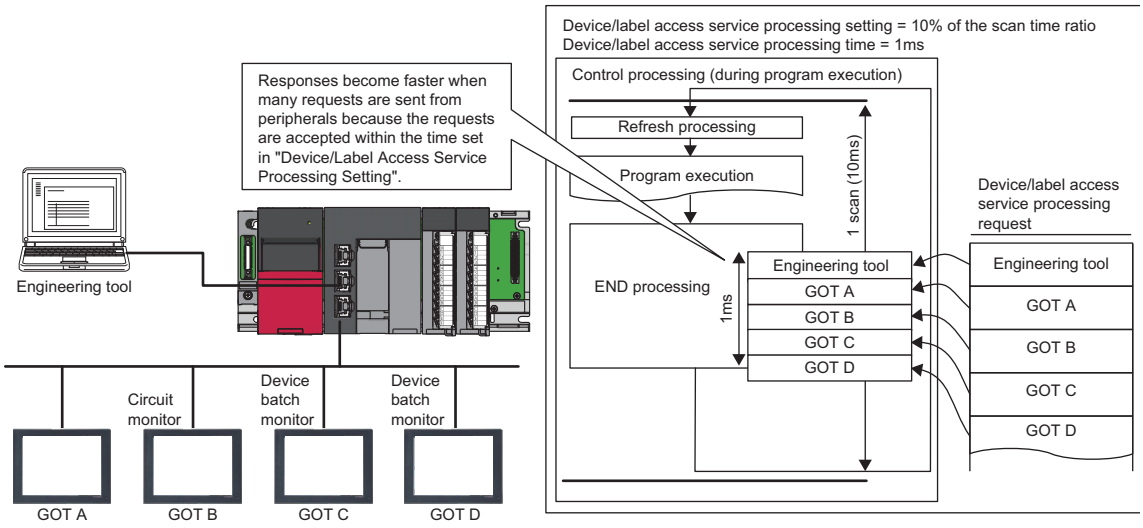
Point

• When "Setting for Constant Wait of Service Processing" is "Disable"

Requests from peripherals received up to the END processing are returned. Therefore, a scan without the device/label access service processing request move to the next scan without performing device/label access service processing, resulting in the scan time being shortened. To make the END processing time shorter than the response delay to peripherals, set "Setting for Constant Wait of Service Processing" to "Disable".
Note that when there are many requests from peripherals, the response may be delayed if the END processing time becomes longer.

• When "Setting for Constant Wait of Service Processing" is "Enable"

The response becomes faster because service processing requests are accepted until the time set in "Device/Label Access Service Processing Setting" is reached. To give priority to the response from a peripheral over the extension of the END processing, set it to "Enable". Regardless of whether there is any service processing request from a peripheral, the scan time is extended by the period of time set in "Device/Label Access Service Processing Setting". Therefore, check that the extension of the scan time does not affect control before using this function.

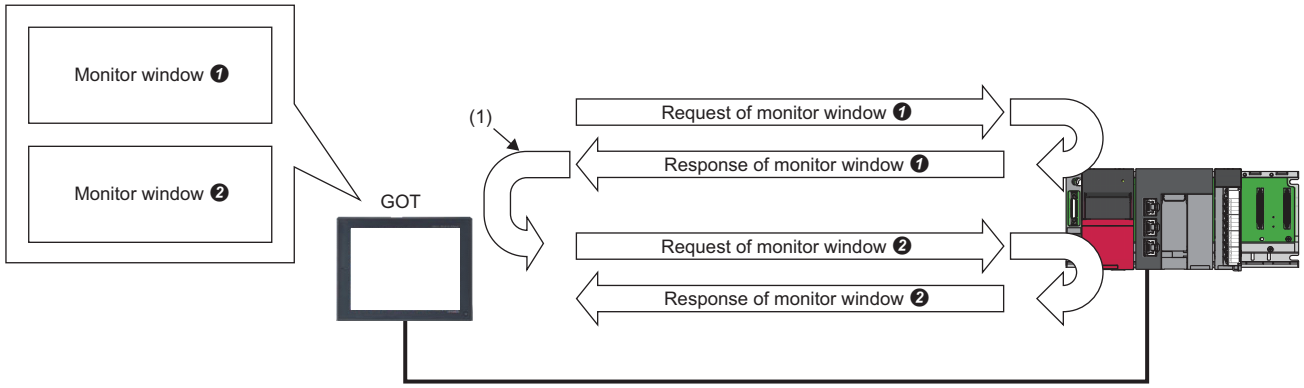


■Operation of the device/label access service processing

This section describes the operation of the device/label access service processing.

Ex.

When updating multiple monitor windows on the GOT



(1) From the time the controller sends a response until the GOT sends the next request, the controller will not receive requests from the GOT.

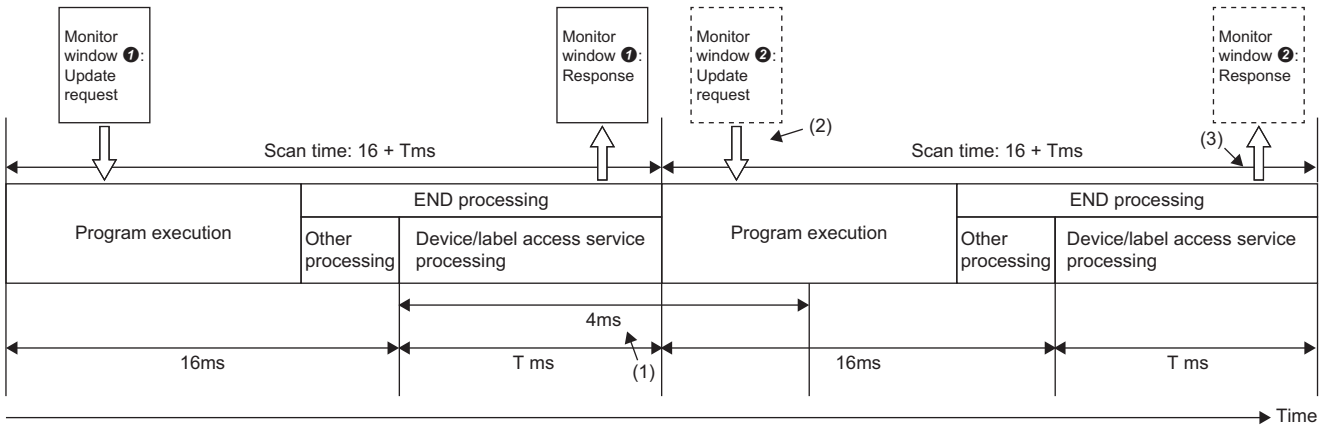
Depending on the GOT, when updating multiple monitor windows, the GOT repeats the action of sending a request (device/label read request) to the controller for each window and waiting for a response (a device/label current value).

As a result, when the windows are updated in the order of monitor window ❶ → monitor window ❷, from the time the controller sends a response for monitor window ❶ until it receives a request for monitor window ❷ that follows, the controller has no request that should be processed.

When in this state, use this setting to specify whether to process a request for monitor window ❷ in the next scan or to wait until the set time is reached before processing in the same scan.

• Operation when this function is disabled

The following figure shows the operation when "Setting for Constant Wait of Service Processing" is set to "Disable". ("Device/Label Access Service Processing Setting": "Set processing time": 4ms)



(1) Since there is no request until the next request is sent from the GOT, service processing is terminated without waiting for the set time.

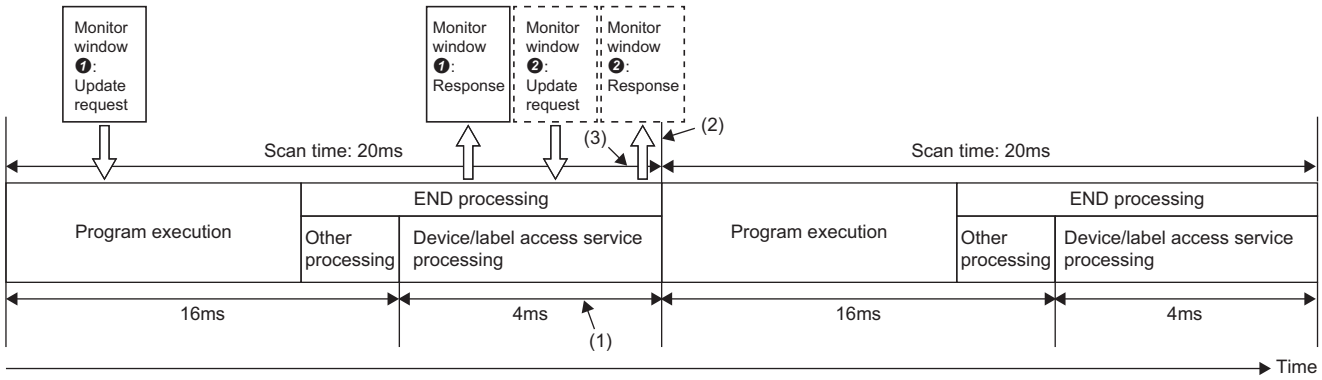
(2) The response is delayed due to waiting until the next device/label access service processing.

(3) One scan will process update requests from one monitor window.

After the controller returns a response to the peripheral, there is no request until the next request is sent from the peripheral. Therefore, immediately after returning the response of the monitor window ❶, the controller exits service processing and moves to the next scan without waiting for the setting time of several minutes. For this reason, even when updating multiple monitor windows, one scan can only process update requests from one monitor window. Therefore, the update interval may become longer.

• Operation when this function is enabled

The following figure shows the operation when "Setting for Constant Wait of Service Processing" is "Enable". ("Device/Label Access Service Processing Setting": "Set processing time": 4ms)



(1) Requests are accepted until the time set in "Device/Label Access Service Processing Setting" is reached.
(2) Update requests from multiple monitor windows can be processed in one scan.
(3) The communication response is improved because requests are accepted within the device/label access service processing time.

Even after the controller returns a response from the GOT, subsequent requests are accepted until the time and ratio specified in "Device/Label Access Service Processing Setting" is reached, thereby enabling update requests from multiple monitor windows to be processed in one scan. This improves the communication response.

■Operation in combination with device/label access service processing setting

When "Setting for Constant Wait of Service Processing" is "Enable", there will be constant wait for the rate or the amount of time set in "Execute the Process as Scan Time Proceeds" or "Set Processing Time" in "Device/Label Access Service Processing Setting".

If "Device/Label Access Service Processing Setting" is not set to "Execute the Process as Scan Time Proceeds" or "Set Processing Time", "Setting for Constant Wait of Service Processing" becomes "Disable" and service processing is performed in accordance with "Device/Label Access Service Processing Setting".

The following table lists the combination operation of "Device/Label Access Service Processing Setting" and "Setting for Constant Wait of Service Processing".

Device/label access service processing setting	Setting for Constant Wait of Service Processing	
	Disable	Enable
Execute the Process as Scan Time Proceeds	Exits processing without waiting for the next device/label access processing request if there is no device/label access processing request from the GOT.	Continues to wait for device/label access processing requests from the GOT for the amount of time set in "Device/Label Access Service Processing Setting".
Set Processing Time		
Set Processing Counts		Exits processing without waiting for the next device/label access processing request if there is no device/label access processing request from the GOT.
Execute END Processing between Programs		

Point

When the constant scan is set, the operation is the same as when constant scan is set, regardless of the settings of "Device/Label Access Service Processing Setting" and "Setting for Constant Wait of Service Processing". (The controller always processes one request during the END processing, and processes the remaining requests during the waiting time for the next constant scan.)

Precautions

This section describes the precautions on the device/label access service processing setting.

■Functions that may prolong the scan time

For the following functions, the scan time may become longer than the specified time during processing even when this setting is applied.

- Online change
- Realtime monitor function
- Data logging function
- Access to intelligent function modules and network modules (buffer memory read/write, diagnostic function and monitor function)
- Controller data backup/restoration function
- OPC UA server function
- Sequence scan synchronization sampling function

■When constant scan is set

The controller always processes one request during the END processing, and processes the remaining requests during the wait time for the next constant scan. Set constant scan setting time considering the time required for the device/label access service processing to execute.

If the program execution time + END processing time and the service processing to be executed exceed the constant scan setting time, Constant scan time error (error code: 1818H) will occur.

■When "Execute END Processing between Programs" is enabled

When "Execute END Processing between Programs" is enabled, the device/label access service processing, such as device access, is performed between program executions and during the END processing. Therefore, when monitoring is performed in the situation where a device value is processed across programs, values of ongoing operation may be read or written. *1

*1 Because the timing of monitoring (during execution of a program or the END processing) cannot be specified, values of ongoing operation may be read or written.

■Reading a label while writing data to the programmable controller

When a label is read while writing, including label add/change, is being performed to the programmable controller, unintended data may be read.

13.6 Data Communication and I/O Processing

Data communication

In data communication, data such as I/O signals, buffer memory, and link device of the controller and intelligent function module are communicated.

There are two modes for data communication: refresh mode which automatically sends/receives the module data into the device or label of the controller at the END processing and direct mode which accesses when an instruction is executed in a program.

When data communication is conducted for the module where a major error occurs, the following operation is performed:

- When access by the contact instruction is executed for the controlled module, non-running, rather than an error, is returned. When direct access by other instructions is executed, Module major error (error code: 2450H) occurs.
- No error occurs when direct access for the non-controlled module is executed.

I/O processing and response delay

The controller uses the refresh mode in I/O processing. Using the direct access input/output in a program, however, allows the controller to perform I/O processing in the direct mode at the time of each instruction execution. This section describes these I/O processing modes of the controller and response delays.

Refresh mode

The controller performs I/O processing collectively at a specified timing. The following table lists the refresh timing which can be specified. (☞ Page 234 Refresh mode)

Refresh timing	Description
When END processing is performed	The refresh processing is performed in every END processing*1.
At the execution time of specified program	The refresh processing is performed before and after specified program execution. (☞ Page 259 Group setting for refresh)

*1 There are modules which performs the refresh processing at a specified END processing rather than at every END processing. (📖 User's manual for the module used)

Direct mode

The controller performs I/O processing when each instruction is executed in a program. To access input/output modules in the direct mode, use the direct access input or direct access output in a program. (☞ Page 241 Direct mode)

Differences between refresh mode and direct mode

The direct mode directly accesses I/O modules at execution of an instruction. Therefore, data is input faster than when it is input in refresh mode. Processing time required for each instruction, however, takes longer. The following table lists the availability of the refresh mode and the direct mode for each input and output.

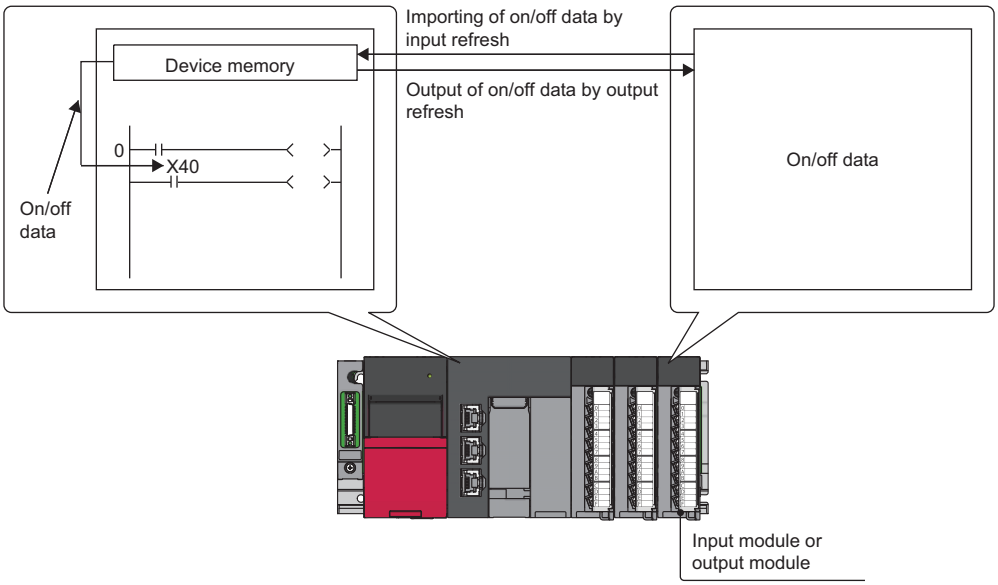
Item	Refresh mode	Direct mode
Input/output modules	Enabled	Enabled
Input/output of intelligent function modules		
Remote input/output in CC-Link IE TSN, CC-Link IE Controller Network, CC-Link IE Field Network, or CC-Link		Disabled

Refresh mode

This mode exchanges data at the specified timing (at the END instruction execution or before the specified program is executed) between the CPU function part memory (device and module labels, network labels) and each module, motion function part, CC-Link IE TSN function part input/output signal (X, Y), and internal memory (link device (RX, RY, RWr, RWw, SB, SW), buffer memory).

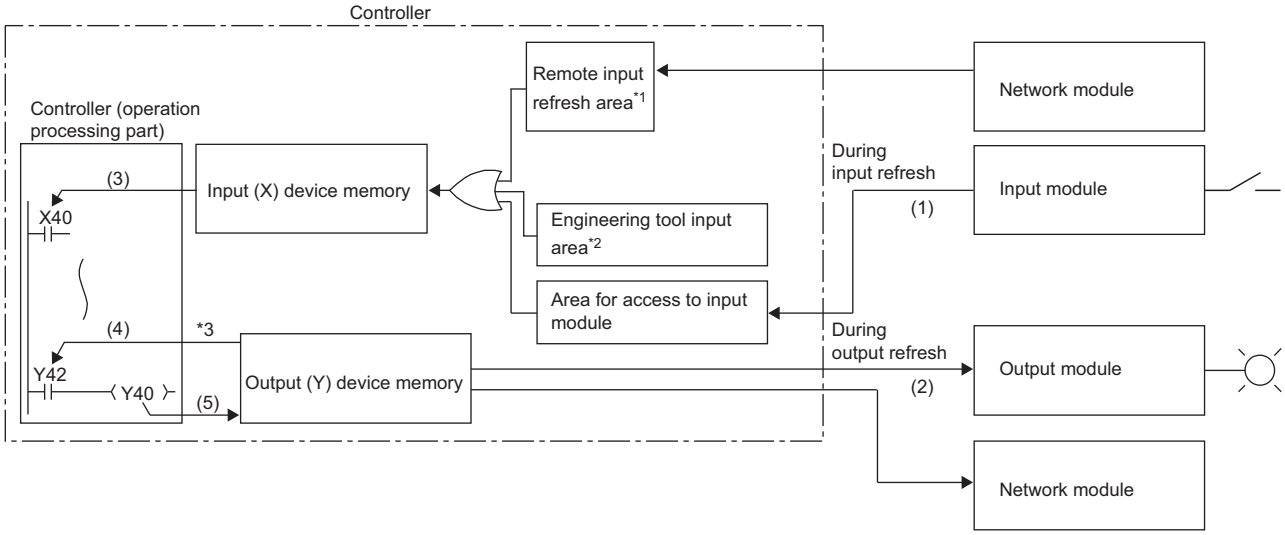
The controller performs I/O processing collectively at a specified timing.

The timing of the input refresh and output refresh follows the specified refresh timing setting.



Outline of the processing

The following describes the details of the refresh mode.



*1 The remote input refresh area indicates the area to be used when refresh is set to the input (X) in CC-Link IE TSN, CC-Link IE Controller Network, CC-Link IE Field Network, or CC-Link.

*2 Data in the engineering tool input area can be turned on or off by the following:
- · Test operation of an engineering tool
- · Writing data from the network module
- · Writing data from an external device using SLMP

*3 Data in the output (Y) device memory can be turned on or off by the following:
- · Test operation of an engineering tool
- · Writing data from the network module
- · Writing data from an external device using SLMP

Item	Description
Input refresh	At a specified timing (at END instruction execution or before specified program execution), input data are collectively read out from the input modules (1), the OR processing with the engineering tool input area and remote input refresh area is executed, and then the data are stored in the input (X) device memory.
Output refresh	At a specified timing (at END instruction execution or before specified program execution), data in the output (Y) device memory (2) are collectively output to the output module.
Execution of an input contact instruction	Input data in the input (X) device memory (3) are read out and the program is executed.
Execution of an output contact instruction	Output data in the output (Y) device memory (4) are read out and the program is executed.
Execution of the OUT instruction	The operation result of the program (5) are stored to the output (Y) device memory.

■Input

ON/ OFF data of an input module are batch-input to the area for communication with the input module in the controller at a specified timing (at END instruction execution or before specified program execution). The controller performs program operations using the on/off data stored in the input (X) device memory.

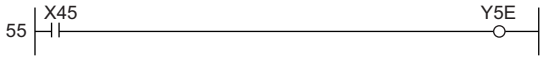
■Output

The operation result of the output (Y) program is output to the output (Y) device memory in the controller every time program operation is performed. Then, the controller batch-outputs the ON/OFF data in the output (Y) device memory to an output module at a specified timing (at END instruction execution or before specified program execution).

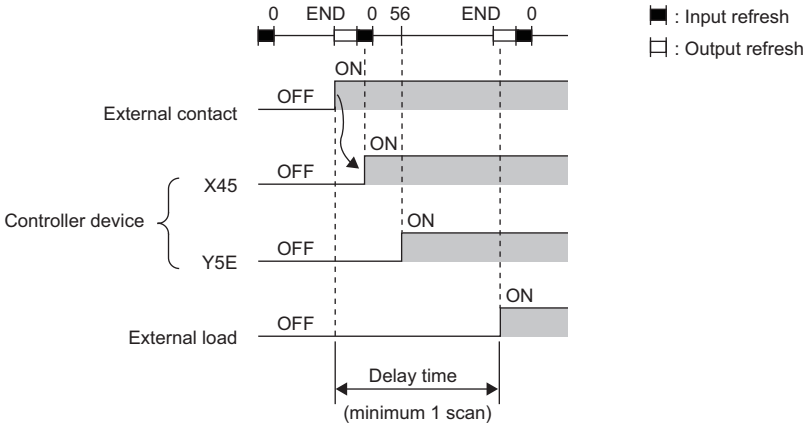
Response delay

An output response which corresponds to the status change in the input module delays for two scans (maximum) depending on the on timing of an external contact.

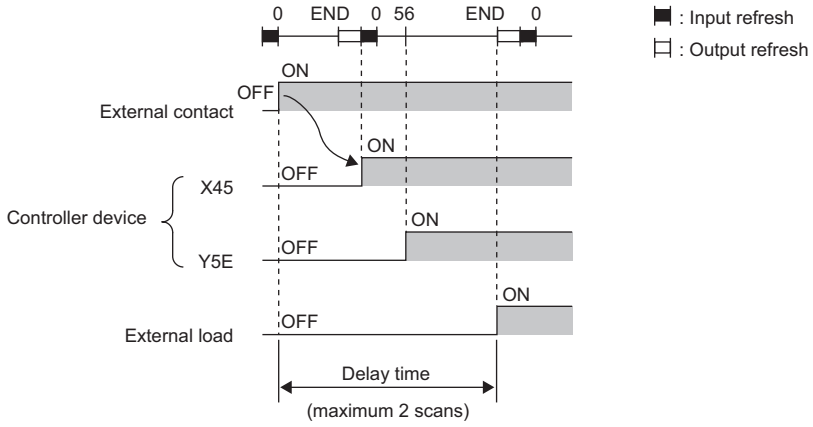
[Example] A program that turns on the output Y5E when the input X45 turns on



• Y5E turns on the earliest



• Y5E turns on the latest



Refresh synchronized with the network communication cycle

When the network synchronous communication function of the built-in network is used, refresh is performed in synchronization with the network communication cycle.

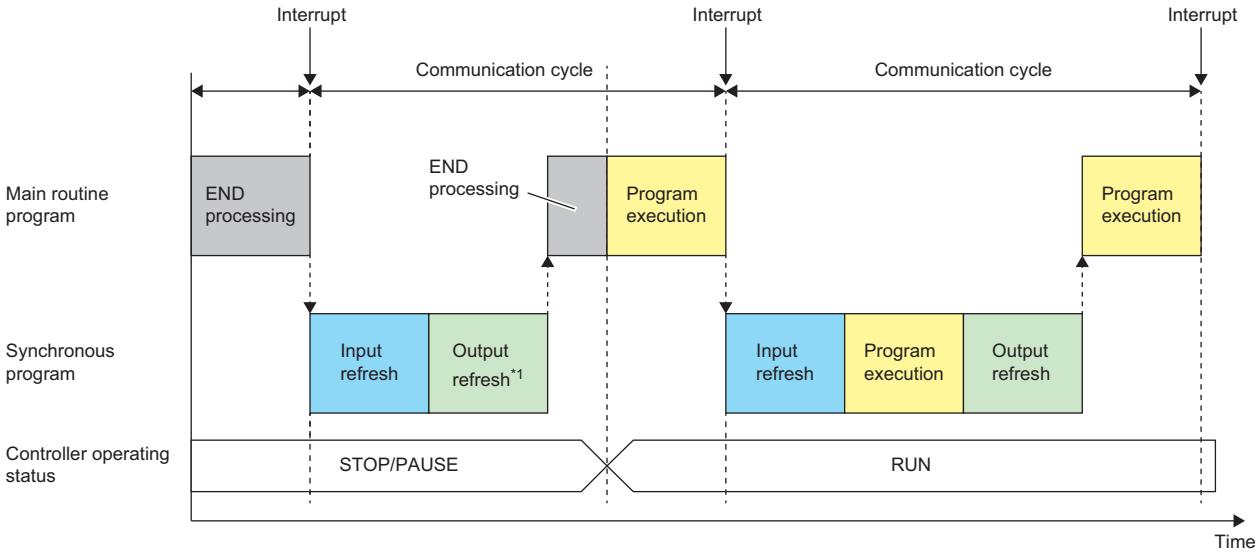
Point

For device stations that refresh in synchronization with the network communication cycle, by using [Network Configuration Settings] under [Basic Settings] of the module parameter (TSN), set [Network Synchronous Communication] to "Synchronous". Device stations set to "Asynchronous" are refreshed by the END processing.

■Operation during STOP/PAUSE

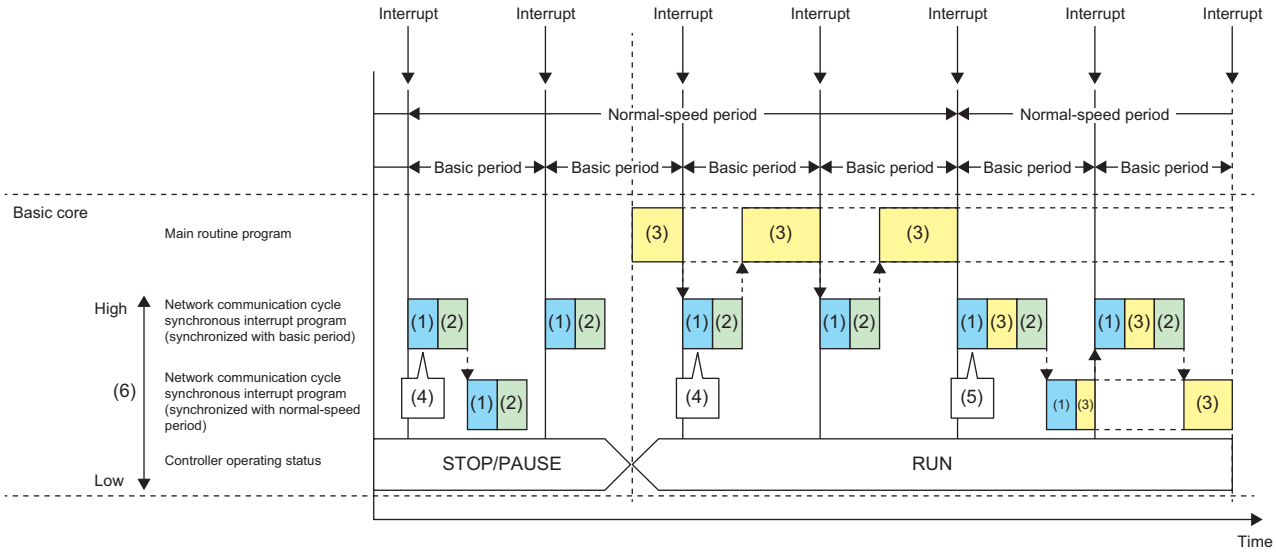
Refresh is performed when an interrupt (synchronous interrupt) occurs in the network communication cycle.
Also, if there is a program that synchronizes with the network communication cycle (event execution type program triggered by network communication cycle synchronization), refresh and program are executed when a synchronization interrupt occurs after transition to RUN.
Also, if there is an event execution type program which uses network communication cycle synchronization with different operation cycles as a trigger, only refresh is performed until the program is executed, and the program is executed in the first cycle (1st/N cycle) of the slowest cycle after transition to RUN.

• Operation during STOP/PAUSE



*1 Only refresh is performed.

• Operation after transition to RUN when multiple cycles are mixed



(1) Input refresh
(2) Output refresh
(3) Program execution
(4) Only refresh is performed.
(5) Program is executed in the first cycle (1st/N cycle) of the slowest cycle.
(6) Interrupt priority

Point

When the controller status changes from RUN to STOP, program execution stops, but motion control decelerates and stops. Therefore, refresh processing continues when a synchronous interrupt occurs.
For information on the operation performed when an axis under motion control stops, refer to the following.
☞ Page 578 Stop

■Operation during RUN

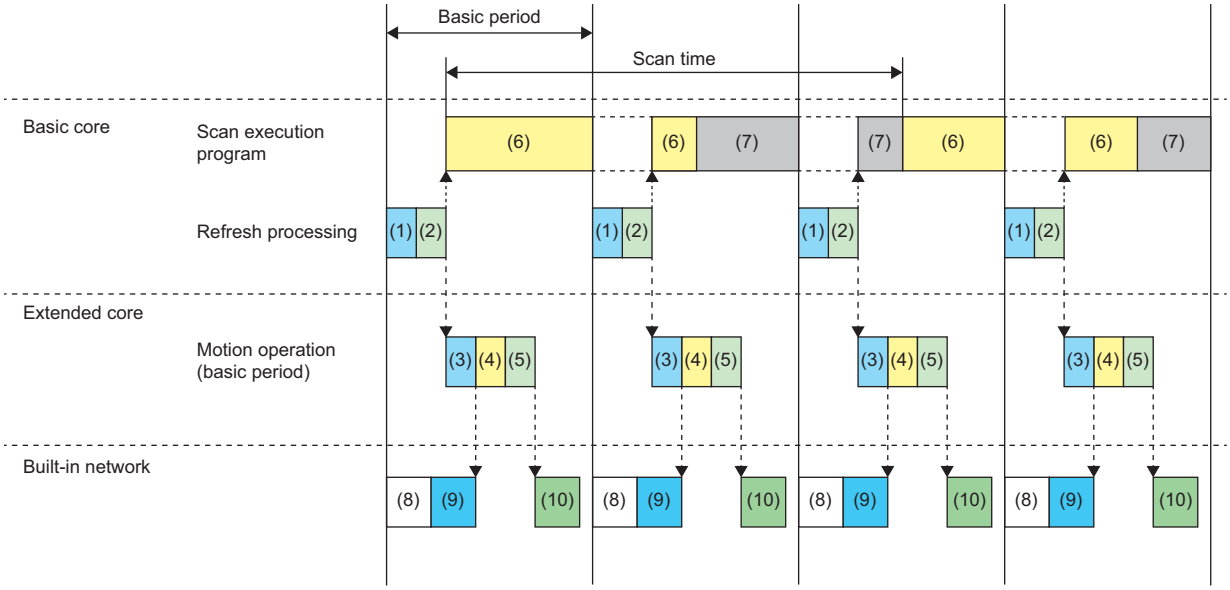
• When an event execution type program which uses network communication cycle synchronization as a trigger is used

Refresh is performed before and after the network communication cycle synchronous interrupt program execution. Therefore, the execution core and interrupt priority for refresh processing are the same as for the synchronous program.

• When an event execution type program which uses network communication cycle synchronization as a trigger is not used

Only refresh is performed when a synchronous interrupt occurs, and motion operation processing is performed after refresh is completed. The refresh processing is executed in the basic core, and the interrupt priority follows the interrupt priority settings of the CPU parameter. (☞ Page 275 Interrupt Priority Setting)

The following figure shows the refresh operation when the synchronization program is not used.



(1) Input refresh of the synchronous station (basic cycle)
(2) Output refresh of the synchronous station (basic cycle)
(3) Input processing of motion operation (basic cycle)
(4) Operation processing of motion operation (basic cycle)
(5) Output processing of motion operation (basic cycle)
(6) Execute the scan execution program.
(7) END processing (input/output refresh of the asynchronous station)
(8) Cyclic transmission
(9) Cyclic receive processing
(10)Cyclic send processing

Point

- When an event execution type program which uses network communication cycle synchronization as a trigger is not used, the interrupt priority for refresh processing follows the interrupt priority settings of the CPU parameter. Therefore, to have refresh processing run first, set the priority of other programs to low. (☞ Page 275 Interrupt Priority Setting)
- When [Network Synchronous Communication] of a device station with the medium-speed or low-speed cycle is set to "Synchronous", set [Network Synchronous Communication] of one or more device stations with the basic cycle to "Synchronous". If only device stations with the medium-speed or low-speed cycle are set to "Synchronous", an internal network error will occur.

■Checking received data using the watchdog counter

In the refresh synchronized with the communication cycle of the network, the watchdog counter sent with the received data from the device to be synchronized is used to check whether the received data is the data generated by the device to be synchronized for each communication cycle, It is checked for each device that is distinguished by the module number.
As a result of the check, if it is determined that the data generated for each communication cycle has been received, the received data is transferred to the device/label. If it is determined that the data is not generated for each communication cycle, the data received from the corresponding device will not be transferred to the device/label.
For the watchdog counter, refer to the following.
☞ Page 289 Watchdog counter
For the module number, refer to the following.
☞ Page 2060 Synchronous communication received data transfer status (Module No.1) to Synchronous communication received data transfer status (Module No.256)

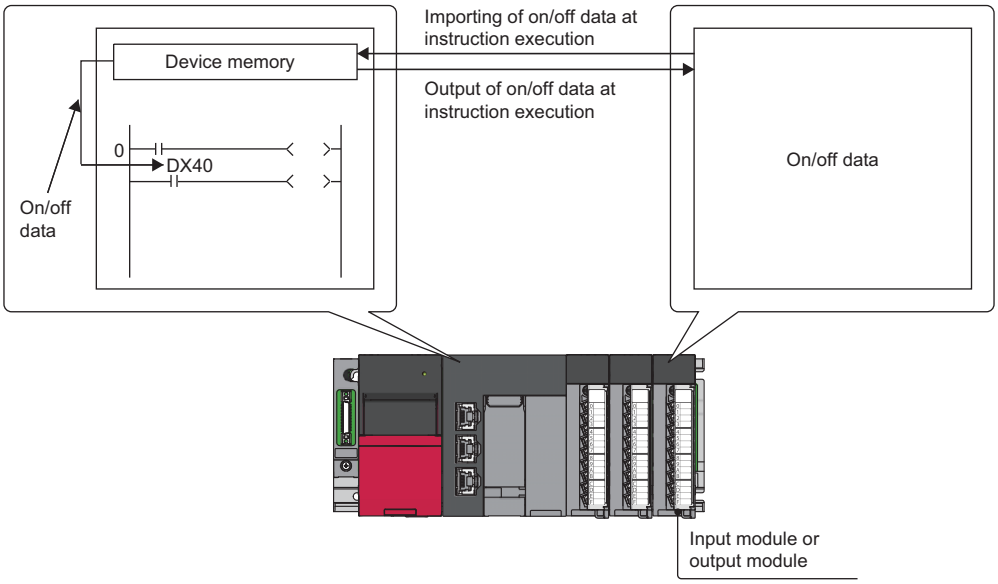
• If data generated for each communication cycle cannot be received over multiple cycles

Received data from the corresponding device will not be transferred to the device/label until the transfer restart condition is satisfied.
The fact that the transfer of receive data to the device/label has stopped is stored in the 'Synchronous communication received data transfer status' (U3E0\G10451 to U3E0\G10706). At this time, Synchronous watchdog counter error (error code: 125AH) or Watchdog counter error (error code: 1A40H) is detected.
To resume the transfer of received data to the device/label, any of the following conditions are to be satisfied.

- A restart request is set in 'Restart transfer of synchronous communication received data' (U3E0\G10708 to U3E0\G10963) and the transfer of received data from the corresponding device is instructed to resume.
- The corresponding device is restarted. (Even if the device is disconnected, it will be reconnected when the device is restarted.)

Direct mode

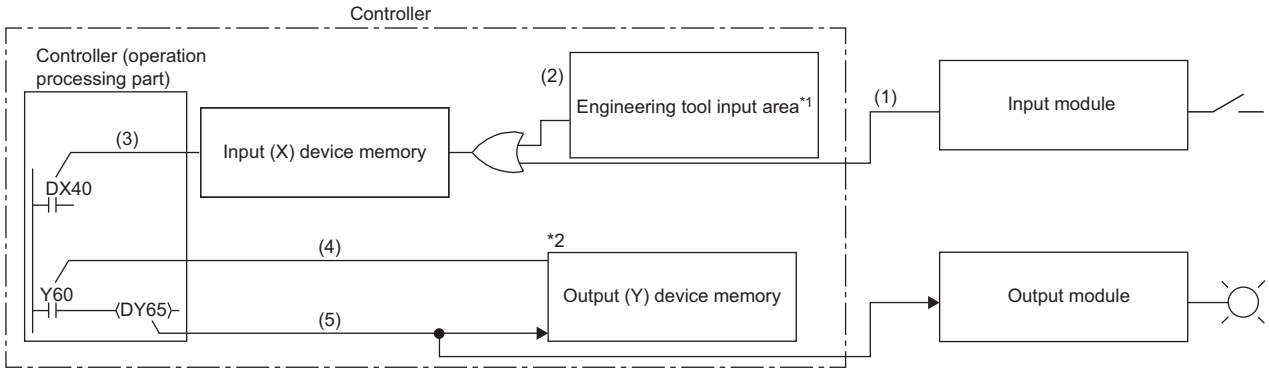
The controller performs I/O processing when each instruction is executed in a program.



The controller uses direct access input (DX) and direct access output (DY) to perform direct I/O processing.

Outline of the processing

The following describes the details of the direct mode.



*1 Data in the engineering tool input area can be turned on or off by the following:
- Test operation of an engineering tool
- Writing data from the network module
- Writing data from an external device using SLMP

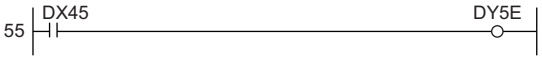
*2 Data in the output (Y) device memory can be turned on or off by the following:
- Test operation of an engineering tool
- Writing data from the network module
- Writing data from an external device using SLMP

Item	Description
Execution of an input contact instruction	The OR processing is executed with the input information of the input module (1) and the input data of the engineering tool input area (2) or remote input refresh area. The result is stored in the input (X) device memory and is used as input data (3) to execute the program.
Execution of an output contact instruction	Output data in the output (Y) device memory (4) are read out and the program is executed.
Execution of the OUT instruction	The operation result of the program (5) is output to the output module, and stored in the output (Y) device memory.

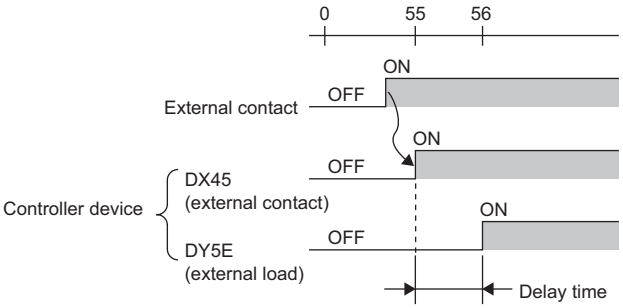
Response delay

An output response which corresponds to the status change in the input module delays for one scan (maximum) depending on the on timing of an external contact.

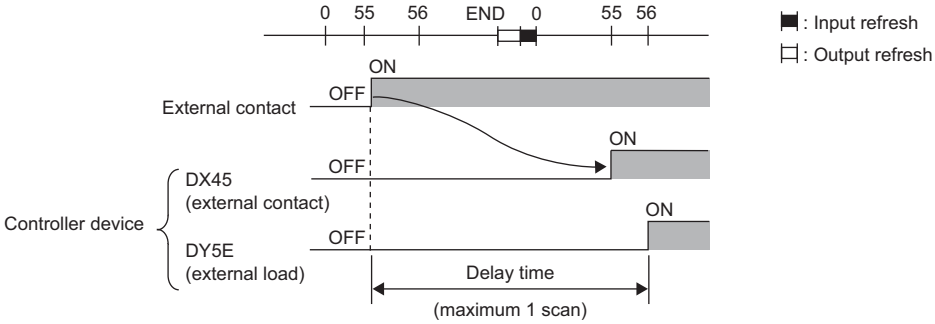
[Example] A program that turns on the output DY5E when the input DX45 turns on



- Y5E turns on the earliest



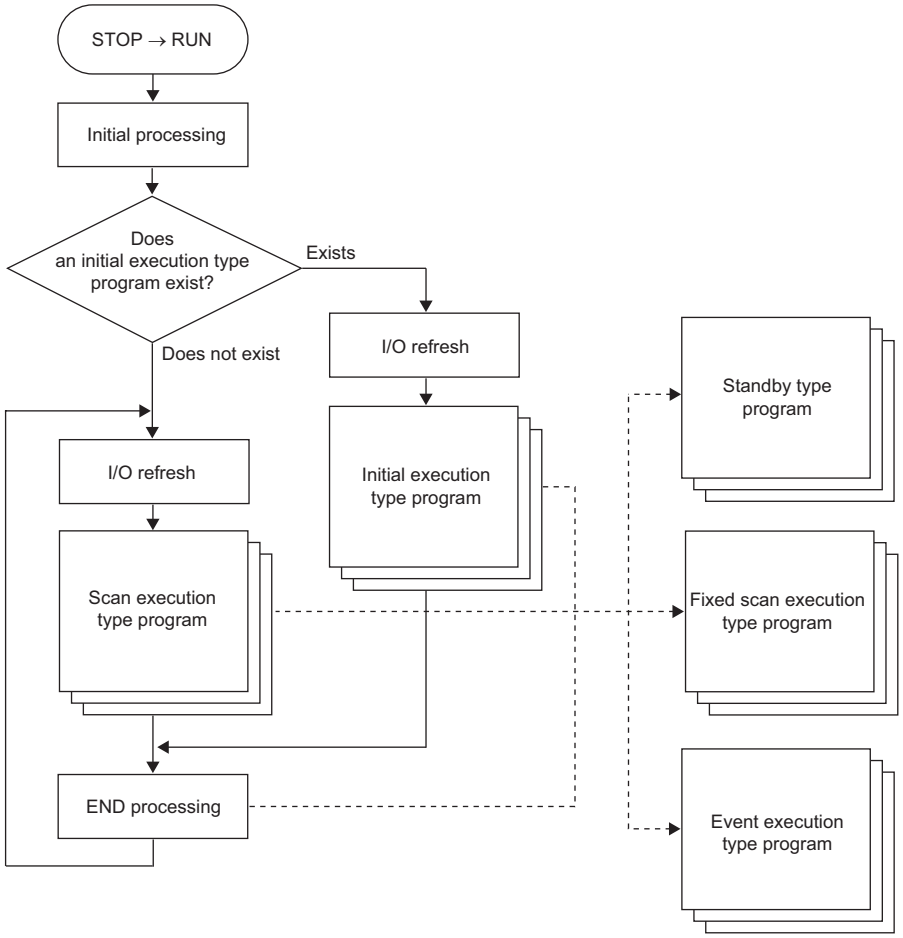
- Y5E turns on the latest



14 RUNNING A PROGRAM

14.1 Program Flow

Programs are executed in order when the controller is switched to the RUN state according to the program execution type and execution sequence settings. (☞ Page 246 Program Execution Type, ☞ Page 258 Execution type change)



Point

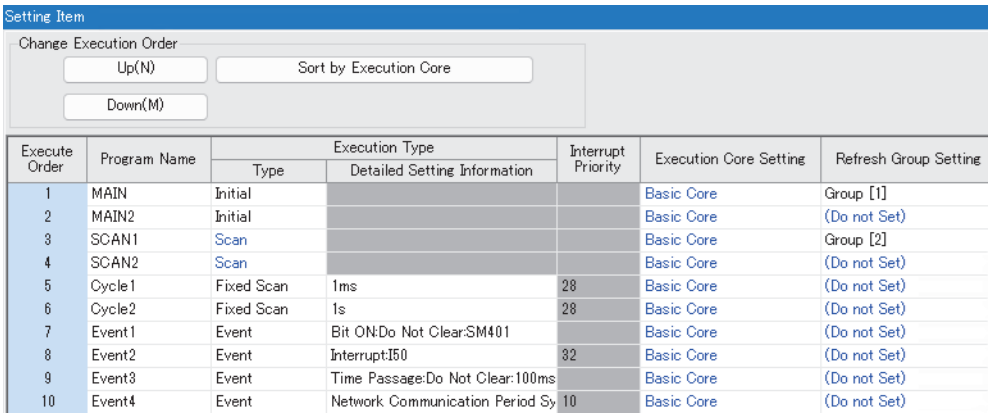
Programs with the same execution type are executed according to the execution sequence settings.

14.2 Program Setting

The program setting function is set in "Program Setting" of "CPU Parameter".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting]

The following is the setting window for the program setting function.



Execute Order	Program Name	Execution Type		Interrupt Priority	Execution Core Setting	Refresh Group Setting
		Type	Detailed Setting Information			
1	MAIN	Initial			Basic Core	Group [1]
2	MAIN2	Initial			Basic Core	(Do not Set)
3	SCAN1	Scan			Basic Core	Group [2]
4	SCAN2	Scan			Basic Core	(Do not Set)
5	Cycle1	Fixed Scan	1ms	28	Basic Core	(Do not Set)
6	Cycle2	Fixed Scan	1s	28	Basic Core	(Do not Set)
7	Event1	Event	Bit ON:Do Not Clear:SM401		Basic Core	(Do not Set)
8	Event2	Event	Interrupt:I50	32	Basic Core	(Do not Set)
9	Event3	Event	Time Passage:Do Not Clear:100ms		Basic Core	(Do not Set)
10	Event4	Event	Network Communication Period Sy	10	Basic Core	(Do not Set)

The items of the program setting function are shown below.

Item		Description	Setting range	Default
Change Execution Order	Up	Moves the execution order of the selected program one step backward.	—	—
	Down	Moves the execution order of the selected program one step forward.	—	—
	Sort by Execution Core	Rearranges the programs so that they are executed in order of the execution cores.	—	—
Execute Order		Indicates the order of program execution.	1 to 380 programs*1	Program creation order
Program Name		Sets the program file name.	1 to 60 characters	—

Item		Description	Setting range		Default
Execution Type	Type	Sets the program execution type.	• Standby • Scan • Initial • Fixed scan • Event		Scan
	Detailed Setting Information	Displays the detailed settings for fixed scan execution type programs and event execution type programs.	■Fixed scan execution type program Sets the fixed scan interval.	Specified Time Intervals: 0.5 to 60000 [ms]/1 to 60 [s]	—
			■Event execution type program Sets a trigger.	■ON of Bit Data (TRUE) Sets the device used as the trigger. • Clear Output and Current Value of Timer: Clear/Do Not Clear	Bit ON: Do Not Clear
				■Interruption Occurrence Sets the interrupt pointer used as the trigger. • I0 to I15, I28 to I31, I48, I49, I50 to I1023	
				■Time Passage Sets the elapsed time that will be the trigger. • Passing Time: 1 to 65535 [ms]/1 to 65535 [s] • Clear Output and Current Value of Timer: Clear/Do Not Clear	
				■Network Communication Period Synchronization Sets the network communication cycle to be synchronized. • Synchronize with Basic Period • Synchronize with Normal-Speed • Synchronize with Low-Speed	
Interrupt Priority		Displays the priority of interrupt programs.	• 1 to 32 (Only the fixed scan execution type and event execution type (when the trigger type is set to Interruption Occurrence or Network Communication Cycle Synchronization) are displayed.) For details on changing the priority, refer to the following. ☞ Page 275 Interrupt Priority Setting		—
Execution Core Setting		Sets the execution core for parallel program execution.	• Basic Core • Extended Core 1 to 3 (only the extended cores set to program execution in the extended core setting)		Basic Core
Refresh Group Setting		Sets a refresh group.	• Group [1] to [64]		(Do not Set)
Device/File Use Or not		Specifies whether to use local device and local index register areas.	Enable		Enable
		Specifies whether to use the initial device value of the local device.	• Use File Setting • Disable		Use File Setting

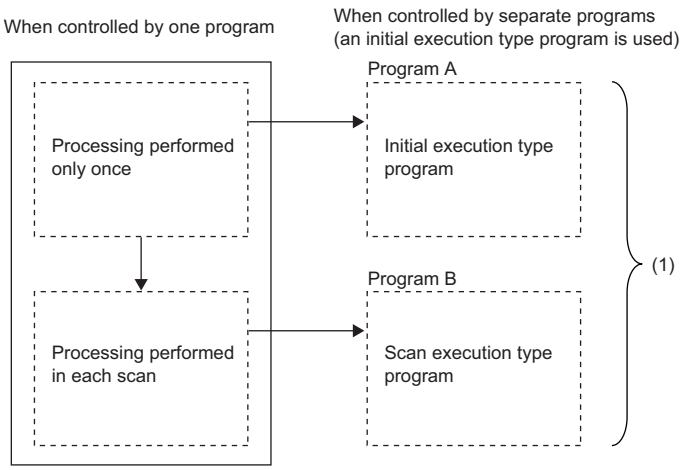
*1 Differs depending on the controller model type. For details on the number of programs, refer to the following.
☞ Page 210 Hardware specifications

14.3 Program Execution Type

Set the execution condition of the program. (☞ Page 258 Execution type change)

Initial execution type program

This program is executed only once when the controller status is changed from the power-on to RUN or from STOP (PAUSE) to RUN. Use this execution type for a program, for example, initial processing for the intelligent function module, which does not need execution after executed once in the initial scan.

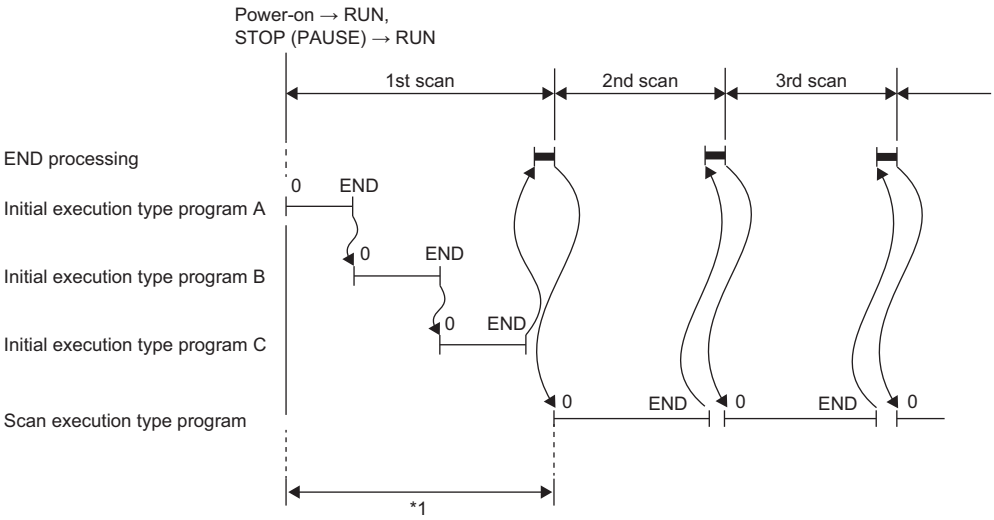


(1) The program is divided into the initial execution type program and scan execution type program.

Point

When an initial execution type program is registered, interrupts are disabled during the execution of the initial execution type program in the first scan after the status is changed to RUN, but interrupts are enabled at the execution of the program in the second and subsequent scans.

Note that the execution time of the initial execution type program is the same as the initial scan time. (☞ Page 222 Initial scan time) When multiple initial execution type programs are executed, the execution time of the initial execution type program will be the total time until all the initial execution type programs finish execution.



*1 The sum of the initial execution type program execution time and END processing time is the initial scan time.

Precautions

The following lists the precautions for the initial execution type programs.

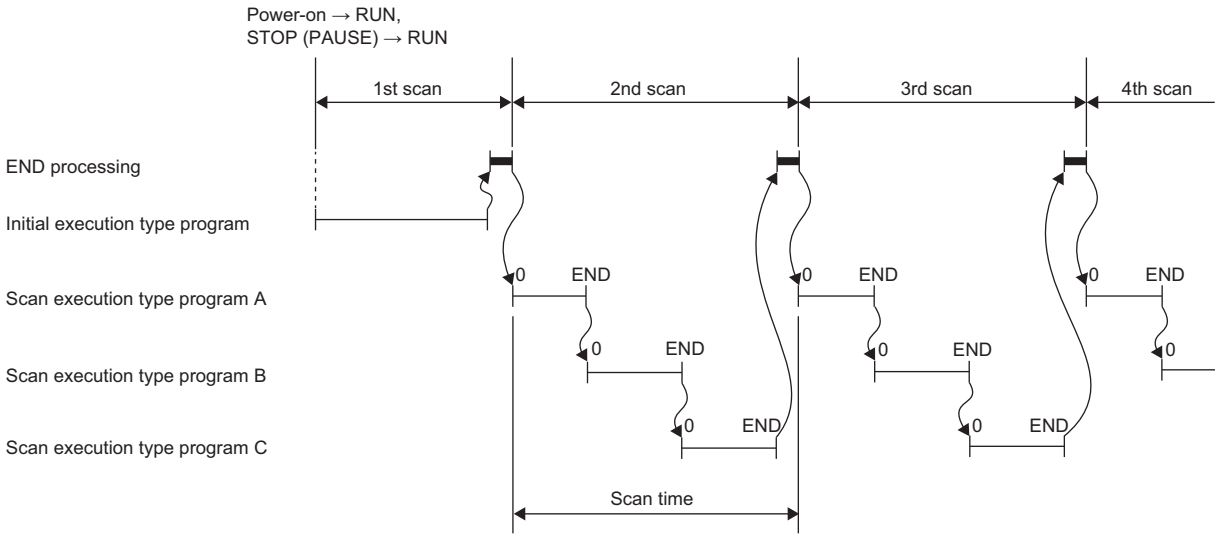
■Restrictions on program creation

In the initial execution type program, do not use an instruction which requires several scans to complete (an instruction with a completion device).

Ex.
Such as the SEND and RECV instructions

Scan execution type program

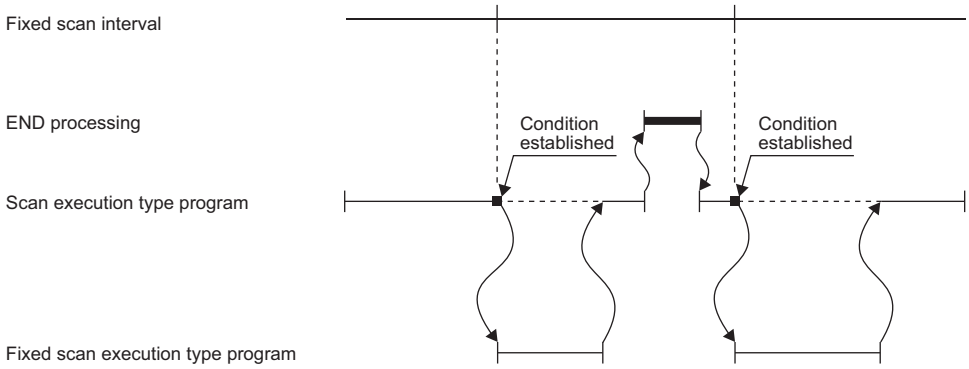
Scan execution type program is executed only once per every scan starting from the scan following the scan in which the initial execution type program was executed.



When multiple scan execution type programs are executed, the execution time of the scan execution type program will be the total time until all the scan execution type programs finish execution. Note that if interrupt program, fixed scan execution type program, and/or event execution type program are executed before the scan execution type program finishes execution, the execution time for these programs is also included.

Fixed scan execution type program

This is an interrupt program which is executed at specified time intervals. Differently from the normal interrupt program, this type of program does not require the interrupt pointer (I) and the IRET instruction and is executed for each program file unit.



Fixed scan interval setting

Set the execution condition of the fixed scan execution type program.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting]

Operating procedure

"Program Setting" window

Item	Setting
Program Setting	
Program Setting	<Detailed Setting>

"Detailed Setting" window

Execute Order	Program Name	Execution Type: Type	Execution Type: Detailed Setting Information	Interrupt Priority	Execution Core Setting	Refresh Group Setting	Device/File Use or not
1	MAIN	Fixed Scan		28	Basic Core	(Do not Set)	<Detailed Setting>
2							

"Fixed Scan Execution Type Detailed Setting" window

Item	Setting
Fixed Scan Interval	
Unit	ms

1. Click "Detailed Setting" on the "Program Setting" window.
2. Select the program name and set the execution type to "Fixed Scan".
3. Click "Detailed Setting Information".
4. Set the fixed scan interval.

Displayed items

Item	Description	Setting range	Default
Fixed Scan Interval	Sets the fixed scan interval to execute the fixed scan execution type program.	• When "ms" is selected: 0.5 to 60000ms (in increments of 0.5ms) • When "s" is selected: 1 to 60s (in increments of 1s)	—
Unit	Selects the unit for the fixed scan interval.	• ms • s	ms

Priority of fixed scan execution type programs

The priority of fixed scan execution type programs can be set. For details, refer to the following.

☞ Page 274 Interrupt priority

Operation when the execution condition is satisfied

The following describes operation of the program.

■If the execution condition is satisfied before the interrupt is enabled by the EI instruction

The program enters the waiting status and is executed when the interrupt is enabled. Note that if the execution condition for this fixed scan execution type program is satisfied more than once during the waiting status, the program is executed only once when the interrupt is enabled.

■If there are multiple fixed scan execution type programs

If the specified time comes simultaneously for these programs, they are executed in order according to the specified execution sequence.

■If another or the same execution condition is satisfied while the fixed scan execution type program is being executed

The program is executed according to the fixed scan execution mode setting.

☞ Page 250 Fixed scan execution type program

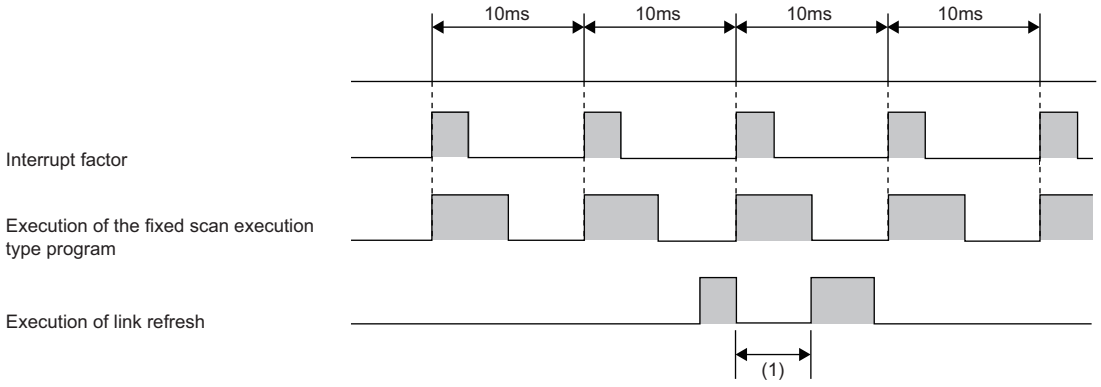
■If the execution condition is satisfied while the interrupt is disabled by the system

The program is executed according to the fixed scan execution mode setting.

☞ Page 250 Fixed scan execution type program

■If an interrupt factor occurs during link refresh

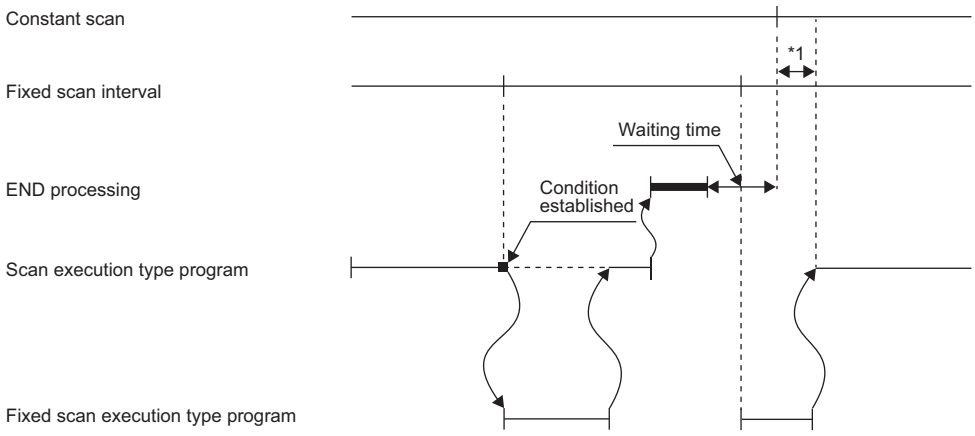
The link refresh is suspended and the fixed scan execution type program is executed. Even while the station-based block data assurance is enabled for cyclic data during refresh of such links as CC-Link IE TSN, if the fixed scan execution type program uses a device specified as the refresh target, the station-based block data assurance for cyclic data is not available.



(1) The link refresh is suspended and the fixed scan execution type program is executed.

■If an interrupt factor occurs during the waiting time after END processing in constant scan execution

The fixed scan execution type program is executed.



*1 If processing does not finish during the waiting time, the scan time is extended.

■If another interrupt occurs while the fixed scan execution type program is being executed

If an interrupt program (including an interrupt which triggers the event execution type program) is triggered while the fixed scan execution type program is being executed, the program operates in accordance with the interrupt priority. (☞ Page 274 Multiple interrupt)

Processing when the fixed scan execution type program starts

The same processing as when the interrupt program starts. (☞ Page 269 Processing at interrupt program startup)

Fixed scan execution mode

For fixed scan interrupts (I28 to I31, I48, I49) triggered by the fixed scan execution type program or the internal timer of the controller, this mode specifies the program execution operation that is performed when more than one interrupt occurs. (☞ Page 262 Operation upon occurrence of an interrupt factor) However, when an execution cause occurs while the interrupt is disabled by the DI instruction or during the execution of the online program change function, the fixed scan execution mode is excluded from the target.

For the online change, refer to the following.

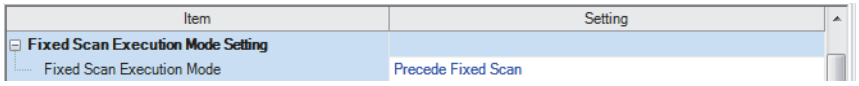
☞ Page 1594 Online Change

■Fixed scan execution mode setting

Use the fixed scan execution mode setting.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Interrupt Settings] ⇨ [Fixed Scan Execution Mode Setting]

Window



Displayed items

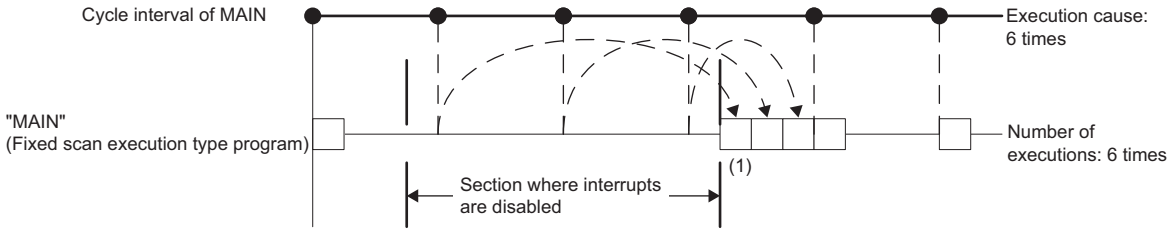
Item	Description	Setting range	Default
Fixed Scan Execution Mode	When fixed scan characteristics are prioritized, an execution is performed within the delay limit value behind a cycle. When the number of executions is prioritized, all the pending executions are performed.	• Precede Fixed Scan • Execution Count Takes Priority	Precede Fixed Scan

■Operation in the fixed scan execution mode

This section describes the operation which can be performed in the fixed scan execution mode.

• Execution Count Takes Priority

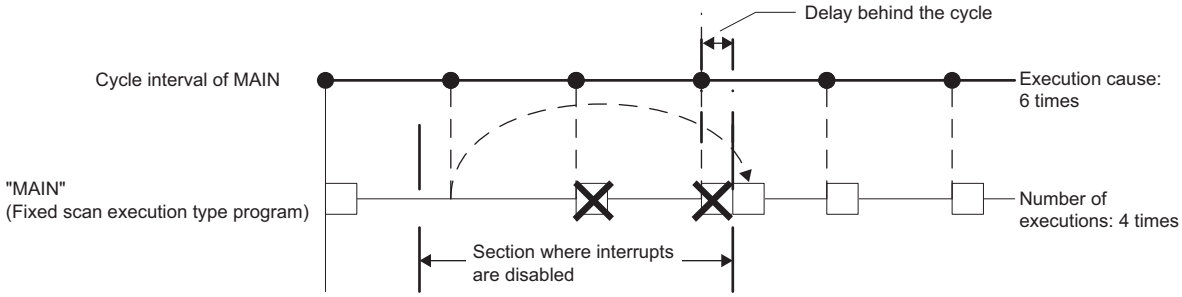
The program is executed for all the pending number of executions so that it can be executed the same number of times as execution causes.



(1) The three pending executions will be executed immediately after an interrupt becomes available.

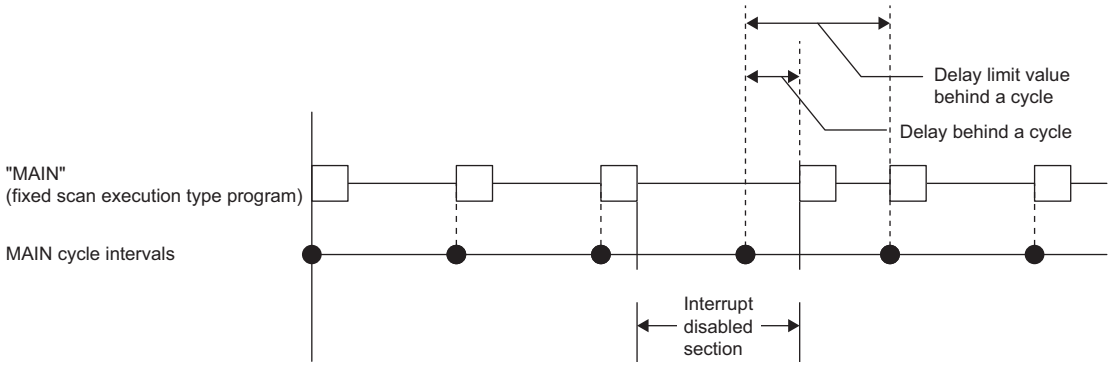
• Precede Fixed Scan

When a pending execution exists, it is performed within the delay limit value behind a cycle. (☞ Page 251 Delay limit value behind a cycle) Note that, even if more than one pending execution exists, only one execution is performed.



■Delay limit value behind a cycle

This value indicates the allowable period of time for a delay (a time lag) behind a cycle and a waiting program is executed if an interrupt is enabled within the period. If an interrupt is enabled outside the period, the program is not executed.



The delay limit value behind a cycle differs as follows.

• For the fixed scan execution type program

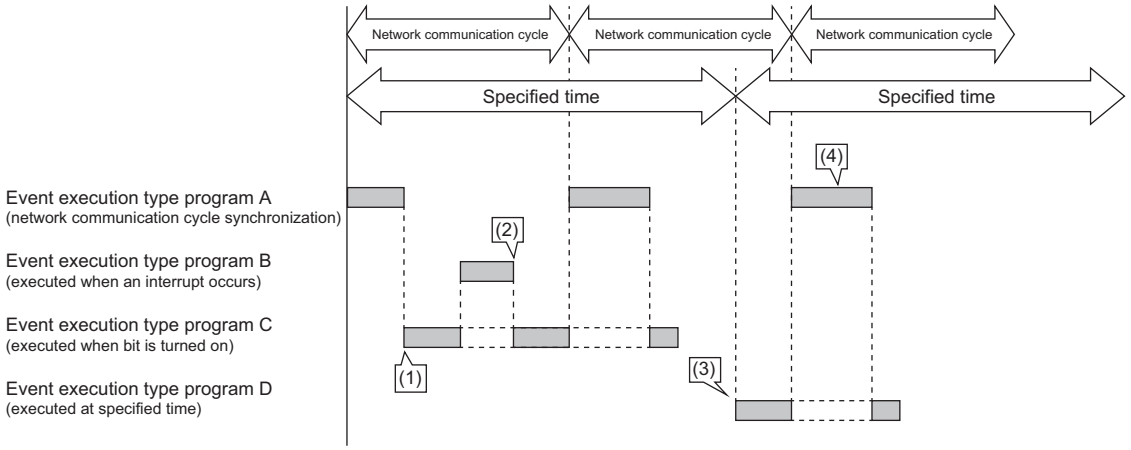
The execution cycle set to each program becomes the delay limit value. For example, if there are fixed scan execution type programs with 2ms, 4ms, and 12ms scan periods, the delay limit value behind a cycle is 2ms, 4ms, and 12ms.

• For fixed scan interrupts (I28 to I31, I48, I49) using the internal timer of the controller

The value is fixed to the same value as the fixed scan interval. For example, if the periods are I28: 100ms and I29: 20ms, the delay limit value behind a cycle is 100ms for I28, and 20ms for I29.

Event execution type program

This type of program starts execution when triggered by a specified event. The program is executed in the order specified by the program settings of the CPU parameters. If the execution conditions of the specified trigger are met when the execution turn of the event execution type program comes, the program is executed.



No.	Item	Description	Reference
(1)	ON of Bit Data (TRUE)	When the event execution type program becomes the target for execution according to the program setting order, if the specified bit data is on (TRUE), the program is executed once.	Page 254 ON of Bit Data (TRUE)
(2)	Interruption Occurrence	When the specified interrupt factor occurs, the program is immediately executed once.	Page 255 Interruption Occurrence
(3)	Passing Time	After the controller has entered the RUN state and the specified time has elapsed, the event execution type program is executed once.	Page 256 Passing Time
(4)	Network Communication Period Synchronization	The event execution type program is executed in synchronization with the network communication cycle.	Page 256 Network Communication Period Synchronization

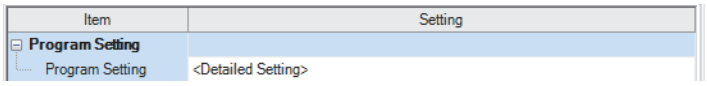
Trigger setting

Use the event execution type detail setting.

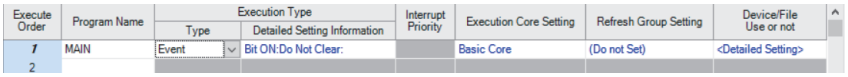
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting]

Operating procedure

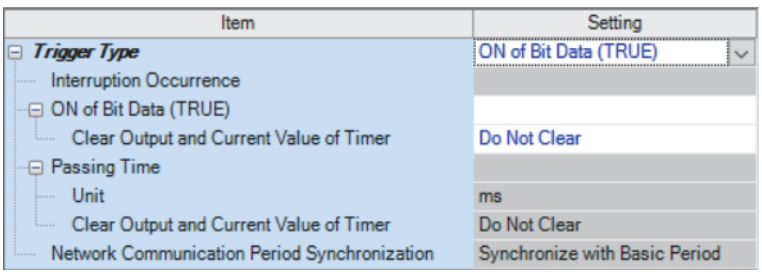
"Program Setting" window



"Detailed Setting" window



"Event Execution Type Detailed Setting" window



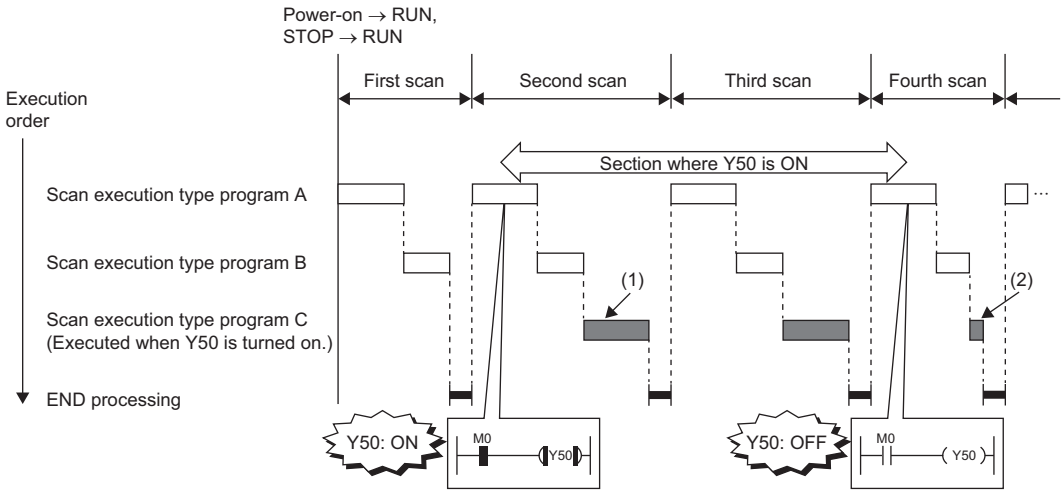
1. Click "Detailed Setting" on the "Program Setting" window.
2. Select the program name and set the execution type to "Event".
3. Click "Detailed Setting Information".
4. Sets the trigger type to execute the event execution type program.

Displayed items

Item		Description	Setting range	Default
Trigger Type		Sets the trigger type for the event execution type program.	• ON of Bit Data (TRUE) • Interruption Occurrence • Passing Time • Network Communication Period Synchronization	ON of Bit Data (TRUE)
ON of Bit Data (TRUE)	—	Sets the device used as the trigger.	☞ Page 254 Delay limit value behind a cycle	—
	Clear Output and Current Value of Timer	Sets that the current values of the output (Y), timer (T), and long timer (LT) used in this program are cleared at the execution order of the event execution type program that comes after the specified bit data is off.	• Do Not Clear • Clear	Do Not Clear
Interruption Occurrence		Sets the interrupt pointer used as the trigger.	I0 to I15, I28 to I31, I48, I49, I50 to I1023	—
Passing Time	Unit	Sets the time passed.	• When "ms" is selected: 1 to 65535ms (in units of 1ms) • When "s" is selected: 1 to 65535s (in units of 1s)	ms
	Clear Output and Current Value of Timer	Sets that the current values of the output (Y), timer (T), and long timer (LT) used in this program are cleared at the execution order of the event execution type program that comes after the specified time passes.	• Do Not Clear • Clear	Do Not Clear
Network Communication Period Synchronization		Sets the network communication cycle to be synchronized as a trigger.	• Synchronize with Basic Period • Synchronize with Normal-Speed • Synchronize with Low-Speed	Synchronize with Basic Period

ON of Bit Data (TRUE)

The program is executed at the execution order specified in program setting of the CPU parameters, and if the specified bit data is on (TRUE) when the execution order of the event execution type program comes, the program is executed. The current values of the output (Y), timer (T), and long timer (LT) used in this program can be cleared at the execution order that comes after the specified bit data is changed from on (TRUE) to off (FALSE).



(1) If Y50 is on when the execution order of the event execution type program C comes, the program is executed. If Y50 is off, the program is not executed.
(2) When "Clear Output and Current Value of Timer" is set, the current values of the output (Y), timer (T), and long timer (LT) used in this program are cleared at the execution order of the event execution type program that comes after Y50 is off.

Applicable devices are as follows.

Item		Description
Device*1	Bit device	X (DX), Y, M, L, F, SM, B, SB, Jn\X, Jn\Y, Jn\B, Jn\SB
	Bit specification of word device	D, SD, W, SW, R*2, ZR*2, RD, Un\G, Jn\W, Jn\SW

*1 A local device or index-modified device cannot be specified.
*2 If no file register is assigned or if specification is out of the range, interrupt is not turned on (TRUE).

Precautions

Note the following when specifying the link device assigned to the synchronous station of the CC-Link IE TSN function.

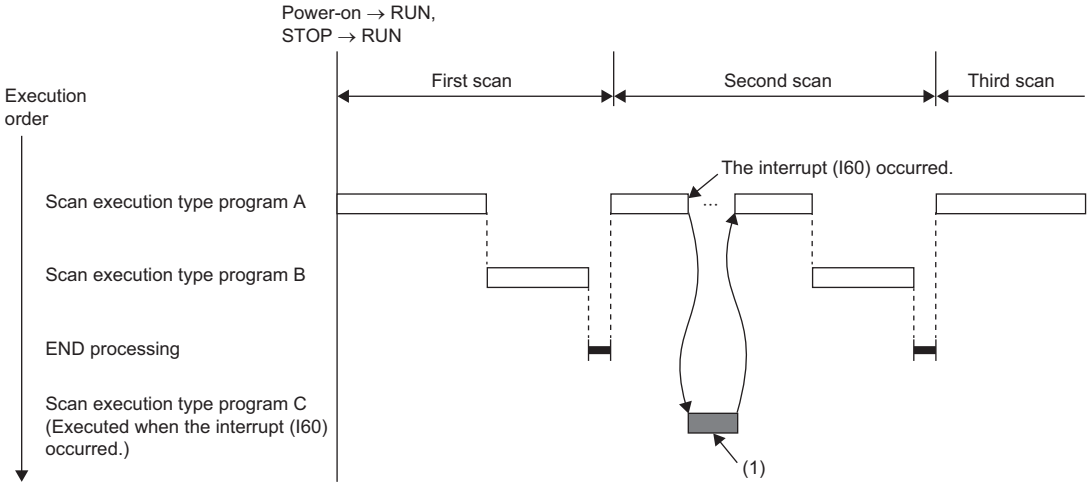
- Specify the refresh target device or label of the same link device.
- Depending on U□\G□ (module access device) and Jn\□ (link direct device), if the same link device is specified, the trigger will not be established.

Point

To measure the timer and the retentive timer continuously even when the trigger execution condition of the event execution type program is not met, use the long timer (LT) and the long retentive timer (LST). The timer (T) and the retentive timer (ST) can be used in the event execution type program. However, they do not measure time when the trigger execution condition of the event execution type program is not met. Set "Clear Output and Current Value of Timer" to "Clear" when using the timer (T) and the retentive timer (ST).
(☞ Page 252 Trigger setting)
Note that if the above parameter is set, the use of the long timer (LT) and the long retentive timer (LST) is limited to the same as that of the timer (T) and the retentive timer (ST). (They do not measure time continuously when the trigger execution condition of the event execution type program is not met.)

Interruption Occurrence

When the specified interrupt factor occurs, the program is immediately executed once. Enabling programs to be independently executed as interrupt programs, this method eliminates the need to write the FEND instruction, interrupt pointers, and the IRET instruction within scan execution type programs.



(1) When an interrupt occurs, the event execution type program C is executed immediately.

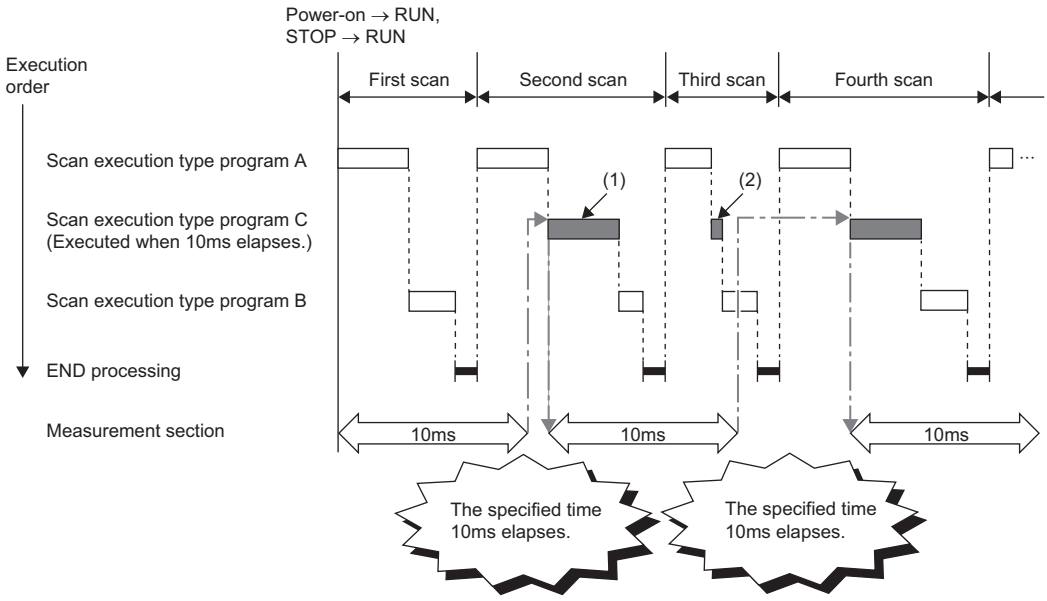
Interrupt pointers (I) which can be specified are I0 to I15, I28 to I31, I48, I49, I50 to I1023.

Point

Execution conditions for the event execution type program which is triggered by interrupt occurrence are the same as those for general interrupt programs. (☞ Page 262 Operation upon occurrence of an interrupt factor)

Passing Time

After the status of the controller is changed into the RUN state, programs are executed in execution order specified in "Program Setting" of "CPU Parameter". If the specified time passes, the event execution type program is executed once when the execution order of the program comes. The time is measured again starting from the program execution and the above operation is repeated. This method can be used when the processing is executed periodically after the specified time passes. This method is not for the interrupt execution which another program execution is interrupted and processed to secure the punctuality. Whether to clear the current values of the output (Y), timer (T), and long timer (LT) used in this program can be selected at the execution order that comes after the specified time passes.



(1) After the specified time elapses, the event execution type program C is executed when the execution order of the program comes.
(2) When "Clear Output and Current Value of Timer" is set, the current values of the output (Y), timer (T), and long timer (LT) used in this program are cleared at the execution order of the event execution type program that comes after the specified time elapses.

Point

To measure time when the trigger type is set to "Passing Time", use the long timer (LT) and the long retentive timer (LST).

Network Communication Period Synchronization

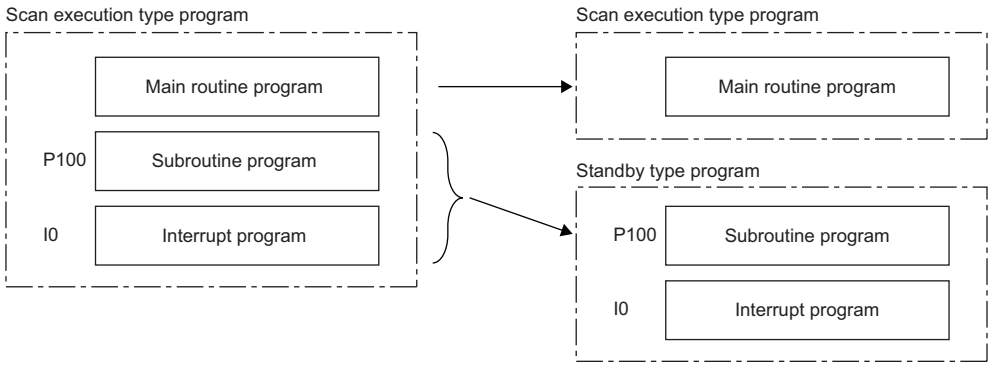
The event execution type program is executed in synchronization with the network communication cycle.
For details, refer to the following.
☞ Page 295 Program Execution Synchronized with Communication Cycle

Standby type program

This type of program is executed only when its execution is requested.

Librarization of programs

Set a subroutine program and/or an interrupt program as a standby type program to manage them separately from the main routine program. In a single standby type program, multiple subroutine programs and interrupt programs can be created.



Program arrangement change

Prepare programs available in all systems to use them only when necessary.

Execution method

The standby type program creates a subroutine program and interrupt program within its program, and then calls them when an interrupt occurs or by specifying with a pointer.

Execution type change

This section describes how to change the execution type of programs.

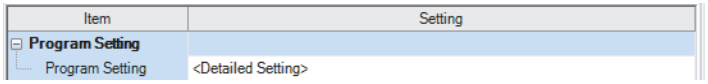
Using parameter settings

"Program Setting" can be used to specify the execution type of programs.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting] ⇨ [Detailed Setting]

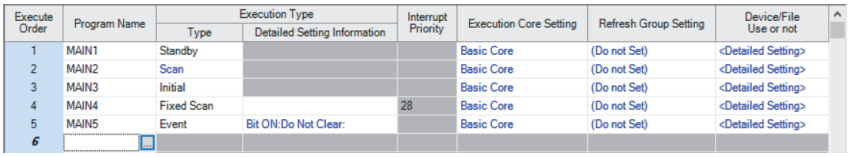
Operating procedure

"Program Setting" window



Item	Setting
Program Setting	
Program Setting	<Detailed Setting>

"Detailed Setting" window



Execute Order	Program Name	Execution Type		Interrupt Priority	Execution Core Setting	Refresh Group Setting	Device/File Use or not
		Type	Detailed Setting Information				
1	MAIN1	Standby			Basic Core	(Do not Set)	<Detailed Setting>
2	MAIN2	Scan			Basic Core	(Do not Set)	<Detailed Setting>
3	MAIN3	Initial			Basic Core	(Do not Set)	<Detailed Setting>
4	MAIN4	Fixed Scan		28	Basic Core	(Do not Set)	<Detailed Setting>
5	MAIN5	Event	Bit ON:Do Not Clear:		Basic Core	(Do not Set)	<Detailed Setting>
6							

1. Click "Detailed Setting" on the "Program Setting" window.

2. For each program, select the execution type in "Type" of "Execution Type".

Group setting for refresh

Refresh can be performed when a specified program is executed[*1] by setting a group number to each program and specifying the number for each module.

*1 Input refresh (load of analog input, Input (X)) is performed before execution of a program, and output refresh (analog output, Output (Y)) is performed after execution of a program.

Refresh group setting

A group number is set to each program.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Program Setting] ⇨ [Program Setting] ⇨ [Detailed Setting]

Window

Execute Order	Program Name	Execution Type		Interrupt Priority	Execution Core Setting	Refresh Group Setting	Device/File Use or not
		Type	Detailed Setting Information				
1	MAIN1	Standby			Basic Core	Group [1]	<Detailed Setting>
2	MAIN2	Scan			Basic Core	(Do not Set)	<Detailed Setting>
3	MAIN3	Initial			Basic Core	Group [2]	<Detailed Setting>
4	MAIN4	Fixed Scan		28	Basic Core	(Do not Set)	<Detailed Setting>
5	MAIN5	Event	Bit ON:Do Not Clear:		Basic Core	(Do not Set)	<Detailed Setting>
6							

Displayed items

Item	Description	Setting range	Default
Refresh Group Setting	Set the group number of each program which is specified for each module.	• Do not Set • Group [1] to [64]	Do not Set

Point

When the specified group number is not set in the refresh settings of each module, the program is executed, but the refresh of the relevant group number is not executed.

Refresh setting of each module

Select "At the execution time of specified program" in "Refresh Setting" of each module, and type the group number of the program to be refreshed.

[Module Parameter] ⇨ [Refresh Setting]

Window

Item	Setting Value
Refresh by the Set Timing	
Refresh Timing	Set refresh timing.
Refresh Timing	At the Execution Time of Specified Program
Refresh Group[n](n:1-64)	1

(Example: The "Refresh Setting" window for an I/O module)

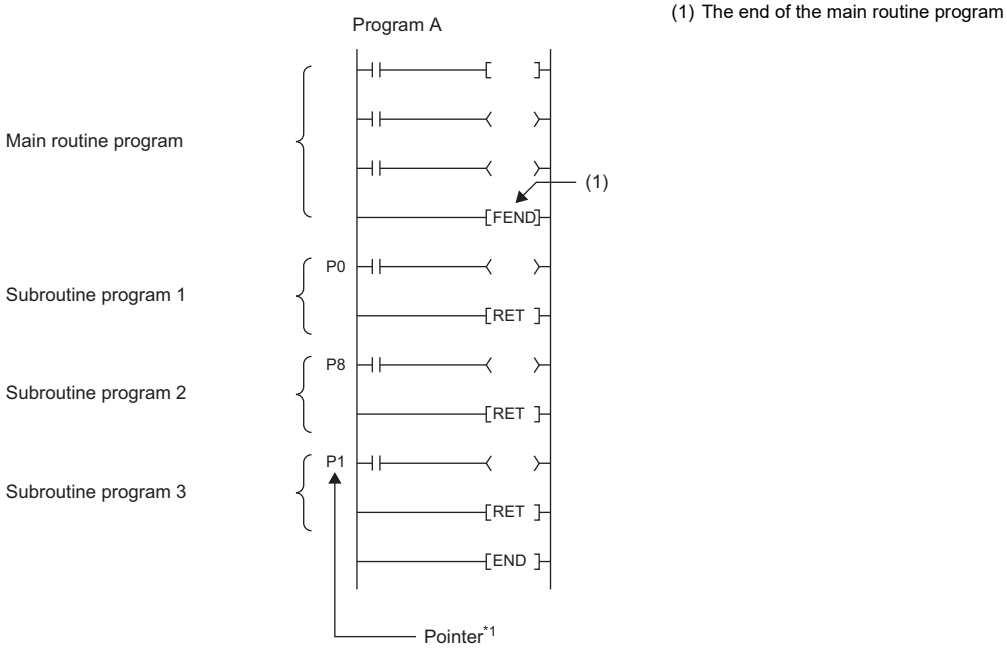
Point

For refresh of each module, refer to the manual for the module used.

14.4 Subroutine Program

Subroutine program is a program that is executed from a pointer (P) through the RET instruction. It is executed only when called by a subroutine call instruction (such as the CALL instruction or the ECALL instruction). A pointer type label can also be used instead of a pointer (P). The subroutine program is used for the following purposes.

- By grouping programs executed multiple times in a single scan into a single subroutine program, the total number of steps in a single program can be decreased.
- By making a program which is only executed in a certain condition a subroutine program, the scan time can be shortened for that program execution.



*1 The pointers are not required to be defined in an ascending order.

Point

- Making a program a standby type allows it to be managed as a separate program. (☞ Page 257 Standby type program) Use the ECALL instruction and other similar instructions to call program files.
- For details on nesting (nesting structure) of subroutine programs, refer to the nesting (N). (📖MELSEC MX Controller MX-R Model Programming Manual)

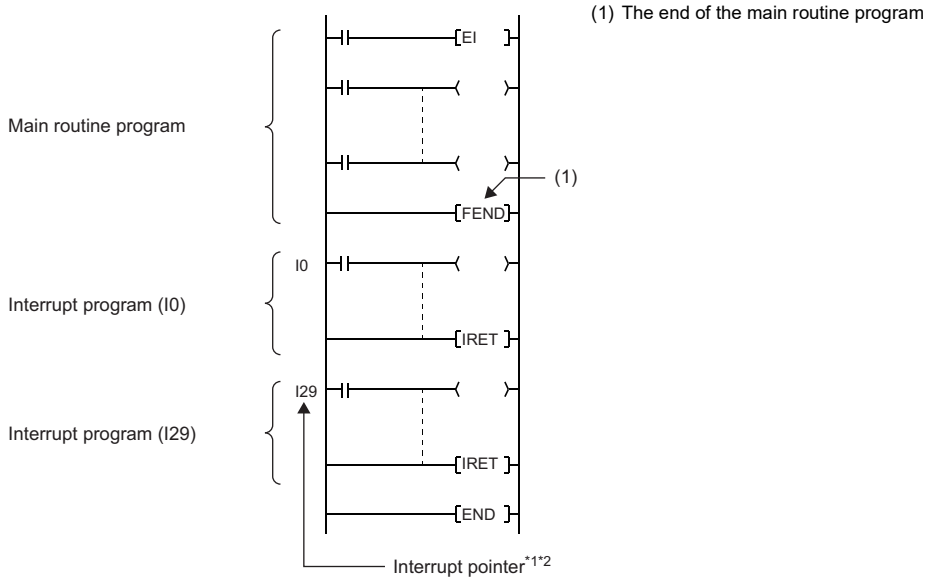
Precautions

The following lists the precautions when using the subroutine program.

- When using a local device, setting of SM776 (Local device setting at CALL) allows for using a local device of a program file at the storage location of the subroutine program.
- Do not use the timer (T, ST). However, the timer can be used if the timer coil (the OUT T☐ instruction) is executed only once per scan.
- When the call occurs, if the RET instruction is not used to return to the calling program and then the program is terminated, an error will occur.
- If a pointer (P) or pointer type global label exists within FB or FUN, an error will occur.

14.5 Interrupt Program

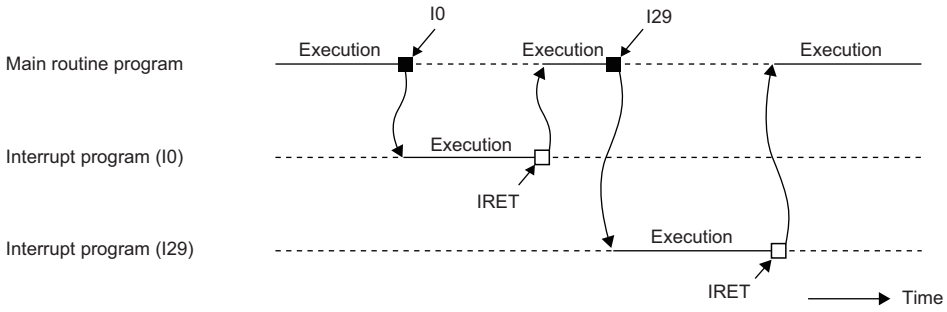
A program from an interrupt pointer (I) through the IRET instruction.



*1 Only one interrupt program can be created with a single interrupt pointer number.

*2 The interrupt pointers are not required to be defined in an ascending order.

When an interrupt factor occurs, the interrupt program corresponding to its interrupt pointer number is executed. (☞ Page 389 Priority for the interrupt pointer numbers and interrupt factors)



I0: Interrupt factor for I0

I29: Interrupt factor for I29

Point

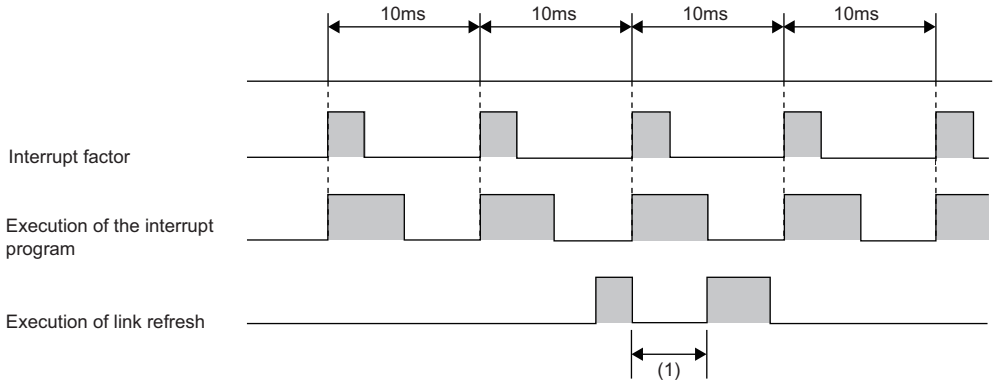
Making a program a standby type allows it to be managed as a separate program. (☞ Page 257 Standby type program)

Operation upon occurrence of an interrupt factor

The following shows the operation when an interrupt factor occurs.

If an interrupt factor occurs during link refresh

The link refresh is suspended and the interrupt program is executed. Even though the station-based block data assurance is enabled for cyclic data during refresh of such links as CC-Link IE TSN, if the interrupt program uses a device specified as the refresh target, the station-based block data assurance for cyclic data is not available.



(1) The link refresh is suspended and the interrupt program is executed.

If an interrupt factor occurs during the waiting time after END processing in constant scan execution

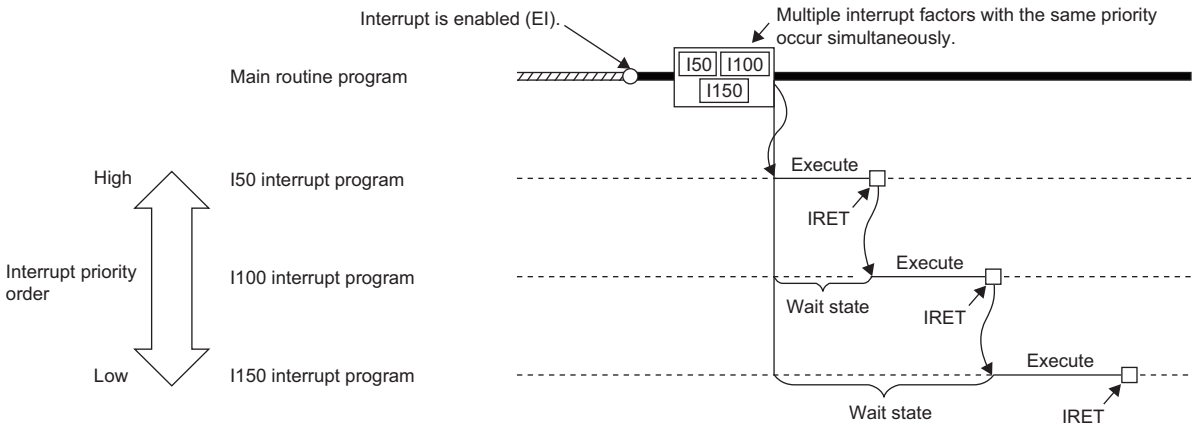
The interrupt program for the interrupt factor is executed.

If another interrupt occurs while the interrupt program is being executed

If an interrupt such as a fixed scan execution type program (including an interrupt which triggers the event execution type program) is triggered while an interrupt program is being executed, the program operates in accordance with the interrupt priority. (☞ Page 274 Interrupt priority)

If multiple interrupt factors occur simultaneously while the interrupt is enabled

The interrupt programs are executed in the order of priority. If multiple interrupts with the same interrupt priority occur simultaneously, the interrupt programs are executed in the order of interrupt priority. (☞ Page 276 Interrupt priority order)
The following example shows how multiple interrupts with the same priority occur simultaneously.



Varying operation depending on the interrupt factor

A list of interrupt pointers and interrupt factors is shown below.

For details on interrupt factors, refer to the following.

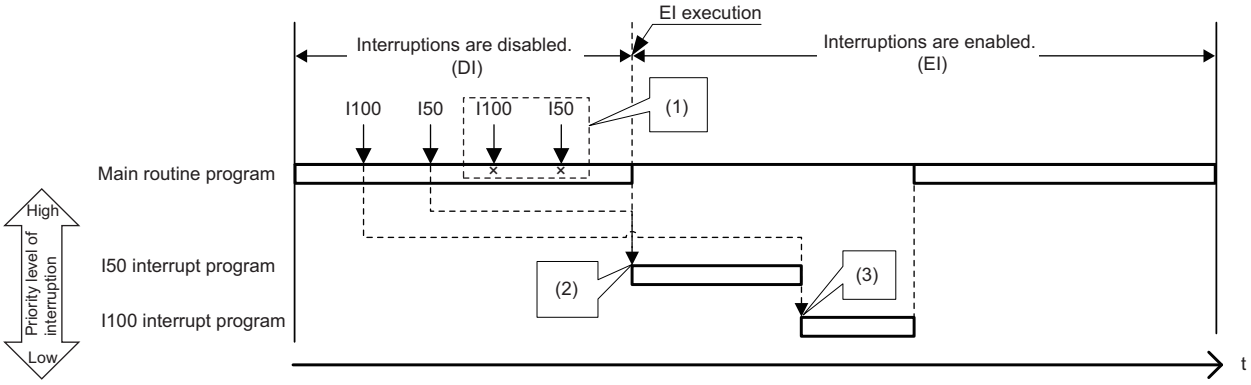
☞ Page 388 Interrupt Pointer (I)

Interrupt factor	Interrupt pointer	Description
Interrupt from module	I0 to I15, I50 to I1023	This interrupt is used for modules which have the interrupt function.
Interrupt by the internal timer	I28 to I31	This interrupt is used in fixed scan interrupts by the internal timer.
High-speed internal timer interrupt 2	I48	This interrupt is used in fixed scan interrupts by the internal timer.
High-speed internal timer interrupt 1	I49	

Interrupt from module (I0 to I15, I50 to I1023)

■If an interrupt factor occurs while interrupt is disabled (DI)

The interrupt factor that has occurred is memorized, and the interrupt program corresponding to the factor will be executed when the interrupt is enabled. Even if the same interrupt factor occurs multiple times, it will be memorized only once. If the IMASK instruction and SIMASK instruction are used to disable the interrupt, all the memorized factors will be discarded.



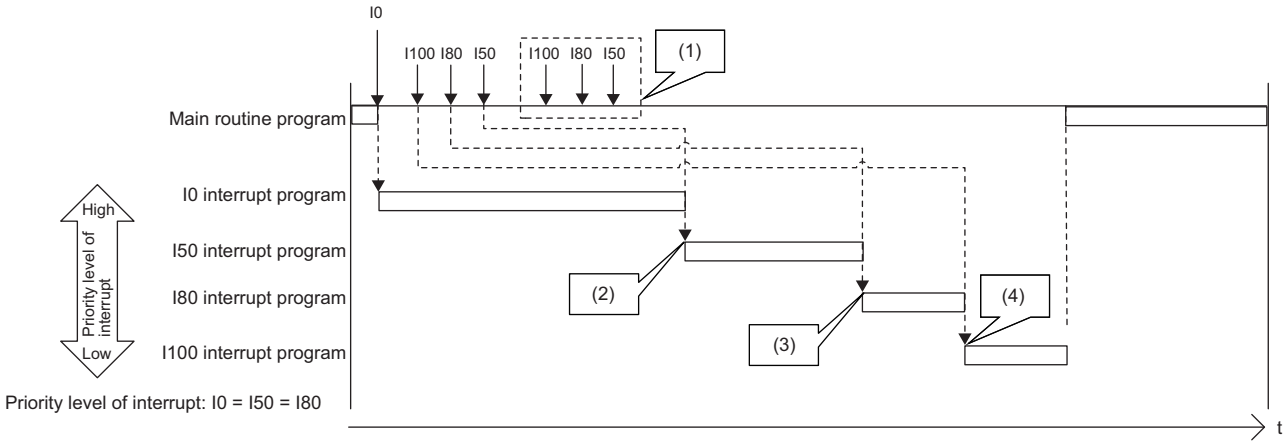
(1) The second and following interrupt factors that occur while interrupts have been disabled (DI) are not memorized.

(2) When interrupts are enabled, interrupts are executed in order from I50 because it has a higher priority.

(3) I100 is executed. (I50 is not executed for the second time.)

■If an interrupt factor with the same or a lower priority occurs while the interrupt program is being executed

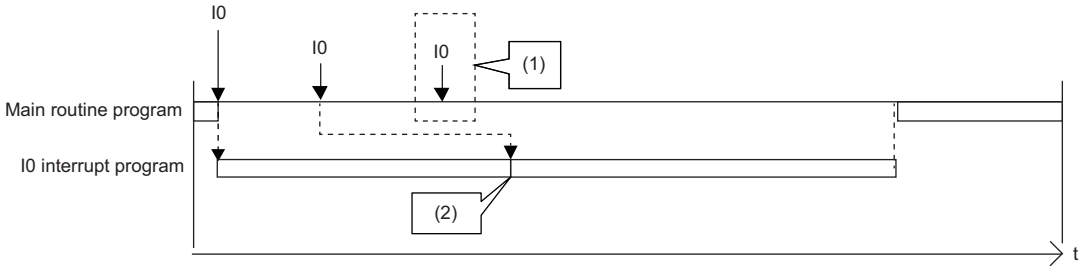
The interrupt factor that has occurred is memorized. After the running interrupt program finishes, the interrupt program corresponding to the factor will be executed. Even if the same interrupt factor occurs multiple times, it will be memorized only once.



(1) The second and following interrupt factors that occur while interrupts have been disabled (DI) are not memorized.
(2) After the interrupt in execution is completed, interrupts are executed in order from I50 because it has a higher priority. Although both I50 and I80 have the same priority level, I50 is executed ahead of I80 because I50 has a higher priority order.
(3) I80 is executed. (I50 is not executed for the second time.)
(4) I100 is executed. (I80 is not executed for the second time.)

■If the same interrupt factor occurs while the interrupt program is being executed

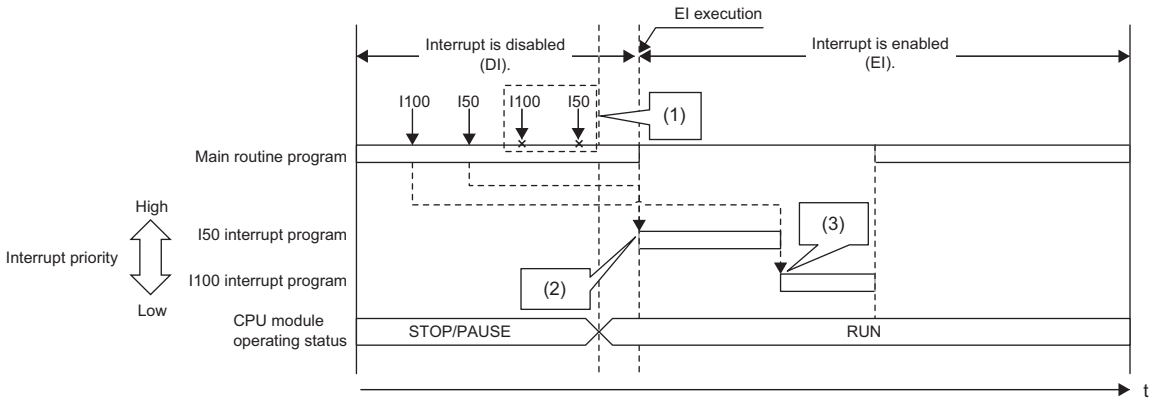
The interrupt factor that has occurred is memorized. After the running interrupt program finishes, the interrupt program corresponding to the factor will be executed. Even if the same interrupt factor occurs multiple times, it will be memorized only once.



(1) The second and following interrupt factors that occur while interrupts are executed are not memorized.
(2) After the interrupt in execution is completed, the first interrupt program is executed.

■If an interrupt factor occurs in the STOP/PAUSE state

The interrupt factor that has occurred is memorized, and the corresponding interrupt program will be executed when the controller switches to the RUN state and the interrupt is enabled. Even if the same interrupt factor occurs multiple times before switching to the RUN state, it will be memorized only once.



(1) The second and following interrupt factors that occur while the controller is in the STOP state are not memorized.
(2) When interrupts are enabled by changing the operating status of the controller from STOP to RUN, interrupts are executed in order from I50 that has a higher priority level.
(3) I100 is executed. (I50 is not executed for the second time.)

Internal timer interrupts (I28 to I31), high-speed internal timer interrupts (I48, I49)

■If an interrupt factor occurs while interrupt is disabled (DI)

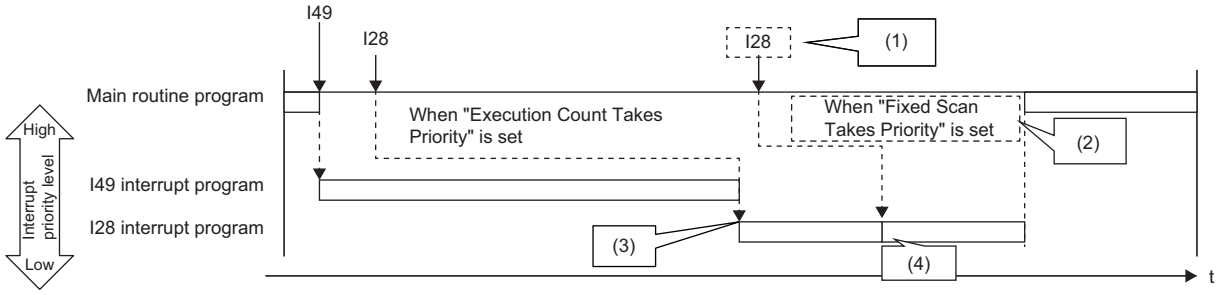
For details, refer to the following.

☞ Page 263 If an interrupt factor occurs while interrupt is disabled (DI)

■If an interrupt factor with the same or a lower priority occurs while the interrupt program is being executed

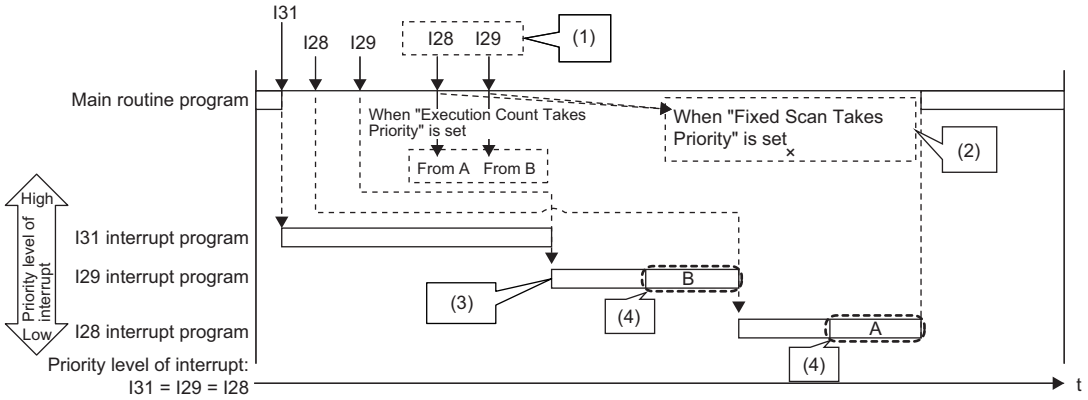
The interrupt factor that has occurred is memorized. After the running interrupt program finishes, the interrupt program corresponding to the factor will be executed. If the same interrupt factor occurs multiple times, it will be memorized once but operation at the second and later occurrences depends on the setting of the fixed scan execution mode. (☞ Page 250 Fixed scan execution mode) When "Execution Count Takes Priority" is enabled, the interrupt program corresponding to the memorized interrupt factor will be executed after the running interrupt program finishes. When "Precede Fixed Scan" is enabled, the second and later interrupt factors will not be memorized.

When interrupts with lower priority level than the one being executed occur



(1) The second and following interrupt factors that occur while interrupts are being executed operate according to the setting of the fixed scan execution mode.
(2) The program is not executed for the second time.
(3) After the interrupt in execution is completed, interrupts are executed in order from I28 because it has a higher priority.
(4) The second interrupt is executed.

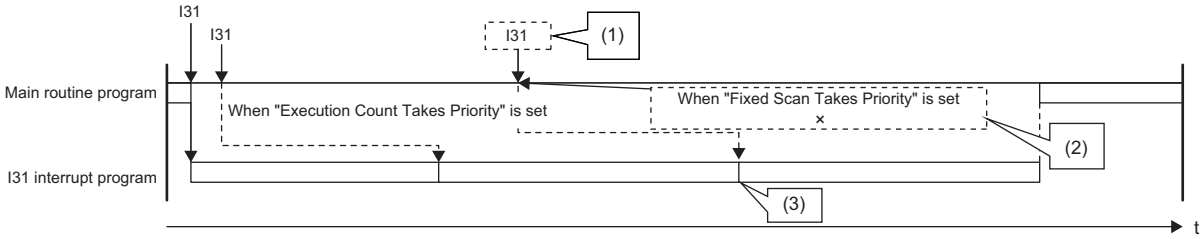
When interrupts with the same priority level as the one being executed occur



(1) The second and following interrupt factors that occur while interrupts are being executed operate according to the setting of the fixed scan execution mode.
(2) The program is not executed for the second time.
(3) After the interrupt in execution is completed, interrupts are executed in order from I29 because it has a higher priority.
(4) The second interrupt is executed.

■If the same interrupt factor occurs while the interrupt program is being executed

The interrupt factor that has occurred is memorized. After the running interrupt program finishes, the interrupt program corresponding to the factor will be executed. If the same interrupt factor occurs multiple times, it will be memorized once but operation at the second and later occurrences depends on the setting of the fixed scan execution mode. (☞ Page 250 Fixed scan execution mode) When "Execution Count Takes Priority" is enabled, the interrupt program corresponding to the memorized interrupt factor will be executed after the running interrupt program finishes. When "Precede Fixed Scan" is enabled, the second and later interrupt factors will not be memorized.



(1) The second and following interrupt factors that occur while interrupts are being executed operate according to the setting of the fixed scan execution mode.
(2) The program is not executed for the second time.
(3) The second interrupt is executed.

■If an interrupt factor occurs in the STOP/PAUSE state

For details, refer to the following.

☞ Page 265 If an interrupt factor occurs in the STOP/PAUSE state

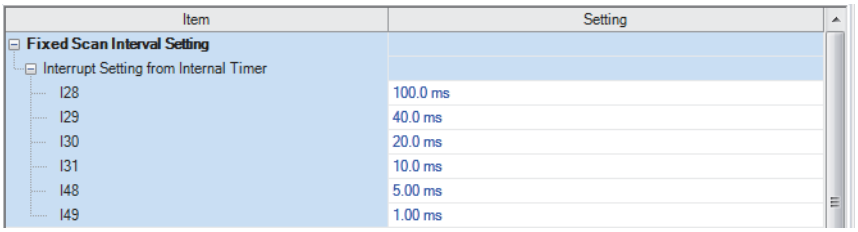
Interrupt period setting

The interrupt cycle based on the internal timer can be specified.

Fixed Scan Interval Setting

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Interrupt Settings] ⇨ [Fixed Scan Interval Setting]

Window



Displayed items

Item	Item	Description	Setting range	Default
Interrupt Setting from Internal Timer	I28	Sets the execution interval of I28.	0.5 to 1000ms (in units of 0.5ms)	100.0ms
	I29	Sets the execution interval of I29.		40.0ms
	I30	Sets the execution interval of I30.		20.0ms
	I31	Sets the execution interval of I31.		10.0ms
	I48	Sets the execution interval of I48.	0.05 to 1000ms (in units of 0.05ms)	5.00ms
	I49	Sets the execution interval of I49.		1.00ms

Processing at interrupt program startup

The processing shown below is performed when the interrupt program starts.

- Saving/restoring of the file register (R) block number
- Saving/restoring of the index register (Z, LZ)

Saving/restoring of the file register (R) block number

When an interrupt program starts, the block number of the file register (R) of the running program is saved and passed to the interrupt program. Also, when the interrupt program finishes, the saved block number is restored to the running program.

■Block No. Save/Recovery Setting

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Interrupt Settings] ⇨ [Block No. Save/Recovery Setting]

Window



Displayed items

Item	Description	Setting range	Default
File Register (R) Block No. of Basic Core	Sets whether or not the block number of the file register (R) is saved/restored when an interrupt program is being executed in the main core.	• Not Saved/ Recovered • Save/Recover	Save/Recover

Point

When the block number of the file register (R) is not changed in an interrupt program, enabling "Not Saved/ Recovered" can reduce the startup time and the termination time of the interrupt program. (☞ Page 2086 Interrupt program overhead time)
To change the block number of the file register (R) while "Not Saved/Recovered" is enabled, the block number of that file register (R) must be saved/restored by the program.

Restriction

When whether to save/restore the file register (R) block number is set to "Not Saved/Recovered", do not change the file register (R) block number by using the RSET (P) instruction within the interrupt program.
If the number is changed, the execution result (file register switching) will be reflected at the start of the next program. Since this behavior does not guarantee that the result is reflected immediately after restoration from the interrupt program, the block number may not be switched until the start of the next program at maximum.

Saving/restoring of the index register (Z, LZ)

When an interrupt program starts, the value of the index register (Z, LZ) of the running program is saved. When the interrupt program finishes, and the saved value is restored to the running program. Note that when an interrupt program starts, the local index register (Z, LZ) is not switched to the different one. When the local index register (Z, LZ) is used for the interrupt program/fixed scan execution type program/event execution type program which uses occurrence of an interrupt as a trigger, the register which has been used for the previous program is continuously used. Thus, the local index register (Z, LZ) cannot be used independently.

■Save/Recover Setting for Index Register

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Interrupt Settings] ⇨ [Save/Recover Setting for Index Register]

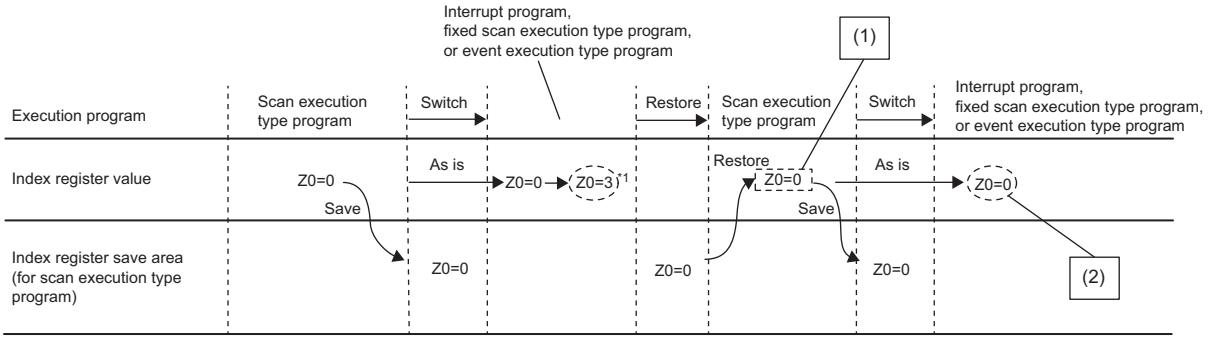
Window



Displayed items

Item	Description	Setting range	Default
Index Register (Z/LZ)	Sets this parameter to change the setting to save/restore the values of the index register and local index register (Z/LZ) when the interrupt program is executed. When the values of the index register and local index register (Z/LZ) are not changed during execution of an interrupt program, enabling "Not Saved/Recovered" can reduce the startup time and the termination time of the interrupt program.	• Not Saved/ Recovered • Save/Recover	Save/Recover

■Operation of saving/restoring of index register



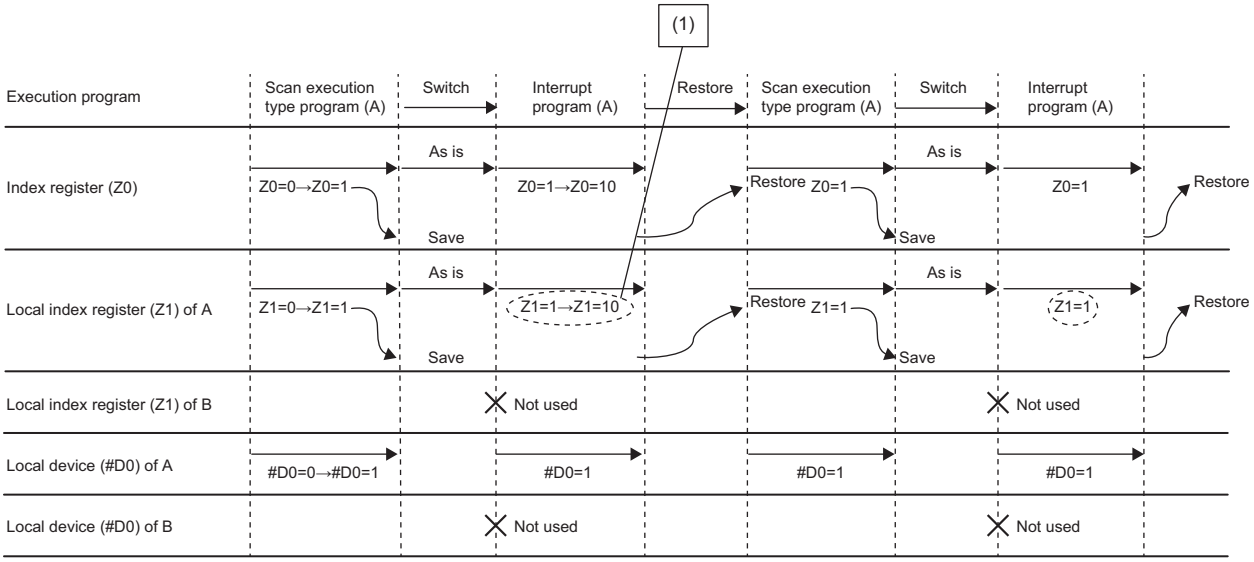
(1) This value can be used as a value specific to the scan execution type program. (Using the value in an interrupt program is not needed to be concerned.)

(2) This value can be used only at the moment an interrupt program, fixed scan execution type program, or event execution type program is executed. (The value cannot be used continuously.)

*1 The value of Z0 is changed by the interrupt program, fixed scan execution type program, or event execution type program.

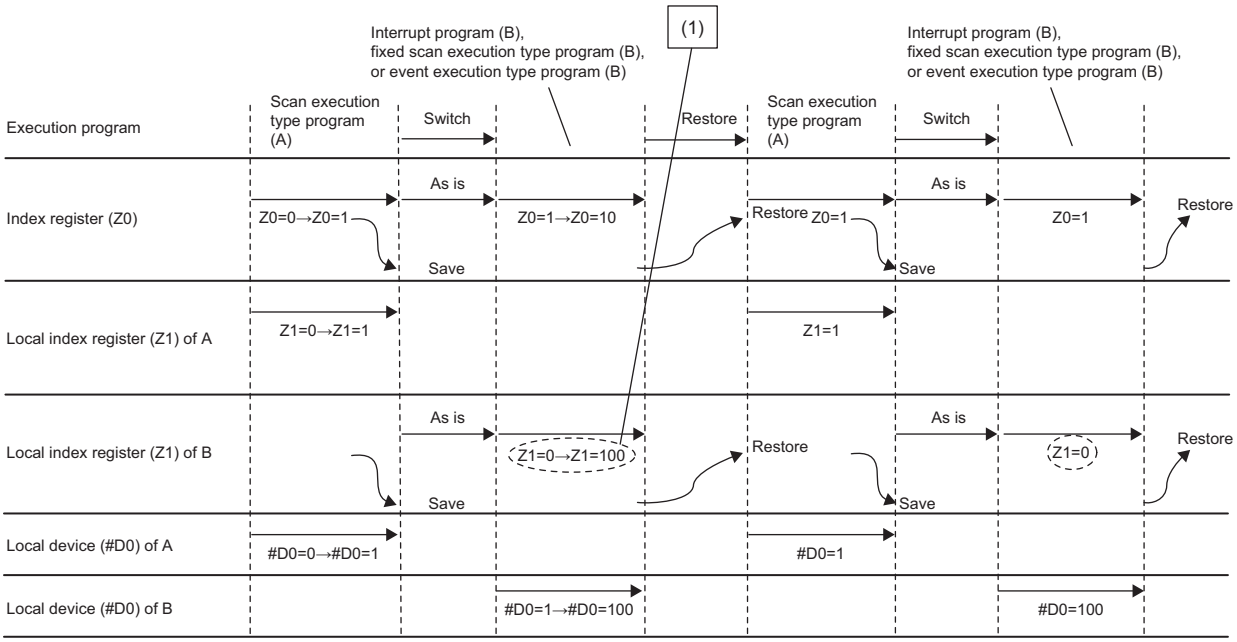
■Operations of the local index register and local device

- Interrupt by a program with the same program number when the index register save/recovery setting is "Save/Recover"



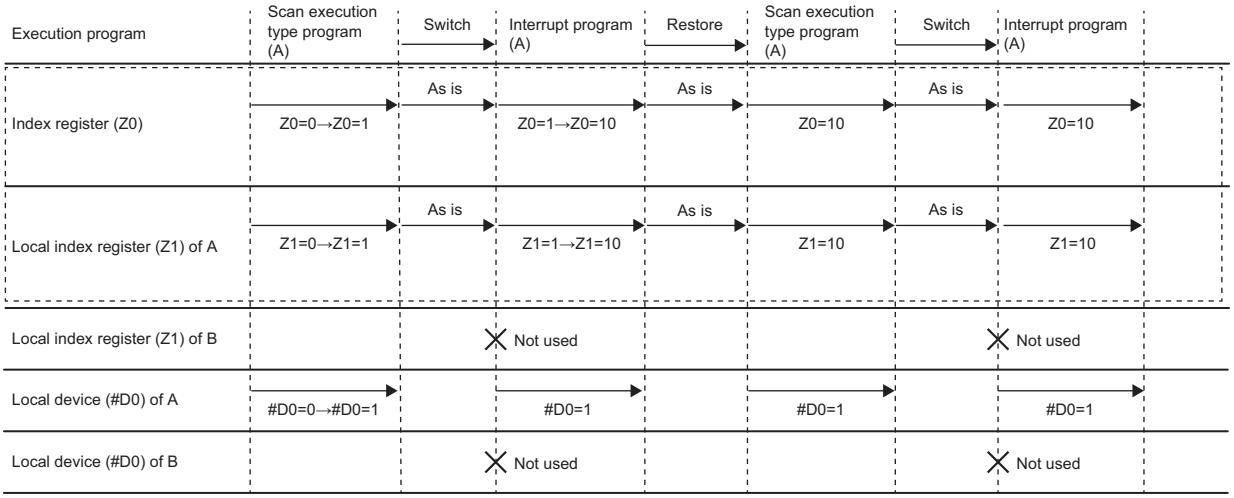
(1) The value of the local index register inherits the value of the scan execution type program (A) before the interrupt program starts, and is discarded when the interrupt program ends.

- Interrupt generated by a program with a different program number when the index register save/recovery setting is "Save/Recover"

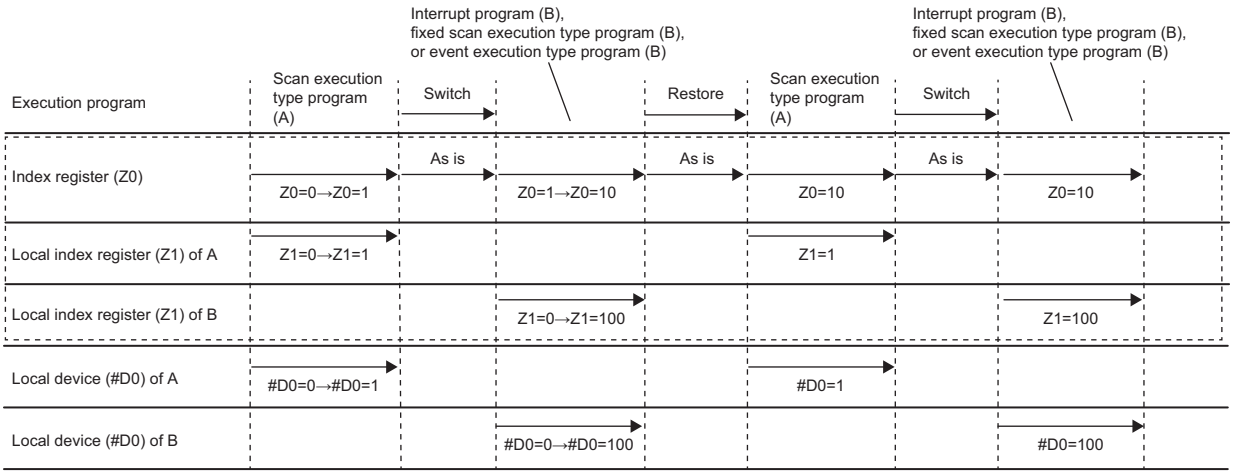


(1) The value of the local index register inherits the value of the scan execution type program (B) before the interrupt program starts, and is discarded when the interrupt program ends.

• Interrupt generated by a program with the same program number when the index register save/recovery setting is "Not Saved/Recovered"

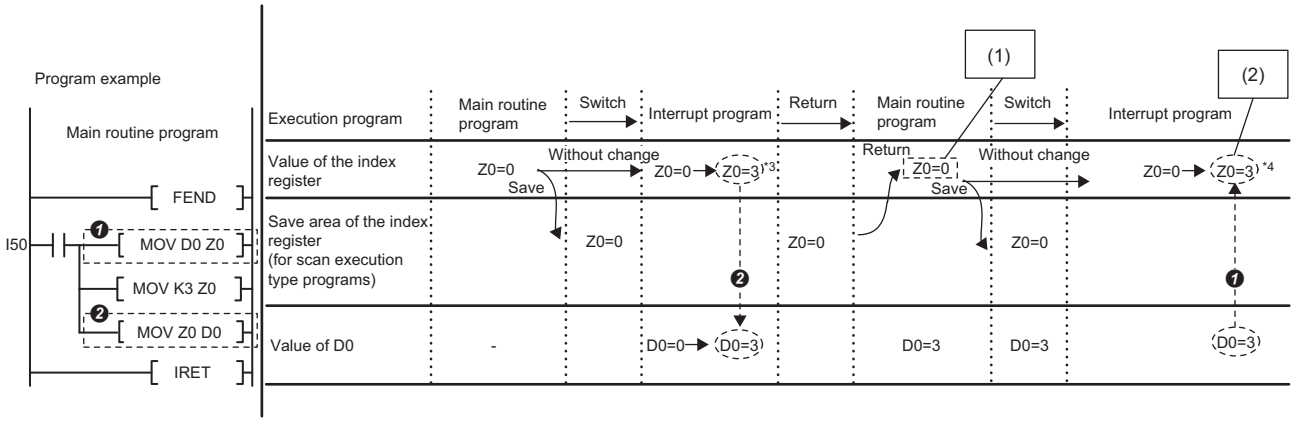


• Interrupt generated by a program with a different program number when the index register save/recovery setting is "Not Saved/Recovered"



Point

If the value of the index register used for the interrupt program is continuously used for the next interrupt program, the value of the index register for the interrupt program must be saved or restored. Create a program to add the MOV instruction and the ZPUSH/ZPOP instruction.
When saving or recovering, the value of the index register is set to 0 in the interrupt program.



*3 A value in Z0 changes at MOV K3 Z0.
*4 Z is zero when the program ❶ and ❷ are not added.

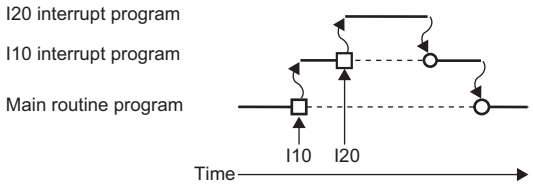
(1) This value can be used as a value specific to the main routine program.
(2) This value can be used as a value specific to the interrupt program. (This value can be used continuously.)

Multiple interrupt

When a new interrupt triggered by another factor occurs during execution of an interrupt program, the running program will be suspended if its priority is lower than that of the new interrupt. A program with higher priority is executed based on the set priority whenever its execution condition is satisfied.
Even if the occurrence timing of multiple interrupts overlaps, the delay from the interrupt occurrence to the completion of the program execution can be reduced.



[Priority]
- I20: High
- I10: Low



If the module access is interrupted and the interrupted program performs module access, the interrupted module access is restarted. Module access of the interrupted program and subsequent operations start after the interrupted module access is completed.

Interrupt priority

If the interrupt priority of a program for which its execution condition has been satisfied is higher than that of the running program, the programs are executed in accordance with their interrupt priority. If the interrupt priority of the new program is the same or lower, it enters the waiting status until the running program finishes.

Interrupt Priority Setting

The interrupt priority (1 to 32) can be changed.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Interrupt Settings] ⇨ [Interrupt Priority Setting]

Point

The interrupt priority can also be checked from the CPU parameter program settings for a fixed scan execution type program or an event execution type program (when the trigger type is set to at interrupt occurrence or network communication cycle synchronization).

For details, refer to the following.

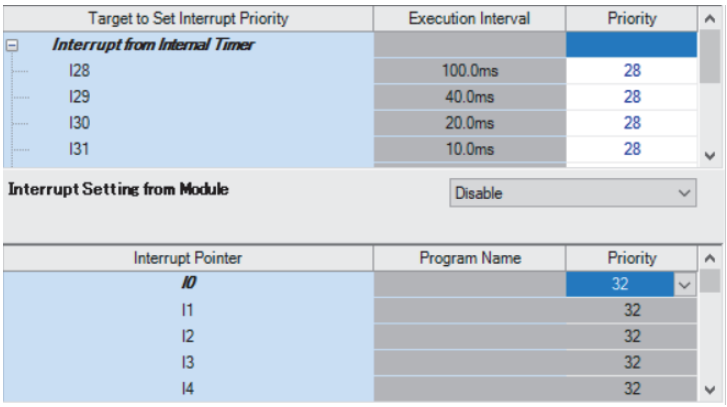
☞ Page 244 Program Setting

Operating procedure

"Interrupt Priority Setting" window



"Detailed Setting" window



1. Click "Detailed Setting" on the "Interrupt Priority Setting" window.
2. Change the priority of each interrupt pointer.

Displayed items

Item		Description
Interrupt Priority Setting	Detailed Setting	Sets the target interrupt for which interrupt priority can be set.

The default priority values are shown below.

Interrupt target			Default value
Fixed scan interrupt	Interrupt from Internal Timer	I49	3
		I48	4
		I28 to I31	28
	Fixed scan execution type program	Fixed scan execution	28
	Event execution type program	Network communication cycle synchronization	10
Interrupt from module		I0 to I15, I50 to I1023 (There is no upper limit on the number of pointers that can be set.)	32

Interrupt priority order

The following describes the interrupt priority order.

Priority	Interrupt factor		Pointer
High ↑ ↓ Low	High-speed internal timer interrupt 1		I49
	High-speed internal timer interrupt 2		I48
	Communication period synchronization	Basic period	—
		Normal-speed period	—
		Low-speed period	—
	Internal timer interrupt (I28 to I31)		I31
			I30
			I29
			I28
	Fixed scan execution type program		—
	Interrupt from module (I0 to I15, I50 to I1023)		I0 to I15, I50 to I1023 (ascending order)

Automatic assignment of priority of fixed scan interrupts

Clicking the [Automatic Assignment] button assigns the priority as follows.

- For the network communication cycle synchronization interrupt setting, the values are assigned (fixed) as follows: Basic cycle: 10, medium speed cycle: 11, low speed cycle: 12.
- The fixed cycle interrupt except for the network communication cycle synchronous interrupt is assigned in the order of 1 to 32 (excluding 10 to 12) in order of shortest execution interval.
- The priority of interrupts (I0 to I15, I50 to I1023) from the module does not change.
- When the execution intervals are the same, the same priority is assigned. If there are 32 or more execution intervals, priority 32 is assigned to all execution cycles from the 33rd onward.

Precautions

The precautions for the interrupt program are mentioned below.

Delay in interrupt programs

Completing low-priority interrupt programs may take time if high-priority interrupt programs are executed frequently. Adjust the processing of high-priority interrupt programs to allow execution of low-priority interrupts as necessary.

Devices and labels used in interrupt programs

Do not use the same global devices and labels in multiple interrupt programs. Otherwise, data inconsistency may occur.

Network communication cycle synchronous interrupt priority setting

Set the network communication cycle synchronous interrupt priority as follows. Otherwise, an error occurs.

- Set the interrupt priority value for the network communication cycle synchronous interrupt as basic cycle < medium speed cycle < low speed cycle.
- Do not set the same interrupt priority that has been already assigned to the network communication cycle synchronous interrupt to other fixed scan interrupts and interrupts from the module.

Cycle over

When an interrupt with a higher priority than the network communication cycle synchronous interrupt is set, a cycle over (error code: 1A00H, 3402H) or cycle over warning (event code: 00F08H) may occur when a program is being executed. If such error or event is detected, take the following actions for the programs with a high priority so that the network communication cycle synchronous interrupt can be executed.

- Lower the interrupt priority such that it is lower than that of the network communication cycle synchronous interrupt.
- Shorten the execution time of the program.
- Extend the execution interval for internal timer interrupts and fixed scan execution type programs.

Restrictions on program creation

- The PLS/PLF instruction performs OFF processing in the next scan after the instruction execution. The device that is turned on remains on until the interrupt program starts again and the instruction is executed.
- The timer (T, ST) cannot be used for interrupt programs.

Data inconsistency

Processing of an instruction may be suspended, and the interrupt program may be executed. Accordingly, if the program suspended due to interruption and the interrupt program both use the same data, data may become inconsistent. Therefore, take the following preventive measures.

- Use the DI instruction to disable the interrupt for an instruction that causes inconsistency when interrupted.
- In an interrupt program, before accessing the device shared by overlapping programs, transfer data to another device in batch to use, and then write back to the shared device in batch.
- When using a word device as 32-bit data, use a device number that is a multiple of 2. When using a word device as 64-bit data, use a device number that is a multiple of 4.

If the interrupt accuracy does not increase

The issue may be improved by performing the following.

- Limit each character string used in a program to 32 characters or less in length.
- Decrease the multiplex interrupts.

When the start-up of an interrupt program is delayed

If the execution interval of the interrupt program is short, the start-up of the interrupt program may be delayed when an instruction with a long processing time is executed, or when online change is executed.

When the data logging function is used

- When occurrence of an interrupt is specified as the data collection condition of data logging, set the fixed scan interval of the interrupt program, taking into consideration the processing time added by the data logging function. (☞ Page 1527 Using together with interrupt programs)
- When occurrence of an interrupt is specified as the data collection condition of the logging function, the processing time of the logging function is added and the processing time of the interrupt program increases. For this reason, if an interrupt program that specifies a short interval, such as setting the high-speed internal timer interrupt 1 (I49) to 0.05ms in the fixed scan interval setting, is used and an interrupt occurrence of high-speed internal timer interrupt 1 (I49) is specified as the data collection condition of the logging function, the processing time of the interrupt program will not be within the interval specified in the fixed scan interval setting and a WDT error (error code: 2501H) may occur.

Instructions that use the signal flow

If subroutine programs that use global pointers (P), including instructions that use the signal flow, and FB instances defined in global labels are used from multiple interrupt programs, the corresponding instruction may not work as intended when the same signal flow is used.

Therefore, it is recommended that different subroutines and FB instances be used for each program.

15 OPERATING STATUS OF THE CONTROLLER

The following is a list of the operating statuses of the CPU function part of the controller.

- RUN state
- STOP state
- PAUSE state

15.1 Operating Statuses

The following table shows the operating statuses of the controller, as well as the LED indication and operation processing under each status.

Operating status	LED indication	Operation processing
RUN	PROGRAM RUN LED: On	Executes the program stored in the controller.
STOP	PROGRAM RUN LED: Off	Stops the operation of the program stored in the controller.
PAUSE	PROGRAM RUN LED: Flashing (every 200ms)	Suspends the operation of the program stored in the controller.
INITIALIZE*1	READY LED: Flashing (every 1s)	Performs pre-processing to execute operation of the program in the controller.
RESET	ERROR LED: All LEDs off after flashing	Resets the controller.

*1 After the initial processing, the state changes to the one set by the RUN/STOP/RESET switch.

The following table shows the operation of external output and communication in each operating status of the controller.

○: Operates ×: Does not operate △: Does not operate (can be output by the device test or another method)

Operating status	External output	Communication with external equipment	Communication with a module
RUN	○	○	○
STOP	△	○	○
PAUSE	○	○	○
INITIALIZE	×	×	×
RESET	×	×	×

Point

The operating statuses of the motion function part are the RUN state and STOP state.
Motion control can be executed when the motion function part is in the RUN state.
Use MotionSystem.Cd.SequenceReady to make a request for switching the STOP/RUN state, and use MotionSystem.Md.Ready to monitor the current status. (☞ Page 543 START AND STOP)

15.2 Operation When Operating Status Is Changed

The following table shows the operation when the operating status of the controller is changed.

Operating status of the controller	Each processing of the controller			
	Program	External output	Device/label data	
			Other than Y	Y
STOP → RUN	Executes the initial execution type program or scan execution type program from the start.	Determines the status depending on the setting of "Output Mode Setting of STOP to RUN" in the CPU parameter. (☞ Page 281 Output mode at operating status change (STOP to RUN))	Retains the device/label data status immediately before the RUN state. However, if a device/label initial value has been set and "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Enable", this initial value is set.*2 Local devices are cleared if "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Enable". (They are not cleared if set to "Disable".)	Determines the status depending on the setting of "Output Mode Setting at STOP to RUN" in the CPU parameter. (☞ Page 281 Output mode at operating status change (STOP to RUN))
RUN → STOP	Executes the program up to the END instruction and then stops.	Saves the output (Y) status immediately before the STOP state, and all points turn off.	Retains the device/label data status immediately before the STOP state.	Saves the output (Y) status immediately before the STOP state, and all points turn off.
RUN → STOP (STOP instruction)	Executes the STOP instruction and then stops.			
RUN → STOP (Stop error)	Suspends the instruction when an error occurs and then stops.	Retains the output (Y) status at STOP.		Retains the output (Y) status at STOP.
RUN → PAUSE*1	Stops after the execution of one scan.	Retains the output (Y) status immediately before the PAUSE state.	Retains the device/label data status immediately before the PAUSE state.	Retains the output (Y) status immediately before the PAUSE state.
PAUSE → RUN*1	Executes the initial execution type program or scan execution type program from the start.	Retains the output (Y) status immediately before the RUN state.	Retains the device/label data status immediately before the RUN state. However, if a device/label initial value has been set and "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Enable", this initial value is set.*2 Local devices are cleared if "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Enable". (They are not cleared if set to "Disable".)	Retains the output (Y) status immediately before the RUN state.
PAUSE → STOP*1	Operation remains stopped.	Saves the output (Y) status immediately before the STOP state, and all points turn off.	Retains the device/label data status immediately before the STOP state.	Saves the output (Y) status immediately before the STOP state, and all points turn off.

*1 The change of status from RUN to PAUSE, PAUSE to RUN, and PAUSE to STOP of the controller is performed by the remote operation.

*2 For the device/label initial value setting, refer to the following.

☞ Page 426 DEVICE/LABEL INITIAL VALUE SETTINGS

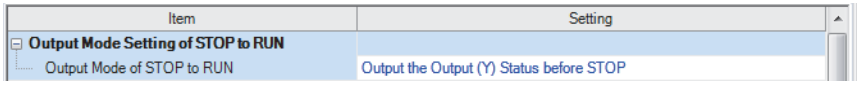
Output mode at operating status change (STOP to RUN)

When the operating status changes from RUN to STOP, for example, the controller internally stores the status of the outputs (Y) to turn them all off.

Set the mode in "Output Mode Setting of STOP to RUN".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Output Mode Setting of STOP to RUN]

Window



Displayed items

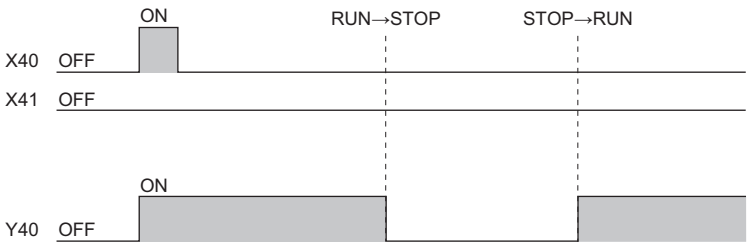
Item	Description	Setting range	Default
Output Mode of STOP to RUN	Set the operation of the output (Y) when the operating status is changed from STOP to RUN.	• Output the Output (Y) Status before STOP • Clear (Output is 1 scan later) the Output (Y)	Output the Output (Y) Status before STOP

Operation when the operating status is changed from STOP to RUN

Select whether or not to resume from the previous output status when the operating status of the controller changes from STOP to RUN by using a holding circuit.

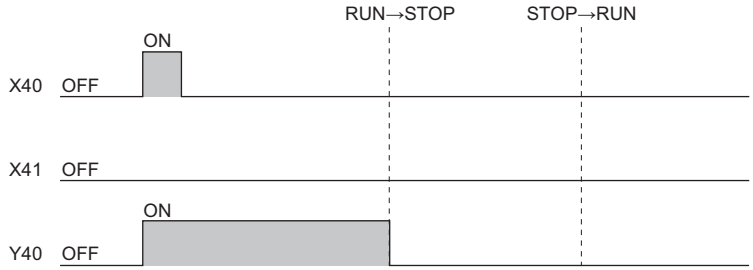
■Output the Output (Y) Status before STOP

The program operation is resumed after outputting the output (Y) status immediately before the operating status of the controller is changed to the STOP state. If the output (Y) is forcibly turned on in the STOP state, the status prior to the STOP state is output. If the output (Y) was off before entering the STOP state, the status when it was on is not retained. (In the following figure, X40 represents the start button, X41 represents the stop button, and Y40 represents an output.)



■Clear (Output is 1 scan later) the Output (Y)

All outputs are turned off, and the output (Y) is output after the program operations are executed. If the output (Y) is forcibly turned on when the operating state is STOP, the ON state is retained. (In the following figure, X40 represents the start button, X41 represents the stop button, and Y40 represents an output.)

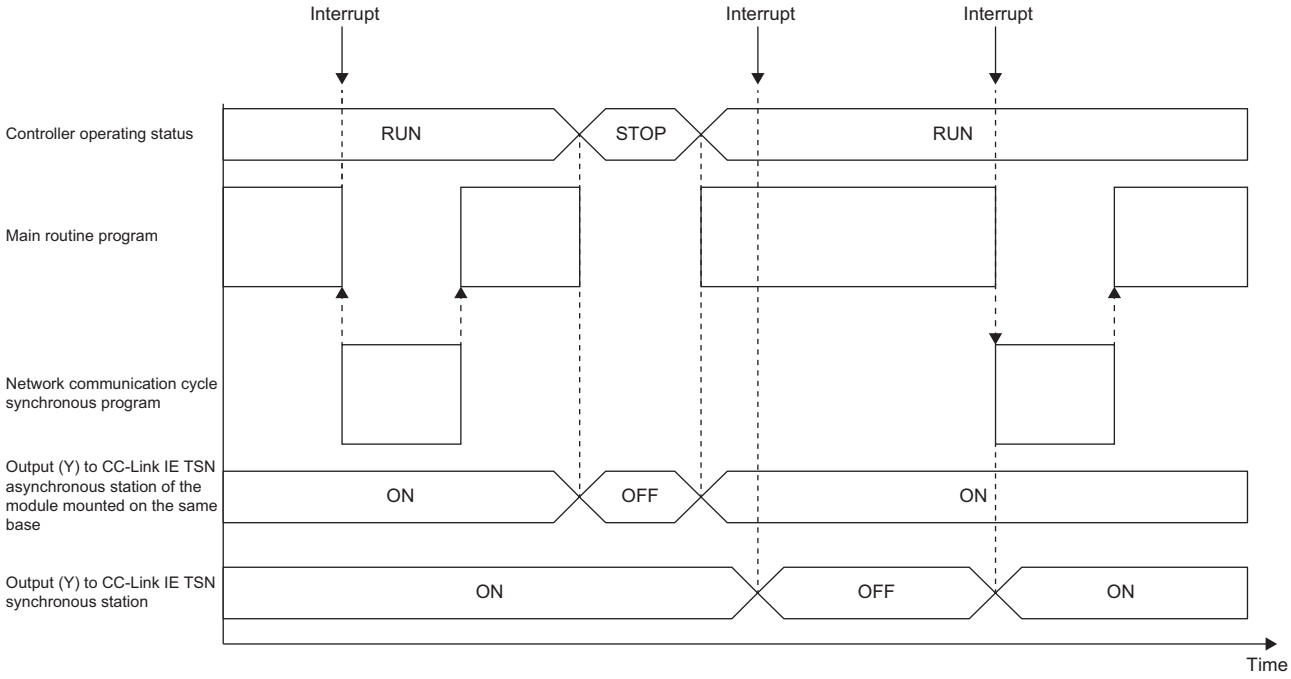


Precautions

- The following table lists the output when the STOP state changes to the RUN state after the output (Y) is forcibly turned on while the controller is in the STOP state.

Setting item	Output when the operating status is changed from STOP to RUN
Output the Output (Y) Status before STOP	Outputs the state before STOP. If the output (Y) was off before entering STOP, the status when it was on is not retained.
Clear (Output is 1 scan later) the Output (Y)	The on state is held.

- Output is performed when the output (Y) is assigned as the refresh target device of the link device assigned to the synchronization station of the CC-Link IE TSN function, and when the STOP state is changed to the RUN state immediately before the network communication cycle synchronous interrupt program execution for the first time after being changed to the RUN state. The following shows the case when "Output Mode of STOP to RUN" is set to "Output the Output (Y) Status before STOP".



15.3 Operation during a Momentary Power Failure

When an input power supply voltage supplied to the power supply module falls below the specified range, a momentary power failure is detected and the following operation is performed.

Momentary power failure not exceeding the allowable momentary power failure time

If a momentary power failure occurs, the event history is registered and operation processing continues, but the storage of values from the input module stops. However, the measurement of the output and the timer device continues.
Also, the scan time does not change due to momentary power failure.

■When recovered from a momentary power failure

After recovering from a momentary power failure, the stopped operation of storing the value to the input (X) resumes.

Momentary power failure exceeding the allowable momentary power failure time

This case results in initial start, and the same operation processing as when the controller is powered on or reset, or when remote reset is performed.

15.4 Operation When an Error Occurs

If the controller detects an error, the self-diagnostic function stores error information in the special relay/special register areas.
For details on the self-diagnosis function, refer to the following.
☞ Page 1745 Self-diagnostic function
There are two types of errors: continuation errors and stop errors. Some errors can be set to either a stop error or a continuation error with the parameter settings.
For error details and error types (stop error or continuation error), refer to the following.
☞ Page 1776 Error Code System
The operation when an error occurs is shown below.

Stop error

If the controller detects an error, the self-diagnostic function stores error information in the special relay/special register areas.
The operation stops and enters the STOP state.
Communication with the controller is possible even if the controller has a stop error.
In addition, the external output of the module follows the combination of the controller operation settings for error detection and the output mode when module parameter error occurs for the module managed by the controller. For details, refer to the following.
☞ Page 1749 System operation

Continuation error

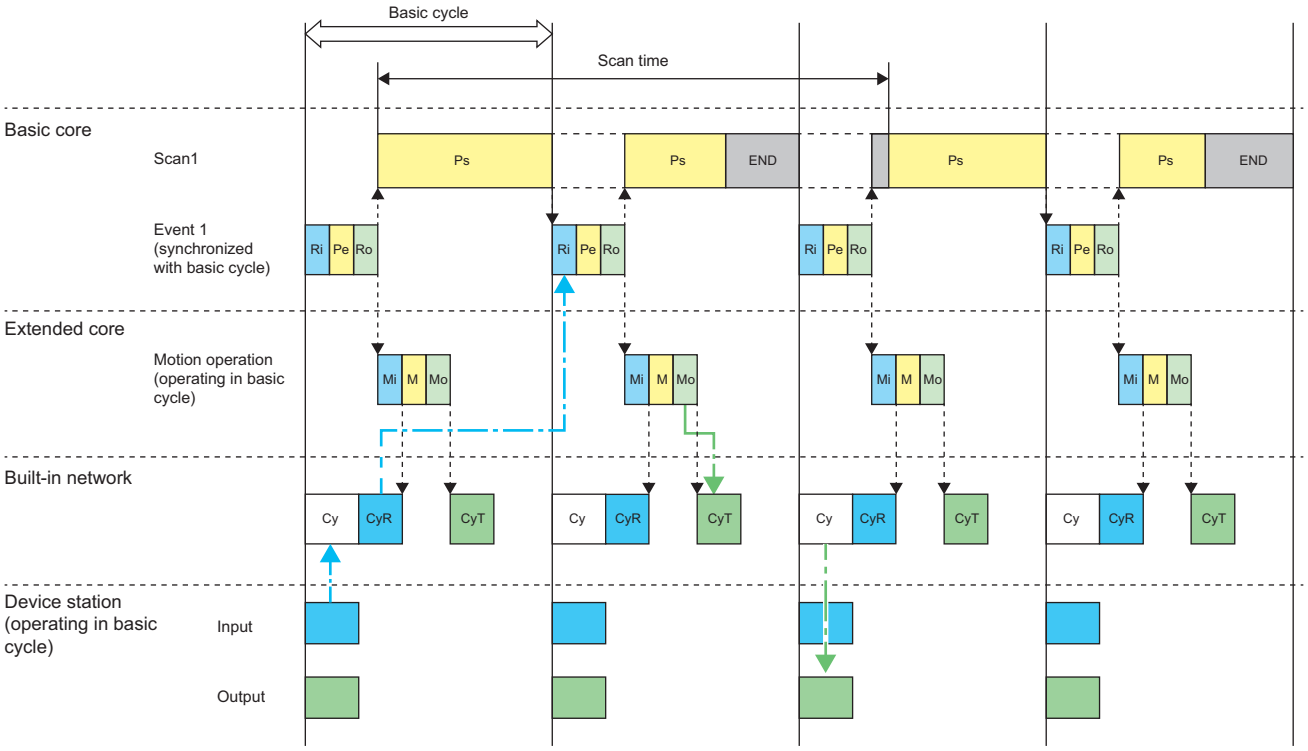
If the controller detects an error, the self-diagnostic function stores error information in the special relay/special register areas.
The operation status is held and the operation is continued.
Continuation errors can be cleared. If the error is cleared and the system is restored, the state returns to that before the error occurred. For details on clearing errors, refer to the following.
☞ Page 1751 Error clear

16 CC-Link IE TSN COMMUNICATION CYCLE AND MOTION OPERATION

Programs can be executed in synchronization with the communication cycle of CC-Link IE TSN. This allows motion control to be executed without being affected by scan time fluctuations.

Ex.

When executing a motion control program (Event1) at each basic cycle and receiving/sending input/output data from/to the device station



Category	Symbol	Item	Description
Basic core	Ps	Scan1 (scan execution type) program execution	Scan execution type Scan1 is executed on the basic core. Input/output refresh is performed in the END processing after program execution.
	END	END processing (input/output refresh of asynchronous station)	
	Ri	Input refresh of synchronous station (basic cycle)	Event execution type (network communication cycle synchronization) Event1 is executed in synchronization with the basic cycle. In network communication cycle synchronous interrupt programs, input refresh (Ri) is performed before program execution and output refresh (Ro) is performed after program execution. Refresh is performed for device stations whose "Network Synchronous Communication" is set to "Synchronous". (☞ Page 289 Network synchronous communication setting)
	Pe	Program execution of Event1 (synchronized with basic cycle)	
	Ro	Output refresh of synchronous station (basic cycle)	
Extended core	Mi	Input processing of motion operation (basic cycle)	After completion of output refresh (Ro) of the synchronous station, the motion operation of the motion control FB in Event1 is executed by the extended core.
	M	Operation processing of motion operation (basic cycle)	
	Mo	Output processing of motion operation (basic cycle)	
Built-in network	Cy	Cyclic transmission	Cyclic receive processing (CyR) is executed after completion of cyclic transmission (Cy), and cyclic send processing (CyT) is executed after completion of output processing of motion operation (basic cycle) (Mo).
	CyR	Cyclic receive processing	
	CyT	Cyclic send processing	

Point

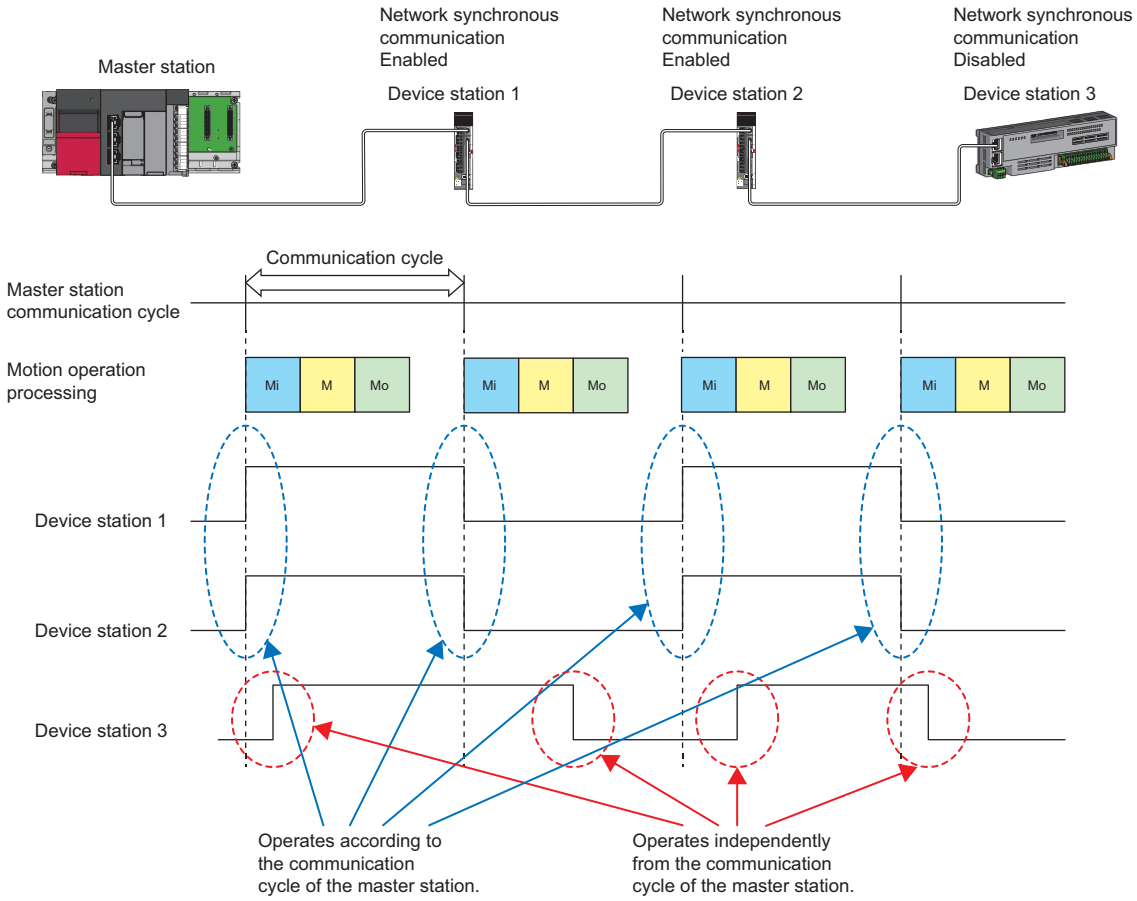
In the motion system, operation processing related to the motion control is performed in the fixed cycle (motion operation cycle).
The shorter the motion operation cycle, the higher the accuracy and responsiveness of motion operation. For details on the motion operation cycle, refer to the following.
☞ Page 522 OPERATION CYCLE

16.1 Network Synchronous Communication

The control cycle of a device station is synchronized according to the communication cycle of the master station.

Point

The following device stations can also be connected: device stations not supporting the CC-Link IE TSN network synchronous communication, or device stations in which the network synchronous communication setting is not set. However, the stations cannot be synchronized with the motion operation of the controller. For the support status of network synchronous communication of each device, refer to the manual of the relevant device.



Mi: Input processing of motion operation (basic cycle)
M: Operation processing of motion operation (basic cycle)
Mo: Output processing of motion operation (basic cycle)

Point

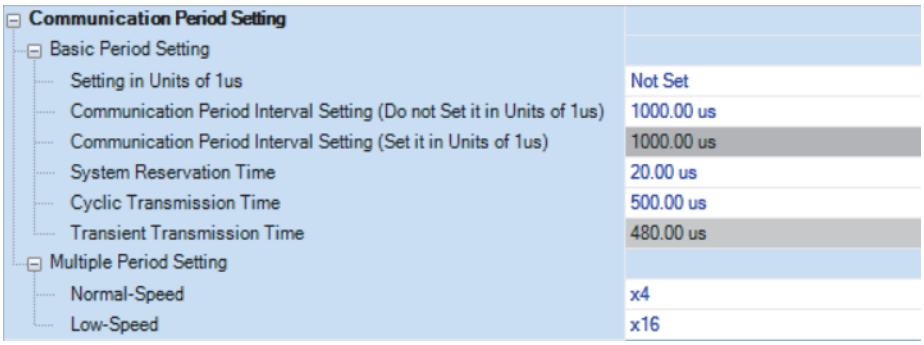
In addition to the Network Communication Cycle Synchronization accuracy, each device station performs the input or output processing after the response time of each device station. (The Network Communication Cycle Synchronization accuracy is the difference between the time at which the device station recognizes the synchronization point and the time of the synchronization point.)
Therefore, the actual time for external output will deviate up to the following amount.
Network communication cycle synchronization accuracy (1000ns) + Device station response time (Tres)
For details on the device station response time (Tres), refer to the manual for the device station used.

Setting method

Set "Basic Period Setting" and "Network Synchronous Communication".

■Basic period setting

[Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Communication Period Setting]



Item		Description	Setting range
Basic Period Setting	Setting in Units of 1μs	Select whether to set the basic cycle in increments of 1μs.	• Set • Not Set (default)
	Communication Period Interval Setting (Do not Set it in Units of 1μs)*1	Select the communication cycle.	• 125.00μs • 250.00μs • 500.00μs • 1000.00μs • 1500.00μs • 2000.00μs (default) • 2500.00μs • 3000.00μs • 3500.00μs • 4000.00μs • 4500.00μs • 5000.00μs • 5500.00μs • 6000.00μs • 6500.00μs • 7000.00μs • 7500.00μs • 8000.00μs
	Communication Period Interval Setting (Set it in Units of 1μs)*1	Input the setting range of the communication cycle interval.	125.00μs to 10000.00μs (in increments of 1μs) (Default: 2000.00μs)
	System Reservation Time	Necessary time for the system to guarantee the communication cycle interval When using a CC-Link IE TSN Class B/A device with a communication speed of 100Mbps in the basic cycle, select 200μs.	• 20.00μs (default) • 200.00μs
	Cyclic Transmission Time*1	Set the time to be allocated to cyclic transmission in communication cycle intervals.	5.00μs to 9966.00μs (in increments of 1μs) (Default: 1000.00μs)
	Transient Transmission Time	The value displayed is the "Basic Period Setting" value minus the "Cyclic Transmission Time" and "System Reservation Time". Secure a transient transmission time of 14.00μs or more.	14.00μs to 9975.00μs (in increments of 1μs) (Default: 980.00μs)
Multiple Period Setting		☞ Page 293 Multiple period setting	

*1 For "Communication Period Interval Setting" and "Cyclic Transmission Time", refer to the following.
☞ Page 306 Communication Cycle Adjustment,Page 2116 Shortening method of the communication cycle interval and cyclic transmission time

Point

- When an industrial switch (CC-Link IE TSN Class B certified) is used, set the timeslot information from the setting values in "Basic Period Setting". The timeslot information can be checked with the buffer memory. (☞ Page 2063 Timeslot information)
- Set "Communication Period Setting" according to the communication cycle supported by the device stations. Even if "Communication Period Setting" in the device station is set to "Normal-speed" or "Low-speed", set the communication cycle value supported by the device station to the value in "Communication Period Interval Setting" of "Basic Period Setting".

■Network synchronous communication setting

Set each device station in the "CC-Link IE TSN Configuration" window as shown below.

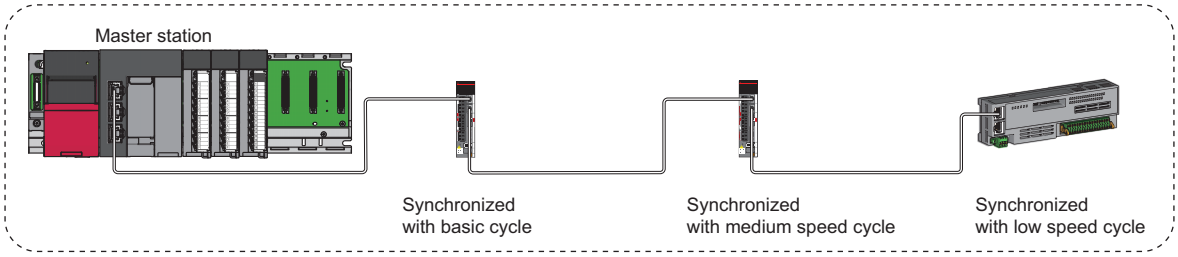
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]

	No.	Model Name	Subnet Mask	Default Gateway	Reserved/Error Invalid Station	Network Synchronous Communication	Communication Period Setting
	0	Host Station					
	1	MR-J5-G			No Setting	Synchronous	Basic Period

Simple display	Detailed display	Description	Setting range
Network Synchronous Communication		Sets whether to synchronize each device station with the network synchronous communication.	• Synchronous • Asynchronous (Default: Varies depending on the set module)

Synchronizable range

The control timing of the master station and device stations can be synchronized within the following range.



Watchdog counter

The watchdog counter is a function used to monitor for normal cyclic transmission between stations on CC-Link IE TSN. Using the watchdog counter, the master station and a device station mutually monitor the data to be updated every communication cycle; the master station monitors data received from a device station and a device station monitors data received from the master station.

Point

Whether the device station is using the watchdog counter during a data link with the master station can be checked with 'Watchdog counter operation status of each station' (SW01D0 to SW01D7).

■Operation

If the data received from the device station at the master station is not updated every communication cycle, a synchronization watchdog counter error (error code 125AH or 1A40H) will occur. If a watchdog counter error occurs, the data of that station will not be received, even after the watchdog counter returns to the normal state. For details on the restart conditions for data reception, refer to the following.

☞ Page 240 Checking received data using the watchdog counter

If the watchdog counter initialization processing of the device station fails, a synchronization watchdog counter initialization error (error code 1871H) will occur.

■Setting method

To enable watchdog counter update and check, set the master station's "Network Synchronous Communication" to "Synchronous". (If the master station's "Network Synchronous Communication" is set to "Asynchronous", watchdog counter update and check will be disabled.)

However, even when the master station's "Network Synchronous Communication" is set to "Synchronous", if the device station does not have a watchdog counter, watchdog counter update and check will be disabled.

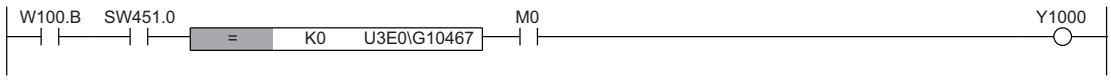
The settings may be required depending on the device station used. (📖Manual for the device station used)

Network communication cycle synchronization programming

The following example shows a program that controls the on and off of a remote output module whose station number is 17 and module number is 17.

The program is created as an event execution type program with "Trigger Type" set to "Network Communication Period Synchronization".

This program turns on Y0 of station number 17 when the execution instruction (M0) is on.



W100.B: Station number 17 remote READY
SW451.0: Station number 17 synchronous operating status information
U3E0\G10467: Module number 17 synchronous communication received data transfer status
M0: Execution instruction
Y1000: Station number 17 Y0

The following shows the network configuration settings of the program example.

	No.	Model Name	STA#	Station Type	Network Label	RX Setting			RY Setting			RWr Setting			RWw Setting		
						Points	Start	End	Points	Start	End	Points	Start	End	Points	Start	End
	17	NZ2GN2S1-32T	17	Remote Station	☐	32	0000	001F	32	0000	001F	4	0000	0003	4	0000	0003

Network Synchronous Communication: Synchronous
CC-Link IE TSN Class: CC-Link IE TSN Class B

The following shows the refresh settings of the program example.

No.	Link Side					CPU Side				
	Device Name	Points	Start	End		Target	Device Name	Points	Start	End
1	RWr	4	00000	00003	⇔	Specify Devi	W	4	00010	00013
2	RY	32	00000	0001F	⇔	Specify Devi	Y	32	01000	0101F

Associated devices and buffer memory

The following table lists the associated link special register areas.

No.	Name	Reference
SW01E9	Network synchronous communication function cycle over detection count	Page 2017 List of link special register (SW)
SW0440 to SW044F*1	Information of CC-Link IE TSN Network synchronous communication function of each station (station number: 1 to 253)	
SW0450 to SW045F*2	Synchronous/asynchronous operating status information of each station (station number: 1 to 253)	

*1 If the station number of the device station to be connected is within 120, SW01C0 to SW01C7 (CC-Link IE TSN network synchronous communication function information (station number 1 to 120) for each station) can also be used.

*2 If the station number of the device station to be connected is within 120, SW01C8 to SW01CF (synchronous/asynchronous operating status information (station number 1 to 120) for each station) can also be used.

The following table lists the associated link special relay areas.

No.	Name	Reference
SB01E1	Setting status of CC-Link IE TSN Network synchronous communication function	Page 2013 List of link special relay (SB)
SB01E9	Network synchronous communication function cycle over occurrence flag	

The following table lists the associated buffer memory area.

No.	Name	Reference
U3E0\G10451 to G10706	Synchronous communication received data transfer status (Module No.1 to 256)*3	Page 2060 Synchronous communication received data transfer status (Module No.1) to Synchronous communication received data transfer status (Module No.256)

*3 This buffer memory area will be used as interlock when the transfer stops for the synchronous communication received data of the station corresponding to the watchdog counter.

Restrictions

- Network synchronous communication is not possible with CC-Link IE TSN Class A devices.
- For the number of connectable devices, connection order, and compatible devices, refer to the following.

☞ Page 171 Structure with CC-Link IE TSN Class B Devices Only
☞ Page 178 Structure with CC-Link IE TSN Class B/A Devices

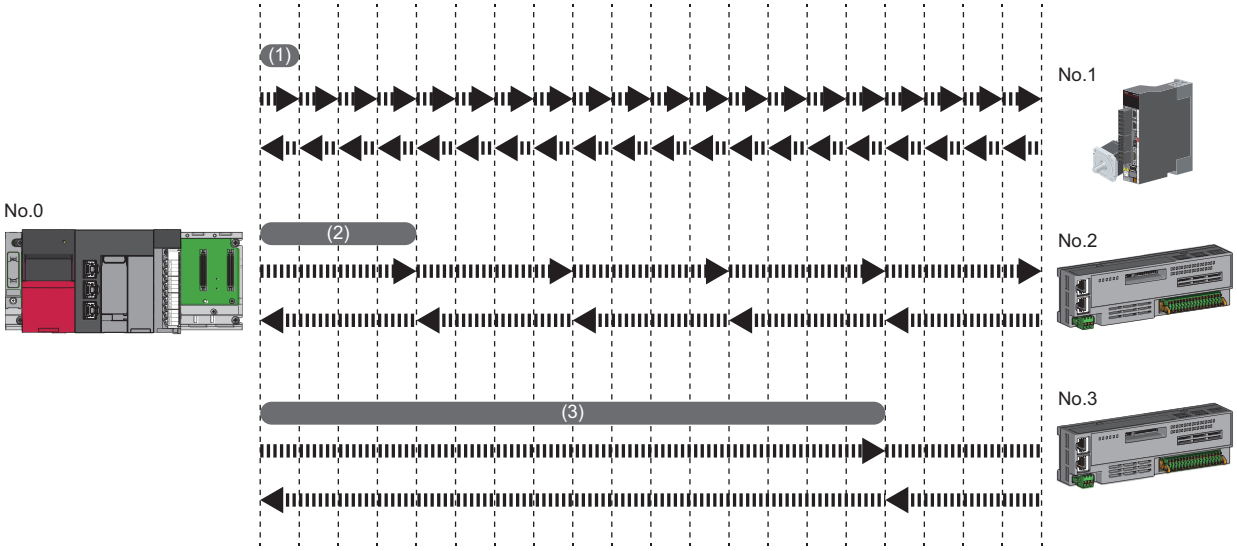
- Network synchronous communication is not possible if the communication is relayed via another network.
- When a switching hub is used, refer to the following and use a compatible product.

☞ Page 63 Industrial switch

- Network synchronous communication is possible when "Network Topology" is set to "Line/Star".

Communication cycle coexistence

If devices with different communication cycles coexist, cyclic data communication can be performed at the cycle of each device. High-speed communication devices and low-speed communication devices can be combined in a single network without affecting the high-speed communication devices with low-speed communication devices.
The master station can communicate with device stations by using three communication cycles consisting of the basic cycle under "Basic Period Setting", as well as "Normal-Speed" and "Low-Speed" under "Multiple Period Setting".



(1) Basic cycle
(2) Medium speed
(3) Low speed

The time for each communication cycle is the total time of cyclic transmission, transient transmission, and system reservation time.
Even if device stations with different communication cycles are connected to a network, a device station with a high-speed communication cycle is not affected by a device station with a low speed.

Point

- By using the motion operation cycle, the first, second, and third operation cycles can be set. The first motion operation cycle synchronizes with the basic cycle of the network. The second motion operation cycle synchronizes with the medium speed cycle of the network, and the third motion operation cycle synchronizes with the low speed cycle of the network.
- A motion operation cycle can include a mix of up to three cycles. A system with many axes can be controlled in divided manner by operating a specific axis at a fast operation cycle and operating other axes at a low speed operation cycle.

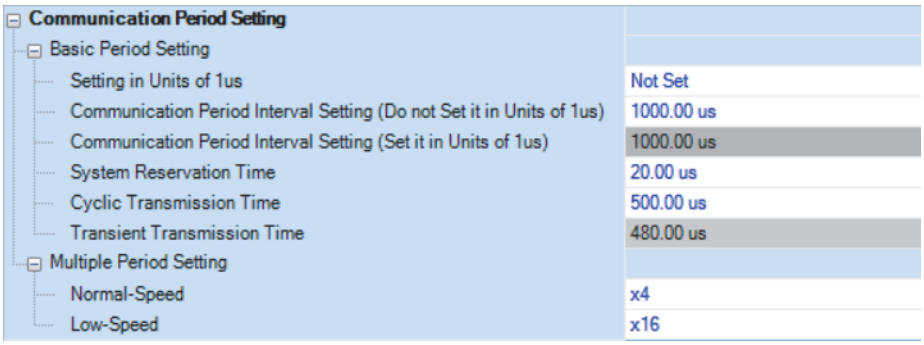
For details on the mixed use of operation cycles for motion operation, refer to the following.
☞ Page 535 Operation Cycle Coexistence

Setting method

Set "Multiple Period Setting" and "Communication Period Setting".

■Multiple period setting

[Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Communication Period Setting]



Item		Description	Setting range
Basic Period Setting		☞ Page 287 Basic period setting	
Multiple Period Setting	Normal-Speed	Select a "Normal-Speed" multiplying factor for a basic cycle. Setting is not required and can be left as "×4".	×4 (default)
	Low-Speed	Select the "Low-Speed" multiplying factor for a basic cycle. Select a value greater than "×16" in the following cases. • The communication cycle interval needs to be shortened for CC-Link IE TSN Class B devices. • The event of invalid communication cycle interval setting and low-speed multiplying factor (error code: 3A60H or 1854H) is detected.	• ×16 (default) • ×32 • ×64 • ×128

Point

- When an industrial switch (CC-Link IE TSN Class B certified) is used, set the timeslot information from the setting values in "Basic Period Setting". The timeslot information can be checked with the buffer memory. (☞ Page 2063 Timeslot information)

Precautions

When the device station used is a CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed", depending on the maximum response time during the time-managed polling method, the "Communication Period Interval Setting" value, and the "Low-Speed" multiplying factor of the device station, send/receive of the cyclic data cannot be guaranteed within the low-speed cycle.

At this time, the event of invalid communication cycle interval setting and low-speed multiplying factor (error code: 3A60H or 1854H) will be detected.

Then, calculation values that guarantee send/receive of the cyclic data within the low-speed cycle will be stored in the following buffer memory addresses. Set values that are equal to or greater than the stored values.

- Multiple cycle setting (low speed) (Un\G1277442)
- Communication cycle interval (calculation value) (Un\G1277443)

■Communication Period Setting

Configure the setting in the "CC-Link IE TSN Configuration" window of the master station according to the communication cycles supported by the device station.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]

	No.	Model Name	Subnet Mask	Default Gateway	Reserved/Error Invalid Station	Network Synchronous Communication	Communication Period Setting
	0	Host Station					
	1	MR-J5-G			No Setting	Synchronous	Basic Period

Simple display	Detailed display	Description	Setting range
Communication Period Setting		When multiple communication cycles are set, set the cycle of each device station.	• Basic Period (default) • Normal-Speed • Low-Speed

Point

After setting, refer to the following and adjust the communication cycle setting.

☞ Page 306 Communication Cycle Adjustment

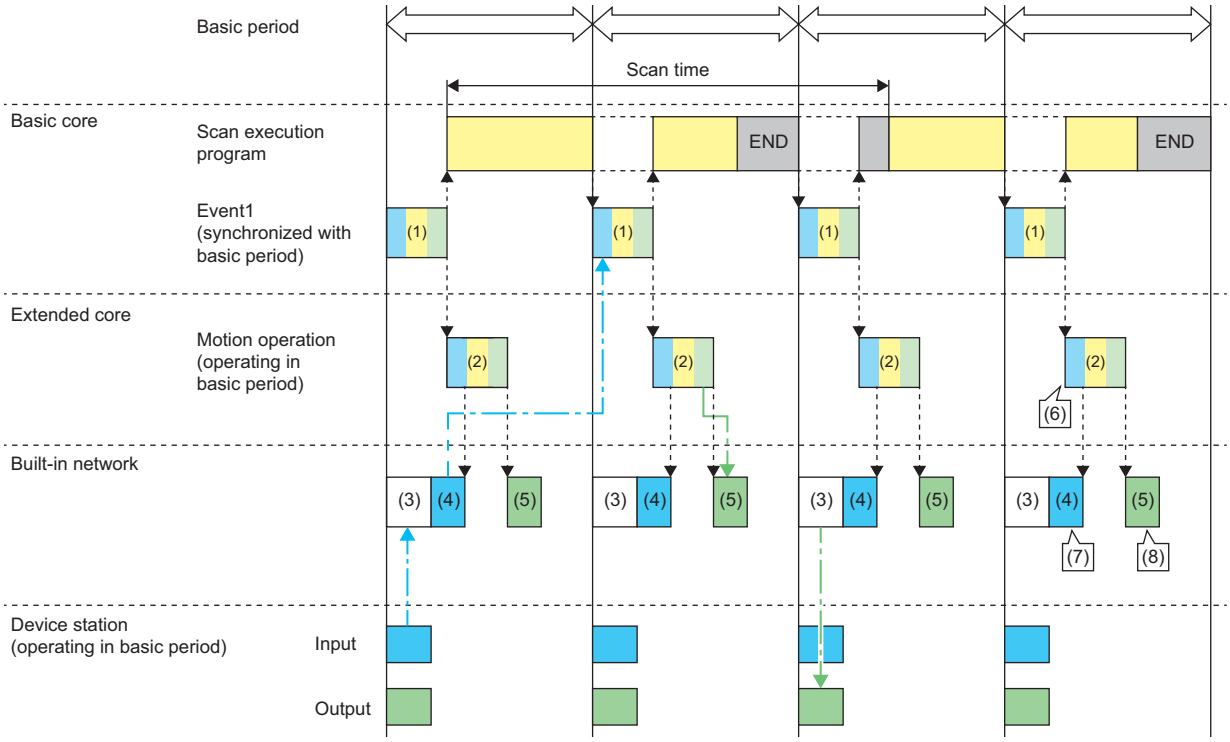
16.2 Program Execution Synchronized with Communication Cycle

The event execution type program is executed in synchronization with the network communication cycle.
The network communication cycle synchronous interrupt program performs refresh before and after executing the program that synchronizes with each communication cycle (basic cycle/normal-speed/low-speed). At that time, refresh is performed for device stations whose "Network Synchronous Communication" in the "CC-Link IE TSN Configuration" window is set to "Synchronous".
In addition, the motion operation processing that is running in each communication cycle is executed after refresh is performed for each communication cycle. Cyclic send processing is executed after completion of motion operation processing.

Point

- The "Network Communication Period Synchronization" can be selected from "Synchronize with Basic Period", "Synchronize with Normal-Speed", and "Synchronize with Low-Speed".
- Only one program with the same execution cycle can be created.

For a single cycle



(1) After input refresh of the synchronous station (basic cycle), the Event1 program (synchronized with the basic cycle) is executed, and then output refresh of the synchronous station is executed.
(2) After the input processing of the motion operation (basic cycle) is completed, the motion operation processing and output processing are executed in that order.
(3) The cyclic transmission is executed.
(4) Cyclic receive processing is executed.
(5) Cyclic send processing is executed.
(6) After completion of output refresh of the synchronous station, motion operation is executed.
(7) After completion of the cyclic transmission, the cyclic receive processing is executed.
(8) After the motion operation output processing is completed, the cyclic send processing is executed.

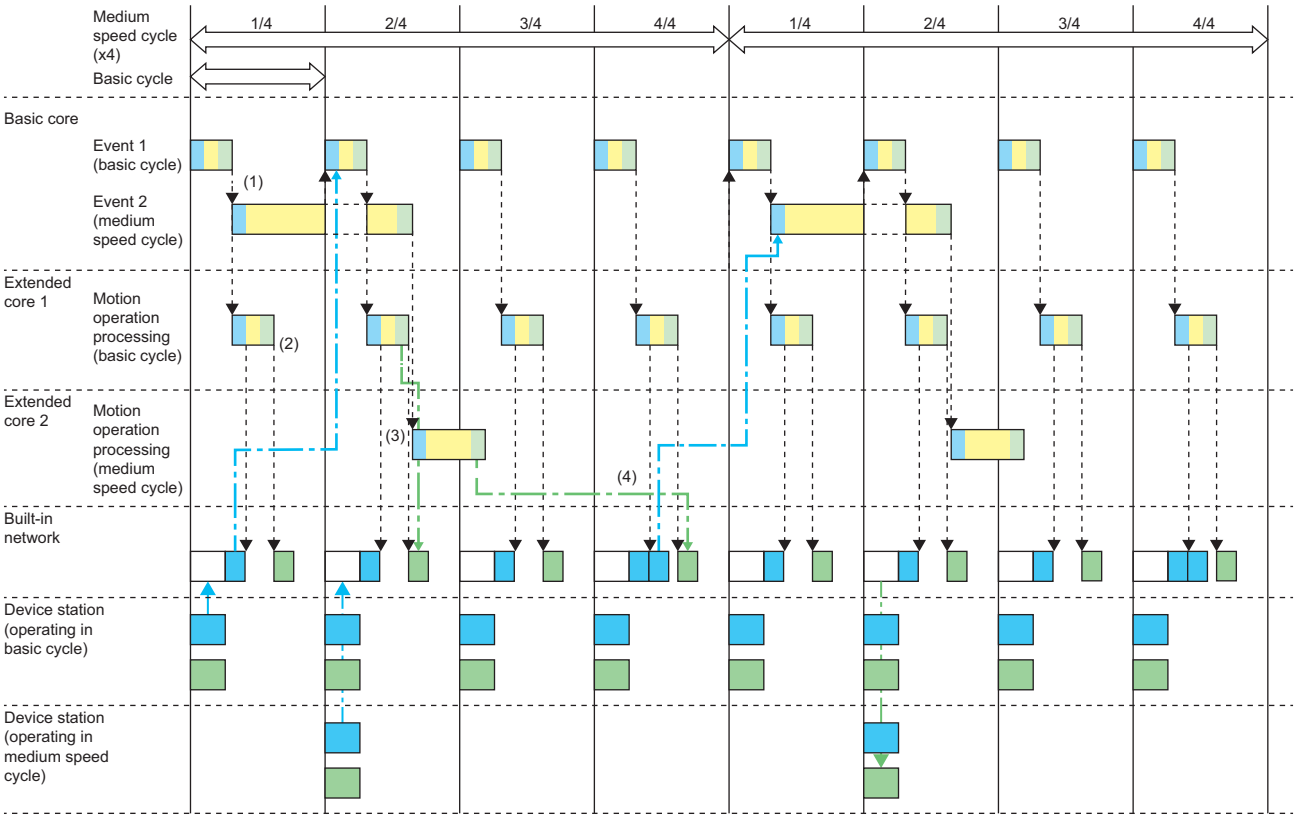
Point

- After the input/output processing (2) of motion operation (basic cycle) is completed, the cyclic send processing (5) is executed. If the motion operation (basic cycle) is not performed, after the output refresh (1) of the synchronous station (basic cycle) is completed before and after program execution, the cyclic send processing (5) is performed.
- Adjust the network communication cycle so that cyclic transmission processing (5) can be completed within the communication cycle. (☞ Page 306 Communication Cycle Adjustment)

For multiple cycles (execution on the basic core)

The following shows an example of "Synchronize with Basic Period" and "Synchronize with Normal-Speed".

Execute Order	Program Name	Execution Type		Interrupt Priority
		Type	Detailed Setting Information	
1	Scan	Scan		
2	Event1	Event	Network Communication Period Synchronization:Synchronize with Basic Period	10
3	Event2	Event	Network Communication Period Synchronization:Synchronize with Normal-Speed	11



(1) The programs are executed according to their priority. After input refresh of the synchronous station (basic cycle), the Event1 (basic cycle) program and output refresh of the synchronous station (basic cycle) are executed in that order. Then, the basic core executes input refresh of the synchronous station (medium speed cycle), Event2 (medium speed cycle), and output refresh of the synchronous station (medium speed cycle).

(2) After the output processing of motion operation (basic cycle) is completed, the cyclic send processing is performed.

(3) After output refresh is completed for the synchronous station (medium speed cycle), motion operation (medium speed cycle) input processing, motion operation, and output processing are executed.

(4) After the output processing of motion operation (medium speed cycle) is completed and after the output processing of motion operation (basic cycle) in the 4/4 cycle is completed, cyclic send processing is executed.

Point

- For device stations that are refreshed in synchronization with the network communication cycle synchronous interrupt program, set "Network Synchronous Communication" in the "CC-Link IE TSN Configuration" window to "Synchronous". Device stations set to "Asynchronous" are refreshed in the END processing.
- Priority can be set for network communication cycle synchronous interrupt programs. Set the priority so that programs with a short communication cycle have higher priority. (☞ Page 275 Interrupt Priority Setting)
- Adjust the network communication cycle so that the output processing of motion operation (normal speed/low speed) can be completed by the completion of the output processing of motion operation (basic cycle) in the cycle (N/N cycle) before the beginning of each cycle. (☞ Page 306 Communication Cycle Adjustment)

Operation when the conditions are satisfied

The processing shown below is performed when the network communication cycle synchronous interrupt program starts.

■If an interrupt factor occurs during link refresh

The link refresh is suspended and the network communication cycle synchronous interrupt program is executed. The same operation is performed as the operation of the fixed scan execution type program. (☞ Page 249 If an interrupt factor occurs during link refresh)

■If an interrupt factor occurs during the waiting time after END processing in constant scan execution

The network communication cycle synchronous interrupt program is executed. The same operation is performed as the operation of the fixed scan execution type program. (☞ Page 250 If an interrupt factor occurs during the waiting time after END processing in constant scan execution)

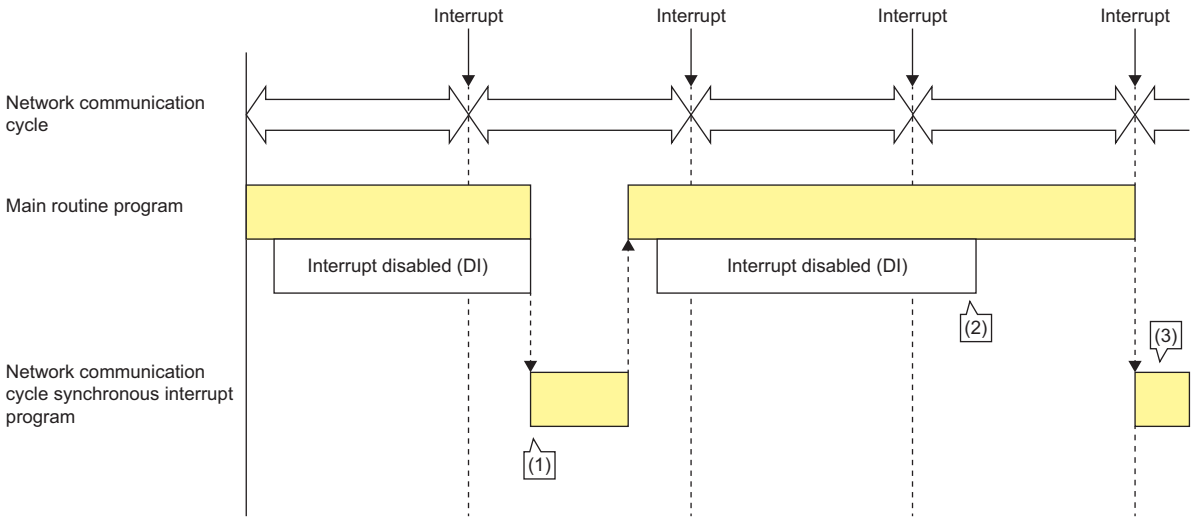
■If another interrupt occurs while the network communication cycle synchronous interrupt program is being executed

The operation is performed according to the interrupt priority. (☞ Page 274 Multiple interrupt)

Operation details

■If an interrupt factor occurs while interrupt is disabled (DI)

The operation differs depending on whether or not interrupts are enabled by the next cycle.



(1) If interrupts are enabled before the next cycle, the network communication cycle synchronous interrupt program will be executed when interrupts are enabled.

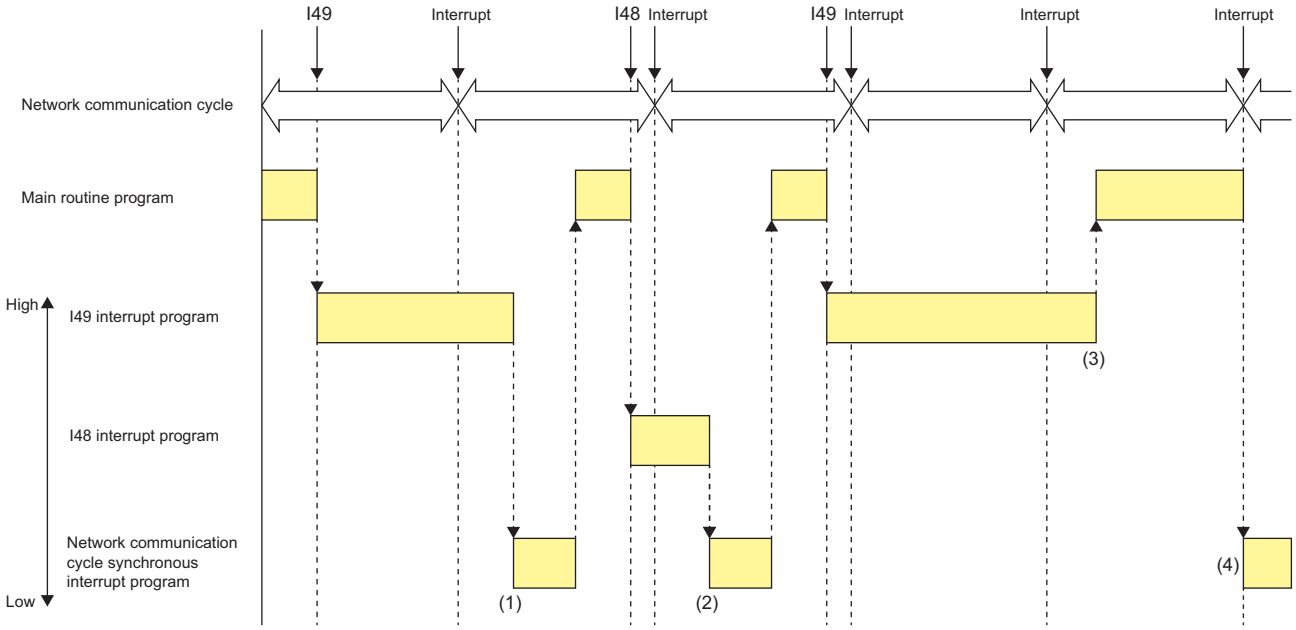
(2) If the interrupt disabled state exceeds the next cycle (2nd cycle), the network communication cycle synchronous interrupt program will not be executed even in the interrupt enabled state. If the network communication cycle synchronous interrupt program cannot be executed due to this factor, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

(3) Since interrupts are enabled, the network communication cycle synchronous interrupt program is executed.

■If an interrupt factor with the same or a lower priority occurs while the interrupt program is being executed

After an interrupt occurs in the network communication cycle, the operation differs depending on whether or not the interrupt program being executed ends before the next cycle.

Program	Interrupt priority
I49 interrupt program	3
I48 interrupt program	5
Network communication cycle synchronous interrupt program	6



(1) The network communication cycle synchronous interrupt program is executed because the I49 interrupt program with the higher priority has finished before the next cycle.

(2) The network communication cycle synchronous interrupt program is executed because the I48 interrupt program whose priority is the same but whose priority order is higher has finished before the next cycle.

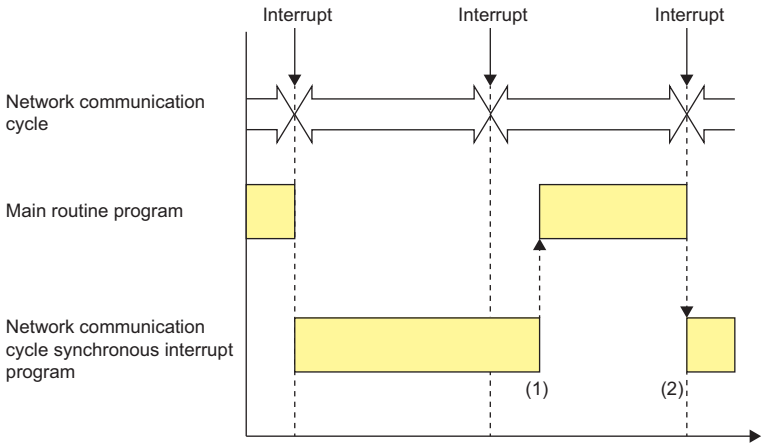
(3) The network communication cycle synchronous interrupt program is not executed because the end of the I49 interrupt program exceeded the second network communication cycle. If the network communication cycle synchronous interrupt program cannot be executed due to this factor, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

(4) Since the I49 interrupt program has finished, the network communication cycle synchronous interrupt program is executed.

■If the same interrupt factor occurs while the interrupt program is being executed

If an interrupt factor which is the same as that for the running interrupt program occurs, the factor is not memorized. Therefore, the network communication cycle synchronous interrupt program will not be executed after the running interrupt program finishes.

If the network communication cycle synchronous interrupt program cannot be executed due to this factor, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

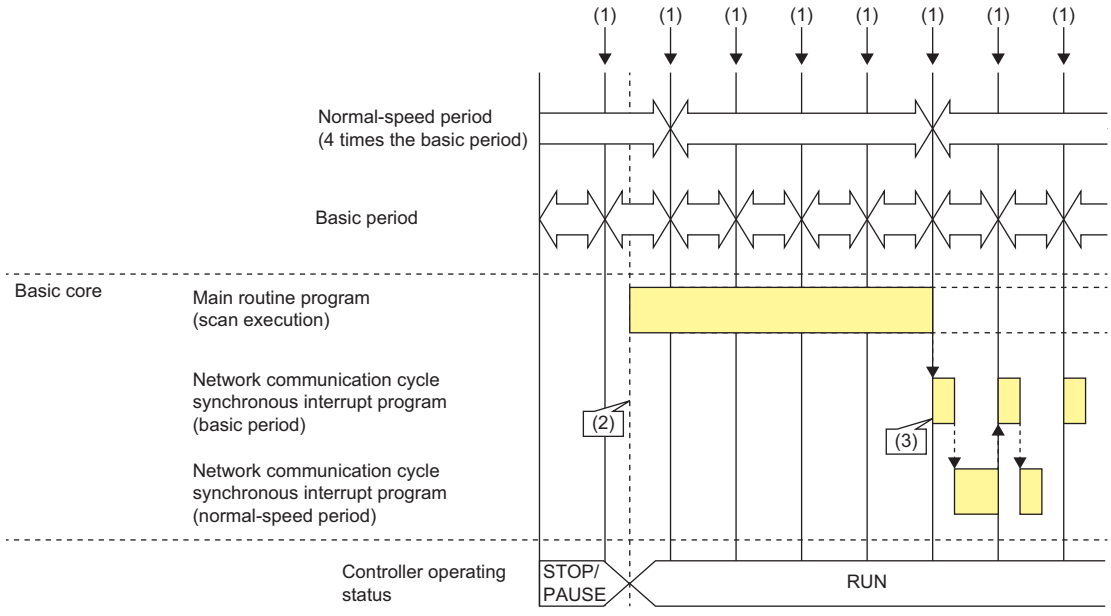


(1) Since the network communication cycle synchronous interrupt program is running, it will not be executed even if the same interrupt factor occurs.
(2) The network communication cycle synchronous interrupt program is executed by the following interrupt factors.

■If an interrupt factor occurs in the STOP/PAUSE state

The interrupt factor that has occurred in the STOP/PAUSE state is not memorized, and therefore the network communication cycle synchronous interrupt program will not be executed even when the controller enters the RUN state and interrupts are enabled.

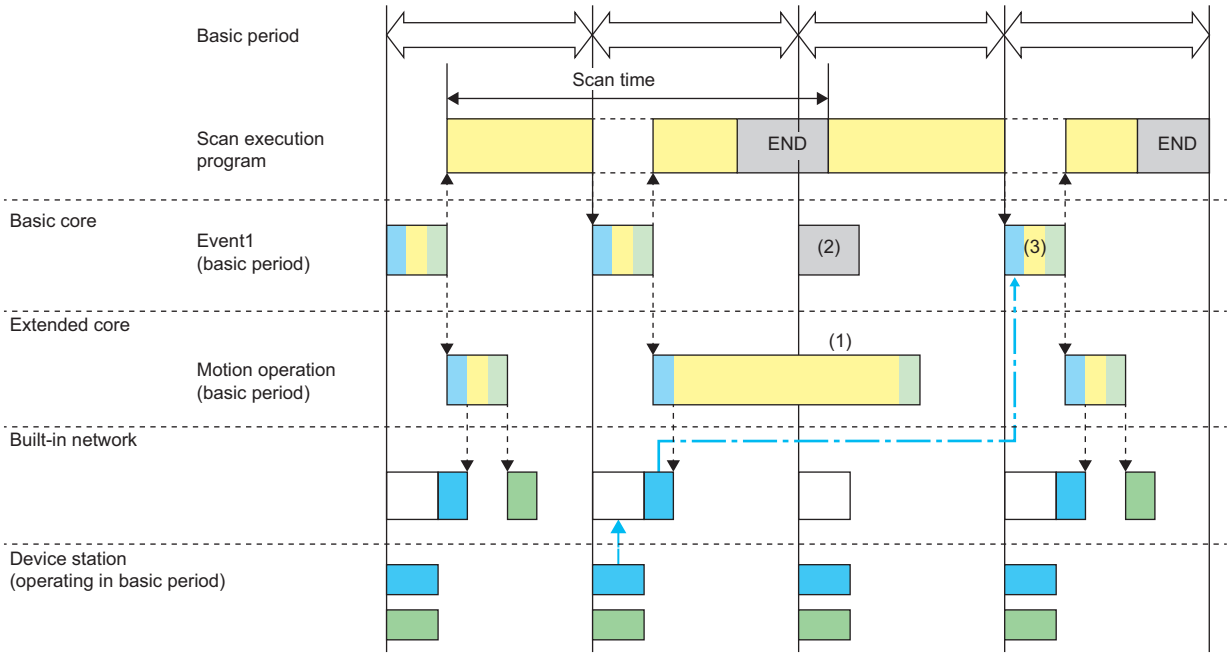
When the controller enters the RUN state and an interrupt occurs, the network communication cycle synchronous interrupt program is executed. Also, if there are network communication cycle synchronous interrupt programs with different operation cycles, the network communication cycle synchronous interrupt program is executed in the first cycle (1/N cycle) of the slowest cycle after the status changes to RUN.



(1) Interrupt
(2) The network communication cycle synchronous interrupt program is not executed because an interrupt factor has occurred in the STOP/PAUSE state.
(3) The network communication cycle synchronous interrupt program is executed from the beginning cycle (1/N cycle) of the slowest cycle.

■If the motion operation processing is not completed

When the motion operation processing is set to synchronize with the same communication cycle as the network communication cycle synchronous interrupt program, the network communication cycle synchronous interrupt program will not be executed if the motion operation processing for the previous cycle has not been completed.



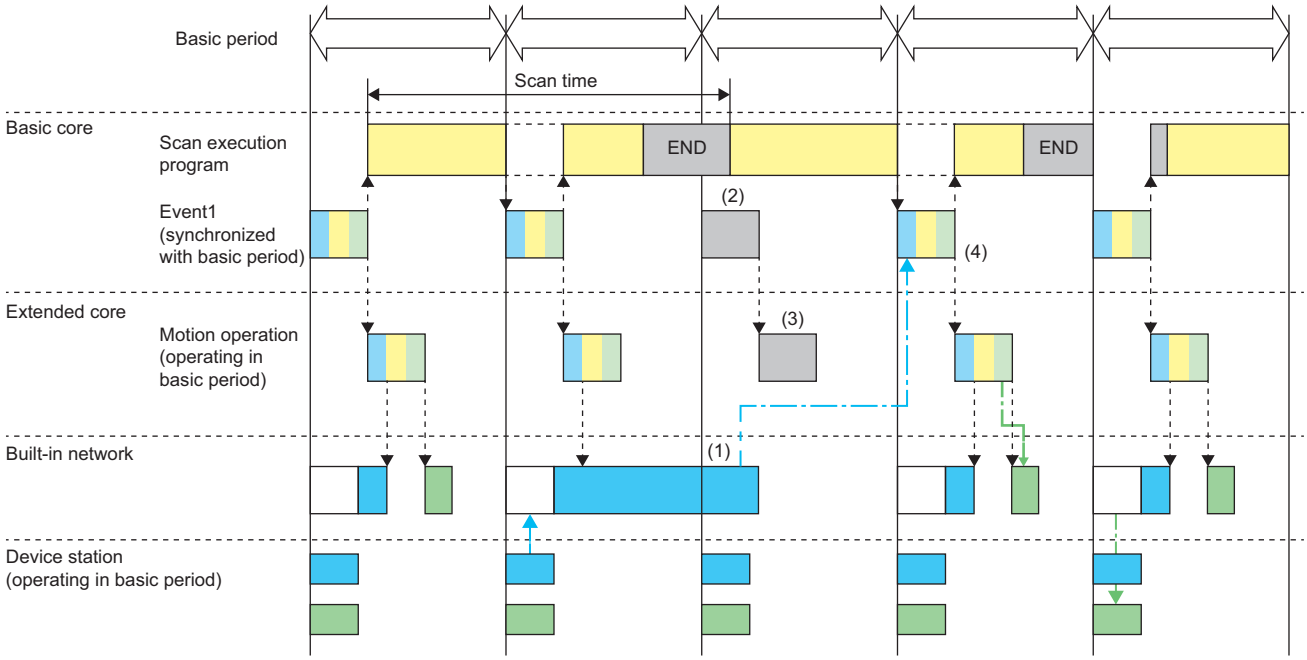
(1) The motion operation of the previous cycle has not been completed.
(2) The program for Event1 (synchronized with the basic cycle) is not executed because motion operation is in progress.
(3) The program for Event1 (synchronized with the basic cycle) is executed.

If the network communication cycle synchronous interrupt program cannot be executed, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

■When the network communication processing is not completed

If the network processing of the previous cycle has not been completed, the current network communication cycle synchronous interrupt program will not be executed.

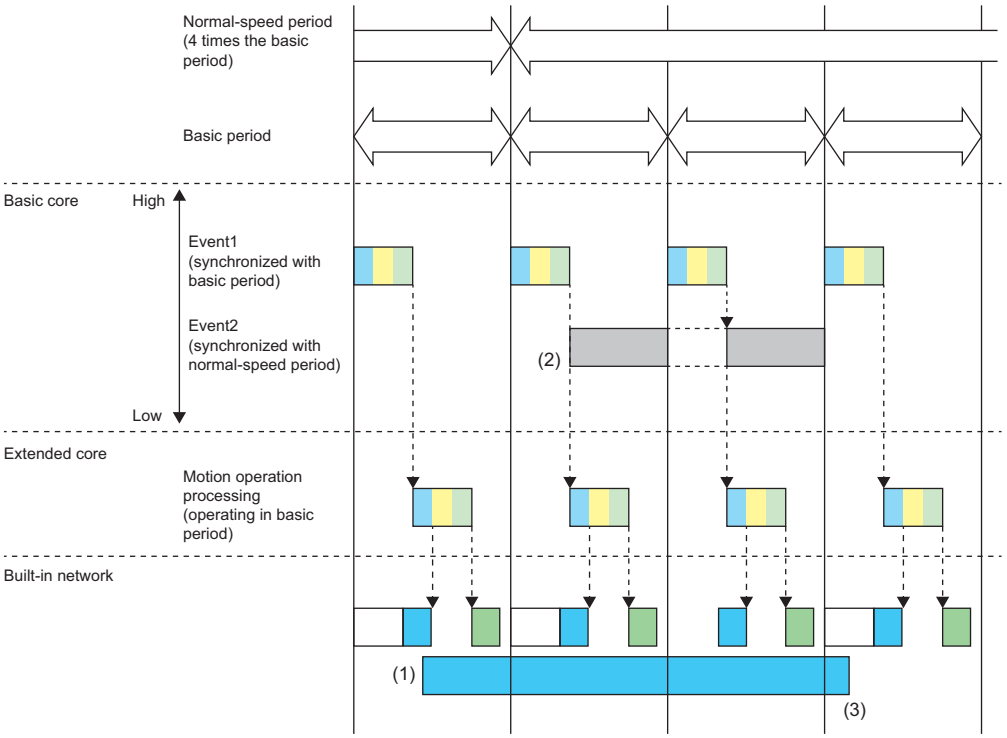
The network communication cycle synchronous interrupt program that synchronizes with the basic cycle will not be executed unless the network communication processing is completed when the conditions are met.



(1) Network communication processing (cyclic send/receive) in the previous cycle has not been completed.
(2) The program for Event1 (synchronized with the basic cycle) is not executed because the network communication is in progress.
(3) Since the program for Event1 (synchronized with the basic cycle) was not executed, the program for motion operation (operating at the basic cycle) will not be executed.
(4) The program for Event1 (synchronized with the basic cycle) is executed.

If the network communication cycle synchronous interrupt program cannot be executed, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

If the network communication processing is not completed when the conditions are met, the network communication cycle synchronous interrupt program that synchronizes with a cycle other than the basic cycle waits for the completion of network communication processing until 1/2 of each communication cycle.
If the network communication processing is not completed even after 1/2 of the communication cycle is exceeded, the network communication cycle synchronous interrupt program will not be executed.



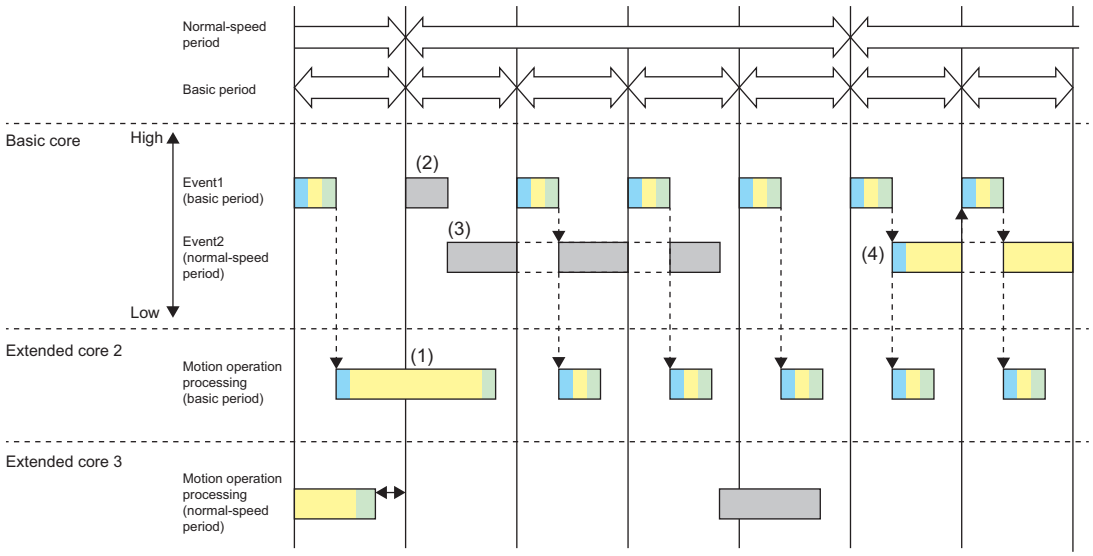
(1) Cyclic receive processing (medium speed cycle)
(2) Since cyclic receive processing (medium speed cycle) is in progress, the program waits for completion of the processing.
(3) The program for Event2 (synchronized with the basic cycle) is not executed because the network communication processing was not completed before 1/2 of the medium speed cycle passed.

■When the network communication cycle synchronous interrupt program that synchronizes with a communication cycle with a small division ratio is not running

The network communication cycle synchronous interrupt program that synchronizes with a communication cycle other than the basic cycle will not be executed in conjunction with other network communication cycle synchronous interrupt programs not being executed.

The network communication cycle synchronous interrupt program that meets all of the following conditions will not be executed.

- The execution condition is met at the same time as another network communication cycle synchronous interrupt program.
- Another network communication cycle synchronous interrupt program whose execution condition is met at the same time is not executed.
- The network communication cycle synchronous interrupt program synchronizes with a communication cycle having a larger division ratio than the other network communication cycle synchronous interrupt programs that have not been executed.



(1) The motion operation (basic cycle) of the previous cycle has not been completed.
(2) This program will not be executed because motion operation (basic cycle) is in progress.
(3) At the same time, since the program that synchronizes with the basic cycle that meets the condition is not executed, the program that synchronizes with the medium speed cycle is not executed either.
(4) The program for Event2 (synchronized with the basic cycle) is executed.

If the network communication cycle synchronous interrupt program cannot be executed due to this factor, the error flag (SM492 (basic cycle)/SM493 (medium speed cycle)/SM494 (low speed cycle)) for the corresponding cycle will turn on, and the number of errors (SD492 (basic cycle)/SD493 (medium speed cycle)/SD494 (low speed cycle)) in the corresponding cycle will be counted up.

Precautions

- To avoid interfering with the execution of the network communication cycle synchronous interrupt program, do not perform the following operation. Otherwise, a network communication cycle synchronization processing error (error code 11F0H, 11F1H) may occur.

Interference operation	Workaround
Disable interrupts by executing the DI instruction.	Ensure that the network communication cycle synchronous interrupt program is not disabled by using the DI instruction with an argument.

- Note the following when setting the link device assigned to the synchronous station of CC-Link IE TSN as the event program trigger.
  - Specify the refresh target device of the same link device.
  - If the same link device is specified by U□\G□ (module access device) and Jn\□ (link direct device), no trigger will be established.
- If a network communication cycle synchronization error (11F0H) occurs, revise the processing contents of the network communication cycle synchronous interrupt program so that the processing can be completed within the interval set in the communication cycle interval setting. (☞ Page 308 Adjustment by reviewing immediately before processing)
- For the precautions on the network communication cycle synchronous interrupt priority, refer to the following.

☞ Page 277 Network communication cycle synchronous interrupt priority setting

16.3 Communication Cycle Adjustment

Adjust the communication cycle interval of CC-Link IE TSN if the motion system needs to be optimized or if cycle over occurred.
This section describes how to re-set "Communication Period Interval Setting" and "Cyclic Transmission Time" and how to review the processing performed immediately before.
☞ Page 306 Adjustment by "Communication Period Interval Setting" and "Cyclic Transmission Time"
☞ Page 308 Adjustment by reviewing immediately before processing

Adjustment by "Communication Period Interval Setting" and "Cyclic Transmission Time"

Adjust the values of "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings".
When performing the network communication cycle synchronization, set the device station and use the network communication cycle synchronous interrupt program that matches the setting of the device station. (☞ Page 286 Network Synchronous Communication)

Adjustment procedure

1. Set the default values for "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings". (☞ Page 287 Basic period setting)
2. Write the program to the controller.
3. Set SD972 (Communication cycle intervals measure setting) to A501H (Communication cycle interval measure enabled). (☞ Page 1996 Latch area)
4. Turn on SM972 (communication cycle intervals measure setting request) to enable actual value measurement. (☞ Page 1959 Latch area)
5. Reset the controller.
6. Check if any errors other than the cycle over error have occurred, and take action if any are found. (☞ Page 1776 ERROR CODES)
7. Check if the cycle over has occurred. (☞ Page 307 Cycle over check)
8. If the cycle over has occurred or "Communication Period Interval Setting" is to be smaller than the current setting value, reset the setting as follows.

- Set a value larger than Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201) for "Communication Period Interval Setting".
- Set "Cyclic Transmission Time" according to Cyclic transmission time (calculation value) (U3E0\G10272 to U3E0\G10273).

However, review the communication cycle interval and cyclic transmission time settings so that the transient transmission time does not fall below the lower limit values[*1].

*1 The lower limit values of the transient transmission time are as follows:
· A master station communication speed of 1Gbps: 14μs
· A master station communication speed of 100Mbps: 140μs

Point

If the cycle over occurs even after re-setting, set a sufficiently large value in "Communication Period Interval Setting" to check that the cycle over does not occur. Then, set the value again referring to Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201).

9. After the adjustment is completed, set a value other than A501H (Communication cycle intervals measure disabled) in SD972 (Communication cycle intervals measure setting) and turn off SM972.
10. Reset the controller.

■Cycle over check

Cycle over indicates a status in which the processing performed for each communication cycle was not completed within the communication cycle.

In this case, the following error occurs.

Error code/event code	Error name/detected event
Error code 11F0H	Network communication cycle synchronization error
Error code 11F1H	Network communication cycle synchronization error
Error code 1A00H	Cycle over
Error code 1860H	Network synchronous communication function transmission skip detection
Error code 1863H	Network communication cycle over
Error code 2600H	Network synchronous communication function processing error
Error code 3402H	Cycle over
Error code 3A6FH	Network communication cycle over
Event code 00F08H	Cycle over warning

Point

When the network communication cycle synchronization is performed, interrupts may be disabled as a cause of cycle over. If interrupts are disabled with the DI instruction, restore the interrupt enabled state with the EI instruction within the communication cycle.

Adjustment by reviewing immediately before processing

The processing executed immediately before cyclic send processing is stored in 'Processing immediately before cyclic send processing' (U3E0\G10202). (☞ Page 2041 Details of buffer memory addresses (CPU function part))
From the contents of the stored processing, one can determine which processing or settings can be reviewed to shorten the communication cycle and adjust it.

Point

If the network communication cycle synchronization is not performed, correct the parameter settings by referring to the following to shorten the cyclic receive processing (basic cycle).
☞ Page 2116 Shortening method of the communication cycle interval and cyclic transmission time
After that, reset the controller and set the cyclic transmission time again by referring to the value stored in 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273).

Adjustment procedure

1. Check the value stored in 'Processing immediately before cyclic send processing' (U3E0\G10202). If the stored value is zero, wait until another value is stored.
2. Based on the value of 'Processing immediately before cyclic send processing' (U3E0\G10202), review the following items.

Value of U3E0\G10202	Content of processing immediately before cyclic send processing	Action to be taken
0	Undetermined	Wait until another value is stored.
1	Synchronous station (basic cycle) output refresh or motion operation (basic cycle) output processing	Correct the processing to shorten the following processing times. • Input refresh and output refresh of synchronous station (basic cycle) • Execution of program (synchronized with the basic cycle) • Input processing and output processing of motion operation (basic cycle) • Operation processing of motion operation (basic cycle)
2	Synchronous station (medium speed cycle) output refresh or motion operation (medium speed cycle) output processing	Correct the processing to shorten the following processing times. • Input refresh and output refresh of synchronous station (medium speed cycle) • Execution of program (synchronized with the medium speed cycle) • Input processing and output processing of motion operation (medium speed cycle) • Operation processing of motion operation (medium speed cycle) • Input refresh and output refresh of synchronous station (basic cycle) • Execution of program (synchronized with the basic cycle)
3	Synchronous station (low speed cycle) output refresh or motion operation (low speed cycle) output processing	Correct the processing to shorten the following processing times. • Input refresh and output refresh of synchronous station (low speed cycle) • Execution of program (synchronized with the low speed cycle) • Input processing and output processing of motion operation (low speed cycle) • Operation processing of motion operation (low speed cycle) • Input processing and output processing of motion operation (medium speed cycle) • Operation processing of motion operation (medium speed cycle) • Input refresh and output refresh of synchronous station (basic cycle) • Execution of program (synchronized with the basic cycle) • Input refresh and output refresh of synchronous station (medium speed cycle) • Execution of program (synchronized with the medium speed cycle)
5	Cyclic receive processing (basic cycle)	Correct the processing to shorten the following processing times. • Cyclic transmission time • Cyclic receive processing (basic cycle)

For the review of each item, refer to the following.

Item	Reference
Input refresh and output refresh of synchronous station	In the network configuration settings, correct either or both of the following parameter settings for device stations whose review target cycle is set in the communication period setting and whose "Network Synchronous Communication" is set to "Synchronous". • Reduce the number of RX, RY, RWr, and RWw points of the target device station. • Reduce the number of connected modules for the target device station. For the parameter settings, refer to the following. ☞ Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings)
Program execution	In the CPU parameter program settings, modify the program of an event whose review target cycle is set in the execution type so that the execution time is shortened. ☞ Page 244 Program Setting
Input processing and output processing of motion operation	Refer to the following and correct the processing. ☞ Page 529 Operation cycle over check
Motion operation processing	
Cyclic transmission time Cyclic receive processing time (basic cycle) Cyclic send processing time	Correct the processing to shorten the processing times by referring to the following. ☞ Page 2116 Shortening method of the communication cycle interval and cyclic transmission time After that, reset the controller and set the cyclic transmission time again by referring to the value stored in 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273).

3. Write the corrective items , such as settings and program, to the controller.

4. Reset the controller or turn on b0 of 'Clear request of communication cycle intervals (actual measurement value)' (U3E0\G10270).

- If parameters has been changed or an error has occurred, reset the controller.
- If no parameter has been changed and no error has occurred, reset the controller or turn on b0 of U3E0\G10270.

5. Repeat the above procedure to shorten the communication cycle interval.

Actual measurement value of processing time

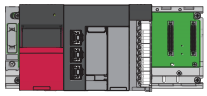
Refer to each processing time stored in the buffer memory areas in the following CPU function part to correct the processing to shorten these times.

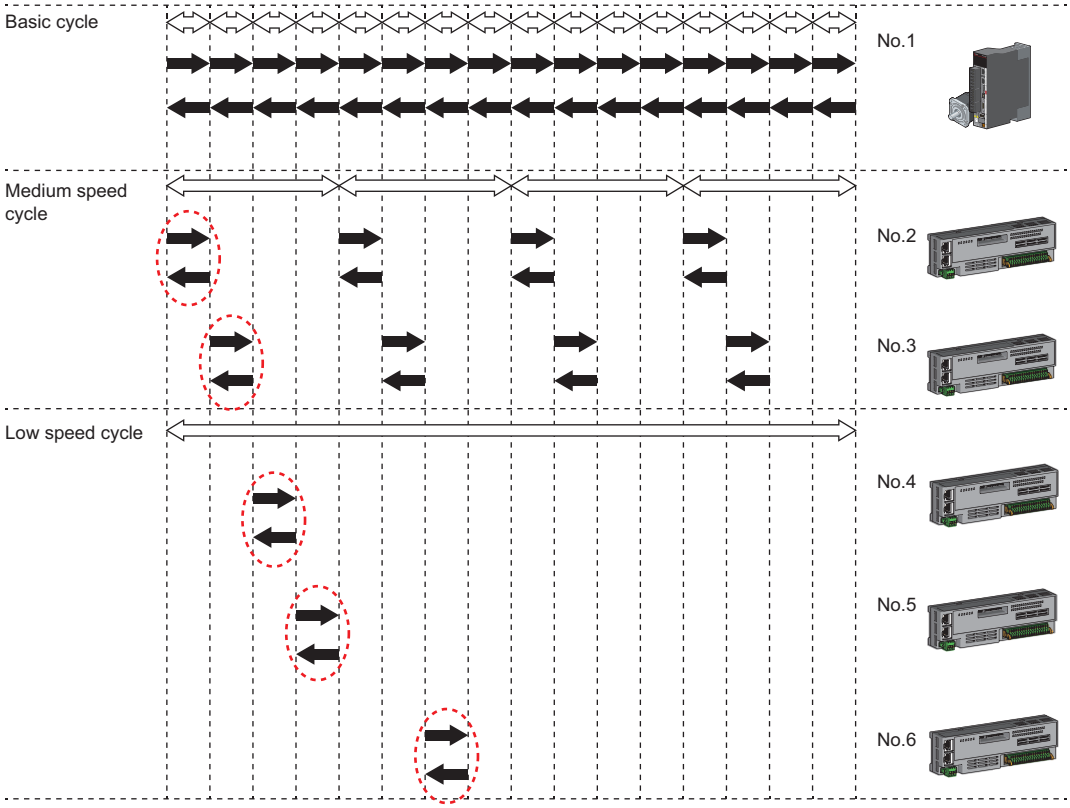
Address	Name	
U3E0\G10210, U3E0\G10211	Processing time of basic cycle	Input refresh time of synchronous station (basic cycle) [ns]
U3E0\G10212, U3E0\G10213		Program execution time (basic cycle) [ns]
U3E0\G10214, U3E0\G10215		Output refresh time of synchronous station (basic cycle) [ns]
U3E0\G10216, U3E0\G10217		Input processing time of motion operation (basic cycle) [ns]
U3E0\G10218, U3E0\G10219		Operation processing time of motion operation (basic cycle) [ns]
U3E0\G10220, U3E0\G10221		Output processing time of motion operation (basic cycle) [ns]
U3E0\G10222, U3E0\G10223	Processing time of medium speed cycle	Processing time of medium speed cycle [ns]
U3E0\G10224, U3E0\G10225		Input refresh time of synchronous station (medium speed cycle) [ns]
U3E0\G10226, U3E0\G10227		Program execution time (medium speed cycle) [ns]
U3E0\G10228, U3E0\G10229		Output refresh time of synchronous station (medium speed cycle) [ns]
U3E0\G10230, U3E0\G10231		Input processing time of motion operation (medium speed cycle) [ns]
U3E0\G10232, U3E0\G10233		Operation processing time of motion operation (medium speed cycle) [ns]
U3E0\G10234, U3E0\G10235		Output processing time of motion operation (medium speed cycle) [ns]
U3E0\G10236, U3E0\G10237	Processing time of low speed cycle	Processing time of low speed cycle [ns]
U3E0\G10238, U3E0\G10239		Input refresh time of synchronous station (low speed cycle) [ns]
U3E0\G10240, U3E0\G10241		Program execution time (low speed cycle) [ns]
U3E0\G10242, U3E0\G10243		Output refresh time of synchronous station (low speed cycle) [ns]
U3E0\G10244, U3E0\G10245		Input processing time of motion operation (low speed cycle) [ns]
U3E0\G10246, U3E0\G10247		Operation processing time of motion operation (low speed cycle) [ns]
U3E0\G10248, U3E0\G10249		Output processing time of motion operation (low speed cycle) [ns]
U3E0\G10264, U3E0\G10265	Cyclic processing time	Cyclic transmission time [ns]
U3E0\G10266, U3E0\G10267		Cyclic receive processing time (basic cycle) [ns]
U3E0\G10268, U3E0\G10269		Cyclic send processing time [ns]

Cyclic transmission distribution

If devices with different communication cycles coexist, the timing of cyclic transmission can be distributed for each station within the communication cycle of medium-speed and low-speed devices.

This distribution shortens the cyclic transmission time of the basic cycle and shortens the communication cycle interval.

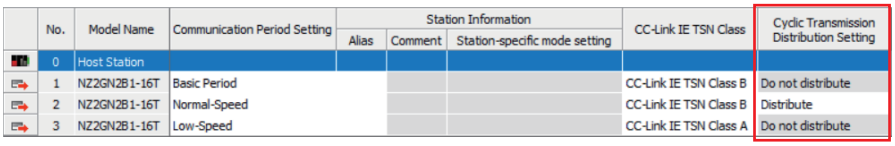




Parameter setting

Set each device station in the "CC-Link IE TSN Configuration" window as shown below.

[Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



	No.	Model Name	Communication Period Setting	Station Information			CC-Link IE TSN Class	Cyclic Transmission Distribution Setting
				Alias	Comment	Station-specific mode setting		
	0	Host Station						
	1	NZ2GN2B1-16T	Basic Period				CC-Link IE TSN Class B	Do not distribute
	2	NZ2GN2B1-16T	Normal-Speed				CC-Link IE TSN Class B	Distribute
	3	NZ2GN2B1-16T	Low-Speed				CC-Link IE TSN Class A	Do not distribute

Item	Description	Setting range
Cyclic Transmission Distribution Setting	Set whether or not to perform cyclic transmission distribution.	• Do not distribute (default) • Distribute

Point

Leave the default settings for "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings".

After setting the parameters, run the system, refer to the values stored in the buffer memory below, and re-set "Communication Period Interval Setting" and "Cyclic Transmission Time".

- Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201)
- Cyclic transmission time (calculation value) (U3E0\G10272 to U3E0\G10273)

Devices that can perform cyclic transmission distribution

Cyclic transmission distribution can be performed with CC-Link IE TSN Class B devices that are set to "Normal-Speed" or "Low-Speed" in "Communication Period Setting" of the network configuration (CC-Link IE TSN configuration).

However, when "Communication Speed" of the master station is set to "1Gbps", cyclic transmission distribution cannot be performed to device stations with a communication speed of 100Mbps. For a device station with a communication speed of 100Mbps, set "Cyclic Transmission Distribution Setting" to "Do not distribute".

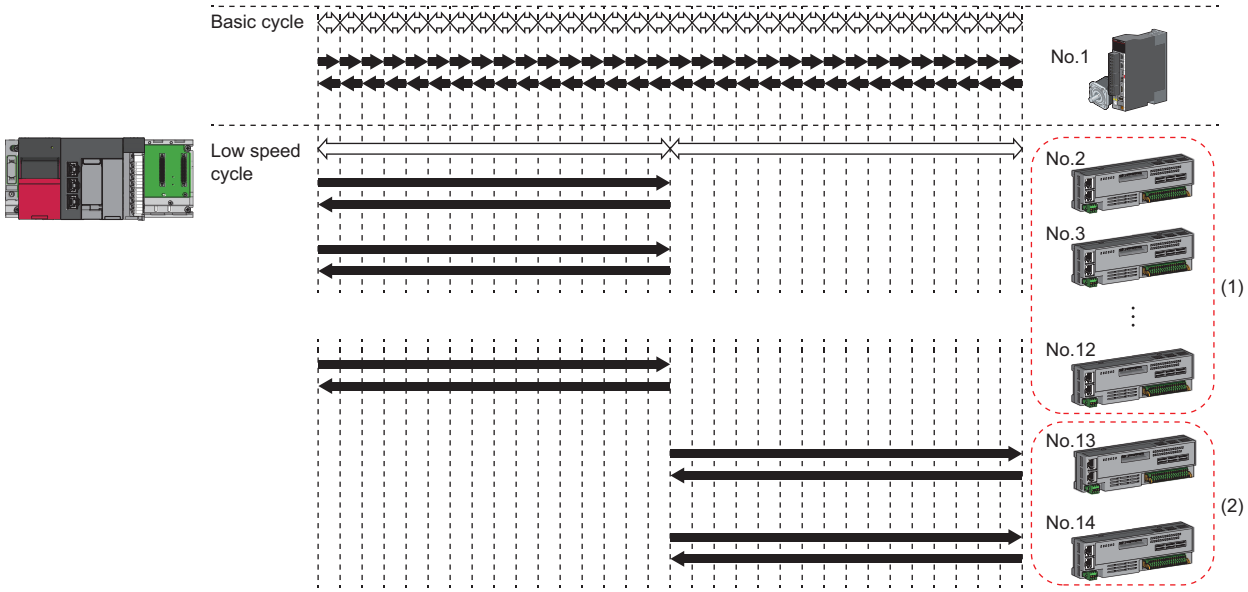
CC-Link IE TSN Class A group send

For CC-Link IE TSN Class A devices, device stations whose "Communication Period Setting" is set to "Low-Speed" are divided into groups according to the cyclic data size, and cyclic transmission is performed in group units.
Grouping is performed so that both of the following are within the specified size for each group.

- Total size of cyclic data sent from the master station to the device stations*1
- Total size of cyclic data that the master station receives from the device stations*1

*1 Refer to the following for the calculation method of the total size of cyclic data sent from the master station to a device station, as well as cyclic data which the master station receives from a device station.
☞ Page 2111 Details of n by which communication cycle intervals are multiplied

To shorten the communication cycle interval, select "2K bytes" for "CC-Link IE TSN Class A Group Send Upper Limit Size Setting". However, for CC-Link IE TSN Class A devices, the cyclic transmission delay time of device stations whose "Communication Period Setting" is set to "Low-Speed" will be longer. In this case, communication with one group is performed in one communication cycle.
For CC-Link IE TSN Class A devices, to shorten the cyclic transmission delay time of a device station whose "Communication Period Setting" is set to "Low-Speed", select "8K bytes". However, the communication cycle interval will become longer. In this case, communication with four groups is performed in one communication cycle.



(1) Stations with a total cyclic data size of up to 2K bytes are grouped as transmission number 1 and cyclic transmission is executed.
(2) Cyclic transmission is executed as a group with transmission number 2. If there are two groups, the communication cycle of CC-Link IE TSN Class A devices with low speed setting is calculated as follows: Communication cycle interval × Multiple specified in "Low-Speed" of "Multiple Period Setting" × 2.

Parameter settings

[Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Connection Device Information]



Item	Description	Setting range
CC-Link IE TSN Class A Group Send Upper Limit Size Setting*1	Set the upper limit of the size of the cyclic data to be sent for each group of device stations whose "CC-Link IE TSN Class" is set to "CC-Link IE TSN Class A" and "Communication Period Setting" is set to "Low-Speed" in the network configuration settings.	• 2K bytes (default) • 8K bytes

*1 The setting is available when "CC-Link IE TSN Class Setting" is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".

Point

Leave the default settings for "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings".

After setting the parameters, run the system, refer to the values stored in the buffer memory below, and re-set "Communication Period Interval Setting" and "Cyclic Transmission Time".

- Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201)
- Cyclic transmission time (calculation value) (U3E0\G10272 to U3E0\G10273)

Precautions

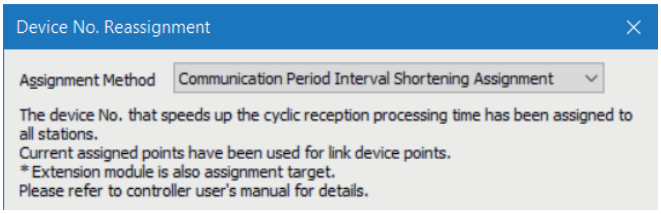
This setting may increase the cyclic transmission delay time of CC-Link IE TSN Class A devices with low speed setting.

Device number reassignment

Assign the device numbers successively to the link device of the specified target station.
For the number of link device points, the points assigned in the list of stations on the "CC-Link IE TSN Configuration" window are used.

Point

This setting shortens the communication cycle interval by assigning consecutive device numbers by selecting "Communication Period Interval Shortening Assignment" in the "Device No. Reassignment" window.



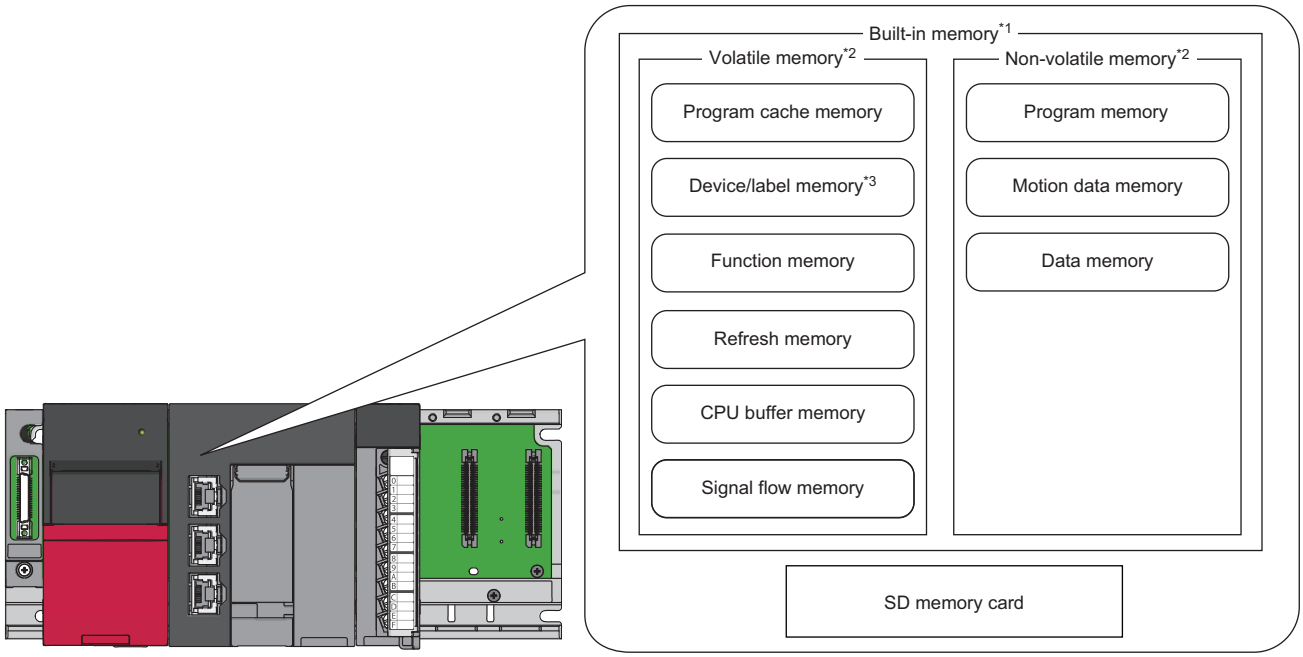
This setting also allows consecutive refresh devices to be more easily set in the refresh settings, creating a good potential of improvement in refresh performance.

For details on the setting, refer to the following.
☞ Page 169 Device number reassignment

17 CONTROLLER MEMORY CONFIGURATION

17.1 Memory Configuration

The following figure shows the memory configuration of the controller.



*1 The built-in memory is a generic term of the memory built in the controller.

*2 Non-volatile memory retains its contents even when the power is turned off. (Volatile memory does not retain its contents when the power is turned off.)

*3 Latch devices and latch labels are retained by transferring them to the built-in memory or SD memory card.

Point

- The usage of the memory can be checked from the engineering tool. (GX Works3 Operating Manual)
- The number of writes for the program memory and data memory is limited to 50000 times. When using the function that the target file is written, pay attention to the number of writes. (☞ Page 336 File types and storage memory) The current number of writes for the program memory and data memory can be checked in the special register (SD630/SD631 and SD634/SD635). (☞ Page 1992 Drive information)

Program memory/program cache memory

The program memory and program cache memory store programs and parameters required for the controller to perform operations.

Data to be allocated

In the program memory, program files and FB files/parameter files are stored. In the program cache memory, program files and the execution program area in an FB file are allocated.

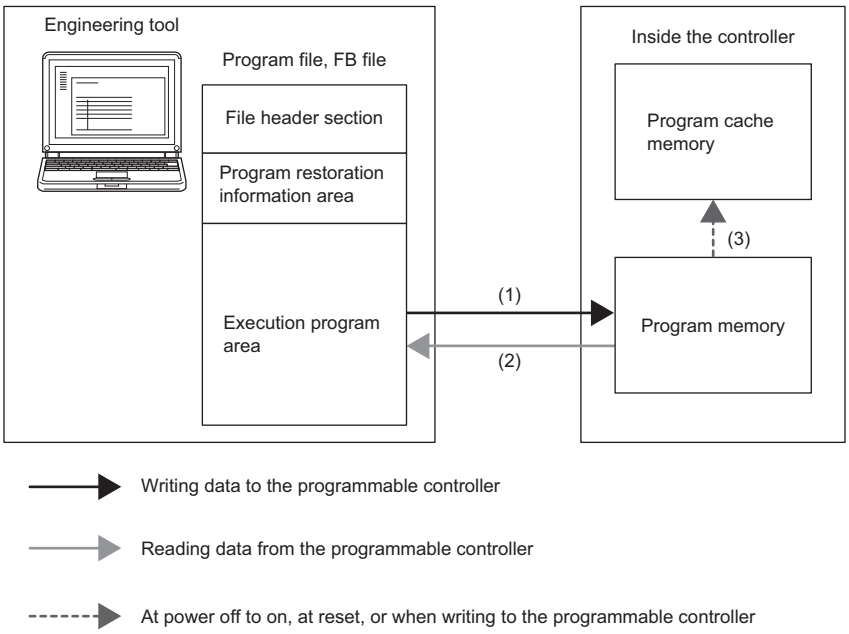
Program files and the execution program area in an FB file are transferred to the program cache memory and executed at the following timings.

- Powered-on
- Reset operation
- Writing data to the programmable controller

If the execution program size exceeds the program cache memory capacity, Program execution error (error code: 3209H, 41D9H) occurs at data transfer.

Data allocation and procedure of read/write operations

The following figure shows the data allocation of the program memory and the procedure of read/write operations from/to the programmable controller.



(1) When writing data to the programmable controller, program file/FB file data is written to the program memory.
(2) When reading data from the programmable controller, program file/FB file data is read from the program memory.
(3) After the controller is powered off and on or is reset, and when writing data to the programmable controller, the data in the execution program area is transferred to the program cache memory.

Point

For the read/write operations from/to the programmable controller, refer to the following.
GX Works3 Operating Manual

Capacity check

The capacity of program cache memory and free space can be checked by the following methods.

■Special register

- Program cache memory capacity: SD666 to SD667
- Program cache memory free space: SD668 to SD669

For details, refer to the following.

☞ Page 1992 Drive information

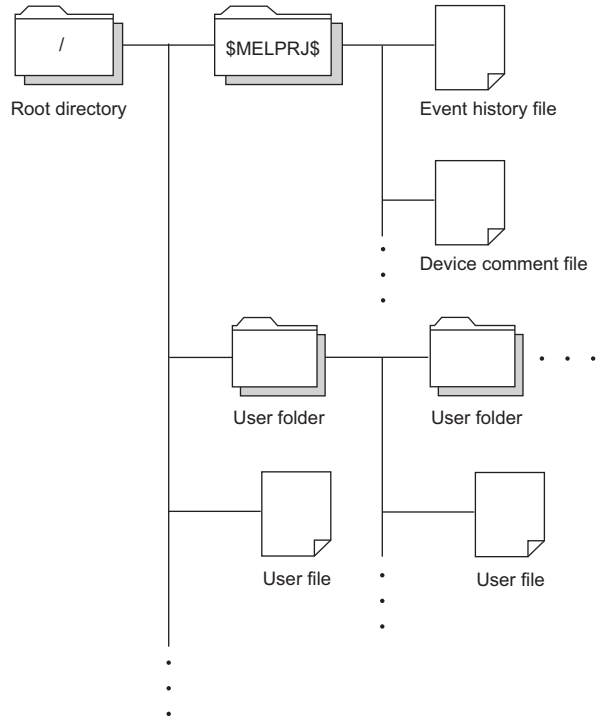
■Engineering tool memory capacity calculation (offline), online data operation window

For details, refer to the following.

📖GX Works3 Operating Manual

Data memory

This memory is used to store the event history, device comment file, and/or the user's folder/file. Data such as the device comment files written by the engineering tool is stored in the "$MELPRJ$" folder. The "$MELPRJ$" folder is created after memory initialization. Note that the "$MELPRJ$" folder cannot be deleted. (Folders under the "$MELPRJ$" folder can be deleted.)



Point

For details on how to create and delete user folders, refer to the following.

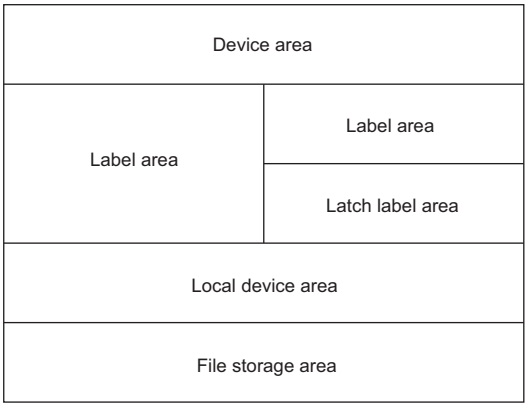
GX Works3 Operating Manual

Precautions

Do not delete or rename the folders or files being accessed or those being executed by a function.

Device/label memory

The device/label memory has the following areas.



The capacity of each area can be changed with the setting of the CPU parameter. (☞ Page 320 Device/label memory area setting)

Data to be allocated

The following table lists the data allocated to each area.

Area		Application
Device area		User device
Label area	Label area	Global label and local label
	Latch label area	Global label and local label with latch specified
Local device area		Local device
File storage area		File register file and other data*1

*1 File register files which are stored in the area for storing file register files can be written or read in file unit.

Point

Free space of areas can be checked in "Device/Label Memory Area Capacity Setting". (☞ Page 320 Device/label memory area setting)

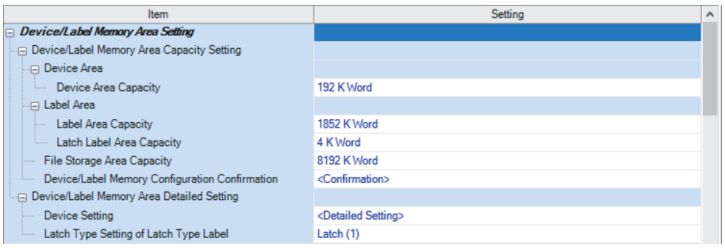
Device/label memory area setting

The capacity of each data area allocated within the device/label memory can be changed. (☞ Page 319 Device/label memory)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting]

Operating procedure

"Device/Label Memory Area Setting" window



1. Set the capacity of each area in "Device/Label Memory Area Capacity Setting".

Displayed items

Item			Description	Setting range	Default
Device/Label Memory Area Capacity Setting	Device Area	Device Area Capacity	Sets the capacity of the device area to be used for global devices.	☞ Page 321 Setting range of capacity of each area	☞ Page 321 Default capacity of each area
	Label Area	Label Area Capacity	Sets the capacity of the label area to be used for global labels (including system-defined global labels) and local labels.		
		Latch Label Area Capacity	Sets the capacity of the latch label area to be used for latch type labels.		
	File Storage Area Capacity		Sets the capacity of the file storage area to be used for storing register files and others.		
	Device/Label Memory Configuration Confirmation		Shows the device/label memory configuration.		
Device/Label Memory Area Detailed Setting	Device Setting		☞ Page 347 Device Setting		
	Latch Type Setting of Latch Type Label		☞ Page 422 Setting latch on labels		

Point

- Please note that the total of the capacity of each area (including the capacity of the local device area) should not exceed the capacity of the device/label memory (☞ Page 210 Hardware specifications). The total of the capacity of each area can be checked in "Device/Label Memory Area Capacity Setting".
- When the capacity of the file storage area is changed, files (file register files) stored in the area are deleted, and therefore it is required to write file register files. Also, when files are stored in the controller, they must be read to other place before the capacity of the file storage area is changed and written back to the controller after the change.

Default capacity of each area

The default capacity of each area is as follows.

Item	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Device area	192K words	192K words
Label area	1852K words	1852K words
Latch label area	4K words	4K words
Local device area	57344K words	120832K words
File storage area	6144K words	8192K words

Point

The capacity of the local device area to be set is obtained by deducting the total capacity of the device area, label area, latch label area, and file storage area from the total capacity of the device/label memory of each model.

Setting range of capacity of each area

The following tables lists the setting range of the capacity of each area on the device/label memory. *1

*1 The rest of other areas are automatically set as the capacity of the local device area.

Item	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Device area	2 to 8192K words	2 to 10240K words
Label area*2	0 to 65534K words	0 to 131070K words
Latch label area*3	• When built-in memory is specified: 0 to 896K words • When SD memory card is specified: 0 to 8190K words	• When built-in memory is specified: 0 to 1214K words • SD memory card: 0 to 10238K words
File storage area	0 to 8160K words	0 to 10208K words

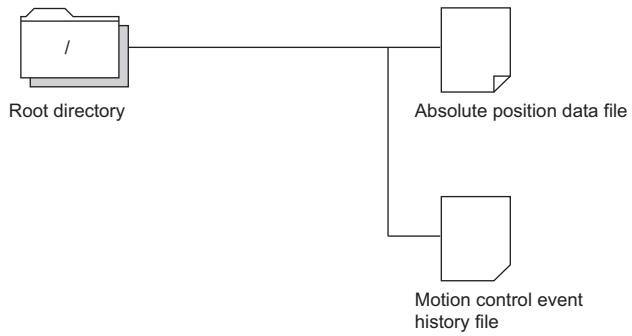
*2 Secure the minimum capacity for system-defined global labels. The number of system-defined global labels used can be checked in "Information" in the "Output" window when "Convert" is executed with the content of the data "Global" not being set.

*3 The setting range differs according to the save destination of the latch data.

Motion data memory

This memory is used to store data used by motion control.

The motion data memory consists of non-volatile memory to store the data that needs to be latched.



Function memory

This memory is temporarily used for the specific function.

Folders are created for each of the following functions, and the capacity is managed by folder.

Folder name	Description	Size
backup	Used for the data backup/restoration function	64MB
LOGGING	Used for the data logging function	40MB
motion	Used for the motion function	32MB
other	Used for functions other than the above	32MB

Precautions

Do not delete or rename the folders or files being accessed or those being executed by a function.

Refresh memory

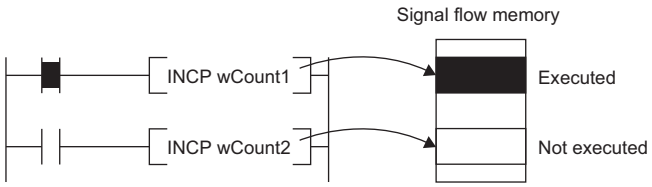
This memory is used to store data used to refresh communication with the network module, intelligent function module, and CC-Link IE TSN function part. (☞ Page 382 Refresh Data Register (RD))

Buffer memory

This memory is used by the network function or others for data communication. (☞ Page 2028 Buffer Memory)

Signal flow memory

This memory is used to memorize the execution status of the instruction in the last scan. The controller judges whether to execute a rising/falling edge execution instruction by referring to the signal flow memory.



The execution status of the last instruction is stored in the signal flow memory in two ways: executed or not executed. The instructions that refer to the signal flow memory judge whether to execute a rising/falling edge execution instruction depending on the input condition of the instruction and the execution status of the last instruction stored in the signal flow memory.
The same number of areas as the number of instructions that refer to the signal flow memory in the program are assigned. For function blocks, different areas are assigned to each instance.
For FB instances, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Point

The following shows the instructions that refer to the last execution status of the signal flow memory.

- Contact instruction: LDP, LDF, ANDP, ANDF, ORP, ORF, LDPI, LDFI, ANDPI, ANDFI, ORPI, and ORFI
- Association instruction: MEP, MEF
- Output instruction: SET F, RST F, PLS, PLF, FF
- Rising edge execution instruction: □P (such as INCP and MOVP), SP.□, ZP.□, GP.□, JP.□, DP.□, MP.□, UDCNT1, UDCNT2, TTMR, STMR, SORTD(_U), DSORTD(_U), LEDR, DUTY, TIMCHK, HOURM, DHOURM, PID, XCALL, SCJ

SD memory card

This memory is used to store the folder/file created by a function using the SD memory card as well as the user's folder/file. The folder configuration is the same as the data memory. (☞ Page 318 Data memory)
However, in the case of the SD memory card, the "$MELPRJ$" folder will be created when the SD memory card becomes available (when the SD memory card is mounted).

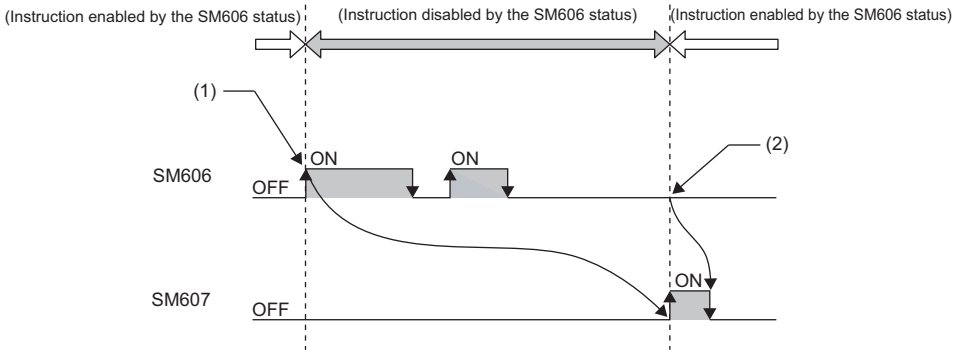
Point

For details on how to insert or remove the SD memory card, refer to the following.
☞ Page 57 Inserting and removing an SD memory card

How to forcibly disable the SD memory card with a special relay

If the SD memory card is removed while the controller is powered on, data in the SD memory card may be corrupted.
Use a special relay to forcibly disable access to the SD memory card without turning on and off the power.
The following shows how to forcibly disable the SD memory card with a special relay.

1. Turn on SM606 (SD memory card forced disable instruction). After an instruction by SM606, and until SM607 changes, an instruction by the ON/OFF state change of SM606 is disabled. Note that after SM607 changes, an instruction by the ON/OFF state change of SM606 is enabled, and operation is performed based on the ON/OFF state of SM606.



(1) Forced disable instruction by the ON state
(2) Instruction to cancel forced disable status by the OFF state enabled

2. Check that the CARD LED is off or SM607 (SD memory card forced disable status flag) is on.
3. Remove the SD memory card.

Point

If the SD memory card is disabled, take either of the following actions to cancel the disabled status:
- Insert the SD memory card again (the CARD LED changes from flashing to on).
- Power off and on or reset the controller.

■Operation of each function accessing the SD memory card

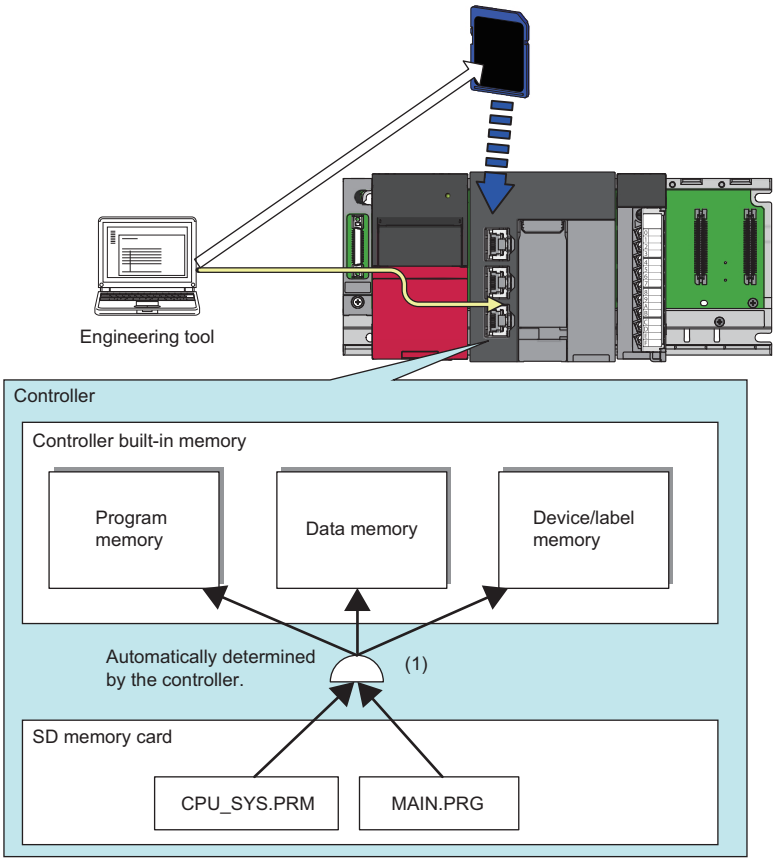
Disabling the SD memory card affects the operation of each function accessing the SD memory card.

- If the SD memory card forced disable function is executed while the SD memory card is being accessed, the SD memory card will be disabled after the current function being executed is executed to the end.
- If the SD memory card is accessed after the use of the SD memory card has been stopped, the same operation occurs as when the SD memory card is not installed, or an error (error code: such as 41D1H and 41FEH) occurs due to SM606 (SD memory card forced stop instruction).

Boot operation

The files stored on the SD memory card are transferred to the storage memory which is automatically determined by the controller when the controller is powered off and on or is reset.

(1) The boot operation is executed according to the boot file setting when the controller is powered on or is reset.



■Boot operation procedure

The boot operation procedure is as follows.

1. Configure the boot setting. (☞ Page 326 Boot setting)
2. Insert the SD memory card into the controller.
3. Write the boot setting and boot file to the SD memory card. (☞ Page 328 Writing boot settings and boot files)
4. Power off and on or reset the controller.

■Specifiable file types

The files which can be booted are as follows.

- System parameter
- CPU parameter
- Module parameter
- Module extension parameter
- Module extension parameter for protocol setting
- Global label*1
- Global label initial value
- Label initial value for each program
- Program file
- FB/FUN file
- Device comment
- Initial device value
- Operation profile data file*2

*1 Network label setting files are also booted. If a global label with the "Access from External Device" checkbox selected is set, the global label assignment information file is also booted.
For creating network labels, refer to the following.
☞ Page 108 Network labels

*2 The files stored in "$MELPRJ$/calc_profile_/" are booted.

■Allowed maximum number of boot files

The number of boot file settings that can be specified is shown below.

Model	Allowed maximum number of boot files
MXR300-16, MXR300-32, MXR300-64	892
MXR500-128, MXR500-256	1084

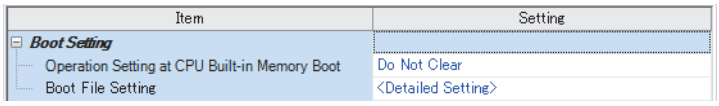
■Boot setting

Configure the necessary settings for the boot operation.

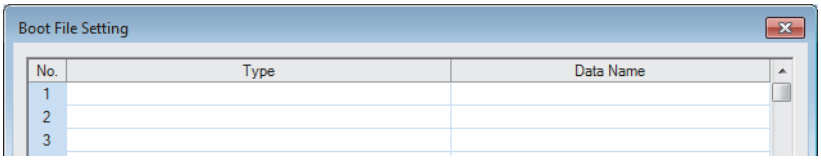
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Memory Card Parameter] ⇨ [Boot Setting]

Operating procedure

"Boot Setting" window



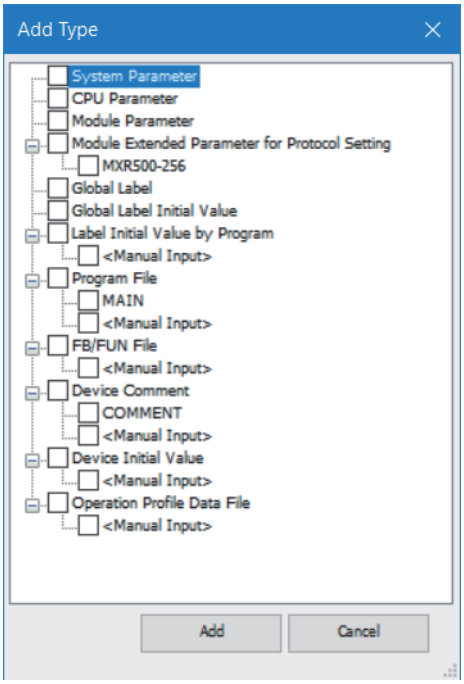
"Boot File Setting" window



1. Click "Detailed Setting" on the "Boot File Setting" window.

2. Click the "Type" column. The maximum number of boot files that can be specified is the same as the number of files that can be stored in the storage memory.

"Add Type" window



3. Select type for the boot file. (Multiple selection is possible.)

"Boot File Setting" window

No.	Type	Data Name
1	System Parameter	SYSTEM
2	CPU Parameter	CPU
3	Module Parameter	UNIT
4	Module Extended Parameter for Protocol Setti	UEX3FF00
5	Global Label	GLBLINF
6	Global Label Initial Value	GLBLINF
7	Label Initial Value by Program	MAIN
8	Program File	MAIN
9	FB/FUN File	FbPou
10	Device Comment	COMMENT
11	Device Initial Value	MAIN
12	Operation Profile Data File	ProfileData001
13		

4. Set the data name (file name).

Displayed items

Item		Description	Setting range	Default
Operation Setting at CPU Built-in Memory Boot		Sets whether or not to clear the CPU built-in memory (program memory and data memory) upon file transfer from the SD memory card.	• Do Not Clear • Clear	Do Not Clear
Boot File Setting	Type	Select the file type of the boot file.	☞ Page 326 Specifiable file types	—
	Data Name	Set the file name of the boot file.	File name*1	—

*1 The boot file name is "SYSTEM" when the system parameter is specified, "CPU" when the CPU parameter is specified, and "UNIT" when the module parameter is specified.
When the module extension parameter is specified, the module extension parameter to be booted is selected. (It will be set as "UEX******".)

■Writing boot settings and boot files

Use the following functions of the engineering tool.

Function	Description
Write to PLC	Use this function to write the data to the SD memory card inserted into the controller. Click [Online] ⇨ [Write to PLC] on the menu bar.
Write to Memory Card	Use this function to write the data to the SD memory card inserted into the computer. Click [Tool] ⇨ [Memory Card] ⇨ [Write to Memory Card] on the menu bar.

Point

The boot settings and boot files cannot be written with a user-data-write operation of the engineering tool.

For details on write operations, refer to the following.

GX Works3 Operating Manual

■Precautions when using the boot operation

- If the transfer destination module is not installed, the boot file will not be transferred. Therefore, install all the modules that are set as the transfer destination in advance.
- When a parameter file is set as boot file, it overwrites the parameter file inside the transfer destination controller. In addition, if a parameter file is not set as boot file even when stored on the SD memory card, the controller operates in accordance with the settings in the parameter file inside it.
- When the transfer destination module is removed during boot execution, the boot file cannot be transferred normally. Therefore, after installing the transfer destination module, power off and on or reset the controller to execute boot.
- If a program in the program memory is changed online during boot operation, the change is also reflected in the transfer source program on the SD memory card.
- Note the model of the program written on the SD memory card (program specified in the boot file settings) and the model of the controller must be the same.
- For the boot file setting, check that the setting is consistent with the program/label setting. When the file is read from the programmable controller after the boot operation without consistency, functions such as conversion may not executed properly due to lack of consistency in project data.

Precautions

Do not delete or rename the folders or files being accessed or those being executed by a function.

■Powering off or resetting the controller during access to the SD memory card

Stop access to the SD memory card, power off or reset the controller, and remove the SD memory card.
If the above mentioned operation is performed during access to the SD memory card, data in the SD memory card (file system) may be corrupted.

- Data in the buffer memory is being saved to the SD memory card. (Data logging function is being executed.)
- During the folder delete by User Data Operation in the engineering tool

In this case, diagnostics of the SD memory card (such as a file system check or restoration processing) is performed when the controller is powered off and on and the SD memory card is inserted or the controller is changed from reset to reset release. If the SD memory card is in the following conditions, the diagnostic time will be longer, and it may take several minutes in some cases. (Note that the data may be not restored depending on the extent to which the file system is damaged.)

- The number of files is large.
- File fragmentation is progressing.

■Precautions when forcibly disabling the SD memory card

- When forced disable operation with the SD CARD OFF button and forced disable operation by SM606 are executed together, the operation executed earlier is enabled, and the operation executed later is disabled. For example, after the SD memory card is forcibly disabled with the SD CARD OFF button, when SM606 is turned on and off without removing the SD memory card, the disabled status of the SD memory card can be canceled. However, after forcibly disabling the SD memory card with the SD CARD OFF button, even by removing the SD memory card, turning on SM606, and inserting the SD memory card, the SD memory card is not enabled. To enable the SD memory card, after it is inserted again, SM606 must be turned off.
- If this function is executed while an external device is writing a file to the SD memory card, writing of the file may fail. Cancel the SD memory card disable status, then write the file again.

■Precautions when using the SD memory card in an environment where unauthorized access to the SD memory card may occur

Do not use the SD memory card in an environment where unauthorized access to the SD memory card may occur.
The following table lists the functions that uses the SD memory card and recommended alternative methods.

Function	Alternative method
Event history function	Specify data memory as the save destination of the event history file.
File operation instruction (SP.FREAD instruction, SP.FWRITE instruction)	• For the data input, use the device/label initial value instead of files. • For the data output, use the latch device/label.
Data logging function	• Set the logging setting file storage location to data memory. • Set the logging result file storage location to data memory or function memory.
Latch function	Specify the built-in memory in the save destination memory setting.
Boot operation	Do not use the boot operation. (Specify the built-in memory for writing data to the controller.)
Label access from external device function	Store label communication data in the program memory.
Device station parameter automatic setting	Store device station parameters in the data memory.
Predefined protocol support function	Store module extension parameters (including module extension parameters of the intelligent function module) in the data memory.
Writing user data	Store general-purpose files in the data memory.

17.2 Memory Capacity

For each memory capacity, refer to the following.

☞ Page 210 Hardware specifications

17.3 File Size Unit in Memory

The minimum unit of capacity for storing a file in the memory is referred to as the file size unit (cluster size).

File size unit based on memory area

Memory area	File size unit
Program memory	4K bytes
Data memory	4K bytes
Device/label memory	1K bytes
Function memory	4K bytes
Motion data memory	512 bytes

File size unit of each SD memory card

SD memory card	File size unit
NZ1MEM-2GBSD	32K bytes
NZ1MEM-4GBSD	
NZ1MEM-8GBSD	
NZ1MEM-16GBSD	

17.4 Number of Storable Files

For the number of storable files for each memory, refer to the following.

☞ Page 210 Hardware specifications

17.5 Number of Storage Folders

There is no restriction on the number of layers in the folder structure and it depends on the capacity of each memory where folders can be created.
If a folder cannot be created in memory where folders can be created, an error occurs.
The following table lists memory where folders can be created and the number of storable folders.

Name	Model	Number of storable folders*1
Data memory	MXR500-128, MXR500-256	7616*2
	MXR300-16, MXR300-32, MXR300-64	15244*2
Function memory	• MXR500-128, MXR500-256 • MXR300-16, MXR300-32, MXR300-64	*2
SD memory card	NZ1MEM-2GBSD	Root directory: 511*3 Under subdirectory: 65534*3
	NZ1MEM-4GBSD	Root directory: 65535*3 Under subdirectory: 65534*3
	NZ1MEM-8GBSD	Root directory: 65535*3 Under subdirectory: 65534*3
	NZ1MEM-16GBSD	Root directory: 65535*3 Under subdirectory: 65534*3

*1 The number of folders includes the system files and system folders.
*2 The maximum number of folders is the same as the upper limit for the number of files. (☞ Page 210 Hardware specifications)
*3 Total number of files and folders that can be stored in the root directory or subdirectory when the number of characters in a folder name (single-byte alphanumeric characters) is 8 or less. If the number of characters in the created folder name (single-byte alphanumeric characters) is 9 or more, the maximum number of folders that can actually be stored may be reduced because the number of consumed directory entries increases.

17.6 Drive Number Definition for Memory

The following table lists the drive number for each memory.

Name	Drive No.
Program memory	Drive 0
SD memory card	Drive 2
Device/label memory	Drive 3
Data memory	Drive 4
Function memory	Drive 5
Motion data memory	Drive 6

For file access using SLMP, FTP server functions, or FTP client functions, memory specification is required by the data storage location (drive number). The following table lists the combinations of drive numbers specified by the user and each memory.
○: Accessible, ×: Not accessible

Drive No.	File access destination	File access using SLMP	File access using FTP server functions	File access using FTP client functions
Drive 0	Program memory	×	×	×
Drive 2	SD memory card	○	○	○
Drive 3	Device/label memory	○	○	○
Drive 4	Data memory	○	○	○
Drive 5	Function memory	○	×	×
Drive 6	Motion data memory	○	○	○

17.7 Memory Operation

Initialization and value clear

Each memory can be initialized and cleared to zero by using the engineering tool. For details on the operation method, refer to the following.

GX Works3 Operating Manual

Items to be specified in the engineering tool				Target
Initialization	Program memory*1			Deletes all the folders and files in the program memory.
	Data memory*1			Deletes all the folders and files in the data memory.
	Device/label memory*1			Deletes all the files in the file storage areas in the device/label memory.
	Motion data memory*1			Deletes all the folders and files in the motion data memory.
	Function memory*1			Deletes all the folders and files in the function memory.
	SD memory card			Deletes all the folders and files in the SD memory card.
Value clear	All clear			Clears Latch (1), Latch (2), devices, labels, and file registers to zero.
	Device, label	Zero clear		Excluding devices and labels with latch specified, clears the following to zero: X, Y, M, B, F, SB, V, T, ST, LT, LST, C, LC, D, W, SW, FX, FY, FD, Z, LZ, RD, and all labels (including module labels).
		Zero clear (including Latches (1) and (2))		Including devices and labels with latch specified, clears the following to zero: X, Y, M, B, F, SB, V, T, ST, LT, LST, C, LC, D, W, SW, FX, FY, FD, Z, LZ, RD, and all labels (including module labels).
	File register	Zero clear	All files	Clears the contents of all the file registers to zero.
			File specification	Clears only the contents of the specified file register(s) to zero.
		Zero clear excluding Latch (2)		Clears the file registers other than Latch (2) to zero.
	Device / label / file register latch clear			Clears devices, labels, and file registers other than Latch (2) to zero.

*1 Initialization can be executed at the same time.

Point

- If the power goes off during initialization or zero clear, the memory is left in the state of that point, and it is necessary to re-execute the memory operation.
- If values including devices and labels are cleared, the device/label initial value is reflected the next time the operating status changes from STOP (PAUSE) to RUN. (☞ Page 426 DEVICE/LABEL INITIAL VALUE SETTINGS)

Memory initialization during execution of another function

Initialization cannot be executed while the function to access the file from the engineering tool is being executed. Check that the function to access the file is not being executed and then execute the initialization.

Clearing values during execution of another function

■Data backup/restoration function

During execution of the data backup/restoration function, devices, labels, file register areas, or latch areas cannot be cleared to zero. Check that the data backup/restoration function is not being executed and then clear devices, labels, file register areas, or latch areas to zero.

■Firmware update function

During execution of the firmware update function, devices, labels, file register areas, or latch areas cannot be cleared to zero. Check that the firmware update function is not being executed and then clear devices, labels, file register areas, or latch areas to zero.

■iQ Sensor Solution data backup/restoration function

During execution of the iQ Sensor Solution data backup/restoration function, file register areas cannot be cleared to zero. Check that the iQ Sensor Solution data backup/restoration function is not being executed and then clear file register areas to zero.

17.8 Memory Access Control

The controller uses the user authentication function to control access to some memory from external devices.

The following table lists the availability of access control to files in each drive.

Name	Drive No.	Access control availability
Program memory	Drive 0	Possible
SD memory card	Drive 2	Not possible*2
Device/label memory	Drive 3	Not possible*1
Data memory	Drive 4	Possible
Function memory	Drive 5	Not possible*2
Motion data memory	Drive 6	Not possible

*1 Access to files is not controlled, but access to devices/labels is controlled.

*2 Access to logging setting files (with extensions LAS and LIS) is controlled in accordance with the logging operation authority.

17.9 Target Memory for All Information Initialization

The following table lists the target memory that will be erased by the all information initialization of the controller.

Name	Drive No.	Delete target status
Program memory	Drive 0	Target
Program cache memory	—	Excluded
Data memory	Drive 4	Target
Device/label memory	Drive 3	Target
Signal flow memory	—	Excluded
Motion data memory	Drive 6	Target
Latch device/label memory	—	Target
Refresh memory	—	Excluded
CPU buffer memory	—	Excluded
Function memory	Drive 5	Target
SD memory card	Drive 2	Excluded

17.10 Files

This section lists the files used by the controller.

File/folder specifications

The following table shows the file/folder specifications.

Item		Specifications
File	File name	• Any character that can be expressed in Unicode can be used in the file name. (Any Unicode characters that are in the Basic Multilingual Plane (BMP) are supported.) Note that /*?<>|":[];,=+%'~@{}&^. and single-byte spaces cannot be used. • Uppercase and lowercase letters can be distinguished and displayed, but they are regarded as the same as file names.*1 • The file name can be up to 64 characters long, including the dot and extension. • The file name cannot be renamed to the same one. • The file path can be up to 255 characters long.
	Extension	The extension can be up to 4 single-byte alphanumeric characters. Uppercase and lowercase letters can be distinguished and displayed, but they are regarded as the same as file names.
	Creation/change date and time	Shows the date and time created or changed in the controller. The date and time are acquired from the controller clock The creation/change date and time of files/folders stored in the program memory, the data memory, and the function memory are affected by the time zone. Therefore, the display of the creation/change date and time of files/folders existing in the corresponding drive may change at the timing such as the time zone is changed by the parameter and daylight saving time is enabled.
	File size*2	Shows a value greater than or equal to 0 in bytes.
	Access right	The access rights to the file are shown below. • Administrators • Users • User-defined group
Folder	Folder name	• Any character that can be expressed in Unicode can be used in the folder name. Note that /*?<>|":[];,=+%'~@{}&^. and single-byte spaces cannot be used. • Uppercase and lowercase letters can be distinguished and displayed, but they are regarded as the same as file names. • The folder name can be up to 64 characters long. • The folder path can be up to 255 characters long.
	Creation/change date and time	Shows the date and time created or changed in the controller. The date and time are acquired from the controller clock

*1 Only full-width and half-width letters are considered to be the same as uppercase and lowercase alphabetic characters. Uppercase and lowercase letters in other languages are treated as different characters.

*2 There is no restriction on the file size per file. However, the operation is not guaranteed when handling files larger than 4GB to 1 byte (4294967295 bytes) with the controller.

File types and storage memory

This table lists the types of files, which are generated by parameter settings and functions in use, as well as their storage memory.

◎: Can be stored (Mandatory), ○: Can be stored, ×: Cannot be stored

File type		CPU built-in memory					SD memory card	File name and extension
		Program memory	Device/ label memory	Data memory	Function memory	Motion data memory		
		Drive 0	Drive 3	Drive 4	Drive 5	Drive 6	Drive 2	
Program		◎	×	×	×	×	○	ANY_STRING.PRG
FB file		○	×	×	×	×	○	ANY_STRING.PFB
CPU parameter		◎	×	×	×	×	○	CPU.PRM
System parameter		◎	×	×	×	×	○	SYSTEM.PRM
Module parameter		○	×	×	×	×	○	UNIT.PRM
Module extension parameter		×	×	○	×	×	○	• UEXmmmnn.PRM • UEXmmm00.PPR*1
Memory card parameter		×	×	×	×	×	○	MEMCARD.PRM
Device comment*2		×	×	○	×	×	○	ANY_STRING.DCM
Initial device value		○	×	×	×	×	○	ANY_STRING.DID
Global label setting file		○	×	×	×	×	○	GLBLINF.IFG
Network label setting file		○	×	×	×	×	○	NWLINF3FF00.IFG
Initial label value file	Initial global label value file	○	×	×	×	×	○	GLBLINF.LID
	Initial local label value file	○	×	×	×	×	○	PROGRAM_NAME.LID
Global label assignment information		○	×	×	×	×	○	• LDB****.GLA • GLBLINF.LLA
Local label assignment information		○	×	×	×	×	○	PROGRAM_NAME.LLA
Operation profile data file		×	×	○	×	×	○	ANY_STRING.csv
Operation profile data file additional information		×	×	○	×	×	○	OperateProfileAddInfo.json
Position data history file*2		×	×	○	×	×	×	PosHist.bin
Axis absolute position data file		×	×	×	×	○	×	abs_axis.bin
Axis absolute position data file (advanced synchronous control)		×	×	×	×	○	×	abs_advsync.bin
File register		×	○	×	×	×	○	ANY_STRING.QDR
Event history*2		×	×	○	×	×	○	EVENC.LOG
Motion control event history*2		×	×	×	×	○	×	EVENM.LOG
General-purpose data		×	×	○	×	×	○	ANY_STRING.CSV/BIN
Device data storage file		×	×	○	×	×	○	DEVSTORE.DST
Device station parameter file		×	×	○	×	×	○	SLAVEmmmnnnxxxx.NSP
Firmware update file*2		×	×	○	×	×	○	mmmm_vv.SYF
Firmware update prohibited file		×	×	○	×	×	○	FWUPDP.SYU
Firmware update information		×	×	○	×	×	○	ANY_STRING.zip
Logging setting file*2	Auto logging setting file	×	×	×	×	×	○	LOGCOM.LAS
	Individual setting file	×	×	○	×	×	○	LOGnn.LIS
Server certificate		×	×	○	×	×	×	ANY_STRING.DER/PEM
Client certificate		×	×	○	×	×	×	ANY_STRING.DER/PEM
Add-on software package*2		×	×	×	×	×	×	ANY_STRING.APK
Add-on safe mode file		×	×	×	×	×	○	• SafeMode (no extension) • SafeModeWithDelete (no extension)

File type		CPU built-in memory					SD memory card	File name and extension
		Program memory	Device/ label memory	Data memory	Function memory	Motion data memory		
		Drive 0	Drive 3	Drive 4	Drive 5	Drive 6	Drive 2	
Add-on loading log file		×	×	×	○	×	×	addonLoadLog_□□.txt □□ indicates one of the following. • SQ • GI • MT
Address space setting file		○	×	×	×	×	○	OpcUaAdressSpace.xml
User Web page file		×	×	×	×	×	○	ANY_STRING.HTML
Latch device/label file*2		×	×	×	×	×	○	LATCH_DEVLAB.BIN
Controller data backup	System file	×	×	×	×	×	○	$BKUP_CPU_INF.BSC $ENC_BKUP_CPU_INF.BSC
	Backup data file	×	×	×	×	×	○	BKUP_CPU.BKD
	Device/label data file	×	×	×	×	×	○	BKUP_CPU_DEVLAB.BKD
iQ Sensor Solution compatible backup/restore*2	System file	×	×	×	×	×	○	$BKUP_UNIT_INF.BSI
	Backup data file (station)	×	×	×	×	×	○	STATION****.QBR
	Backup data file (station sub ID)	×	×	×	×	×	○	SUBID****.QBR
	Backup data file (ID)	×	×	×	×	×	○	• ID_OUT_****.QBR • ID_IN_****.QBR
System Web page file		×	×	×	×	×	×	MXRWebFile_XX_YY.HVF
Program monitor file		×	×	×	×	×	○	PRGMON.zip
Program monitor CRC file		×	×	×	×	×	○	PrgMonCrc.PMC

*1 The module extension parameter for the protocol setting is a file for storing protocol setting information in the predefined protocol support function.

*2 These types are not targets of logging the file operation events.

Access control target files by user authentication

Some files are the target of access control by user authentication.

○: Control target, ×: Not applicable

File type		Access control[*1]	Category
Program		○	Program
FB file		○	Program
CPU parameter		○	Parameter
System parameter		○	Parameter
Module parameter		○	Parameter
Module extension parameter		○	Parameter
Memory card parameter		×	—
Device comment		×	—
Initial device value		○	Program
Global label setting file		×	—
Network label setting file		×	—
Initial label value file	Initial global label value file	○	Program
	Initial local label value file	○	Program
Global label assignment information		×	—
Local label assignment information		×	—
Operation profile data file		○	Program
Operation profile data file additional information		×	—
Position data history file		×	—
Axis absolute position data file		×	—
Axis absolute position data file (advanced synchronous control)		×	—
File register		×[*2]	—
Event history		○	—[*3]
Motion control event history		×	—
General-purpose data		×	—
Device data storage file		×	—
Device station parameter file		×	—
Firmware update file		×	—
Firmware update prohibited file		○	Parameter
Firmware update information		×	—
Logging setting file	Auto logging setting file	○	—[*3]
	Individual setting file	○	—[*3]
Server certificate		○	—[*3]
Client certificate		○	—[*3]
Add-on software package		○	—[*3]
Add-on safe mode file		×	—
Add-on loading log file		×	—
Address space setting file		○	Parameter
User Web page file		×	—
Latch device/label file		×	—
Controller data backup	System file	○	—[*3]
	Backup data file	○	—[*3]
	Device/label data file	○	—[*3]
iQ Sensor Solution compatible backup/restore	System file	×	—
	Backup data file (station)	×	—
	Backup data file (station sub ID)	×	—
	Backup data file (ID)	×	—
System Web page file		×	—
Program monitor file		○	—[*3]
Program monitor CRC file		○	—[*3]

File type	Access control*1	Category
Global device data	×*2	—
Local device data	×*2	—

*1 Access is controlled when the storage location is the program memory, data memory, or system memory.
*2 Access to files is not controlled, but access to devices is controlled.
*3 The user authentication function implements access control as is set in the operation authority settings of each online operation.

File operation available

The following table lists the file operations that can be executed to each file in the controller by external devices.

○: Can be executed, —: No applicable operation, ×: Cannot be executed

File type		Operation from engineering tool			Operation using SLMP or FTP server function[*16]			Operation via instruction		Transfer operation using the FTP client function	
		Write	Read	Delete	Write	Read	Delete	Write	Read	Transfer to server	Obtain from server
Program		○[*1]	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○	○
FB file		○[*1*6]	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○	○
CPU parameter		○[*4]	○	○[*4]	○[*3*5]	○	○[*3]	—	—	○	○
System parameter		○[*4]	○	○[*4]	○[*3*5]	○	○[*3]	—	—	○	○
Module parameter		○[*4*20]	○	○[*4*20]	○[*3*5]	○	○[*3]	—	—	○	○
Module extension parameter		○[*4]	○	○[*4]	○[*3*5]	○	○[*3]	—	—	○	○
Memory card parameter		○[*4]	○	○[*4]	○[*3*5]	○	○[*3]	—	—	×	×
Device comment		○	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○[*9]	○[*9]
Initial device value		○	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○	○
Global label setting file		○[*1*6*15]	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○	○
Network label setting file		○[*4]	○	○[*4]	○[*3*5]	○	○[*3*5]	—	—	○	○
Initial label value	Global label initial value	○	○	○[*4]	○[*3]	○	○[*3*5]	—	—	○	○
	Local label default value	○	○	○[*4]	○[*3]	○	○[*3*5]	—	—	○	○
Global label assignment information		○	—	○[*4]	○[*3*5*19]	○[*19]	○[*3*5*19]	—	—	○[*19]	○[*19]
Local label assignment information		○	—	○[*4]	○[*3*5*19]	○[*19]	○[*3*5*19]	—	—	○[*19]	○[*19]
Operation profile data file		○	○	○[*4*23]	○	○	○[*3]	○[*17]	○[*17]	○	○
Operation profile data file additional information		○	○	○[*4*23]	○	○	○	—	—	○	○
Position data history file		—	○	—	○	○	○[*3]	—	—	○	○
Axis absolute position data file		—	—	—	○	○	○	—	—	○	○
File register		○	○	○[*4]	○	○	○[*3]	○	○	○[*10]	×
Event history		—	—	—	○	○	○	—	—	○[*10]	×
Motion control event history		—	—	—	○	○	○	—	—	○[*10]	×
General-purpose data[*2]		○	○	○[*4]	○	○	○[*3]	○	○	○[*11]	○[*11]
Device data storage file[*2]		○[*18]	○	○[*18]	○[*3*5]	○	○[*3*5]	○	○	○[*10]	○
Device station parameter file		○	○	○[*4*22]	○[*7]	○[*7]	○[*3]	—	—	○	○
Firmware update file		○	○	○[*3]	○	○	○[*3]	—	—	○	○
Firmware update prohibited file		○	○	○[*3]	○	○	○[*3]	—	—	○	○
Firmware update information		○[*21]	—	—	○	○	○	—	—	○	○
Logging setting file	Auto logging setting file	○[*14]	○[*14]	○[*14]	○	○	○	—	—	×	×
	Individual setting file	○[*14]	○[*14]	○[*14]	○	○	○	—	—	×	×
Server certificate		○[*12]	○	○	○[*13]	○	○	—	—	○[*13]	○
Client certificate		○[*12]	○	○	○[*13]	○	○	—	—	○[*13]	○
Add-on software package		○	○	○	×	×	×	—	—	×	×
Add-on safe mode file		—	—	—	○[*3]	○	○[*3]	—	—	○	○
Add-on loading log file		—	—	—	○	○	○	—	—	×	×
Address space setting file		○[*20]	○	○[*20]	○[*20]	○	○[*20]	—	—	○	○
User Web page file		×	×	×	○	○	○	×	×	○	○
Latch device/label file		×	×	×	×	×	×	×	×	×	×

File type		Operation from engineering tool			Operation using SLMP or FTP server function*16			Operation via instruction		Transfer operation using the FTP client function	
		Write	Read	Delete	Write	Read	Delete	Write	Read	Transfer to server	Obtain from server
Controller data backup	System file	—	—	—	○	○	○	—	—	○	○
	Backup data file	○	○	○*4	○	○	○*3	—	—	○	○
	Device/label data file	○	○	○*4	○	○	○*3	—	—	○	○
iQ Sensor Solution compatible backup/ restore	System file	—	—	—	○	○	○	×	×	○	○
	Backup data file (station)	○	○	○*4	○	○	○*3	×	×	○	○
	Backup data file (station sub ID)	○	○	○*4	○	○	○*3	×	×	○	○
	Backup data file (ID)	○	○	○*4	○	○	○*3	×	×	○	○
System Web page file		×	×	×	×	×	×	×	×	×	×
Program monitor file		○	○	○	○	○	○	○	○	○	○
Program monitor CRC file		○	○	○	○	○	○	○	○	○	○

*1 When the operating status of the controller is STOP, write to the programmable controller. When the operating status is RUN, use the RUN change function. When the controller is in the RUN state, write operation is possible only if it has been registered in the parameter and the target file has been written to the controller.

*2 The module extension parameter for protocol setting is operated by writing, reading, or deleting user data.

*3 Operation is possible only when the operating status of the controller is STOP/PAUSE. A communication error occurs when operated in the RUN state.

*4 Operation is possible only when the operating status of the controller is STOP/PAUSE. When a program tries to perform memory operation while the controller is RUN, the operation is continued after the operation status is changed through remote STOP.

*5 When the operation target is the SD memory card, the operation can be performed even while the controller is RUN.

*6 Write operation can be performed using the engineering tool during RUN. For details on the engineering tool support, refer to the following.
GX Works3 Operating Manual

*7 File read/write operation is also performed from the CC-Link IE TSN master station (device station).

*8 Data can be sent to or received only from the SD memory card (Drive 2). It is not possible for the file storage location program memory (Drive 0).

*9 Data can be sent to or received only from the SD memory card (Drive 2). It is not possible for the file storage location data memory (Drive 4).

*10 If the transfer completion file deletion setting is enabled and file transmission (GP.FTPCPUT) is executed, the file cannot be transferred.

*11 Files whose name contains two or more dots cannot be transferred. Use one dot or no dot (file name only).

*12 Write, read, or delete it from the dedicated window of the engineering tool.

*13 Encrypted communication cannot be used when writing from other than the engineering tool. For encrypted communication, write the certificate from the dedicated window of the engineering tool.

*14 This item indicates operation on CPU Module Logging Configuration Tool.

*15 When the controller is in the RUN state, the file operation is available only when the target file is already written to the controller.

*16 SLMP and FTP commands cannot be used to access the program memory (drive 0).

*17 Use "MCv_ReadProfileData" to read the operation profile data, and use "MCv_WriteProfileData" to write the operation profile data. For details, refer to the following.
Page 824 OPERATION PROFILE DATA FUNCTION

*18 This is when the target memory is a memory card (Drive 2). Data memory (drive 4) can be operated only when the operating status is STOP/PAUSE. A communication error is returned when the operating status is RUN.

*19 When prohibiting operations is required for security, restrict access by using the user authentication function.

*20 When the target memory is the program memory (drive 0), the operation can only be executed while the OPC UA server is stopped.

*21 The operation is executed through the firmware update function window.

*22 In the user data operation, the confirmation window for whether to perform a remote STOP is not displayed. Therefore, a communication error will occur during RUN.

*23 The operation by user data operation can be operated regardless of the operating status of the controller.

17.11 Specifying Path for Motion Control

The program and parameters used in motion system control are stored in a file. The file storage destination can be freely specified using various control parameters and FB I/O variables.
The controller built-in memory and SD memory card can be used as data area for file storage.

Operation of this function for each system status

○: Available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Drive configuration

The file storage memory and SD memory card slot of the motion system are collectively called a drive.
Drives that can be used in the motion system are as follows.

Item	Data memory	Function memory	Motion data memory	SD memory card
Application	For manufacturer	For manufacturer	• Absolute position data • Synchronized restore data	• Project data • General data
Drive identifier	/rom	/ram	/lch	/sdc

Specifying path

Specify the path (including the file name) of a file used in control by using various control parameters and FB I/O variables with STRING or FILE_LOCATION type label. The path specifications are as follows.

- The file path can contain alphanumeric characters (a-z, A-Z, 0-9), symbols (!#$%&'()+,-.;=@[]^_`{}~), space, and directory delimiters (/). Wide characters can be used.
- Depending on the function, wildcards (*?) can be used in the file name. Refer to each function for availability of wildcards.
- The maximum path length is 127 characters.
- The path setting is not case-sensitive.

How to specify a path

There are two ways to specify a path: absolute path and relative path.

■Absolute path

A path beginning with / is an absolute path. An absolute path must be expressed as a string that combines a drive identifier with a file name.
For the drive identifier and file name, refer to the following.
☞ Page 342 Drive configuration
☞ Page 336 File types and storage memory

Ex.
/sdc/$MELPRJ$/calc_profile_/cam0001.csv

■Relative path

A path that does not begin with / is a relative path. The actual file access is performed using root path + relative path. The root path varies depending on each function, so refer to the function to be used.

The following table lists the relative paths for add-on developers:

Specified root path %PROJECT_ROOT%*1	Specified root drive %PROJECT_ROOT_DRIVE%*1
/rom/$MELPRJ$/	/rom

*1 The root path is stored in the system-defined environment variable PROJECT_ROOT. Also, the drive name (root drive) containing the root path is stored in the environment variable PROJECT_ROOT_DRIVE.

Ex.

When relative path calc_profile_/cam0002.csv is specified

The actual file to be accessed becomes:

/rom/$MELPRJ$/calc_profile_/cam0002.csv

Special relative paths ./ (which indicates the current directory) and ../ (which indicates the directory above) can be used.

Ex.

When relative path: ../cam0002.csv is specified

The actual file to be accessed becomes:

/sdc/cam0002.csv

■Environmental variables

A path can contain environment variables. Environment variables are specified in the format "%environment variable name%".

The following table lists the system-defined environment variables.

Environmental variable	Description	Default value
PROJECT_ROOT	Root directory	/rom/$MELPRJ$
PROJECT_ROOT_DRIVE	Root drive	/rom
TEMP	Working directory	/ram/temp
CALC_PROFILE_ROOT	Operation profile data root directory	/rom/$MELPRJ$ (Varies depending on the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive))
CALC_PROFILE_ROOT_DRIVE*1	Operation profile data root drive	/rom (Varies depending on the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive))

*1 The drive part of CALC_PROFILE_ROOT.

■Drive No.

When accessing a file in a motion system via SLMP communications, the file is accessed using a path that combines the "file name" part in the drive identifier that corresponds to the "drive number" part of the SLMP message.

Working folder

When operating files with each function, a temporary work file may be created in the working folder (the folder indicated by the environment variable "%TEMP%"). Data in the working folder must not be changed or deleted. (An error may occur in the function being controlled.)

Precautions

File read/write

- File read/write is performed as background processes by the motion system. The read/write time varies depending on the file size and system load. This may result in longer time in system startup or switching from STOP to RUN.
- When the free space of the data memory becomes low, the write time may become longer.
- During file read/write, communication with the engineering tool may not be possible and may result in a timeout error. In this case, wait for a while and try the operation again.

Powering off (including reset) during file operation

- If a software reset is performed or the motion system is powered off or reset during a file operation other than data read, the file content is not guaranteed. To prevent data corruption, be sure to complete the file operation before turning the power off (including reset).
- When the motion system is initialized (or when an SD memory card is inserted), a consistency check is performed on the file system. If there are many files in the drive, the check may take some time.

Simultaneous access to the same file

If the following operations are executed using the engineering tool, SLMP, FTP server function, FTP client function, file operation instructions, or MCFB (such as MCv_ReadProfileData (profile read), MCv_WriteProfileData (profile write), and MC_CamTableSelect (cam table selection)), an error will occur in the request source. Execute the next access after the processing of one request source is completed.

- Perform operations (read/write/create/delete/move/copy/rename) on the same file from multiple request sources.

Simultaneous access to different files from multiple request sources

A maximum of 16 different files can be accessed simultaneously from different request sources.

PART 8 DEVICES, LABELS, AND CONSTANTS

This part consists of the following chapters.

18 DEVICES AND CONSTANTS

19 LABELS

20 LATCH FUNCTION

21 DEVICE/LABEL INITIAL VALUE SETTINGS

18 DEVICES AND CONSTANTS

This chapter describes devices and constants.

18.1 Device List

This section lists the devices.

Classification	Type	Device name	Symbol	Number of points of default	Changeability with parameter settings	Notation
User device	Bit	Input	X	12K points*1	Unchangeable	Hexadecimal
	Bit	Output	Y	12K points*1	Unchangeable	Hexadecimal
	Bit	Internal relay	M	64K points	Changeable (☞ Page 347 Device Setting)	Decimal
	Bit	Link relay	B	32K points		Hexadecimal
	Bit	Annunciator	F	2K points		Decimal
	Bit	Link special relay	SB	2K points		Hexadecimal
	Bit	Edge relay	V	2K points		Decimal
	Bit/word	Timer	T	1K points		Decimal
	Bit/word	Retentive timer	ST	0 points		Decimal
	Bit/double word	Long timer	LT	4K points		Decimal
	Bit/double word	Long retentive timer	LST	0 points		Decimal
	Bit/word	Counter	C	512 points		Decimal
	Bit/double word	Long counter	LC	512 points		Decimal
	Word	Data register	D	64K points		Decimal
	Word	Link register	W	32K points		Hexadecimal
	Word	Link special register	SW	2K points		Hexadecimal
	Bit	Latch relay	L	8K points		Decimal
System device	Bit	Function input	FX	—	Unchangeable	Hexadecimal
	Bit	Function output	FY	—		Hexadecimal
	Word	Function register	FD	—		Decimal
	Bit	Special relay	SM	—		Decimal
	Word	Special register	SD	—		Decimal
Link direct device	Bit	Link input	Jn\X	—	Unchangeable	Hexadecimal
	Bit	Link output	Jn\Y	—		Hexadecimal
	Bit	Link relay	Jn\B	—		Hexadecimal
	Bit	Link special relay	Jn\SB	—		Hexadecimal
	Word	Link register	Jn\W	—		Hexadecimal
	Word	Link special register	Jn\SW	—		Hexadecimal
Module access device	Word	Module access device	Un\G	—	Unchangeable	Decimal
CPU buffer memory access device	Word	CPU buffer memory access device	U3En\G	—	Unchangeable	Decimal
Index register	Word	Index register	Z	24 points	Unchangeable	Decimal
	Double word	Long index register	LZ	12 points		Decimal
File register	Word	File register	R/ZR	0 points	Changeable	Decimal
Refresh data register	Word	Refresh data register	RD	1024K points	Changeable	Decimal
Nesting	—	Nesting	N	—	Unchangeable	Decimal
Pointer	—	Pointer	P	16384 points	Changeable (☞ Page 387 Pointer setting)	Decimal
	—	Interrupt pointer	I	—	Unchangeable	Decimal
Other devices	—	Network No. specification device	J	—	Unchangeable	Decimal
	—	I/O No. specification device	U	—		Hexadecimal

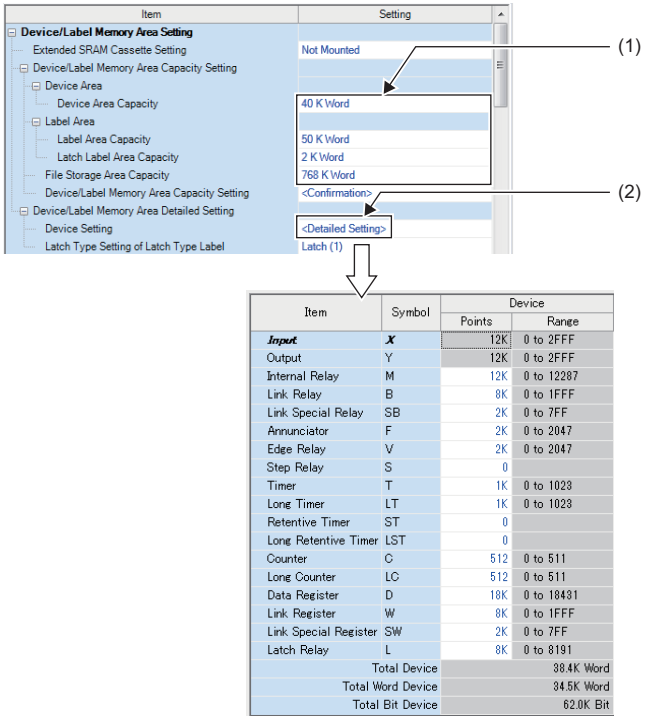
*1 X/Y0 to FFF are used as input/output points for I/O modules and intelligent function modules.

18.2 Device Setting

The number of points of each user device can be changed (☞ Page 349 User Device)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting] ⇨ [Device/Label Memory Area Detailed Setting] ⇨ [Device Setting] ⇨ <Detailed Setting>

Window



Item	Symbol	Device	
		Points	Range
Input	X	12K	0 to 2FFF
Output	Y	12K	0 to 2FFF
Internal Relay	M	12K	0 to 12287
Link Relay	B	8K	0 to 1FFF
Link Special Relay	SB	2K	0 to 7FF
Annunciator	F	2K	0 to 2047
Edge Relay	V	2K	0 to 2047
Step Relay	S	0	
Timer	T	1K	0 to 1023
Long Timer	LT	1K	0 to 1023
Retentive Timer	ST	0	
Long Retentive Timer	LST	0	
Counter	C	512	0 to 511
Long Counter	LC	512	0 to 511
Data Register	D	18K	0 to 18431
Link Register	W	8K	0 to 1FFF
Link Special Register	SW	2K	0 to 7FF
Latch Relay	L	8K	0 to 8191
Total Device			38.4K Word
Total Word Device			34.5K Word
Total Bit Device			62.0K Bit

(1) The capacity of each area can be changed. (☞ Page 320 Device/label memory area setting)
(2) The number of points of user devices can be changed.

Point

Specify each item so that the total number of points for each user device does not exceed the capacity of the device area. (☞ Page 320 Device/label memory area setting)

Range of use of device points

The following table lists the range of use of device points to be set in the device setting.

Type	Device name	Symbol	Range of use	Increment of setting
Bit	Input	X	X0 to X2FFF	—
Bit	Output	Y	Y0 to Y2FFF	—
Bit	Internal relay	M	M0 to M167747583*1	64 points
Bit	Link relay	B	B0 to B9FF9FFF*1	64 points
Bit	Annunciator	F	F0 to F32767	64 points
Bit	Link special relay	SB	SB0 to SB9FF9FFF*1	64 points
Bit	Edge relay	V	V0 to V32767	64 points
Word	Timer	T	T0 to T9319295*1	32 points
Word	Retentive timer	ST	ST0 to ST9319295*1	32 points
Word	Long timer	LT	LT0 to LT2621055*1	1 point
Word	Long retentive timer	LST	LST0 to LST2621055*1	1 point
Word	Counter	C	C0 to C9319295*1	32 points
Word	Long counter	LC	LC0 to LC4933727*1	32 points
Word	Data register	D	D0 to D10484223*1	4 points
Word	Link register	W	W0 to W9FF9FF*1	4 points
Word	Link special register	SW	SW0 to SW9FF9FF*1	4 points
Bit	Latch relay	L	L0 to L32767	64 points

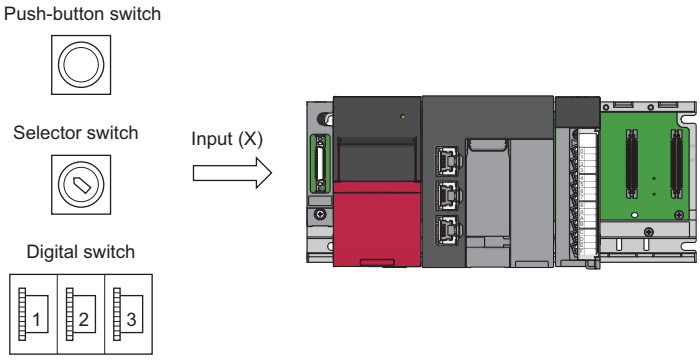
*1 The actual maximum usable device range depends on the usage of global labels.

18.3 User Device

This section describes the user device.

Input (X)

This device provides the controller with commands and/or data using an external device, such as pushbutton, transfer switch, limit switch, and digital switch.



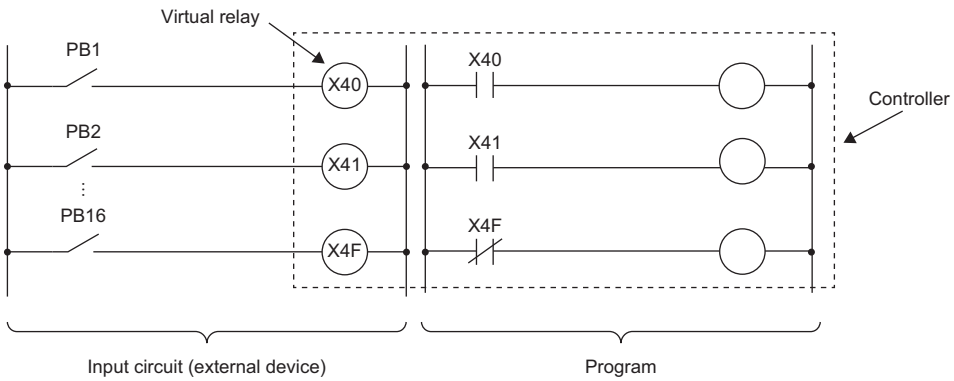
Point

For the input signal assignment of the controller itself, refer to the following.

☞ Page 1945 I/O Signals

Concept of input

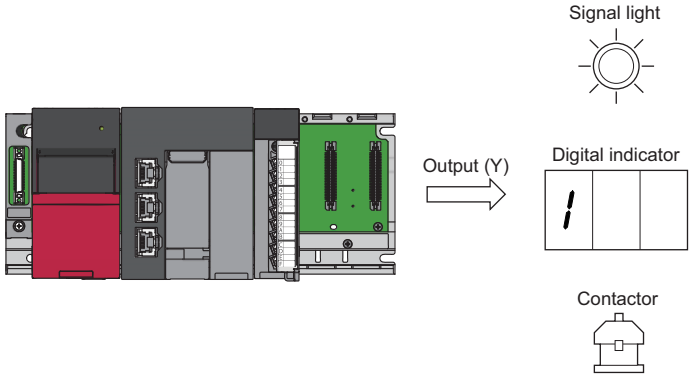
Assume that one virtual relay Xn is incorporated into the controller for each input point. In the program, a normally open contact and normally closed contact for the Xn are used.



Also, the input can be used as a refresh target (controller side) device of the remote input (RX), such as the CC-Link IE TSN.

Output (Y)

This device outputs the control results of the program to various devices, such as external signal light/digital HMI/electromagnetic switch (contactor)/solenoid.



Point

For the output signal assignment of the controller itself, refer to the following.

☞ Page 1945 I/O Signals

Internal relay (M)

This device is used as an auxiliary relay within the controller. The following operations turn off all the internal relays.

- Controller powering off and on
- Reset
- Latch clear

Latch relay (L)

This device is an auxiliary relay which enables latching (data retention during power failure). This device is used within the controller. This device latches operation results (ON/OFF information) even after the following operations.

- Controller powering off and on
- Reset

Link relay (B)

This device is used as a controller side device when refreshing bit data between the network module and the controller.

Refreshing network modules using link relay

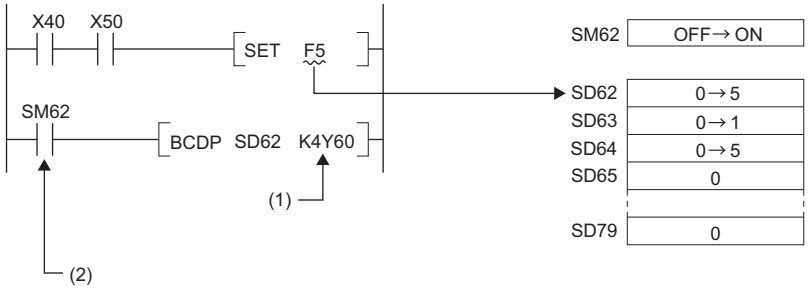
Data are transferred/received between the link relay (B) within the controller and the link relay (LB) of the network module, such as CC-Link IE TSN. The refresh range is specified using parameters on the network module. The part which is not used for refreshing can be used for other applications.

Annunciator (F)

This device is an internal relay used for a customer-created program which detects malfunction/failure of the equipment. When the annunciators are turned on, SM62 (Annunciator) is turned on, the number of activated annunciators and their device numbers are stored in SD62 (Annunciator number) to SD79 (Table of detected annunciator numbers).

Ex.

Failure detection program



(1) Outputs the annunciator number of the annunciator that turned on.
(2) ON detection of the annunciator

Also the number of the annunciator turned on first (the number stored in SD62) is registered in the event history.

Point

Only one annunciator number is registered in the event history while power is turned on.

On/off method for annunciator

Annunciators are turned on by either the SET F□instruction or the OUT F□ instruction. Annunciators are turned off by the RST F□instruction or the LEDR instruction or the BKRST instruction.

Point

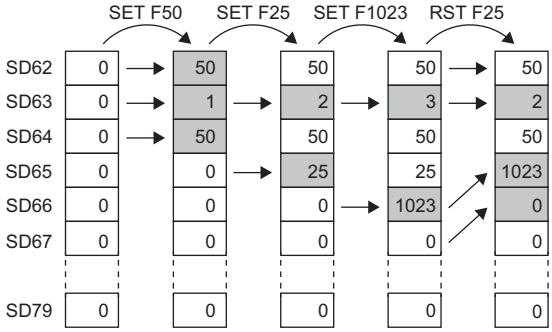
When the annunciators are turned on/off using any methods (e.g. the MOV instruction) other than shown above, the operation is the same as that of internal relays. As a result, SM62 is not turned on and annunciator numbers are not stored into SD62 and SD64 (Table of detected annunciator numbers) to SD79.

■Operations when annunciators are turned on

1. The annunciator numbers turned on are stored sequentially into SD64 to SD79.
2. The annunciator number stored into SD64 is stored into SD62.
3. SD63 value (Number of annunciators) is incremented by one.

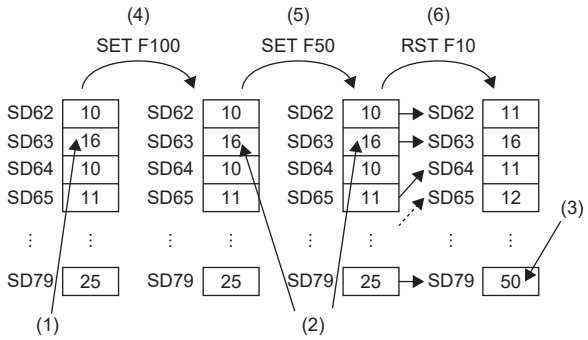
■Operations when annunciators are turned off

1. The number of the annunciator deactivated is removed, and the numbers of annunciators, which were lined up behind the removed one, move forward one by one.
2. When the annunciator number stored into SD64 is turned off, the annunciator number newly stored into SD64 is stored into SD62.
3. The value of SD63 is decremented by one. When the SD63 value gets decremented to 0, SM62 is turned off.



Point

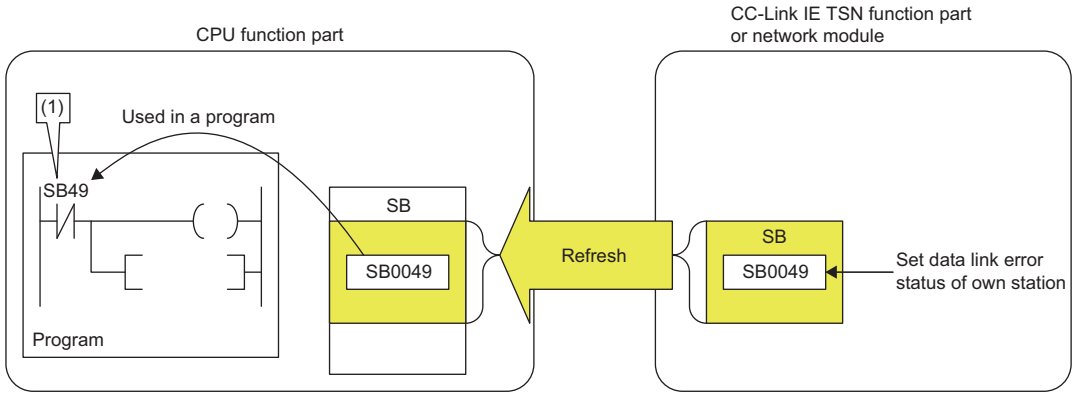
If more than 16 annunciators are turned on, the 17th annunciator onwards are not stored into SD64 to SD79. However, if the numbers of annunciators registered in SD64 to SD79 are turned off, the lowest numbers, which are not registered in SD62 to SD79, of the numbers of annunciators which were turned on for the 17th on and after, are stored into SD64 to SD79.



(1) Annunciators have been stored for the maximum number (16).
(2) Because annunciators have been stored for the maximum number, the value does not change.
(3) The smallest number is stored.
(4) Turn on the 17th device.
(5) Turn on the 18th device.
(6) Turn off the first device.

Link special relay (SB)

The communication status and error detection status of network modules are output to the link special relay (J□\SB□) on the network. The link special relay (SB) is a device for using as a refreshing target of link special relays in the network. The part which is not used for refreshing can be used for other applications.



(1) The network status is checked.

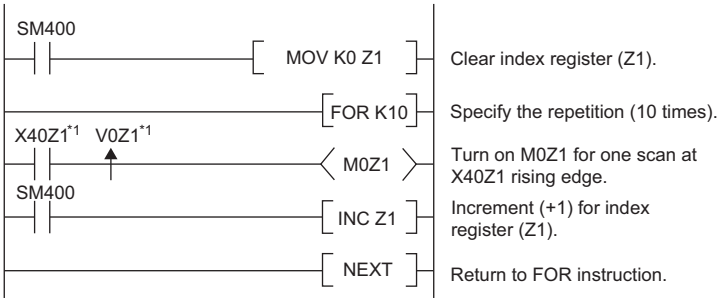
Point

For the link special relay assignment of the controller itself, refer to the following.

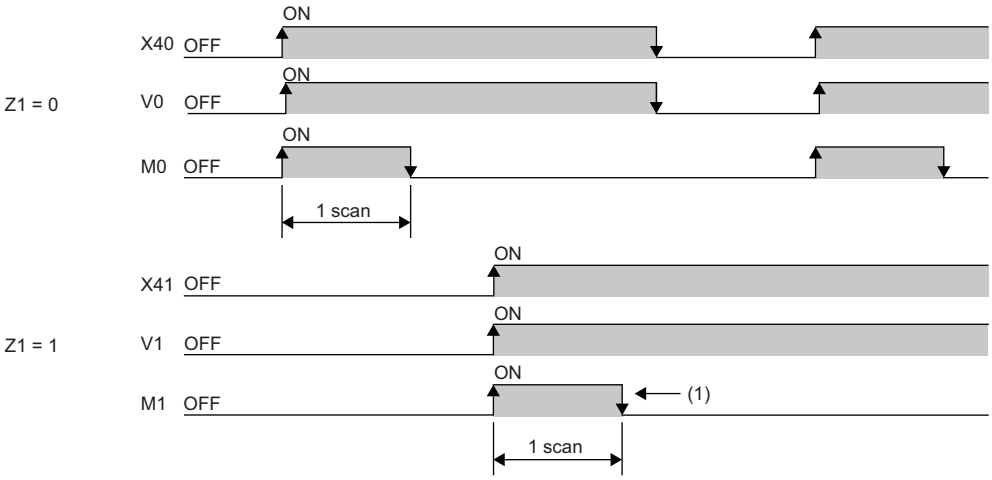
☞ Page 2013 List of Link Special Relay (SB)

Edge relay (V)

The edge relay is a device that memorizes operation results (on/off information) from the head of the ladder block, allowing its use only by the EGP/EGF instruction. This device is executed for various objectives such as the rising (off and on) detection in the structured programs by the index modification.



*1 Edge relay V0Z1 memorizes on/off information of X0Z1.



(1) When X41 is rising, this device is turned on for one scan duration.

Precautions

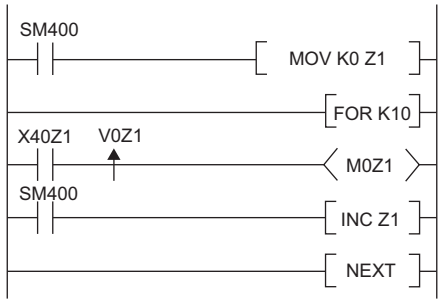
■Index modification by the edge relay (V) between FOR and NEXT instructions

Between the FOR instruction and the NEXT instruction, pulse output is provided through the edge relay (V).

However, pulse output by the PLS, PLF, or pulse conversion (□P) instruction is not available.

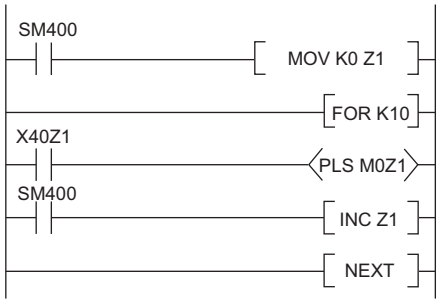
When edge relay is used

Pulse output of M0Z1 is provided normally.



When edge relay is not used

Pulse output of M0Z1 is not provided normally.



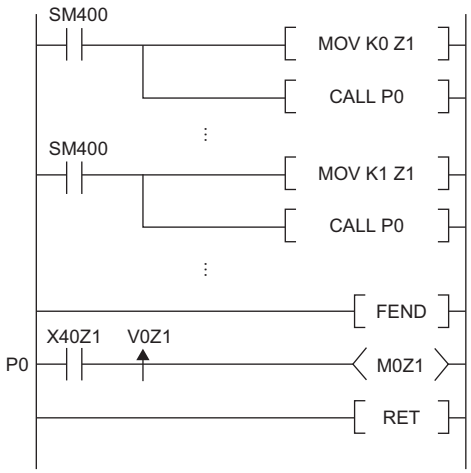
■Index modification by the edge relay (V) with CALL instruction

In the CALL instruction, pulse output is provided through the edge relay (V).

However, pulse output by the PLS, PLF, or pulse conversion (□P) instruction is not available.

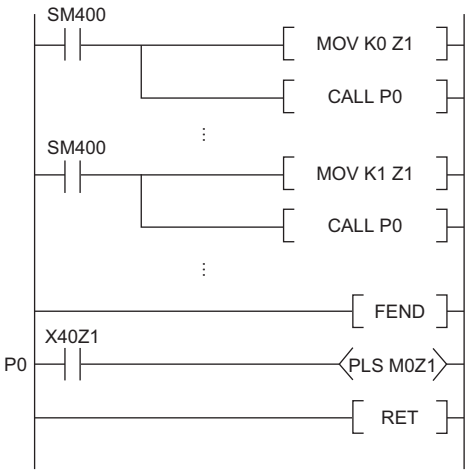
When edge relay is used

Pulse output of M0Z1 is provided normally.



When edge relay is not used

Pulse output of M0Z1 is not provided normally.



Timer

This device starts measurement when the timer coil is turned on. When the current value reaches a setting value, time is up and the contact is turned on. This timer is an up-timing type device and therefore the current value matches a setting value when the timer time is up.

Types of timers

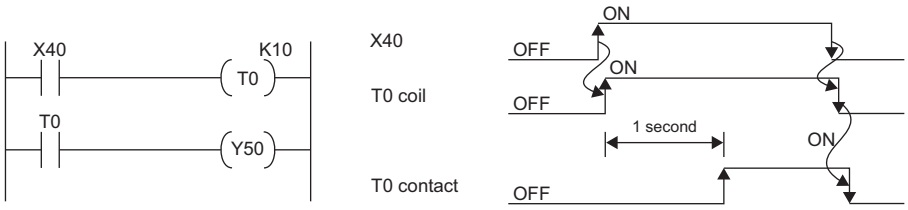
There are two types of timers: timer (T) which retains the current value in 16-bit units and long timer (LT) which retains it in 32-bit units. The timer (T) and the long timer (LT) are different devices and the number of device points can be set for each of them. In addition, there are the retentive timer (ST) and the long retentive timer (LST), both of which retain the current value even if the coil is turned off. *1

Type of timer			
Timer	Current value = 16 bits	Timer (T)	Low-speed timer
			High-speed timer
		Retentive timer (ST)	Low-speed retentive timer
			High-speed retentive timer
	Current value = 32 bits	Long timer (LT)	
		Long retentive timer (LST)	

*1 For the timer (T)/long timer (LT), the current value returns to 0 when the coil is turned off.

■Timer (T)

This device starts measurement when the coil of the timer is turned on. When the timer current value matches a setting value, time is up and the timer contact is turned on. When the timer coil is turned off, the current value returns to 0 and the timer contact is turned off.

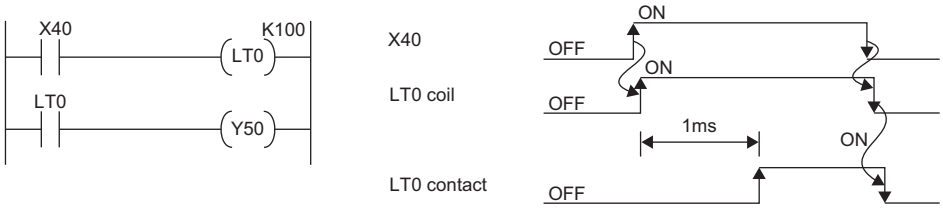


This figure shows the example when the timer time limit value is 100ms.

■Long timer (LT)

This device can count from 0 to 4294967295 to measure the time. If the measuring unit is set to 0.01ms, the measurable time range of this device is from 0 to about 11.9 hours. The current value of the long timers is updated by adding a difference of the counter which is used in the system when the OUT LT☐ instruction is executed. Proper time can be measured even when the coil instruction of the long timer cannot be executed once per scanning because the counters used in the system count asynchronously with scanning.

When the long timer coil is turned on, measurement starts and when the long timer current value matches a setting value, time is up and the long timer contact is turned on. When the long timer coil is turned off, the current value returns to 0 and the long timer contact is turned off.



This figure shows the example when the long timer time limit value is 0.01ms.

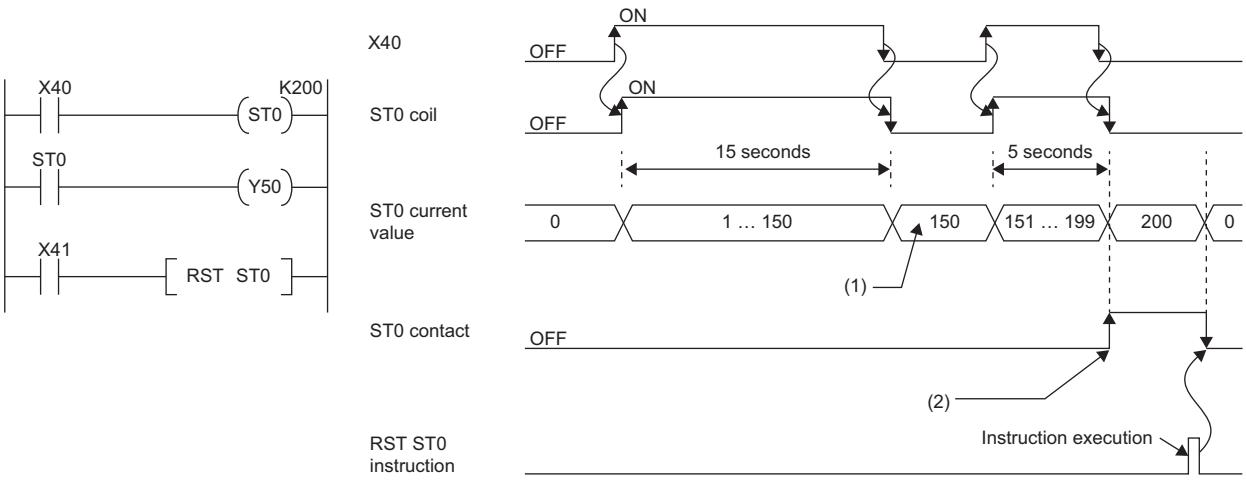
The long timer contact is turned on at the following coil execution after the long timer coil is turned off and on. The long timer contact is not turned on simultaneously when the long timer coil is turned off and on.

Point

The long timer (LT) can be used in interrupt programs. (☞ Page 261 Interrupt Program)

■Retentive timer (ST)

This device counts the sum of time duration in which the coil is turned on. When the retentive timer coil is turned on, measurement starts and when the timer current value matches a setting value (when time is up), the retentive timer contact is turned on. The current value and the contact on/off state is retained even when the retentive timer coil is turned off. When the coil is turned on again, measurement starts with the retained current value. To clear the retentive timer current value and turn off the contact, issue the RST ST☐ instruction.



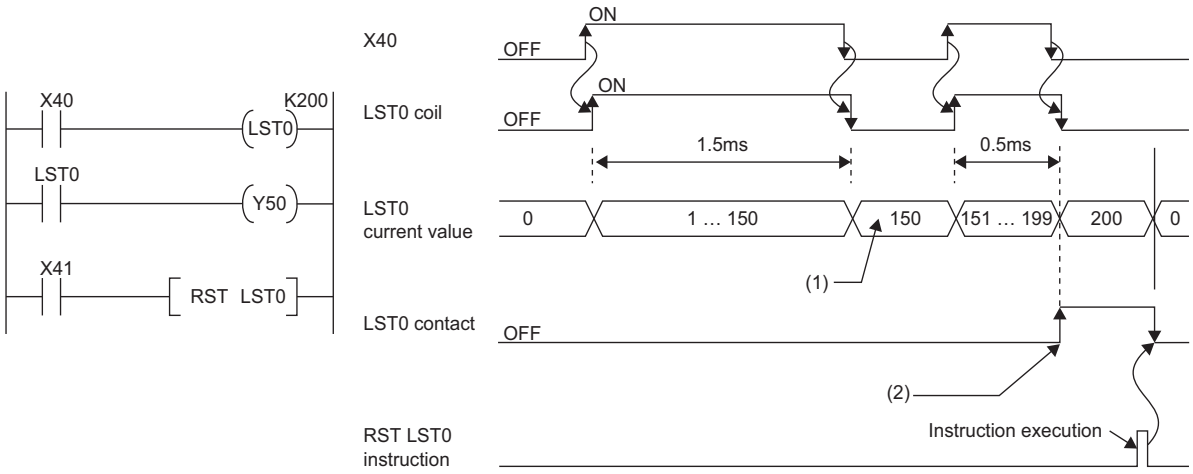
This figure shows the example when the retentive timer time limit value is 100ms.

(1) Even though the ST0 coil turns off, the current value is held.

(2) Even though the ST0 coil turns off, the contact remains on.

■Long retentive timer (LST)

This device counts the sum of time duration in which the coil is turned on. When the long retentive timer coil is turned on, measurement starts and when the timer current value matches a setting value (when time is up), the contact is turned on. The current value and the contact on/off state is retained even when the long retentive timer coil is turned off. When the coil is turned on again, measurement starts with the retained current value. To clear the long retentive timer current value and turn off the contact, issue the RST LST☐ instruction.



This figure shows the example when the long retentive timer time limit value is 0.01ms.

(1) Even though the coil turns off, the current value is held.

(2) Even though the coil turns off, the contact remains on.

Point

The long retentive timer (LST) can be used in interrupt programs. (☞ Page 261 Interrupt Program)

■Low-speed/high-speed timer (T/ST)

The low-speed timer and high-speed timer are the same device which is set to a low speed or high speed timer by writing the instruction accordingly to specify it on the timer. For example, specifying OUT T0 generates a low-speed timer and specifying OUTH T0 produces a high-speed timer even when using the same T0 device. This also applies to the retentive timer.

Timer time limit value

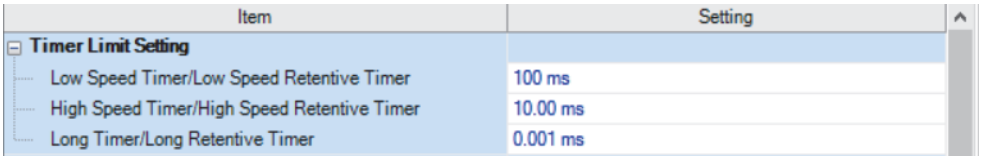
Although the low-speed timer and high-speed timer are the same device, timer limit value are different depending on how to specify the timer device (how to write the instruction). For example, specifying OUT T0 generates a low-speed timer and specifying OUT H T0 produces a high-speed timer even when using the same T0 device. This also applies to the retentive timer. The long timer cannot be set to a low-speed or high speed device. The time limit value for each timer is set in "Timer Limit Setting".

■Timer limit setting

The following window is to set the timer time limit values.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Timer Limit Setting]

Window



Displayed items

Item	Description	Setting range	Default
Low Speed Timer/Low Speed Retentive Timer	Set the timer time limit value of T and ST used for the low-speed timer and low-speed retentive timer.	1 to 10000ms (unit: 1ms)	100ms
High Speed Timer/High Speed Retentive Timer	Set the timer time limit value of T and ST used for the high-speed timer and high-speed retentive timer.	0.01 to 100ms (unit: 0.01ms)	10.00ms
Long Timer/Long Retentive Timer	Set the timer time limit value of LT and LST used for the long timer and long retentive timer.	0.001 to 1000ms (unit: 0.001ms)	0.001ms

Timer current value and the measurable range

This sections describes the timer current value and the measurable range.

■Timer (T/ST)

The current value range is 0 to 65535. The measurable time range is from 0 to (timer time limit value × 65535).

■Long timer (LT/LST)

The setting range of the current value is 0 to 4294967295, which is the same as the range of unsigned 32-bit integers. The measurable time range is from long timer time limit value to (timer time limit value × 4294967295).

Handling timers

When executing the timer coil (the OUT T☐ instruction), the timer coil is turned on/off, the current value is updated, and the contact is turned on/off.

Accuracy of timers

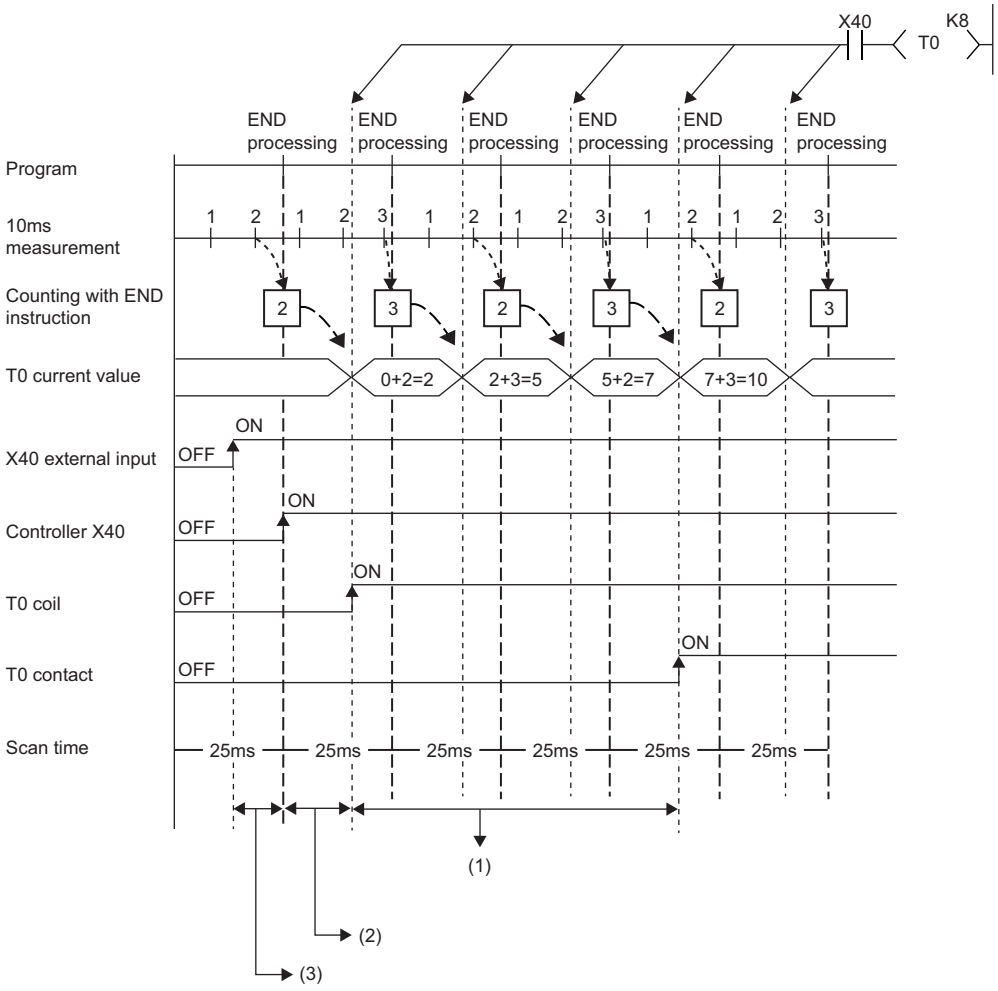
This sections describes the accuracy of timers.

■Timer (T/ST)

The scan time value measured by the END instruction is added to the current value when the OUT T☐ instruction is executed. If the timer coil is turned off when the OUT T☐ instruction is executed, the current value is not updated. The maximum response accuracy of the timer (the time duration from capture of an input (X) to output of it) is "2 scan time + timer time limit setting".

Ex.

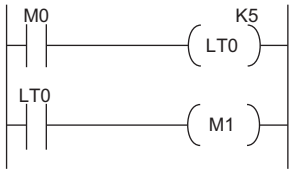
Timer limit setting = 10ms, setting value of T0 = 8 (10ms × 8 = 80ms), scan time = 25ms

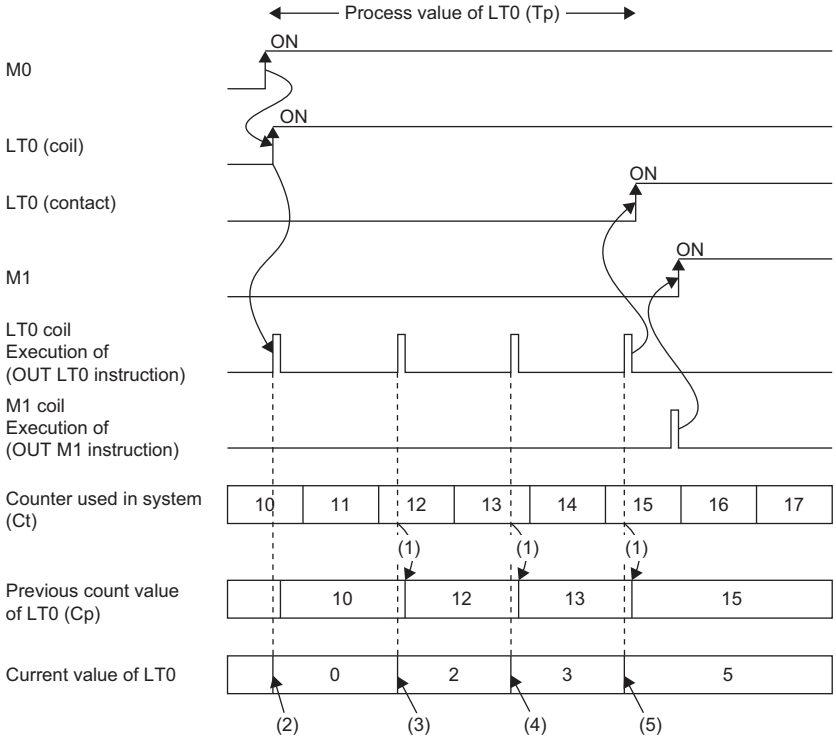


(1) Accuracy from when the coil of the timer turns on until when the contact of the timer turns on - (1 scan time + Timer limit setting) to (1 scan time)
(2) Timing on when the coil of the timer turns on
(3) Input fetching timing

■Long timer (LT/LST)

In the following program, the accuracy of Tp (the time duration from the long timer coil activation to long timer contact activation) is (Ts-Tu) ≤ Tp < (Ts + Tu).

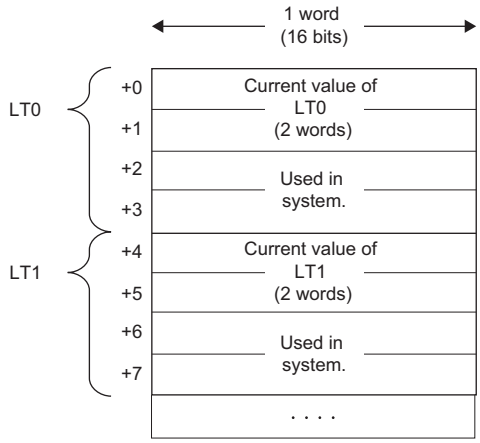




(1) Cp is updated.
(2) LT0 is initialized to 0.
(3) The result of (Ct - Cp) is added.: 0 + (12 - 10) = 2
(4) The result of (Ct - Cp) is added.: 2 + (13 - 12) = 3
(5) The result of (Ct - Cp) is added.: 3 + (15 - 13) = 5
Tp: time duration from the long timer coil activation to long timer contact activation
Ts: setting value of the long timer
Tu: time limit value of the long timer

Data configuration of long timer (LT/LST)

The long timer (LT) and the long retentive timer (LST) use four words (64 bits) for each point. If the most significant two words are changed in a program, it is impossible to measure the time properly, because they are used by the system.



Point

The current value of the long timer (LT) and the long retentive timer (LST) is 32-bit data. It can be specified by the instructions which can specify signed or unsigned 32 bit data. (It cannot be specified with the BK + Instruction.)

Precautions

This section describes the precautions when using the timer and long timer.

■Precautions about timer usage

- Do not describe more than one coil (the OUT T☐ instruction) on the same timer during a single scanning. Doing so results in improper measurement because the timer current value is updated when the coil for each timer is executed.
- When timer is not used for data collection for each scan: While the coil on a timer (e.g. T1) is turned on, the timer coil (the OUT T☐ instruction) cannot be skipped by the instructions such as the CJ. When the timer coil is skipped, proper measurement is impossible because the timer current value is not updated. In addition, when the timer exists in a subroutine program, be sure to execute a subroutine call including T1 coil only once for each scanning operation while the coil of the timer (e.g. T1) is turned on. Otherwise proper measurement is impossible.
- The timer cannot be used in the initial execution type program, the fixed scan execution type program, or the event execution type program where the occurrence of an interrupt is set to be a trigger. The timer can be used in standby type programs if the coil of timer (OUT T☐ instruction) is executed one time for one scan using a subroutine program.
- The timer cannot be used in interrupt programs. The timer can be used in subroutine programs or FB programs if the coil of timer (OUT T☐ instruction) is executed one time for one scan.
- When setting value is 0: The contact is turned on when the OUT T☐ instruction is executed.
- Even when the setting value is increased after the timer time is up, the timer status does not change (time continues to be up) and the timer does not operate.

■Precautions about long timer usage

This section describes the precautions when using long timers (LT/LST).

- The long timer cannot be used in initial execution type programs.
- Even when the setting value is increased after the long timer time is up, the long timer status does not change (time continues to be up) and the long timer does not operate.

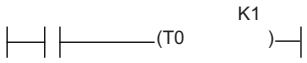
■Timer setting value and timer limit setting

When the condition is "Timer setting value < Scan time + Timer limit setting", the coil and the contact may be turned on at the same time depending on the timing when the coil turns on. When the condition is not satisfied, reduce the timer limit setting value to satisfy the condition.

Ex.

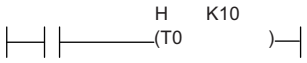
When changing the low-speed timer to high-speed timer and reducing the timer limit setting value (scan time: 20ms)

Before change (low-speed timer)



■Timer limit setting
Low Speed Timer/Low Speed Retentive Timer: 100ms
Timer setting value (100ms × 1 = 100ms) < Scan time (20ms) + Timer limit setting (100ms)

After change (high-speed timer)

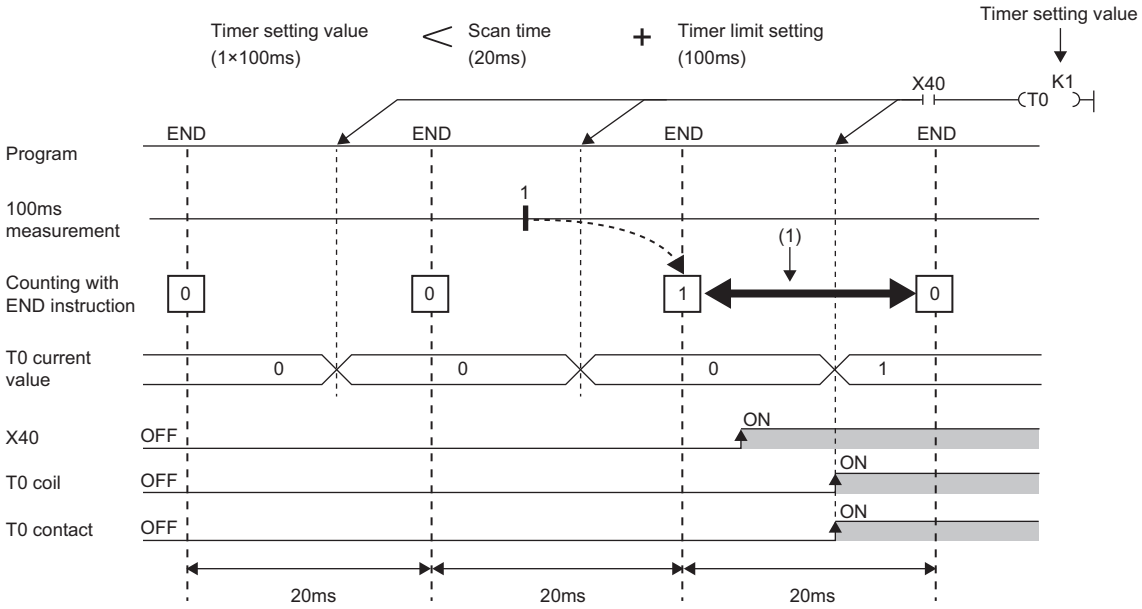


■Timer limit setting
High Speed Timer/High Speed Retentive Timer: 10.00ms
Timer setting value (10.00ms × 10 = 100ms) ≥ Scan time (20ms) + Timer limit setting (10ms)

The following shows an example of when the coil and the contact are turned on at the same time when the condition is "Timer setting value < Scan time + Timer limit setting".

Ex.

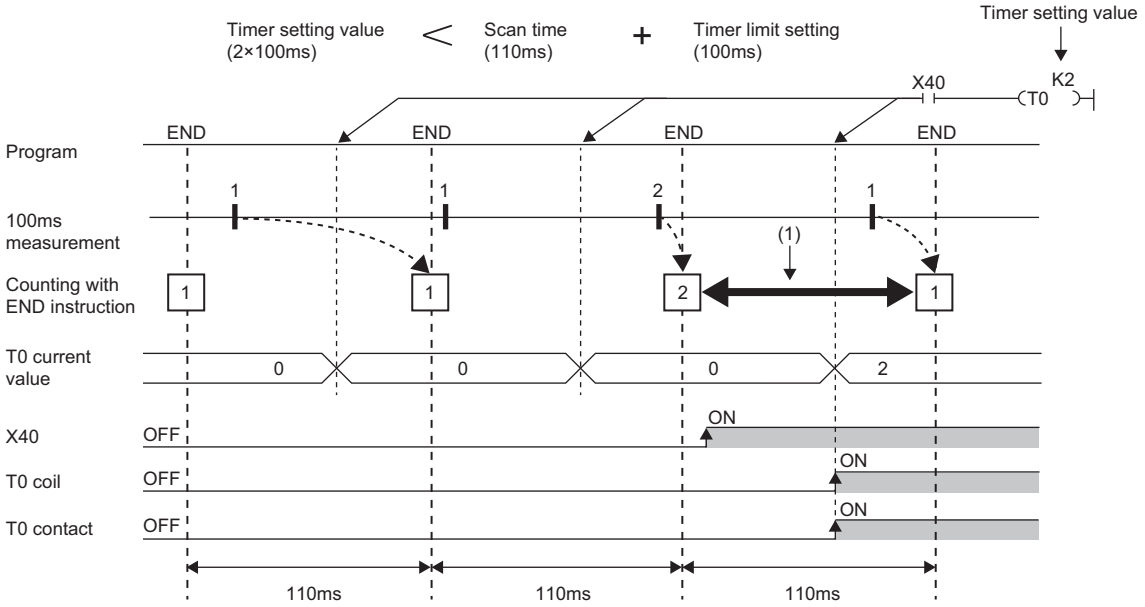
In the case where the values are set as follows (timer setting value: 1 (1 × 100ms), scan time: 20ms, and timer limit setting: 100ms), when the coil of the timer (T0) turns on in the next scan after the coefficient of the END instruction becomes equal to or higher than the timer setting value, the coil and the contact turn on at the same time because the timer current value becomes equal to the timer setting value at startup of the timer.



(1) The coefficient of the END instruction becomes equal to or higher than the timer setting value. Therefore, when the coil turns on during this period, the contact also turns on at the same time.

Ex.

In the case where the values are set as follows (timer setting value: 2 (2 × 100ms), scan time: 110ms, and timer limit setting: 100ms), when the coil of the timer (T0) turns on in the next scan after the coefficient of the END instruction becomes equal to or higher than the timer setting value, the coil and the contact turn on at the same time because the timer current value becomes equal to the timer setting value at startup of the timer.



(1) The coefficient of the END instruction becomes equal to or higher than the timer setting value. Therefore, when the coil turns on during this period, the contact also turns on at the same time.

Counter

This device counts the number of rising operation of the input condition in the program. The counter is an up-timing type device and therefore when the count value matches a setting value, the counter counts up and the contact is turned on.

Types of counters

There are two types of counters: counter (C) which retains the counter values in 16-bit units and long counter (LC) which retains them in 32-bit units. The counter (C) and the long counter (LC) are different devices and the number of device points can be set for each of them.

■Counter (C)

This device uses one word for each point. The measurable range is 0 to 65535.

■Long counter (LC)

This device uses two words for each point. The measurable range is 0 to 4294967295.

Point

The long counter (LC) can be used in interrupt programs. (☞ Page 261 Interrupt Program)

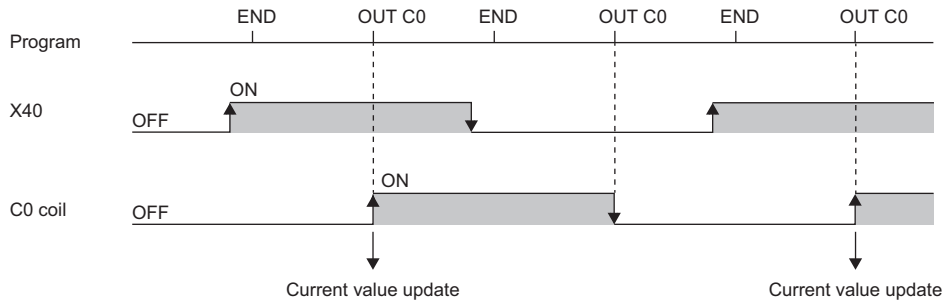
Counting process

When executing the counter coil (OUT C☐instruction / OUT LC☐instruction), the counter coil is turned on/off, the current value is updated (count value +1), and the contact is turned on/off. The current value is updated (count value +1), when the counter coil input is rising (off and on). The current value is not updated when the coil input is turned off, on and on, and on and off.

[Ladder example]



[Current value update timing]



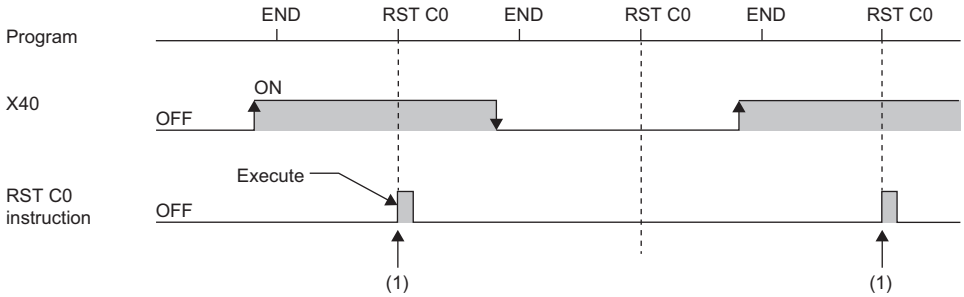
Resetting counters

The counter current value is not cleared even when the counter coil input is turned off. To clear the counter current value (resetting) and turn off the contact, issue the RST C☐/RST LC☐ instruction. When executing the RST C☐ instruction, the counter value is cleared and the contact is turned off.

[Ladder example]



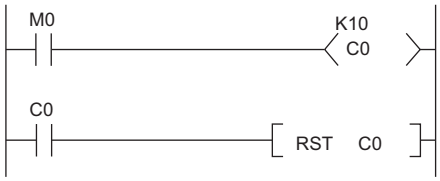
[Counter reset timing]



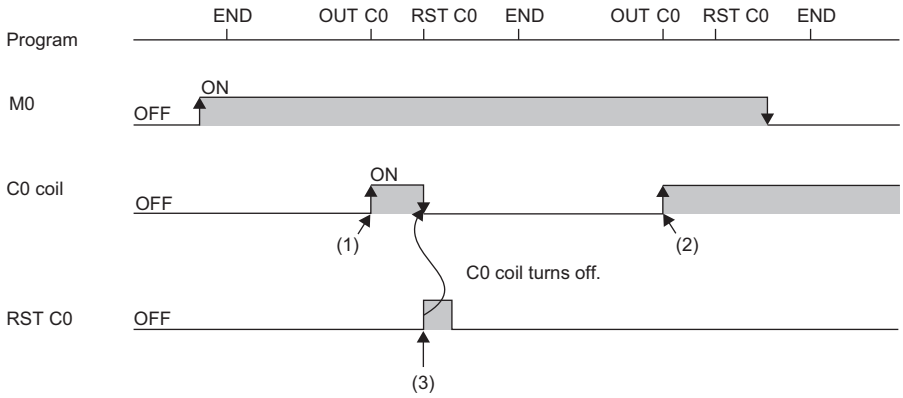
(1) The count value is cleared, and the contact turns off.

■Precautions about counter reset

When executing the RST C☐ instruction, the coil for C☐ is also turned off. If the execution condition for the OUT C☐ instruction is turned on after the RST C☐ instruction is executed, the coil of C☐ is turned on and the current value is updated (count value +1) when the OUT C☐ instruction is executed.

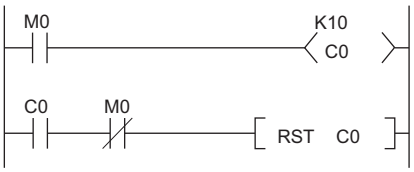


In the above ladder example, the coil of C0 is turned on by turning off and on M0 and as a result the current value is updated. When C0 counts up, C0 contact is turned on and C0 current value is cleared by execution of the RST C0 instruction. At this time C0 coil is also turned off. When M0 is turned on at the next scanning, the current value is updated because C0 coil is turned off and on during the OUT C0 instruction execution (the current value is changed to 1).



(1) The current value update contact turns on.
(2) The current value is updated because the coil of C0 turns on.
(3) The count value is cleared, and the contact turns off.

To address the above problem, insert a normally closed contact of the execution condition for the OUT C0 instruction into the execution condition for the RST C0 instruction to prevent C0 coil from being turned off while the execution condition (M0) of the OUT C0 instruction is turned on as shown in the following ladder example.

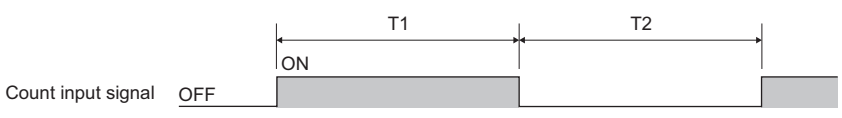


Maximum counting speed for counters

Counting is possible only when on/off time of the input condition is longer than the execution interval of the same OUT C☐ instruction. Maximum counting speed for counters can be obtained by the following equation:

$$\text{Maximum counting speed Cmax} = \frac{n}{100} \times \frac{1}{T} \text{ [times/s]}$$

*1 Duty (n) is a value which expresses the ratio of on/off time of the count input signal as a percent (%) value.



- When $T1 \geq T2$, $n = \frac{T2}{T1+T2} \times 100\%$
- When $T1 < T2$, $n = \frac{T1}{T1+T2} \times 100\%$

Data register (D)

This device can store numerical values.

Link register (W)

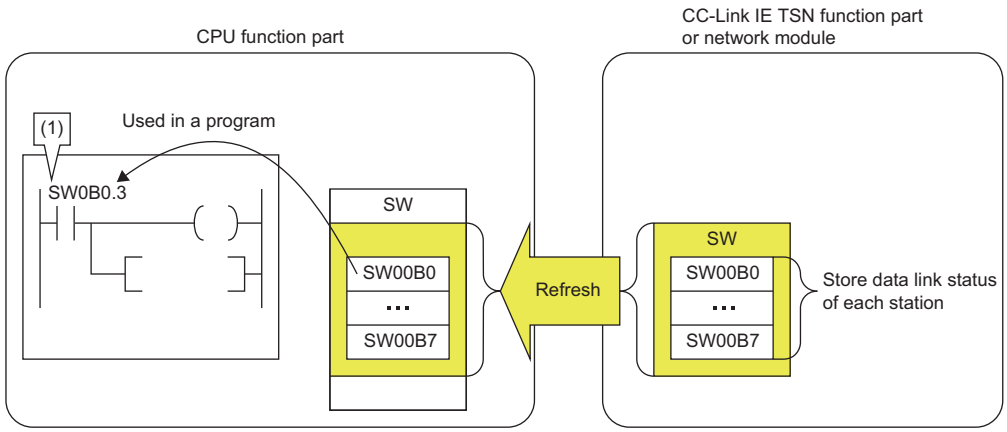
This device is used as a controller side device when refreshing word data between the network module and the controller.

Refreshing network modules using link register

Data are transferred/received between the link relay (W) within the controller and the link register (LW) of the network module. The refresh range is specified using parameters on the network module. The part which is not used for refreshing can be used for other applications.

Link special register (SW)

Word data information on the communication status and error detection status of a network are output into the link special register (J□\SW□) on the network. The link special register (SW) is a device for using as a refreshing target of link special registers in the network. The part which is not used for refreshing can be used for other applications.



(1) The network status is checked.

Point

For the link special register assignment of the controller itself, refer to the following.

Page 2017 List of Link Special Register (SW)

18.4 System Device

The system device is used by the system. Assignment/capacity is fixed and cannot optionally be altered.

Function device (FX/FY/FD)

This device is used for the subroutine programs with argument passing. Data is written/read between the subroutine call sources with argument passing and the subroutine programs with argument passing. When using the function device in a subroutine program, the device used in each subroutine program call source can be determined. As a result, when using the same subroutine program, it can be used without being aware of the call source of other subroutine programs.

Function input (FX)

This device is used when passing on/off data to a subroutine program. In the subroutine program, bit data specified in a subroutine call instruction with argument passing are captured and used for operation. All the bit data specification devices of the controller are available.

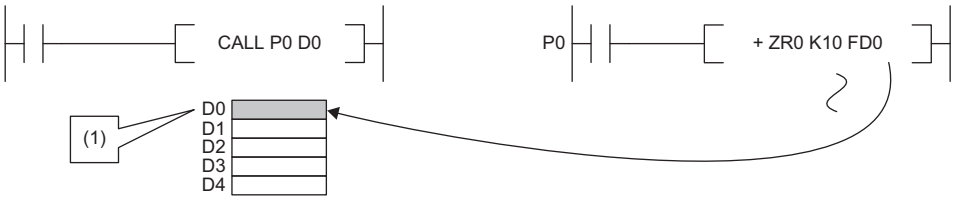
Function output (FY)

This device is used when passing operation results (on/off data) in a subroutine program to a subroutine program call source. Operation results are stored into the device specified in the subroutine program with argument passing. All the bit data specification devices except controller input (X) are available.

Function register (FD)

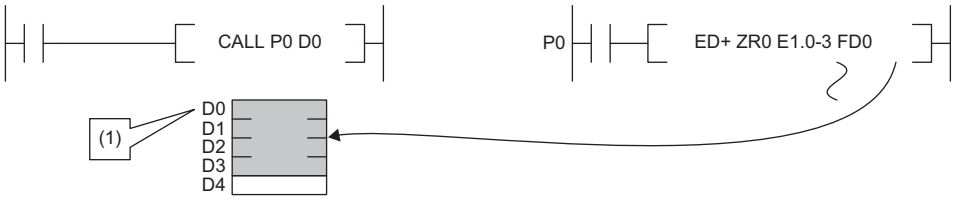
This device is used for writing/reading between the subroutine call source and the subroutine program. The input/output condition of the function register is automatically identified by the controller. "Source data" in a subroutine program means data input into the subroutine program. "Destination data" in a subroutine program means data output from the subroutine program. One point of a function register occupies maximum of four words and can store 16-bit data, 32-bit data, 64-bit data, single-precision real number, and double-precision real number. However the number of words to be used depends on the instruction in the subroutine program.

For example, for the destination of addition instruction (+instruction) of 16-bit signed integer, one word is used.



(1) The data is stored in one point of D0.

Besides, for the destination of addition instruction (ED+instruction) of double-precision real number, four words are used.



(1) The data is stored in four points of D0 to D3.

Special relay (SM)

This is the internal relay for which the specification is defined in the controller, where the status of the controller is stored. (☞ Page 1949 List of Special Relay (SM) Areas)

Special register (SD)

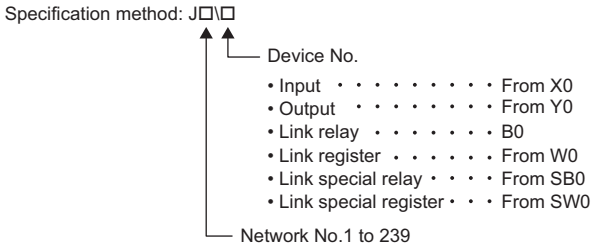
This is the internal register for which the specification is defined in the controller, where the status of the controller (such as diagnostics information and system information) is stored. (☞ Page 1968 List of Special Register (SD) Areas)

18.5 Link Direct Device

This device directly accesses link relays and/or link registers of the network module.

Specification method

Specify a link direct device as shown below: The link register 10 (W10) of the network number 2 can be specified as "J2\W10".



Point

For bit devices, digit specification is allowed. (Example: J1\K1X0, J10\K4B0)

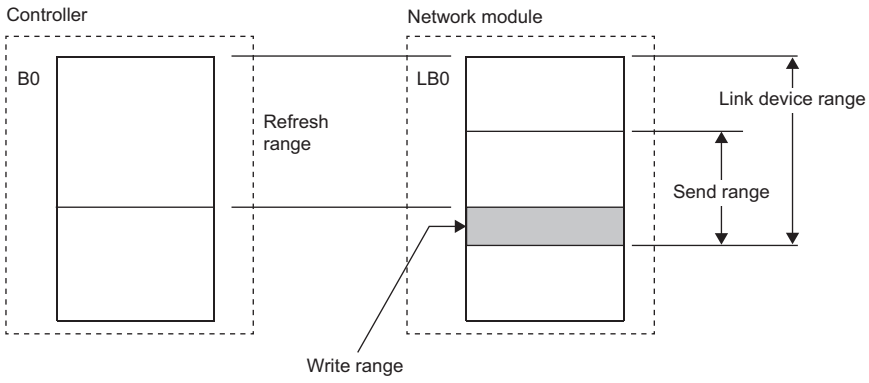
Specification range

All the link devices of the network module can be specified. The link devices which fall outside the range specified with "Refresh Setting" can also be specified.

Specification range for writing

Writing should be done for the range which is within the link device range specified as a sending range of network parameters and outside the range specified as a refresh range for "Refresh Setting". *1

Note that writing in the range specified as the refresh range overwrites link device data of the network module during refresh process. When writing data to a writing range of another station using the link direct device, data is overwritten with received data during data reception from another station.



*1 There is only one network module to which the link direct device can write data for each network number. When more than one network module with the same network number is mounted, the network module with the lowest slot number is the target for writing by the link direct device.

Specification range for reading

Data can be read from all the range of link devices of the network module.

Difference from link refresh

The following table shows the difference between the link direct device and link refresh.

Item		Link direct device	Link refresh
Description method in program	Input	Jn\K4X0...	X0...
	Output	Jn\K4Y0...	Y0...
	Link relay	Jn\K4B0...	B0...
	Link register	Jn\W0...	W0...
	Link special relay	Jn\K4SB0...	SB0... Or module label
	Link special register	Jn\SW0...	SW0... Or module label
Access range in relation to network module		All the link devices for each network module	The range specified in "Refresh Setting"
Guarantee range of access data		In word (16-bit) units	In word (16-bit) units

How to access CC-Link IE TSN link device

CC-Link IE TSN link devices can be accessed using link direct devices.
However, the link device assigned to the synchronous station cannot be accessed using the link direct device. Make refresh settings for the same link device and access the refresh target device or label.

18.6 Module Access Device

This device directly accesses from the controller to the buffer memory of the intelligent function module mounted on the main base unit and extension base unit.

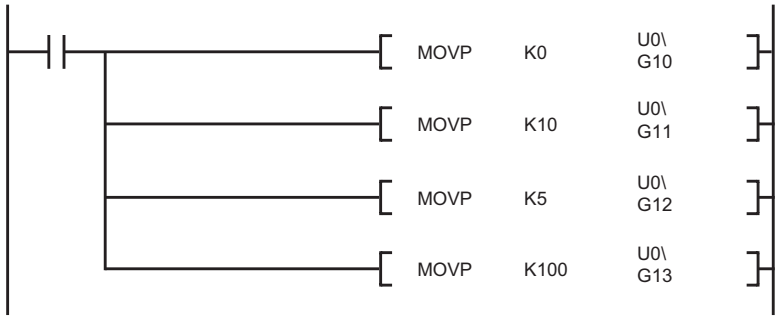
Specify this device with 'Un\Gn'. (Example: U5\G11)

Specified item		Value to be specified
Un	Start I/O number of intelligent function modules	Upper two digits when a start I/O number is described in three digits (00H to FFH) Example: 4F stands for X/Y4F0
Gn	Buffer memory address	0 to 268435455 (decimal)

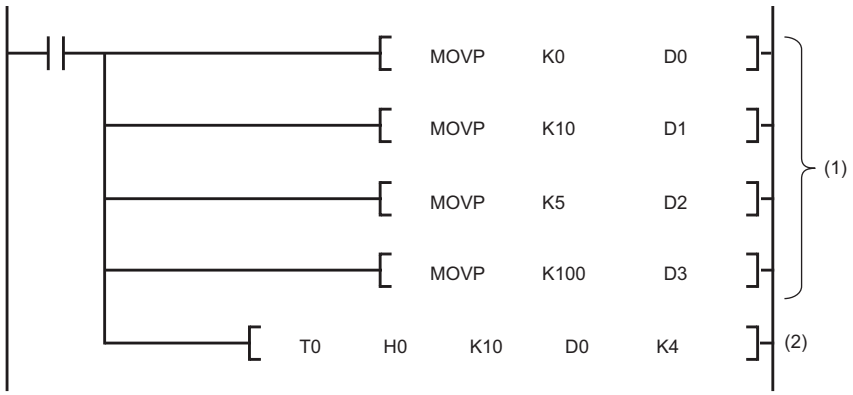
Point

When reading/writing the buffer memory data using the module access device twice or more within a program, the processing speed can be increased by conducting read/write operations at a single point of the program using the FROM/TO instruction.

• When data is written using more than one module access device:



• When data is written at a single point of the program using the TO instruction:



(1) Store data to devices such as the data register (D).

(2) Write data to only one point in the program.

Buffer memory specification method

Specify this device with Un\Gn. The following lists specification examples of the buffer memory areas.

Buffer memory			Specification example
CPU function part (start I/O number: 3E0)		Communication speed setting (G82)	U3E0\G82
		Connection No.1 latest error code (G130)	U3E0\G130
CC-Link IE TSN function part (start I/O number: 00)*1		Remote input (RX) (G57344 to G58367)	U00\G57344 to U00\G58367
		Initial status (G6291480)	U00\G6291480
Motion function part (start I/O number: 02)*1		Accessibility to labels for motion function (G14032767.0)	U02\G14032767.0
Intelligent function module	RJ71GP21-SX (start I/O number: 04)	Number of transient transmission errors (G2592)	U04\G2592
	R60AD4 (start I/O number: 06)	Latest alarm code (G2)	U06\G2

*1 When the start I/O number is changed, the start number is also changed.

How to access CC-Link IE TSN link device

CC-Link IE TSN link devices are allocated in the buffer memory area of the controller and can be accessed via the module access device.

However, the link device assigned to the synchronous station cannot be accessed via the module access device. Make refresh settings for the same link device and access the refresh target device or label.

Precautions

The following describes the precautions for when the module access device is used.

- If data is written to the refresh-target memory using a program while the refresh function is being used, the controller overwrites the data in the target memory at the execution of the refresh function. Thus, the expected operation may not be acquired. When the refresh function is used, do not write the data directly to the refresh-target memory but write it to the refresh-source memory.

*1 When the data is transferred from the controller to the module, the target memory is the buffer memory or link device. When the data is transferred from the module to the controller, the target memory is the specified device of the controller.

18.7 CPU Buffer Memory Access Device

This device accesses memory used by the built-in functions of the controller such the Ethernet function. (☞ Page 2028 List of buffer memory addresses)

Buffer memory specification method

Specify this device with Un\Gn. For details, refer to the following.

☞ Page 374 Buffer memory specification method

How to access CC-Link IE TSN link device

CC-Link IE TSN link devices are allocated in the buffer memory area of the controller and can be accessed via the CPU buffer memory access device.

However, the link device assigned to the synchronous station cannot be accessed via the CPU buffer memory access device. Make refresh settings for the same link device and access the refresh target device or label.

Point

For the buffer memory assignment of the controller itself, refer to the following.

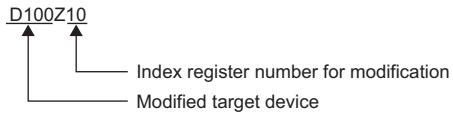
☞ Page 2028 Buffer Memory

18.8 Index Register (Z/LZ)

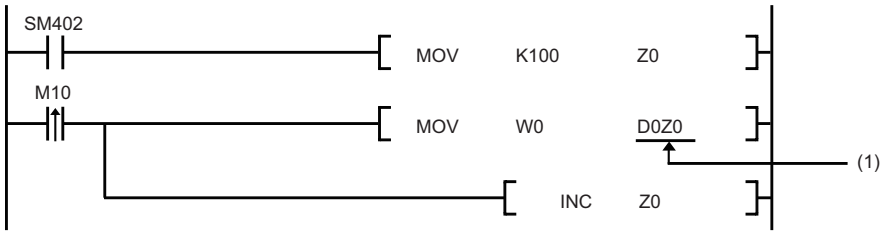
This device is used for the index modification of the device. The index modification is the indirect specification using the index register.
Specify the device with the number obtained from "Device number of device targeted for modification" + "Contents of index register".

16-bit index modification

The device number is modified using the index register (Z). The modification range for the device in the case of the 16-bit index modification is -32768 to 32767.



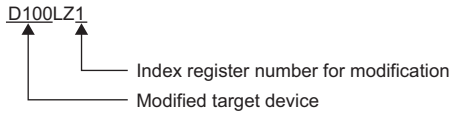
Ex.
Modifying D0 with Z0



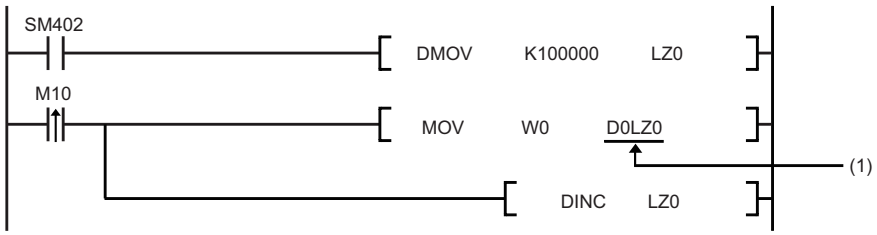
(1) Access D0Z0 = D100.

32-bit index modification

The device number is modified using the long index register (LZ). The modification range for the device in the case of the 32-bit index modification is -2147483648 to 2147483647.



Ex.
Modifying D0 with LZ0



(1) Access D0LZ0 = D100000.

In addition, 32-bit index modification with ZZ expression using two index registers is also available.

Device for which index modification can be performed

The following table lists the devices that can be targeted for index modification.

Item	Description
16-bit index modification	X, DX, Y, DY, M, L, B, F, SB, V, T*1, LT*1, ST*1, LST*1, C*1, LC*1, D, W, SW, SM, SD, Jn\X, Jn\Y, Jn\B, Jn\SB, Jn\W, Jn\SW, Un\G, U3En\G, R, ZR, RD, P*3, I*3, J, U, K, H
32-bit index modification	M, B, SB, T*1, LT*1, ST*1, LST*1, C*1, LC*1, D, W, SW, Jn\B*2, Jn\W*2, Un\G*2, U3En\G*2, R, ZR, RD, K, H

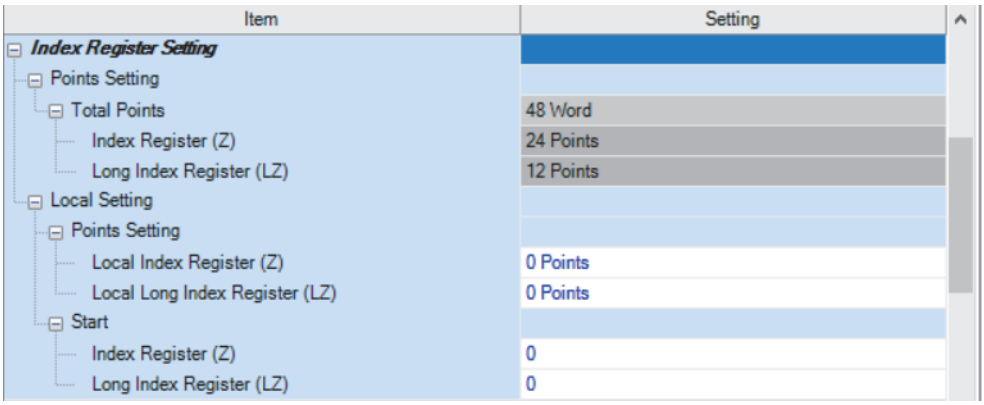
*1 The devices can be used for the contact, coil and current value.
*2 For network numbers and the specification source of I/O numbers, 32-bit index modification cannot be performed.
*3 When the devices are used as a label, index modification cannot be performed.

Index register setting

The ranges to be used as a local device for the index register (Z) and long index register (LZ) are set.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Index Register Setting]

Window



Displayed items

Item			Description	Setting range	Default
Points Setting	Total Points		Check the total number of points for index register and long index register. The number of points is fixed at 48 words.	48 words (fixed)	48 words (fixed)
	Index Register (Z)		Check the number of points for index register. The number of points is fixed at 24 points.	24 points (fixed)	24 points (fixed)
	Long Index Register (LZ)		Check the number of points for long index register. The number of points is fixed at 12 points.	12 points (fixed)	12 points (fixed)
Local Setting	Points Setting	Local Index Register (Z)	Set the number of points for index registers used as a local device. Set within the range of the index register.	0 to 24 points (in one-point increments)	0 points
		Local Long Index Register (LZ)	Set the number of points for long index registers used as a local device. Set within the range of the long index register.	0 to 12 points (in one-point increments)	0 points
	Start	Index Register (Z)	Set the start number for the local index registers. Set within the range of the index register.	0 to 23	0
		Long Index Register (LZ)	Set the start number for the local long index registers. Set within the range of the long index register.	0 to 11	0

Combination of index modification

This section describes the combination of index modification.

Modification order for the device specification and index modification

According to the priority order shown below, the device specification (digit specification, bit specification, indirect specification) and index modification can be applied. However, some word devices may not follow the priority order shown below.

Order of priority	When the device targeted for the device specification and index modification is the bit device	When the device targeted for the device specification and index modification is the word device
High ↑ ↓ Low	1: Index modification 2: Digit specification	1: Index modification 2: Indirect specification 3: Bit specification

Specification method combined with device specification

The device targeted for specification is modified in order of: 1st modification, 2nd modification and then 3rd modification. Besides, the following contents can be used only for the device for which the 1st modification can be applied. (For example, index modification + digit specification is impossible for the function input (FX).)

Device targeted for specification	1st modification	2nd modification	3rd modification	Example
Bit device	Index modification	Digit specification	—	K4M100Z2
Word device	Index modification	Bit specification	—	D10Z2.0
	Index modification	Indirect specification	—	@D10Z2
	Bit specification	Index modification	—	D10.8Z2
	Indirect specification	Bit specification	—	@D10.8
	Index modification	Indirect specification	Bit specification	@D10Z2.8
	Indirect specification	Bit specification	Index modification	@D10.8Z2

Precautions

This section describes the precautions on using index modification.

Device range check for index modification

For details on the device range check when index modification is performed, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

32-bit index modification (ZZ)

- To perform the 32-bit index modification specification with ZZ expression, review the range of the index register (Z). Note that the range within the LZ cannot be specified.
- For 32-bit index modification with ZZ expression, because the specified index register (Zn) and the immediately following index register (Zn+1) are used, caution must be taken to prevent duplicated index registers from being used.

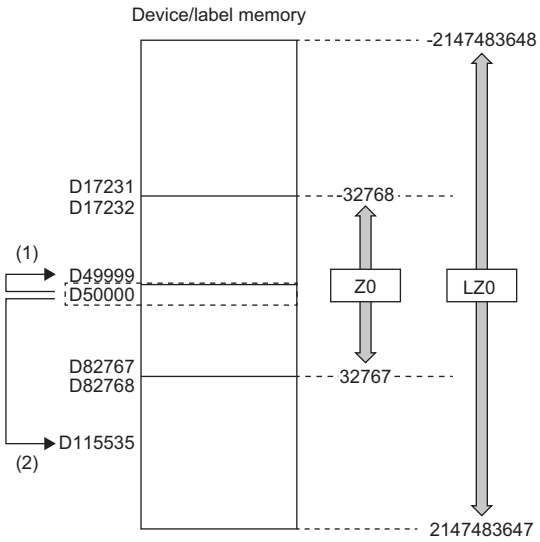
When values are stored in the index registers

For 16-bit index modification using the index register (Z), the range is -32768 to 32767.

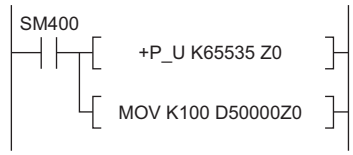
Therefore, when values within the range from 32768 to 65535 are stored in the index register (Z) for an instruction which processes unsigned data, the instruction does not work in design because the range of the index modification will be -32768 to 32767. For the range of values larger than or equal to 32768, the long index register (LZ) must be used so that 32-bit-based index modification can be applied.

Ex.

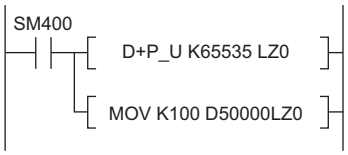
Operation for Index modification



(1) When unexpected operation is executed



(2) When proper operation is executed



(1) When the value 65535 is stored in the index register (Z), D50000(-1) to D49999 are accessed because the value is turned into -1 when an index modification is performed.

(2) When a value larger than or equal to 32768 is used for an index modification, the value must be stored in the long index register (LZ). In doing so, the value 65535 is used as such for an index modification using the long index register (LZ) and D50000 (65535) to D115535 become accessible.

18.9 File Register (R/ZR)

This device is a word device for extension. This device is specifically a file register file which exists in the file storage area on the device/label memory.

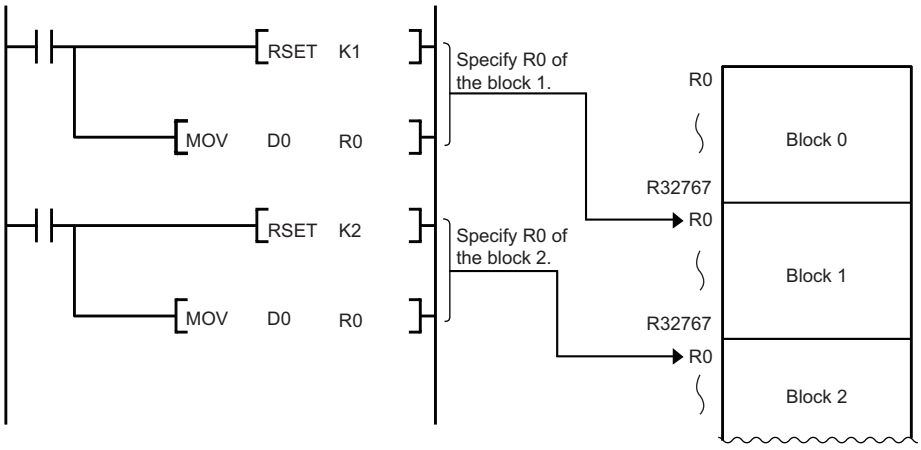
Specification method

There are two types of the specification methods for the file register: block switching and serial number methods.

Block switching method

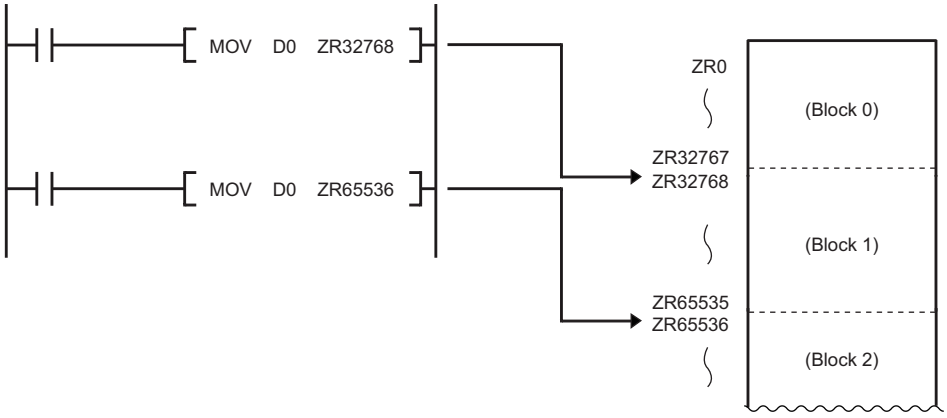
In this method the number of points of file register being used is specified by being divided in increments of 32K point (R0 to R32767). When using more than one block, specification is conducted by switching to the block number used by the RSET instruction. "R" is used as the device symbol. The range of "R" is from R0 to R32767. However in the following cases the upper limit of the device number is "block size (unit: word) -1".

- The file register file size is smaller than 64K bytes.
- The file register file size is not a multiple of 64K bytes and the end block is specified in the RSET instruction.



Serial number method

In this method file registers having more than 32K points are specified using serial device numbers. File registers of the multiple blocks can be used as consecutive file registers. "ZR" is used as the device symbol. The range of ZR is from ZR0 to (file register file size (unit: word) -1).



Setting file registers

This section describes the settings required to use the file registers.

Configuration procedure

This section describes the procedure to use the file registers.

1. Set the file register usage with [CPU Parameter].
2. Create in advance the device memory which will become the file register file.

(GX Works3 Operating Manual)

3. When using the file registers, which are common for all programs, a file register file with the name and capacity set in the file register setting is created. *1

*1 If the capacity is not set (blank), a file register file is not created.

4. Write parameters and file register files into the controller.

File register setting

This setting must be completed before using the file registers.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [File Setting] ⇨ [File Register Setting]

Window



Displayed items

Item	Description	Setting range	Default
Use Or Not Setting	Specify whether or not file registers should be used.	• Not Use • Use Common File Register in All Programs	Not Use
Capacity	Specify the capacity of the file register in increments of 32K words when "Use Common File Register in All Programs" is selected.*1	• MXR500-128, MXR500-256: 10208K words maximum • MXR300-16, MXR300-32, MXR300-64: 8160K words maximum Specify the following range for the setting range. File register ≤ File storage area ≤ Maximum value	—
File Name	Assign a file name to the file register when "Use Common File Register in All Programs" is selected.	60 characters or less	—

*1 If the capacity is not set (blank), an error occurs at power-on or reset operation.

■Precautions

- When the capacity of the file register file setting is changed, the file capacity is changed to the changed size when the parameter is reflected. (If the size of the file register file that has already been written is smaller than the new parameter, it is extended, and if the size is larger, it is reduced.)

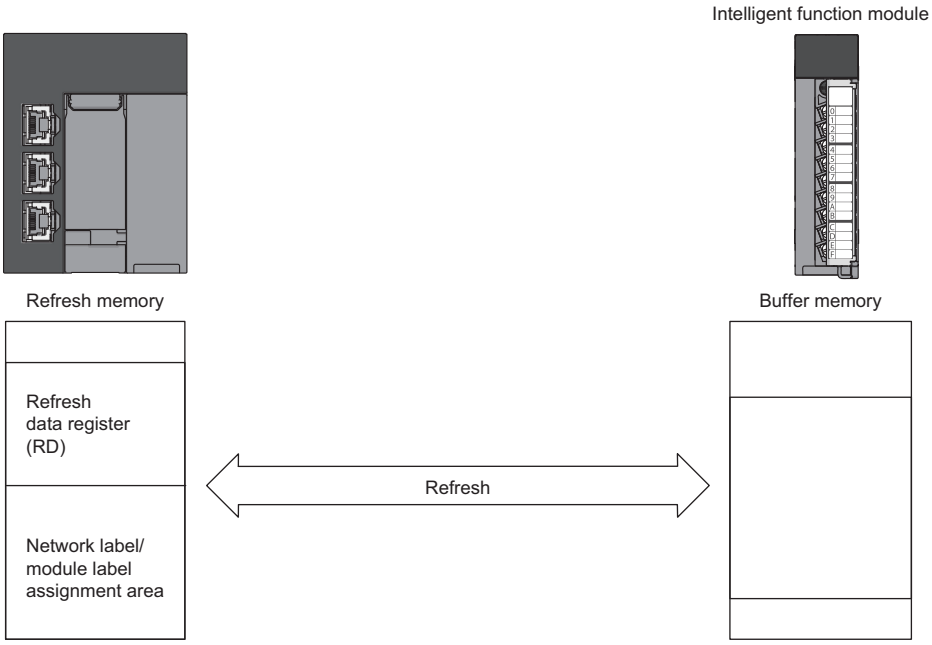
Clearing file registers

To clear the file registers, use the following methods (☞ Page 332 Memory Operation)

- Clearing in the program: write 0 into the file register range to be cleared.
- Clearing with engineering tool: clear them using engineering tool (GX Works3 Operating Manual)

18.10 Refresh Data Register (RD)

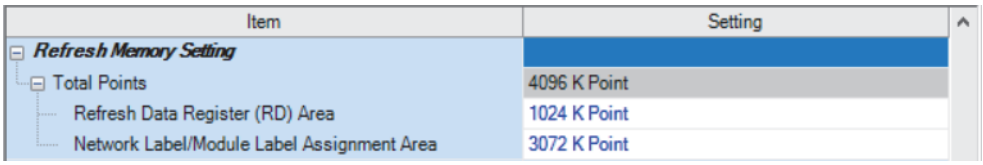
This device is provided for using as a refreshing target of buffer memory on the various devices, such as an intelligent function module. Refresh Data Register (RD) is assigned into the refresh memory area. (☞ Page 322 Refresh memory)



Refresh memory setting

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Refresh Memory Setting]

Window



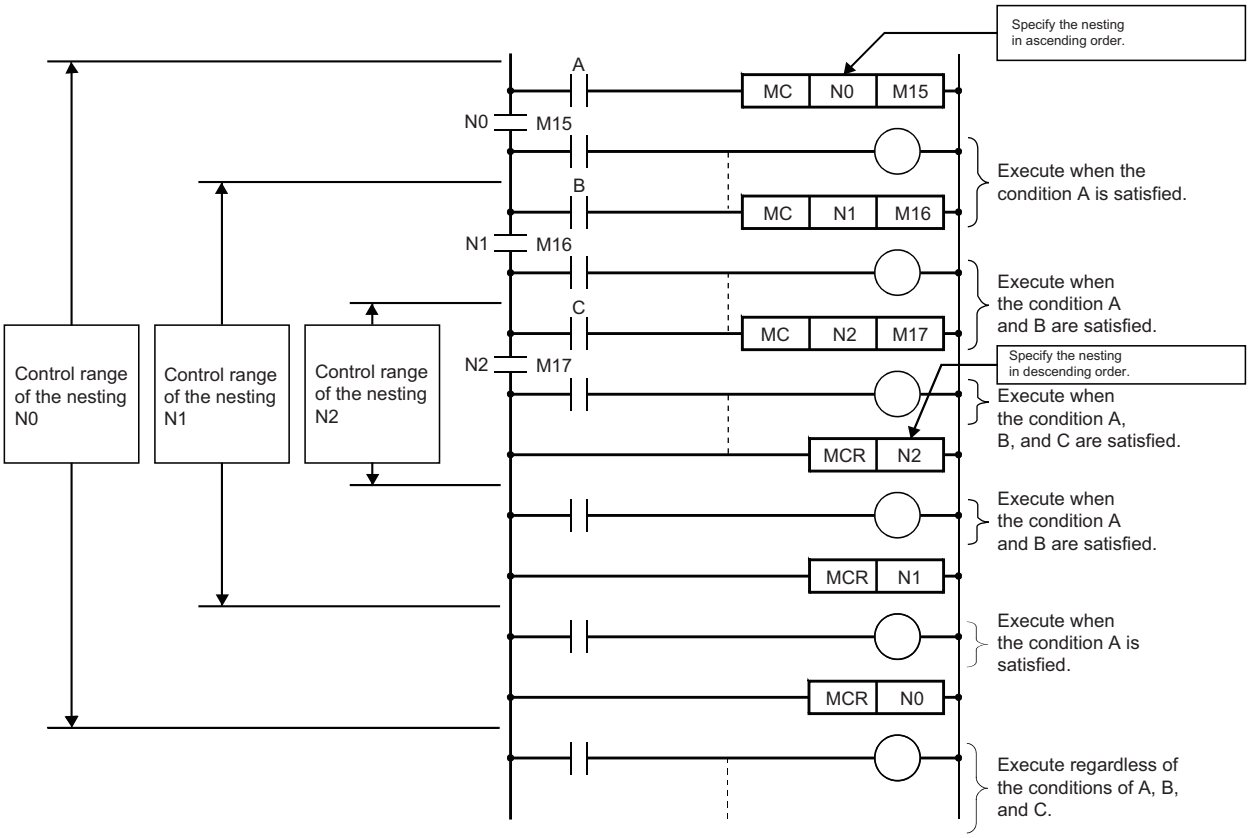
Displayed items

Item	Description	Setting range	Default
Total Points	Check the total number of points for the refresh data register and the assigned area.	—	4096K points
Refresh Data Register (RD) Area	Set the number of points of refresh data register.	0 to 4096K points (in one-point increments)*1	1024K points
Network Label/Module Label Assignment Area	Set the number of points in the network label/module label assignment area.	0 to 4096K points (in one-point increments)*1	3072K points

*1 Set it so that the total of the refresh data register (RD) area and network label/module label assignment area is 4096K points or less.

18.11 Nesting (N)

This device is used in the master control instructions (the MC/MCR instruction)*1 and enables the programming of operation conditions in a nesting structure. Specify this device from outside the nesting structure starting with the lowest number (in ascending order from N0 to N14).



*1 This instruction creates an effective ladder-switching program using opening/closing the common rail of the ladders.

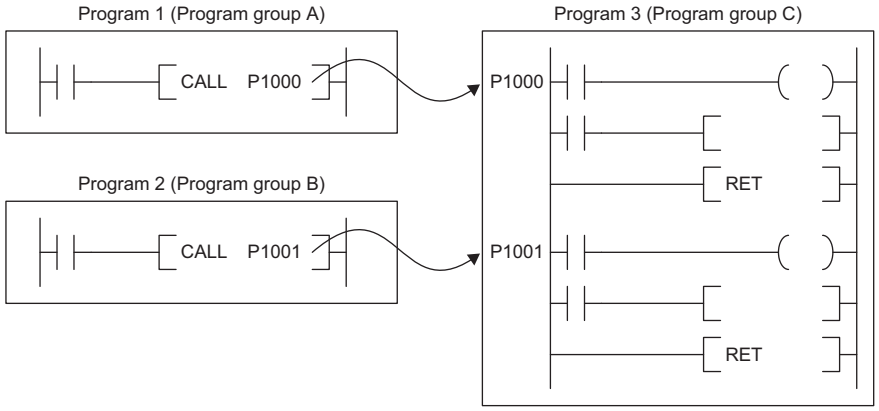
18.12 Pointer (P)

This device is used in the jump instructions (the CJ/SCJ/JMP instruction) and/or subroutine program call instructions (such as the CALL instruction). There are two types of pointer: the global pointer and the local pointer. Use the pointer when:

- Specifying the jump destination and label of the jump instructions (the CJ/SCJ/JMP instruction).
- Specifying the call destination and label (the head of subroutine program) of the subroutine call instructions (such as the CALL instruction).

Global pointer

This is the pointer which enables calling by the subroutine call instruction from all the program being executed.



Effective use of number of points

The number of points for global pointers can be obtained with the following formula: "number of points set by the parameters" - "the total number of points of the local pointers being used for each program".

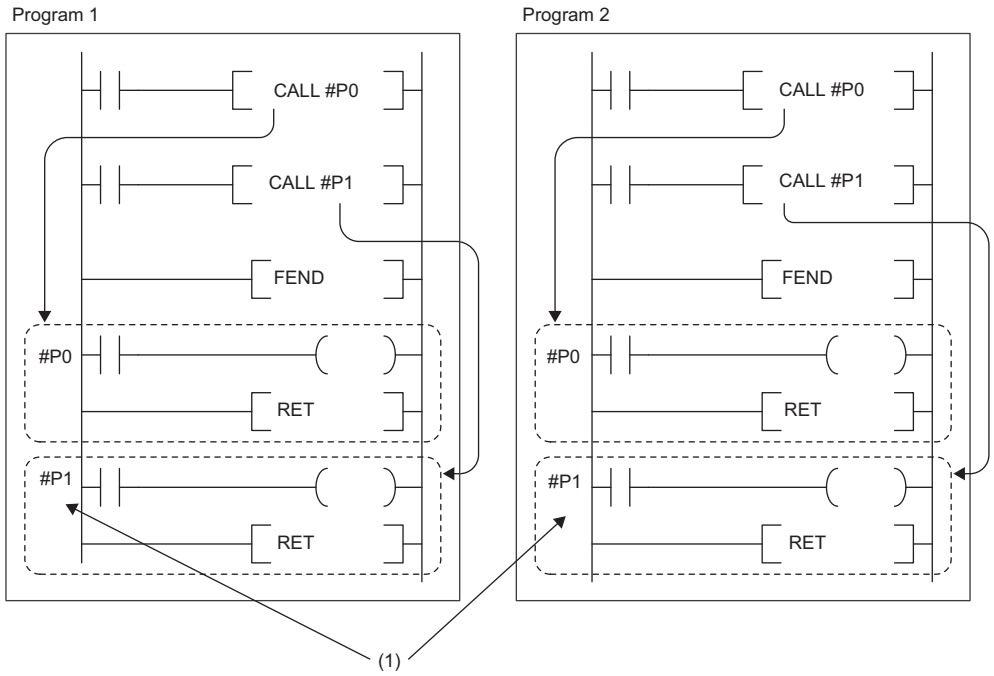
Precautions

This section describes the precautions when the global pointer is used.

- The global pointer with the same pointer number cannot be set as a label in multiple points.

Local pointer

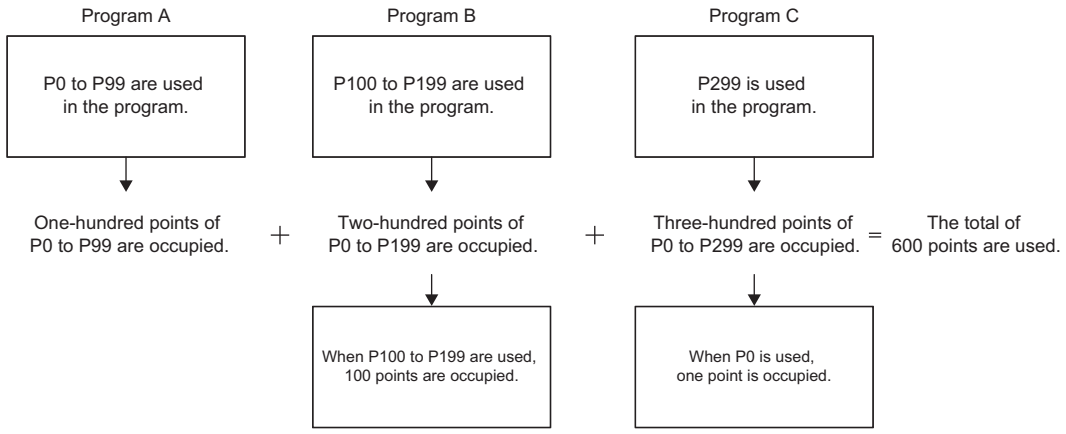
This is the pointer to be independently used in each program where the same pointer number can be used. This pointer is specified in the following format: # (pointer number) (Example: #P0) (☞ Page 394 Specification method for the local devices).



(1) The local pointers with the same number can be used between different programs.

Effective use of number of points

Local pointer number of points are shared among all the programs. The range of the local pointer number of points used by each program is from P0 to the maximum value of the local pointer being used in that program. For example, even when a program actually uses only P99, 100 points (P0 to P99) are considered to be used. When local pointers are used in multiple programs, an effective way is to use them in ascending order, starting from P0, in each program group.

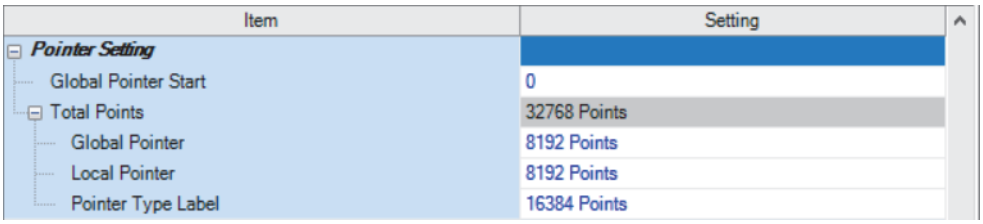


Pointer setting

The following menu item is to set pointers.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Pointer Setting]

Window



Displayed items

Item	Description	Setting range		Default	
		MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256	MXR300-16 MXR300-32 MXR300-64	MXR500-128 MXR500-256
Global Pointer Start	Set the start number of the global pointer.	0 or more*1		0	
Total Points	Check the total number of points for the pointer.	0 to 16384 points (in one-point increments)	0 to 32768 points (in one-point increments)	16384 points	32768 points
Global Pointer	Set the number of points of the global pointer.	0 to 16384 points (in one-point increments)	0 to 32768 points (in one-point increments)	4096 points	8192 points
Local Pointer	Set the number of points of the local pointer.			4096 points	8192 points
Pointer Type Label	Set the number of points for the pointer type label assignment area.			8192 points	16384 points

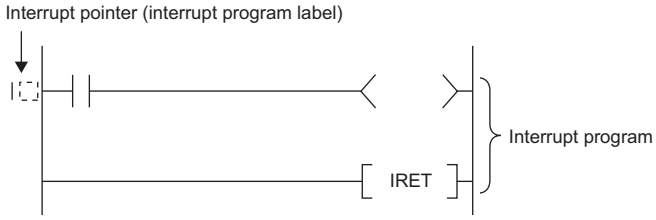
*1 Up to the number of "the total number of points - the number of points for global pointers".

Point

Specify a pointer number which is equal to or lower than "(end number of the pointer range specified in the parameter) - (number of points of the global pointers)".

18.13 Interrupt Pointer (I)

This device is used as a label located at the head of the interrupt program. This pointer can be used in all the programs being executed.



Point

Setting the execution type of program to the event execution type eliminates the need to write (I☐) the interrupt pointer. (☞ Page 255 Interruption Occurrence)

Interrupt factors of the interrupt pointer numbers

The interrupt factors of the interrupt pointer numbers are indicated.

Interrupt factor	Interrupt pointer number	Description
Interrupt from module	I0 to I15	This is a pointer used for modules which have the interrupt function.
Interrupt by the internal timer	I28 to I31	This interrupt pointer is used in fixed scan interrupts by the internal timer.
High-speed internal timer interrupt 2	I48	This interrupt pointer is used in fixed scan interrupts by the internal timer and can be specified in a shorter interval than interrupt pointer numbers I28 to I31.
High-speed internal timer interrupt 1	I49	
Interrupt from module	I50 to I1023	This is a pointer used for modules which have the interrupt function.

Priority for the interrupt pointer numbers and interrupt factors

The priority for the interrupt pointer numbers and interrupt factors are indicated.

Interrupt pointer number	Interrupt factor		Default priority
I0	Interrupt from module	1st point	32
I1		2nd point	
I2		3rd point	
I3		4th point	
I4		5th point	
I5		6th point	
I6		7th point	
I7		8th point	
I8		9th point	
I9		10th point	
I10		11th point	
I11		12th point	
I12		13th point	
I13		14th point	
I14		15th point	
I15		16th point	
I28	Interrupt by the internal timer		28
I29			
I30			
I31			
I48	High-speed internal timer interrupt 2		4
I49	High-speed internal timer interrupt 1		3
I50 to I1023	Interrupt from module		32

Point

- The interrupt priority is the order which is executed at the time of the multiple interrupt. (☞ Page 274 Interrupt priority)
- The interrupt priority order is the order which is executed when the interrupt factor with the same interrupt priority is generated. (☞ Page 276 Interrupt priority order)

18.14 Network No. Specification Device (J)

This device is used when specifying a network number with the Link dedicated instruction. (MELSEC MX Controller MX-R Model Programming Manual)

18.15 I/O No. Specification Device (U)

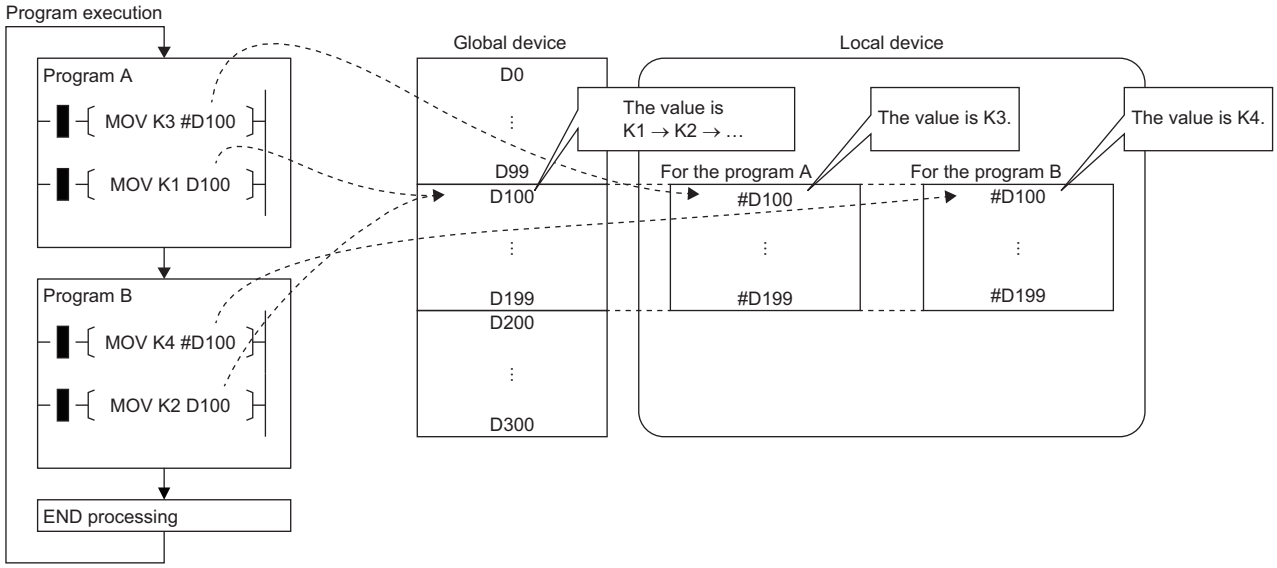
This device is used when specifying an I/O number with the intelligent function module dedicated instruction. (MELSEC MX Controller MX-R Model Programming Manual)

18.16 Global Device

This device can be shared by all the programs.

18.17 Local Device

This device can be used independently in each program. When creating multiple programs, programming can be completed without being aware of devices used in other programs.



Point

The local device area must be reserved independently from the global device area. Therefore a local device and global device with the same device number can exist.

Devices available as local device

The following devices are available as local devices.

- Internal relay (M)
- Edge relay (V)
- Timer (T, LT, ST, LST)
- Counter (C, LC)
- Data register (D)
- Index register (Z, LZ)
- Pointer (P)

Local device area

The controller reserves the local device area on the device/label memory based on the number of points setting of the local device at the following timing.

- When the controller is powered off and on or is reset.
- When the operating status of the controller is switched from STOP to RUN

When local device is used in subroutine program

Local devices to be used vary depending on whether SM776 (Local device setting at CALL) is turned on or off. Local index register to be used is also determined according to the SM776 setting.

SM776	Local device to be used
Off	Uses local devices of the program file from which subroutine program is called.
On	Uses local devices of the program file into which the subroutine program is stored.

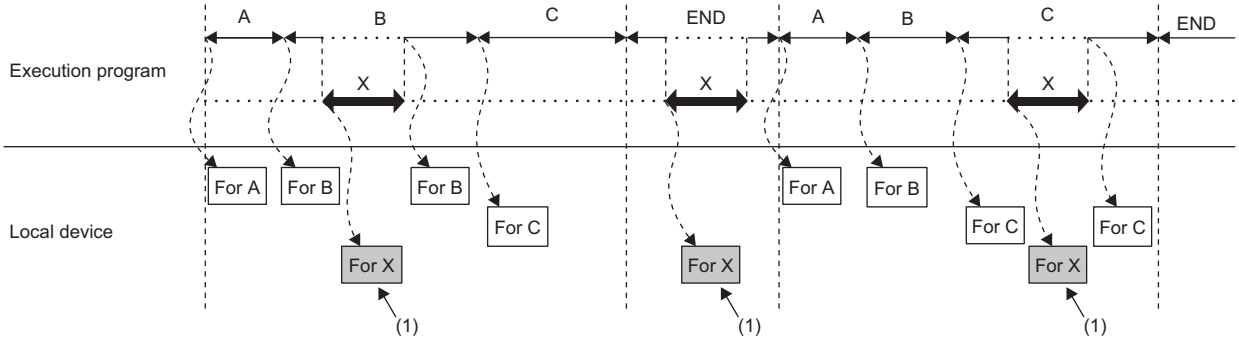
Restriction

- In terms of on/off setting for SM776, the value (on or off) used when the subroutine call occurs is considered to be effective. Therefore when on/off setting for SM776 is switched in the subroutine program, the modified value (on or off) is not effective until the next subroutine call occurs.
- On/off setting for SM776 cannot be specified for each program file because it is enabled for each controller.

When local device is used in interrupt and other programs

The following shows cases when using a local device for an interrupt program, a fixed scan execution type program, or an event execution type program triggered by occurrence of an interrupt.

Program name	Execution type	Local device use/not use
A	Scan	Use
B	Scan	Use
C	Scan	Use
X	Fixed scan	Use



(1) Uses the program X local device.

Restriction

When the local device monitor is executed, the monitor switches to the applicable local device.

Clearing local device

Local device can be cleared to 0 by the following operations:

- When the controller is powered off and on or is reset.
- When the operating status of the controller is switched from STOP to RUN*1
- When the operating status of the controller is switched from PAUSE to RUN*1

*1 Only when "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Enable" by selecting the following: Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [File Setting] ⇨ [Device/Label Initial Value Reflection Setting]
☞ Page 427 Initial value setting

Setting method for the local devices

Set the range where each device will be used as a local device and also set whether or not it should be used.

■Range setting

The range setting for local devices is common to all the programs. Therefore, the range for local devices cannot be set for each program.

Operating procedure

"Device/Label Memory Area Detailed Setting" window



1. Click "Detailed Setting" on the "Device Setting" window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting] ⇨ [Device/Label Memory Area Detailed Setting] ⇨ [Device Setting] ⇨ <Detailed Setting>

2. Set the range where each device will be used as a local device.

"Device Setting" window

Item	Symbol	Device	
		Points	Range
Input	*X*	12K	0 to 2FFF
Output	Y	12K	0 to 2FFF
Internal Relay	M	64K	0 to 65535
Link Relay	B	32K	0 to 7FFF
Link Special Relay	SB	2K	0 to 7FF
Annunciator	F	2K	0 to 2047
Edge Relay	V	2K	0 to 2047
Step Relay	S	0	
Timer	T	1K	0 to 1023
Long Timer	LT	4K	0 to 4095
Retentive Timer	ST	0	
Long Retentive Time	LST	0	
Counter	C	512	0 to 511
Long Counter	LC	512	0 to 511
Data Register	D	64K	0 to 65535
Link Register	W	32K	0 to 7FFF
Link Special Registe	SW	2K	0 to 7FF
Latch Relay	L	8K	0 to 8191
Total Device			125.2K Word
Total Word Device			116.5K Word
Total Bit Device			138.0K Bit

Point

Configure the setting range of the local device within the range which has been set for the number of device points. The number of local devices used is calculated by the following calculation formula. Set the number of local devices used so that the number is equal to or less than the capacity of the local device area.

Total number of local devices used = ((A ÷ 16) + B + (C × 2) + (D × 4) + ((E × 2) ÷ 16)) × F

- A: Number of points of the local devices M and V
- B: Number of points of the local devices D, T (current value), ST (current value), and C (current value)
- C: Number of points of the local device LC (current value)
- D: Number of points of the local devices LT and LST
- E: Number of points of the local devices T (contact/coil), ST (contact/coil), C (contact/coil), and LC (contact/coil)
- F: Number of programs using the local device

■Setting unit

The increment of setting of a local device is the same as that of a global device. (☞ Page 348 Range of use of device points)

Setting whether or not it should be used

Whether or not to use local devices cannot be set for each program.

Specification method for the local devices

To specify the local device in the program, add "#".

Ex.

For example, #D100, K4#M0, and @#D0 can be used.

Point

- Local device is listed with a preceding # symbol in the program. This symbol is helpful to differentiate local devices from global devices.
- The local index register performs index modification on other devices. Therefore, unlike other local device specifications, the device name is not preceded by "#".

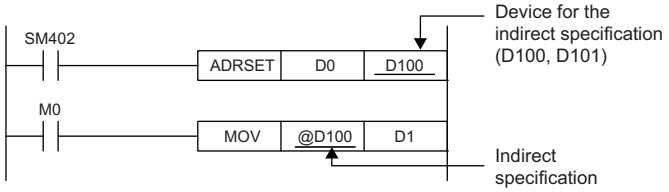
Precautions

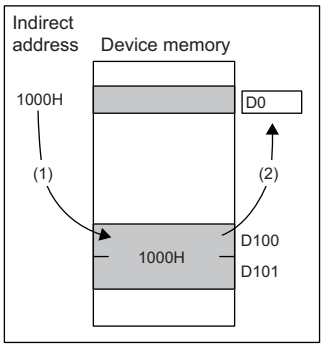
This section describes the precautions when using local devices.

- Accessing the range including both global and local devices by the index modification is not allowed.
- Local devices are not latched.

18.18 Device Indirect Specification

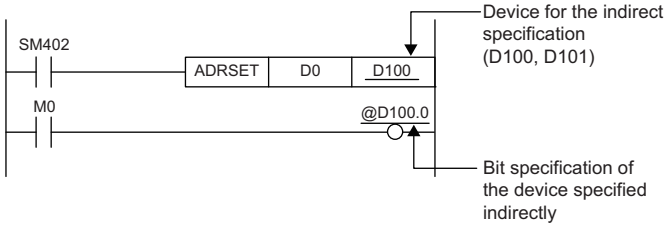
Specify the device using the indirect address of device. Store the indirect address of device to be specified into the device for indirect specification, and write as "@ + Device for indirect specification".

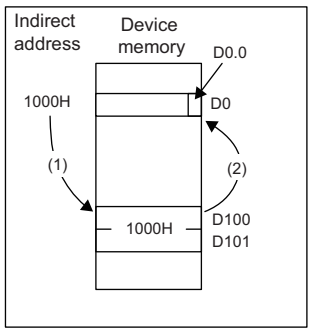




(1) The indirect address of D0 is read into D100, D101.
(2) The indirect address is used to indirectly specify D0.

Besides, specifying a bit of a word device allows the indirect specification for the instruction that specifies bits.





(1) The indirect address of D0 is read into D100, D101.
(2) The indirect address is used to output at the 0th bit of D0 which was indirectly specified using the indirect address.

The indirect specification can be used in the device/label memory or refresh memory.

Indirect address of device

To specify, use the 32-bit data, and to hold the value, use the device of two words. The indirect address of the device can be obtained with the ADRSET instruction. The ADRSET instruction specifies the indirect address of the device using instructions that handle 32-bit data. For the ADRSET instruction, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Point

When the block or the file of the file register is switched through the RSET instruction, the indirect address refers to the one of the block or the file before they are switched. To allow the indirect address in the device for indirect specification to specify the block or file after the file register is switched, specify the ADRSET instruction to obtain the indirect address again after block or file are switched.

Devices that can allow indirect specification

This section lists devices that can allow indirect specification.

Type	Device*3
Devices that can allow indirect specification where @ is added*1	T, ST, C, D, W, SW, FD, SD, Un\G, Jn\W, Jn\SW, U3En\G, R, ZR, RD
Devices that can acquire the indirect address through the ADRSET instruction*2	X, Y, M, L, B, F, SB, T, ST, LT, LST, C, LC, D, W, SW, FX, FY, FD, SM, SD, R, ZR, RD

*1 Also can be used for the local device. (e.g.: @#D0)
*2 The indirect address of device can be obtained for the local device as well. (e.g.: ADRSET #D0 D100)
*3 Devices that cannot be used as operands of instructions cannot be used even when they are indirectly specified.

18.19 Constants

This section describes constants.

Decimal constant (K)

Use this type of constants when specifying decimal data in a program. Specify the decimal constant using K☐ character (e.g. K1234). The specification range depends on the argument data type of the instruction using the decimal constant as shown in the following table:

Argument data type of the instruction		Specification range for decimal constant
Data size	Data type name	
16 bit	Word (signed)	K-32768 to K32767
	Word (unsigned)/bit string (16 bit)	K0 to K65535
	16-bit data	K-32768 to K65535
32 bit	Double word (signed)	K-2147483648 to K2147483647
	Double word (unsigned)/bit string (32 bit)	K0 to K4294967295
	32-bit data	K-2147483648 to K4294967295

Hexadecimal constant (H)

Use this type of constants when specifying hexadecimal data in a program. Specify the hexadecimal constant using H☐ character (e.g. H1234). To specify data in BCD, specify each digit of hexadecimal value with numerical characters 0 to 9. The specification range depends on the argument data type of the instruction using the hexadecimal constant. The range is H0 to HFFFF for 16-bit data size, and H0 to HFFFFFFFF for 32-bit data size.

Real constant (E)

Use this type of constants when specifying a real number in a program. There are two types of real numbers: single-precision real number and double-precision real number. Specify it using E☐character. (e.g. E1.234).

Setting range for real numbers

The setting ranges are different between the single-precision real number and double-precision real number.

■Specification range for single-precision real numbers

The following is the specification range for single-precision real numbers.

$-2^{128} < \text{device} \leq -2^{-126}$, 0, $2^{-126} \leq \text{device} < 2^{128}$

(E-3.40282347+38 to E-1.17549435-38, 0, E1.17549435-38 to E3.40282347+38)

■Specification range for double-precision real number

The following is the specification range for single-precision real numbers.

$-2^{1024} < \text{device} \leq -2^{-1022}$, 0, $2^{-1022} \leq \text{device} < 2^{1024}$

(E-1.7976931348623157+308 to E-2.2250738585072014-308, 0, E2.2250738585072014-308 to E1.7976931348623157+308)

Point

For the number of significant digits and input range of real number data input by the engineering tool, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Processing when operation is in progress

This section describes the processing when operation is in progress.

■When overflow and/or underflow occurs:

If an overflow and/or underflow occurs when the operation is in progress, the following process is performed:

- When overflow occurs: An error is returned.
- When underflow occurs: 0 is returned (no error occurs).

■When a special value is input:

When a special value*1 is used for the input data operation, an error is returned. Note that when "-0" is generated during the operation is in progress, it is handled as "+0" and therefore "-0" is not returned as an operation result.

*1 The special values include -0, denormalized number, nonnumeric number, and ±∞.

Character string constant

The character string can be specified by enclosing it with single quotation marks (' ') or double quotation marks (" "). (Example: "ABCDE") Note that the NULL character (00H) becomes the termination character.

Point

For details on character string data, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Notation of constants

This section describes the notation of constants.

Type		Notation	Example	Applicable data type
Boolean value		Set "FALSE" or "TRUE".	TRUE, FALSE	Bit
		Add "K" or "H" before "0" or "1".	K0, K1, H0, H1	
Integral	Binary	Add "2#" before a binary number.	2#0010, 2#01101010, 2#1111_1111	• Word [unsigned]/bit string [16 bits] • Double word [unsigned]/bit string [32 bits] • Word [signed] • Double word [signed]
	Octal	Add "8#" before an octal number.	8#0, 8#337, 8#1_1	
	Decimal	Directly enter a signed or unsigned decimal number.	123, +123, -123, 12_3	
		Add "K" before a signed or unsigned decimal number.	K123, K-123	
	Hexadecimal	Add "16#" before a hexadecimal number.	16#FF, 16#1_1	
		Add "H" before a hexadecimal number.	HFF, HEAD	
Real number	Decimal notation	Directly enter a signed or unsigned real decimal number with a decimal point.	2.34, +2.34, -2.34, 3.14_15	• Single-precision real number • Double-precision real number
		Add "E" before a signed or unsigned real decimal number with a decimal point.	E2.34, E-2.34	
	Exponential notation	Add "E" and a signed or unsigned exponent (decimal) at the end of the real number.	1.0E6, 1.0E-6	
		Add a signed exponent (decimal) at the end of the real number with "E".	E1.001+5, E1.001-6	
String	String	Enclose a string in single quotation marks (' ').	'ABC'	String
	String [Unicode]	Enclose a string in double quotation marks (" ").	"ABC"	String [Unicode]
Time		Add "T#" or "TIME#" at the beginning. (☞ Page 398 Notation of time)	T#1h, T#1d2h3m4s5ms, TIME#1h	Time

Point

In the notation of binary, octal, decimal, hexadecimal, and real numbers, the numbers can be separated using an underscore (_) to make programs easy to see. For example, the double word [unsigned] in the notation of binary is as follows.

2#1100_1100_1100_1100

The separations by underscores (_) are ignored in program processing.

Notation of time

In the notation of time, add "T#" or "TIME#" at the beginning of the value specified in units of time; d (day), h (hour), m (minute), s (second), and ms (millisecond). The following table lists the effective range for each unit of time.

Item	Effective range
d (day)	0 to 24
h (hour)	0 to 23
m (minute)	0 to 59
s (second)	0 to 59
ms (millisecond)	0 to 999

- Each unit of time can be omitted sequentially from the beginning to the end or in reverse order.
  T#31m23s, T#31m0s648ms
- A sign can be added only before the first unit of time.
  T#-31m23s
- An unsigned real decimal number with a decimal point can be used for the last unit of time. The values after the decimal point of ms (millisecond) are rounded down.
  T#-24d20h31m23s648.123ms (The time is treated as T#-24d20h31m23s648ms.)
  T#1.2345ms (The time is treated as T#1ms.)
- Only for the first unit of time other than d, the following values within the effective range can be input.
  h: 0 to 596
  m: 0 to 35791
  s: 0 to 2147483
  ms: 0 to 2147483647

Special character (escape sequence)

"$" is used as an escape sequence in a string. The following characters can be input as escape sequences with "$".

Symbol used in a string or printer code	Escape sequence
$	$$
'	$'
"	$"
Line feed	$L or $l
Line break	$N or $n
Page feed	$P or $p
Return	$R or $r
Tab	$T or $t
Two hexadecimal digits and characters that correspond to the ASCII code	Two hexadecimal digits following $

If the two hexadecimal digits following "$" do not correspond to the ASCII code, a conversion error occurs.

19 LABELS

A label is a variable consisting of a specified string used in I/O data or internal processing.
Programs can be created without considering the size of devices and buffer memory by using labels. For this reason, a program using labels can be reused easily even in a system having a different module configuration.
When labels are used, there are some precautions on programming and functions used. For details, refer to the following.
☞ Page 415 Precautions

Point

There are two types of labels described in this manual.
- Global labels
- Local labels

There are other types of labels available in addition to the global labels and local labels.
[System labels]
A system label is a label that provides the same data in all projects compatible with iQ Works. It can be referenced from the GOT and the controller and motion controllers on other stations, and used for monitoring and accessing data.
For details, refer to the following.
📖Let's start iQ Works Version 2
[Network labels]
Once a network label is created, the label access can be executed to other modules on the network, which are not on the same base unit.
The network label is created for remote stations and is registered as a global label.
For the network label creation procedure, refer to the following.
☞ Page 108 Network labels
For the list of labels used by the motion control FB, refer to the following.
📖MELSEC MX Controller MX-R Model Programming Manual

19.1 Global Labels

A global label is a label that provides the same data within a single project. It can be used in all programs in the project.
A global label can be used in program blocks and FB.
The settings of a global label include a label name, class, and data type.
By opening global labels, they can be referenced from GOTs and the controllers on other stations, and can be used for monitoring and accessing data.

Device assignment

Devices can be assigned to global labels.

Item	Description
Label to which no device is assigned	• Programming without being aware of devices is possible. • Defined labels are allocated to the label area or latch label area in the device/label memory.
Label to which a device is assigned	• When a device is to be programmed as a label against a device that is being used for input or output, the device can be assigned directly. • Defined labels are allocated to the device area in the device/label memory.

Module label

A module label is a label defined uniquely by each module. A module label is automatically generated by the engineering tool from the module used, and can be used as a global label.
The I/O signals, buffer memory, SM, SD, SB, and SW of the controller can be accessed using a module label.

Structure of the module label

The module label name is defined with the following structure.

- Instance name.Label name
- Instance name.Label name_D

(_D indicates that the module label is for direct access.)

■Instance name

The following table lists the instance names.

Item	Instance name
CPU function part	MX_SQ
CC-Link IE TSN function part	MX_TSN
Motion function part	MX_MT

19.2 Local Labels

A local label is a label that can be used only in the declared POU. Local labels outside the declared POU cannot be used.
The settings of a local label include a label name, class, and data type.

19.3 Classes

The label class indicates from which POU and how a label can be used.
Different classes can be selected depending on the type of POU.

Global label

The following table lists the global label classes and applicable POUs.

Class	Description	Applicable POU		
		Program block	Function block (FB)	Function (FUN)
VAR_GLOBAL	A common label that can be used in both program blocks and FB	○	○	×
VAR_GLOBAL_CONSTANT	A common constant that can be used in both program blocks and FB	○	○	×
VAR_GLOBAL_RETAIN	A latch type label that can be used in both program blocks and FB	○	○	×

Local label

The following table lists the local label classes and applicable POUs.

Class	Description	Applicable POU		
		Program block	Function block (FB)	Function (FUN)
VAR	A label that can be used within the range of a declared POU. This label cannot be used in other POUs.	○	○	○
VAR_CONSTANT	A constant that can be used within the range of a declared POU. This label cannot be used in other POUs.	○	○	○
VAR_RETAIN	A latch type label that can be used within the range of a declared POU. This label cannot be used in other POUs.	○	○	×
VAR_INPUT	A label that inputs a value into a function or FB This label receives a value, and the received value cannot be changed in a POU.	×	○	○
VAR_OUTPUT	A label that outputs a value from a function or FB	×	○	○
VAR_OUTPUT_RETAIN	A latch type label that outputs a value from an FB	×	○	×
VAR_IN_OUT	A local label that receives a value and outputs the value from a POU. The value can be changed in a POU.	×	○	×
VAR_PUBLIC	A label that can be accessed as the public variable from other POUs	×	○	×
VAR_PUBLIC_RETAIN	A latch type label that can be accessed as the public variable from other POUs	×	○	×

19.4 Data Types

The data types of a label are classified according to the bit length, processing method, and value range.

There are two data types.

- Primitive data type
- Generic data type (ANY type)

Primitive data type

The following table lists the data types included in the primitive data type.

Data type		Description	Value range	Bit length
Bit	BOOL	Represents the alternative status, such as on or off.	0 (FALSE), 1 (TRUE)	1 bit
Word [unsigned]/bit string [16 bits]	WORD	16-bit array	0 to 65535	16 bits
Double word [unsigned]/ bit string [32 bits]	DWORD	32-bit array	0 to 4294967295	32 bits
Word [signed]	INT	Positive and negative integer values	-32768 to 32767	16 bits
Double word [signed]	DINT	Positive and negative double-precision integer values	-2147483648 to 2147483647	32 bits
Single-precision real number*1	REAL	Numerical values of decimal places (single-precision real number values)	-2^{128} to -2^{-126}, 0, 2^{-126} to 2^{128} E-3.402823+38 to E-1.175495-38, 0, E1.175495-38 to E3.402823+38	32 bits
Double-precision real number*1	LREAL	Numerical values of decimal places (double-precision real number values)	-2^{1024} to -2^{-1022}, 0, 2^{-1022} to 2^{1024} E-1.79769313486231+308 to E-2.22507385850721-308, 0, E2.22507385850721-308 to E1.79769313486231+308	64 bits
Time*2	TIME	Numerical values as day, hour, minute, second, and millisecond (☞ Page 398 Notation of time)	T#-24d20h31m23s648ms to T#24d20h31m23s647ms	32 bits
String	STRING	Characters represented by ASCII code or Shift JIS code	255 one-byte characters maximum	Variable
String [Unicode]	WSTRING	Characters represented by Unicode	255 characters maximum	Variable
Timer	TIMER	Structure corresponding to the device, timer (T)	☞ Page 403 Timer and counter data types	
Retentive timer	RETENTIVETIMER	Structure corresponding to the device, retentive timer (ST)		
Long timer	LTIMER	Structure corresponding to the device, long timer (LT)		
Long retentive timer	LRETENTIVETIMER	Structure corresponding to the device, timer (LST)		
Counter	COUNTER	Structure corresponding to the device, counter (C)		
Long counter	LCOUNTER	Structure corresponding to the device, counter (LC)		
Pointer	POINTER	Type corresponding to the device, pointer (P) (☞ Page 385 Pointer (P))		

*1 For the number of significant digits and input range of real number data input by the engineering tool, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

*2 The time type is used in a time data type function of standard functions. For standard functions, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Point

- The bit data in the word type label can be used by specifying a bit number.
- The bit type array label can be used as 16-bit or 32-bit data by specifying the number of digits.

For the bit specification and digit specification methods, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

■Timer and counter data types

The data types of the timer, counter, long counter, retentive timer, long retentive timer, and long timer are the structures having a contact, coil, and current value.

Data type		Member name	Member data type	Description	Value range
Timer	TIMER	S	Bit	Indicates a contact. The operation is the same as the contact (TS) of a timer device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (TC) of a timer device.	0 (FALSE), 1 (TRUE)
		N	Word [unsigned]/bit string [16 bits]	Indicates the current value. The operation is the same as the current value (TN) of a timer device.	0 to 65535*1
Retentive timer	RETENTIVETIMER	S	Bit	Indicates a contact. The operation is the same as the contact (STS) of a retentive timer device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (STC) of a retentive timer device.	0 (FALSE), 1 (TRUE)
		N	Word [unsigned]/bit string [16 bits]	Indicates the current value. The operation is the same as the current value (STN) of a retentive timer device.	0 to 65535*1
Long timer	LTIMER	S	Bit	Indicates a contact. The operation is the same as the contact (LTS) of a long timer device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (LTC) of a long timer device.	0 (FALSE), 1 (TRUE)
		N	Double word [unsigned]/bit string [32 bits]	Indicates the current value. The operation is the same as the current value (LTN) of a long timer device.	0 to 4294967295*1
Long retentive timer	LRETENTIVETIMER	S	Bit	Indicates a contact. The operation is the same as the contact (LSTS) of a long retentive timer device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (LSTC) of a long retentive timer device.	0 (FALSE), 1 (TRUE)
		N	Double word [unsigned]/bit string [32 bits]	Indicates the current value. The operation is the same as the current value (LSTN) of a long retentive timer device.	0 to 4294967295*1
Counter	COUNTER	S	Bit	Indicates a contact. The operation is the same as the contact (CS) of a counter device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (CC) of a counter device.	0 (FALSE), 1 (TRUE)
		N	Word [unsigned]/bit string [16 bits]	Indicates the current value. The operation is the same as the current value (CN) of a counter device.	0 to 65535
Long counter	LCOUNTER	S	Bit	Indicates a contact. The operation is the same as the contact (LCS) of a long counter device.	0 (FALSE), 1 (TRUE)
		C	Bit	Indicates a coil. The operation is the same as the coil (LCC) of a long counter device.	0 (FALSE), 1 (TRUE)
		N	Double word [unsigned]/bit string [32 bits]	Indicates the current value. The operation is the same as the current value (LCN) of a long counter device.	0 to 4294967295

*1 The unit of the current value is set in CPU parameters ("Timer Limit Setting").

For details on the operation of each device, refer to the following.

☞ Page 346 DEVICES AND CONSTANTS

The specification method of each member is the same as that of the structure data type. (☞ Page 410 Structures)

Generic data type (ANY type)

The generic data type is the data type of the labels which summarize several primitive data types.

Generic data types are used when multiple data types are allowed for function and FB arguments and return values.

Labels defined in generic data types can be used in any sub-level data type.

For the types of generic data types and the primitive data types, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Definable data types and initial values

The following tables list the definable data types and initial value setting possibilities for each label class.

■Global label

Class	Definable data type	Initial value setting possibility
VAR_GLOBAL	Primitive data type[*1]	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Pointer type	Not possible
	Structure type	Possible
	FB	Possible
	Array type	Possible
VAR_GLOBAL_CONSTANT	Primitive data type[*1]	Not possible
VAR_GLOBAL_RETAIN	Primitive data type[*1]	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible

■Local label (program block)

Class	Definable data type	Initial value setting possibility
VAR	Primitive data type[*1]	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Pointer type	Not possible
	Structure type	Possible
	FB	Possible
	Array type	Possible
VAR_CONSTANT	Primitive data type[*1]	Not possible
VAR_RETAIN	Primitive data type[*1]	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible

■Local label (function)

Class	Definable data type	Initial value setting possibility
VAR	Primitive data type[*2], pointer type, array type, structure type	Not possible
VAR_CONSTANT	Primitive data type[*1]	Not possible
VAR_INPUT	Primitive data type[*1], array type, structure type	Not possible
VAR_OUTPUT		Not possible
Return value		Not possible

■Local labels (FB)

Class	Definable data type	Initial value setting possibility
VAR	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Pointer type	Not possible
	Structure type	Possible
	FB	Possible
	Array type	Possible
VAR_CONSTANT	Primitive data type*1	Not possible
VAR_RETAIN	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible
VAR_INPUT	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible
VAR_OUTPUT	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible
VAR_OUTPUT_RETAIN	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible
VAR_IN_OUT	Primitive data type*1	Not possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Not possible
VAR_PUBLIC	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible
VAR_PUBLIC_RETAIN	Primitive data type*1	Possible
	Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	Not possible
	Structure type	Possible
	Array type	Possible

*1 The timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type, and pointer type are excluded.

*2 The timer type, retentive timer type, long timer type, long retentive timer type, counter type, and long counter type are excluded.

Point

- The initial value of the global label where the device has been assigned follows that in the device.
- The initial value of the FB follows the local label setting within the FB.

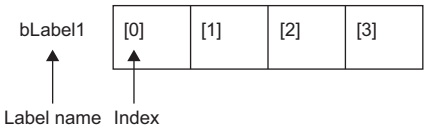
19.5 Arrays

An array represents a consecutive aggregation of the same data type labels as a single name.
Primitive data types, structures, and FB type can be defined as arrays.

Ex.

Array image and setting in engineering tool

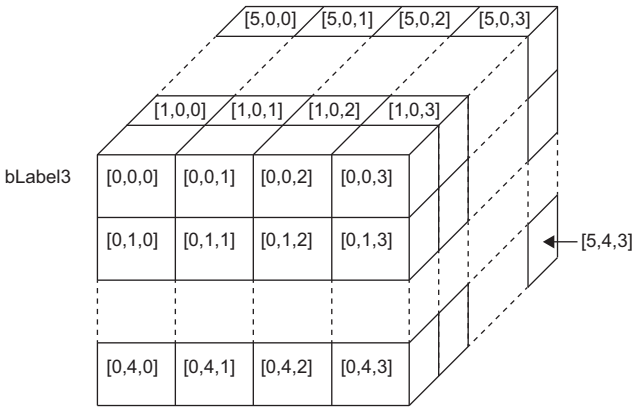
- One-dimensional array (The number of elements is 4.)



- Two-dimensional array (The number of elements is 5 × 4.)

bLabel2				
	[0,0]	[0,1]	[0,2]	[0,3]
	[1,0]	[1,1]	[1,2]	[1,3]
	[4,0]	[4,1]	[4,2]	[4,3]

- Three-dimensional array (The number of elements is 6 × 5 × 4.)



- Settings in the engineering tool

	Label Name	Data Type		Class
1	bLabel1	Bit(0..3)	...	VAR
2	bLabel2	Bit(0..4,0..3)	...	VAR
3	bLabel3	Bit(0..5,0..4,0..3)	...	VAR

Defining arrays

■Array elements

When an array is defined, the number of elements, or the length of array, must be determined. For the range of the number of elements, refer to the following.

☞ Page 409 Range of the number of array elements

■Dimension number of multidimensional array

Up to three-dimensional array can be defined.

Only one-dimensional array can be defined for the maximum number of dimensions of FB type array.

■Definition format

The following table lists definition format.

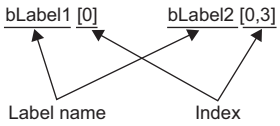
The range from the array start value to the array end value is the number of elements.

Number of array dimensions	Format	Remarks
One dimension	Array of primitive data type/structure name (array start value..array end value)	• For the primitive data type: ☞ Page 402 Primitive data type • For the structure name: ☞ Page 410 Structures
	[Definition example] Bit (0..15)	
Two dimensions	Array of primitive data type/structure name (array start value..array end value, array start value..array end value)	
	[Definition example] Bit (0..1, 0..15)	
Three dimensions	Array of primitive data type/structure name (array start value..array end value, array start value..array end value, array start value..array end value)	
	[Definition example] Bit (0..2, 0..1, 0..15)	

How to use arrays

To use an array, add an index enclosed by '[ ]' after each label name to identify individual labels.

An array with two or more dimensions should be expressed with indexes delimited by a comma (,) in '[ ]'.

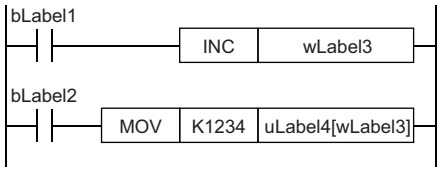


The following table lists the types of indexes that can be specified for arrays.

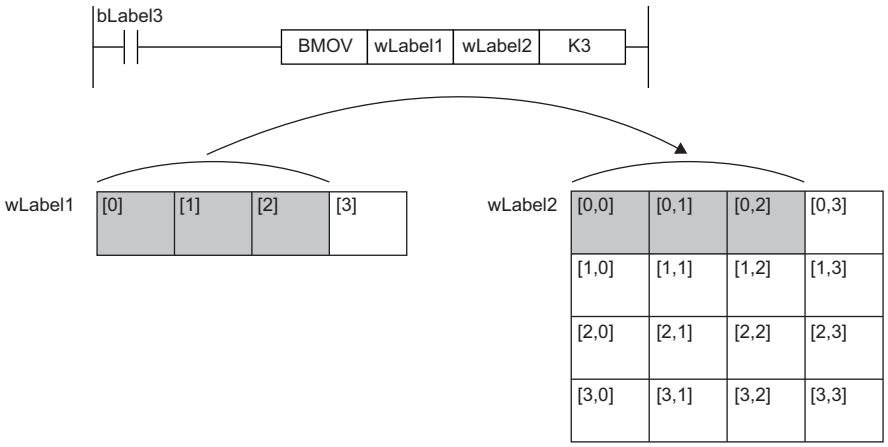
Type	Specification example	Remarks
Constant	bLabel1[0]	An integer can be specified.
Device	bLabel1[D0]	A word device, double-word device, decimal constant, or hexadecimal constant can be specified. (ST, LST, G, and HG cannot be specified.)
Label	bLabel1[uLabel2]	The following data types can be specified. • Word [unsigned]/bit string [16 bits] • Double word [unsigned]/bit string [32 bits] • Word [signed] • Double word [signed]
Expression	bLabel1[5+4]	Expressions can be specified only in ST language.

Point

- The data storage location becomes dynamic by specifying a label for the array index. This enables arrays to be used in a program that executes loop processing. The following is a program example that consecutively stores "1234" in the "uLabel4" array.



- The element number of the array can be omitted in ladder diagram. If the element number is omitted, it is regarded as the start number and converted. For example, when the defined label name is "boolAry" and the data type is "Bit (0..2, 0..2)", the operation of "boolAry[0,0]" is the same as that of "boolAry".
- When a multidimensional array is specified as setting data of instructions, standard functions, and standard FB that use arrays, the rightmost element is regarded as a one-dimensional array.



Range of the number of array elements

The maxim number of array elements varies depending on the data type.

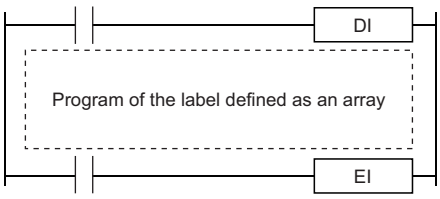
Data type	Setting range
Bit Word [unsigned]/bit string [16 bits] Word [signed]	1 to 2147483648
Double word [unsigned]/bit string [32 bits] Double word [signed] Single-precision real number Time	1 to 1073741824
Timer Counter Retentive timer Long counter Long retentive timer Long timer	1 to 32768
Double-precision real number	1 to 536870912
String	1 to 67108864
String [Unicode]	1 to 33554432
Structure type FB type	1 to 32768

Precautions

■When an interrupt program is used

When a label or device is specified for the array index, the operation is performed with a combination of multiple instructions. For this reason, if an interrupt occurs during operation of the label defined as an array, data inconsistency may occur producing an unintended operation result.

To prevent data inconsistency, create a program using the DI/EI instructions that disables/enables interrupt programs as shown below.



For the DI/EI instructions, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

■Array elements

When accessing the element defined in an array, access it within the range of the number of elements.

If a constant out of the range defined for the array index is specified, a compile error will occur.

If the array index is specified with data other than a constant, the following range check is performed to the element number when the label is accessed, and if the element number is outside of the range, Device, label, or buffer memory specification error (error code: 2820H) occurs.

- Check that the element number specified at the access to the start number and the number of elements defined in a label is within the range.
- Check that the element number of each dimension is within the range at the access to the multidimensional array label.

Note that the range for number of elements and padding are reserved in units of 16 bits for bit type arrays. Accessing a value outside the element number range of the bit type array does not result in an error if it is within the range including padding.

For details on the range check, refer to the following.

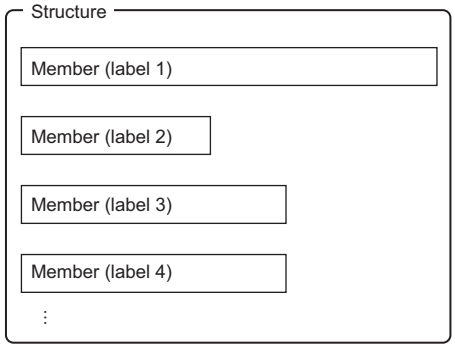
MELSEC MX Controller MX-R Model Programming Manual

19.6 Structures

A structure is a data type containing one or more labels and can be used in all POUs.
Members (labels) included in a structure can be defined even when their data types are different.

Creating structures

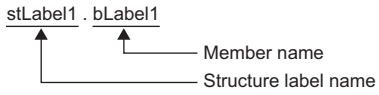
To create a structure, first define the structure, and then define members in the structure.



How to use structures

To use a structure, register a label using the defined structure as the data type.
To specify each member in a structure, add the member name after the structure label name with a period '.' as a delimiter in between.

Ex.
Specifying a member in the structure

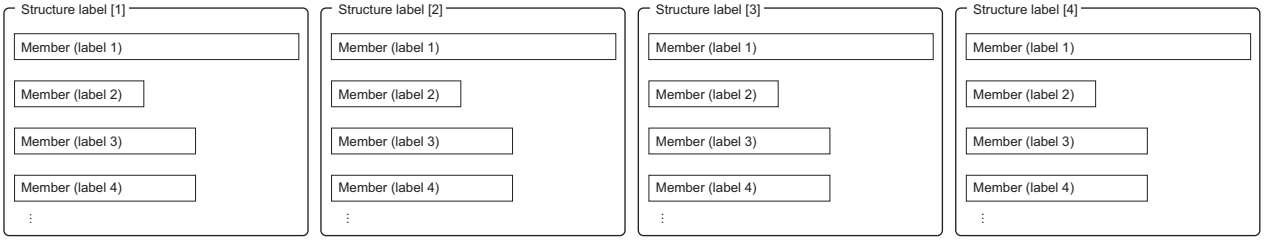


Point

The structure label is assigned in the order of label registration.
For details, refer to the following.
GX Works3 Operating Manual

Structure arrays

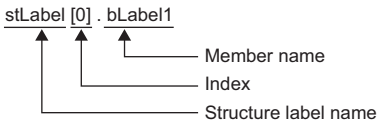
A structure can also be used as an array.



When a structure is declared as an array, add an index enclosed by '[ ]' after the structure label name.
A structure array can also be specified as an argument of a function or FB.

Ex.

Specifying an element of a structure declared as an array



Data types and initial values that can be specified

The following data types can be specified as structure members.

- Primitive data type*1
- Array
- Other structures

*1 The pointer type cannot be defined.

■Initial values

The following tables list the initial value setting possibilities.

Data type	Initial value setting possibility
Primitive data type	○
Timer type, retentive timer type, long timer type, long retentive timer type, counter type, long counter type	×
Structure type	×
Array type	○

Types of structures

Each of the following labels is predefined as a structure.

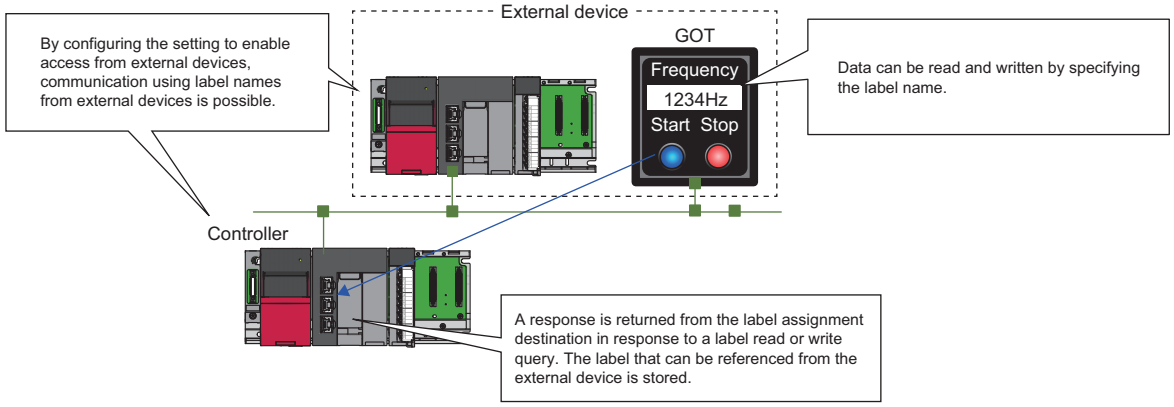
Type	Reference
Module label	📖 Function Block Reference for the module used
Timer type	Page 402 Data Types
Retentive timer type	
Counter type	
Long timer type	
Long retentive timer type	
Long counter type	

Precautions

Do not access elements outside the range of the defined structure type label. When the label is specified with an instruction, a range check is performed. If a label outside the range is specified, an error occurs.
For details on the range check, refer to the following.
📖MELSEC MX Controller MX-R Model Programming Manual

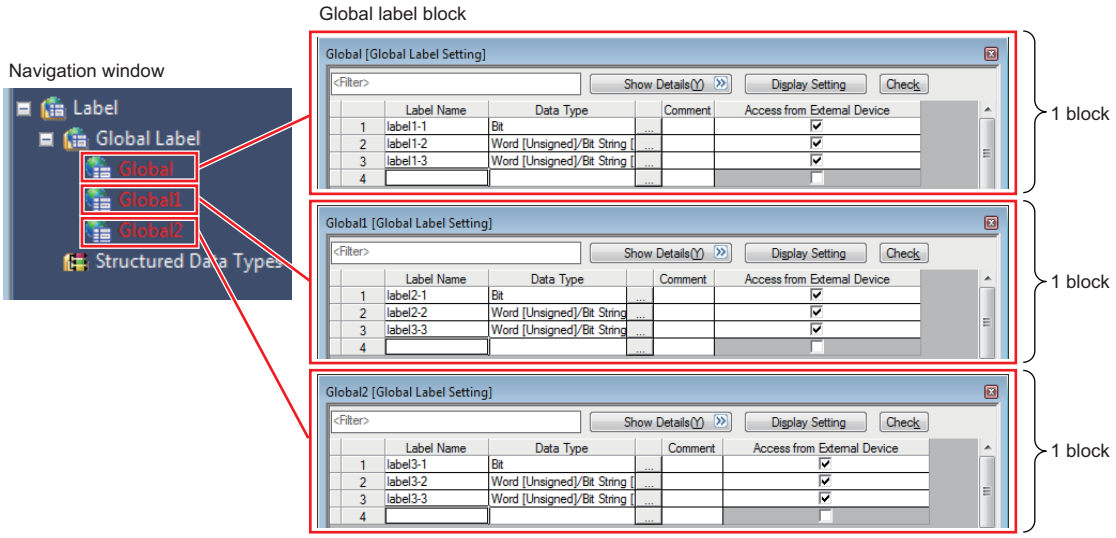
19.7 Label Access Setting from External Device

This setting is used for reading/writing data by specifying label names from an external device that can communicate with the controller such as a monitoring device (including the GOT, SLMP-compatible device, and SCADA), or a personal computer.



Point

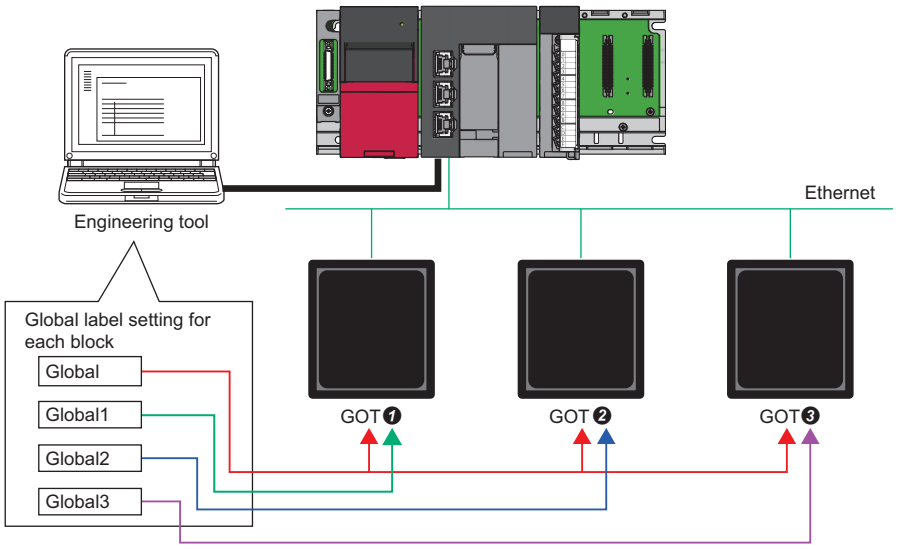
The controller controls global labels in the global label setting by block.
One global label setting is expressed as one block as below.



Set the global label setting for each label used with GOT in units of blocks.
When "Perform the label name resolution in global label block unit" is selected in the GT Designer3 setting, the label name resolution after online change is processed efficiently. However, during online change that involves addition of blocks, label names are resolved collectively, not in units of blocks.
For the GT Designer3 setting, refer to the following.
GT Designer3 (GOT2000) Screen Design Manual
The following shows an example of access to three GOT units.

- "Global": Global label setting that compiles labels accessed from multiple GOTs (GOT❶ to GOT❸)
- "Global1": Global label setting that compiles labels accessed from GOT❶
- "Global2": Global label setting that compiles labels accessed from GOT❷
- "Global3": Global label setting that compiles labels accessed from GOT❸

In this case, because global labels in each global label setting are accessed in units of blocks, the number of times of updating label communication data from GOT decreases.

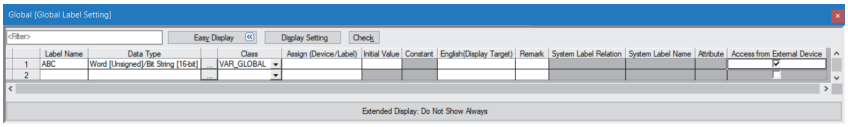


Configuration procedure

This section describes the configuration procedure to enable access by specifying the global label from external devices.

Operating procedure

"Global Label Setting" window



1. Set the label in "Global Label Setting" and select the "Access from External Device" checkbox.
2. Check the capacity of the global label assignment information.

☞ Page 414 Maximum capacity of global label assignment information

3. Write parameters, global label settings, and global label assignment information files to the controller.

Global label assignment information

The global label assignment information consists of the label name and label system information, which are label assignment information of the global label with the "Access from External Device" checkbox selected. Label system information refers to label data type and assignment destination device information.

By writing global label assignment information to the controller, communication becomes possible with label names specified from external devices and auto-tracking becomes available when label assignments are changed. In the controller, the written global label assignment information is stored in the area (label assignment information management area) dedicated for this function and label communications are performed.

The label assignment information management area is used by the system even if global label assignment information is not written.

Maximum capacity of global label assignment information

The capacity of the label assignment information management area is 30M bytes maximum. In addition, the label assignment information management area capacity and label assignment information management area free space can be checked using a special register (SD2404 to SD2407).

Auto-tracking when the label assignment is changed

This function is used for the external device to refer to the changed device by auto-tracking when the device assigned to the controller label is changed. There is no need to change the label settings on the external device side.

The following table lists the necessity of changing the external device side in the label change content.

○: No need to change the external device side. ×: Need to change the external device side

Controller label change content	Whether the external device side needs to be changed	
	Necessity	Description
Changing the label assignment destination device	○	There is no need to change the label settings on the external device side.
Changing the label data type	×	Whether or not an external device referencing a label whose data type has been changed is treated as a label communication error depends on the specifications of the external device. However, when data specifying a label name is written, if the write data size differs from the data type, a label communication error will occur. The setting of the external device must be changed to the same data type as the label data type changed on the controller.
Deleting the label	×	Whether an external device referencing the deleted label is treated as a label communication error depends on the specifications of the external device. The external device needs to be modified so that the label deleted by the controller is not used by the program.

19.8 Precautions

Functions with restrictions

The following functions have restrictions on the use of labels.

Item		Description
CPU parameter	Trigger of an event execution type program	Use devices because global labels nor local labels cannot be specified for these functions.
Module parameter	• Predefined protocol support function	
	• Refresh setting of intelligent function module • Refresh setting of network module (SB/SW only)	Use module labels for these functions. Use devices if module labels are not used.
	• Refresh setting of network module (other than SB/SW)	Use devices because global labels nor local labels cannot be specified for these functions.

■Defining and using a global label with a device assigned

Define a global label following the procedure below, and use it when the functions having restriction on the use of labels are executed.

Since the device area in the device/label memory is used, secure the device area capacity.

1. Secure the device area to be used.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting]

2. Define a label as a global label, and assign a device manually.

3. Use the label defined in step 2 for the functions having no restrictions on the use of labels. Use the device assigned to the label for the function having restrictions on the use of labels.

■Copying the value of a label used to a different device

If a device cannot be assigned to a global label, copy the value of the label to a different device and use the device for the function having restrictions on the use of labels.

Since the device area in the device/label memory is used, secure the device area capacity.

1. Secure the device area to be used.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting]

2. Create a program using the label. The following is the program example for copying the data. (The data logging function uses the data in udLabel1.)



3. Use the device where the data has been transferred in step 2 for the function having restrictions on the use of labels. (In the program example in step 2, use D0.)

Point

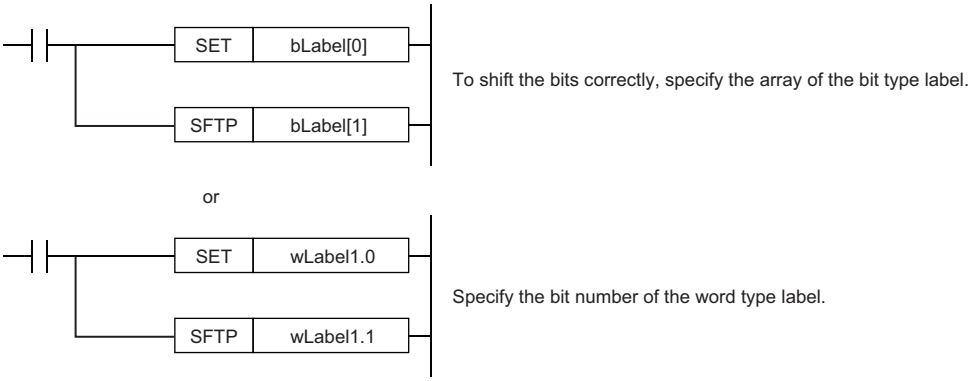
- The number of steps increases because of the transfer instruction. (The scan time increases.)
- Decide the transfer instruction position considering the timing of writing data to the label and executing the function.

Precautions for creating programs

When specifying a label as an operand used in instructions, match the data type of the label with that of the operand. In addition, when specifying a label as an operand used in instructions that control continuous data, specify the data range used in instructions within the data range of the label.

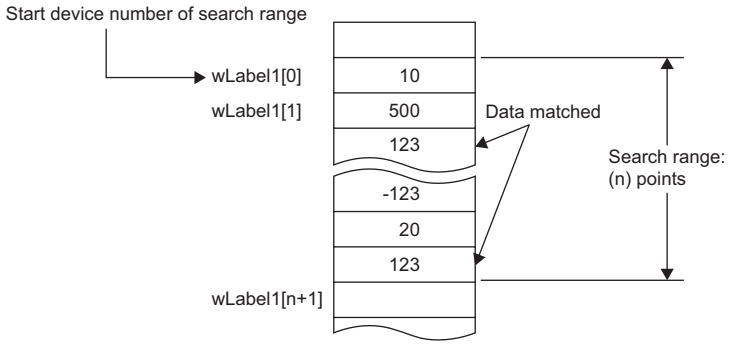
Ex.

SFT(P) instruction



Ex.

SER(P) instruction



Specify a label which has a larger data range than the search range (n) points.

Restrictions on naming labels

The following restrictions apply when naming labels.

- Start the name with a character or underline (_). Numbers cannot be used at the beginning of label names.
- Reserved words cannot be used.

For details on the reserved words, refer to the following.

GX Works3 Operating Manual

Access from external devices

- Global labels to which accesses from external devices are permitted cannot be accessed while the global label setting file has been written by writing to the programmable controller or using the online change (during global label assignment information update), when the controller is powered off and on, and while the label communications have been prepared immediately after the reset. If accessed, an error occurs.
- When the global label which is set to the "Access from External Device" is deleted or the online change including label name change is executed, change the program of external devices that refer to the global label deleted/changed.
- If the number of global labels to which access from external devices is permitted increases, the time for writing data to the programmable controller, the time for the online change, or the GOT label name resolution time may increase.
- If the number of external devices accessing global labels to which access from external devices is permitted increases, the GOT label name resolution time may increase.

Label access by specifying a value outside the range of the element number

For an array type label, the label cannot be accessed by specifying a value outside the range of the element number. (Note that the range for number of elements and padding are reserved in units of 16 bits for bit type arrays. Therefore, accessing a value outside the element number range does not result in an error if it is within the range including padding.) When an element number outside the range is specified, the following occurs depending on the data type of the element number.

- When the element number is specified with a constant: An error occurs when the program is converted.
- When the element number is specified with a value other than a constant (device, label, formula): An execution error (Device, label, or buffer memory specification error) (error code: 2820H) occurs.

20 LATCH FUNCTION

20.1 Device/Label Latch

The data in each device/label of the controller is cleared to its default value in the following cases:

- When the controller is powered off and on
- When the controller is reset
- When a power failure exceeding the allowable momentary power failure time occurs

The data in each device/label with latch setting is retained even under the above described conditions. For this reason, control can be continued with the retained data even if the power of the controller is turned off or a power failure exceeding the allowable momentary power failure time occurs while the data is managed by a sequential control.

Types of latch

The following types of latch are available:

- Latch (1): Data in this range can be cleared by a latch clear operation
- Latch (2): Data in this range cannot be cleared by a latch clear operation

Applicable devices and labels

This section describes the devices/labels that can be latched.

Applicable devices

The devices below can be latched. However, local devices cannot be latched.

Device	Specification method	Applicable latch type
Internal relay (M)	Specify the latch range.	Latch (1) or Latch (2)
Link relay (B)	Specify the latch range.	Latch (1) or Latch (2)
Annunciator (F)	Specify the latch range.	Latch (1) or Latch (2)
Edge relay (V)	Specify the latch range.	Latch (1) or Latch (2)
Timer (T)/Long timer (LT)/Retentive timer (ST)/Long retentive timer (LST)	Specify the latch range.	Latch (1) or Latch (2)
Counter (C) and Long counter (LC)	Specify the latch range.	Latch (1) or Latch (2)
Data register (D)	Specify the latch range.	Latch (1) or Latch (2)
Link register (W)	Specify the latch range.	Latch (1) or Latch (2)
Latch relay (L)	Specify the number of points (latch is performed the same number of times as the specified number of points).	Latch (2) only
File register (R, ZR)	Specify the number of points (latch is performed the same number of times as the specified number of points). Specify the latch range.*1	Latch (2) only

*1 When "Use Common File Register in All Programs" is enabled, any of the number of points is registered within the range for Latch (2). Also, the range can be specified in "Latch (2)" of "Latch Range Setting" (values out of the specified range are cleared to 0).

Applicable labels

The labels below can be latched.

Label type	Class	Data type
Global label	VAR_GLOBAL_RETAIN	Primitive data type, array, structure
Local label of a program block	VAR_RETAIN	
FB local label	VAR_RETAIN	
	VAR_OUTPUT_RETAIN	
	VAR_PUBLIC_RETAIN	

Setting latch on devices

Multiple latch ranges can be set for a device type. A total of 32 latch ranges of latch (1) and latch (2) can be set. However, the ranges of latch (1) and latch (2) must not overlap.

Setting a latch range

Set the device to latch, its range, and the latch type.

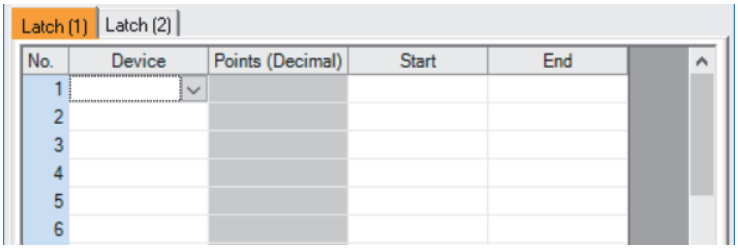
Operating procedure

"Device Setting" window



Item	Symbol	Latch (1)	Latch (2)
Input	*X*		
Output	Y		
Internal Relay	M	No Setting	No Setting
Link Relay	B	No Setting	No Setting
Link Special Relay	SB		
Annunciator	F	No Setting	No Setting
Edge Relay	V	No Setting	No Setting
Step Relay	S		
Timer	T	No Setting	No Setting
Long Timer	LT	No Setting	No Setting
Retentive Timer	ST	No Setting	No Setting
Long Retentive Time	LST	No Setting	No Setting
Counter	C	No Setting	No Setting
Long Counter	LC	No Setting	No Setting
Data Register	D	No Setting	No Setting
Link Register	W	No Setting	No Setting
Link Special Registe	SW		
Latch Relay	L		No Setting
Total Device			
Total Word Device			
Total Bit Device			

"Latch Range Setting" window



1. Click "Detailed Setting" on the "Device Setting" window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/ Device Setting] ⇨ [Device/Label Memory Area Setting] ⇨ [Device/Label Memory Area Detailed Setting] ⇨ [Device Setting] ⇨ <Detailed Setting>

2. In the "Device Setting" window, select the type of latch for the target device. The "Latch Range Setting" window is displayed.

3. Check the tab for the latch type, select the device to set and set the latch range (Start, End).

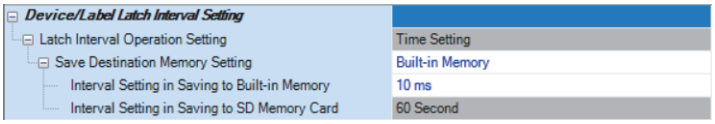
Device/label latch interval setting

Set the latch interval operation (☞ Page 421 Device/label latch interval setting).

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Latch Interval Setting]

Operating procedure

"Device/Label Latch Interval Setting" window



1. In "Latch Interval Operation Setting", select the timing of the latch processing.

Displayed items

Item	Description	Setting range	Default
Latch Interval Operation Setting	Sets the timing of the latch processing.	Time Setting	Time Setting
Save Destination Memory Setting	Selects the save destination memory for the device and label for which the latch setting has been made. • Select "Built-in Memory" if latching at high speed is desired. However, there is a limit to the latch capacity. For the latch capacity, refer to the following. ☞ Page 423 Number of points that can be latched • Select "SD Memory Card" if latching more devices and labels is desired.	• Built-in Memory • SD Memory Card	Built-in Memory
Interval Setting in Saving to Built-in Memory	Use this setting when latching to internal memory.*1	1 to 2000ms (in units of 1ms)	10ms
Interval Setting in Saving to SD Memory Card	Use this setting for latching at fixed time intervals.*1	1 to 3600s (in increments of 1s)	60s

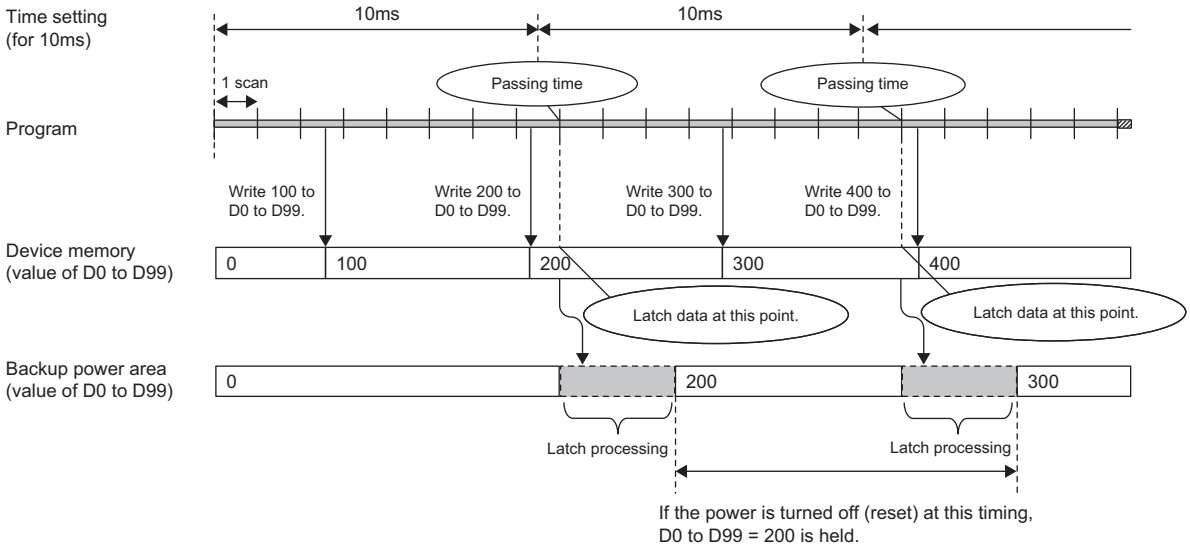
*1 For executing latch processing, the save time varies depending on the changed volume to be latched. (The more latch devices changed per scan, the longer it takes to save.) As a result, if execution is not possible at the set time interval, the latch processing is executed at the best possible interval for the system.
The current latch processing interval and the maximum latch processing interval can be checked using the special register. (☞ Page 424 Related special relay/special register areas)

■Timing of the latch processing

The timing of the latch processing is determined based on the effective range of the latch interval setting and the operation setting for the specified latch interval (☞ Page 420 Device/label latch interval setting)

• When set to "Time Setting"

Latch processing is started in the END processing executed after the set time. Since latch processing is performed asynchronously with the sequence program, the extension of scan time can be minimized.



Point

• The more the latch points, the more it takes to complete the latch processing. If the set time elapses while latch processing is still executing, the next one is executed in the END processing that follows the completion of the previous latch processing. Set a latch interval longer than the latch processing time so that the specified time does not elapse during latch processing. For the latch processing time, refer to the following.

☞ Page 1996 Latch area

• If the latch interval is shorter than the scan time, latch timing occurs more than once within one scan. However, latch processing is executed once during the END processing.

■Save destination memory

• If the save destination is "Built-in Memory"

Latch processing is executed during the END processing, which can always be executed.

Note that the time required for latch processing varies depending on the number of changed latch targets.

• If the save destination is "SD Memory Card"

The data saved to the SD memory card can be restored only to controllers with the same latch range setting. If the latch range setting is different, the data will not be restored. For details, refer to the following.

☞ Page 425 Precautions

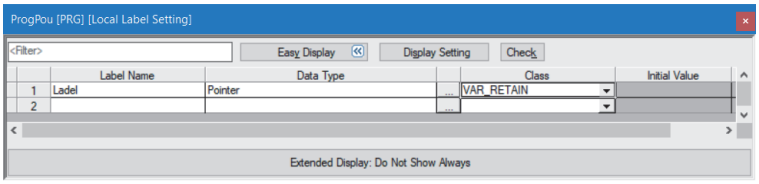
Even if the save destination is set to "SD Memory Card", the special relay and special register are saved to the built-in memory. Therefore, even if the data is restored to the controller with the same latch range setting, the data cannot be restored.

Setting latch on labels

This section describes latch setting on labels.

Operating procedure

Label edit window



"Device/Label Memory Area Detailed Setting" window



1. In the label edit window, specify "RETAIN" for label attribute.

2. There are two types of latch for labels: latch (1) and latch (2). Select one. The selected latch type is applied to labels of all latch attributes.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Device/Label Memory Area Setting] ⇨ [Device/Label Memory Area Detailed Setting] ⇨ [Latch Type Setting of Latch Type Label]

Clearing latch range data

Latch range data is cleared by either of the operations below. (☞ Page 332 Memory Operation)

- Latch clear: Performed from the engineering tool. (GX Works3 Operating Manual)
- Latch clear by program: Execute the RST instruction for latched devices, or clear by transferring K0 by using the MOV or FMOV instruction.

Number of points that can be latched

The following table lists the latch capacity when the built-in memory or SD memory card is used.
If the save destination memory setting is set to "Built-in Memory", there is a limit on the data capacity that can be latched. Therefore, do not let the total latch size of the number of latch relay points, the device latch range setting (except for latch relay), and latch label area capacity set by this function exceed the latch capacity described below.

Conditions	Model	Latch capacity*1
When the built-in memory is used	MXR500-128, MXR500-256	1214K words
	MXR300-16, MXR300-32, MXR300-64	896K words
When the SD memory card is used	MXR500-128, MXR500-256	10238K words
	MXR300-16, MXR300-32, MXR300-64	8190K words

*1 The maximum total capacity of the number of latch relay points, devices that the latch range is set (except for latch relay), and latch labels. For the available setting range of device/label memory, refer to the following.
☞ Page 210 Hardware specifications

An error occurs if the size exceeds the limit that can be latched when the power turns off and on or the status changes from STOP to RUN. When an error occurs, latch processing is not performed for all devices and labels.
In the RUN state, a file register written externally by FTP transfer and other operations is not latched.
The calculation method for the latch size is as follows.

α^{*1} = ((M1 + M2 + (M3 × 2)) ÷ 16) + (M4 + (M5 × 4) + (M6 × 2)) + M7 [Word]

Variable name	Description
α	Latch size
M1	Number of M, B, F, and V points in the latch range setting
M2	Number of L points in the device setting
M3	Number of T, ST, C, and LC points in the latch range setting
M4	Number of D, W, ZR, T, ST and C points in the latch range setting
M5	Number of LT and LST points in the latch range setting
M6	Number of LC points in the latch range setting
M7	Latch label area capacity in the label area setting

*1 In division calculation, values after the decimal point are rounded up.

When SD memory card is specified

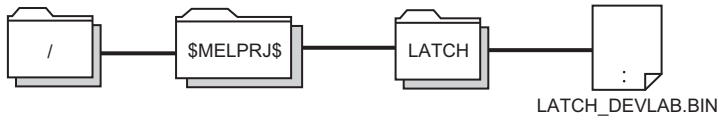
File name

If "SD Memory Card" is specified in the save destination memory setting, the latch device/label file will be saved to the SD memory card.

File type	File name	Extension	Description
Latch device/label file	LATCH_DEVLAB	BIN	The device/label data that has been latched is stored.

Folder configuration

The following figure shows the folder structure in the SD memory card when "SD Memory Card" is specified in the save destination memory setting.



Error processing

If "SD Memory Card" is specified in the save destination memory setting, an error (continuation error) will occur if the SD memory card is not inserted when latch processing starts or if the write protect switch of the SD memory card is locked (write inhibited). The same error will occur if the SD memory card is disabled by SM606 (SD memory card forced disable instruction) during latch processing.

The error above is detected only the first time writing to the SD memory card fails. If writing to the SD memory card becomes possible after error handling, latch processing resumes.

Related special relay/special register areas

The following lists the related special relay area.

Special relay	Name
SM4102	Max latch interval time clear request
SM4098	Latch save completion flag after latch setting change

The following lists the related special register areas.

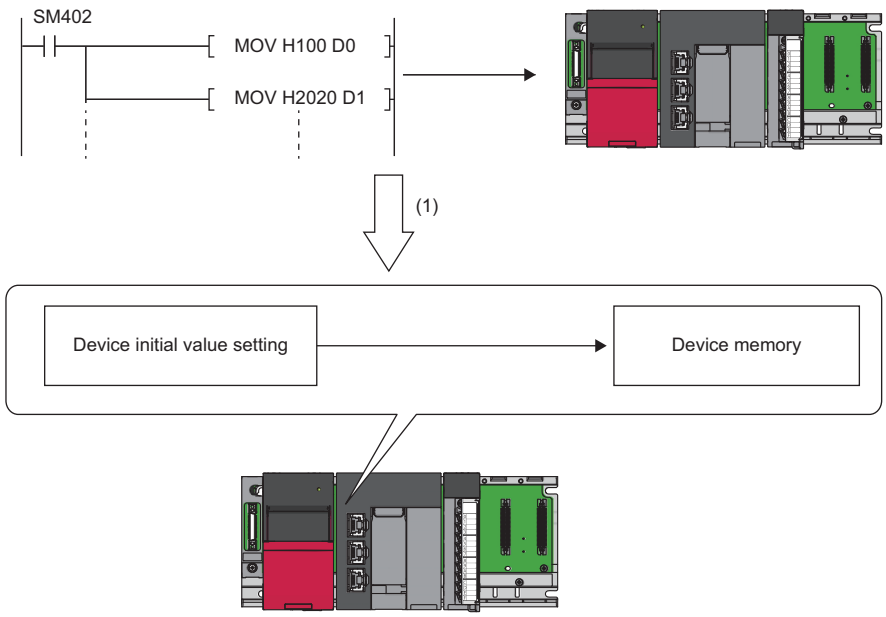
Special register	Name
SD4100 SD4101	Current latch interval time
SD4102 SD4103	Max latch interval time

Precautions

- When the latch range setting and the device/label latch interval setting are changed, a parameter error (error code: 2223H) occurs after the CPU parameters are written to the controller. Therefore, check the completion of latch save in SM4098 (Latch save completion flag after latch setting change) and turn the power off and on or change the operating status from reset to reset clear. If power-off/reset operation is performed after writing parameters but before latch saving is completed, the latch range setting of CPU parameters will not match the latch range setting held in the saved data when power-on or reset clear is performed, or the latch data will not exist in the save destination memory set in the device/label latch interval setting. As a result, the latch data will be discarded and the value of the device with latch setting will not be restored. (Latch relay and latch label also cannot be restored.)
- When the latch label area capacity is changed, all data must be rebuilt (reassigned). As the device/label is initialized when a reset is performed or the power is turned off and on (the initial value is reflected if the initial value is set, or the value is cleared to zero if no initial value is set) after the CPU parameters are written to the controller, the latch label value will not be restored. In addition, if the number of device points in latch relay or the latch label area capacity is changed, or if the latch save destination memory is set to "SD Memory Card", the latch device/label value will not be restored when a reset is performed or the power is turned off and on after the CPU parameters are written to the controller. (The initial value is reflected if the initial value is set, or the value is cleared to zero if no initial value is set.)
- If the number of device points in the latch relay is changed, or if the latch save destination memory is set to "SD Memory Card", the latch device/label value will not be restored when the power is turned off and on or when the operating status changes from reset to reset clear after the CPU parameters are written to the controller. (The initial value is reflected for the device/label whose initial value is set, and the value is cleared to zero for the device/label whose initial value is not set.)
- Latch data is not guaranteed if a power or cable disconnection occurs during write operation to the programmable controller and the online change. Execute the write operation to the programmable controller and the online change again.
- If a latch-specified device is used in a sequence program, when using a word device as 32-bit data, specify a device number that is a multiple of 2. When using a word device as 64-bit data, specify a device number that is a multiple of 4. Failure to do so may cause data inconsistency of the latched data.

21 DEVICE/LABEL INITIAL VALUE SETTINGS

This function sets the initial values of devices and labels used in the program directly (not via the program) to the devices, labels, and buffer memory areas of intelligent function modules.



(1) If device initial values are used, a program to set data to the devices becomes unnecessary.

21.1 Setting Device/Label Initial Values

This section describes the settings required to use device/label initial values.

Setting device initial values

This section describes the settings of device initial values.

Setting procedure

The procedure for using device initial values is as follows.

1. First, the user must create a device initial value file and an initial label value file. To set initial values to a local device, create a device initial value file with the same name as the program which sets these values, and specify the range of the values. To set initial values to a global device, create a device initial value file (with any name) which sets these initial values, and specify the range of the values.
2. On the device memory, set up device initial value data within the range specified in the device initial value file.

📖 GX Works3 Operating Manual

3. In the "Device Memory Register Diversion", select the device memory which was set up in Step 2. Setting "Device Memory Register Diversion" enables data set up on the device memory to be used as device initial values for the device which is specified in the device initial value file.

📖 GX Works3 Operating Manual

4. Configure CPU parameters. (☞ Page 427 Initial value setting)
5. Write the set device initial value file and the CPU parameter to the controller.

📖 GX Works3 Operating Manual

6. The data in the specified device initial value file is automatically set to the specified device or buffer memory of the intelligent function module when the controller is powered off and on, reset, or the status changes from STOP to RUN.

Initial value setting

Configure the initial value setting.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [File Setting] ⇨ [Initial Value Setting]

Window



Displayed items

Item	Description	Setting range	Default
Target Memory	Sets the storage memory for the device initial value file, initial global label value file, and initial local label value file.	• Program Memory • SD Memory Card*2	Program Memory
Setting of Device Initial Value Use Or Not	Selects whether or not to use device initial values.*3	• Not Use • Use	Not Use
Global Device Initial Value File Name	Sets the name of the initial global device value file.*1	60 characters or less	—
Device/Label Initial Value Reflection Setting at STOP to RUN	Enables or disables the device/label initial value reflection at status change from STOP to RUN.	• Enable • Disable	Disable

*1 If nothing is specified, initial global device values are not applied.

*2 If the free space in the program memory is not enough, select "SD Memory Card" in "Target Memory" and write the initial value file to the SD memory card. Note that when the label initial value is set, boot a target file from the SD memory card with the boot function. (☞ Page 325 Boot operation)

*3 When "Use" is set in "Setting of Device Initial Value Use Or Not" and the specified global device initial value file does not exist, an error occurs. If the other file (local device initial value file, global label initial value file, or local label initial value file) does not exist, an initial value is not applied, but an error does not occur.

Applicable range of device initial value files

The applicable range of device initial value files is as follows.

Target device	Applicable range
Global device	Device initial values set up in the initial value file of the global device are used.
Buffer memory	
Local device	Device initial values set up in the initial value file of the local device (Program Name.DID) are used.
File register	When a common file register is used across all programs, device initial values set up in the initial value file of the global device are used.

Number of device initial value settings and maximum range of one range

Up to 1000 ranges can be set in one device initial value file. Up to 8000 data points can be set in one range.

Setting initial label values

This section describes the settings of initial label values. For labels assigned to a device, the initial value setting follows the device initial value.

Setting procedure

The procedure for using initial label values is as follows.

1. Set up initial label values using a global label and local label.
2. Configure CPU parameters (☞ Page 427 Initial value setting)
3. The CPU parameters, programs, initial global label value file, and initial local label value file are written to the controller.

📖 GX Works3 Operating Manual

■Timing for reflecting the device/label initial value

The device/label initial value is reflected at the following timing.

- Power off to on (including from reset to reset release)
- STOP (PAUSE) → RUN

The device/label initial value is reflected at the following timing, depending on the setting of "Device/Label Initial Value Reflection Setting at STOP to RUN" in "CPU Parameter" and the non-latch/latch setting of the initial value set device/label.

CPU parameter	Device/label latch setting	Timing for reflecting the initial value	
Device/label initial value reflection at status change from STOP to RUN		Power off to on (including from reset to reset release)	STOP (PAUSE) → RUN
Disable	No latch	Reflected	Not reflected*1
	Latch	Not reflected*1	Not reflected*1
Enable	No latch	Reflected	Reflected
	Latch	Reflected	Reflected

*1 In any of the following cases, the device/label initial values are reflected even if "Device/Label Initial Value Reflection Setting at STOP to RUN" is set to "Disable".
· After all data is rebuilt and the data is written to the programmable controller
· After the device/label clear operation is executed

Initial value setting of arrays and structures

The following initial values can be set for each array element or structure instance.

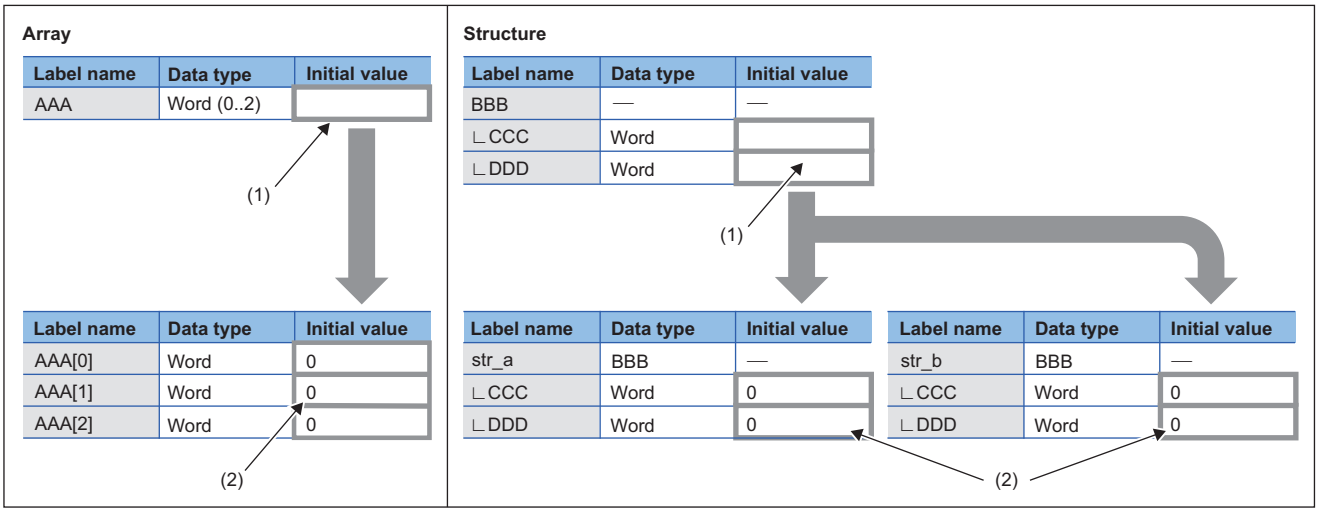
- Initial value unset
- Setting with the global label settings
- Setting with the label initial value settings

Point

When "setting with the label initial value settings" is used, the option settings in the engineering tool must be enabled.

■Initial value unset

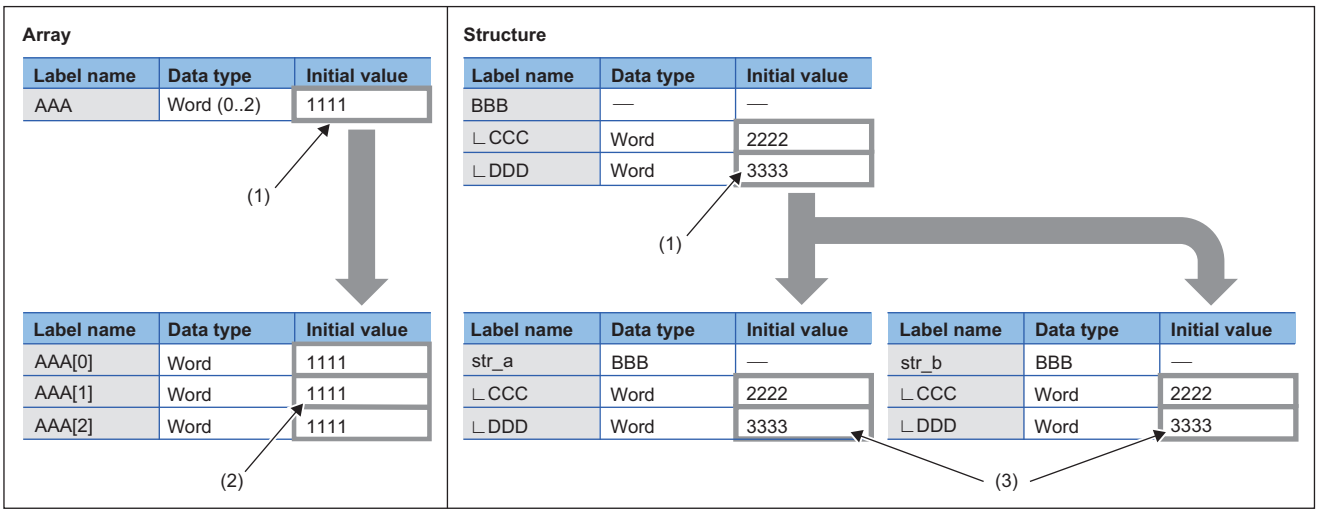
"Initial value unset" refers to the initial value determined for each data type. If no initial value is set for an array or structure, "initial value unset" is applied.



(1) An initial value is not set.
(2) Default initial value (In this case, 0 is applied.)

■Setting with the global label settings

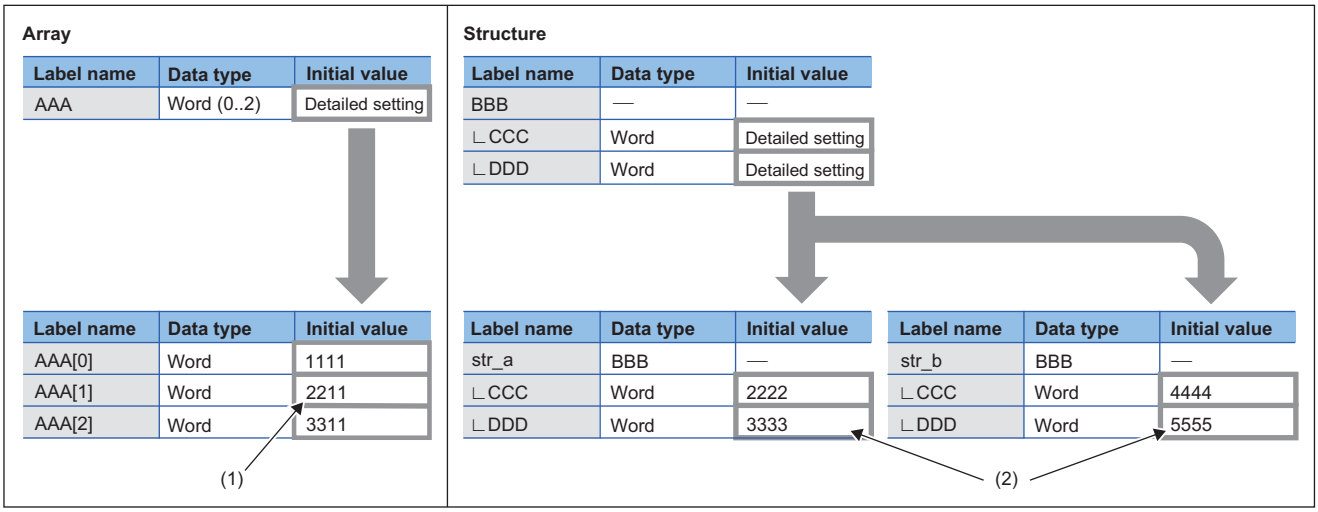
"Setting with the global label settings" refers to the initial value set for an array or structure member. The same initial value is applied to array elements or structure members.



(1) An initial value is set.
(2) The same initial value is applied to all elements.
(3) The same initial value is applied to all instances.

■Setting with the label initial value settings

"Setting with the label initial value settings" refers to the initial value set for an array element or structure member (for each instance). A different initial value can be set for an array element or structure member (for each instance).



(1) An initial value can be set for each element.
(2) An initial value can be set for each instance.

■Order of priority for initial values

The initial label value can be set to both "setting with the global label settings" and "setting with the label initial value settings". The following table shows the order of priority of initial values applied when both are set.

Order of priority	Initial value type	Remarks
High ↑ ↓ Low	Setting with the label initial value settings	—
	Setting with the global label settings	—
	Initial value unset	This is applied when neither "setting with the global label settings" nor "setting with the label initial value settings" is configured.

As shown below, for a label where both "setting with the label initial value settings" and "setting with the global label settings" are configured (data01 in the following figure), "setting with the label initial value settings" is applied instead of "setting with the global label settings".

Structure: Define ABCD. ("Initial value not set")

Label name	Data type	Initial value
data01	Word	100
data02	Word	200
data03	Word	(No setting)

Define the global label for the structure ABCD.

Label name	Data type	Initial value
str00	ABCD	Detailed setting

Configure "setting with label initial value setting" of str00.

Label name	Data type	Initial value
str00.data01	Word	999
str00.data02	Word	(No setting)
str00.data03	Word	(No setting)

Actual initial value

Label name	Initial value
str00.data01	999 ("setting with label initial value setting" has priority.)
str00.data02	200 (Since "setting with label initial value setting" does not exist, use "setting with global label setting".)
str00.data03	0 (Since the initial value setting does not exist, use "initial value not set".)

21.2 Applicable Devices/Labels

For details on devices/labels to which initial device/label values can be set, refer to the following.

GX Works3 Operating Manual

21.3 Device/Label Initialization After Writing

When all data is rebuilt with an engineering tool, the device/label is initialized when the power is turned off and on or when the operating status changes from STOP (PAUSE) to RUN after writing data to the programmable controller (the initial value is reflected for the device/label whose initial value is set, and the initial value is cleared for the label whose initial value is not set). Also, the previous execution information of instruction executed on the rising/falling edge is initialized.

Point

The device/label is initialized only when the first write operation to the controller is performed after all data is rebuilt. Thus, to write the same project to the other controller, rebuilt all data.

Device/label to be initialized

The following are the devices/labels to be initialized.

- X, Y, M, L, B, F, SB, V, S, T, ST, LT, LST, C, LC, D, W, SW, FX, FY, FD, Z, LZ, R, ZR, RD, and all labels

21.4 Device/Label Initial Value Reflection After Device/Label Clear Operation Is Executed

When the device/label clear operation is executed from the engineering tool or using SLMP, the device/label initial value is reflected when the power is turned off and on or when the status is changed from STOP (PAUSE) to RUN after the clear operation is executed regardless of the setting of "Device/Label Initial Value Reflection Setting at STOP to RUN".

Operation to be performed

The following table lists the target operations for which the device/label initial value reflection is executed.

Category	Operation to be performed
Operation from the engineering tool	Selects "Clear other than latch" or "All clear" for the device/label memory at RUN operation in the remote operation window, and executes remote RUN.*1
	Clears the device/label values in the CPU memory operation window of the engineering tool.*2
Operation using SLMP	Executes the remote RUN command. (Only when clearing the devices outside the latch range or clearing all the devices (including the latch range) is selected for the clear mode)
	Executes the remote latch clear command.

*1 When "Not Cleared" is selected for the device/label memory, the device/label initial value reflection is not executed regardless of the setting of the rising/falling instruction execution conditions.

*2 When a device/label is not to be cleared (when only a file register is to be cleared), the device/label initial value reflection is not executed.

Target device/label

Regardless of the device/label clear range (non-latch/latch (1)/latch (2)), all devices/labels with initial value settings reflect the initial device/label values.

21.5 Precautions

This section describes the precautions when using the initial device/label value setting.

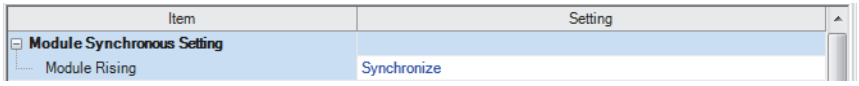
- When device initial values or label initial values are overlapped with the latch range, these initial values take precedence over the latch range. Therefore, even if a device or label is already latched, its values are changed to the specified initial values.
- Device/label initialization after all data is rebuilt and data is written to the programmable controller cannot be performed using the MC protocol, FTP command operations, boot function or controller backup/restoration function.
- When setting the initial value to the link device assigned to the synchronization station of the CC-Link IE TSN function, set the link refresh and then set the initial value to the refresh destination device or label. Even if U☐\G☐ (module access device) and Jn\☐ (link direct device) are specified, the initial value is not reflected in the link device. For Jn\☐ (link direct device), see the following.

☞ Page 371 Link Direct Device

- To make the controller hold a device only when its values fall into the range of device initial setting (such as module access device and link direct device), the start-up time between the device and the controller must be synchronized using the CPU parameter, "Module Synchronous Setting".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Module Synchronous Setting]

Window



PART 9 FUNCTIONS

This part consists of the following chapter.

22 FUNCTION LIST

22 FUNCTION LIST

This chapter describes the function list of the controller. For details, refer to the references for each function.

Function	Description	Reference
Motion control	Describes the settings, functions, operation cycle, and each control for performing the motion control.	Page 434 Motion Control
CC-Link IE TSN	Describes the cyclic transmission, transient transmission, and other functions of CC-Link IE TSN.	Page 437 CC-Link IE TSN
Ethernet	Describes each communication using Ethernet. (SLMP, predefined protocol, FTP, OPC UA, and others)	Page 438 Ethernet
Data collection	Describes how to collect device values at a specified interval or at a desired timing.	Page 439 Data Collection
Security	Describes how to prevent unauthorized access and data outflow.	Page 439 Security

22.1 Motion Control

Function		Description	Reference
Axis management	Technical units	Sets the position command unit and the velocity command unit used in the motion control for the unit setting. Since the unit can be specified freely depending on the control target, intuitive programming and monitoring are available.	Page 490 Units
	Servo ON/OFF	Executes servo ON/OFF of the real axis connected to the motion system. The real axis can be operated by servo ON.	Page 501 Servo ON/OFF
	Follow up	Reflects the input (current position) from the axis-assigned device station in the set position of the axis.	Page 504 Follow Up
	Absolute position control	Restores the current position of an axis.	Page 510 Absolute Position Control
Operation cycle		In the motion system, performs operation processing related to the motion control in the fixed cycle (motion operation cycle).	Page 522 OPERATION CYCLE
Start and stop	Start	Starts motion control.	Page 543 Start
	Retrigger/continuous update	Changes the control of the ongoing FB with a retrigger/continuous update. With a retrigger/continuous update of the FB, input variables can be imported again to the on-going FB instance without interrupting operation.	Page 546 Retrigger/Continuous Update
	Multiple start (buffer mode)	Executes multiple motion control FBs continuously without stopping by executing the motion FB of another instance to the axis and the axes group that are executing the motion control FB.	Page 547 Multiple Start (Buffer Mode)
	Stop	Stops motion control.	Page 578 Stop
	Forced stop	Stops axes by the forced stop signal.	Page 609 Forced Stop
Homing	Driver homing method	Switches the drive unit to Homing mode, and executes homing based on the positioning pattern set on the drive unit side.	Page 620 Driver homing method
	Data set homing method	Executes the homing to a virtual axis and a real axis that does not have the home position information in the device station side. It is completed in the motion system, and external signals or others are not used.	Page 623 Data set homing method
Axis control	Single axis positioning control	Executes positioning to the specified position by using address information.	Page 627 Single Axis Positioning Control
	Single axis speed control	Executes the speed control for the specified axis with the specified speed. For speed control excluding position loop, refer to the following. ☞ Page 715 Velocity Control	Page 629 Single Axis Speed Control
	Single axis manual control	Executes the random positioning operation by inputting a signal from an external device.	Page 631 Single Axis Manual Control
	Multiple axes positioning control	Uses address information and executes positioning to the specified position using interpolation control.	Page 636 Multiple Axes Positioning Control

Function		Description	Reference
Direct control	Absolute position follow-up control	Changes the target position of the absolute position by restart/ continuous update, and performs positioning control without completing the instruction.	Page 712 Absolute Position Follow-up Control
	Velocity control	Switches the drive unit control mode to the cyclic synchronous velocity mode (csv), and performs control excluding the position loop. For speed control including position loop, refer to the following. ☞ Page 629 Single Axis Speed Control	Page 715 Velocity Control
	Torque control	Switches the drive unit control mode to the cyclic synchronous torque mode (cst), and performs control.	Page 726 Torque Control
	Pressure control	Switches the drive unit control mode to the cyclic synchronous pressure mode (cspr), and performs control.	Page 742 Pressure Control
Motion cyclic control	Motion cyclic positioning control	Switches the drive unit control mode to the cyclic synchronous position mode (csp), and sends the target position.	Page 761 Motion Cyclic Positioning Control
	Motion cyclic velocity control	Switches the drive unit control mode to the cyclic synchronous velocity mode (csv), and sends the target velocity.	Page 768 Motion Cyclic Velocity Control
	Motion cyclic torque control	Switches the drive unit control mode to the cyclic synchronous torque mode (cst), and sends the target torque.	Page 774 Motion Cyclic Torque Control
Synchronous control	Cam operation	Operates by synchronizing the slave axis with the master axis based on cam table.	Page 784 Cam Operation
	Gear operation	Sets the speed ratio between the master axis and the slave axis, and starts gear operation.	Page 816 Gear Operation
	Addition/Subtraction positioning	Combines the movement amount of two axes and transmits.	Page 819 Addition/Subtraction Positioning
Operation profile data		Performs opening profile for the cam and reading/writing for the cam.	Page 824 OPERATION PROFILE DATA FUNCTION
Advanced synchronous control		Advanced synchronous control can be achieved using software instead of controlling mechanically with gears, clutches, speed change gears, cams, or others.	Page 889 ADVANCED SYNCHRONOUS CONTROL
Functions related to position	Current position change function	Changes the set position and cumulative current position to any address.	Page 1054 Current Position Change Function
	Command in-position	Checks the remaining distance to the target position, and turns the command in-position flag to TRUE. The command in-position flag is used as a front-loading signal indicating beforehand the completion of the control.	Page 1059 Command In-position
	Software stroke limit	Sets an address as the movable range. Even if a movement command to the address outside the setting range is issued, the command will not be executed. By not executing the command outside the movable area, even if an incorrect command or unexpected operation occurs, the system will not operate out of the movable area and damage to the machine can be prevented.	Page 1061 Software Stroke Limit
	Hardware stroke limit	Limit switches are set at the upper/lower limit of the physical movable range, and the control is stopped by the input of a signal from the limit switch. Damage to the machine can be prevented by stopping the control before the upper/lower limit of the physical movable range is reached.	Page 1069 Hardware Stroke Limit
Functions related to speed	Acceleration/deceleration processing function	Adjusts the acceleration/deceleration of each motion control to the acceleration/deceleration curve suitable for device.	Page 1078 Acceleration/ Deceleration Processing Function
	Speed limit	Limits the command velocity to a value within the speed limit value setting range when the command velocity during control exceeds the speed limit value. By limiting the command velocity within the preset velocity limit value setting range, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.	Page 1112 Velocity Limit
	Override function	Changes the target velocity and the target acceleration/deceleration during the execution of the control by setting the override coefficient.	Page 1116 Override Function
Functions related to torque	Torque limit	Limits the generated torque to a value within the torque limit value range when the torque generated in the servomotor exceeds the torque limit value. It controls the operation so that unnecessary force is not applied to the load and machine by limiting the generated torque.	Page 1124 Torque Limit
	Torque limit value change function	Changes the torque limit value during control.	Page 1127 Torque Limit Value Change Function

Function		Description	Reference
Compensation function	Driver unit conversion function	Converts the machine feed value to the driver command value and passes it to the target position (Target position). Also, this function converts the current position (Position actual value) of the drive unit and calculates the actual position.	Page 1129 COMPENSATION FUNCTION
Command filter	Smoothing filter	Used to suppress load-side vibration, such as work-side vibration and base shake. Frequencies higher than the set frequency can be removed.	Page 1134 Smoothing Filter
	Direction limit filter	Restricts the movement of the slave axis to one direction relative to the movement of the master axis. This helps to avoid reverse operation caused by machine vibration or other factors.	Page 1137 Moving Direction Restriction Filter
	Speed limit filter	Limits a speed of axis. The speed input by the master axis can be limited to the specific speed and can be output to the slave axis.	Page 1138 Speed Limit Filter
	Backlash compensation filter	Compensates amount of mechanical backlash (play). Each time the movement direction changes, outputs the extra commands equivalent to the set up backlash compensation amount.	Page 1139 Backlash Compensation Filter
Input variable change in execution		Changes input variables during control. In the control whose start condition is Execute command (Execute), data such as Target position (Position) and Velocity (Velocity) can be re-imported without interrupting the operation by Execute command (Execute) retrigger.	Page 1146 INPUT VARIABLE CHANGE IN EXECUTION
External signal selection		Sets I/O signals to be used in various control.	Page 1154 EXTERNAL SIGNAL SELECTION
Touch probe		Records (latches) any data at trigger input signal detection.	Page 1166 TOUCH PROBE
Digital cam switch		Digital cam switch outputs the on/off signals according to a value of any data (data source).	Page 1175 DIGITAL CAM SWITCH
Axis emulate		Performs axis control on the real axis without connecting any device station. When using the emulate function, even if the device station is not connected, the axis can be operated virtually (regarded as it is connected). This function enables to debug the user program at the start-up of the device or verify the positioning operation.	Page 1186 AXIS EMULATION
Axis control wait		Starts the axis operation of the simultaneously-started motion FBs immediately at the input timing of the execution permission signal.	Page 1190 AXIS CONTROL WAIT

22.2 CC-Link IE TSN

Cyclic transmission

This function allows periodic data communications among stations on the network using link devices.

Function		Description	Reference
Communications using RX, RY, RWr, and RWw		Communicates data in units of bits and words between the master station and device station.	Page 1235 Communications Using RX, RY, RWr, and RWw
Link refresh		Automatically transfers data between devices in the CPU function part and link devices in the CC-Link IE TSN function part.	Page 1236 Link Refresh
Direct access to link devices		Directly reads/writes the corresponding data from/to link devices of the CC-Link IE TSN function part using the program.	Page 1241 Direct Access to Link Devices
Cyclic data assurance		Assures the cyclic data integrity in units of 32 bits or station-based units.	Page 1243 Cyclic data assurance
Communication cycle coexistence		When device stations with different communication cycles are included in the network, multiple communication cycles according to each device station are used for communications.	Page 292 Communication cycle coexistence
I/O maintenance settings	Output hold/clear setting during controller STOP	When the CPU/motion function of the controller is changed from RUN to STOP, the output is forcibly held or cleared.	Page 1247 I/O Maintenance Settings
	Data link faulty station setting	Select whether to hold or clear input from a disconnected station to the controller.	
	Controller error output mode setting	When stop error of the CPU/motion function of the controller occurs, the output is forcibly held or cleared.	
CANopen communications		Controls a servo amplifier that supports the CANopen profile.	Page 1251 CANopen Communications

Transient transmission

This function is used for data exchange at any timing.

Function		Description	Reference
Communication by a dedicated instruction		Reads/writes data from the master station to the devices in the controller on a remote station or the buffer memory areas of a remote station by the dedicated instructions.	MELSEC MX Controller MX-R Model Programming Manual
Communications using the SLMP		Reads/writes data from external devices such as the network module, a personal computer, and HMI (Human Machine Interface) to the devices of the controller on the master station and the buffer memory areas of the remote station via an SLMP.	Page 1254 Communications Using the SLMP
Routing	Routing setting	Sets the communication path required for transient communication to the stations on the different network.	Page 1255 Routing
	Dynamic routing	Generates the communication path required for transient communication to the stations on the different network.	

Others

Function	Description	Reference
Reserved station setting	A reserved station is a device station that is set in the parameters and included as a station in the network when its number is counted. This station is reserved for network extension in the future, and thus the station is not actually connected, and is not detected as a faulty station despite being not connected.	Page 1257 Reserved Station Setting
Error invalid station setting	An error invalid station is a device station that is set to be not detected as a faulty station by the master station. Perform this setting when replacing a device station during a data link as well.	Page 1257 Error Invalid Station Setting
Time synchronization	Synchronizes the time of device stations with the time synchronization source (controller of the master station).	Page 1257 Time Synchronization

22.3 Ethernet

○: Supported, ×: Not supported

Function		Port for CC-Link IE TSN	Port for Ethernet	Description	Reference
SLMP communications		○	○	Reads/writes the buffer memory, devices, and others from the external device such as a personal computer or an HMI (Human Machine Interface) to an SLMP-compatible device. Data can also be read/written to a device in the controller.	Page 1260 SLMP COMMUNICATION
Simple CPU communication function		×	○	Sends/receives device data between the controller connected by Ethernet and the controller or CPU module.	Page 1266 SIMPLE CPU COMMUNICATION FUNCTION
Predefined protocol communications		×	○	Allows the communication processing only with the program of the start instruction when the protocol data for communications with the external device is registered using the engineering tool. The protocol required for communications with the external device (such as temperature controller and barcode reader) can be set easily using the engineering tool's communication protocol support function.	Page 1291 PREDEFINED PROTOCOL COMMUNICATIONS
Socket communications		×	○	Exchanges any data with an external device connected by Ethernet over TCP/IP or UDP/IP using dedicated instructions.	Page 1318 SOCKET COMMUNICATIONS
FTP function	FTP server	×	○	Reads/writes data in file units using the dedicated FTP commands from an external device.	Page 1345 FTP Server
	FTP client	×	○	Enables the controller, as an FTP client, to transfer files to an FTP server connected over Ethernet by using the file transfer function instructions.	Page 1367 FTP Client
Web server function		×	○	A function of software that provides the display of HTML and objects (such as images) in response to HTTP (Hyper Text Transfer Protocol) requests from clients (web browsers).	Page 1379 WEB SERVER FUNCTION
OPC UA server function		×	○	The external device with the OPC UA client function can access labels of the controller.	Page 1405 OPC UA Communication Function
Network setting change function		×	○	The network settings (such as IP address) of the controller is changed without changing the parameter settings.	Page 1430 Network Setting Change Function
DNS client function		×	○	Queries the DNS server for the IP address based on the server name set in the file transfer function (FTP client). Using the returned IP address, each client function performs communication processing.	Page 1437 DNS Client Function
Discard received data at CPU STOP		×	○	Discards received data from the communication destination when the status of the controller is changed from RUN to STOP (PAUSE).	Page 1438 Discard Received Data at CPU STOP

22.4 Data Collection

Function	Description	Reference
Data logging function	Collects data at a specified interval or a desired timing, and stores them as a file.	Page 1440 DATA LOGGING FUNCTION CPU Module Logging Configuration Tool Version 1 Operating Manual
Sequence scan synchronization sampling function	Collects device data of the controller in the END processing, and transfers them to the module that supports the corresponding function.	Page 1531 SEQUENCE SCAN SYNCHRONIZATION SAMPLING FUNCTION

22.5 Security

Classification	Description	Reference
Protection of information assets in the controller	Protection for information assets such as user programs stored in the controller is provided against theft, tampering, faulty operation, and unauthorized execution resulting from unauthorized access by an outsider.	Page 1536 PROTECTION OF INFORMATION ASSETS IN THE CONTROLLER
Protection of the network connected to the controller	Protection for the communication data flowing through an unprotected network connected to the controller is provided against eavesdropping and tampering resulting from unauthorized access by an outsider.	Page 1558 PROTECTION OF THE NETWORK CONNECTED TO THE CONTROLLER
Protection of operation by controller	Preset operations are performed when the controller detects an error due to receiving a DoS attack or similar issue.	Page 1591 PROTECTION OF CONTROLLER OPERATION

MEMO

PART 10 MOTION CONTROL

This part consists of the following chapters.

23 AXIS SETTING

24 AXIS MANAGEMENT FUNCTIONS

25 OPERATION CYCLE

26 START AND STOP

27 HOMING

28 AXIS CONTROL FUNCTIONS

29 DIRECT CONTROL

30 MOTION CYCLIC CONTROL

31 SYNCHRONOUS CONTROL

32 OPERATION PROFILE DATA FUNCTION

33 ADVANCED SYNCHRONOUS CONTROL

34 FUNCTIONS RELATED TO POSITION

35 FUNCTIONS RELATED TO VELOCITY

36 FUNCTIONS RELATED TO TORQUE

37 COMPENSATION FUNCTION

38 COMMAND FILTER

39 INPUT VARIABLE CHANGE IN EXECUTION

40 EXTERNAL SIGNAL SELECTION

41 TOUCH PROBE

42 DIGITAL CAM SWITCH

43 AXIS EMULATION

44 AXIS CONTROL WAIT

45 PROGRAM EXAMPLES

23 AXIS SETTING

23.1 Axis

In the motion system, the control target is called an axis. Axes are classified into real axes which target the drive units connected to the network and virtual axes which virtually generate commands and position in the motion system.

Classification	Axis type	Description
Real axis	Real drive axis	Uses the drive unit corresponding to the CiA402 drive profile connected to CC-Link IE TSN. It is counted as the number of control axes.
	Real encoder axis	Generates the current position from the synchronous encoder output pulse connected to the drive unit on the CC-Link IE TSN.
Virtual axis	Virtual drive axis	Virtually generates commands in the motion system. The real drive unit is not used.
	Virtual encoder axis	Generates the current position from the motion system variables. Used as an input axis for the single axis synchronous control.
	Virtual linked axis	Connects FBs of the single axis synchronous control. The minimum data required in the single axis synchronous control is defined.

Relevant variable

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)

Point

The underlined part of the variables described in this manual indicates that the variable name is user-defined.

AxisName.AxisRef.AxisNo

A variable to be defined by the user

Maximum number of controlled axes

The maximum number of axes controlled by the motion system is the number of real drive axes. Other types of axes are not counted in the number of axes.

Axis type	MXR300-16	MXR300-32	MXR300-64	MXR500-128	MXR500-256
Real drive axis*1	16 axes	32 axes	64 axes	128 axes	256 axes
Virtual drive axis	Up to 10000 axes can be set. The number of settable axes depends on the setting of the system memory capacity.*2 Axis assignment can be set from the axis setting window of the engineering tool. (Up to 1024 axes can be set.) ☞ Page 466 Axis Assignment				
Virtual linked axis					
Real encoder axis					
Virtual encoder axis					

*1 When a multi-axis drive unit and a general output device are used as multiple axes, the number of those axes is counted.
(Example) For a two-axis drive unit, the number of axes counted is two axes.

*2 For the memory capacity, refer to the following.
☞ Page 471 Memory usage

If the axis setting exceeds the maximum number of controlled axes, Maximum Setting Axis Number Over Warning (event code: 00F0BH) occurs.

The axis is used as the control axis sequentially which the axis is assigned as the axis variable to the global label data and the axis which exceeds the maximum number of controlled axes turns Axis Status (AxisName.Md.AxisStatus) to "-1: Axis variable uninitialization/Axis parameter error (Invalid)" and it cannot be used for the control.

Required settings for axes

Set the following items in the axis setting window of the engineering tool to set the axes. For axis setting methods, refer to the following.

☞ Page 466 Axis Assignment

Item	Description
Axis name	Sets an axis name.
Axis No.	Sets a control axis No. of the motion system.
Axis type	Sets the axis type.
Station address	Sets the station address of a drive unit related to the axis. When a multi-axis drive unit is used, the multidrop No. needs to be set as well.
Absolute position control setting	Sets the absolute position control method of axis.
Control cycle	Sets the cycle to execute control.

Other than above items, additional parameters must be set for each axis type.

For details on parameter settings, refer to the specifications of each axis type.

Axis variables

An axis is generated/initialized by the axis setting in the engineering tool. The set axis is assigned to the global label data as an axis variable.

The axis is defined as an axis variable configured with monitor information such as parameter information, current position, and status.

An axis variable data type changes depending on the axis type.

For the setting of the engineering tool, refer to the following.

Navigation window ⇨ [Motion Setting (CPU Built-in)] ⇨ [Axis] ⇨ Right-click ⇨ [Add New Data]

Axis variable name (default)

The following names are assigned based on the setting axis No. These can be changed to an arbitrary name. For details, refer to the following.

☞ Page 466 Axis Assignment

Setting axis No.	Engineering tool default axis name
1	Axis0001
2	Axis0002
⋮	⋮
10000	Axis10000

Data type

The following data types are assigned based on the axis type. For details on data type, refer to the relevant variables of each axis type.

Axis type	Data type
Real drive axis	AXIS_REAL
Real encoder axis	AXIS_ENCODER
Virtual drive axis	AXIS_VIRTUAL
Virtual encoder axis	AXIS_VIRTUAL_ENCODER
Virtual linked axis	AXIS_VIRTUAL_LINK

Each data type has the following members.

Member name	Data type	Description
AxisRef	AXIS_REF	A data structure for input/output of motion control FBs. The type is fixed regardless of the axis type.
PrConst	Differs by the axis type.	Stores the axis parameter data (constant). Opens the setting value at the axis variable initialization. Re-importing to the control data is not executed after axis variables initialization.
Pr		Stores the axis parameter data. Opens the default value at the axis variable initialization. The timing to import to the control changes depending on the parameter.
Md		Stores the axis monitor data. Data refresh is performed at a fixed interval for each monitor data.
Cd		Stores the axis control command data. Acquires the latest value every control operation cycle and uses it for the control.

Axis variable initialization timing

Axis variables are initialized at the following timing.

Timing	Processing
At power supply When the controller is reset	Refers to the global label data, and initializes all set axis variables.
When PLC READY (MotionSystem.Cd.SequenceReady) is turned on	■Uninitialized axes Refers to the global label data and initializes all axes variables. ■Initialized axes Refer to the global label data for the axis parameter data and reload again. When the parameter error occurs at loading, the axis is not deleted. At this time, built-in motion ready [X20] does not turn on. For the label initialization processing when PLC READY (MotionSystem.Cd.SequenceReady) is turned on, refer to the following. ☞ Page 426 DEVICE/LABEL INITIAL VALUE SETTINGS

For a real axis, the device network connection is required to actually operate an axis after the axis variable is initialized. If the device of the station address has been connected, it must be disconnected and then reconnected. (The axes can be emulated without network connection. (☞ Page 1186 AXIS EMULATION))

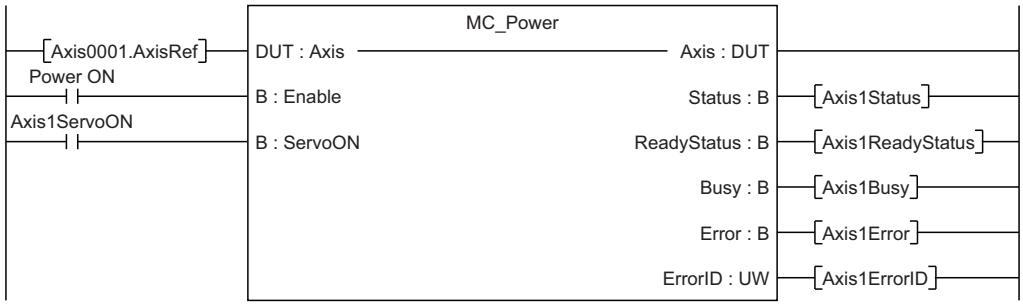
How to specify in a user program

When specifying the axis by the motion control FB, set the AXIS_REF type member (AxisName.AxisRef) of the axis variable to the I/O variables whose data type is "AXIS_REF".

Ex.

When executing the MC_Power (Operation Available) with the following conditions:

- Axis type: Real drive axis
- Axis No.: 1
- Axis name: Axis0001



Axis status

Axis state transition

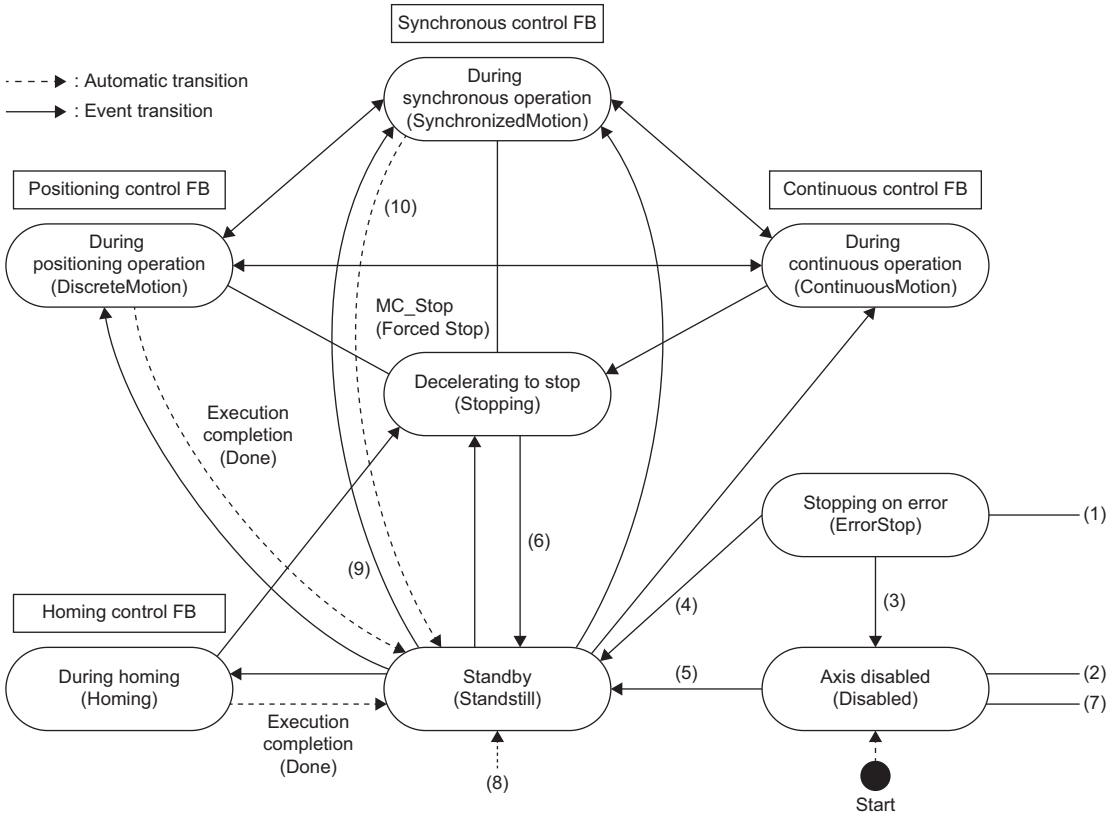
The following shows the status that a single axis can be in.

The current status can be checked in Axis Status (AxisName.Md.AxisStatus) or in MC_ReadStatus (single axis status reading).

Status	Description
-1: Axis variable uninitialization/Axis parameter error (Invalid)	Axes cannot be used in this status due to axis variable uninitialization (parameter error occurrence at an initialization or other factors).
0: Axis disabled (Disabled)	The status where the axis cannot be used. For a real drive axis, this status indicates the servo OFF stop. For a real axis, this status occurs also when the device station is disconnected from the network.
1: Stopping on error (ErrorStop)	The status where the deceleration stop or stop by error occurrence. For a real drive axis, the axis is servo ON or servo OFF depending on the error.
2: Decelerating to stop (Stopping)	The status where the deceleration stop has been executed by MC_Stop (Forced Stop). After the axis stop is completed, this status continues until the Execution command (Execute) of MC_Stop (Forced Stop) changes to FALSE. Motion control FBs cannot be executed in this status.
3: During home position return (Homing)	The status where homing has been executed in the drive unit or the motion system by the homing control FB.
4: Standby (Standstill)	The status where the motion control FB can be used. For a real drive axis, the axis is servo ON stop.
5: During positioning operation (DiscreteMotion)	The status where the positioning operation has been executed by the positioning control FB.
6: During continuous operation (ContinuousMotion)	The status where the continuous control has been executed by the continuous control FB (such as the FB of speed control and torque control) or the manual control FB.
7: During synchronous operation (SynchronizedMotion)	The status where the axis synchronizes with the master axis by the single axis synchronous control FB. The status transits to this status after the axes group set as the configuration axes changes to the "5: Operating (GroupMoving)" status.

The status transits as shown below according to the start of the motion control FB. The state transition may varies depending on the axis type. For the specifications of each axis type, refer to the following.

☞ Page 449 Axis Type



No.	State transition description
(1)	From any state, the status transits when an error occurs on the axis.
(2)	• From any state, the status transits when Enable (Enable) of MC_Power (Operation Available) is FALSE, and no error occurs on the axis. • Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and no error occurs in the axis. • Transits when Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "0: Ignore (Ignore)" and Servo ON request (ServoON) of MC_Power (Operation Available) turns to FALSE from "2: Decelerating to stop (Stopping)".*1
(3)	Transits by the status error cancel for the error reset command during the servo OFF state.
(4)	Transits by the status error cancel for the error reset command during the servo ON state.
(5)	Transits when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.
(6)	Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execution command (Execute) of MC_Stop (Forced Stop) is FALSE.
(7)	• From "4: Standby (Standstill)", the status transitions when the forced servo OFF is enabled by the drive unit. • From "4: Standby (Standstill)", the status transitions when the drive unit fails to communicate.
(8)	Transits automatically when the virtual axis is enabled.
(9)	Transits when the axes group used as configuration axes changes to "5: Operating (GroupMoving)".
(10)	The conditions for transition differ depending on the function. Refer to the state transition of each function.

*1 The axis status does not transit until the axis is stopped completely. After the axis stops completely, the status transits to "0: Axis disabled (Disabled)". For details, refer to the following.

☞ Page 578 Stop

Single axis status reading

Axis variables can also be read by the motion control FB.

Function block symbol	Process description
MC_ReadStatus	Acquires the state transition status of the specified axis.

For details on how to read the data using the motion control FB, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Restriction

Before using this function, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

Precautions

Out of parameter range (axis) (error code: 1A60H) occurs if a parameter error occurs at the axis variable initialization. At this time, Axis Status (AxisName.Md.AxisStatus) will be "-1: Axis variable uninitialization/Axis parameter error (Invalid)". The monitor data and other items of the axis where "-1: Axis variable uninitialization/Axis parameter error (Invalid)" occurred are not refreshed. If the axis is specified by the user program, Out of axis No. range (error code: 1B82H) occurs.
Deleting an axis or axes group variable by writing to the controller (including online program change) causes an Invalid write to the controller (error code: 3408H). Then, the motor will immediately stop due to the setting. Note that immediate stop may damage the machine.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- NetworkDriver_CCIETSN*1
- ServoDriver_CANopen*1

*1 When using the real axis

System memory capacity

For details, refer to the following.
☞ Page 471 Memory usage

23.2 Axis Type

Relevant variables

Real drive axis data type AXIS_REAL members (excluding AxisRef)

■Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. ☞ Page 466 Axis type
AddressOfStation	Station Address Setting	Sets the station address (IP address) with a character string. ☞ Page 467 Station address
OperationCycle	Control Cycle Setting	Sets the control operation cycle. ☞ Page 467 Control Cycle
SlaveObject	Object Data	Sets the object of the device station. Only [OBJ] and [CONST] can be set as the data type. ☞ Page 456 Object data settings

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
UseInGroup	Using Axes Group	Displays whether the axis is being used in the axis group or not. • FALSE: Not used • TRUE: Used
Io_PosActualValue	Object Data_PosActualValue	Displays the value of object data Position actual value (6064H). ☞ Page 469 Object data settings
Io_Statusword	Object Data_Statusword	Indicates a value of object data_Statusword. Displays the value of object data Statusword (6041H). ☞ Page 469 Object data settings
Io_TargetPos	Object Data_TargetPos	Displays the value of object data Target position (607AH). ☞ Page 469 Object data settings

Real encoder axis data type AXIS_ENCODER members (excluding AxisRef)

■Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. ☞ Page 466 Axis type
AddressOfStation	Station Address Setting	Via drive unit: Sets the same station address as the real drive axis that the encoder is connected.
Encoder_AxisType	Real Encoder Axis Type Setting	Sets the type of the real encoder axis. • 1: Via drive unit (Drive)
Encoder_CounterDisableSignal	Counter Disabling Signal	Sets the signal to switch to the counter disable. ☞ Page 504 Follow Up

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill)
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the encoder. • FALSE: Counter enabled • TRUE: Counter disabled
Io_Statusword	Object Data_Statusword	Displays the synchronous encoder status emulated by the motion system.
Io_PosActualValue	Object Data_PosActualValue	Displays the input pulse value [encoder pulse unit] acquired from the synchronous encoder.
Io_PosEncoderResolution	Object Data_PosEncoderResolution	Displays the synchronous encoder resolution. Reads the value from the setting location when the drive unit is connected.

Virtual drive axis data type AXIS_VIRTUAL members (excluding AxisRef)

■Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. ☞ Page 466 Axis type
OperationCycle	Control Cycle Setting	Sets the control operation cycle. ☞ Page 467 Control Cycle

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
Io_TargetPos	Object Data_TargetPos	Displays a value which is converted into the command value in a driver unit from the cumulative current position.

Virtual encoder axis data type AXIS_VIRTUAL_ENCODER members (excluding AxisRef)

■Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. ☞ Page 466 Axis type
Encoder_CounterDisableSignal	Counter Disabling Signal	Sets the signal to switch to the counter disable. ☞ Page 504 Follow Up
Encoder_RingCout_LowerValue	Encoder Ring Counter Lower Limit Value	Sets the encoder ring counter lower limit value. ■One-word PosActualValue -32768 to 32767*1 ■Two-word PosActualValue or omits PosActualValue -2147483648 to 2147483647
Encoder_RingCout_UpperValue	Encoder Ring Counter Upper Limit Value	Sets the encoder ring counter upper limit value. ■One-word PosActualValue -32768 to 32767*1 ■Two-word PosActualValue or omits PosActualValue -2147483648 to 2147483647
SlaveObject	Object Data	Sets the object of the device station.
PosActualValue	PosActualValue	Sets the data storing synchronous encoder input. • One-word specified: -32768 to 32767 • Two-word specified: -2147483648 to 2147483647

*1 If a value outside the 1-word range is set, Out of parameter range (axis) (error code: 1A60H) occurs.

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill)
Encoder_Connected	Connection Status	Displays the virtual encoder axis connection status. • FALSE: Not connected • TRUE: Connected
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the encoder. • FALSE: Counter enabled • TRUE: Counter disabled
Io_PosActualValue	Object Data_PosActualValue	Displays the value [encoder pulse unit] acquired from the encoder input.
Io_PosEncoderResolution	Object Data_PosEncoderResolution	Displays the synchronous encoder resolution.

■Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
Encoder_Connect	Connection Command	The signal for enabling the connection status of the virtual encoder axis input. • FALSE: Disabled • TRUE: Enabled
Encoder_InputValue	Encoder Input Value	Sets the value sequentially used as the virtual encoder axis input value.

Virtual linked axis data type AXIS_VIRTUAL_LINK members (excluding AxisRef)

■Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. ☞ Page 466 Axis type
OperationCycle	Control Cycle Setting	Sets the control operation cycle. ☞ Page 467 Control Cycle

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)

Real drive axis

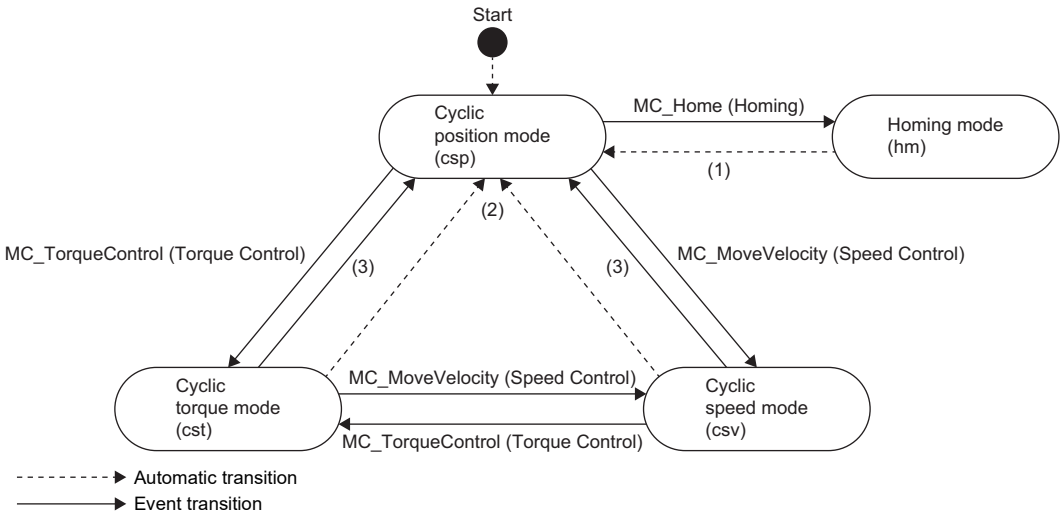
This axis uses the drive unit which is compatible with the CiA402 drive profile connected to CC-Link IE TSN.
It is counted as the number of control axes.

Driver control mode transition

A drive unit connected as a real drive axis follows the CiA402 drive protocol, and changes the control mode according to the "Modes of operation" object output from the motion system. The drive unit inputs the current control mode as the "Modes of operation display" object in the motion system and displays it in Driver Control Mode (AxisName.Md.Driver_Mode).
The motion system supports the operation of the following control modes.
Control modes other than the ones shown below are available for some drive units. (☞ Page 2165 Driver control mode)

Supported control mode		Description	Reference
Homing mode (hm)	6: hm	Executes homing operation by a driver.	Page 620 Driver homing method
Cyclic position mode (csp)	8: csp	Executes control following the sequential positioning command from the controller in each communication cycle.	Page 710 DIRECT CONTROL
Cyclic velocity mode (csv)	9: csv	Executes control following the velocity command from the controller in each communication cycle.	
Cyclic torque mode (cst)	10: cst	Executes control following the torque command from the controller in each communication cycle.	

The control mode of the drive unit must be cyclic synchronous position mode (csp) when the unit is connected.
Control mode switching of the drive unit is executed at the same time when the motion control FB is executed. The state transition is shown below.



No.	State transition description
(1)	Transits after the axis is stopped by homing completion or error occurrence.
(2)	Transits at stop completion or error occurrence.
(3)	Transits when operation system FBs (such as positioning control FBs) are multiple started in the cyclic synchronous position mode (csp).

Parameter setting items

Set values for drive units being used as shown below.

• MELSERVO

Do not change the values from the initial values.

• Drive units other than the MELSERVO

Refer to the manuals for each drive unit.

Set values as shown in the following setting value format.

Data type	Setting value format
[OBJ]*1	[OBJ] 0xXXXXYYZZ (hexadecimal) XXXX: Specify the index. YY: Specify the subindex. ZZ: Specify the size (in bits). (Set any of 08, 10, or 20.) If the values are not set as shown in the format, Out of parameter range (axis) (error code: 1A60H) will occur.
[CONST]*2	[CONST] Constant (decimal) [CONST] 0xConstant (hexadecimal) If the values are not set as shown in the format, Out of parameter range (axis) (error code: 1A60H) will occur.
Other than [OBJ] and [CONST]	No settings are available. If settings are configured, Object Data Setting Incorrect (error code: 1AEEH) will occur.

*1 If an overlap of setting values of object data in the same axis occurs, intended data cannot be received or sent because object data and object cannot be linked with each other. Therefore, the function using the object data cannot operate normally.

*2 Regarding the object data with [CONST] set as the data type, the set constant is used for operation without using the value received via PDO from the device station. The set constant is not sent to the device station via PDO.

Precautions

If the axis parameter has an error when the controller power is turned on with the drive unit being connected, the faulty axis will not be generated, and the drive unit will be connected as a module that is not controlled by the motion system.

In this state, if the axis parameter is reviewed and the PLC READY (MotionSystem.Cd.SequenceReady) is turned on again, the axis is generated, but the drive unit cannot be connected as an axis.

To connect the drive unit as an axis, power on the controller and the drive unit again.

Real encoder axis

Generates the current position from the synchronous encoder output pulse connected to the drive unit on the CC-Link IE TSN. This will be used at the "single axis synchronous control".

This axis can control the synchronous encoder shown below as the real encoder axis.

Real encoder axis type	Description
Via drive unit	Uses the following synchronous encoder connected to the drive unit (such as the MR-J5(W)-G) corresponding to the scale measurement function as the real encoder axis. • HK-KT, HK-MT servo motor encoder

Point

When the linear encoder and phase ABZ differential output type rotary encoder are connected to the drive unit, use the encoders as virtual encoder axes. For details, refer to the following.

☞ Page 461 Virtual encoder axis

Parameter setting items

Set the following items to use the real encoder axis.

○: Necessary, △: Optional, —: Unnecessary, ●: Necessary for the same station address real drive axis

Setting item		Real encoder axis type	Reference
		Via drive unit	
Axis No.		○	Page 466 Axis No.
Axis type		○	Page 466 Axis type
Real Encoder Axis Type Setting		○	Page 456 Real encoder axis type setting
Station address		○	Page 456 Station address Page 467 Station address
Absolute Position Control Setting		○	Page 467 Absolute Position Control Setting
Control cycle		○	Page 467 Control Cycle
Object Data Setting	Encoder status 2	●	Page 456 Object data settings Page 469 Object data settings
	Scale ABS counter	●	
	Scale cycle counter	●	
	Scale measurement encoder Resolution	●	
	Scale measurement encoder reception status	●	
Driver Unit Conversion Numerator		○	Page 1130 Driver Unit Conversion Function
Driver Unit Conversion Denominator		○	
Position Command Unit setting		○	Page 490 Units
Velocity Command Unit setting		○	
Command unit string		○	
Ring Counter Enabled Selection		○	Page 496 Positioning Range
Ring Counter Upper Limit Value		△	
Ring Counter Lower Limit Value		△	
Counter Disabling Signal		△	Page 504 Follow Up

Real encoder axis type setting

Sets the synchronous encoder type which will be the origin of generating the real encoder axis input value.

Setting value	Description
1: Via drive unit (Drive)	Uses the synchronous encoder input value via drive unit connected to the specified drive unit as the synchronous encoder input.

To use via drive unit type, set the real drive axis of the same station address and assign the required objects listed below.

☞ Page 456 Object data settings

For details on the real drive axis setting method, refer to the following.

☞ Page 466 Axis Assignment

Station address

Depending on the real encoder axis type, set the following.

Real encoder axis type	Applicable device set as station address
Via drive unit	Drive unit connected with the synchronous encoder

For details on the setting value, refer to the following.

☞ Page 466 Axis Assignment

Object data settings

Depending on the real encoder axis type, set the following.

Real encoder axis type	Setting item	Object to be set	Description*1
Via drive unit	Real drive axis of the same station address*3	Encoder status 2	Specify the object ID storing the drive unit scale measurement function setting. • bit 0: Scale measurement function ABS system correspondent • bit 1: Scale measurement function * Valid when TRUE Reads the value from the setting location when connecting to the drive unit. When bit 1 is FALSE, Synchronous encoder via drive unit setting incorrect (error code: 1AEAH) occurs.
		Scale ABS counter*2	Specify the object ID storing the current synchronous encoder multiple revolution counter. ■Setting range Handled as -32768 to 32767.
		Scale cycle counter*2	Specify the object ID storing the current synchronous encoder position within one revolution. ■Setting range 0 to the range specified by the scale measurement encoder resolution.
		Scale measurement encoder Resolution	Specify the object ID storing the synchronous encoder resolution. The synchronous encoder with setting value 0 cannot be connected.
		Scale measurement encoder reception status*2	Specify the object ID storing the alarm information of the scale measurement encoder. • bit 0: CPU alarm • bit 1: LED alarm • bit 2: Data alarm • bit 5: Multi-revolution counter alarm • bit 6: ABS erased alarm * When TRUE, corresponding alarm occurs

*1 For details on the setting value, refer to the following.
☞ Page 1158 TARGET_REF Structure

*2 If all of the object data are not assigned to PDO, Synchronous encoder via drive unit setting incorrect (error code: 1AEAH) occurs.

*3 If the required objects are not set for object data, Synchronous encoder via drive unit setting incorrect (error code: 1AEAH) occurs.

Functions required

The following are the functions required to use the real encoder axis.

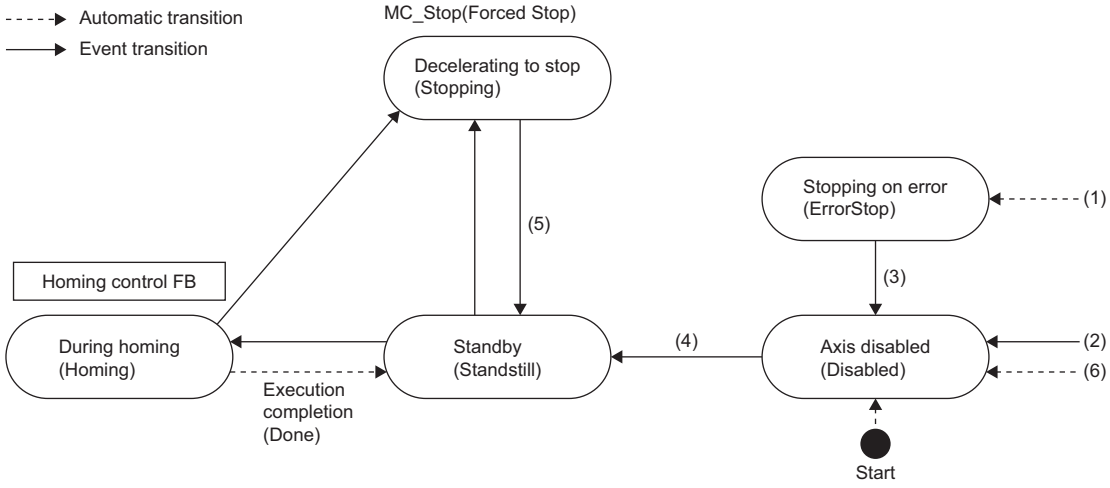
Function		Reference	Axis type specific detailed information
Axis assignment		Page 466 Axis Assignment	—
Unit		Page 490 Units	—
Compensation function	Driver unit conversion function	Page 1130 Driver Unit Conversion Function	—
Absolute position control		Page 510 Absolute Position Control	—
Operation cycle		Page 522 OPERATION CYCLE	—
State transition	Single axis state transition	Page 457 Single axis state transition	Page 457 State transition
Follow-up (counter enabled/counter disabled)		Page 504 Follow Up	—
Servo ON/OFF		Page 501 Servo ON/OFF	—
Ring counter setting		Page 496 Positioning Range	—
Control change function	Current position change function	Page 1054 Current Position Change Function	Page 458 Control change function
Command filter	Smoothing filter	Page 1133 COMMAND FILTER	—
	Moving direction restriction filter		—

For other functions, refer to each function and check the required object data for the function. If the axis holds the required object data, the function is valid.

State transition

■Single axis state transition

The real encoder axis (via drive unit) transits to the status shown below.



No.	State transition description
(1)	Transits from any state when an error of the axis occurs.
(2)	• Transits from any state when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is FALSE and no error occurs in the axis. • Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and no error occurs in the axis.
(3)	Transits by the status error cancel for the error reset command during the servo OFF state.
(4)	After the real drive axis with the same station address is connected, the status transits when Enable (Enable) of MC_Power (Operation Available)/ MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.
(5)	Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execution command (Execute) of MC_Stop (Forced Stop) is FALSE.
(6)	Transits from any state other than the "1: Stopping on error (ErrorStop)" status when the real drive axis which is the same station address is not to be connected.

Point

- Follow-up is executed for "4: Standby (Standstill)" or "3: During homing (Homing)".
- Follow-up is disabled in "0: Axis disabled (Disabled)", "1: Stopping on error (ErrorStop)", and "2: Decelerating to stop (Stopping)". For the set position when follow-up is disabled, refer to the following.

☞ Page 506 Disabling follow up

- When encoder alarm information is received from the real drive axis to which the encoder is connected, communication error of connected encoder (error code: 1B17H) occurs and the real encoder axis is disconnected. Check the real drive axis and remove the cause of the error, then connect the real drive axis again.

Control change function

When starting the current position change control unconditionally, use the MC_SetPosition (Current Position Change).

Point

To use the control change function by the real encoder axis, Axis Status (AxisName.Md.AxisStatus) of the real encoder axis is required to be set as "4: Standby (Standstill)" by Servo ON/OFF function.

Setting example

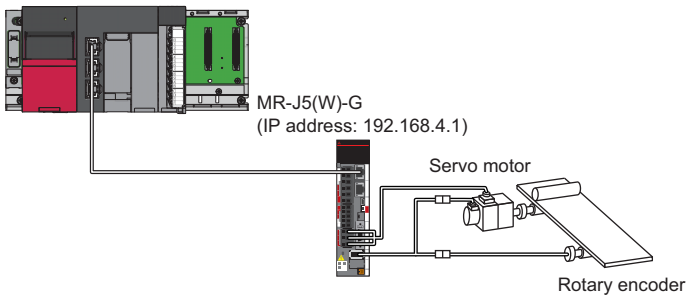
The setting example of the real encoder axis is shown below.

[Via drive unit]

Depending on the connected drive unit or version, available functions and encoders are restricted. For details, refer to the manuals for the drive unit used.

Ex.

To use the scale measurement device of real drive axis 1 (MR-J5(W)-G station address: 192.168.4.1) as the input of real encoder axis 2



■Axis setting

Setting item	Axis setting	
	Real drive axis setting	Real encoder axis setting
Axis No.	1	2
Axis type	0: Real drive axis (DriveAxis)	2: Real encoder axis (EncoderAxis)
Real Encoder Axis Type Setting	Unnecessary	1: Via drive unit (Drive)
Station address	192.168.4.1	192.168.4.1 (Specify the station address of the drive unit that the synchronous encoder is connected.)
Absolute Position Control Setting	-1: Automatic Setting (Acquire from Connected Device) (Auto)	Optional*1
Control Cycle	0	0*2

*1 Set the setting that matches with the setting of the synchronous encoder and drive unit side to be connected. When "-1: Automatic Setting (Acquire from Connected Device) (Auto)" is set, the absolute position system setting is acquired from the drive unit side.

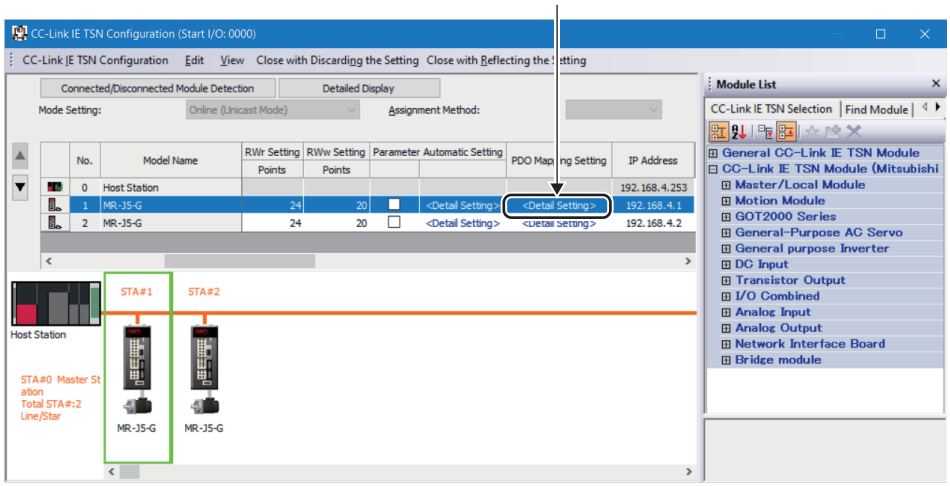
*2 The data refresh cycle of the synchronous encoder is the control cycle of the connected real drive axis and the axis control may not be executed by each data refresh cycle when it differs with the real encoder axis setting. Thus, It is recommended that the real encoder axis control cycle is set as the same cycle as the connecting real drive axis.

■PDO mapping setting

Regarding the network configuration setting of GX Works3, set all three objects of the following to the PDO mapping (TxPDO) of the real drive axis 1 (MR-J5(W)-G station address: 192.168.4.1).

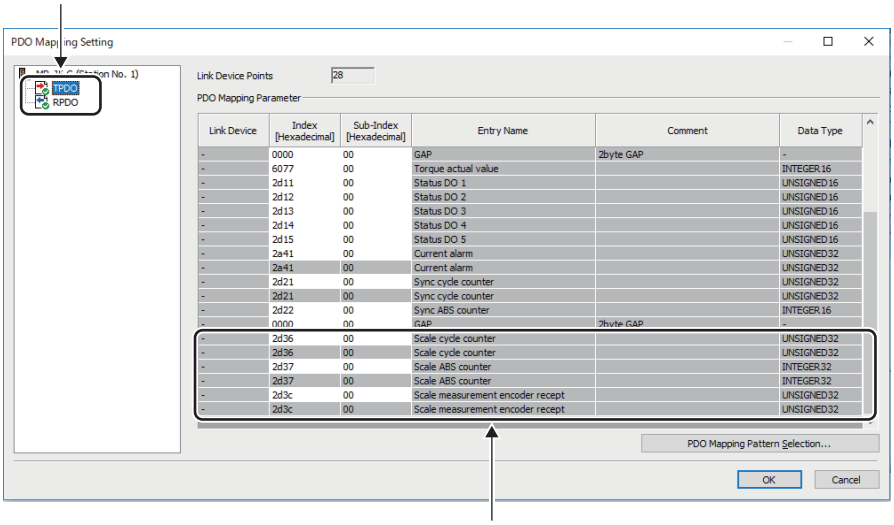
- Scale cycle counter (Index: 2d36, subindex: 00)
- Scale ABS counter (Index: 2d37, subindex: 00)
- Scale measurement encoder reception status (Index: 2d3c, subindex: 00)

Executes PDO mapping setting to the first station to use the scale measurement device of the first station as an input of the real encoder axis 2.



Change "RWr Setting" and "RWw Setting" to the required number of points in the PDO mapping setting.

The setting window of TPDO and RPDO can be switched here.
Select TPDO.



Add required objects via drive unit.

■Drive unit side (MR-J5(W)-G) setting

To enable the scale measurement function on the MR-J5(W)-G, set the parameter below.

For details on the parameter and connection method of the encoder, refer to the manual of the drive unit used.

No.	Abbreviation	Name	Overview
PA22.3*1	**PCS	Scale measurement function selection	Select scale measurement function. • 0: Invalid (initial setting) • 1: Use with absolute position detection system • 2: Use with incremental system

*1 Available since MR-J5(W)-G (version A5)

Precautions

The following behavior occurs when PE51 is set to a value other than 0 for the phase ABZ differential output type rotary encoder.

- The Scale cycle counter changes suddenly when phase Z is passed for the first time.
- If PE51 is set to an incorrect encoder resolution, the Scale cycle counter value may become invalid.

■Axis setting

Setting item	Axis setting	
	Real drive axis setting	Virtual encoder axis setting
Axis No.	1	4
Axis type	0: Real drive axis (DriveAxis)	4: Virtual Encoder Axis (VirtualEncoderAxis)
Station address	192.168.3.1	Unnecessary
Encoder Ring Counter Upper Limit Value*1	Unnecessary	0
Encoder Ring Counter Lower Limit Value*1	Unnecessary	0
Absolute Position Control Setting	-1	0: Disable Absolute Position System (ABSDisabled)
Control Cycle	0	0
Object Data Setting_PosActualValue	Unnecessary	[VAR](DWORD)MR_J5_G_RJ_001_ScaleCycleCounter

*1 Set the values to fall within the range of the Scale cycle counter.
When the range of the Scale cycle counter is from 0 to 4294967295, the setting will be valid by setting the encoder ring counter upper limit value and the encoder ring counter lower limit value to the same value.
Setting example: Because the range of the Scale cycle counter is from 0 to 4294967295, set the Encoder Ring Counter Upper Limit Value and Encoder Ring Counter Lower Limit Value to 0.

Virtual drive axis

This axis can generate commands virtually in the motion system. The real drive unit is not used. The available commands/functions are partly different from those of the real axis.

Point

Since the virtual drive axis is specialized for generating the position command and it does not simulate a situation that the drive unit is connected, available functions are restricted. For simulating the operation close to the state when the drive unit is connected, use the axis emulation function for the real drive axis. For details, refer to the following.

☞ Page 1186 AXIS EMULATION

Virtual encoder axis

Generates the current position from the motion system variables. Used as an input axis for the single axis synchronous control.

Parameter setting items

Set the following items to use the virtual encoder axis.

○: Necessary, △: Optional, —: Unnecessary

Setting item		Virtual encoder axis	Reference
Axis No.		○	Page 466 Axis No.
Axis type		○	Page 466 Axis type
Station address		—	—
Absolute position control setting		○	Page 467 Absolute Position Control Setting
Control cycle		○	Page 467 Control Cycle
Object Data Setting	PosActualValue	△	Page 462 Object data settings
Driver Unit Conversion Numerator		○	Page 1130 Driver Unit Conversion Function
Driver Unit Conversion Denominator		○	
Position Command Unit setting		○	Page 490 Units
Velocity Command Unit setting		○	
Command unit string		○	
Ring Counter Enabled Selection		○	Page 496 Positioning Range
Ring Counter Upper Limit Value		△	
Ring Counter Lower Limit Value		△	
Encoder Ring Counter Upper Limit Value		○	Page 462 Encoder ring counter upper limit value/lower limit value
Encoder Ring Counter Lower Limit Value		○	
Counter Disabling Signal		△	Page 504 Follow Up

Object data settings

Set the following.

Object to be set	Description
PosActualValue	Set the string format data used as the encoder input value.*1 Use "Encoder Input Value (AxisName.Cd.Encoder_InputValue)" as the encoder input value when omitted. Set the encoder input value sequentially by encoder pulse unit. • Only [VAR], [DEV], and [CONST] can be specified for the type. If the setting value is not within the valid range, Out of parameter range (axis) (error code: 1A60H) occurs. • When [VAR] type is set, specify the data type to be (INT), (DINT), (WORD) or (DWORD) data. If the data type is other than the above, Out of parameter range (axis) (error code: 1A60H) occurs. • When [DEV] or [CONST] type is set, specify the data type to be (INT), (DINT), (WORD) or (DWORD). If the data type is not specified or the data type is other than the above, Out of parameter range (axis) (error code: 1A60H) occurs. • When [VAR] type is used, do not specify the local label.

*1 For details on the setting value, refer to the following.
☞ Page 1158 TARGET_REF Structure

Encoder ring counter upper limit value/lower limit value

Sets the upper limit value and lower limit value of the encoder input value.
Set the encoder ring counter lower limit value and encoder ring counter upper limit value in accordance with the lower limit value/upper limit value of the encoder input value. If the range of the encoder input value and "the encoder ring counter lower limit value to the encoder ring counter upper limit value" differ, the encoder input value will not be read correctly.
If the encoder ring counter upper limit value = encoder ring counter lower limit value is set, the encoder input value is processed as the 32-bit counter of "-2147483648 to 2147483647" or as the 16-bit counter of "-32768 to 32767".
If the encoder ring counter lower limit value > the encoder ring counter upper limit value, Out of encoder ring counter setting range (error code: 1B13H) occurs.

Point

- For the encoder input value, set the cycle counter of "the encoder ring counter lower limit value ≤ the encoder input value ≤ the encoder ring counter upper limit value" as the input value. If the encoder input value is out of the above range, the encoder input value will not be read.
- Set the encoder input value that one operation cycle movement amount meets the following equation. If it does not meet, the actual input movement amount and the movement amount counted by the motion system may not match.

$$\text{One operation cycle movement amount} < \frac{|\text{Encoder ring counter upper limit value} - \text{Encoder ring counter lower limit value} + 1|}{2}$$

- If the encoder input value is out of range of "the encoder ring counter lower limit value to the encoder ring counter upper limit value" when it is connected to the encoder, the encoder current value will restore as below.
  · Absolute position system: Restore to the backup data value
  · Incremental system: Clamp by the encoder ring counter upper limit value/lower limit value

Functions required

The following are the functions required to use the virtual encoder axis.

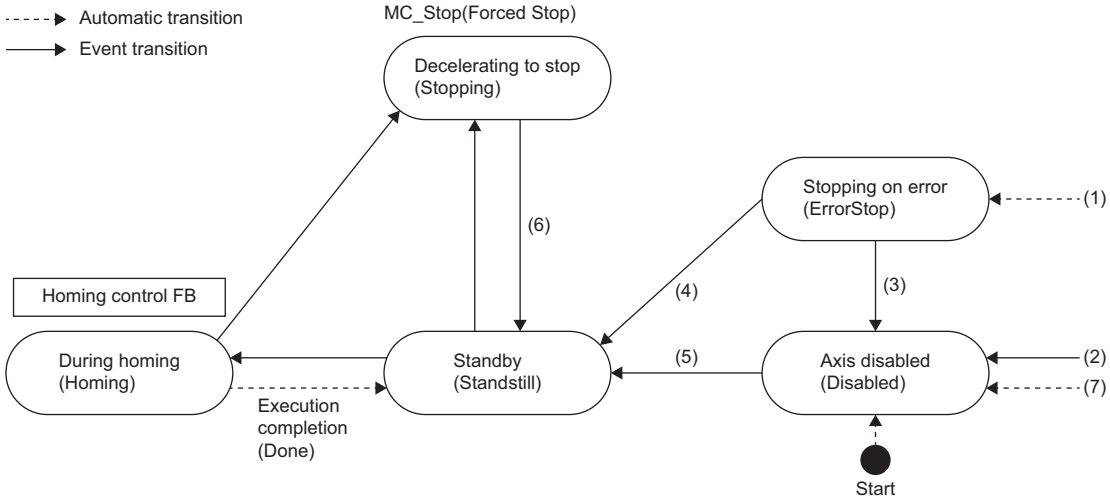
Function		Reference	Axis type specific detailed information
Axis assignment		Page 466 Axis Assignment	—
Unit		Page 490 Units	—
Compensation function	Driver unit conversion function	Page 1130 Driver Unit Conversion Function	—
Absolute position control		Page 510 Absolute Position Control	—
Operation cycle		Page 522 OPERATION CYCLE	—
State transition	Single axis state transition	Page 463 Single axis state transition	Page 463 State transition
Follow-up (counter enabled/counter disabled)		Page 504 Follow Up	—
Ring counter setting		Page 496 Positioning Range	—
Control change function	Current position change function	Page 1054 Current Position Change Function	Page 458 Control change function
Command filter	Smoothing filter	Page 1133 COMMAND FILTER	—
	Moving Direction Restriction Filter		—

For other functions, refer to each function and check the required object data for the function. If the axis holds the required object data, the function is valid.

State transition

■Single axis state transition

The virtual encoder axis transits to the following state.



No.	State transition description
(1)	Transits from any state when an error of the axis occurs.
(2)	• Transits from any state when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is FALSE and no error occurs in the axis. • Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and no error occurs in the axis.
(3)	Transits by the status error cancel for the error reset command during the servo OFF state.
(4)	Transits by the status error cancel for the error reset command during the servo ON state.
(5)	After Connection Command (AxisName.Cd.Encoder_Connect) is set to TRUE, the status transits when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.
(6)	Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execution command (Execute) of MC_Stop (Forced Stop) is FALSE.
(7)	Transits from any state other than the "1: Stopping on error (ErrorStop)" status when Connection Command (AxisName.Cd.Encoder_Connect) is FALSE.

Point

- Follow-up is performed in "4: Standby (Standstill)" and "3: During homing (Homing)".
- Follow-up is disabled in "0: Axis disabled (Disabled)", "1: Stopping on error (ErrorStop)", and "2: Decelerating to stop (Stopping)". For the set position when follow-up is disabled, refer to the following.

☞ Page 506 Disabling follow up

Control change function

When starting the current position change control unconditionally, use the MC_SetPosition (Current Position Change).

Restriction

The encoder input value will be read by every virtual encoder axis control cycle. When the encoder input value update cycle is slow, the velocity change increases. Use the smoothing filter to smooth the velocity change.

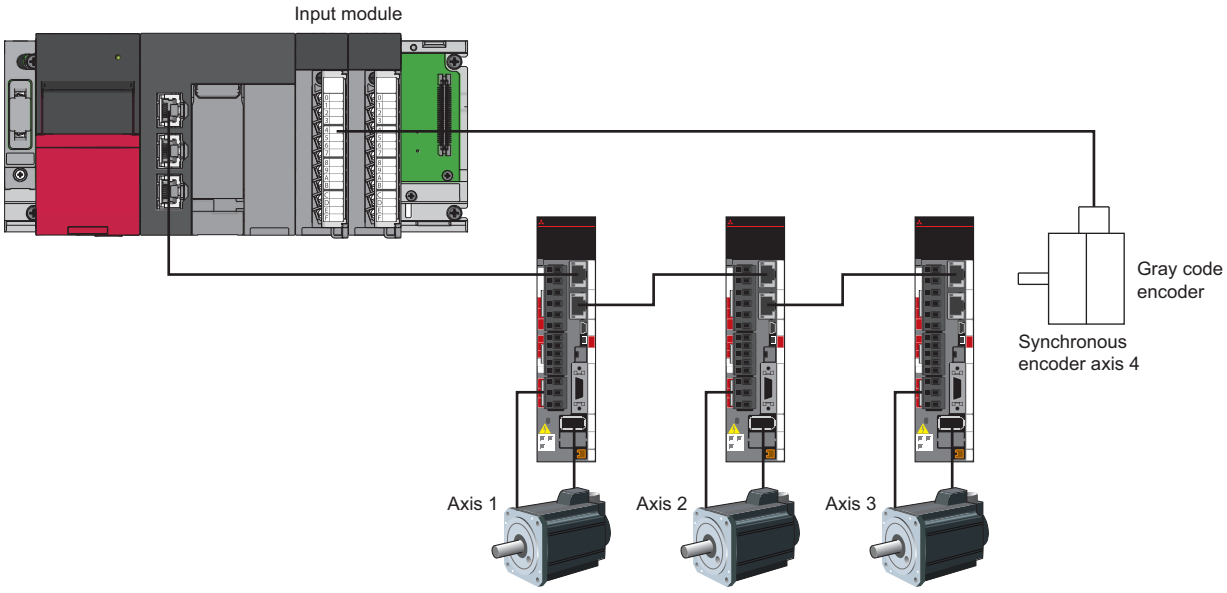
Setting example

The setting example of the virtual encoder axis and the method of use are shown below.

Ex.

When the axis 4 is used as the virtual encoder axis.

(Gray code encoder connected to the input module: The resolution 4096 [pulse/rev] encoder value is used to control.)



■Axis setting

Setting item	Setting value
Axis No.	4
Axis type	4: Virtual Encoder Axis (VirtualEncoderAxis)
Absolute Position Control Setting	0: Disable Absolute Position System (ABSDisabled)
Encoder Ring Counter Upper Limit Value*1	4095
Encoder Ring Counter Lower Limit Value*1	0
Object data_PosActualValue	[DEV](DINT)G11478000

*1 Set the value according to the resolution of the gray code encoder.

■How to use virtual encoder axis

1. Set Connection Command (AxisName.Cd.Encoder_Connect) to TRUE.
2. Check that Current Position Restoration Status (AxisName.Md.PosRestoration_Status) is "2: Restoration Completed in Incremental System (RestoredInIncSystem)" and Connection Status (AxisName.Md.Encoder_Connected) is TRUE.
3. Set Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) and Servo ON request (ServoON) to TRUE.
4. Check that Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
5. Read the encoder value of the gray code encoder by program, update the device setup on PosActualValue with object data setting sequentially. (The virtual encoder axis will be controlled based on the change amount of PosActualValue.)

Virtual linked axis

This axis connects FBs of single axis synchronous control. Since the minimum data for FB connection is defined, the processing load is reduced compared to the FB connection using, for example, a virtual drive axis.

How to generate an axis

Set it according to axis assignment. For the axis assignment method, refer to the following.

☞ Page 466 Axis Assignment

Precautions

- Software stroke limit cannot be set in the virtual linked axis. When virtual linked axes are used to connect between each user program of single axis synchronous control, set the software stroke limit in the end axis of connected single axis synchronous control.
- When temporarily generated axis is started, it will take longer than the usual to start the axis because the axis variables are generated in the motion service processing.

23.3 Axis Assignment

Axes are generated/initialized by setting axis settings on the axis setting window in the engineering tool. The axes set on the axis setting window are assigned to the global label as axis variables. For the setting method, refer to Help of the engineering tool.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

Setting item

The items set to the axis type are shown below.

○: Necessary, —: Unnecessary

Axis type	Setting item					
	Axis name	Axis No.	Axis type	Station address	Absolute position control setting	Control cycle
Real drive axis	○	○	○	○	○	○
Real encoder axis	○	○	○	○	○	○
Virtual drive axis	○	○	○	—	○	○
Virtual encoder axis	○	○	○	—	○	○
Virtual linked axis	○	○	○	—	○	○

■Axis Name

Set an arbitrarily axis name of the applicable axes within 127 characters.

An instance is generated as the set axis name.

■Axis No.

It is an identifier on the motion system control.

If the same No. is set in the multiple axes, Axis No. setting duplication error (error code: 1AEBH) will occur.

Axis setting	Axis No.
User specification	1 to 10000
Virtual linked axis generated automatically	20001 to 30000

■Axis type

Specify an axis type of the axis.

Axis type	Setting value
Real drive axis	0: DriveAxis
Real encoder axis	2: EncoderAxis
Virtual drive axis	3: VirtualDriveAxis
Virtual encoder axis	4: VirtualEncoderAxis
Virtual linked axis	5: VirtualLinkAxis

The data type that an axis variable can take differs depending on the axis type.

For details on data types of each axis type, refer to the following.

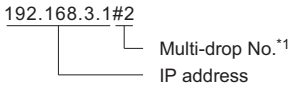
☞ Page 445 Data type

■Station address

Specify the station address (IP address) of the target device to connect a network device as a real axis. Also, specify the multidrop No. for connecting a device which can control multiple axes with one device (multiple axes device).

Ex.

When specifying the C-axis of a multiple axes device (MR-J5(W)-G)



*1 The multidrop No. is specified as "# + No. (decimal)". When omitted, it is regarded as "#0".
· #0: A-axis
· #1: B-axis
· #2: C-axis

When the station address of a device that cannot be used on real axes is specified, SLMP communication error (error code: 1A42H) or Station address setting incorrect (error code: 1AEDH) occurs. (Example: When a station address of an I/O module is specified)

Only station addresses connected to the port for CC-Link IE TSN can be specified.

These settings are unnecessary to the virtual axis.

For the station address, specify the same format as "Target modification (character string starts with @)" of TARGET_REF structure. For details on the TARGET_REF structure, refer to the following.

☞ Page 1158 TARGET_REF Structure

Even though the station address has not been set ("") in the real axis, setting Axis Emulation Enabled (AxisName.PrConst.SlaveEmulate_Enable) to TRUE allows it to be used as the axis emulate function. If axis emulate function is not used, Station address setting incorrect (error code: 1AEDH) occurs and the axis will not be ready for operation.

■Absolute Position Control Setting

Specify whether applicable axes are used as the absolute position system. For details, refer to the following.

☞ Page 510 Absolute Position Control

■Control Cycle

Specify which operation cycle is used for the applicable axis to control. For details, refer to the following.

☞ Page 522 OPERATION CYCLE

Relevant variables

AxisName in the following table indicates the instance name of the structure type for each axis type.

- AXIS_REAL: Real drive axis
- AXIS_ENCODER: Real encoder axis
- AXIS_VIRTUAL: Virtual drive axis
- AXIS_VIRTUAL_ENCODER: Virtual encoder axis
- AXIS_VIRTUAL_LINK: Virtual linked axis

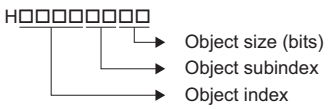
Axis information (AxisName.AxisRef.)

Variable/structure name	Name	Details
AxisNo	Axis No.	Sets the axis No. • 0: Not set • 1 to 10000: Set axis No.

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
AxisType	Axis Type Setting	Sets the axis type. • 0: Real Drive Axis (DriveAxis) • 2: Real Encoder Axis (EncoderAxis) • 3: Virtual Drive Axis (VirtualDriveAxis) • 4: Virtual Encoder Axis (VirtualEncoderAxis) • 5: Virtual Linked Axis (VirtualLinkAxis)
AddressOfStation	Station Address Setting	Sets network address of the device station with a character string.
PosRestoration_AbsPosEnable	Absolute Position Control Setting	Sets the absolute position control setting. • 0: Disable Absolute Position System (ABSDisabled) • 1: Enable Absolute Position System (Enabled) • -1: Automatic Setting (Acquire from Connected Device) (Auto)
OperationCycle	Control Cycle Setting	Sets the control operation cycle. For details, refer to the following. ☞ Page 522 OPERATION CYCLE
SlaveObject	Object Data	Sets the object of the device station.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisName	Axis Name	Displays the axis name.
Io_PosActualValue	Object Data_PosActualValue	Displays the value of object data Position actual value (6064H).
Io_PosEncoderResolution	Object Data_PosEncoderResolution	Displays the value of object data Position encoder resolution (608FH).
Io_Statusword	Object Data_Statusword	Displays the value of object data Statusword (6041H).
Io_TargetPos	Object Data_TargetPos	Displays the value of object data Target position (607AH).
Drive_RPDO[1..64]	RPDO (the device to the motion system) mapping	Indicates the object index specified to the nth place in the RPDO/TPDO mapping settings of the network parameter.  • The object size displays 1 byte, 2 bytes, 4 bytes, and 8 bytes in bits. • When the size of the nth object is 1 byte, a padding object is inserted in the nth+1 place.
Drive_TPDO[1..64]	TPDO (the motion system to the device) mapping	

Object data settings

In the motion system, the data that sends/receives information to/from the connected device in the motion operation processing is called object data.

With object data settings, the motion system can be customized to adjust to the device station by setting the data related to the device station to the object data.

For one set of object data, set as follows.

Setting item	Setting value
Each member of Object Data (AxisName.PrConst.SlaveObject)	Specifies the target data to set. The data that can be used differs depending on the axis type. Refer to the following. ☞ Page 449 Axis Type For details on the format to specify the data, refer to the following. ☞ Page 1158 TARGET_REF Structure * For whether or not mapping to cyclic data is required when using [OBJ], refer to the following. ☞ Page 472 Object data list * For whether or not the target modification must be used, refer to the following. ☞ Page 1163 @Target modification

If unavailable data is set, Mapping communication error (error code: 1AC7H) will occur at the axis variable initialization.

There are object data whose settings are necessary depending on the axis type. A valid setting value other than "no setting" must be set in the applicable object data. (If the setting is illegal, "Object Data Setting Incorrect (error code: 1AEEH)" will occur at the axis variable initialization.)

For object data whose settings are necessary, refer to the following.

☞ Page 472 Object data list

When "no setting" is set in the object data setting, motion system functions that need the applicable object data cannot be used. For details, refer to the following.

☞ Page 477 Motion system function and object data

Data and information of the setting location are sent/received based on the data type of each object data in the motion operation processing.

Access	Data size	Description of the motion operation processing
R: Device station → Motion system	(Object data) < (Setting location data)	Converts the setting location data to data size of object data and imports it. Exceeded upper bit information is discarded.
	(Setting location data) ≤ (Object data)	Converts the setting location data to data type of object data and imports it.
W: Motion system → Device station	(Setting location data) < (Object data)	Stores an object data value as it is to the setting location data. After it is stored, shorted upper bit does not change before and after refreshing.
	(Object data) ≤ (Setting location data)	Converts a value to data size of the setting location data and stores it. Exceeded upper bit information is discarded.

PDO mapping setting

Data (object) that is sent/received between the controller and the device station in cyclic transmission (PDO communication) must be mapped in advance to control each function in the real drive axis.

For details on the PDO mapping setting, refer to the following.

☞ Page 165 PDO mapping setting

Mapping is required for some objects to be connected as real drive axes in the motion system. The following objects must be mapped. (If the objects are not mapped, Necessary object data unset (error code: 1AF7H) will occur.)

Mapping	Required object data
Output (RPDO)	Controlword (6040H)
	Target position (607AH)
	Modes of operation (6060H)
Input (TPDO)	Statusword (6041H)
	Position actual value (6064H)
	Modes of operation display (6061H)

Setting procedure

This section describes the procedure to newly set a real drive axis by using the engineering tool.

1. Add the device station to the network configuration setting, and set IP address and PDO map information.
2. Select adding axis in the axis setting of the motion system, and set axis information.
3. Double-click the set axis and set the axis parameters.
4. Select the object data setting, and assign object data.
5. Write the parameters in the motion system.

Memory usage

Axis variables use the following memory.

Name	Setting method
Label Memory	Set in Label Area Capacity of the engineering tool.
Add-on Axis System Memory	AddonSystem.PrConst.MT_Axis.RamSizeMax

The system memory usage differs depending on the axis type. Specify the memory capacity of the system according to the axis type and the number of axes.
Memory capacity per one axis for each axis type is shown below

Axis type	Memory usage (K bytes/axis)
Real drive axis	160
Real encoder axis	40
Virtual drive axis	60
Virtual encoder axis	40
Virtual linked axis	40

Point

Regarding the system memory to be used, memory is secured at the following timing:

- Secure memory: At axis variable initialization

When there is no sufficient free space, Axis data memory size over (error code: 1AC5H) occurs, and the relevant axis is not generated. Check the memory capacity and restart the system.
Check the memory capacity of the following add-on library as needed.

- MotionEngine
- NetworkDriver_CCIETSN*1
- ServoDriver_CANopen*1
- SignalIO*2
- ExternalSignal*2

*1 For using real drive axis
*2 For using external signal

Object data list

The following shows attributes of object data.

Attribute	Description
PDO mapping	Indicates whether the mapping to cyclic transmission is enabled or not for the object when [OBJ] is specified. • No: Mapping to TxPDO and RxPDO is not required. • TxPDO: Mapping to TxPDO is enabled. • RxPDO: Mapping to RxPDO is enabled. Shows the relationship of access between the motion system and the device station when the axis type is a real drive axis or a real encoder axis. • No: The motion system will access to the data unperiodically even after mapping. • TxPDO: Mapping enables the motion system to read the data from the device station in fixed-cycle. • RxPDO: Mapping enables the motion system to write the data to the device station in fixed-cycle.
Default	Indicates the default value of the object data for the real drive axis.

The object data lists are shown below.

Whether each axis type can be set or not is as shown below depending on the object data setting and the PDO mapping setting (real drive axis only).

○: Setting possible··· It can be set in the object data setting of the engineering tool. For object data whose PDO mapping attribute is TxPDO or RxPDO in the real drive axis, be sure to set the setting value of the object data setting to the PDO mapping setting. When the setting is valid, the axis holds the applicable object data.

×: Setting not possible··· It cannot be set in the object data setting of the engineering tool. The axis does not hold the applicable object data.

—: Unnecessary··· It cannot be set in the object data setting of the engineering tool. However, since it is emulated in the motion system, the axis holds the applicable object data.

Object data name	PDO mapping	Default	Data sent from motion system ○: Applicable —: Not applicable	Description	Whether each axis type can be set				
					Real drive axis	Real encoder axis*1	Virtual drive axis	Virtual encoder axis	Virtual linked axis
Supported drive modes	No	65020020	○	Acquires the control mode supported by the drive unit.	○	×	×	×	×
Modes of operation	RxPDO	60600008	○	Requests switching the control mode to the drive unit.	○	×	×	×	×
Modes of operation display	TxPDO	60610008	○	Acquires the control mode of the drive unit.	○	×	×	×	×
Controlword	RxPDO	60400010	○	Requires switching the status to the drive unit.	○	×	×	×	×

Object data name	PDO mapping	Default	Data sent from motion system ○: Applicable —: Not applicable	Description	Whether each axis type can be set				
					Real drive axis	Real encoder axis*1	Virtual drive axis	Virtual encoder axis	Virtual linked axis
Control DI 1	RxPDO	2D010010	—	Sets the input device in the drive unit.	○	×	×	×	×
Control DI 2	RxPDO	2D020010	—		○	×	×	×	×
Control DI 3	RxPDO	2D030010	—		○	×	×	×	×
Control DI 4	RxPDO	2D040010	• Bit 0: — • Bit 1: — • Bit 2: — • Bit 3: — • Bit 4: — • Bit 5: — • Bit 6: — • Bit 7: — • Bit 8: — • Bit 9: — • Bit 10: — • Bit 11: — • Bit 12: ○ • Bit 13: ○ • Bit 14: — • Bit 15: —		○	×	×	×	×
Control DI 5	RxPDO	2D050010	• Bit 0: — • Bit 1: — • Bit 2: — • Bit 3: — • Bit 4: — • Bit 5: — • Bit 6: — • Bit 7: — • Bit 8: — • Bit 9: ○ • Bit 10: ○ • Bit 11: ○ • Bit 12: — • Bit 13: — • Bit 14: — • Bit 15: —		○	×	×	×	×
Control DI 6	No	2D060010	—		○	×	×	×	×
Control DI 7	No	2D070010	—		○	×	×	×	×
Statusword	TxPDO	60410010	○	Acquires the status of the drive unit.	○	×	×	×	×
Status DO 1	TxPDO	2D110010	○	Sets the output device in the drive unit.	○	×	×	×	×
Status DO 2	TxPDO	2D120010	○		○	×	×	×	×
Status DO 3	TxPDO	2D130010	○		○	×	×	×	×
Status DO 4	TxPDO	2D140010	○		○	×	×	×	×
Status DO 5	TxPDO	2D150010	○		○	×	×	×	×
Status DO 6	No	2D160010	○		○	×	×	×	×
Status DO 7	No	2D170010	○		○	×	×	×	×
Target position	RxPDO	607A0020	○	The command position to output to the drive unit	○	×	—	×	×
Target velocity	RxPDO	60FF0020	○	The command velocity to output to the drive unit	○	×	×	×	×
Target torque	RxPDO	60710010	○	The command torque to output to the drive unit	○	×	×	×	×
Positive torque limit value	RxPDO	60E00010	○	Sets the positive direction torque limit value in the drive unit.	○	×	×	×	×
Negative torque limit value	RxPDO	60E10010	○	Sets the negative direction torque limit value in the drive unit.	○	×	×	×	×
Position actual value	TxPDO	60640020	○	The current position of the drive unit	○	—	—	○	×

Object data name	PDO mapping	Default	Data sent from motion system ○: Applicable —: Not applicable	Description	Whether each axis type can be set				
					Real drive axis	Real encoder axis*1	Virtual drive axis	Virtual encoder axis	Virtual linked axis
Velocity actual value	TxPDO	606C0020	○	The current velocity of the drive unit	○	×	×	×	×
Following error actual value	TxPDO	60F40020	○	The droop pulse of the drive unit	○	×	×	×	×
Torque actual value	TxPDO	60770010	○	The current torque of the drive unit	○	×	×	×	×
Polarity	No	607E0008	○	Sets the rotation direction selection of the drive unit.	○	×	×	×	×
Position encoder resolution	No	608F0008	○	The total number of Sub Indexes (2) is returned.	○	×	×	×	×
Encoder increments	No	608F0120	○	Acquires the encoder resolution of the drive unit.	○	×	×	×	×
Motor revolutions (Position encoder resolution)*2	No	608F0220	○	Acquires the motor speed of the drive unit.	○	×	×	×	×
Motor revolutions (Gear ratio)*2	No	60910120	○	Sets the servo motor axis speed (numerator) of the drive unit.	○	×	×	×	×
Shaft revolutions	No	60910220	○	Sets the drive axis speed (denominator) of the drive unit.	○	×	×	×	×
SI unit position	No	60A80020	○	Acquires the SI unit position of the drive unit.	○	×	×	×	×
SI unit velocity	No	60A90020	○	Acquires the SI unit velocity of the drive unit.	○	×	×	×	×
Max motor speed	No	60800020	○	Acquires the maximum speed of the servo motor from the drive unit.	○	×	×	×	×
Max torque	No	60720010	○	Acquires the maximum torque of the servo motor from the drive unit.	○	×	×	×	×
Watch dog counter DL	RxPDO	1D010110	○	Notifies the watch dog counter value to the drive unit.	○	×	×	×	×
Watch dog counter UL	TxPDO	1D020110	○	Acquires the watch dog counter value to the drive unit.	○	×	×	×	×
Supported Control DI 1	No	2D000110	○	Acquires the input device supported by the drive unit.	○	×	×	×	×
Supported Control DI 2	No	2D000210	○		○	×	×	×	×
Supported Control DI 3	No	2D000310	○		○	×	×	×	×
Supported Control DI 4	No	2D000410	○		○	×	×	×	×
Supported Control DI 5	No	2D000510	○		○	×	×	×	×
Supported Control DI 6	No	2D000610	○		○	×	×	×	×
Supported Control DI 7	No	2D000710	○		○	×	×	×	×

Object data name	PDO mapping	Default	Data sent from motion system ○: Applicable —: Not applicable	Description	Whether each axis type can be set				
					Real drive axis	Real encoder axis*1	Virtual drive axis	Virtual encoder axis	Virtual linked axis
Supported Status DO 1	No	2D100110	○	Acquires the output device supported by the drive unit.	○	×	×	×	×
Supported Status DO 2	No	2D100210	○		○	×	×	×	×
Supported Status DO 3	No	2D100310	○		○	×	×	×	×
Supported Status DO 4	No	2D100410	○		○	×	×	×	×
Supported Status DO 5	No	2D100510	○		○	×	×	×	×
Supported Status DO 6	No	2D100610	○		○	×	×	×	×
Supported Status DO 7	No	2D100710	○		○	×	×	×	×
Home offset	No	607C0020	○	Sets the difference between zero position and homing position of the machine coordinate system in the drive unit.	○	×	×	×	×
Home cycle counter	No	2D3D0020	○	Acquires the encoder position within one revolution saved as the homing position from the drive unit.	○	×	×	×	×
Home ABS counter	No	2D3E0010	○	Acquires the encoder multiple revolution counter saved as the homing position from the drive unit.	○	×	×	×	×
Initial position	No	2D3F0020	○	Acquires the current position at power-on from the drive unit.	○	×	×	×	×
Initial cycle counter	No	2D400020	○	Acquires the encoder position within one revolution at power-on from the drive unit.	○	×	×	×	×
Initial ABS counter	No	2D410010	○	Acquires the encoder multiple revolution counter at power-on from the drive unit.	○	×	×	×	×
Max ABS counter	No	2D420020	○	Acquires the maximum value of the encoder multiple revolution counter from the drive unit.	○	×	×	×	×
Velocity limit value	RxPDO	2D200020	○	Sets the velocity limit value in the drive unit.	○	×	×	×	×
Encoder status 1	No	2D350120	○	Acquires the encoder status from the drive unit.	○	×	×	×	×
Encoder status 2	No	2D350220	○	Acquires the scale measurement encoder status from the drive unit.	○	×	×	×	×
Scale measurement encoder resolution	No	2D380020	○	Acquires the scale measurement encoder resolution from the drive unit.	○	×	×	×	×
Current alarm	TxPDO	2A410020	○	Acquires the occurring alarm from the drive unit.	○	×	×	×	×
Sync ABS counter	TxPDO	2D220010	○	Acquires the encoder multiple revolution counter from the drive unit.	○	×	×	×	×
Sync cycle counter	TxPDO	2D210020	○	Acquires the encoder multiple revolution counter from the drive unit.	○	×	×	×	×

Object data name	PDO mapping	Default	Data sent from motion system ○: Applicable —: Not applicable	Description	Whether each axis type can be set				
					Real drive axis	Real encoder axis*1	Virtual drive axis	Virtual encoder axis	Virtual linked axis
Scale measurement encoder reception status	No	2D3C0020	○	Acquires the encoder position within one revolution from the drive unit.	○	×	×	×	×
Scale cycle counter	No	2D360020	○	Acquires the position within one revolution of the scale measurement encoder from the drive unit.	○	×	×	×	×
Scale ABS counter	No	2D370010	○	Acquires the multiple revolution counter of the scale measurement encoder from the drive unit.	○	×	×	×	×
Target pressure	RxPDO	2E500020	○	The command pressure to output to the drive unit	○	×	×	×	×
Pressure actual value	TxPDO	2E520020	○	The current pressure of the drive unit	○	×	×	×	×
Forward-side stop function	RxPDO	2E560020	○	The forward end position to output to the drive unit	○	×	×	×	×

*1 For the real encoder axis object data names, refer to the following.
☞ Page 455 Real encoder axis

*2 The names in parentheses are the object names associated with Index.

Point

- If a value larger than DataType is set for the object data, the upper bits of DataType or higher are rounded off and converted to the same size as DataType.
- When the data type [OBJ] is set, an object whose DataType is INTEGER 8, 16, or 32 or UNSIGNED 8, 16, or 32 can be set. If an object whose DataType is other than the above is specified, intended data cannot be sent or received and the function using the object data does not operate normally.
  If a size other than 8 bits, 16 bits, or 32 bits is set in the DataType part of the setting value, Object Data Setting Incorrect (error code: 1AEEH) will occur.

Motion system function and object data

If no object data is registered in the axis, there will be errors and restrictions in the following functions.

Instruction/function	Required object data	Reference
MC_MoveVelocity (Speed Control)	TargetVelocity	Page 715 Velocity Control
MC_TorqueControl (Torque Control)	TargetTorque	Page 726 Torque Control
Torque limit function	PositiveTorqueLimitValue NegativeTorqueLimitValue	Page 1124 Torque Limit
MC_Home (Homing)	HomeOffset	Page 620 Driver homing method

Precautions

- The motion system does not check the command limit, issue an emergency stop command, or reset an error for the MR-J5(W)-G whose axis is not assigned. Provide safety measures in the user program or on the MR-J5(W)-G side.
- In the graph function of MR Configurator2, if a drive unit whose axis is not assigned is included as the measurement target axis, specify a drive unit whose axis has been assigned as the trigger axis. Also, create a network label as shown below and add a fixed scan execution program (Cycle: Operation cycle).

Measurement target drive unit	Object used	Network label name example
Drive unit specified as the trigger axis	Status DO 4	MR_J5_G_001_StatusDO4
Drive unit in which axes other than the trigger axis are not assigned	Control DI 4	MR_J5_G_002_ControlDI4 MR_J5_G_003_ControlDI4
Drive unit in which axes other than the trigger axis are assigned	None	

- If the drive unit whose axis is not assigned is specified as the trigger axis or the following program is not added, waveform data measurement will not be completed even if the trigger condition is satisfied.

ST program
// MR Configurator2 multi-axis graph measurement MR_J5_G_002_ControlDI4.c := MR_J5_G_001_StatusDO4.c; MR_J5_G_003_ControlDI4.c := MR_J5_G_001_StatusDO4.c;

Relevant add-on

The following add-ons are required to use this function.

- Axis

System memory capacity

For details, refer to the following.

☞ Page 471 Memory usage

23.4 Axes Group

Axes group is used for multiple axes control such as linear interpolation control and circular interpolation control.
The maximum setting number of axes groups depends on the memory. If an axes group cannot be set for memory shortage, Maximum number of registrations for axes group over (error code: 1AC8H) occurs. The maximum number of configuration axes of the axes group to be registered is 16.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○*1
RUN	○
Moderate error	○*2
Major error	×

*1 Only monitor is available. When the axes group status is Standby, Axes Group Disabled occurs.
*2 When a necessary add-on has stopped due to an Add-on Library Load Error or Insufficient Add-on System Memory (RAM), operation is not possible.

Relevant variables

Axes group information (AxesGroupName.AxesGroupRef.)

Variable/structure name	Name	Details
GroupNo	Axes Group No.	Sets axes group No. in the motion system. • 0: Not set • 1 and later: Setting axes group No.

Axes group information (AxesGroupName.PrConst.)

Variable/structure name	Name	Details
AxesGroupType	Axes group type	Sets the axes group type.

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
GroupStatus	Axes Group Status	Displays the current axes group status. • -1: Axes group variable not initialized/axes group parameter error (Invalid) • 0: Axes group disabled (GroupDisabled) • 1: Stopping on error (GroupErrorStop) • 2: Decelerating to stop (GroupStopping) • 4: Standby (GroupStandby) • 5: Operating (GroupMoving)
GroupName	Axes Group Name	Stores the axes group name.
Axis[1..16]	Configuration Axis	Stores Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Relevant FBs

For details on motion control FBs, refer to the following.

📖MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_GroupEnable	Axes Group Enabled	Transits the specified axes group status from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)".
MC_GroupDisable	Axes Group Disabled	Transits the specified axes group status to "0: Axes group disabled (GroupDisabled)".

Settings required for axes group

Set the following parameters using the engineering tool to set axes groups.

For setting methods of axes group, refer to the following.

☞ Page 487 Axes Group Assignment

Item	Description
Axes group No.	Sets axes group No. of the motion system.
Axes group name	Sets an arbitrary axes group name.
Configuration axis	Sets Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Axes group variables

Axes group variables are generated by adding the axes group setting in the engineering tool. A generated axes group is assigned to the global label as an axes group variable.

Axes group is defined as an axes group variable configured with monitor information such as parameter information, the current position, and the status.

Axes group variable name (default)

The following names are assigned based on the axes group No. They can be changed to an arbitrary name. For details, refer to the following.

☞ Page 487 Axes Group Assignment

Set axes group No.	Engineering tool default axis name
1	AxesGroup001
2	AxesGroup002
⋮	⋮

Data type

Data types of axes groups are expressed using the AXES_GROUP type. Data types of axes groups have the following members.

Member name	Data type	Description
AxesGroupRef	AXES_GROUP_REF	A data structure for input/output of motion control FBs.
PrConst	AXES_GROUP_PRM_CONST	Stores parameter data (constant) of the axes group. Opens the default value at axes group variable generation. Re-importing to the control data is not executed after axes group variables initialization.
Pr	AXES_GROUP_PRM	Stores parameter data of the axes group. Opens the default value at axes group variable generation. The timing to import to the control changes depending on the parameter.
Md	AXES_GROUP_MONI	Stores monitor data of the axes group. Executes refresh in the fixed cycle for each monitor data.
Cd	AXES_GROUP_CMD	Stores command data for axes group control. Acquires the latest value every control operation cycle and uses it for the control.

Axes group variable initialization timing

Axes group variables are initialized at the following timings.

Timing	Processing
At power supply When the controller is reset	Refers to the global label data, and initializes all set axes group variables.
When PLC READY (MotionSystem.Cd.SequenceReady) is turned on	■Uninitialized axis group Refers to the global label data and initializes all axes group variables. ■Initialized axes group Refers to the global label data for the axes group parameter data and imports it again. However, the configuration axis is not imported again. When the parameter error occurs at importing, the axes group is not deleted. At this time, built-in motion ready [X20] does not turn on. For the label initialization processing when PLC READY (MotionSystem.Cd.SequenceReady) is turned on, refer to the following. ☞ Page 426 DEVICE/LABEL INITIAL VALUE SETTINGS
At online program change	Refers to the global label data and initializes the axes group variables that have not yet been initialized.

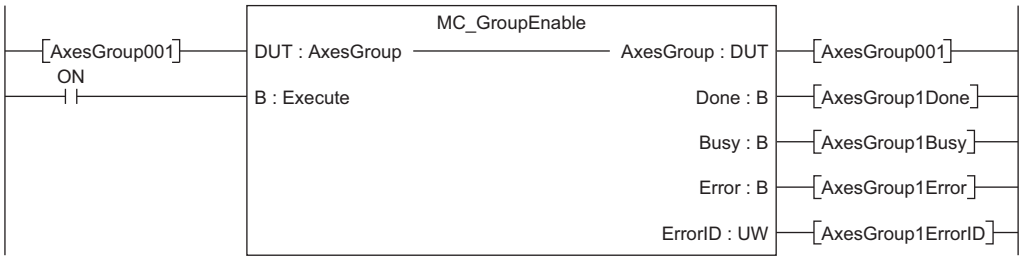
How to specify in a user program

When specifying the axes group by the motion control FB, set the AXES_GROUP_REF type member (AxesGroupName.AxesGroupRef) of each axes group variable to the I/O variables whose data type is "AXES_GROUP_REF".

Ex.

When executing the MC_GroupEnable (Axes Group Enabled) with the following settings

- Axes group number: 1
- Axes group name: AxesGroup0001



Axes group status

When an axes group is used in the motion FB, Axes Group Status (AxesGroupName.Md.GroupStatus) must be set to "4: Standby (GroupStandby)" by executing MC_GroupEnable (Axes Group Enabled) to the axes group. The axes group can be started in the motion FB when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)" and Axis Status (AxisName.Md.AxisStatus) of all configuration axes is "4: Standby (Standstill)".

Axes group state transition

The following shows status that an axes group can enter.

The current status can be checked with Axes Group Status (AxesGroupName.Md.GroupStatus).

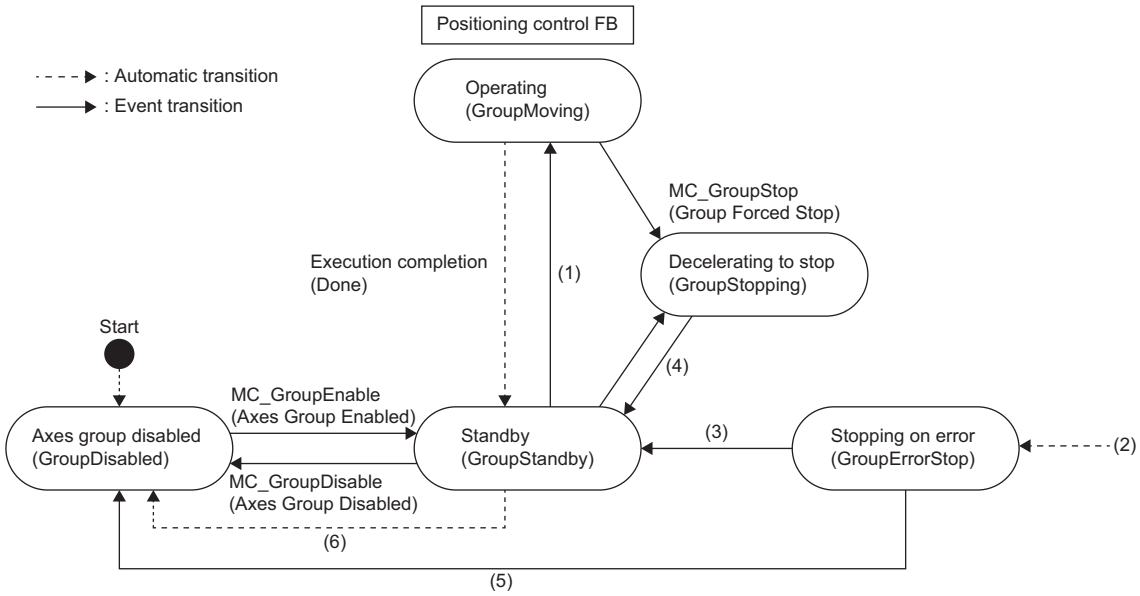
When the axes group changes to "4: Standby (GroupStandby)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes TRUE.

When the motion FB is executed for the axis (the axis of which Using Axes Group (AxisName.Md.UseInGroup) is TRUE) used in the axes group, Start not possible (error code: 1AFCH) occurs. Disable the axes group by MC_GroupDisable (Axes Group Disabled).

Status	Description
-1: Axes group variable not initialized/axes group parameter error (Invalid)	Axes group is disabled because the axes group variables are not initialized (such as a parameter error occurrence at initialization).

Status	Description
0: Axes group disabled (GroupDisabled)	Axes group is disabled. Motion control FBs cannot be executed in this status. The axis which is being controlled will be stopped immediately to transit to this state.
1: Stopping on error (GroupErrorStop)	Axes group is in the deceleration stop or the stop status by an error occurrence. When Axis Status (AxisName.Md.AxisStatus) is set to "1: Stopping on error (ErrorStop)" in any of the configuration axes, the axes group also enters this status.
2: Decelerating to stop (GroupStopping)	The deceleration stop is executed by MC_GroupStop (Group Forced Stop). After the axis stop is completed, this status will be maintained until the Execution command (Execute) of MC_GroupStop (Group Forced Stop) becomes FALSE. Motion control FBs cannot be executed in this status.
4: Standby (GroupStandby)	Axes group is enabled and stand-by. (Not depending on the servo ON/OFF status of the configuration axis.)
5: Operating (GroupMoving)	The positioning control FB is executed in an axes group. When transiting into this status, Axis Status (AxisName.Md.AxisStatus) of all configuration axes turns to "7: During synchronous operation (SynchronizedMotion)".

The status transits as shown below according to the start of the motion control FB.



No.	State transition description
(1)	All group motion FBs
(2)	• Transits when an error caused by an axes group occurs in the status other than "0: Axes group disabled (GroupDisabled)". • Transits when an error caused by a configuration axis occurs in the status other than "0: Axes group disabled (GroupDisabled)".
(3)	Transits when status error is cleared by axes group error reset. For clearing errors, refer to the following. ☞ Page 1751 Error clear
(4)	Transits when Execution completion (Done) of MC_GroupStop (Group Forced Stop) is TRUE and Execution command (Execute) of MC_GroupStop (Group Forced Stop) is FALSE.
(5)	Transits when the axes group is disabled at executing MC_GroupDisable (Axes Group Disabled) or clearing the status error by axes group error reset.
(6)	Transits when a stop of program execution is completed by a change from the RUN status → STOP status.

Axes group enabled

This section describes enabling an axes group.

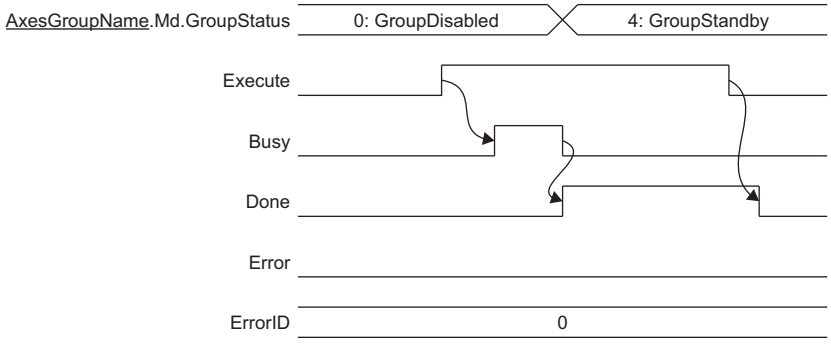
Control details

Axes Group Status (AxesGroupName.Md.GroupStatus) can be changed to "4: Standby (GroupStandby)" by specifying Axes Group Information (AxesGroup).

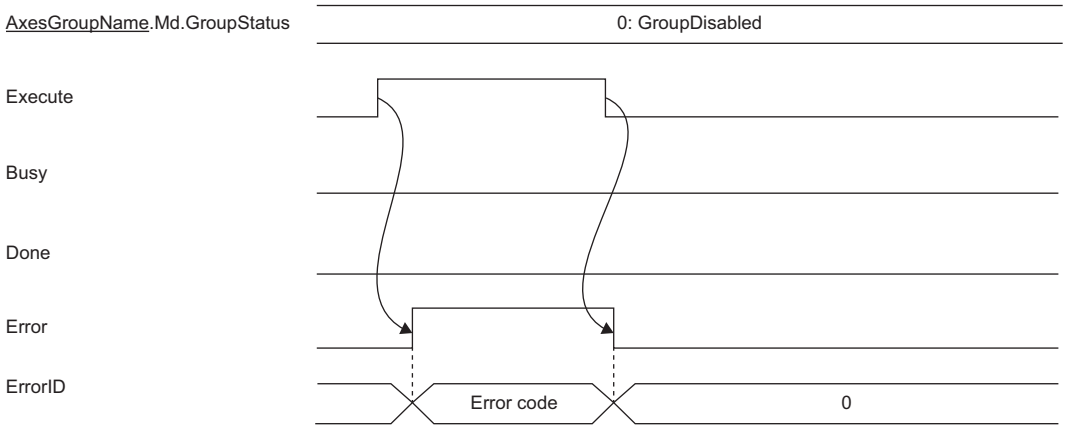
- The axes group can start the motion FB only when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)".
- MC_GroupEnable (Axes Group Enabled) can be executed only when Axis Status (AxisName.Md.AxisStatus) of all configuration axes is "4: Standby (Standstill)" or "0: Axis disabled (Disabled)".
- When Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "4: Standby (GroupStandby)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes TRUE.
- When executing MC_GroupEnable (Axes Group Enabled) with another axes group specified that includes a configuration axis for which Using Axes Group (AxisName.Md.UseInGroup) is TRUE, Axes group configuration axis is in use (error code: 1BB8H) occurs.
- If the error occurs in any of the configuration axes, Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "1: Stopping on error (GroupErrorStop)".
- When MC_GroupEnable (Axes Group Enabled) is executed for an axes group that has already been enabled, Execution completion (Done) becomes TRUE and the execution ends.

■Timing chart

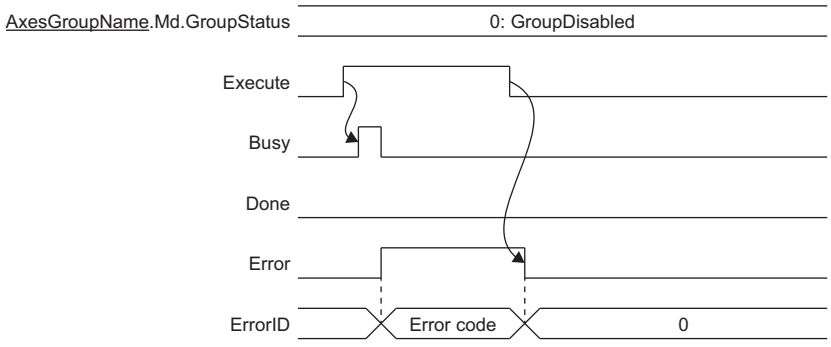
- When the operation is normally completed



- When the I/O variables are abnormal



- When the operation is completed with an error



Precautions

Before executing MC_GroupEnable (Axes Group Enabled), ensure that the axes group number (AxesGroupNo) of AXIS_REF structure is set in advance.

Axes group disabled

This section describes disabling an axes group.

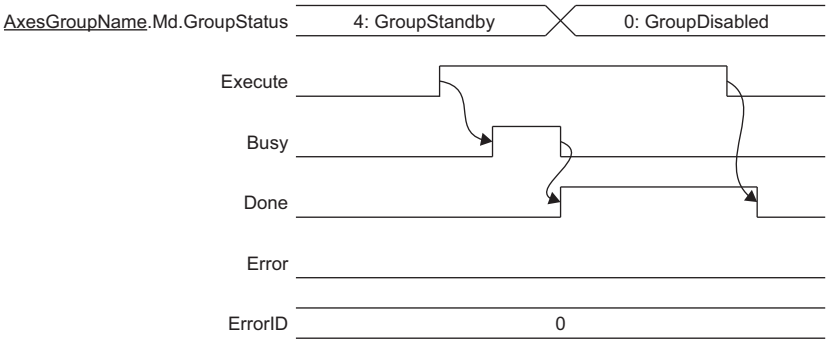
Control details

Axes Group Status (AxesGroupName.Md.GroupStatus) can be changed to "0: Axes group disabled (GroupDisabled)" by specifying Axes Group Information (AxesGroup).

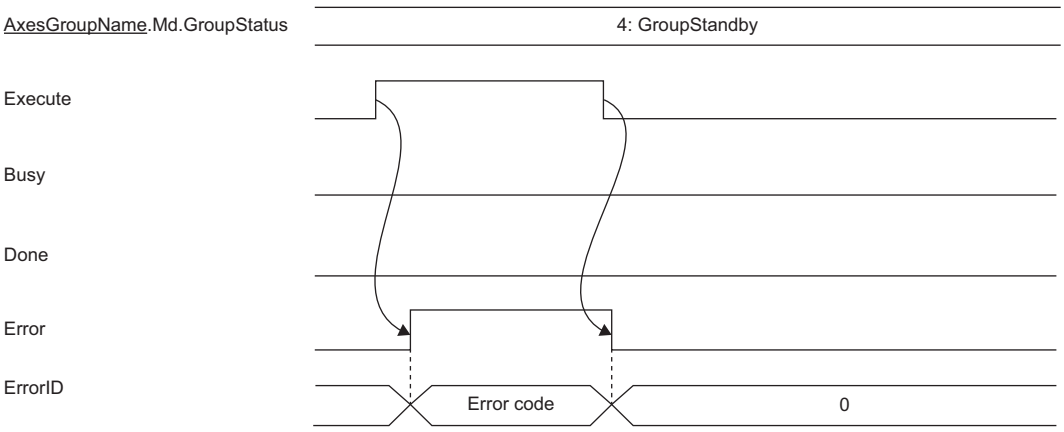
- An axes group cannot execute the motion FB when Axes Group Status (AxesGroupName.Md.GroupStatus) is "0: Axes group disabled (GroupDisabled)".
- MC_GroupDisable (Axes Group Disabled) can only be executed when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)". When executing this FB while Axes Group Status is "1: Stopping on error (GroupErrorStop)" and the axes group is in operation, the axes group status transits to "0: Axes group disabled (GroupDisabled)" after the stop completes. When this FB is executed while Axes Group Status (AxesGroupName.Md.GroupStatus) is other than "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)", Axes group status incorrect (when axes group is disabled) (error code: 1AEFH) occurs and the positioning control FB stops. For details on stop processing, refer to the following.
  ☞ Page 578 Stop
- When Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "0: Axes group disabled (GroupDisabled)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes FALSE.
- When MC_GroupDisable (Axes Group Disabled) is executed for an axes group that has already been disabled, Execution completion (Done) becomes TRUE and the execution ends.

■Timing chart

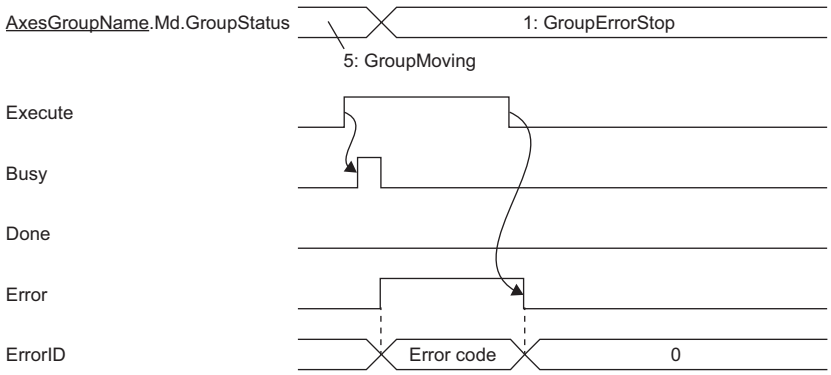
- When the operation is normally completed



- When the I/O variables are abnormal



- When the operation is completed with an error (Example where Axes Group Disabled is executed when Axes Group Status is "5: Operating (GroupMoving)")



Precautions

Before executing MC_GroupDisable (Axes Group Disabled), ensure that the axes group number (AxesGroupNo) of AXIS_REF structure is set in advance.

Precautions

If the parameter error occurs at axes group variable initialization, Out of parameter range (axes group) (error code: 1A61H) occurs. In this case, Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "-1: Axes group variable not initialized/axes group parameter error (Invalid)". Refreshing of monitor data and other items is not executed for axes groups whose status is " -1: Axes group variable not initialized/axes group parameter error (Invalid)".
Deleting an axis or axes group variable by writing to the controller (including online program change) causes an Invalid write to the controller (error code: 3408H). Then, the motor will immediately stop due to the setting. Note that immediate stop may damage the machine.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- MotionControl_General

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

23.5 Axes Group Assignment

Axes groups can be set in the engineering tool. For the setting method, refer to Help of the engineering tool.
Based on parameter settings of the axes group, the instance of the axes group is initialized when the controller is powered on, the controller is reset, or PLC READY (MotionSystem.Cd.SequenceReady) is turned on.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

Relevant variables

Axes group monitor data (AxesGroupName.AxesGroupRef.)

Variable/structure name	Name	Details
GroupNo	Axes Group No.	Sets the axes group No. • 0: Not set • 1 to 10000: Set axes group No.

Axes group monitor data (AxesGroupName.Pr.)

Variable/structure name	Name	Details
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
NumberOfAxes	Number of Configuration Axes	Indicates the number of configuration axes of the axes group.
GroupName	Axes Group Name	Stores the axes group name.
Axis[1..16]	Configuration Axis	Stores Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Setting with engineering tool

In the axes group setting window of the engineering tool, an axes group can be generated/initialized by setting the axes group setting as a parameter. The axes group set in the axes group setting window is assigned to the global label data as an axes group variable.

Setting items

■Axes group No.

It is an identifier on the motion system control.

If the same No. is set in the multiple axes groups, Axes group No. setting duplication error (error code: 1AC1H) occurs.

The axes group whose axes group No. is "0" is regarded as an unset axes group, and it cannot be used for control.

Item	Setting range
Axes group No.	1 to 10000

■Axes group name

Set an axes group name of the applicable axes group arbitrarily with up to 127 characters.

An instance is generated as a set axes group name.

■Configuration axis

Set configuration axes of an applicable axes group with Configuration Axis (AxesGroupName.Pr.Axis[1..16]).

Set the AxisName.AxesRef structure of the axis variable for the configuration axes.

Set the configuration axes of the maximum 16 axes in the left-justified format from the configuration axis 1.

No axis (error code: 1AF1H) and Axes group configuration axis operation cycle incorrect (error code: 1AC2H) occur for the following cases.

- When there is no configuration axis
- When the operation cycles of the configuration axes are mismatched.

■Axes group type

Specify the axes group type.

Axes group type	Setting value
Normal	0: Standard

The data type that an axis variable can take differs depending on the axes group type.

For details on data types of each axes group type, refer to the following.

☞ Page 478 Axes Group

Setting procedures with the engineering tool

The following shows how to create an axes group with the engineering tool.

1. Create an axis, and set the axis name. (A variable instance of the AXIS_* type is generated.)

Navigation window ⇨ [Motion Setting (CPU Built-in)] ⇨ [Axis] ⇨ Right-click ⇨ [Add New Data]

2. Create an axes group, and set the axes group No. and the axes group name. (A variable instance of the AXES_GROUP type is generated.)

Navigation window ⇨ [Motion Setting (CPU Built-in)] ⇨ [Axes Group] ⇨ Right-click ⇨ [Add New Data]

3. Add an axis to the configuration axes of the axes group.

[Axes group setting]

Precautions

Relevant add-on

The following add-ons are required to use this function.

- Axis

System memory capacity

Axes group variables use the following memory.

Name	Setting method
Label Memory	Set in Label Area Capacity of the engineering tool.
Add-on Axis System Memory	AddonSystem.PrConst.MT_Addon_Axis.RamSizeMax

The system memory usage for the axes group is 60K bytes per axes group.

Point

Regarding the system memory to be used, memory is secured at the following timing:

- Secure memory: At axes group variable initialization

When there is no sufficient free space, Maximum number of registrations for axes group over (error code: 1AC8H) occurs, and the relevant axes group is not generated. Check the memory capacity and restart the system.

24 AXIS MANAGEMENT FUNCTIONS

24.1 Units

The position command unit and the velocity command unit used in the motion control can be set in the "unit setting". Since the unit can be specified freely depending on the control target, intuitive programming and monitoring are available.

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
Unit_Position	Position Command Unit	Sets the position command unit to be used in the motion control. ☞ Page 491 Position command unit (AxisName(AxesGroupName).Pr.Unit_Position)
Unit_Velocity	Velocity Command Unit	Sets the velocity command unit to be used in the motion control. ☞ Page 492 Velocity command unit (AxisName(AxesGroupName).Pr.Unit_Velocity)
Unit_PositionString	Position Command Unit String	Sets the command unit to be used in the motion control in a character string. It is used when the position unit is set to HFF (an arbitrary unit character string).

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Unit_PositionDisplay	Position Command Unit Display	Outputs the position command unit that is being controlled in a character string.
Unit_VelocityDisplay	Velocity Command Unit Display	Outputs the velocity command unit that is being controlled in a character string.

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
Unit_Position	Position Command Unit	Sets the position command unit to be used in the motion control. ☞ Page 491 Position command unit (AxisName(AxesGroupName).Pr.Unit_Position)
Unit_Velocity	Velocity Command Unit	Sets the velocity command unit to be used in the motion control. ☞ Page 492 Velocity command unit (AxisName(AxesGroupName).Pr.Unit_Velocity)
Unit_PositionString	Position Command Unit String	Sets the command unit to be used in the motion control in a character string. It is used when the position unit is set to HFF (an arbitrary unit character string).

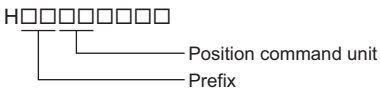
Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
Unit_PositionDisplay	Position Command Unit Display	Outputs the position command unit that is being controlled in a character string.
Unit_VelocityDisplay	Velocity Command Unit Display	Outputs the velocity command unit that is being controlled in a character string.

Setting methods

The Position Command Unit and the Velocity Command Unit setting method is shown below.

Position command unit (AxisName(AxesGroupName).Pr.Unit_Position)



■Setting value of the position command unit

Setting value	Position command unit
H00	pulse
H01	m
H41	degree
HB4	Revolution
HC0	inch
HFF	An arbitrary unit character string*1

*1 For setting an arbitrary unit character string, set Position Command Unit String (AxisName(AxesGroupName).Pr.Unit_PositionString). (A blank can also be set.)

■Setting value of the prefix

When the position command unit setting is HFF (an arbitrary unit character string), this setting is ignored and the control is operated with H00 ($\times 10^0$).

Setting value	Prefix
H00	$\times 10^0$
HFD	$\times 10^{-3}$ [m]
HFA	$\times 10^{-6}$ [μ]
HF7	$\times 10^{-9}$ [n]

■Display examples

The following is a display example of Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay) according to the setting values of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position).

Ex.

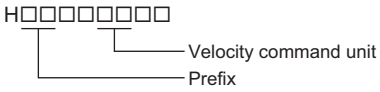
Setting values of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) and Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay)

Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position)	Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay)
H00010000	m
HFD010000	mm
HFA010000	μm
HF7010000	nm
H00B40000	Revolution
H00410000	degree
HFA410000	$\times 10^{-6}$degree
H00000000	pulse
H00C00000	inch

Point

If "1" is set in the program when Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) is "HFD010000", the position will be regarded as "1.0mm".

Velocity command unit (AxisName(AxesGroupName).Pr.Unit_Velocity)



■Setting value of the velocity command unit

Setting value	Velocity command unit
H03	s
H47	min

■Setting value of the prefix

Setting value	Prefix
H00	$\times 10^{0}$
HFD	$\times 10^{-3}$ [m]
HFA	$\times 10^{-6}$ [μ]
HF7	$\times 10^{-9}$ [n]

■Display examples

The following shows display examples of Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay) according to the setting value of Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity).

Ex.

Setting values of Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) and Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)

Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity)	Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)
H00004700	[Position command unit]/min
HFD000300	[Position command unit]/ms
HFA000300	[Position command unit]/μs
HF7000300	[Position command unit]/ns

Point

- If Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) is "HFF000000 (an arbitrary unit character string)", the number of displayable characters from the beginning out of the position command unit strings is displayed on Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay).
- If "1" is set in the program when Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) is "HFD000300", the velocity will be regarded as "1.0 [position command unit]/ms".

- The following shows display examples of Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay) according to the setting value of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) and Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity).

Ex.

Setting values of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) and Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) and Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)

Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position)	Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity)	Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)
HFD010000	HFD000300	[mm/ms]

Combination of command units during multiple axes positioning control

During multiple axes positioning control, set command units of the axes group and the interpolation axes to be matched.
When the command units are mismatched, specify the input value of FB as shown below.

- For the input (such as Target position (Position) and Movement amount (Distance)) regarding position in multiple axes positioning control, be sure to specify the value based on the position command unit of each interpolation axis.
- For the input (Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk)) of multiple axes positioning control, be sure to specify the value based on the velocity command unit used for each control.

Velocity command units used for each control are shown below.
The following operations depend on interpolation controls.

■Linear interpolation control (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control), MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))

Velocity Mode (VelocityMode)	Operation
0: Vector Velocity (VectorSpeed)	• The movement amount on the linear path (combined movement amount) is calculated from the value of current position and Target position (Position) or Movement amount (Distance). The position command unit of the axes group and the interpolation axes is not affected. • The unit of the axes group is used for the velocity command unit in controlling.
1: Long Axis Velocity (LongAxisSpeed)	• The axis whose movement amount value is the largest is regarded as the long axis from the value of current position and Target position (Position) or Movement amount (Distance). The position command unit of the axes group and the interpolation axes is not affected. • The unit of the long axis is used for the velocity command unit in controlling. Unit of the axes group is not used.
2: Reference Axis Velocity (ReferenceAxisSpeed)	• The unit of the reference axis (First element of Linear interpolation axes (LinearAxes)) is used for the velocity command unit in controlling.

For details on linear interpolation control, refer to the following.
☞ Page 649 Linear interpolation control

■Circular interpolation control (MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control), MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control))

- Calculates circular path from the value of current position, Sub point (AuxPoint), and End point (EndPoint). The position command unit of the axes group and the configuration axes is not affected.
- The unit of the axes group is used for the velocity command unit in controlling.

For details on circular interpolation control, refer to the following.
☞ Page 655 Circular interpolation control

■Operation when axes group unit and interpolation axes unit are mismatched

The following shows the operation example when the position/velocity command units of the configuration axis 1 and 2, and axes group in linear interpolation control are different.

Ex.

Operation example

- Axis setting and Axes group setting

Setting item	Setting details	Setting value
Position/Velocity command unit of the axes group	mm/ms	Position Command Unit (AxesGroupName.Pr.Unit_Position): HFD010000 Velocity Command Unit (AxesGroupName.Pr.Unit_Velocity): HFD000300
Position/Velocity command unit of the configuration axis 1	mm/s	Position Command Unit (AxisName.Pr.Unit_Position): HFD010000 Velocity Command Unit (AxisName.Pr.Unit_Velocity): H00000300
Position/Velocity command unit of the configuration axis 2	degree/min	Position Command Unit (AxisName.Pr.Unit_Position): H00410000 Velocity Command Unit (AxisName.Pr.Unit_Velocity): H00004700

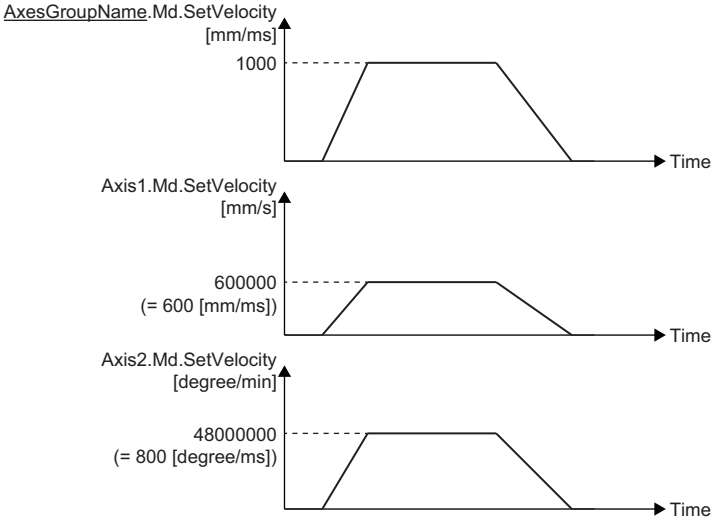
- FB input (MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Movement amount (Distance[0])	300
Movement amount (Distance[1])	400
Velocity (Velocity)	1000
Velocity Mode (VelocityMode)	0: Vector Velocity (VectorSpeed)

<Operation>

- Linear interpolation is performed by Movement Amount (Distance) "300 [mm]" of the configuration axis 1, and "400 [degree]" of the configuration axis 2.
- Position and velocity command units of axes group are used for the unit of Velocity (Velocity) as a vector velocity. It will be controlled by the vector velocity at "1000 [mm/ms]".
- The motion system calculates a combined movement amount = $\sqrt{(300^2 + 400^2)}$ = 500 [mm] from each value of the configuration axis movement amount (Distance). Each axis movement amount of every operation cycle is calculated from the combined movement amount 500 [mm] and vector velocity 1000 [mm/s]. The calculated amount is commanded as a movement amount in the position command unit of each axis.
  The motion system calculates positioning speed of each axis as follows.
  A monitor value of each axis speed is stored by the velocity command unit of each axis.

Positioning speed of each axis	Calculated value
Positioning speed of configuration axis 1	1000 × 300 / 500 = 600 [mm/ms] (= 600000 [mm/s])
Positioning speed of configuration axis 2	1000 × 400 / 500 = 800 [degree/ms] (= 48000000 [degree/min])



Precautions

- For Out of Position Command Unit Range Warning (event code: 00D2DH), the initial value is stored in Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay). (Default value of position command unit: pulse)
- For Out of Velocity Command Unit Range Warning (event code: 00D2EH), the initial value is stored in Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay). (Velocity command unit: pulses/s)
- Even if Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position), Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity), and Position Command Unit String (AxisName(AxesGroupName).Pr.Unit_PositionString) are changed, the homing request will not become TRUE.

24.2 Positioning Range

"Positioning Range" is "-10000000000.0 ≤ positioning range < 10000000000.0".
The range of Set Position (AxisName.Md.SetPosition) is determined by Ring Counter Upper Limit Value (AxisName.PrConst.RingCount_UpperValue) and Ring Counter Lower Limit Value (AxisName.PrConst.RingCount_LowerValue).

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
RingCount_Enable	Ring Counter Enabled Selection	Selects the ring counter enable/disable. • FALSE: Disabled*1 • TRUE: Enabled*2
RingCount_UpperValue	Ring Counter Upper Limit Value	Sets the ring counter upper limit value.*3 • -10000000000.0 to 10000000000.0
RingCount_LowerValue	Ring Counter Lower Limit Value	Sets the ring counter lower limit value.*3 • -10000000000.0 to 10000000000.0

*1 The range is "-10000000000.0 ≤ positioning range < 10000000000.0".
*2 If the ring counter upper/lower limit value is set to match the positioning range, the ring counter will be disabled.
*3 The value is not fetched when the ring counter is disabled.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SetPosition	Set Position	Stores the current position address.*1 The set position is a value which the cumulative current value is rounded with the ring counter range.
CumulativePosition	Cumulative Current Position	Stores the current position address. When the current position is changed, the address is changed to the one after change. The ring address is "-10000000000.0 ≤ cumulative current position < 10000000000.0".
FeedMachinePosition	Machine Feed Value	Stores the current position address by the machine coordinate. The accumulative value from the homing completed position is set. The address is not changed even if the current position is changed. The ring address is "-10000000000.0 ≤ Machine feed value < 10000000000.0".
CommandedPosition	Commanded Position	Stores Target position (Position)/Movement amount (Distance) imported by the positioning control FB being controlled. Stores "0" after the positioning is completed.
ActualPosition	Actual Position	Stores the actual current position. The value of "current position × driver unit conversion denominator / driver unit conversion numerator" is set. For details, refer to the following. ☞ Page 1130 Driver Unit Conversion Function The actual position is a value which is rounded with the ring counter range.

*1 The stored value includes an error because a floating-point error occurs.

Set position

Set Position (AxisName.Md.SetPosition) can be set to an arbitrary ring address by setting Ring Counter Upper Limit Value (AxisName.PrConst.RingCount_UpperValue) and Ring Counter Lower Limit Value (AxisName.PrConst.RingCount_LowerValue). The Ring Counter Upper Limit Value/Ring Counter Lower Limit Value can be set within the range of -10000000000.0 to 10000000000.0.

Restrictions

The motion control uses the real number data (floating-point data) for the axis current position, instruction target position, or others. Therefore, it may include the truncation error.

Ex.

When the positioning of relative position specification such as MC_MoveRelative (Relative Value Positioning) is executed repeatedly

Truncation errors may accumulate between the set position and the specified movement value.

If the truncation error is a problem, execute the positioning of absolute position specification such as MC_MoveAbsolute (Absolute Value Positioning).

Ex.

When positioning for automatic deceleration at a low speed

When the target position is reached, Overrun warning (event code: 00D10H) or Overrun error (error code: 1AE3H) may be detected due to a truncation error.

By configuring the settings so that digits after the decimal point are not included in real data type parameters related to the motion control, truncation errors caused by the real number data processing inside the function can be suppressed.

When the truncation error is a problem in setting (A), the setting (B) becomes a change candidate.

- Setting (A)

Setting item	Setting details
Position Command Unit*1	[mm]
Ring Counter Upper Limit Value	100.3 [mm]
Ring Counter Lower Limit Value	-100.7 [mm]
The minimum scale of the target position/movement amount specified by FB input	0.05 [mm]

- Setting (B)

Setting item	Setting details
Position Command Unit*1	[μm]
Ring Counter Upper Limit Value	100300 [μm]
Ring Counter Lower Limit Value	-100700 [μm]
The minimum scale of the target position/movement amount specified by FB input	50 [μm]

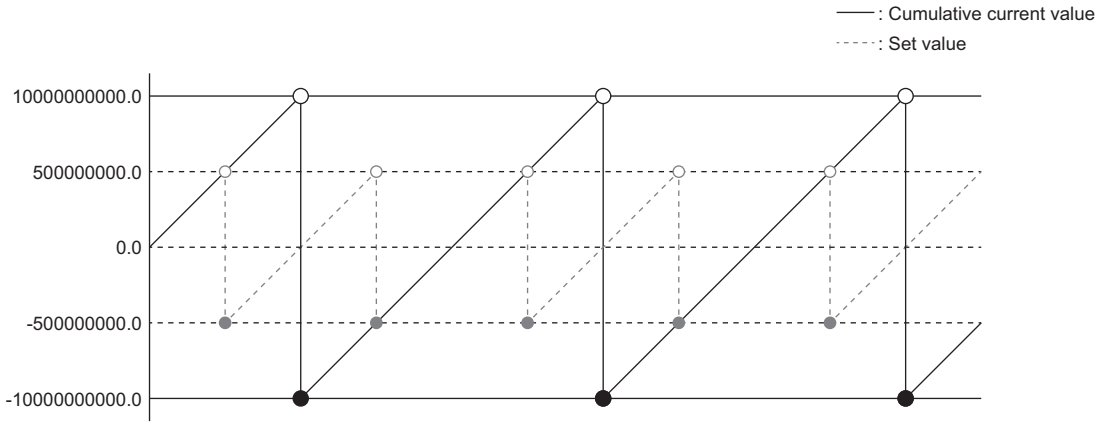
*1 For details on the setting method, refer to the following.
☞ Page 490 Units

Control details

Set Position (AxisName.Md.SetPosition) to be the ring address is calculated based on Cumulative Current Position (AxisName.Md.CumulativePosition). The cumulative current position will be the ring address of "-10000000000.0 ≤ cumulative current position < 10000000000.0" regardless of the setting of the Ring Counter Upper Limit Value/Ring Counter Lower Limit Value.

Ex.

The Ring Counter Lower Limit Value is "-500000000.0" and the Ring Counter Upper Limit Value is "500000000.0"
Set Position is the ring address of "-500000000.0 ≤ Set Position < 500000000.0".



The ring counter upper/lower limit value is fetched to the parameter at the timing when the axis is enabled.

Combination with other functions

The available range of positioning differs depending on the type of the positioning control FB.

- Absolute position specification: Within the range of the ring counter
- Relative position specification: Maximum movement amount | 10000000000.0 |

Precautions

When Ring Counter Enabled Selection (AxisName.PrConst.RingCount_Enable) is "TRUE (Enabled)", error is checked.
If the Ring Counter Upper Limit Value/Ring Counter Lower Limit Value is set as follows, an error will occur.

- The ring counter upper/lower limit value is set outside the positioning range.
- The ring counter lower limit value > The ring counter upper limit value
- | The ring counter upper limit value - The ring counter lower limit value | < 2.0

24.3 Velocity Range

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SetVelocity	Set Velocity	Stores the set output velocity.*1 This velocity is calculated from the difference of the set position. The value is positive when moving in the positive direction (Address increase direction), and the value is negative when moving in the negative direction (Address decrease direction). Stores the set velocity of the configuration axis during the axes group operation.
CommandedVelocity	Commanded Velocity	Stores the commanded velocity imported by the motion FB being controlled. Stores "0.0" after the control is completed. Stores "0.0" in Commanded Velocity (AxisName.Md.CommandedVelocity) of the configuration axis during the axes group operation.
TargetVelocity	Target Velocity	Stores the actual target velocity whose override and velocity limit value are considered. Stores "0.0" after the control is completed. Stores "0.0" in Target Velocity (AxisName.Md.TargetVelocity) of the configuration axis during axes group operation. ■For the positioning control FB The value becomes "0.0" or more regardless of the movement direction. ■For other than the positioning control FB The value is positive when moving in the positive direction (Address increase direction), and the value is negative when moving in the negative direction (Address decrease direction).
ActualVelocity	Actual Velocity	Stores the actual velocity. This velocity is calculated from the difference of the actual position. The value is positive when moving in the positive direction (Address increase direction), and the value is negative when moving in the negative direction (Address decrease direction).

*1 The stored value includes an error because a floating-point error occurs.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
SetVelocity	Set Velocity	Stores the set output velocity during the axes group operation. The value becomes "0.0" or more regardless of the movement direction of the configuration axis. Stores "0.0" after the control is completed. * When "1: Long Axis Velocity (LongAxisSpeed)" or "2: Reference Axis Velocity (ReferenceAxisSpeed)" is specified in Velocity Mode (VelocityMode) of the linear interpolation control, the absolute value of set velocity of the relevant axis is stored.
CommandedVelocity	Commanded Velocity	Stores the commanded velocity imported by the motion FB being controlled. Stores "0.0" after the control is completed. * When "1: Long Axis Velocity (LongAxisSpeed)" or "2: Reference Axis Velocity (ReferenceAxisSpeed)" is specified in Velocity Mode (VelocityMode) of the linear interpolation control, the commanded velocity of the relevant axis is stored.
TargetVelocity	Target Velocity	Stores the actual target velocity whose override and velocity limit value are considered. The value becomes "0.0" or more regardless of the movement direction of the configuration axis. Stores "0.0" after the control is completed. * When "1: Long Axis Velocity (LongAxisSpeed)" or "2: Reference Axis Velocity (ReferenceAxisSpeed)" is specified in Velocity Mode (VelocityMode) of the linear interpolation control, the target velocity of the relevant axis is stored.
ActualVelocity	Actual Velocity	Stores the actual velocity. It is the vector velocity of the actual velocity of the configuration axes. The value becomes "0.0" or more regardless of the movement direction of the configuration axis. Stores "0.0" when the axes group is invalid.

Velocity command range

The command velocity range in the motion system is as follows.

Name	Description	Range
Commanded Velocity	Velocity that is specified in the motion FB	0, ±0.0001 to ±2500000000.0
Target Velocity	Actual command velocity whose override and velocity limit value are considered with the commanded velocity	

- For the valid range of the commanded velocity of each motion FB, refer to the specifications of each FB.
- Refer to the following for the operation when the target velocity goes out of range due to the use of the override function.

☞ Page 1116 Override Function

- When 0 is set to the commanded velocity in the FB to execute multiple start, the commanded velocity of previous FB will be set. For details, refer to the following.

☞ Page 547 Multiple Start (Buffer Mode)

- To perform floating-point operation, the lower limit value of the commanded velocity is limited by the following restrictions.

If the velocity converted from the commanded velocity to operation cycle is less than 0.00001, Out of operation cycle converted velocity range (error code: 1B16H) (when changing the velocity, Out of operation cycle converted velocity range warning (event code: 00D2FH) occurs.

To improve the precision of floating-point operation, specify the speed that is converted into operation cycle so as not to be less than 0.00001 by changing Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) or Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity).

Ex.

When the operation cycle is "0.5 [ms]" and the commanded velocity is set with the following units

If the command velocity is specified for "0.0001" with the following units, the operation cycle converted velocity is as follows.

Variable name	Setting value	Unit
Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position)	H00000000	1×10^{0} [pulse]
Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity)	H00000300	1×10^{0} [pulse/s]

Operation cycle converted velocity = 0.0001 [pulse/s] ÷ 1000 × 0.5 [ms] = 0.00000005 [pulse]

Out of operation cycle converted velocity range (error code: 1B16H) occurs.

If Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) is changed from "[pulse] (H00000000)" to "$\times 10^{-3}$ [pulse] (HFD000000)", and the command velocity is changed to "0.1", the operation cycle converted velocity is as follows.

Operation cycle converted velocity = 0.1×10^{-3} [pulse/s] ÷ 1000 × 0.5 [ms] = 0.00005×10^{-3} [pulse]. Thus an error can be avoided by changing the commanded velocity to match the change of the position command unit.

Precautions

When "0 < velocity after velocity override < 0.0001" occurs, Out of Velocity Range Clamping Warning (event code: 00D34H) occurs and the velocity will become 0.

24.4 Servo ON/OFF

This function executes servo ON/OFF of the real axis connected to the motion system.
The real axis can be operated by servo ON.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Driver_ReadyOn	Driver Ready On Status	Displays the status of the drive unit to be connected. Becomes TRUE when Driver Status (AxisName.Md.Driver_State) of the connected driver is as follows. • 2: Fault Reaction Active (FaultReactionActive) • 5: Switched On (SwitchedOn) • 6: Operation Enable (OperationEnable) • 7: Quick Stop Active (QuickStopActive)
Driver_ServoOn	Driver Servo On Status	Displays the status of the drive unit to be connected. Becomes TRUE when Driver Status (AxisName.Md.Driver_State) of the connected driver is as follows. • 6: Operation Enable (OperationEnable) • 7: Quick Stop Active (QuickStopActive)

Relevant FBs

For details on motion control FBs, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_Power	Operation possible	Switches a specified axis to the operation possible status.
MCv_AllPower	All axes operation possible	Switches every axis to the operation possible status.

Control details

Servo ON/OFF

The servo ON/OFF of the real axis connected to the motion system is controlled by MC_Power (operation possible) for single axis and MCv_AllPower (all axes operation possible) for all axes.

For the drive unit status, refer to the following.

☞ Page 503 Drive unit state transition

■MC_Power (Operation Available) input/output and servo ON/OFF status

The servo ON/OFF status and the drive unit status of the selected axis can be switched as follows by inputting Enable (Enable) and Servo ON request (ServoON) of MC_Power (Operation Available).

Input variables		Output variables		Servo ON/OFF status	Driver Status (AxisName.Md.Driver_State)
Enable (Enable)	Servo ON request (ServoON)	Ready ON status (ReadyStatus)	Operable (Status)		
TRUE	TRUE	TRUE	TRUE	Servo ON	6: Operation Enable (OperationEnable)
	FALSE	TRUE	FALSE	Servo OFF	5: Switched On (SwitchedOn)
FALSE	TRUE	FALSE	FALSE	Servo OFF	3: Switched On Disabled (SwitchOnDisabled)
	FALSE	FALSE	FALSE	Servo OFF	3: Switched On Disabled (SwitchOnDisabled)

- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during the servo OFF status depends on the drive unit specification.
- While the drive unit error occurs, since the MC_Power (Operation Available) instruction/MCv_AllPower (All Axes Operation Available) instruction has been sent to the drive unit, Enable (Enable) and Servo ON request (ServoON) are not required to be turned from FALSE to TRUE again.

■Input/Output of MCv_AllPower and servo ON/OFF status

The servo ON/OFF status and the drive unit status of all real axes can be switched as follows by inputting Enable (Enable) and Servo ON request (ServoON) of MCv_AllPower (All Axes Operation Available).

Input variables		Servo ON/OFF status	Driver Status (AxisName.Md.Driver_State)
Enable (Enable)	Servo ON request (ServoON)		
TRUE	TRUE	Servo ON	6: Operation Enable (OperationEnable)
	FALSE	Servo OFF	5: Switched On (SwitchedOn)
FALSE	TRUE	Servo OFF	3: Switched On Disabled (SwitchOnDisabled)
	FALSE	Servo OFF	3: Switched On Disabled (SwitchOnDisabled)

- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during the servo OFF status depends on the drive unit specification.
- While the drive unit error occurs, since the MC_Power (Operation Available) instruction/MCv_AllPower (All Axes Operation Available) instruction has been sent to the drive unit, Enable (Enable) and Servo ON request (ServoON) are not required to be turned from FALSE to TRUE again.

Point

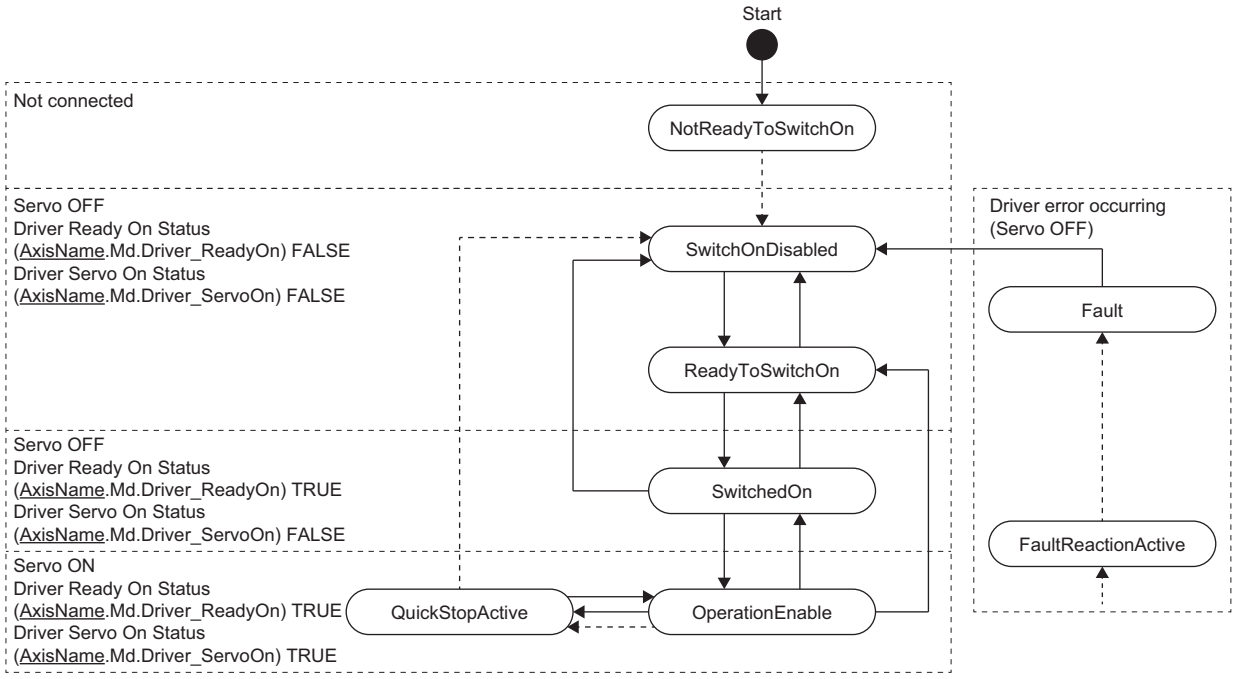
To individually execute servo OFF when using MCv_AllPower (All Axes Operation Available), use MC_Power (Operation Available) together. When MCv_AllPower (All Axes Operation Available) and MC_Power (Operation Available) are used together, the command of MC_Power (Operation Available) is given priority.

Drive unit state transition

The connected drive unit as an axis operates according to the status transition defined by the CiA402 drive profile shown below. The motion system determines whether the drive unit is being servo ON or OFF status based on the current drive unit status.

The current drive unit status can be monitored by Driver Status (AxisName.Md.Driver_State).

For details, refer to the manual of the drive unit to be connected.



Precautions

- MC_Power (Operation Available) establishes the axis information the first time that an instruction is called after PLC READY (MotionSystem.Cd.SequenceReady) is switched to on. Even if the axis information is changed while Enable (Enable) is FALSE, the change is not reflected.
- Do not set two or more MC_Power (Operation Available) for one axis. The operation is not guaranteed if set.
- The servo ON/OFF status when the program is stopped is maintained while built-in motion ready [X20] is off.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- MotionControl_General

24.5 Follow Up

This function reflects the input (current position) from the axis-assigned device station in the set position of the axis.
In an axis which has the current position (Position actual value) as the object data, this function can convert the unit of the current position by the driver unit conversion numerator/denominator (electronic gear) and reflect in the set position.

Axis type	Description
Real drive axis	The current position of the drive unit is converted and reflected in the set position in the servo OFF status. For this processing, even if the current position of the drive unit is moved during servo OFF, the drive unit will not move by the amount of droop pulses and can execute positioning from the stop position when the servo ON occurs next time. For the following cases, the follow up is executed even when the servo status is on. • When operating in a driver control mode other than cyclic synchronous position mode (csp) • The driver control mode of the drive unit is connected by motion system axis control unsupported mode.
Real encoder axis	This function can convert the unit of the current position of the synchronous encoder and reflect it in the set position. By switching the follow up enabled/disabled allows input enabled/disabled from the synchronous encoder.
Virtual encoder axis	

Operation of this function for each system status

○: Available, ×: Not available

Status	Operation availability
STOP	○
RUN	○
Moderate error	○*1
Major error	×

*1 Operation may not be performed depending on the status of add-ons and device stations.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
Encoder_CounterDisableSignal	Counter Disabling Signal	Sets a signal to switch to the counter disable. The following shows the specific setting and the operation of Counter Disabling Signal (Encoder_CounterDisableSignal). ■Target (Source.Target) Only [VAR], [DEV], and [CONST] can be specified for data type. Only "Synchronous" can be specified for the network synchronous communication setting of the device station being referred to when [VAR] or [DEV] is specified. ■Signal detection method (Detection) Only the following level detections can be set. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel) ■Compensation time (CompensationTime) Only "0.0 [s]" can be specified. ■Filter time (FilterTime) The setting range is "0.0 to 5.0 [s]". * If a value outside the range is set, Out of parameter range (axis) (error code: 1A60H) occurs.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
FollowupDisable	Follow-up Disabled	Displays the follow up disable status. When it is disabled, the follow up is not executed. • FALSE: Follow-up enabled • TRUE: Follow-up disabled
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the synchronous encoder. • FALSE: Counter enabled • TRUE: Counter disabled
Io_PosActualValue	Object Data_PosActualValue	Follow up can be used in the axis which has this object data.

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
FollowupDisable	Follow-up Disabled	Disables follow up. • FALSE: Not execute • TRUE: Execute the follow-up disable request
Encoder_CounterDisable	Counter Disabled	Switches to the counter disable. • FALSE: Not execute • TRUE: Execute the counter disable request

Disabling follow up

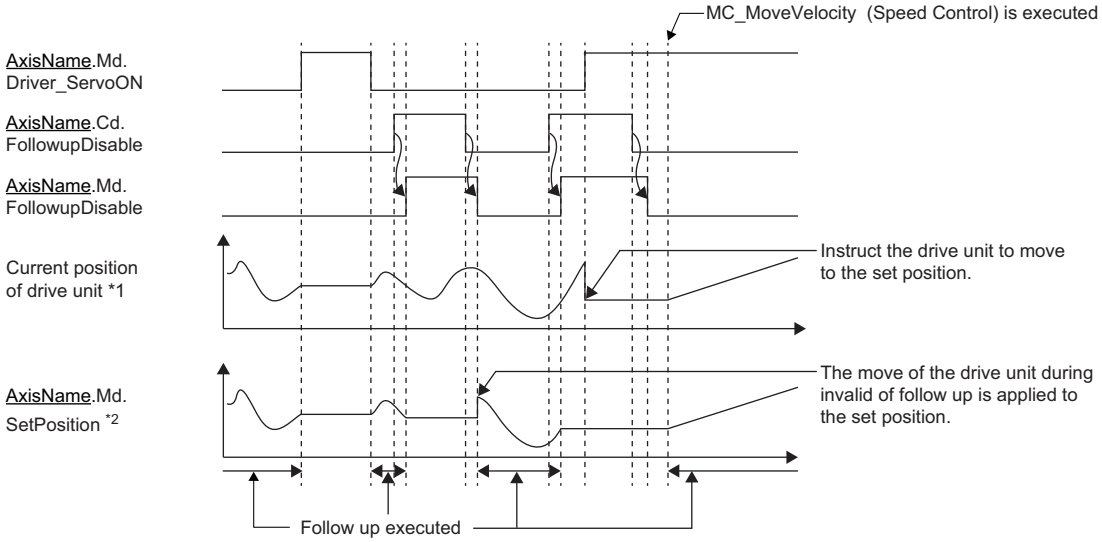
The follow up enabled/disabled status can be switched for each axis (default status: enabled). Input (current position) from the device station whose axis assignment has been executed is disabled and not reflected in the set position.

Point

That the follow up enabled/disabled is switched is recorded in the event history. Also, for the real drive axis, the servo ON from the follow up disabled status during the servo OFF is recorded in the event history as well. At this time, the difference [driver-based] between the drive unit target position (Target position) and the current position (Position actual value) is also recorded in the event history.

For real drive axis

Follow-up Disabled (AxisName.Md.FollowupDisable) becomes TRUE by setting Follow-up Disabled (AxisName.Cd.FollowupDisable) to TRUE, and the follow up is disabled.



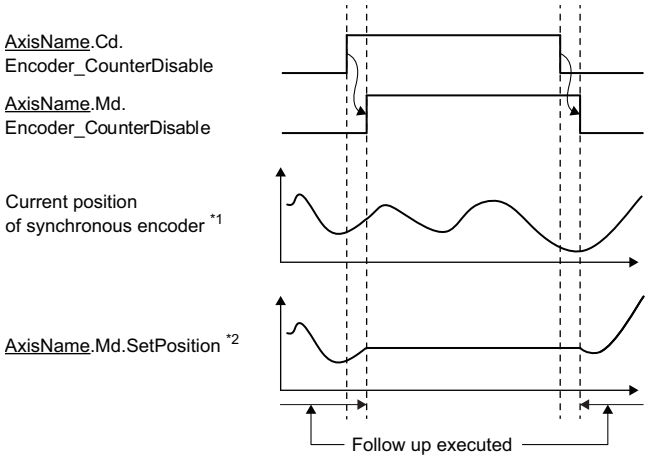
*1 When checking with the network label

*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

For real encoder axis/virtual encoder axis

■When Counter Disabling Signal (AxisName.PrConst.Encoder_CounterDisableSignal) is "no setting"

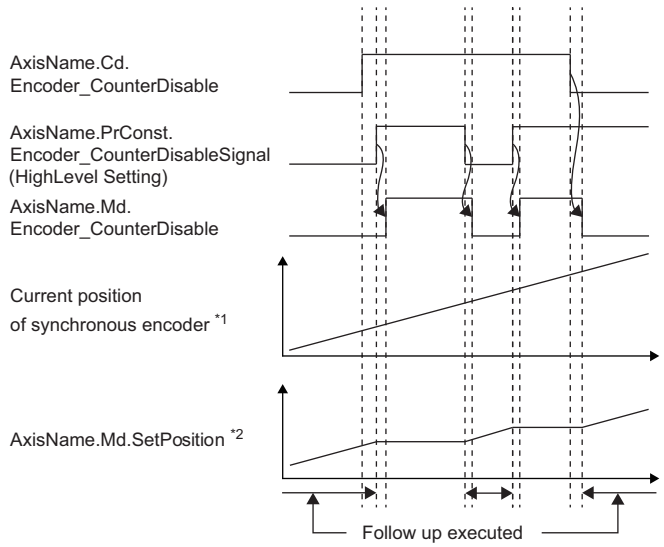
Counter Disabled (AxisName.Md.Encoder_CounterDisable) becomes TRUE by setting Counter Disabled (AxisName.Cd.Encoder_CounterDisable) to TRUE and the input from the synchronous encoder will be disabled.



*1 When checking with the network label
*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

■When Counter Disabling Signal (AxisName.PrConst.Encoder_CounterDisableSignal) is set

While Counter Disabled (AxisName.Cd.Encoder_CounterDisable) is TRUE, the counter disabling signal will be valid. Counter Disabled (AxisName.Md.Encoder_CounterDisable) becomes TRUE while the signal is in detection, and becomes the counter disable. While Counter Disabled (AxisName.Cd.Encoder_CounterDisable) is FALSE, the counter disable signal becomes invalid.

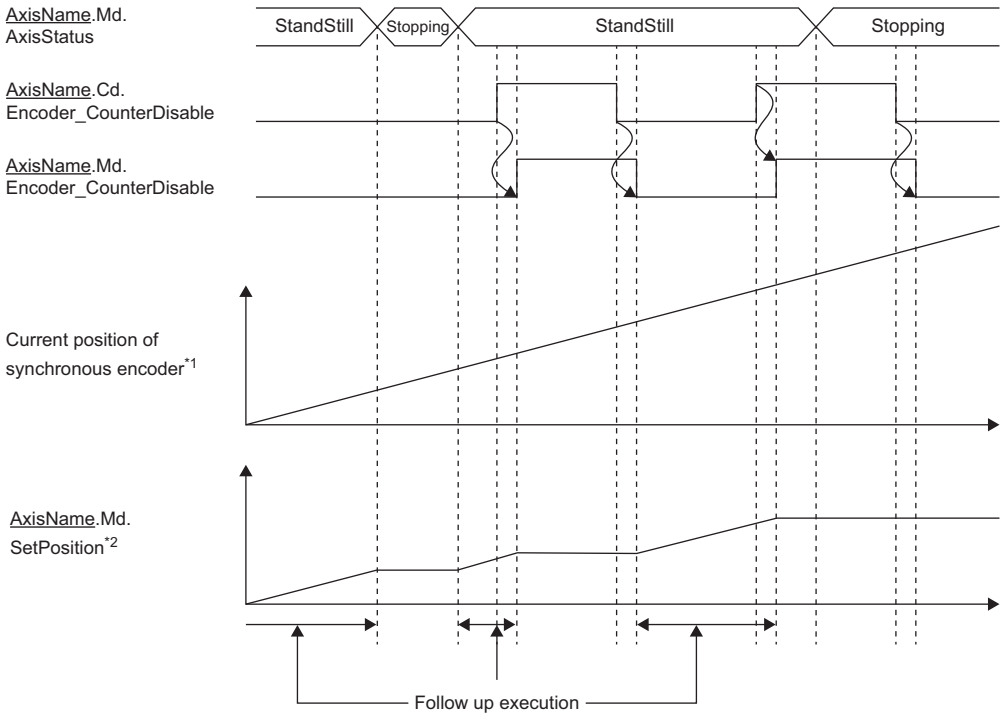


*1 When checking with the network label
*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

■When Axis Status (AxisName.Md.AxisStatus) is "0: Axis disabled (Disabled)", "1: Stopping on error (ErrorStop)", or "2: Decelerating to stop (Stopping)"

Follow-up is disabled while Axis Status (AxisName.Md.AxisStatus) is "0: Axis disabled (Disabled)", "1: Stopping on error (ErrorStop)", or "2: Decelerating to stop (Stopping)".

At this time, Counter Disabled (AxisName.Md.Encoder_CounterDisable) does not change.



Precautions

For real drive axis

- When the follow up is enabled after the current position of the drive unit is moved while the follow up is disabled, the motion system reflects the distance from the drive unit in the set position in one operation cycle. Therefore, when a single axis synchronous control is executed using an applicable axis as the master axis, the command of the movement amount of the set position is transmitted to the slave axis.
- The motion system outputs the distance to the drive unit in one operation cycle for the following cases. Note that a rapid operation may occur in the drive unit.
  - When the servo ON occurs next time after the current position of the drive unit is moved in the follow up disabled status during the servo OFF
  - When the system stopped in the servo ON status after the control excluding the position loop, such as the speed control, was executed with the follow up disabled status
- The software stroke limit function is invalid during the servo OFF. Therefore, set the software stroke limit in the slave axis or the following axis for safety to transmit the command under follow up in the single axis synchronous control to the slave axis.

For real encoder axis or virtual encoder axis

Follow up may not be performed depending on the status of the axis. For details, refer to the following.

☞ Page 455 Real encoder axis
☞ Page 461 Virtual encoder axis

For all axes types

When the movement amount per operation cycle exceeds the following range, the follow-up does not operate normally because the movement amount of the axis is different from the movement amount of the device station. Use the device stations so that their movement amount is within the following range.

Axis type	Valid range for available follow-up per operation cycle
Real drive axis	(Movement amount per operation cycle) [Driver unit] within signed 32-bit integral number range
Real encoder axis (Real encoder axes types: Via drive unit)	- ((Multiple revolution counter maximum value) / 2 × (Encoder resolution)) ≤ (Movement amount per operation cycle) [Encoder pulse unit] ≤ ((Multiple revolution counter maximum value) / 2 × (Encoder resolution) - 1)
Virtual encoder axis	- (Encoder ring counter upper limit value - Encoder ring counter lower limit value + 1) / 2 < (Movement amount per operation cycle) [Encoder pulse unit] < (Encoder ring counter upper limit value - Encoder ring counter lower limit value + 1) / 2

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine

24.6 Absolute Position Control

This function restores the current position of an axis.

Absolute position system

The absolute position system maintains the current position of axes. The absolute position system configuration differs depending on the axis type. For details, refer to the following.

☞ Page 517 Current position restoration for each axis type

The absolute position data used in the absolute position system control is maintained inside the motion system as a backup file.

Current position restoration

This function restores the current position of the axis to the previous position when the motion system power is turned on again or reset or when a device station whose axis assignment has been executed is connected.

When a drive unit other than the MELSERVO is used, the current position is set after connection.

Whether to restore with the retained absolute position data or not can be specified in Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) of the axis parameter. For details, refer to the following.

☞ Page 512 Current position restoration

Operation of this function for each system status

○: Available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○*1

*1 Operation may not be performed depending on the error status.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
PosRestoration_AbsPosEnable	Absolute Position Control Setting	Sets the absolute position control setting. • 0: Disable Absolute Position System (ABSDisabled) • 1: Enable Absolute Position System (Enabled) • -1: Automatic Setting (Acquire from Connected Device) (Auto)
PosRestoration_RestorationBase	Current Position Restoration Reference Position Setting	Sets the reference position of current position restoration to use the absolute position system. • 0: Backup Position (BackupPosition) • 1: Home Position (HomePosition) • -1: Automatic Judgment (Auto)

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
Homing_Required	Homing Required or Not	Sets whether homing is required or not. Sets FALSE when the homing is not required. If FALSE is set, the homing request will not become TRUE at the current position restoration. • FALSE: Homing is unnecessary. • TRUE: Homing is necessary.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Homing_Required	Homing Required or Not	Displays whether the axis requires the homing or not. If FALSE is set, the homing request will not become TRUE at the current position restoration. • FALSE: Homing is unnecessary. • TRUE: Homing is necessary.
PosRestoration_Status	Current Position Restoration Status	Displays the current position restoration status. • 0: Not Executed (NotExecute) • 1: Waiting for Restoration Request (WaitingRequest) • 2: Restoration Completed in Incremental System (RestoredInIncSystem) • 3: Restoration Completed in Absolute Position System (Homing Uncompleted) (RestoredInAbsSystemUnHomed) • 4: Restoration Completed in Absolute Position System (RestoredInAbsSystem) * When Current Position Restoration Request must be executed, "1: Waiting for Restoration Request (WaitingRequest)" is displayed upon connecting the device station. * "0: Not Executed (NotExecute)" is displayed when the device station is disconnected.
Homing_Request	Homing Request	Displays whether homing is required or not. The timing of becoming TRUE differs depending on the Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable). For details, refer to the following. ☞ Page 514 Homing request Becomes FALSE when the homing is completed. • FALSE: No homing request • TRUE: Homing request
SetPosition	Set Position	Stores the current position address. The set position is a value which rounds the cumulative current value with the ring counter range.
CumulativePosition	Cumulative Current Position	Stores the current position address. When the current position is changed, the address is changed to the one after change.
FeedMachinePosition	Machine Feed Value	Stores the current position address by the machine coordinate. The accumulative value from the homing completed position is set. The address is not changed even if the current position is changed.

Current position restoration

Specify whether the absolute position system is used for the current position restoration or not in Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable).

Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable)	Details
0: Disable Absolute Position System (ABSDisabled)	☞ Page 512 Incremental system
1: Enable Absolute Position System (Enabled)	☞ Page 513 Absolute position system
-1: Automatic Setting (Acquire from Connected Device) (Auto)	☞ Page 514 Connected device setting

- Set "-1: Automatic Setting (Acquire from Connected Device) (Auto)" when the connected device has the Encoder status 1 object.
- When "-1: Automatic Setting (Acquire from Connected Device) (Auto)" is not set, the connected device side setting and the motion system side setting must be matched. If not matched, normal current position control cannot be executed. (If the connected device has Encoder status 1 object and the settings are mismatched, Absolute position control setting mismatch (error code: 1AF2H) will occur at the current position restoration.)

Ex.

When the absolute position system is used,
select "1: Enabled (absolute position detection system)" for "Absolute position detection system selection (PA03.0)" of the servo parameter (basic parameter) in the MR-J5(W)-G. In the motion system, select "1: Enable Absolute Position System (Enabled)" for Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) in the real drive axis which uses the MR-J5(W)-G as the connected device.
The current position restoration timing differs depending on the axis type. For details, refer to the following.
☞ Page 517 Current position restoration for each axis type

Point

Whether "incremental system" or "absolute position system" was used for the current position restoration is recorded in the event history.

- When "-1: Acquire from Connected Device" is set for an axis whose Encoder status 1 object setting value remains blank, Connection setting incorrect warning for drive units other than MELSERVO (event code: 00D4CH) will occur, and it will operate as "Incremental system".

Incremental system

This system restores the current position without using the absolute position data.
When the current position restoration is completed, the axis current position (Cumulative Current Position, Machine Feed Value) becomes "0", and the Homing Request (AxisName.Md.Homing_Request) becomes TRUE. (The set position may not become "0" depending on the ring counter setting. (☞ Page 496 Positioning Range))
When restoration is completed, Current Position Restoration Status (AxisName.Md.PosRestoration_Status) of the axis becomes "2: Restoration Completed in Incremental System (RestoredInIncSystem)".
If the machine position establishment with the device station is not required, set Homing Required or Not (AxisName.Pr.Homing_Required) to FALSE. This prevents Homing Request (AxisName.Md.Homing_Request) from becoming TRUE at the restoration.
The absolute position data backup is not executed.

Absolute position system

This system restores the current position using the absolute position data.
At the current position restoration, the axis current position (set position, cumulative current position, and machine feed value) is restored based on backed up absolute position data. When restoration is completed, Current Position Restoration Status (AxisName.Md.PosRestoration_Status) of the axis becomes "4: Restoration Completed in Absolute Position System (RestoredInAbsSystem)".
However, if Absolute Position Data Incorrect Warning (event code: 00D00H) has been detected at restoration, Current Position Restoration Status (AxisName.Md.PosRestoration_Status) of the axis becomes "3: Restoration Completed in Absolute Position System (Homing Uncompleted) (RestoredInAbsSystemUnHomed)". The current position is restored with the same content as the incremental system and Homing Request (AxisName.Md.Homing_Request) becomes TRUE. (The absolute position data is maintained.)
At this time, the absolute position system is not enabled until homing is completed. Be sure to execute homing. (When homing has been normally completed, Current Position Restoration Status (AxisName.Md.PosRestoration_Status) of the axis becomes "4: Restoration Completed in Absolute Position System (RestoredInAbsSystem)".)
When the absolute position system is used, the restoration content differs depending on the axis type. For details, refer to the following.
☞ Page 517 Current position restoration for each axis type
In the following cases, Absolute Position Data Incorrect Warning (event code: 00D00H) occurs.

- The absolute position data is illegal at the current position restoration by the following causes.
  - The axis type is changed. (The axis type of the absolute position data does not match the axis variable.)
  - The absolute position data is deleted by the memory error or others.
  - The homing request has been TRUE at backup.
  - The axis driver unit conversion (numerator/denominator) is changed.
- Even though the machine homing has been started, it has not been normally completed.
- For real drive axes, an error occurs by the following causes.
  - "Absolute position erased" is detected on the drive unit side.
  - "Polarity" b7: position polarity of the object data is changed.
  - "HomeOffset" of the object data is changed.
  - The connected drive unit was changed.
  - The encoder resolution of the connected drive unit was changed.
- For real encoder axes (via drive unit), an error occurs by the following causes.
  - "Absolute position erased" is detected in the scale measurement encoder.
  - The encoder resolution of the scale measurement encoder is changed.
- For virtual encoder axes, an error occurs by the following causes.
  - The encoder ring counter upper/lower limit values are changed.

The following object data is used to acquire the detection result of absolute position erased/current position restoration disabled on the drive unit side.

Setting item (AxisName.PrConst.SlaveObject.)	Application
vStatusDo1 (StatusDo1)	Used to determine the current position restoration availability and the absolute position erased on the drive unit side.
vStatusDo2 (StatusDo2)	Used to determine the absolute position erased on the drive unit side.
vSupportedStatusDo1 (SupportedStatusDo1)	Acquires the corresponding status for each bit of StatusDo1.
vSupportedStatusDo2 (SupportedStatusDo2)	Acquires the corresponding status for each bit of StatusDo2.

Precautions

- All setting values of object data used to acquire the detection result of absolute position erased/current position restoration disabled for the drive unit must be set. If even one setting value of object data used to acquire the detection result of absolute position erased/current position restoration disabled for the drive unit is blank, restoration to the correct position may not be possible.
- When a drive unit other than the MELSERVO is used, the detection result of absolute position erased for the drive unit is not acquired. When using an absolute position system with a drive unit other than the MELSERVO, execute the operation after checking that the drive unit is not in absolute position erased status. When the drive unit is in absolute position erased status, execute homing before executing the operation.

Connected device setting

The connected device that has the Encoder status 1 object in the real axis acquires the absolute position system setting by the SDO communication and restores the current position.
Set the absolute position system setting in the connected device side.
For virtual axes, the device operates as the incremental system.

Homing request

The Homing Request (AxisName.Md.Homing_Request) will be TRUE in the following cases.

Point

The reason why Homing Request (AxisName.Md.Homing_Request) became TRUE is recorded in event history.

Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable)*1	Cause		Detection timing*2
Common	The system power is turned on or reset.*3		At the system power-ON or after reset
	The axis type is changed.		At the current position restoration
	Homing is started. (The homing request flag will not become FALSE unless homing is normally completed.)		At homing start
	The axis driver unit conversion (numerator/denominator) is changed.		At the current position restoration When PLC READY (MotionSystem.Cd.SequenceReady) is turned on
	The drive unit power turns on.*3 (The real drive axis only)		At the current position restoration
Disable absolute position system	The current position restoration is executed.		At the current position restoration
Enable absolute position system	The absolute position data in the motion system has been erased due to an error such as a memory error.		At the current position restoration
	A change of the drive unit and the motor encoder is detected.		
	Only for real drive axes	"Polarity" b7: position polarity of the object data is changed.	
		An electronic gear on the drive unit side is changed.	
		"Absolute position erased" is detected on the drive unit side.	At the current position restoration and cause occurring
	Only for real encoder axes (via drive unit)	"Absolute position erased" is detected in the scale measurement encoder.	At the current position restoration
		The encoder resolution of the scale measurement encoder is changed.	
	Only for virtual encoder axes	The encoder ring counter upper/lower limit values are changed.	

*1 For the "-1: Automatic Setting (Acquire from Connected Device) (Auto)" setting, refer to the connected device setting.
*2 When Homing Required or Not (AxisName.Pr.Homing_Required) is FALSE, Homing Request (AxisName.Md.Homing_Request) will not become TRUE even though the cause is occurring at the current position restoration.
*3 When the system/drive unit power is off when "1: Enable Absolute Position System (Enabled)" is set and homing is completed at resetting, the homing request will not become TRUE.

Absolute position data backup

When the absolute position system is used, the absolute position data of each axis is backed up. The absolute position data is backed up with it linked to the axis variable (axis No.) and the axis type. At the current position restoration, if the setting values do not match with the axis variable (axis No.) and the axis type of the absolute position data, the absolute position data will be discarded. (Absolute Position Data Incorrect Warning (event code: 00D00H) occurs.)
At the current position restoration, if the setting values match with the axis variable (axis No.) and the axis type of the absolute position data, the absolute position data will be taken over even when the variable name is different.

Ex.
For the following operation, Axis0002 takes over the absolute position data of Axis0001.
- Delete the axis (Variable name: Axis0001, Axis number: 1, Axis type: Real drive axis) and execute writing.
- Add the axis (Variable name: Axis0002, Axis number: 1, Axis type: Real drive axis) and execute writing.
- Execute current position restoration.

Backup is executed while Homing Request (AxisName.Md.Homing_Request) is FALSE. (When Homing Request (AxisName.Md.Homing_Request) becomes TRUE, the absolute position data is discarded.)
Backup is executed at approximately 2 [s] intervals after the previous backup.

Storage folder and file name

The following shows the storage folder and file name of the backed up absolute position data.
- Storage folder: /lch
- File name: abs_axis.bin

Memory capacity

Memory capacity of the absolute position data differs depending on the axis type. Specify memory capacity of the absolute position data according to the axis type and the number of axes. The following table lists the maximum absolute position data size based on the specifications.

Axis type	Memory usage	Maximum memory capacity
Real Drive Axis	220 bytes/axis	56320 bytes (220 bytes × 256 axes)
Real Encoder Axis	170 bytes/axis	1700000 bytes (170 bytes × 10000 axes)
Virtual Drive Axis	90 bytes/axis	900000 bytes (90 bytes × 10000 axes)
Virtual Encoder Axis	170 bytes/axis	1700000 bytes (170 bytes × 10000 axes)
Virtual Linked Axis	90 bytes/axis	900000 bytes (90 bytes × 10000 axes)

Memory capacity used for the absolute position data can be specified in Maximum Backup RAM Size (System.PrConst.AddonAbsSystem.BackupRamSizeMax).
If the file size required for backup exceeds specified memory capacity when the current position of each axis is restored, Insufficient current position backup capacity (error code: 1B11H) occurs and the target axis is not restored completely. Check the memory capacity and turn on the system again or reset it.
Discarded absolute position data is deleted from the file when the system power is turned on again or reset.

Saving (backup) and restoration (restored) of the absolute position data

The absolute position data maintained inside the motion system can be backed up and restored using tools such as the engineering tool. When exchanging the motion module, restarting time can be shortened by saving/restoring not only programs and parameters but also the absolute position data.

During backup or restoration, the motion system stops backing up the absolute position data.

For the real drive axis, Homing Request (AxisName.Md.Homing_Request) becomes TRUE when the restored absolute position data is different from Home Offset (607CH), the device, and the resolution of the connected drive unit.

For details on saving (backup) and restoration (restored), refer to the following.

☞ Page 1622 CONTROLLER DATA BACKUP/RESTORATION FUNCTION

Point

- The current position of the moved axes after backup stop is not saved. It is recommended to execute the backup after checking all axes have stopped.
- When the current position is restored using the 32-bit restoration, if the value of the current position (Position actual value) has changed beyond the signed 32-bit integer range since the previous backup, the current position after the drive unit re-connection becomes an error value.

Current position restoration for each axis type

This section describes the current position restoration for each axis type.

Real drive axis

Each current position is restored as follows.

Current position		Incremental system	Absolute position system	
			Reference position	
			Backup position	Home position
Machine feed value		Restored to "0".	Differs depending on the restoration method. For details, refer to the following. ☞ Page 518 Absolute position system	—
Cumulative current position		—		The same value as restored machine feed value.
Set position	Ring counter enabled selection: Disabled	The same value as restored cumulative current position.		
	Ring counter enabled selection: Enabled	—	Restored to the backup data value.*1	A value obtained by rounding the restored machine feed value with the ring counter

*1 If the setting value of the ring counter upper limit value or ring counter lower limit value is changed after homing, the position may not be restored correctly as the restoration is executed based on the backup data before the setting value is changed. Execute homing again.

When the current value is changed, the current position to be restored after the motion system or the drive unit is powered on again is as follows.

Current position		Reference position	
		Backup position	Home position
Machine feed value		—(Not subject to current position change)	
Cumulative current position		The position returns to the one before current position change.	The position returns to the one before current position change.
Set position	Ring counter enabled selection: Disabled		
	Ring counter enabled selection: Enabled	The position is the one after current position change.	

■Current position restoration timing

If object data required to construct the absolute position system for 64-bit current position restoration exist, restoration is automatically executed at the initial communication with the device station. For details on the absolute position system to execute the 64-bit current position restoration, refer to the following.

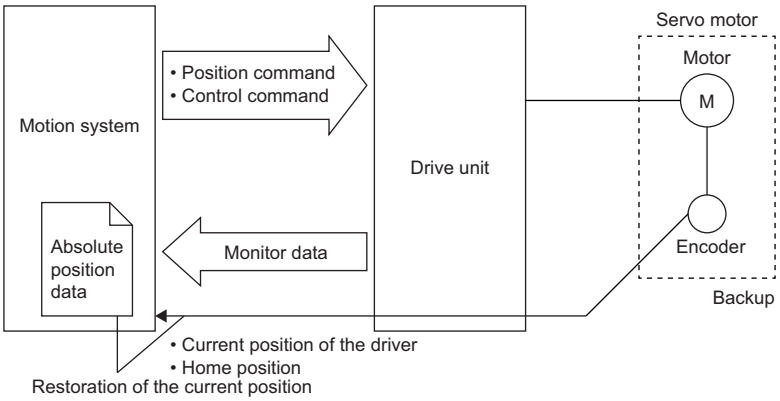
☞ Page 518 Absolute position system

The servo ON status is not established until the current position restoration is completed.

■Absolute position system

This section describes precautions for constructing the absolute position system in a real drive axis.

The following shows the absolute position system configuration when the drive unit is used as the servo amplifier.



A drive unit/servo motor which can detect the absolute position must be used to construct the absolute position system.

For details on the absolute position system setting of the drive unit side, refer to each drive unit manual.

For MR-J5(W)-G: MR-J5-G/MR-J5W-G User's Manual (Parameters)

The current position restoration of the absolute position system can be classified into the following four methods.

Current position restoration method	Reference position	Description	Remark
32-bit restoration (Drive unit current position restoration)	Backup position	Correctly executes the current position restoration within the signed 32-bit integral number range [driver-based] from the reference position. The position is restored using position data backed up by the motion system.	• If object data required to construct the 64-bit absolute position system are not set, 32-bit restoration will be executed. • 64-bit restoration is a restoration based on the home position when the connected device station has been changed.
	Home position	Correctly executes the current position restoration within the signed 32-bit integral number range [driver-based] from the reference position. The position is restored with respect to the drive unit current position.	
64-bit restoration (Drive unit ABS counter position restoration)	Backup position	Correctly executes the current position restoration within up to the signed 64-bit integral number range*1 [driver-based] from the reference position. The position is restored using position data backed up by the motion system.	
	Home position	Correctly executes the current position restoration within up to the signed 64-bit integral number range*1 [driver-based] from the reference position. The position is restored with respect to the drive unit current position.	

*1 Actual restoration possible range is shown below.
- ((Multiple revolution counter maximum value) / 2 × (Encoder resolution)) to ((Multiple revolution counter maximum value) / 2 × (Encoder resolution) - 1)

Point

In the real drive axis, which method was used for the current position restoration of the absolute position system, "32-bit restoration, 64-bit restoration (backup position), 32-bit restoration (home position), or 64-bit restoration (home position)" is recorded in the event history.

The following shows object data required to construct the 64-bit absolute position system.
If any one of the following parameters is not specified, 32-bit restoration is executed.

Setting item Object Data (AxisName.PrConst.SlaveObject) (SLAVE_OBJECT_REAL)	Setting details
vHomeCycleCounter (HomeCycleCounter)	Specifies the object ID storing the encoder position within one revolution at homing.
vHomeAbsCounter (HomeAbsCounter)	Specifies the object ID storing the encoder multiple revolution counter at homing.
vInitialPos (InitialPos)	Specifies the object ID storing Position actual value at connection.
vInitialCycleCounter (InitialCycleCounter)	Specifies the object ID storing the encoder position within one revolution at connection.
vInitialAbsCounter (InitialAbsCounter)	Specifies the object ID storing the encoder multiple revolution counter at connection.
vMaxAbsCounter (MaxAbsCounter)	Specifies the object ID storing the maximum value of the multiple revolution counter.

Precautions

- Even if the above parameters have been specified, Driver restoration data incorrect (error code: 1B12H (detail code: 0001H)) will occur and the current position restoration may not be completed. Execute reconnecting after correcting the parameter of the drive unit.
- When the maximum value of encoder resolution or encoder multiple revolution counter is other than 2 to the power of n, the 32-bit restoration is executed.
- When the 32-bit restoration is executed, if the value of Position actual value has changed beyond the signed 32-bit integer range during the drive unit disconnection, the current position after the drive unit connection becomes an error value. Execute homing if necessary.
- When the 32-bit restoration is executed, if a disconnection or power off occurs while the operation is being performed at a speed where the drive unit command velocity is 536870912U/s or higher, the current position may not be restored normally. Execute homing if necessary.
- When the MR-J5(W)-G cannot restore the current position, Driver restoration data incorrect (error code: 1B12H (detail code: 0002H)) will occur in the motion system, and the current position restoration is not completed. The current position may be restored by checking the status of the MR-J5(W)-G and reconnecting it. During reconnection, when homing request becomes TRUE, execute homing again.

■When the MR-J5(W)-G is used

The following explains the settings and the current position restoration method when the absolute position system is constructed using the MR-J5(W)-G.

- MR-J5(W)-G setting

Select "1: Enabled (absolute position detection system)" in "Absolute position detection system selection (PA03.0)" of the servo parameter (basic setting). In addition, select "0: Disabled" in "Absolute position counter warning (AL. E3) selection (PC29.5)" of the servo parameter (extension setting).
Depending on the "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)" setting of the servo parameter, Driver restoration data incorrect (error code: 1B12H) may occur. Correct the following.

- When the resolution of the connected encoder is 2 to the power of n, set the electronic gear of the MR-J5(W)-G to be 1:1 or multiple of 2 to the power of n.
- When the resolution of the connected encoder is other than 2 to the power of n, set the electronic gear of the MR-J5(W)-G to "1:1".

- Motion system setting

Select "-1: Automatic Setting (Acquire from Connected Device) (Auto)" or "1: Enable Absolute Position System (Enabled)" in Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) in the real drive axis whose connected device is the MR-J5(W)-G.

- Current position restoration method

Execute the 64-bit current position restoration.

Real encoder axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored to "0".	Restores the position based on the synchronous encoder movement amount by using backup data of the motion system. When the axis state transitions to Standby (Standstill) for the first time after restoration is complete, the movement amount from the completion of restoration is followed up.
Set position	A value obtained by rounding the restored cumulative current position with the ring counter	

The restoration method for the absolute position system depends on Real Encoder Axis Type Setting (AxisName.PrConst.Encoder_AxisType) of the axis parameter shown below.

Real encoder axis type	Current position restoration method	Description	Remark
Via drive unit	64-bit current position restoration	Correctly executes the current position restoration within up to the signed 64-bit integral number range*1 [encoder pulse unit] from the backup position.	Only the synchronous encoder connected to the drive unit can be used. For details on the setting, refer to the following. ☞ Page 443 Axis

*1 Actual restoration possible range is shown below.
- ((Multiple revolution counter maximum value) / 2 × (Encoder resolution)) to ((Multiple revolution counter maximum value) / 2 × (Encoder resolution) - 1)

■Current position restoration timing

Current position restoration is executed after the real drive axis of the same station address is connected.

Virtual drive axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored to "0".	Restored to the backup data value.
Set position	A value obtained by rounding the restored cumulative current position with the ring counter	

■Current position restoration timing

Current position restoration is executed at the axis variable initialization. For details on the axis variable initialization timing, refer to the following.

☞ Page 445 Axis variable initialization timing

Virtual encoder axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored to "0".	Restores the current position based on the movement amount from the backup data to the position at restoration. Correctly executes the current position restoration within the signed 32-bit integral number range [encoder pulse unit] from the backup position. When the axis state transitions to Standby (Standstill) for the first time after restoration is complete, the movement amount from the completion of restoration is followed up.
Set position	A value obtained by rounding the restored cumulative current position with the ring counter	

■Current position restoration timing

Executes the current position restoration as Connection Command (AxisName.Cd.Encoder_Connect) becomes TRUE.

Virtual linked axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored to "0".	Restored to the backup data value.
Set position	A value obtained by rounding the restored cumulative current position with the ring counter	

■Current position restoration timing

Current position restoration is executed at the axis variable initialization. For details on the axis variable initialization timing, refer to the following.

☞ Page 445 Axis variable initialization timing

Required object data

When executing 64-bit restoration for the real drive axis, refer to the following.

☞ Page 518 Absolute position system

Precautions

- In the absolute position control setting, when the connected device side setting and the motion system side setting are mismatched, normal current position control may not be executed. (If the connected device has Encoder status 1 object, Absolute position control setting mismatch (error code: 1AF2H) will occur at the current position restoration.)
- If Homing Required or Not (AxisName.Pr.Homing_Required) is set to TRUE, address information stored in the motion system is not guaranteed.
- A backup file created with a different model can be used. However, current position restoration can only be executed for the number of axes of the backup file.
  Example: When a backup file is created with a 4-axis model, and the backup file is moved to an 8-axis model, the current position restoration is executed for 4 axes and not for the remaining 4 axes.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- AbsSystem

25 OPERATION CYCLE

In the motion system, operation processing related to the motion control is performed in the fixed cycle (motion operation cycle). This section describes operation cycles which can be set in the motion system.
An operation cycle can include a mix of up to three cycles. A system with many axes can be controlled in divided manner by operating a specific axis at a fast operation cycle and operating other axes at a low speed operation cycle.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

25.1 Relevant Variables

CYCLE_PARAM.

Variable/structure name	Name	Details
NumOfCycleOverWngDetectTimes	Number of Cycle Over Warning Detections	Sets the number of cycles until the cycle over warning of each cycle is detected. Warning is not detected when 0 is set. • 0 to 5 times
NumOfCycleOverErrDetectTimes	Number of Cycle Over Error Detections	Sets the number of cycles until the cycle over error of each cycle is detected. Operates at 5 (default value) when 0 is set. • 1 to 5 times
CycleOverErrorType	Cycle Over Error Selection	Selects an assignment for the over error of each cycle. • 2: Minor Error (MinorError) • 3: Moderate Error (ModerateError)

System Parameter Constant (MotionSystem.PrConst.)

Variable/structure name	Name	Details
OperationCycle[1].NumOfCycleOverWngDetectTimes	Number of Cycle Over Warning Detections	Stores each setting value of the first operation cycle. For details, refer to the following. ☞ Page 522 CYCLE_PARAM.
OperationCycle[1].NumOfCycleOverErrDetectTimes	Number of Cycle Over Error Detections	
OperationCycle[1].CycleOverErrorType	Cycle Over Error Selection	
OperationCycle[2].NumOfCycleOverWngDetectTimes	Number of Cycle Over Warning Detections	Stores each setting value of the second operation cycle. For details, refer to the following. ☞ Page 522 CYCLE_PARAM.
OperationCycle[2].NumOfCycleOverErrDetectTimes	Number of Cycle Over Error Detections	
OperationCycle[2].CycleOverErrorType	Cycle Over Error Selection	
OperationCycle[3].NumOfCycleOverWngDetectTimes	Number of Cycle Over Warning Detections	Stores each setting value of the third operation cycle. For details, refer to the following. ☞ Page 522 CYCLE_PARAM.
OperationCycle[3].NumOfCycleOverErrDetectTimes	Number of Cycle Over Error Detections	
OperationCycle[3].CycleOverErrorType	Cycle Over Error Selection	

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
OperationCycle	Control Cycle Setting	Sets the control operation cycle of the axis. • 0: Automatic setting For a real axis, the same operation cycle as the communication cycle of the device station assigned to the axis is automatically selected. For a virtual axis, the system operates in the first operation cycle. • 1: Operate in the first operation cycle • 2: Operate in the second operation cycle • 3: Operate in the third operation cycle When a setting that does not match the communication cycle of the device is selected on the real axis, Cycle assignment incorrect (axis) (error code: 1B2BH) occurs.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
OperationCycle	Control Cycle Setting	Stores the control operation cycle of the axis. 0: Axis uninitialized/Control cycle setting out of range 1: Operate in the first operation cycle 2: Operate in the second operation cycle 3: Operate in the third operation cycle

CYCLE_MONI.

Variable/structure name	Name	Details
Cycle	Setting Cycle	Stores the cycle setting of each cycle. • First operation cycle: 125000 to 10000000ns • Second operation cycle: 500000 to 40000000ns • Third operation cycle: 2000000 to 1280000000ns
ProcessingTime	Processing Time	Stores the processing time of each cycle. 0 to 4294967295ns
MaximumProcessingTime	Maximum Processing Time	Stores the maximum processing time of each cycle. 0 to 4294967295ns
CycleOver	Cycle Over	Becomes TRUE when the cycle over of each cycle is detected.

System monitor data (MotionSystem.Md.)

Variable/structure name	Name	Details
OperationCycle[1].Cycle	Setting Cycle	Stores the monitor value of the first operation cycle. For details, refer to the following. ☞ Page 523 CYCLE_MONI.
OperationCycle[1].ProcessingTime	Processing Time	
OperationCycle[1].MaximumProcessingTime	Maximum Processing Time	
OperationCycle[1].CycleOver	Cycle Over	
OperationCycle[2].Cycle	Setting Cycle	Stores the monitor value of the second operation cycle. For details, refer to the following. ☞ Page 523 CYCLE_MONI.
OperationCycle[2].ProcessingTime	Processing Time	
OperationCycle[2].MaximumProcessingTime	Maximum Processing Time	
OperationCycle[2].CycleOver	Cycle Over	
OperationCycle[3].Cycle	Setting Cycle	Stores the monitor value of the third operation cycle. For details, refer to the following. ☞ Page 523 CYCLE_MONI.
OperationCycle[3].ProcessingTime	Processing Time	
OperationCycle[3].MaximumProcessingTime	Maximum Processing Time	
OperationCycle[3].CycleOver	Cycle Over	
MotionService.Cycle*1	Setting Cycle	Stores the monitor value of the motion service processing. For details, refer to the following. ☞ Page 523 CYCLE_MONI.
MotionService.ProcessingTime	Processing Time	
MotionService.MaximumProcessingTime	Maximum Processing Time	
MotionService.CycleOver*2	Cycle Over	

*1 "0" is always stored because the cycle setting does not exist.

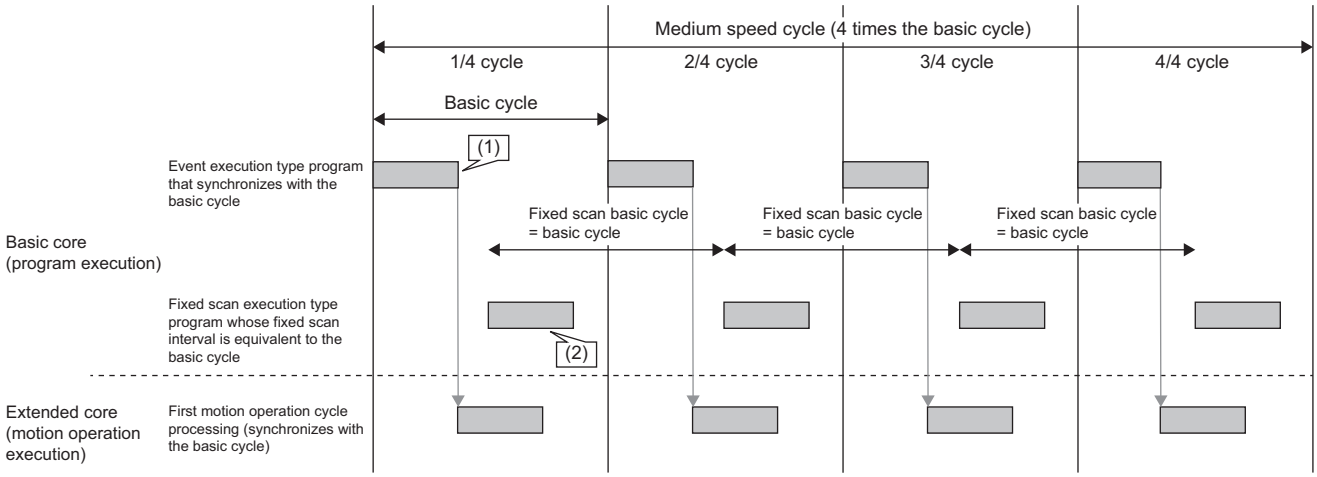
*2 FALSE is always set because the cycle over detection is not executed.

25.2 Motion Operation Cycle Setting

By using the motion operation cycle setting, the first, second, and third operation cycles can be set.
The shorter the motion operation cycle, the more accurate and responsive the motion operation becomes. The first motion operation cycle synchronizes with the basic cycle of the network. The second motion operation cycle synchronizes with the medium speed cycle of the network, and the third motion operation cycle synchronizes with the low speed cycle of the network.
For the communication period setting of the network, refer to the following.
☞ Page 287 Basic period setting
☞ Page 293 Multiple period setting
The motion operation cycle can be synchronized with the program execution cycle. When the execution order of a motion operation and a program starts from the beginning of the network communication cycle, with the program always being executed first, followed by the motion operation, this is referred to as a "program synchronous with the motion operation cycle".
The following table lists the combinations of network communication cycles and programs to be synchronized with motion operation cycles.

Motion operation cycle	Synchronous network communication cycle	Synchronous program		
		Execution type	Trigger type	Execution cycle
First operation cycle	Basic cycle	Event	Network communication cycle synchronization	Basic cycle
Second operation cycle	Normal-speed cycle			Normal-speed cycle
Third operation cycle	Low-speed cycle			Low-speed cycle

For the event execution type program, refer to the following.
☞ Page 252 Event execution type program
The motion operation cycle and program will not be synchronized in any combinations other than those listed above.
For example, when the basic cycle is 1ms, the event execution type program to be synchronized with the basic cycle will be synchronized with the first motion operation cycle. However, a fixed scan execution type program whose fixed scan interval is 1ms will not be synchronized with the first motion operation cycle even though their cycles match.



(1) Program that is synchronized with the motion operation cycle (the program will always be executed first, followed by the motion operation.)
(2) Program that is not synchronized with the motion operation cycle (the program execution cycle will not be synchronized with the motion operation cycle even though their operation cycles match. In addition, the execution order of the program and motion operation will not be guaranteed.)

A rough standard for the operation cycle settings

The following shows a reference of the operation cycle settings.

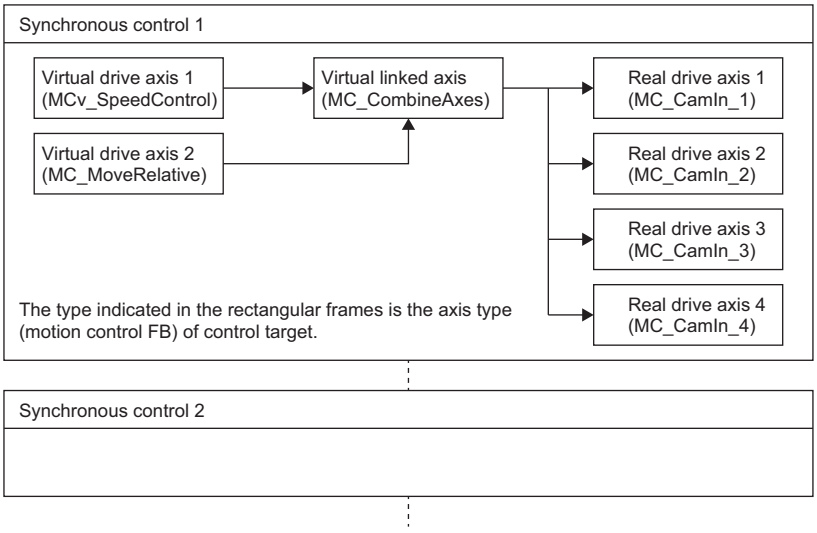
■A rough standard for the number of axes and the operation cycle settings when using the positioning control

The rough standard shown below is the one when real drive axes are set as axes groups of two axes each and positioning control is performed repeatedly.

Operation cycle	MXR300-16	MXR300-32	MXR300-64	MXR500-128	MXR500-256
125 [μs]	2 axes			4 axes	
250 [μs]	16 axes	22 axes		26 axes	
500 [μs]	16 axes	32 axes	48 axes	58 axes	
1.0 [ms]	16 axes	32 axes	64 axes	108 axes	
1.5 [ms]	16 axes	32 axes	64 axes	128 axes	140 axes
2.0 [ms]	16 axes	32 axes	64 axes	128 axes	180 axes
3.0 [ms]	16 axes	32 axes	64 axes	128 axes	256 axes
4.0 [ms]	16 axes	32 axes	64 axes	128 axes	256 axes
8.0 [ms]	16 axes	32 axes	64 axes	128 axes	256 axes

■A rough standard for the number of axes and the operation cycle settings when using the synchronous control

A rough standard is shown below when Synchronous control 1 in the following configuration example is one unit, Virtual drive axis 1 and Virtual drive axis 2 are controlled, and four Real drive axes are synchronized. (The number of using axes shown in the table indicates the number of real drive axes in the configuration example.)



Operation cycle	MXR300-16	MXR300-32	MXR300-64	MXR500-128	MXR500-256
125 [μs]	—			4 axes	
250 [μs]	12 axes			20 axes	
500 [μs]	16 axes	32 axes		40 axes	
1.0 [ms]	16 axes	32 axes	60 axes	68 axes	
1.5 [ms]	16 axes	32 axes	64 axes	92 axes	
2.0 [ms]	16 axes	32 axes	64 axes	120 axes	
3.0 [ms]	16 axes	32 axes	64 axes	128 axes	164 axes
4.0 [ms]	16 axes	32 axes	64 axes	128 axes	216 axes
8.0 [ms]	16 axes	32 axes	64 axes	128 axes	256 axes

Point

- Adjust the operation cycle setting depending on the system load status.
- The operation time increases when the motion control FB starts. The increase of operation time can be reduced by changing the start timing.
- Note the following for parameter setting values, and adjust them depending on the system load status.
  (1) As the operation time increases while Cycle Over Warning (event code: 00F08H) is output, set "0" to Number of Cycle Over Warning Detections (MotionSystem.PrConst.OperationCycle[1].NumOfCycleOverWngDetectTimes), so Cycle Over Warning (event code: 00F08H) will not be output.
  (2) The user needs to check the normal operation range of Number of Cycle Over Error Detections (MotionSystem.PrConst.OperationCycle[1].NumOfCycleOverErrDetectTimes), and change values to avoid Cycle over (error code: 1A00H, 3402H).
- If the processing load of a program with a higher priority than the motion operation cycle such as an event execution type program that synchronizes with the basic cycle is high, the operation cycle may increase. Change the communication cycle setting according to the system load status, or reduce the processing load of the event execution type program that synchronizes with the network communication cycle.

25.3 Operation Cycle Assignment

An operation cycle of the axis can be set by Control Cycle Setting (AxisName.PrConst.OperationCycle).
The motion system controls axes in the interval of the specified operation cycle. Values that can be set differ depending on the axis type. For details, refer to the following.
☞ Page 522 Relevant Variables
The control operation cycle upper limit of the axis is 8ms regardless of the axis type. If a cycle longer than 8ms is set, Cycle assignment incorrect (axis) (error code: 1B2BH) occurs. In this case, perform the following.

- Change the control operation cycle of the axis to a shorter operation cycle. (Example: Change the control operation cycle of the axis from the third operation cycle to the second or first operation cycle.)
- Change the basic cycle interval of the network to a shorter cycle.*1
- When the third operation cycle is specified for the control operation cycle of the axis, change the low-speed cycle interval of the network to a shorter cycle.*1

Note that the control operation cycle of the axis cannot be set in 1μs increments. When such a setting is configured, Cycle assignment incorrect (axis) (error code: 1B2BH) occurs. When performing motion control, set "Setting in Units of 1μs" in basic cycle settings for the network to "Not Set". *1

*1 For the network communication cycle setting method, refer to the following.
☞ Page 287 Basic period setting
☞ Page 293 Multiple period setting

25.4 Motion Operation Processing Time Monitor

The processing time of the motion operation and its details can be monitored.

Operation of this function for each system status

○: Available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant Variables

The following variables are relevant to the motion operation processing time monitor:

- CYCLE_PARAM.
- System parameter constant (MotionSystem.PrConst.)
- CYCLE_MONI.
- System monitor data (MotionSystem.Md.)

For details, refer to the following.

☞ Page 522 Relevant Variables

Control details

The following contents are controlled by the motion operation processing time monitor.

Operation cycle settings

The first operation cycle setting to third operation cycle setting are stored in the following with a unit of nanosecond [ns].

- MotionSystem.Md.OperationCycle[1].Cycle
- MotionSystem.Md.OperationCycle[2].Cycle
- MotionSystem.Md.OperationCycle[3].Cycle

Operation cycle processing time

The first operation cycle processing time to third operation cycle processing time are stored in the following with a unit of nanosecond [ns]. It includes the time of the processing whose priority is higher than each operation cycle.

- MotionSystem.Md.OperationCycle[1].ProcessingTime
- MotionSystem.Md.OperationCycle[2].ProcessingTime
- MotionSystem.Md.OperationCycle[3].ProcessingTime

Operation cycle maximum processing time

The maximum values of the first operation cycle processing time to third operation cycle processing time are stored in the following.

- MotionSystem.Md.OperationCycle[1].MaximumProcessingTime
- MotionSystem.Md.OperationCycle[2].MaximumProcessingTime
- MotionSystem.Md.OperationCycle[3].MaximumProcessingTime

Motion service processing time

The motion service processing time is stored in Processing Time (MotionSystem.Md.MotionService.ProcessingTime) with a unit of nanosecond [ns]. It includes the task processing time whose priority is higher than the motion service processing.

Motion service maximum processing time

The maximum value of the motion service processing time is stored in Maximum Processing Time (MotionSystem.Md.MotionService.MaximumProcessingTime).

Operation cycle over check

If the processing of each operation cycle has not been completed by the start of the next operation cycle processing, Cycle Over (MotionSystem.Md.OperationCycle[1..3].CycleOver) of the operation cycle will be TRUE. If an operation cycle over is detected, the new operation cycle processing will not be executed within the current cycle and will be executed at the start of the next operation cycle processing.

To reset the operation cycle over, set Cycle Over (MotionSystem.Md.OperationCycle[1..3].CycleOver) to FALSE by using a program or other means. If an operation cycle over is detected again after the system is reset, Cycle Over (MotionSystem.Md.OperationCycle[1..3].CycleOver) of the operation cycle will be TRUE.

Point

At the start of operation cycle processing, if an operation cycle over has already occurred for an operation cycle with the shorter period, a cycle over will also occur for the operation cycle with the longer period. In this case, the operation cycle with the longer period will not be executed.

If an operation cycle over is detected, take one of the following actions.

- Adjust the operation cycle setting (network communication period setting) to a larger value. Set the value of the operation cycle by referring to the value of each label of the operation cycle or the value of the maximum processing time of each operation cycle displayed on the axis monitor of the engineering tool. For information on how to adjust the cycle settings, refer to the following.

☞ Page 287 Setting method

- Reduce the processing load that has caused the cycle over. Changing the axis control operation cycle can distribute the processing load. (Example: Change the control operation cycle of the axis from the first operation cycle to the second operation cycle.)

Cycle over warning/error detection

If the number of consecutive cycle over for each cycle has reached the set number of cycle over warning or error detections, a cycle over warning or error will be detected. The warning will not be detected if the number of cycle over warning detections is set to a value equal to or greater than the number of cycle over error detections. The warning will also not be detected if the number of cycle over warning detections is set to zero.

For the cycle over error type of each cycle, either a minor error or moderate error can be selected. When a cycle over error occurs, the operation stops according to the process selected by Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) or Stop Selection at All Axes Stop Cause Occurrence (MotionSystem.Pr.StopMode_All).

Point

- When a moderate error occurs due to WDT error (error code: 2500H, 2501H) detection, the operation may fail to perform deceleration stop and result in immediate stop when WDT error (error code: 2500H, 2501H) is detected depending on the system status.
- When a minor error is selected for the cycle over error type, the operation may continue until a WDT error (error code: 2500H, 2501H) is detected. Ensure the safety even in such a case.

Precautions

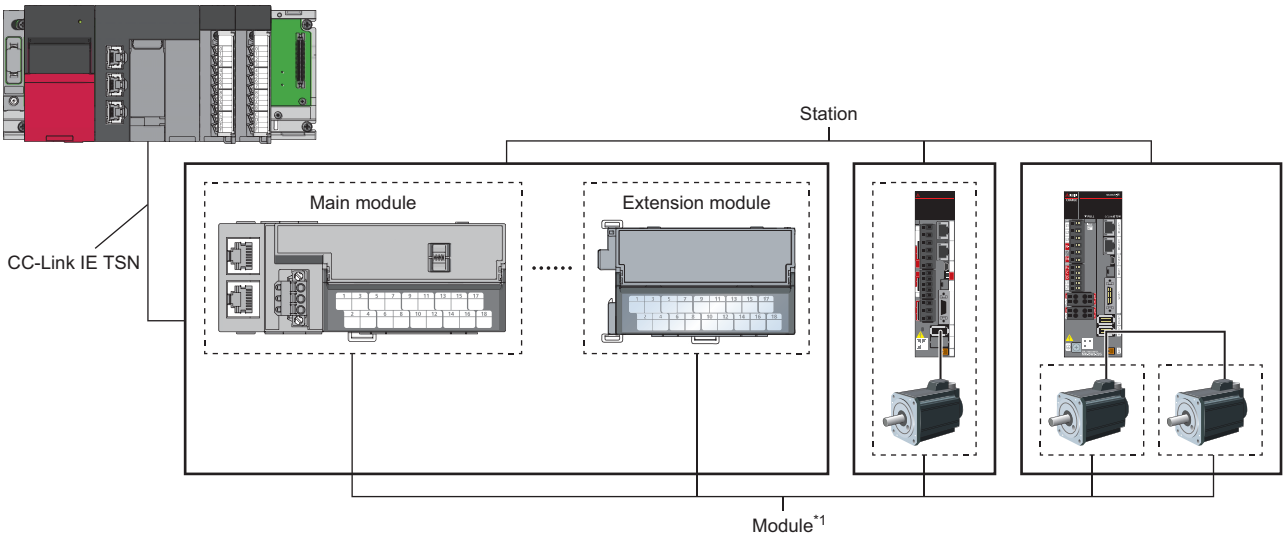
When a disabling interrupt (DI) instruction is used, a cycle over error may occur.

For details on the DI instruction, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

25.5 Specifications of Modules on CC-Link IE TSN Configuration Controlled by the Motion System

The motion system can control modules on the following CC-Link IE TSN configuration.



*1 The first axis of a multi-axis amplifier is considered the main module and the second and subsequent axes are considered extension modules.

The motion system controls the main module and extension module that meet any of the following conditions when the motion system starts up.

- When a main module or extension module whose IP address and multidrop number are set as the station address of the real drive axis or real encoder axis
- When an MC_TRIGGER_REF type or MC_OUTPUT_REF type global label refers to the refresh target (network label or device) of cyclic data of a main module or extension module
- When an MC_TRIGGER_REF type global label refers to a CANopen object of a main module or extension module
- Modules with an MC_OUTPUT_REF type global label that refers to input (X) and output (Y) that are already set for the synchronization timing control mode of the module
- Modules that refer to the clutch signal setting of the advanced synchronization control function

Control details

Be sure to set the network synchronous communication setting of the module controlled by the motion system to "Synchronous".

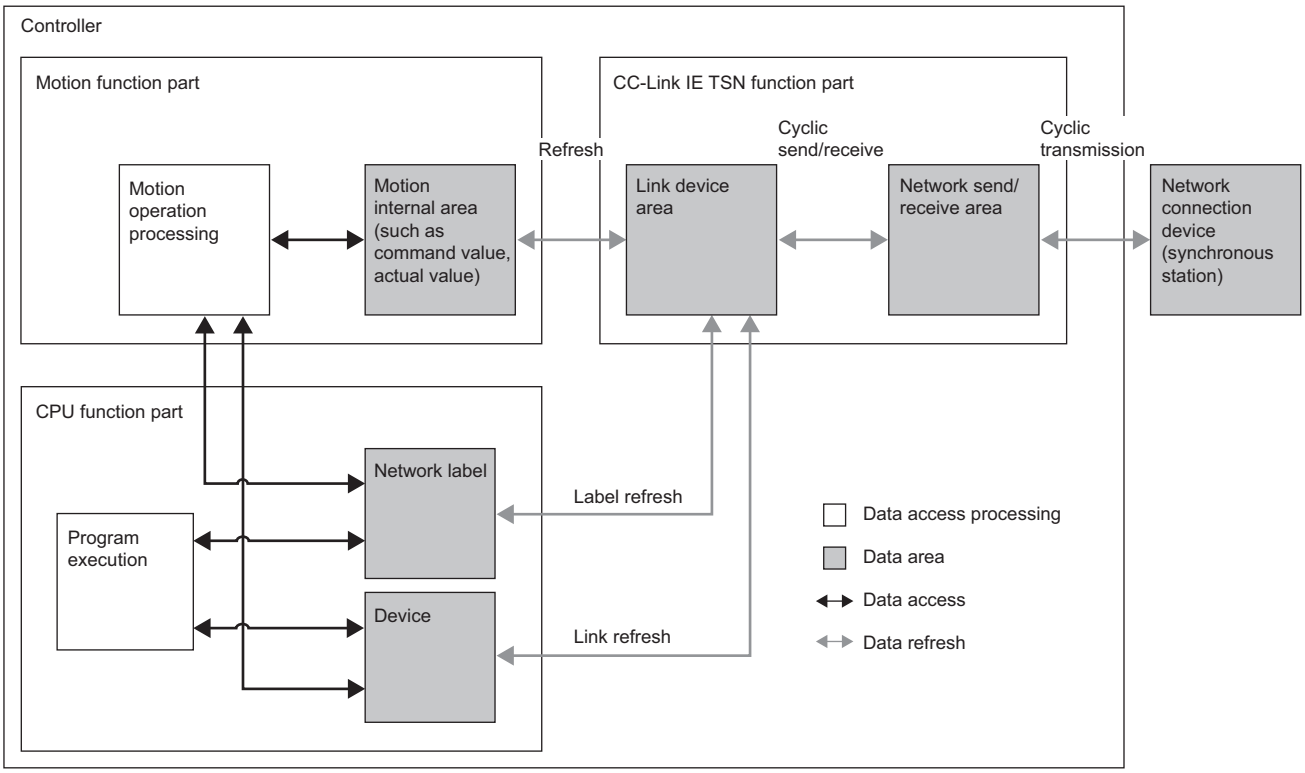
When the network synchronous communication setting is set to "Asynchronous" when the motion system starts up, Synchronization setting combination error (at system startup) (error code: 3407H) occurs.

Refer to each function for the operation when the axis parameters have been changed by starting the FB or performing online program change or if any of the global labels listed below has been added or deleted after the motion system starts up and the network synchronous communication of the module controlled by the motion system is set to "Asynchronous".

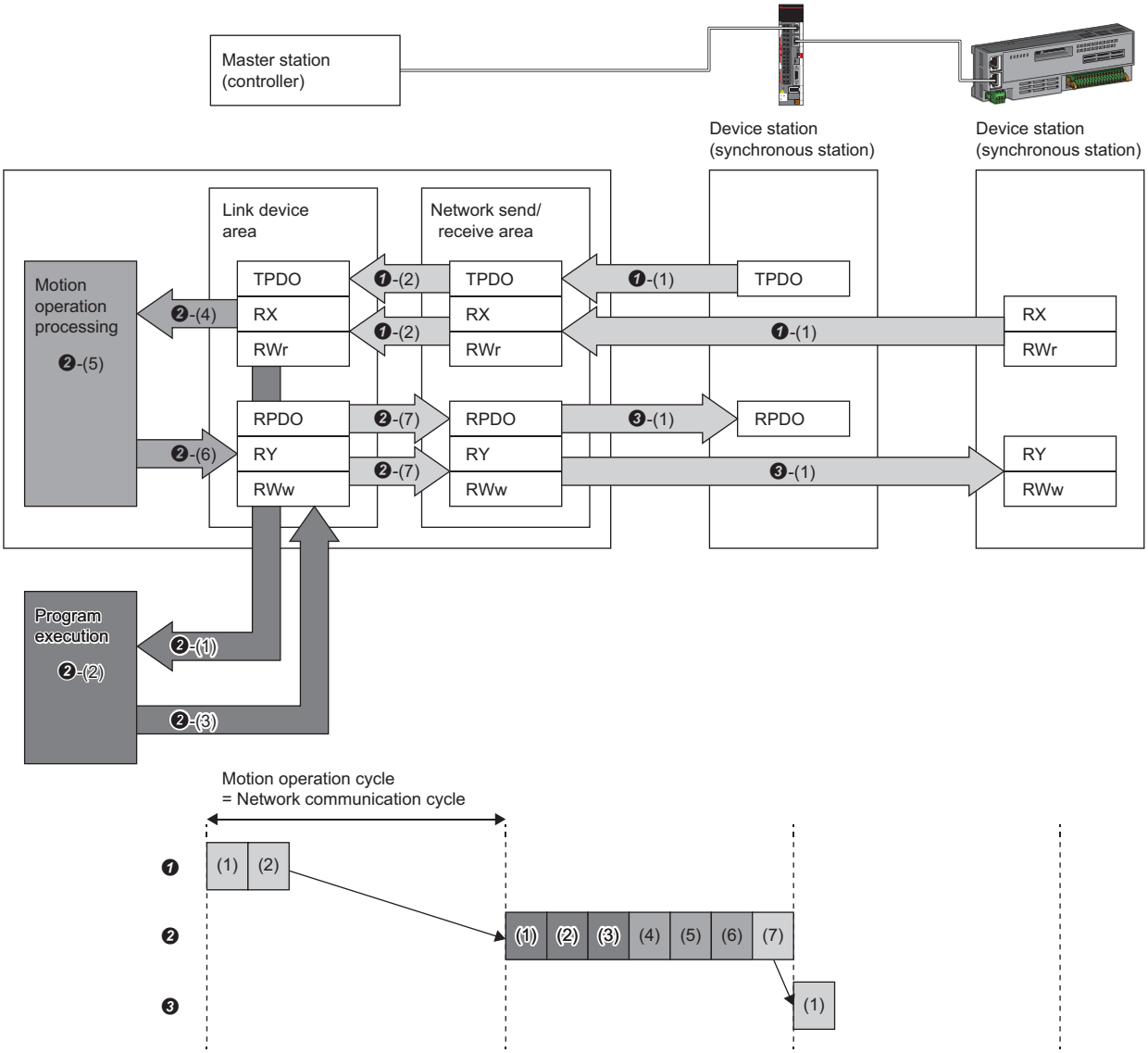
- MC_TRIGGER_REF type
- MC_OUTPUT_REF type
- SIGNAL_SELECT type set for the clutch signal setting of the advanced synchronization control

25.6 Send/Receive Data Refresh of Network Connected Devices

The following figure shows the relation of data areas and the refresh.



The execution timing of the data area refresh described above and data access processing is shown below.
For the connected device, it takes three cycles in the unit of motion operation cycle to receive a feedback to the data sent from the connected device.



❶-(1) Cyclic transmission
❶-(2) Cyclic receive processing
❷-(1) Input refresh of synchronous station
❷-(2) Program execution
❷-(3) Output refresh of synchronous station
❷-(4) Input processing of motion operation
❷-(5) Operation processing of motion operation
❷-(6) Output processing of motion operation
❷-(7) Cyclic send processing
❸-(1) Cyclic transmission

When multiple operation cycles coexist, the processing above is performed during each cycle (basic, medium speed, low speed). For details, refer to the following.

☞ Page 535 Operation Cycle Coexistence

When Watchdog counter error (error code: 1A40H) occurs, perform an axis error reset for the relevant axis and restart the transfer of receive data to the device/label.

For details on either a network label refresh or device link refresh, refer to the following.

☞ Page 234 Refresh mode

For details on either watchdog counter or the procedure to restart the transfer of receive data to the device/label, refer to the following.

☞ Page 240 Checking received data using the watchdog counter

Point

- When the same network label or link refresh target device values have been rewritten between the motion operation and program that are synchronous to the same network communication cycle, writing by the motion operation takes priority. (Regarding data sent from the motion system, values written by the program are rewritten by the motion operation.) For data to be sent from the motion system, refer to the following.

☞ Page 472 Object data list

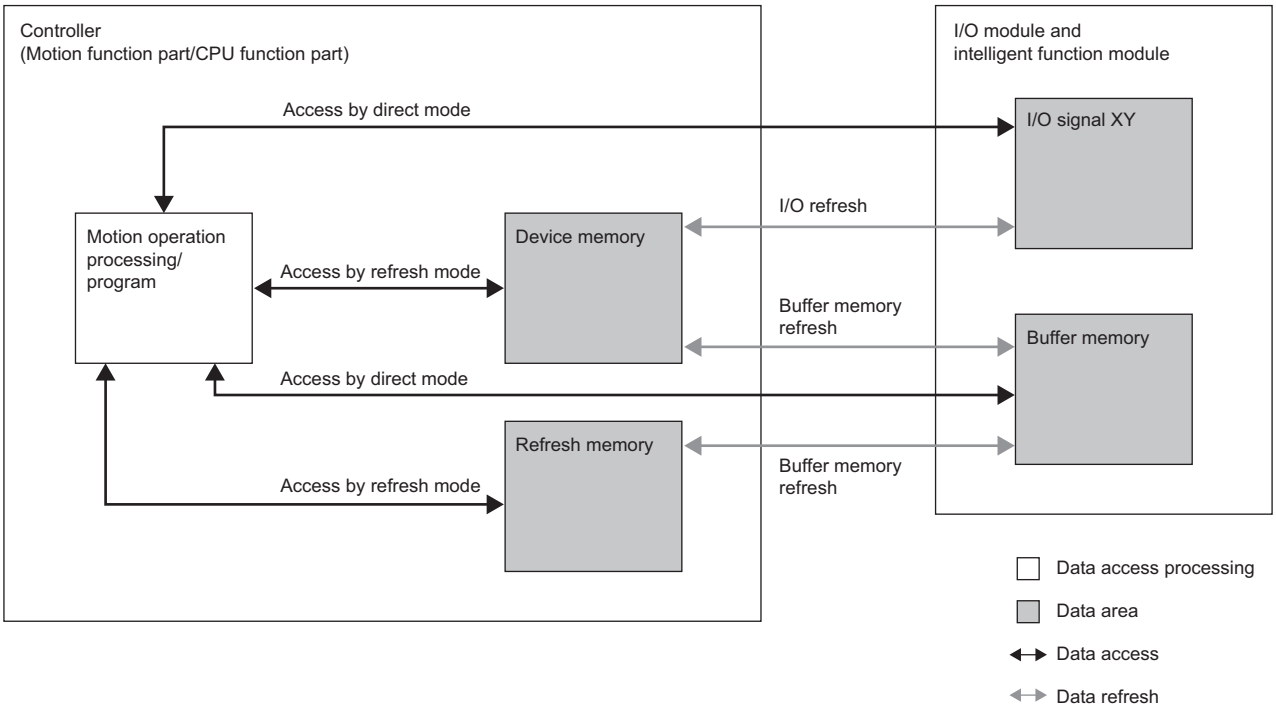
- When the same network label or link refresh target device values have been rewritten between the motion operation and program that are not synchronous to the same network communication cycle, whether the writing by the motion operation or by the program is reflected will be undefined. (The writing to be reflected depends on the timing of writing.)
- If the value in the link device area is rewritten by the motion operation, the same network label and link refresh target device will not be updated.

Example 1: If the RWw0 network label is Label0, the rewritten RWw0 value is not reflected in Label0.

Example 2: If the link refresh target device of RWw0 is W0, the rewritten RWw0 value is not reflected in W0.

25.7 Send/Receive Data Refresh of I/O Modules and Intelligent Function Modules

The following figure shows the relation of data areas that communicate between the I/O modules, intelligent function modules, and motion function part and their refresh.



The execution timing of the data area refresh described above and data access processing differs depending on the access method (refresh mode or direct mode).

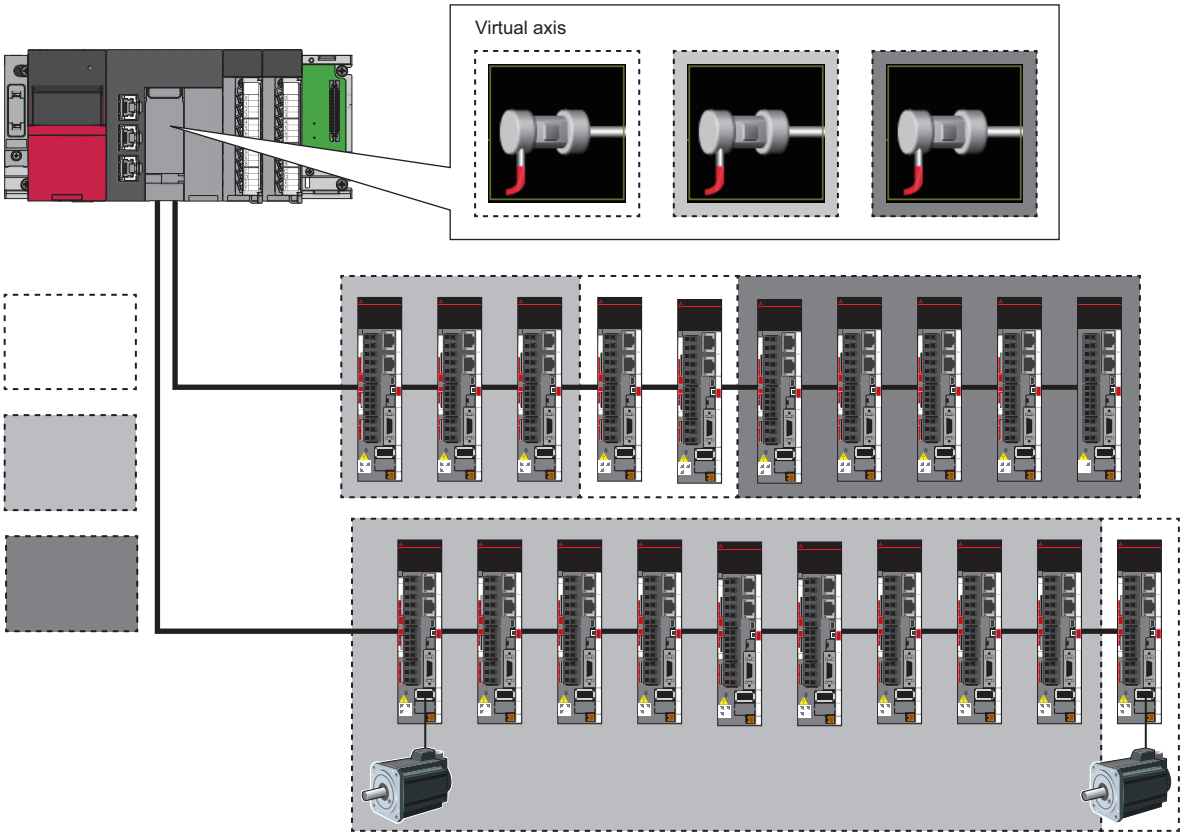
For details on the processing execution timing for each access method, refer to the following.

☞ Page 1236 Link Refresh

☞ Page 1241 Direct Access to Link Devices

25.8 Operation Cycle Coexistence

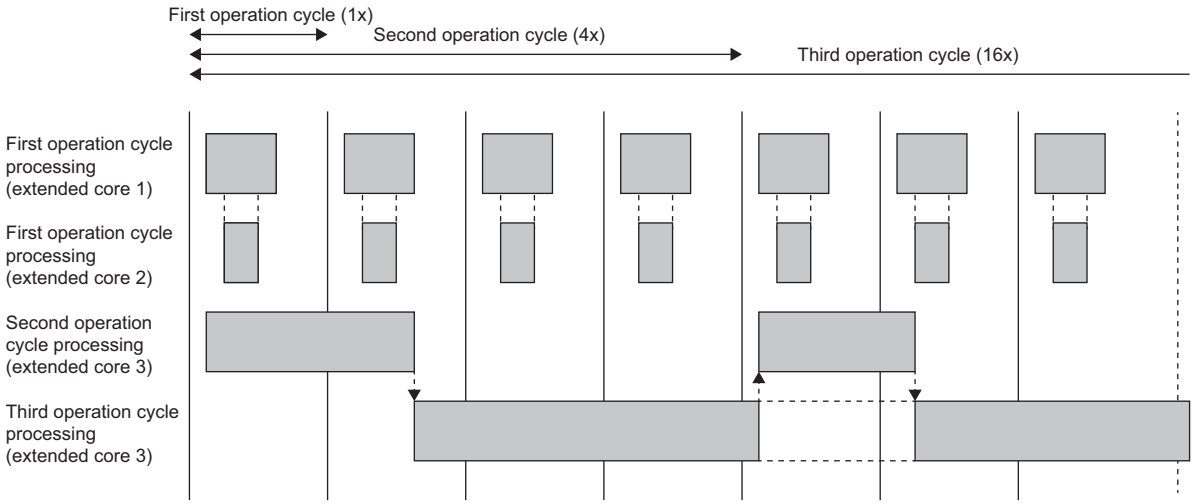
This function is used to divide and execute operation cycle processing of the motion system in different cycles (maximum of three operation cycles).
A system with many controlled axes can be controlled in divided manner by operating a specific axis at a fast operation cycle and operating other axes at a low speed operation cycle.



Control details

Priority has been determined regarding processing inside the motion system. When the execution conditions for high-priority operation cycle processing are met, such processing is executed preferentially than low-priority operation cycle processing. The first operation cycle has higher priority than the second operation cycle and the second operation cycle has higher priority than the third operation cycle.

The following figure shows the processing timing inside the motion system when the first operation cycle is set to the basic cycle of the network, the second operation cycle is set to the medium speed cycle of the network (4 times the basic cycle), and the third operation cycle is set to the low speed cycle of the network (16 times the basic cycle).



- Among the first operation cycle processing, processes that can be executed in parallel are executed using two extension cores. Also, the first operation cycle processing is executed in parallel with the second and third operation cycle processing.
- The third operation cycle processing is executed after the second operation cycle processing is completed. If the execution conditions for the second operation cycle processing are met while the third operation cycle processing is executed, the third operation cycle is suspended and the second operation cycle processing is executed.

Point

Low-priority operation cycle processing is executed during the vacant time of high-priority operation cycle processing. For this reason, if the high-priority operation cycle processing load increases, sufficient time may not be secured for executing low-priority operation cycle processing. If Cycle over (error code: 1A00H, 3402H) occurs, correct the axis assignment to operation cycles, communication period setting of the network, and program details.

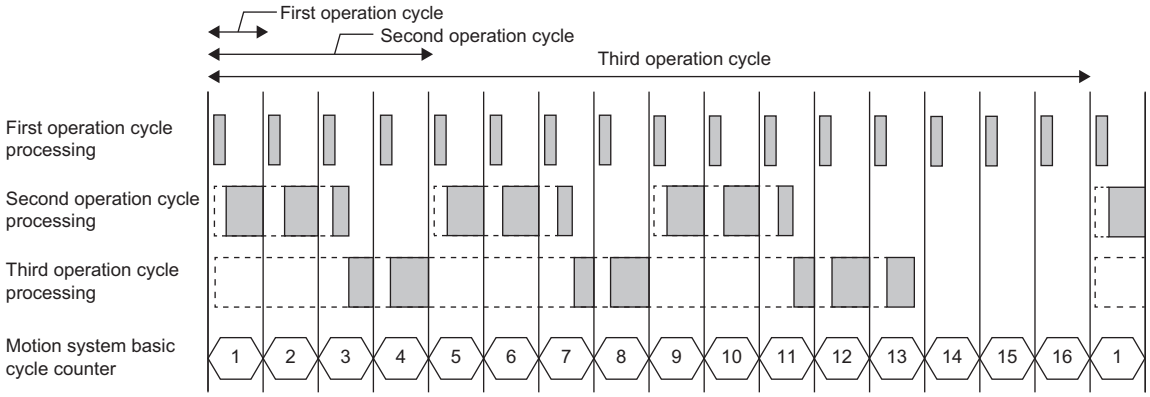
For a rough standard for the number of axes that can operate in each operation cycle, refer to the following.

☞ Page 525 A rough standard for the operation cycle settings

■Motion system basic cycle counter

The system basic cycle counter (System.Md.SystemBaseCycle_Counter) counts up by one at basic cycle intervals of the network, and returns to one when the cycle is greater than the least common multiple of each motion operation cycle. This counter can be used to check the timing for executing each motion operation cycle processing.

The following figure shows the processing timing inside the motion system when the first operation cycle is set to the basic cycle of the network, the second operation cycle is set to the normal speed cycle of the network (4 times the basic cycle), and the third operation cycle is set to the low speed cycle of the network (16 times the basic cycle).



■Control operation cycle synchronization

If the control operation cycle is different between input and output in the following function, synchronize input with the control operation cycle of output using Synchronize Control Operation Cycle (MCv_SyncOperationCycles) before control.

- Single axis synchronous control FB

For details on Synchronize Control Operation Cycle (MCv_SyncOperationCycles), refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

For details on touch probe control (trigger input signal detection and latching), refer to the following.

☞ Page 1166 TOUCH PROBE

Program example

■Overview

The following example shows a program that executes the synchronous control on axes with different control cycles by using Synchronize Control Operation Cycle (MCv_SyncOperationCycles).

In this program example, MC_GearIn is started while Axis0001 to be controlled in the first operation cycle is regarded as the master axis and Axis0002 to be controlled in the second operation cycle is regarded as the slave axis.

A program that executes servo ON for the MR-J5-G is omitted.

■Setting

• CC-Link IE TSN configuration

Station No.	Model name	IP address	Network synchronous communication setting	Communication period setting
1	MR-J5-G	192.168.4.1	Synchronous	Basic period
2	MR-J5-G	192.168.4.2	Synchronous	Normal-speed

• Axis

Axis No.	Label name	Station address setting	Axis type	Control cycle setting
1	Axis0001	192.168.4.1	Real drive axis	Operates in the first operation cycle.
2	Axis0002	192.168.4.2	Real drive axis	Operates in the second operation cycle.

• Labels used

Label name	Data type	Comment
bSyncStart	Bit	Synchronous control start
bMCGearInExecute	Bit	Gear operation start
MCv_SyncOperationCycles _1	MCv_SyncOperationCycles	Control operation cycle synchronization FB
MC_GearIn_1	MC_GearIn	Gear operation start FB

■Program

ST programs are shown below.

```
SET( MCv_SyncOperationCycles_1.Enabled , bMCGearInExecute );
//-----Control operation cycle synchronization-----
MCv_SyncOperationCycles_1(
    Axis:= Axis0001.AxisRef ,
//  ValueSource:= ?TARGET_REF? ,//Omitted
    Enable:= bSyncStart,
    OperationCycle:= 2 ,//2: Second operation cycle
    Options:= 0
);

//-----Gear operation start-----
MC_GearIn_1(
    Master:= Axis0001.AxisRef ,
    Slave:= Axis0002.AxisRef ,
    Execute:= bMCGearInExecute ,
    ContinuousUpdate:= TRUE ,
    RatioNumerator:= 1 ,
    RatioDenominator:= 1 ,
    MasterValueSource:= MC_SOURCE__mcSetValue ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
    Options:= 0
);
```

Precautions

■Timing of importation of the control data of the axis and axes group and external input signals

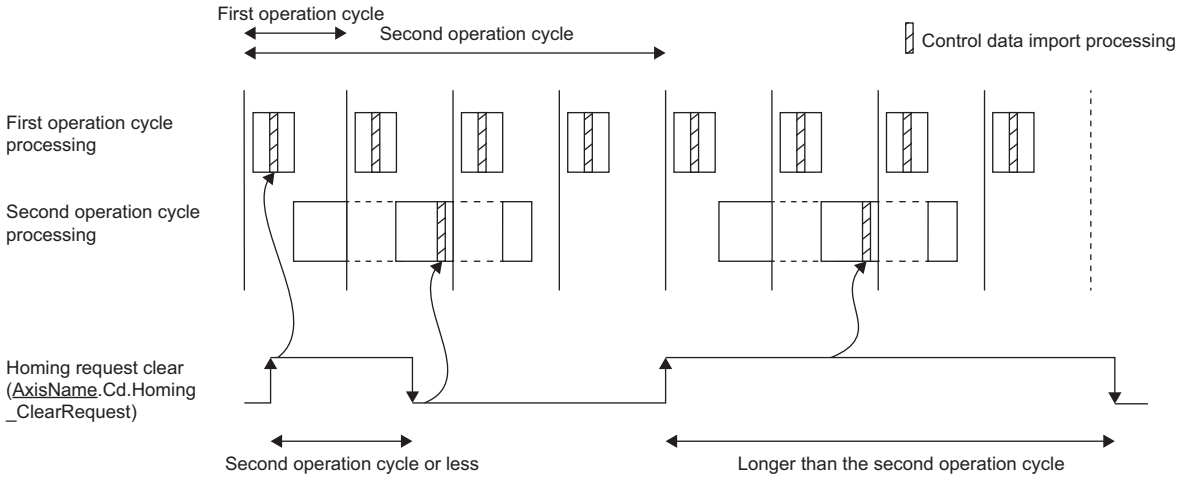
Importation of the control data of the axis and axes group and the following external input signals is performed at the control operation cycle of the axis. Therefore, if control data or external input signals are updated at an interval equal to or shorter than the control operation cycle, the update may not be detected.

Be sure that the interval to update the control data of the axis and external input signals is longer than the control operation cycle of the relevant axis.

- Upper Limit Signal (AxisName.PrConst.HwStrokeLimit_FlsSignal)
- Lower Limit Signal (AxisName.PrConst.HwStrokeLimit_RlsSignal)
- Forced Stop Signal (AxisName.Pr.ForcedStop_Signal)
- Stop Signal (AxisName.Pr.StopSignal)
- Counter Disabling Signal (AxisName.PrConst.Encoder_CounterDisableSignal)

Ex.

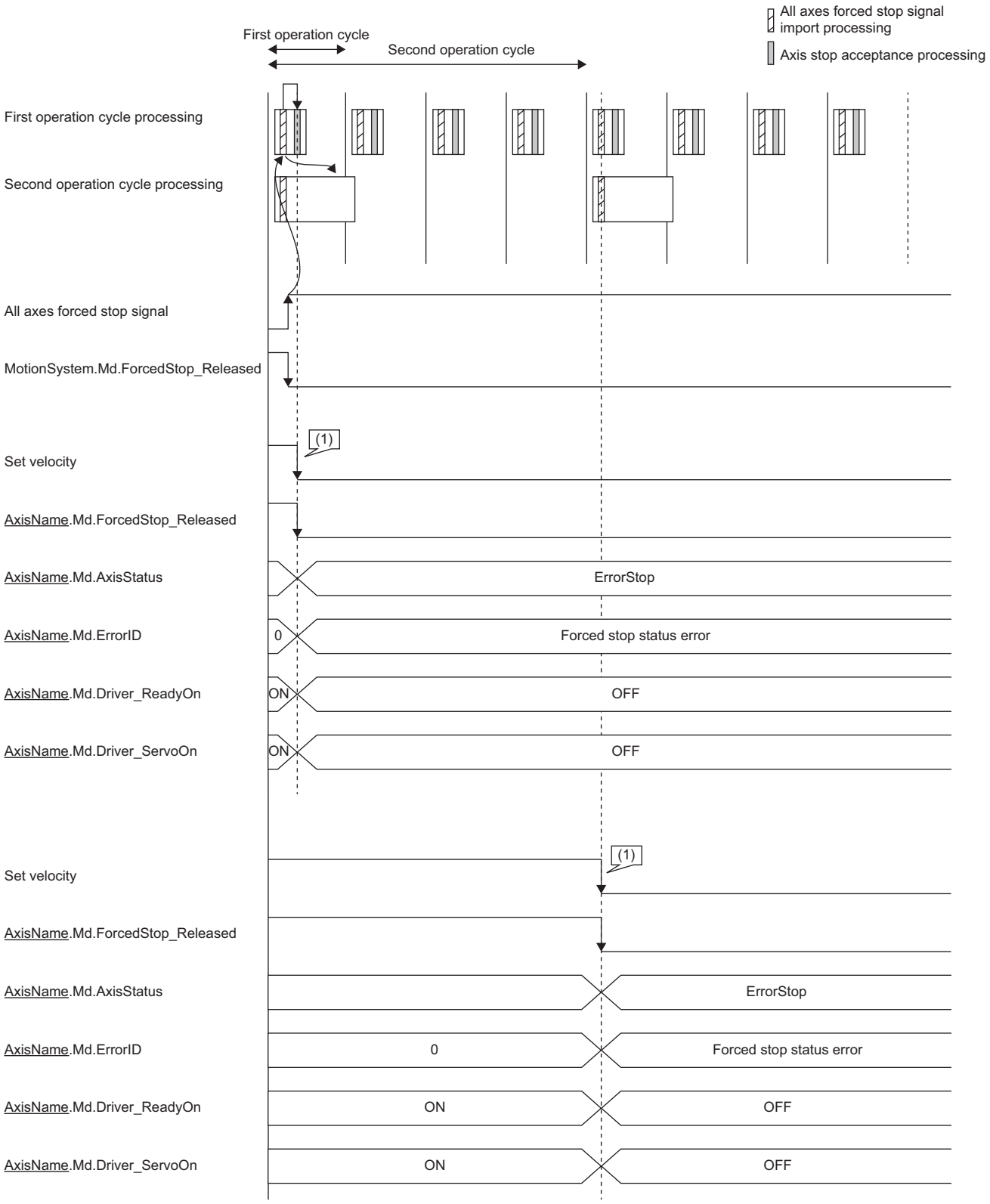
When setting Homing Request to FALSE by using Homing Request Clear (AxisName.Cd.Homing_ClearRequest)



■Timing of importation of the all axes forced stop signal

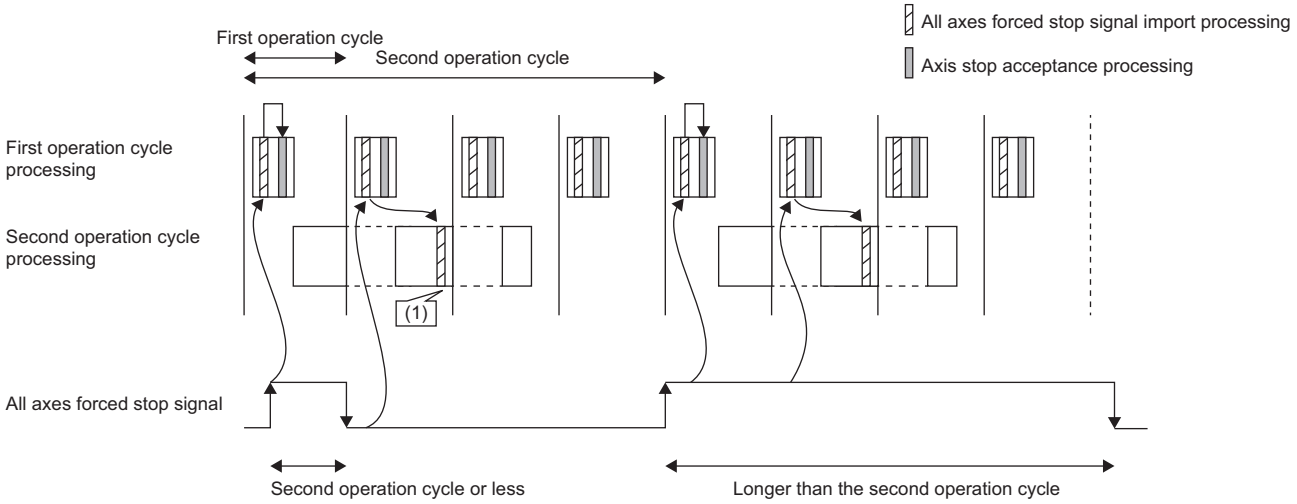
Importation of the all axes forced stop signal is performed in the first operation cycle and the stop processing is performed at the operation cycle of the axis.

Therefore, the stop processing of the axis assigned to the second or third operation cycle may be delayed by the second or third operation cycle at the most as compared to the axis assigned to the first operation cycle.



(1) Immediate stop

If the all axes forced stop signal is updated at an interval equal to or shorter than the second and third operation cycles, the update may not be detected. Be sure that the interval to update the all axes forced stop signal is longer than the second and third operation cycles.



(1) The stop processing is not executed because the input of all the axes forced stop signal cannot be obtained.

25.9 Precautions for Programming

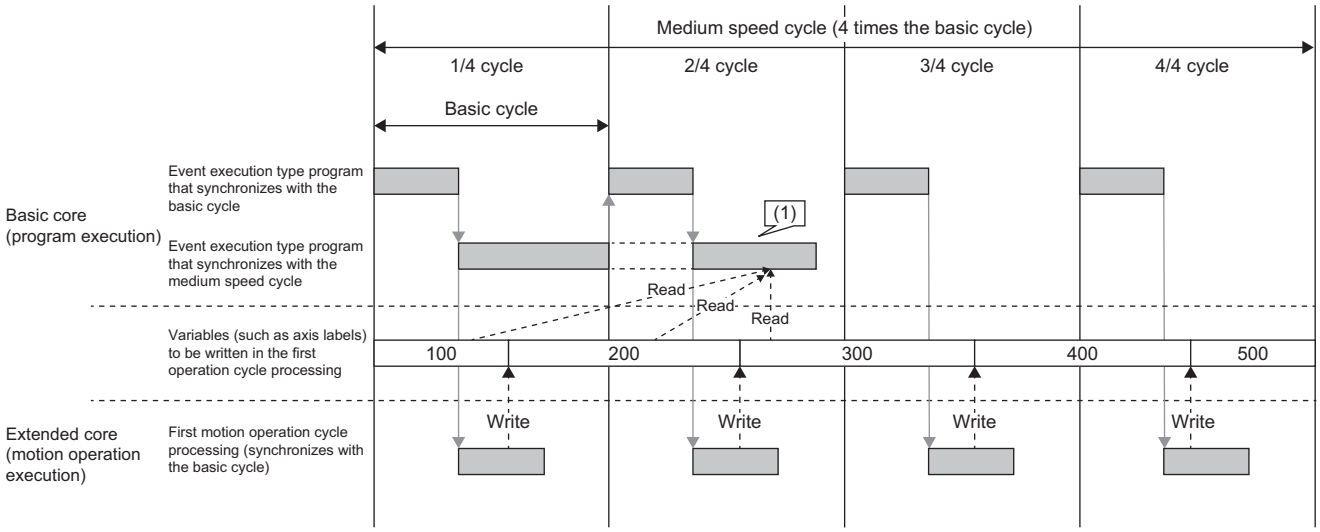
The user program and motion operation are executed in parallel on the multi-core. When a variable to be used is accessed by the motion operation from a user program at an execution cycle different from the motion operation cycle, the update timing for the variable may become undefined. When the update timing for the variable is important, access the variable from a program synchronous with the motion operation cycle.

For details on the program synchronous with the motion operation cycle, refer to the following.

☞ Page 524 Motion Operation Cycle Setting

Ex.

If the update timing for the variable is undefined



(1) Since the update timing for the variable is undefined when viewed from the program, a value other than the latest value (300) may be read.

Examples where the motion operation cycle is asynchronous with the user program execution cycle are described below.

- Access to a label of an axis/axes group to be controlled at the first operation cycle from a program other than an event execution type program that synchronizes with the basic cycle
- Access to a label of an axis/axes group to be controlled at the second operation cycle from a program other than an event execution type program that synchronizes with the normal speed cycle
- Access to a label of an axis/axes group to be controlled at the third operation cycle from a program other than an event execution type program that synchronizes with the low speed cycle
- Access to a label of an axis/axes group to be controlled at the first operation cycle from a fixed scan execution type program whose fixed scan interval matches that of the first operation cycle (also applies to second and third operation cycles)
- Access to a label of a motion control FB from a program whose execution type and execution cycle are different from those of the motion control FB source program

26 START AND STOP

26.1 Start

This function starts motion control.
This section describes how to start an axis of the motion system.
In the motion system, motion control can be executed by executing the motion control FB from programs.
Starting the motion control by executing the motion FB with Axis Status (AxisName.Md.AxisStatus) set to "4: Standby (Standstill)" or Axes Group Status (AxesGroupName.Md.GroupStatus) set to "4: Standby (GroupStandby)" is called "start" of the axis.
FBs have Execution command (Execute) type and Enable (Enable) type, and these are started at the rising edge of Execution command (Execute) or Enable (Enable) which are input variables of the motion control FB.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis Status	Displays the axis status. • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
UseInGroup	Using Axes Group	Displays whether the axis is being used in the axis group or not. • FALSE: Not used • TRUE: Used
Homing_Request	Homing Request	Displays whether homing is required or not. Becomes FALSE when the homing is completed. • FALSE: No homing request • TRUE: Homing request
HwStrokeLimit_FlsStatus	Upper Limit Signal Status	Displays the detection status of the upper limit signal (FLS). • FALSE: Detecting the upper limit signal (FLS) • TRUE: Not detecting the upper limit signal (FLS)
HwStrokeLimit_RlsStatus	Lower Limit Signal Status	Displays the detection status of the lower limit signal (RLS). • FALSE: Detecting the lower limit signal (RLS) • TRUE: Not detecting the lower limit signal (RLS)
ForcedStop_Released	Forced Stop Cancelling	Displays the forced stop cancel status. • FALSE: Forced stop • TRUE: Forced stop release
StopStatus	Stop Status	Displays the input status of the stop signal (STOP). • FALSE: Stop processing released • TRUE: During stop processing

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
GroupStatus	Axes Group Status	Displays the axes group status • 0: Axes group disabled (GroupDisabled) • 1: Stopping on error (GroupErrorStop) • 2: Decelerating to stop (GroupStopping) • 4: Standby (GroupStandby) • 5: Operating (GroupMoving)

System control data (MotionSystem.Cd.)

Variable/structure name	Name	Details
SequenceReady	PLC READY	Checks that the status of the CPU function part is normal and displays the signal status to be notified to the motion function part. • FALSE: PLC READY OFF • TRUE: PLC READY ON

■Conditions of TRUE/FALSE status

Conditions where PLC READY (MotionSystem.Cd.SequenceReady) becomes TRUE/FALSE are shown below.

Programmable controller ready interlock selection (MotionSystem.PrConst.SequenceReadyInterlock)	Condition	PLC Ready (MotionSystem.Cd.SequenceReady)
TRUE	While the synchronization flag [X21] was on, the status of the CPU function part changed from STOP to PAUSE/RUN.	TRUE
	While the synchronization flag [X21] was on, the status of the CPU function part changed from initialization complete to PAUSE/RUN.	
	While the status of the CPU function part was PAUSE/RUN, the synchronization flag [X21] changed from off to on.	
FALSE	While the synchronization flag [X21] was on and also the status of the CPU function part was PAUSE/RUN, PLC READY [Y20] changed from off to on.	
	While the synchronization flag [X21] was on and also PLC READY [Y20] was on, the status of the CPU function part changed from STOP to PAUSE/RUN.	
	While the status of the CPU function part was PAUSE/RUN and also PLC READY [Y20] was on, the synchronization flag [X21] changed from off to on.	
TRUE	The status of the CPU function part changed from PAUSE/RUN to STOP.	FALSE
	The synchronization flag [X21] was turned off.	
FALSE	The status of the CPU function part changed from PAUSE/RUN to STOP.	
	PLC READY [Y20] was turned off.	
	The synchronization flag [X21] was turned off.	

System Monitor Data (MotionSystem.Md.)

Variable/structure name	Name	Details
Ready	Ready	Displays the on/off status of built-in Motion Ready [X20]. • FALSE: Off (Not READY) • TRUE: On (READY)
Sync	Synchronization flag	Displays the on/off status of the synchronization flag [X21]. • FALSE: Off (Module access disabled) • TRUE: On (Module access enabled)

Starting conditions

To start the control, the following conditions must be satisfied.
The necessary conditions must be incorporated in the program so that the axis is not started when the conditions are not satisfied.
Starting conditions of the axis are mainly controlled by the state transition and the signal state of the axis and axes group.

Starting conditions for motion FB of the axis

■State transition

Name	State	Variable name
Axis Status	4: Standby (Standstill)	AxisName.Md.AxisStatus

■Signal state

Signal name		Signal state		Variable name
I/O signal	PLC READY [Y20]*1	On	RUN	MotionSystem.Cd.SequenceReady
	Built-in Motion Ready [X20]	On	Built-in motion ready	MotionSystem.Md.Ready
	Synchronization flag [X21]	On	Module access enabled	MotionSystem.Md.Sync
	Using Axes Group	FALSE	Not used	AxisName.Md.UseInGroup
	Homing Request	FALSE	Homing request FALSE	AxisName.Md.Homing_Request
External signal	Forced Stop Cancelling	TRUE	Emergency stop input FALSE (Forced stop cancel)	AxisName.Md.ForcedStop_Released
	Upper Limit Signal Status	FALSE	Within the upper limit range	AxisName.Md.HwStrokeLimit_FlsStatus
	Lower Limit Signal Status	FALSE	Within the lower limit range	AxisName.Md.HwStrokeLimit_RlsStatus
	Stop Status	FALSE	Stop signal (STOP) FALSE	AxisName.Md.StopStatus

*1 If Programmable controller ready interlock selection (MotionSystem.PrConst.SequenceReadyInterlock) is TRUE (default), PLC READY [Y20] is not included in the starting conditions.

Starting conditions for motion FB of the axes group

■State transition

Name	State	Variable name
Axis Status	4: Standby (Standstill)	AxisName.Md.AxisStatus
Axes Group Status	4: Standby (GroupStandby)	AxesGroupName.Md.GroupStatus

■Signal state

Signal name		Signal state		Variable name
I/O signal	PLC READY [Y20]*1	On	RUN	MotionSystem.Cd.SequenceReady
	Built-in Motion Ready [X20]	On	Built-in motion ready	MotionSystem.Md.Ready
	Synchronization flag [X21]	On	Module access enabled	MotionSystem.Md.Sync
	Homing Request	FALSE	Homing request FALSE	AxisName.Md.Homing_Request
External signal	Forced Stop Cancelling	TRUE	Emergency stop input FALSE (Forced stop cancel)	AxisName.Md.ForcedStop_Released
	Upper Limit Signal Status	FALSE	Within the upper limit range	AxisName.Md.HwStrokeLimit_FlsStatus
	Lower Limit Signal Status	FALSE	Within the lower limit range	AxisName.Md.HwStrokeLimit_RlsStatus
	Stop Status	FALSE	Stop signal (STOP) FALSE	AxisName.Md.StopStatus

*1 If Programmable controller ready interlock selection (MotionSystem.PrConst.SequenceReadyInterlock) is TRUE (default), PLC READY [Y20] is not included in the starting conditions.

26.2 Retrigger/Continuous Update

This function changes the control of the on-going FB with a retrigger/continuous update.
With a retrigger/continuous update of the FB, input variables can be imported again to the on-going FB instance without interrupting operation.
The following methods can be used to change the control of the on-going FB.

- Retrigger (Inputting Execution command (Execute) again)
- Continuous update (ContinuousUpdate)

The fetch cycle of each input variable depends on the longest cycle in the following lists.

- Execution cycle of POU (abbreviation for Program Organization Unit) that calls the FB
- Operation cycle

To change input variables when Execute command (Execute) becomes FALSE to TRUE and when Continuous update (ContinuousUpdate) becomes TRUE, be sure to secure time equal to or longer than the cycle.
Also, when a retrigger/continuous update is performed to an instruction being buffered by multiple start of the motion control FB, the change will be reflected at the FB switching.

Point

- A retrigger/continuous update which is immediately after execution and immediately before termination of the FB may be ignored.
  · Immediately after execution: While Analyzing (AxisName.Md.Analyzing) is TRUE
  · Immediately before termination: Immediately before Execution Completed (Done) becomes TRUE
- Even if a retrigger/continuous update is performed to an instruction being buffered, it may affect the control in operation.

Retrigger

In an FB whose start condition is Execution command (Execute), a retrigger can be executed by the re-rising edge of Execution command (Execute).
For input variables that can be changed by a retrigger, refer to the specifications of each FB.

Continuous update

If Continuous update (ContinuousUpdate) is TRUE when Execute command (Execute) changes FALSE to TRUE, input variables will be continuously imported.
For input variables that can be imported, refer to the specifications of each FB.

26.3 Multiple Start (Buffer Mode)

Multiple motion control FBs can be executed continuously without stopping by executing the motion FB of another instance to the axis and the axes group that are executing the motion control FB.

Point

- To execute the motion control FB with the axis and the axes group stop status ("4: Standby (Standstill)" or "4: Standby (GroupStandby)") is called "start". For details, refer to the following.
  ☞ Page 543 Start
- When Axis Status (AxisName.Md.AxisStatus) and Axes Group Status (AxesGroupName.Md.GroupStatus) are as follows, to execute the motion FB of another instance is called "multiple start".
  [Axes Status (AxisName.Md.AxisStatus) that can be multiple started]
  · 3: During homing (Homing) (Only MC_Stop (Forced Stop))
  · 5: During positioning operation (DiscreteMotion)
  · 6: During continuous operation (ContinuousMotion)
  · 7: During synchronous operation (SynchronizedMotion)
  [Axes Group Status (AxesGroupName.Md.GroupStatus) that can be multiple started]
  · 5: In Operation (GroupMoving)
- Multiple start of the single axis control FB cannot be executed to an axis operated in the axes group. A stop caused by multiple start will result in Motion FB issue error to the axis during axes group operating (error code: 1AE2H). In other cases, Start not possible (error code: 1AFCH) will occur.

Buffer mode type

The following types can be specified to the buffer mode, and the type that can be specified differs depending on the FB.

Setting value	Buffer mode type	Description	Reference	
			During single axis operation	During multiple axes operation
0: mcAborting	Aborting	Aborts (cancels) the under-control FB and executes the next FB immediately.	Page 556 Aborting during single axis operation	Page 564 Aborting during multiple axes operation
1: mcBuffered	Buffered	Buffers the next FB on the under-control FB. If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after completion of the under-control FB.	Page 557 Buffered during single axis operation	Page 565 Buffered during multiple axes operation
2: mcBlendingLow	BlendingLow	Buffers the next FB on the under-control FB.*1 If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the under-control FB reaches the target position. The lower target velocity between the under-control FB and the buffering FB is used as the switching speed.	Page 560 BlendingLow	Page 568 BlendingLow
3: mcBlendingPrevious	BlendingPrevious	Buffers the next FB on the under-control FB.*1 If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the under-control FB reaches the target position. The target velocity of the under-control FB is used as the switching speed.	Page 558 BlendingPrevious	Page 566 BlendingPrevious
4: mcBlendingNext	BlendingNext	Buffers the next FB on the under-control FB.*1 If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the under-control FB reaches the target position. The target velocity of the buffering FB is used as the switching speed.	Page 559 BlendingNext	Page 567 BlendingNext
5: mcBlendingHigh	BlendingHigh	Buffers the next FB on the under-control FB.*1 If the under-control FB already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the under-control FB reaches the target position. The higher target velocity value between the under-control FB and the buffering FB is used as the switching speed.	Page 560 BlendingHigh	Page 568 BlendingHigh

*1 Stops are not performed between the under-control FB and the buffering FB.

Point

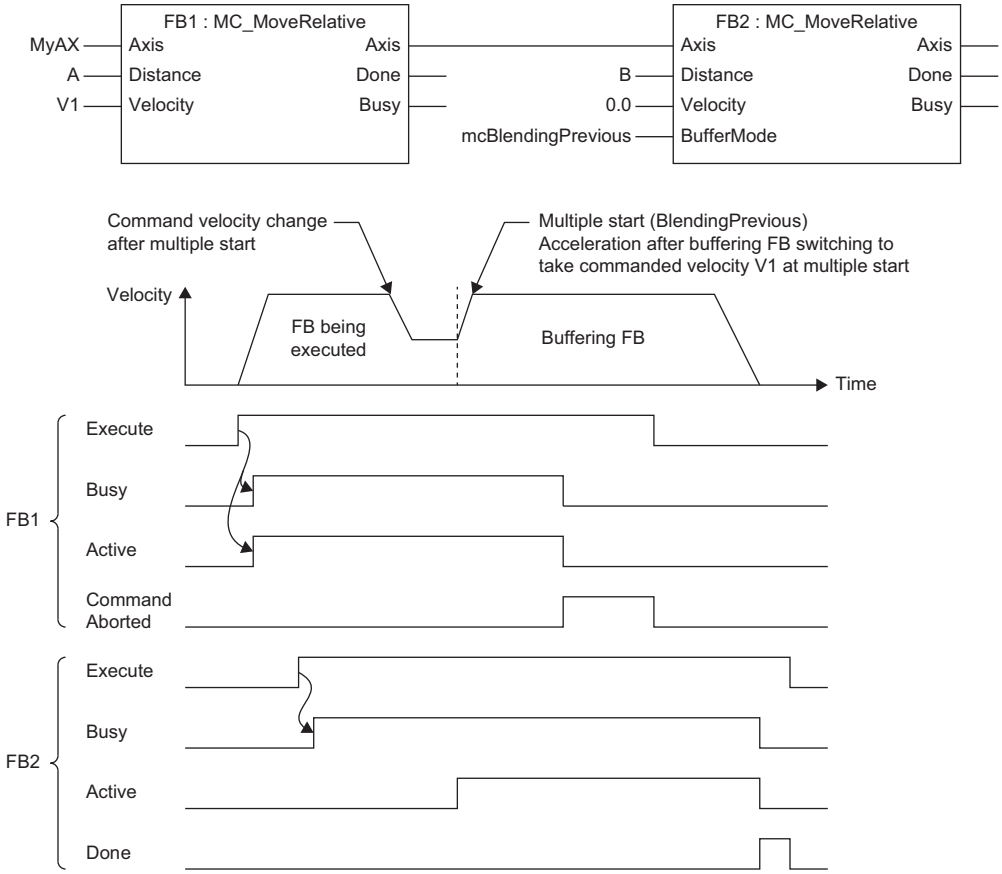
- Up to two motion FBs can be buffered after multiple start in one axis and an axes group. If multiple start is executed when two FBs have already been multiple started, Warning Starting over Number of Buffering FBs (event code: 00D22H) occurs and the buffering FB waits for its analysis until under-control FB is completed. Even though the warning occurs each multiple start, filter setting can be set not to detect the warning. For details on filter setting, refer to the following.
  ☞ Page 1756 Filter setting
  When an error or a stop cause occurred in the under-control FB, FBs which are waiting for the analysis are interrupted.
- When Warning starting over number of buffering FBs (event code: 00D22H) occurs, note that multiple starts should not be executed until the under-control FB is completed. If the multiple FBs are waiting for the analysis by the multiple start, the next buffering FB may not be in order.
- Since multiple started FBs are executed immediately when Aborting has been specified, the FBs are not buffered. When the under-control FBs include a buffering FB, all buffering FBs are interrupted. However, as the FBs which are awaiting analysis are not interrupted, those FBs start after the multiple started FBs are completed by specifying Aborting.
- Do not multiple start FBs for which Aborting is specified three times or more in the same operation cycle. Buffering FB analysis disabled (error code: 1B03H) may occur.
- When an error or a stop cause occurs in the under-control FB, all buffering FBs are interrupted (the output of Abortion of execution (CommandAborted) becomes TRUE).

Command omission at multiple start

When omitting the commanded velocity, the acceleration specification, and the deceleration specification in an FB that executes multiple start, commanded velocity of "the previous FB of buffering FB" at multiple start is taken over. If the commanded velocity input does not exist in "the previous FB of buffering FB", buffering is executed with speed 0.0.

Point

When buffering with velocity 0.0 using Blending buffer mode type, the target position may not be reached when the velocity of the previous FB becomes 0.0 (switching speed), and the FB may not switch. When buffering with velocity 0.0, use Buffered buffer mode type.



- When FB switching is executed by multiple start, velocity change is executed to the target velocity of next FB. For the velocity waveform operation when the jerk is not specified with "0.0", refer to the following.
  ☞ Page 1078 Acceleration/deceleration method
- When multiple FBs are multiple started at the same execution cycle, the order of FBs to be buffered is uncertain. To determine the buffering order, execute multiple start after checking that the previous FB is started (Executing (Busy) is TRUE).

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
BufferingFBs	Number of Buffering FBs	Displays the number of buffering FBs (0 to 2).

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. • 1: Immediate Stop (ImmediateStop)

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
BufferingFBs	Number of Buffering FBs	Displays the number of buffering FBs (0 to 2).

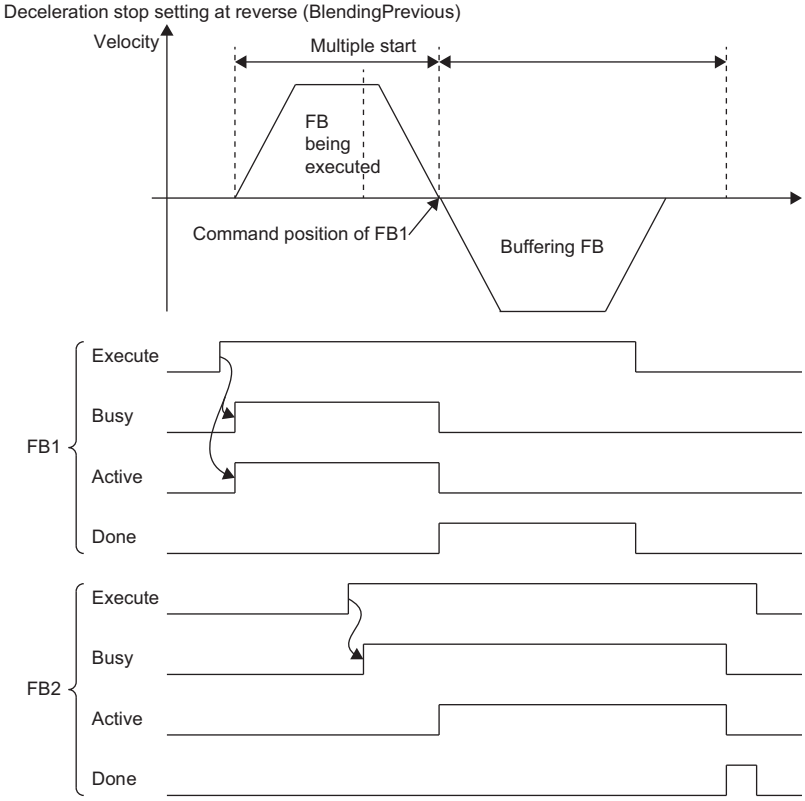
Multiple start during single axis operation

- When axis operation state is as follows, multiple start is enabled by starting a motion FB of another instance. (If the axis operation is in the "4: Standby (Standstill)" status, it is regarded as "start".)

■Axis Status (AxisName.Md.AxisStatus) that can be multiple started
- 3: During homing (Homing) (Only MC_Stop (Forced Stop) is possible.)
- 5: During positioning operation (DiscreteMotion)
- 6: During continuous operation (ContinuousMotion)
- 7: During synchronous operation (SynchronizedMotion)

- When the buffering FB input includes Direction selection (Direction) and "4: Current Direction (mcCurrentDirection)" is selected, the previous FB operation direction is taken over.
- When the directions are different between the under-control FB and next FB in the single axis motion FB, the operation differs depending on the selection in the case of having Reverse rotation permission selection (Options (Options): bit 5). The operation is the same as the operation at reverse rotation permission in the case of not having Reverse rotation permission selection (Options (Options): bit5).
- When the direction is reversed while Blending is specified, a deceleration stop is executed at the target position of the under-control FB, and velocity change is executed to the target velocity of the buffering FB after the under-control FB is switched to the buffering FB. (It is the same operation as Buffered is specified.)

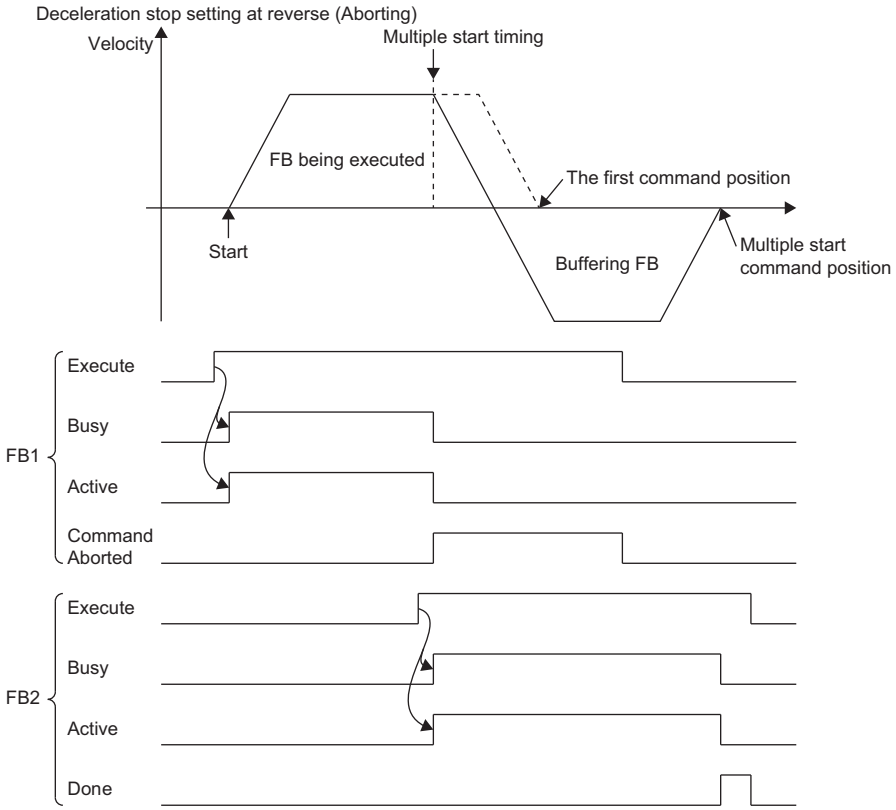
Deceleration stop setting at reverse (BlendingPrevious)



Operations with reverse rotation permission selection (Options (Options): bit5)

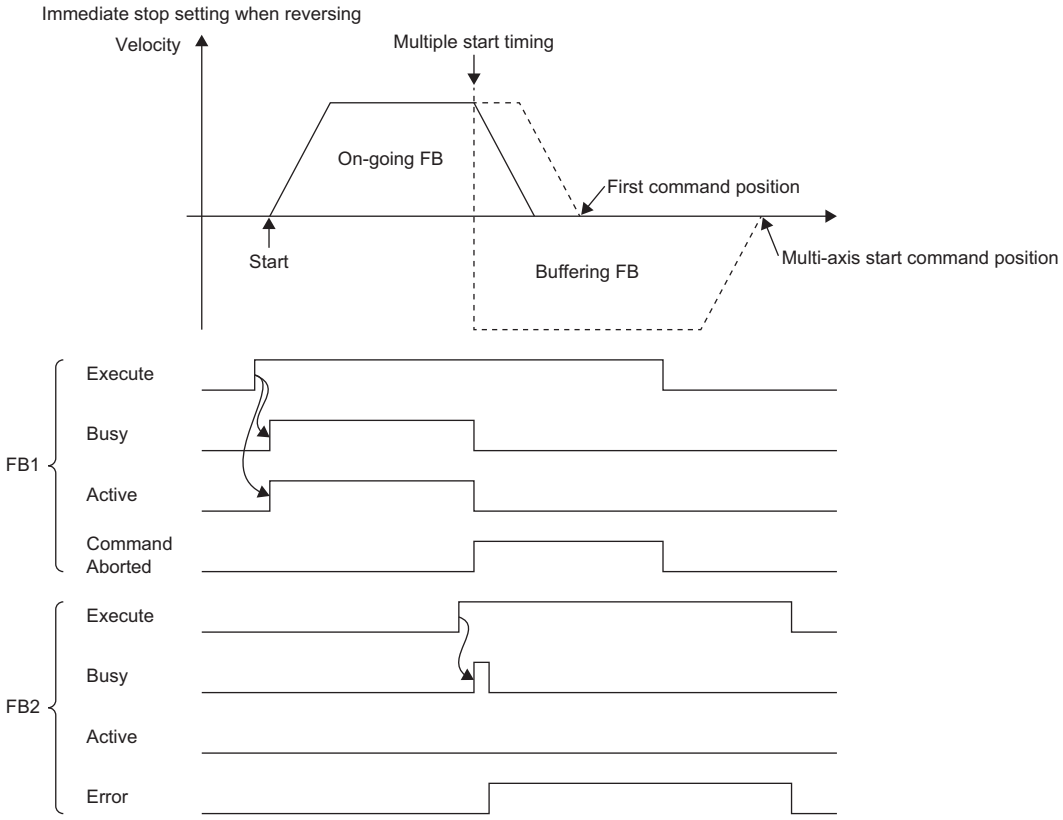
■When reverse is enabled

When reverse rotation permission (0: Allow) is set in Reverse rotation permission selection (Options (Options): bit5), a deceleration stop is executed once. After the deceleration stop is completed, operation is started to the changed direction.



■When reverse is disabled

When reverse rotation no permission (1: Do not allow) is set in Reverse rotation permission selection (Options (Options): bit5), Overrun error (error code: 1AE3H) occurs at switching and the axis decelerates to a stop.



Buffer mode that can be set

The following shows buffer modes that can be specified in the single axis control FB. For operation details on each FB, refer to the specifications of each FB.

○: Buffer mode setting possible, —: Buffer mode setting not possible (axis error)

FB	Setting possible in FB			Completion output	Setting possible in the later motion FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_Home (Homing)	—*1	—	—	Execution Completed (Done)	○*2	—	—
MC_Stop (Forced Stop)	○	—	—	Execution Completed (Done)	○*2	—	—
MC_MoveAbsolute (Absolute Value Positioning)	○	○	○	Execution Completed (Done)	○	○	○
MC_MoveRelative (Relative Value Positioning)	○	○	○	Execution Completed (Done)	○	○	○
MCv_Jog (JOG Operation)	—*1	—	—	Execution Completed (Done)	○	○	—
MCv_SpeedControl (Speed Control (Including Position Loop))	○	○	○	Target Velocity Reached (InVelocity)	○	○	—
MCv_PositionControl (Absolute Position Follow-up Control)	○	○	○	Target Position Reached (InAddress)	○	○	—
MC_MoveVelocity (Speed Control)	○	○	—	Target Velocity Reached (InVelocity)	○	○	—
MC_TorqueControl (Torque Control)	○	○	—	Target torque reached (InTorque)	○	○	—
MCv_PressureControl (Pressure Control)	○	○	—	Pressure Reached (InPressure)	○*3	○*3	—
MCv_CyclicPosition (Motion Cyclic Position Control)	○	—	—	Target Position Reached (InAddress)	○	○	—
MCv_CyclicVelocity (Motion Cyclic Speed Control)	○	—	—	Target Velocity Reached (InVelocity)	○	○	—
MCv_CyclicTorque (Motion Cyclic Torque Control)	○	—	—	Target torque reached (InTorque)	○	○	—
MC_CamIn (Cam Operation Start)	○	○	—	Cam cycle completion (EndOfProfile)	○	○	—
MC_GearIn (Gear Operation Start)	○	○	—	Gear ratio reached (InGear)	○	○	—
MC_CombineAxes (Addition/Subtraction Positioning)	○	○	—	In synchronization (InSync)	○	○	—
MCv_SmoothingFilter (Smoothing Filter)	—*1	—	—	—	○*2	—	—
MCv_DirectionFilter (Moving Direction Restriction Filter)	—*1	—	—	—	○*2	—	—
MCv_SpeedLimitFilter (Speed Limit Filter)	—*1	—	—	—	○*2	—	—
MCv_BacklashCompensationFilter (Backlash Compensation Filter)	—*1	—	—	—	○*2	—	—
MCv_AdvancedSync (Advanced Synchronous Control)	—*1	—	—	Cam cycle completion (CycleZeroPoint)	○	○	—
MCv_MoveWait (Axis Control Start Wait)	—*1	—	—	Execution Completed (Done)	○	○	—

*1 Multiple start cannot be executed because this FB can be started only when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".

*2 Only MC_Stop (Forced Stop) is possible.

*3 MCv_PressureControl (Pressure Control) cannot be specified.

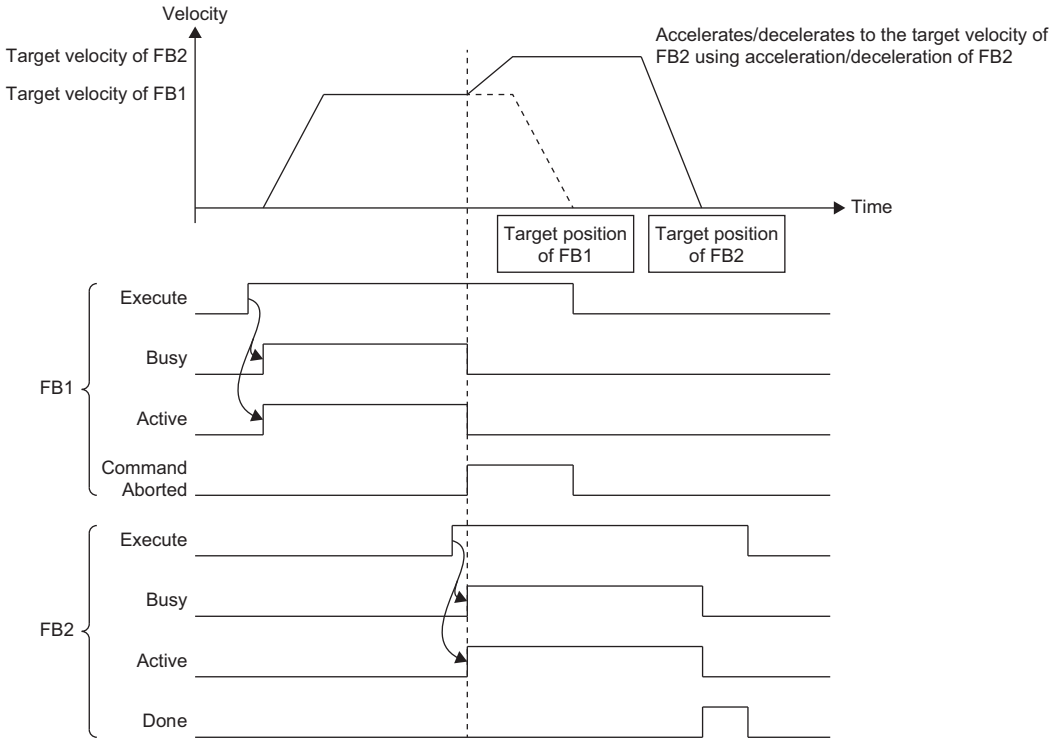
Aborting during single axis operation

The under-control FB is interrupted and the next FB is executed.

Since a buffer is not used, an error does not occur even if two of under-control FBs have already been in buffering, and the FB is executed. (All FBs during buffering are interrupted.)

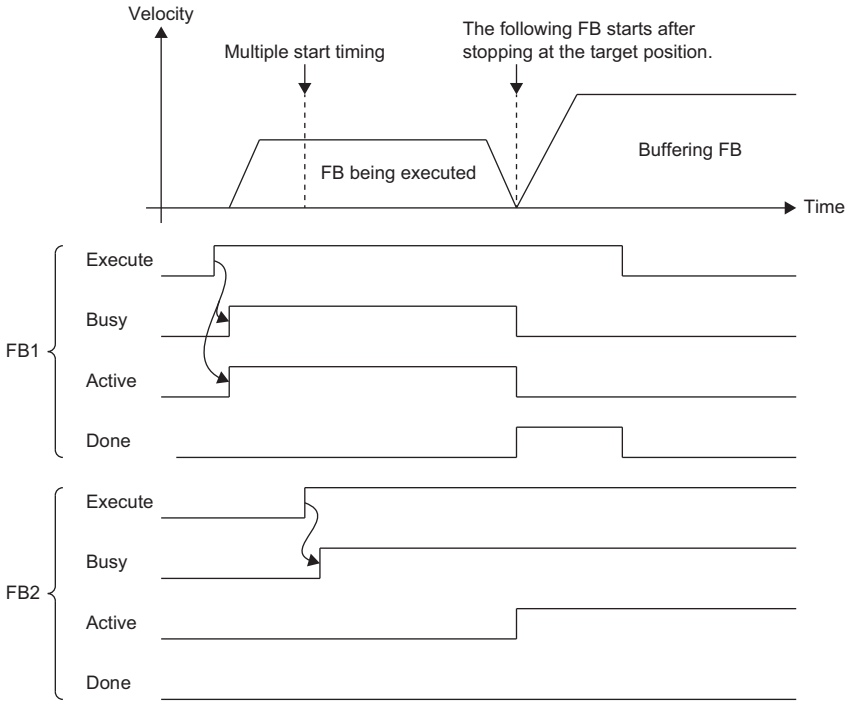
When omitting to specify the buffer mode, this operation is performed.

An operation example when Aborting is executed to the under-control FB1 with the linked start FB2 is shown below.



Buffered during single axis operation

Multiple started FBs are buffered and wait (Executing (Busy) is TRUE) until the under-control FB is completed. After the under-control FB is normally completed, multiple started FBs are performed in the order of being buffered.



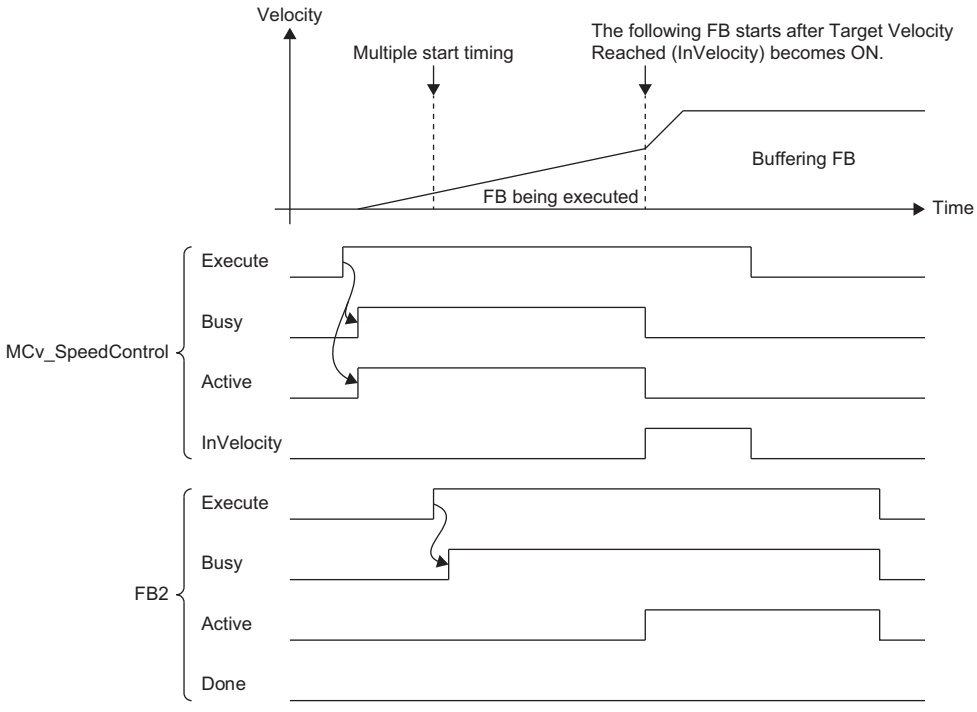
Conditions to determine completion are different depending on the motion control FB, and the FB may not be in the stop status with speed 0 at completion. For details, refer to the following.

☞ Page 552 Multiple start during single axis operation

Ex.

When an FB is multiple started with Buffered in MCv_SpeedControl (Speed Control (Including Position Loop))

In MCv_SpeedControl (Speed Control (Including Position Loop)), the FB is determined that it is completed when Target velocity reached (InVelocity) becomes TRUE, and the following buffering FB is executed. (The current speed at this time is used as the switching speed.)

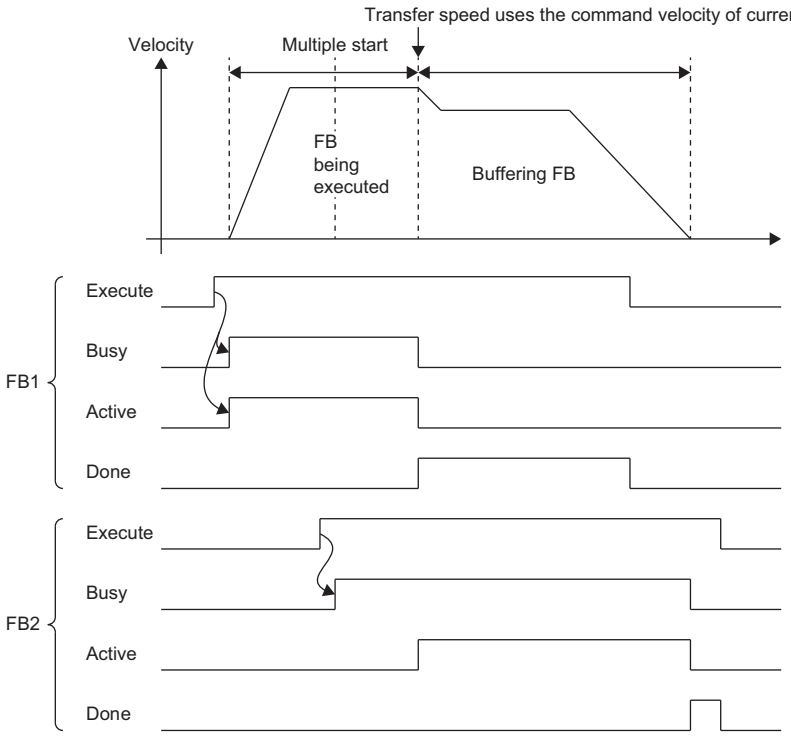


Blending during single axis operation

Multiple started FBs are buffered and wait until the under-control FB is completed. After the under-control FB reached the target position, buffering FBs are performed in order. In this case, the switching speed differs depending on the mode specified in the buffer mode.

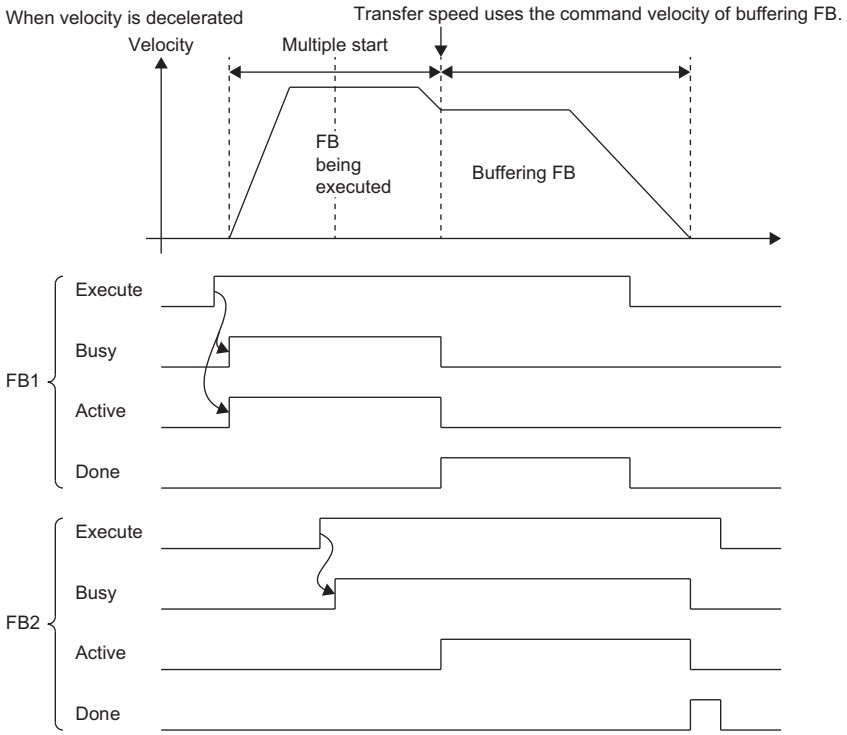
■BlendingPrevious

The FB is operated at the speed of the current under-control FB to the target position of the under-control FB. After switching to the FB that is during buffering, velocity change is executed to the target velocity of the buffering FB.

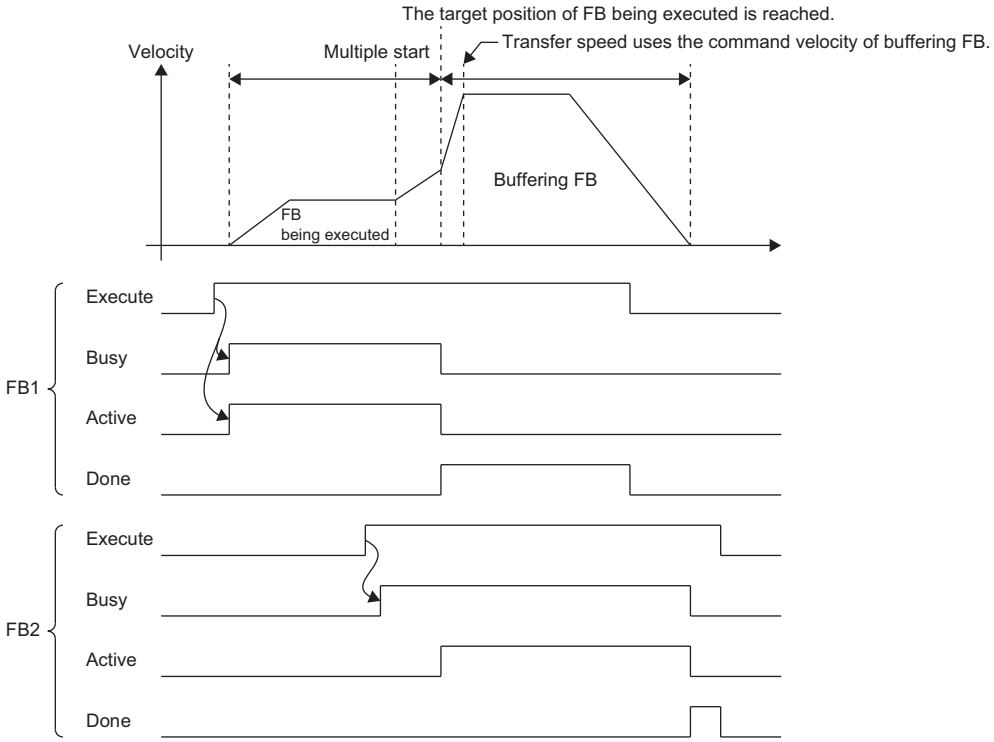


■BlendingNext

The FB is operated so that the velocity becomes the target velocity of the FB in buffering at the target position of the under-control FB.



Depending on the multiple start timing, the movement amount to change the speed to the target velocity of the FB in buffering may be insufficient at the target position of the under-control FB. In this case, velocity change is executed immediately, but the velocity cannot reach the target velocity of the FB that is during buffering at the target position of the under-control FB. If the target position of an under-control FB is reached during acceleration/deceleration, control is changed by the acceleration/deceleration of the buffering FB at that time.



When the acceleration/deceleration method specified in the under-control FB is jerk acceleration/deceleration, if the next FB is multiple started during acceleration/deceleration of the under-control FB, the target speed of the buffering FB may not be reached at the target position of the under-control FB.

■BlendingLow

The slower target velocity between the under-control FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the under-control FB target velocity is slower, and it is same as BlendingNext when the buffering FB target velocity is slower.

■BlendingHigh

The higher target velocity between the under-control FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the under-control FB target velocity is higher, and it is same as BlendingNext when the buffering FB target velocity is higher.

Multiple start during multiple axes operation

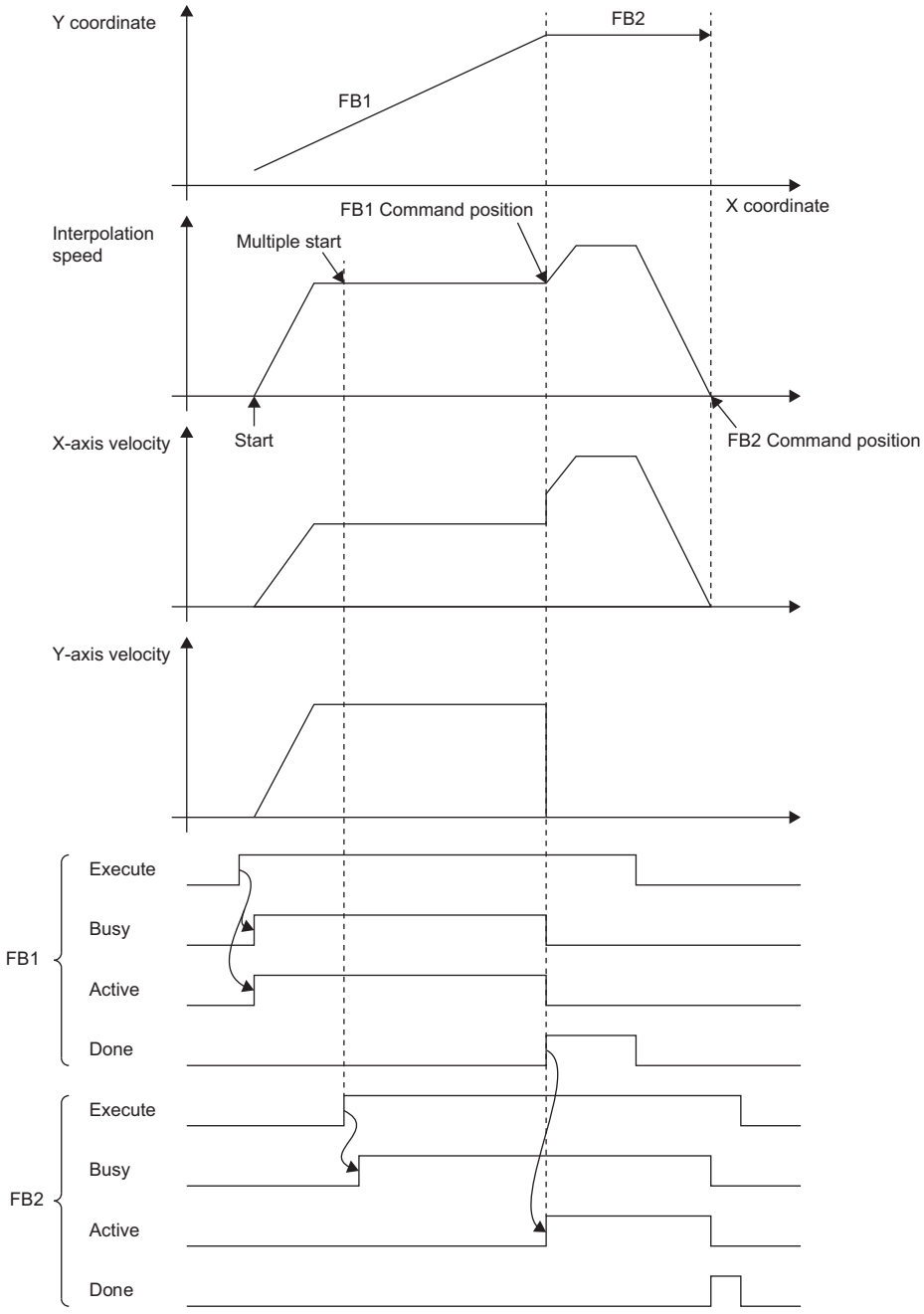
- When the axes group operation state is as follows, multiple start is enabled by executing the motion FB of another instance. (If the axis operation is in the "4: Standby (GroupStandby)" status, it is regarded as "start".)

■Axes Group Status (AxesGroupName.Md.GroupStatus) that can be multiple started

- 5: Operating (GroupMoving)

- In multiple start during multiple axes operation, the current interpolation speed of the under-control FB is used as the switching speed. Therefore, acceleration/deceleration may not be executed and a rapid velocity change may occur depending on the movement amount and direction of each axis in the buffering FB.

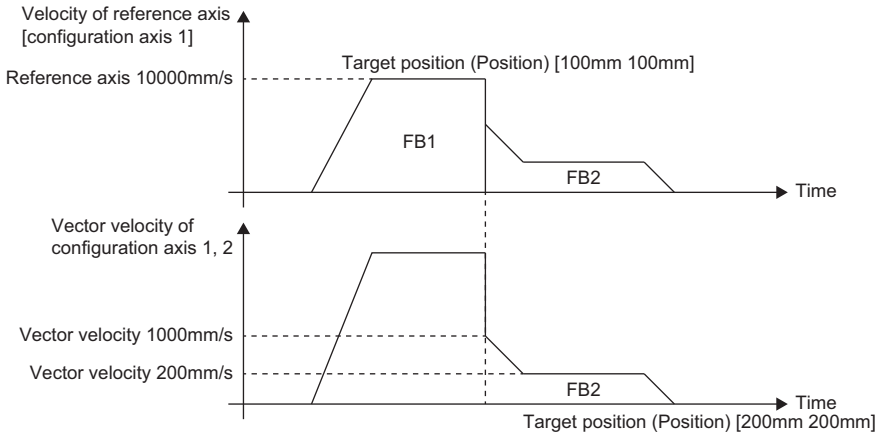
Example of speed pattern for each axis at switching FB (BlendingPrevious)



- When multiple start is performed by specifying Aborting or Blending, if the under-control FB (FB1) or next FB (FB2) has Velocity mode (VelocityMode) input and the velocity mode settings are different between FBs, Multiple Start Velocity Mode Specified Mismatch Warning (event code: 00D11H) is output because the velocity may change suddenly. In such a case, FB1 Velocity mode (VelocityMode) is used in FB1 and FB2 Velocity mode (VelocityMode) is used in FB2 to control. In this case, the switching speed is controlled using only values. (Unit/speed conversion by Velocity mode (VelocityMode) is not executed.)

Ex.

When multiple start by specifying BlendingPrevious from FB1 with the reference axis velocity to FB2 with the vector velocity.



The operation is carried out so that the reference axis velocity of FB1 becomes the velocity set in Velocity (Velocity) (reference axis velocity 1000 [mm/s]). The reference axis velocity at the target position of FB1 is regarded as the switching speed and the current vector velocity value of FB2 without conversion, and it accelerates and decelerates the vector velocity (200 [mm/s]) set in Velocity (Velocity) of FB2.

- Multiple start of the single axis control FB cannot be executed to the axis that is during operation in the axes group. If it is executed, Motion FB issue error to the axis during axes group operating (error code: 1AE2H) will occur in the target axis, and the axes group FB under execution will stop.

Buffer mode that can be set

The following shows buffer modes that can be specified in the multiple axes control FB. For operation details on each FB, refer to the specifications of each FB.

○: Buffer mode setting possible, —: Buffer mode setting not possible (axes group error)

FB	Setting possible in FB			Completion output	Setting possible in the later motion FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_GroupStop (Group Forced Stop)	—*1	—	—	Execution Completed (Done)	○*2	—	—
MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)	○	○	○	Execution Completed (Done)	○	○	○
MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)	○	○	○	Execution Completed (Done)	○	○	○
MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control)	○	○	○	Execution Completed (Done)	○	○	○
MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control)	○	○	○	Execution Completed (Done)	○	○	○
MCv_MovePositioningData (Multiple Axes Positioning Data Operation)	○	○	—	Execution Completed (Done)	○	—	—
MCv_GroupMoveWait (Axis Group Control Start Wait)	—*3	—	—	Execution Completed (Done)	○	○	—

*1 When it is started during axis operation, the operation will be same as Aborting.

*2 Only MC_GroupStop (Group Forced Stop) is possible.

*3 Multiple start cannot be executed because this FB can be started only when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)".

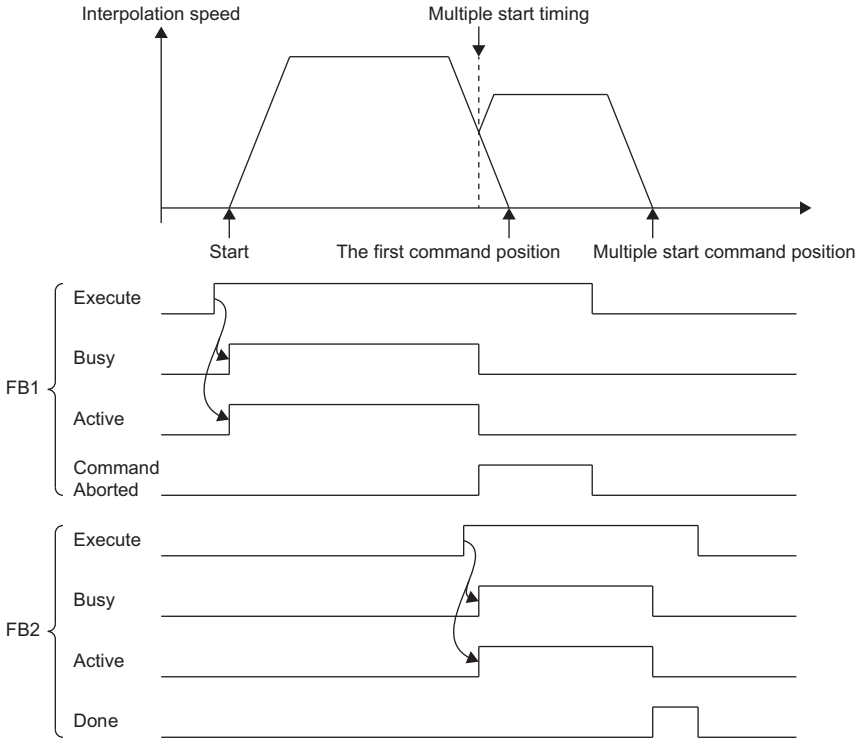
Aborting during multiple axes operation

The under-control FB is interrupted and the multiple started FB is executed.

Since a buffer is not used, an error does not occur even if two of under-control FBs have already been in buffering, and the FB is executed. (All FBs during buffering are interrupted.)

When omitting to specify the buffer mode, this operation is performed.

An operation example when Aborting is executed to the under-control FB1 with the linked start FB2 is shown below.

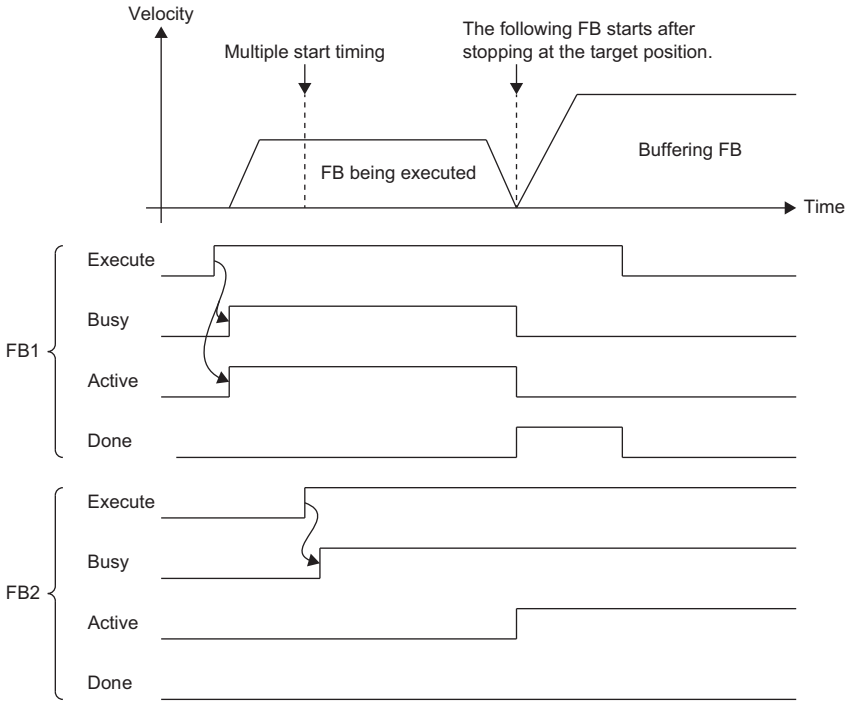


Point

At multiple start during multiple axes operation, if Software stroke limit over (target position) (error code: 1A80H) or any other axes group errors are detected at the same time as when the FB is being switched, the operation may stop immediately regardless of the setting in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) of the axes group.

Buffered during multiple axes operation

Multiple started FBs are buffered and wait until the under-control FB is completed. After the under-control FB is normally completed, multiple started FBs are performed in the order of being buffered.

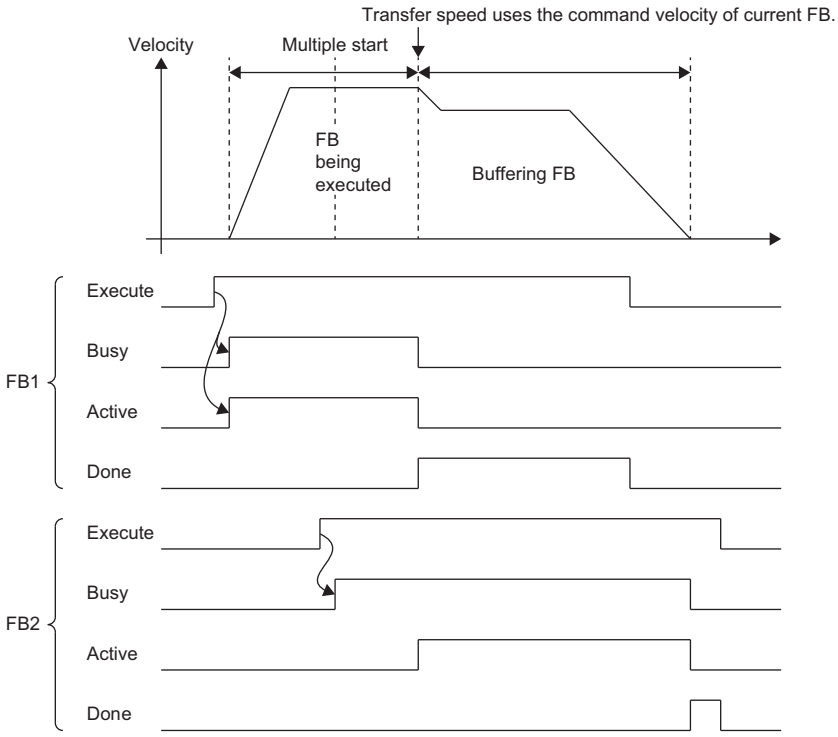


Blending during multiple axes operation

Multiple started FBs are buffered and wait until the under-control FB is completed. After the under-control FB reached the target position, buffering FBs are performed in order. In this case, the switching speed differs depending on the mode specified in the buffer mode.

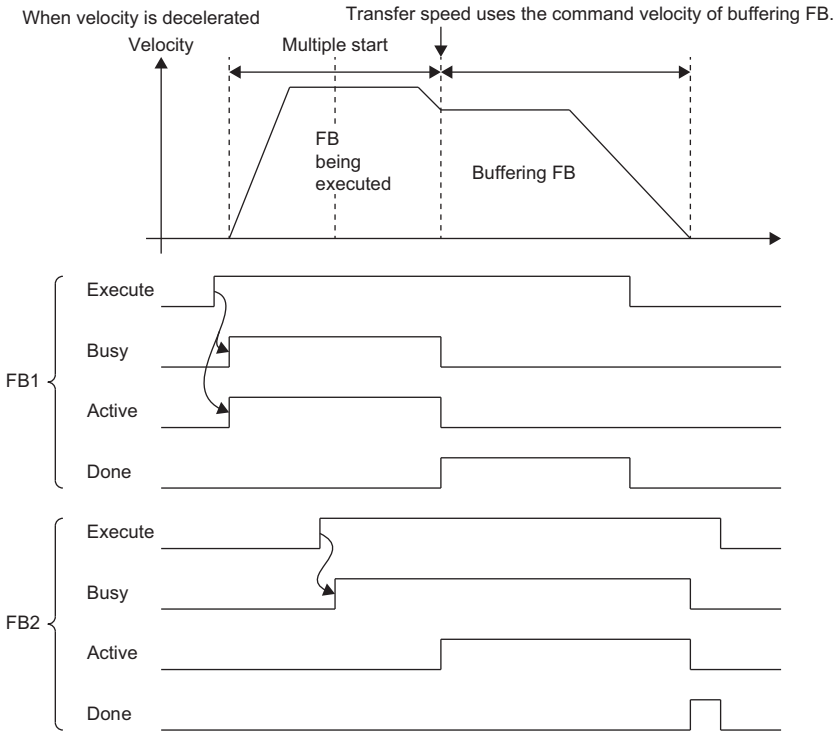
■BlendingPrevious

The FB is operated with the interpolation velocity of current under-control FB to the target position of the under-control FB. After switching to the FB that is during buffering, velocity change is executed to the target velocity of the buffering FB.

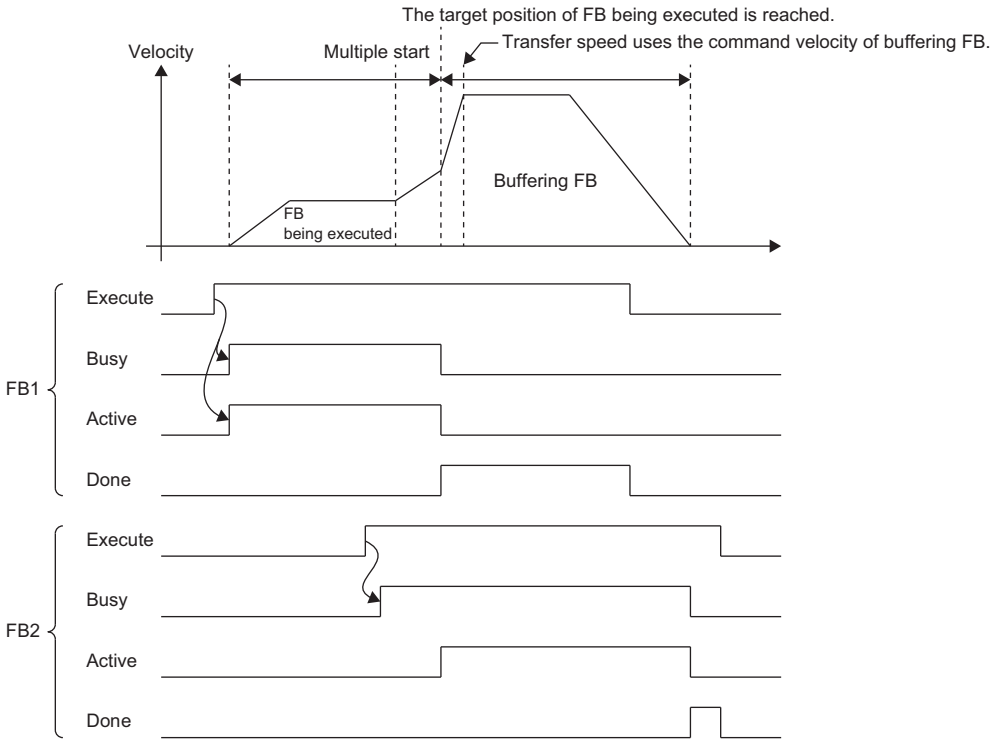


■BlendingNext

The FB is operated so that the interpolation velocity becomes the target velocity of FB that is during buffering at the target position of the under-control FB.



Depending on the multiple start timing, the movement amount to change the speed to the target velocity of the FB in buffering may be insufficient at the target position of the under-control FB. In this case, velocity change is executed immediately, but the velocity cannot reach the target velocity of the FB that is during buffering at the target position of the under-control FB. If the target velocity of an under-control FB is reached during acceleration/deceleration, control is changed by the acceleration/deceleration of the buffering FB at that time.



When the acceleration/deceleration method specified in the under-control FB is jerk acceleration/deceleration, if the next FB is multiple started during acceleration/deceleration of the under-control FB, the target speed of the buffering FB may not be reached at the target position of the under-control FB.

■BlendingLow

The smaller target velocity between the under-control FB and the buffering FB is used as the switching velocity.
When the smaller switching velocity is the under-control FB, the control is the same as BlendingPrevious, and when the smaller switching velocity is the buffering FB, the control is the same as BlendingNext.

■BlendingHigh

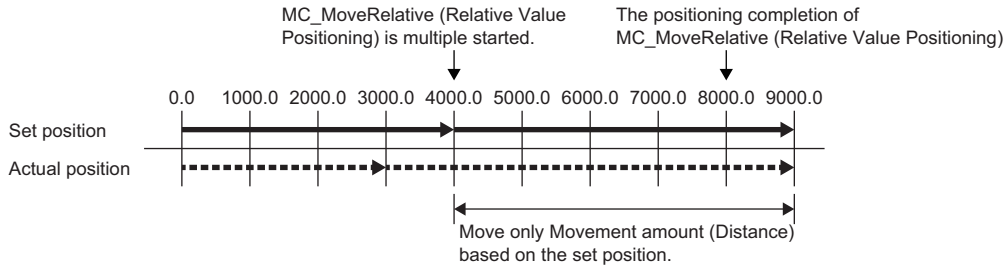
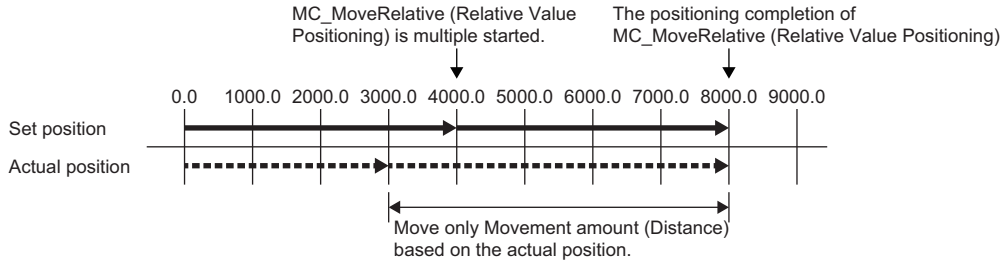
The larger target velocity between the under-control FB and the buffering FB is used as the switching velocity.
When the larger switching velocity is the under-control FB, the control is the same as BlendingPrevious, and when the larger switching velocity is the buffering FB, the control is the same as BlendingNext.

Options of buffering FB

Set the option of the function used for the buffering FB by Options (Options) of the buffering FB. For the positioning control FB which can be specified, refer to operation details on each positioning control FB.
The option to be used by the multiple start is shown below.

Positioning selection in the buffer mode (Options (Options): bit3)

When the relative value positioning control is multiple started, the relative value positioning control from set position or actual position is carried out by Position selection at the multiple start of FB (Options (Options): bit 3).
The axis type which does not have the actual position ignores this setting.

Setting value	Description
0: Set position	The relative position control from set position (Example) When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000000H (bit 3 is 0: Set position)" 
1: Actual position	The relative position control from actual position (Example) When multiple start is performed with Movement amount (Distance) set to "5000.0" and Options (Options) set to "00000008H (bit 3 is 1: Actual position)" 

Reverse rotation permission selection (Options (Options): bit 5)

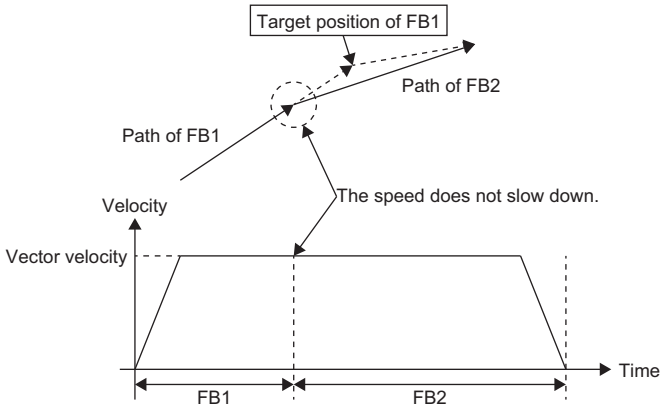
In the single axis motion FB, reverse rotation is allowed when the operation direction differs between the under-control FB and the buffering FB. For details, refer to the following.
☞ Page 552 Multiple start during single axis operation

Setting value	Description
0: Allow	Reverse rotation is allowed. Performs a deceleration stop once, and starts operation in the changed direction after deceleration stop is completed.
1: Not allowed	Reverse rotation is not allowed. When switched, Overrun error (error code: 1AE3H) occurs and a deceleration stop is performed.

Near pass

At multiple start by Blending, near pass is performed to suppress machine vibration which occurs at switching of the positioning control FB.
The remainder of the movement amount which occurs at the end of the positioning control FB is used for the next one.
Command velocity does not decrease and machine vibration which occurs by the velocity change can be suppressed as the positioning is not carried out for each positioning control FB.
Since the alignment is not performed every positioning control FB, the operation is controlled in a path that passes near the position set in the FB.

Ex.
For multiple starting the 2-axes linear interpolation control with Blending (multiple start of FB2 during control of FB1)



Precautions

At multiple start by Blending, the command velocity may not reach the target velocity if the movement amount of the previous FB is small.

Combination with retrigger/continuous update

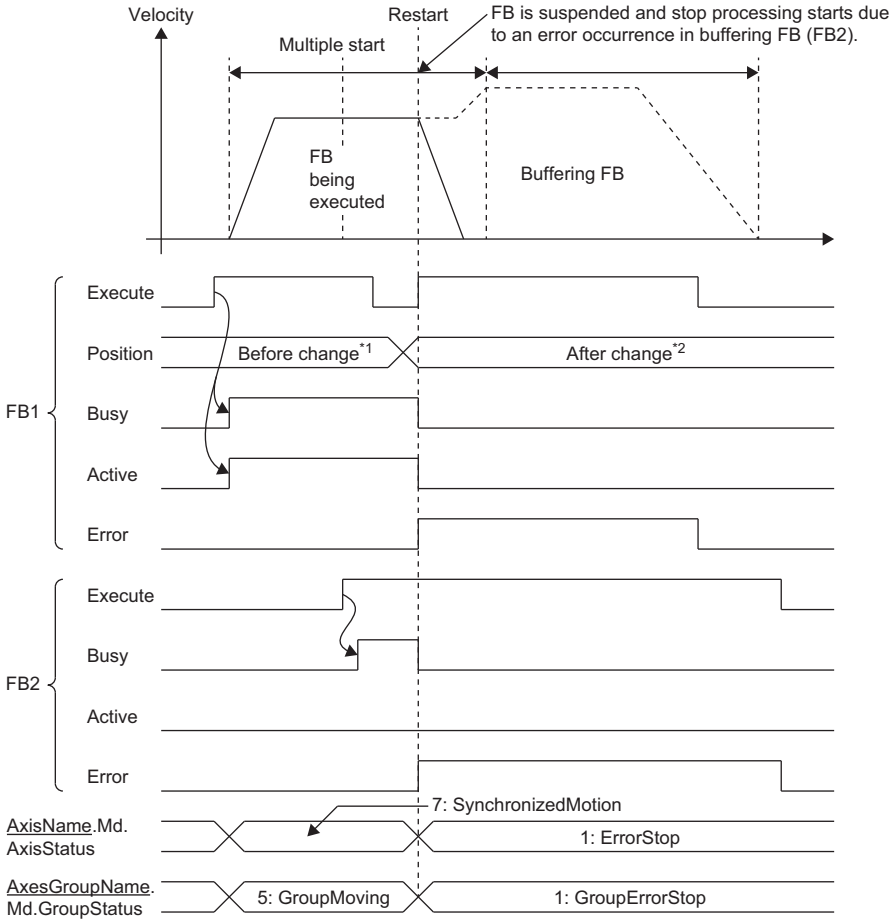
Reanalysis of the buffering FB by retrigger/continuous update

When the target position or the target velocity is changed by retrigger/continuous update for the under-control FB, the reanalysis of the buffering FB may be needed.

As a result of reanalysis, when an error occurs in any of the FBs, Axis Status (AxisName.Md.AxisStatus) becomes "1: Stopping on error (ErrorStop)" or Axes Group Status (AxesGroupName.Md.GroupStatus) becomes "1: Stopping on error (GroupErrorStop)" and the under-control FB is interrupted and stopped. (The buffering FB is canceled.)

Ex.

The changed target position is out of the software stroke limit range by retriggering the under-control FB.

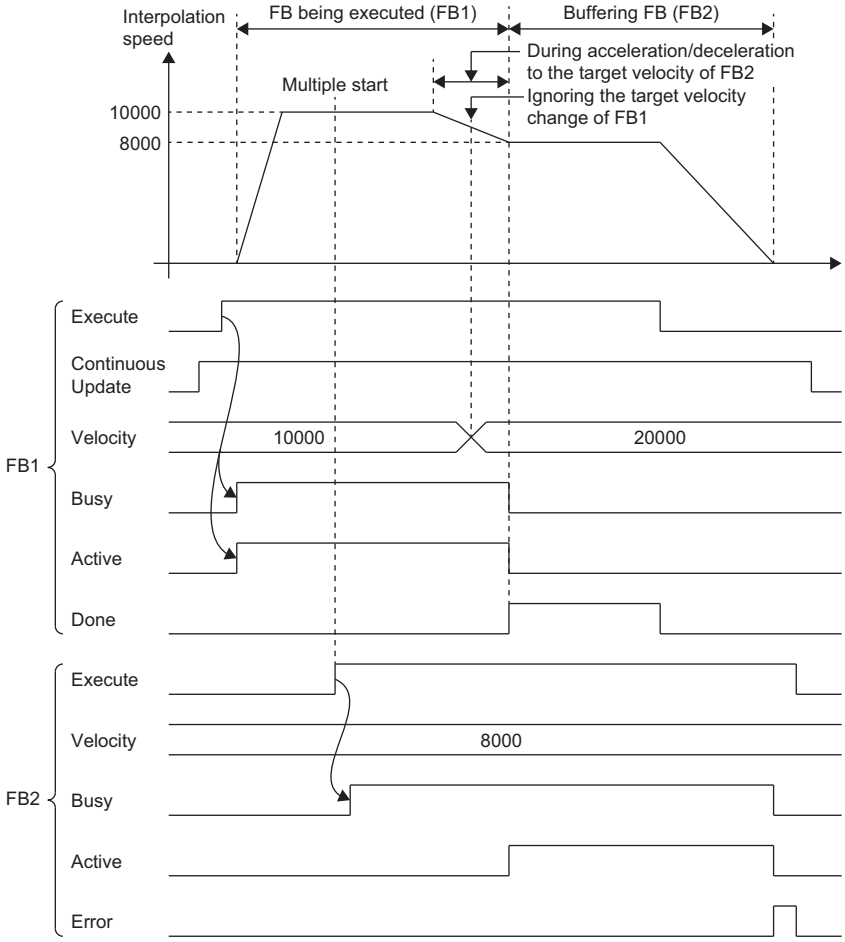


*1 The target position is within the software stroke limit range.

*2 The target position is out of the software stroke limit range.

BlendingNext changes target velocity at accelerating/decelerating

As BlendingNext is specified and the multiple start is executed, while the buffering FB is accelerating/decelerating to its target velocity (transfer speed), the target velocity change of under-control FB is not allowed.
The target velocity change is allowed if it is changed by Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride).



After the target velocity of the buffering FB is reached by acceleration/deceleration by BlendingNext, the velocity change by the input variable of under-control FB is allowed. However, the velocity change value during acceleration/deceleration by BlendingNext is ignored even if a retrigger/continuous update is performed after the target velocity of the buffering FB is reached.
Also, if the target velocity is changed with the under-control FB, acceleration/deceleration is performed toward the target velocity of the buffering FB after the FB is switched.

BlendingLow/BlendingHigh changes target velocity after multiple start

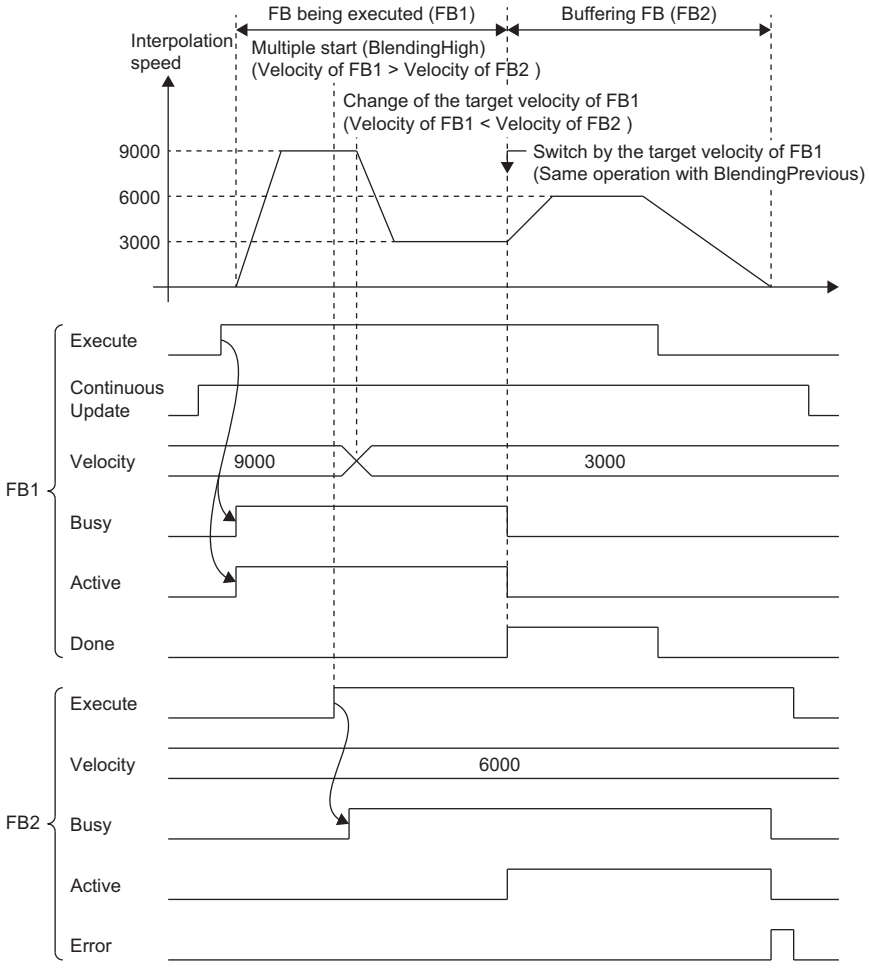
Multiple start by BlendingLow/BlendingHigh determines whether to switch with the velocity of the under-control FB or the buffering FB.

Therefore, if the size related to the target velocity between the under-control FB and the buffering FB is changed by target velocity change after multiple start, the switching velocity is still determined as the target velocity that was determined at multiple start.

When the velocity for the under-control FB and buffering FB is the same at multiple start, the velocity of the under-control FB is used for switching for both BlendingLow and BlendingHigh. Therefore, if the target velocity is changed after multiple start, the under-control FB velocity after the change is used for switching.

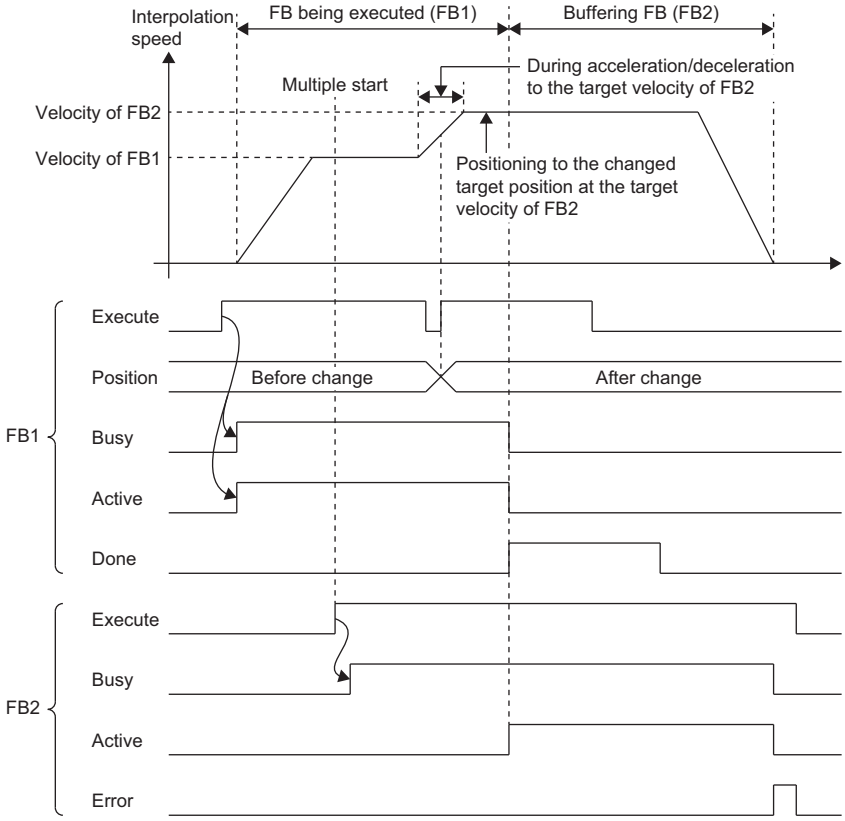
Ex.

When the target velocity is changed after multiple start by BlendingHigh

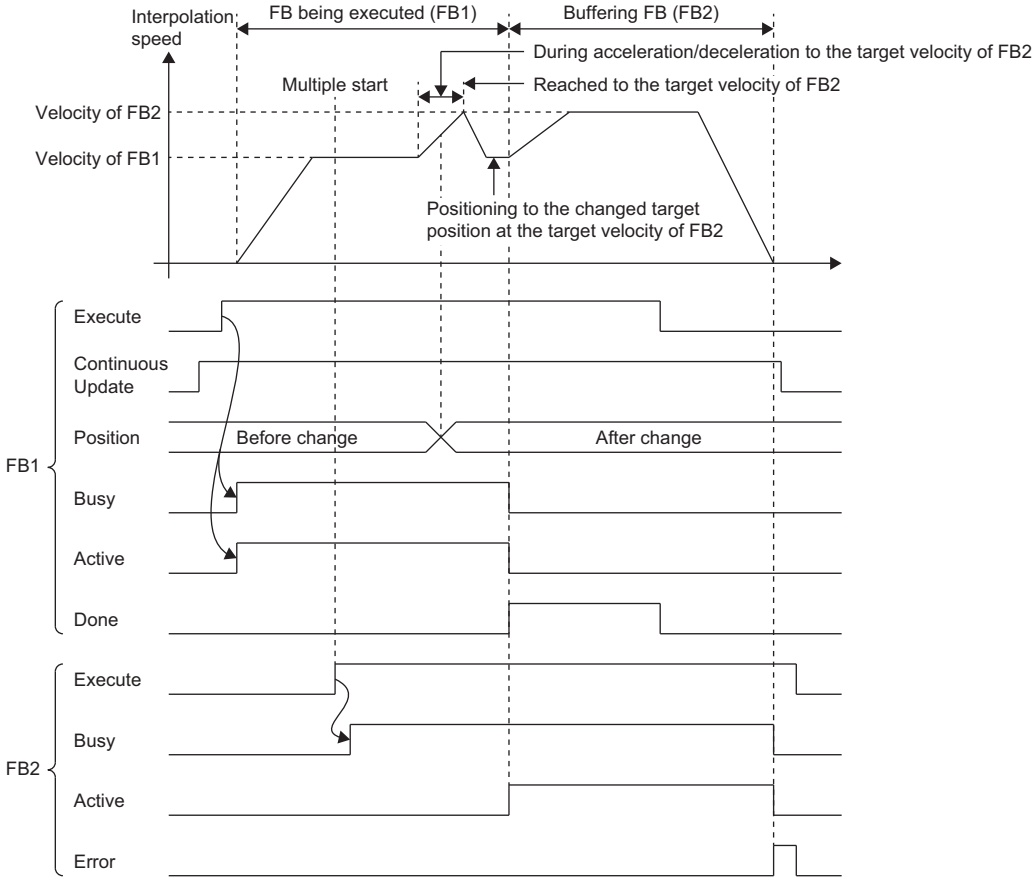


BlendingNext changes target position/movement distance at accelerating/decelerating

The following figure shows the operation in which the target position/movement distance is changed during acceleration/deceleration to the target velocity (transfer speed) of the buffering FB at multiple start by specifying BlendingNext.
When the movement amount is increased by the target position/movement distance change, positioning is executed to the target position/movement distance changed with the target velocity (transfer speed) of the buffering FB.



When the movement amount is reduced by the target position/movement distance change, the FB is switched during acceleration/deceleration to the target velocity (transfer speed) of the buffering FB. Also, the operation direction is reversed when the target position/movement distance is changed to a position before the current position.
For operations in the reversed direction, refer to the following.
☞ Page 552 Multiple start during single axis operation

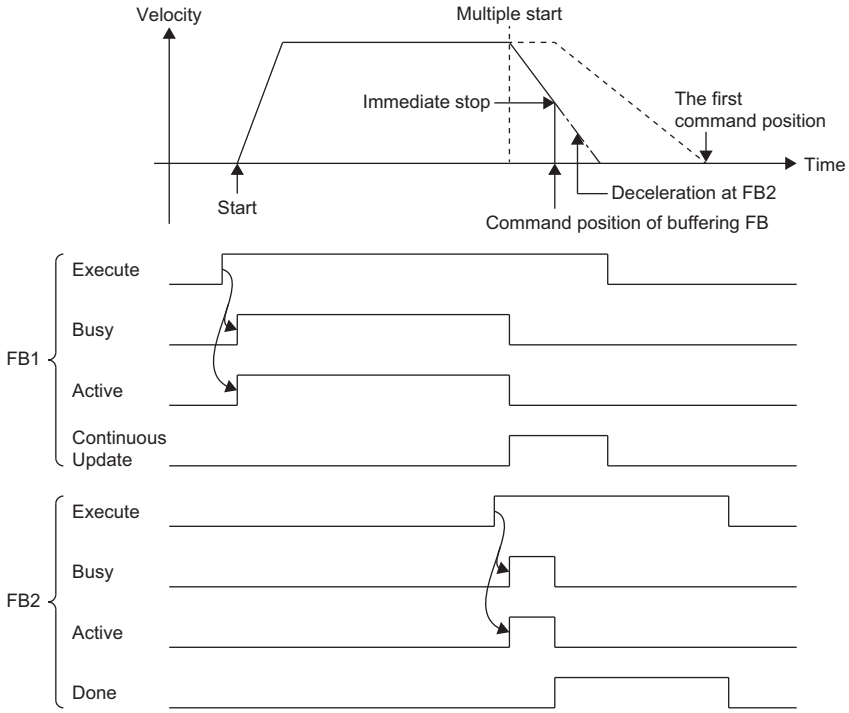


Precautions

- When deceleration distance of a buffering FB cannot be secured with the switching speed and the target position is overrun at switching to the buffering FB, automatic deceleration operation is performed according to the setting of Operation Setting at Overrun (AxisName(AxesGroupName).Pr.OverrunOperation).

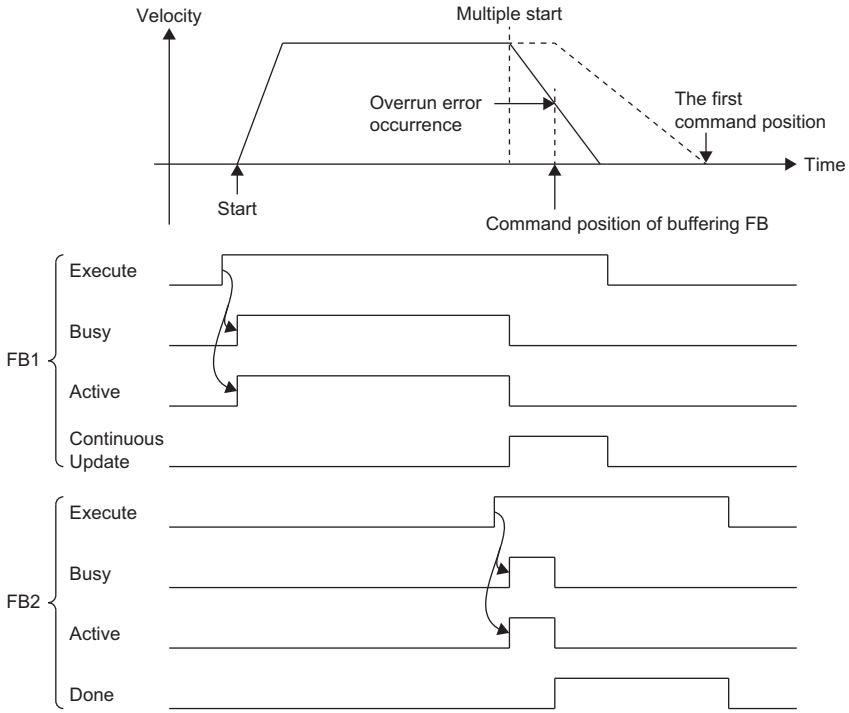
■When "1: Immediate Stop (ImmediateStop)" is set

The axis starts deceleration immediately, and it stops immediately at reaching the target position after outputting Overrun Warning (event code: 00D10H).



■When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set (Only for single axis)

The axis starts deceleration immediately, and it stops after exceeding the target position. When the stop address is exceeded, Overrun error (error code: 1AE3H) is output. However, when the error occurs, the operation stops according to the setting of Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General). To stop the axis after it exceeds the target position, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).



Point

When a new FB is multiple started during deceleration due to movement amount shortage, the operation becomes as follows.

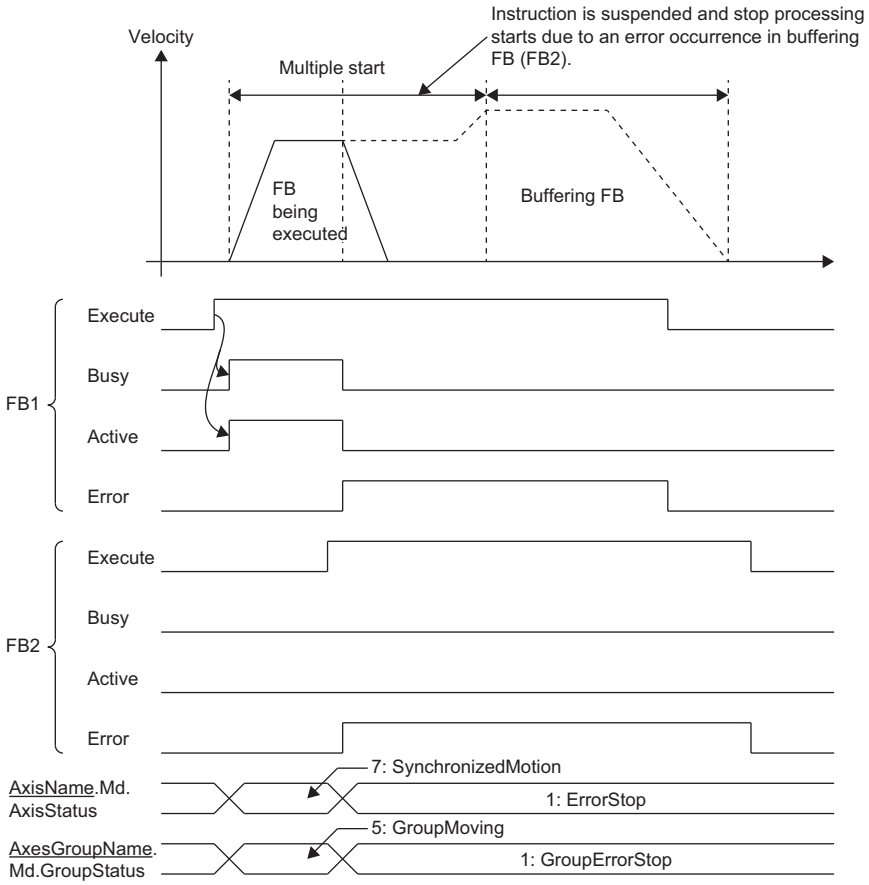
[When the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting is "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)"]

- If the target position has already been reached when the multiple start happens (when Overrun error (error code: 1AE3H) occurs), the buffering FB will be disabled.
- If the target position has not been reached when the multiple start happens and if Aborting and Blending are set, deceleration will be canceled. If Buffered is set, the multiple start will be executed but canceled with Overrun error (error code: 1AE3H) occurrence.

[When the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting is other than "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)"]

- If a new FB is multiple started when Aborting and Blending are set, deceleration stop will be canceled.
- If a new FB is multiple started when Buffered is set, automatic deceleration will be continued. The multiple started FBs will be executed after the axis stops.

- If an error occurs in the following FB analysis processing at multiple start, Axis Status (AxisName.Md.AxisStatus) and Axes Group Status (AxesGroupName.Md.GroupStatus) will be "1: Stopping on error (GroupErrorStop)" and the under-control FBs will stop.



- If the acceleration/deceleration method settings are different between the under-control FB and the next FB, Acceleration/Deceleration method mismatched (error code: 1A8AH) will occur and the FBs will stop. Set the same acceleration/deceleration method in the FBs to be carried out multiple start.
- Changes are reflected at the switching of FB when a retrigger/continuous update is performed on the buffering FB after multiple start. If the warning occurs at the switching of FB, it operates with the value at multiple start without accepting the changes.

26.4 Stop

This function stops motion control.

This section describes how to stop an axis of the motion system.

Each control is stopped in the following cases.

This section describes stop processing other than when each control in the following cases is completed normally.

For operation details when a stop cause occurs in another function (such as stop processing of homing), refer to each function.

Axis operation stop

- When each control is completed normally
- When the "forced stop input" is turned off
- When the drive unit power supply is turned off
- When the drive unit network disconnection is detected
- When the drive unit error occurs
- When the forced stop is input to the drive unit
- When "Enable (Enable)" of MC_Power (Operation Available) is FALSE
- When "Servo ON request (ServoON)" of MC_Power (Operation Available) is FALSE
- When the hardware stroke limit upper/lower limit error occurs
- When a moderate or major error of the controller occurs
- When PLC READY (MotionSystem.Cd.SequenceReady) is turned off
- When the cycle over error occurs
- When a moderate error or a major error of the motion system occurs
- When the software stroke limit upper/lower limit error occurs
- When an axis error is detected
- When "Execution command (Execute)" of MC_Stop (Forced Stop) is TRUE
- When "Stop Signal (STOP)" of external input signal is TRUE

Hardware stroke limit upper/lower limit error	Software stroke limit upper/lower limit error
• FLS signal detection (at start) (error code: 1A9EH) • RLS signal detection (at start) (error code: 1A9FH) • FLS signal detection (controlling) (error code: 1AA0H) • RLS signal detection (controlling) (error code: 1AA1H)	• Software stroke limit over (forward direction) (error code: 1A83H) • Software stroke limit over (reverse direction) (error code: 1A84H)

Axes group operation stop

- When each control is completed normally
- When a stop cause occurs in the configuration axis
- When an axes group error is detected
- When "Execution command (Execute)" of MC_GroupStop (Group Forced Stop) is TRUE
- When "Stop Signal (STOP)" of external input signal is TRUE

Operation of this function for each system status

○: Available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Selects operation when the hardware stroke limit upper/lower limit error occurs. • 1: Immediate Stop (ImmediateStop) (Initial value) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) * Immediate stop will be executed when executing an instruction without deceleration specification.
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	Selects operation when the software stroke limit upper/lower limit error occurs. • 1: Immediate Stop (ImmediateStop) (Initial value) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) * Immediate stop will be executed when executing an instruction without deceleration specification.
StopMode_General	Stop Selection at Stop Cause Occurrence	Selects operation when a stop cause for each axis other than the stop cause 1 and 2 occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Initial value) * Immediate stop will be executed when executing an instruction without deceleration specification.
StopMode_Deceleration	Deceleration at Stop	Specifies the deceleration/deceleration time at deceleration stop by stop cause occurrence. ■When acceleration/deceleration method to specify the acceleration/deceleration • Unit: Specify with U/s^2. • Range: 0.0000, a positive number from 0.0001 to 2147483647 [U/s^2]*1 ■When acceleration/deceleration method to specify the acceleration/deceleration time • Unit: Specify with s. • Range: 0.000000, a positive number from 0.000001 to 8400.0 [s]*1 * If "0" is set, immediate stop will be executed regardless of the operation selection at start acceleration/deceleration 0 (AccelerationZeroBehavior) setting.
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Selects operation when a stop cause occurs during deceleration (including a stop cause and automatic deceleration). • 1: Recreate Deceleration Curve (OverrideCurve) (Initial value)
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Selects operation when Servo ON request (ServoON) of MC_Power (Operation Available) becomes FALSE during operation. • 0: Ignore (Ignore) (Initial value) • 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop) • 5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)
OverrunOperation	Operation Setting at Overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. • 1: Immediate Stop (ImmediateStop) (Initial value) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Variable/structure name	Name	Details
StopSignal	Stop Signal	Sets a signal that uses the stop signal (STOP) of the external input signal. Stop signal (StopSignal) is a structure of SIGNAL_SELECT type. The fetch timing of the label is at Ready ON, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure It may be regarded as signal detection, depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following. ☞ Page 1154 EXTERNAL SIGNAL SELECTION The specific setting and the operation of this signal are shown below. ■I/O Number (StartIO) Ignores the input value. ■Target (Target) When the specification is not set, signal disabled is determined and the signal not detecting status is always set. Only [VAR], [DEV], and [CONST] can be specified for the data type. * If an unavailable value is set, Out of parameter range (axis) (error code: 1A60H) occurs. The error cause can be checked with the following detail codes. • An incorrect string was set (detail code: 0001H) • An unavailable data type was set (detail code: 0002H) • An unavailable type was specified (detail code: 0003H) • A type other than the numerical value type was specified at label specification (detail code: 0004H) • A signal that does not exist was set (detail code: 0005H) • A global label where access from an external device is disabled was set (detail code: 0005H) • The number of characters exceeded the upper limit (detail code: 0007H). • "Asynchronous" was set in the network synchronous communication setting of the device station being referred to (detail code: 8002H) • An unsupported device was set (detail code: 8002H) • A device number out of range was set (detail code: 8002H) ■Signal Detection Method (Detection) The specification is allowed at the following level detection only. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel) * When edge detection specification is set, Out of parameter range (axis) (error code: 1A60H) (detail code: 8003H) occurs. ■Compensation Time (CompensationTime) Ignores the input value. ■Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. * When a value outside the range is set, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs and the axis operates with 0.0 of the filter time.
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Select whether to detect the command discard status of the drive unit and stop with error during operation of the axis or not. • 0: FALSE Detection Disabled • 1: TRUE Detection Enabled (Initial value)

*1 Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as 0 (Immediate stop) when lower limit value is out of the range.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
StopSignal	Stop Signal	Displays the input status of the stop signal (STOP) among external input signals. Stop signal (StopSignal) is a structure of SIGNAL_SELECT type. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure The specific output of this signal is shown below. ■I/O Number (StartIO) "0" is always displayed. ■Target (Target) The fetch result of the parameter is displayed. ■Signal Detection Method (Detection) The fetch result of the parameter is displayed. ■Compensation Time (CompensationTime) "0.0" is always displayed. ■Filter Time (FilterTime) The fetch result of the parameter is displayed.
StopStatus	Stop Status	Displays the input status of the stop signal (STOP) among external input signals. • FALSE: Stop processing released • TRUE: During stop processing
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Displays input status of the stop processing selection at deceleration stop.
StopMode_Deceleration	Deceleration at Stop	Displays input status of the deceleration at stop.
StopMode_General	Stop Selection at Stop Cause Occurrence	Displays input status of the stop selection at stop cause occurrence.
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Displays input status of the stop selection at the hardware stroke limit error occurrence.
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Displays input status of the processing selection at servo OFF command during operation.
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	Displays input status of the stop selection at the software stroke limit error occurrence.
OverrunOperation	Operation Setting at Overrun	Displays the input status of the overrun operation setting.
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Displays driver command discard detection setting status.

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
StopMode_General	Stop Selection at Stop Cause Occurrence	Selects operation when a stop cause of the axes group occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Initial value) * Immediate stop will be executed when executing an instruction without deceleration specification.
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Selects operation when a stop cause occurs during deceleration (including a stop cause and automatic deceleration). • 1: Recreate Deceleration Curve (OverrideCurve) (Initial value)
OverrunOperation	Operation Setting at Overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. If other than "1: Immediate Stop (ImmediateStop)" (Initial value) is set, an error will occur. • 1: Immediate Stop (ImmediateStop)
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	During operation in the axes group, when the drive unit servo is turned off on the configuration axis and an immediate stop axis error occurs, it sets the operation of the axes on which the axis error has not occurred. • 1: Immediate Stop (ImmediateStop)
StopMode_Deceleration	Deceleration at Stop	Specifies the deceleration/deceleration time at deceleration stop by axes group stop cause occurrence. ■When acceleration/deceleration method to specify the acceleration/deceleration • Unit: Specify with U/s^2. • Range: 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2][*1] ■When acceleration/deceleration method to specify the acceleration/deceleration time • Unit: Specify with s. • Range: 0.000000, a positive number from 0.000001 to 8400.0 [s][*1] * If "0" is set, immediate stop will be executed regardless of the operation selection at start acceleration/deceleration 0 (AccelerationZeroBehavior) setting.

*1 Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as 0 (Immediate stop) when lower limit value is out of the range.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
StopMode_Deceleration	Deceleration at Stop	Displays input status of the deceleration at stop.
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Displays input status of the stop processing selection at deceleration stop.
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	Displays input status of the configuration axes operation selection at axis stop cause occurrence.
StopMode_General	Stop Selection at Stop Cause Occurrence	Displays input status of the stop selection at stop cause occurrence.
OverrunOperation	Operation Setting at Overrun	Displays the input status of the overrun operation setting.

System parameter (MotionSystem.Pr.)

Variable/structure name	Name	Details
StopMode_All	Stop Selection at All Axes Stop Cause Occurrence	Selects whether to stop immediately or decelerate to stop when an all axes stop cause occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Initial value) * Immediate stop will be executed when executing an instruction without deceleration specification.
StopMode_AllDeceleration	Deceleration at All Axes Stop	Specifies the deceleration/deceleration time at deceleration stop when an all axes stop cause occurred. ■When acceleration/deceleration method to specify the acceleration/deceleration • Unit: Specify with U/s^2. • Range: 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2][*1] ■When acceleration/deceleration method to specify the acceleration/deceleration time • Unit: Specify with s. • Range: 0.000000, a positive number from 0.000001 to 8400.0 [s][*1] * If "0" is set, immediate stop will be executed regardless of the operation selection at start acceleration/deceleration 0 (AccelerationZeroBehavior) setting.

*1 Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as 0 (Immediate stop) when lower limit value is out of the range.

Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_Stop	Forced stop	Decelerates specified axis to stop.
MC_GroupStop	Group forced stop	Decelerates specified axes group to stop.

Stop cause lists

Stop causes during axis operation

The following shows stop causes during axis operation and the process when each cause occurs.

Cause No.	Stop cause	Stop axis	Axis Status (AxisName.Md.AxisStatus)		Stop process[*1]
			During deceleration stop	After stop	
1	"Forced stop input" is FALSE	Each axis/All axes	—	1: Stopping on error (ErrorStop)	Immediate Stop[*2]
2	Drive unit power supply is off	Each axis	—	1: Stopping on error (ErrorStop)	Immediate Stop[*2]
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable (Enable) of MC_Power (Operation Available) is FALSE				
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)")[*3]				
	Drive unit control mode has switched to the control mode which the motion system axis control is not supported.				Immediate Stop[*6]
3	Hardware stroke limit upper/lower limit error occurrence	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit))
4	Occurrence of a moderate or major error of the controller	All axes	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at All Axes Stop Cause Occurrence (MotionSystem.Pr.StopMode_All))[*7]
	PLC READY (MotionSystem.Cd.SequenceReady) was turned off.				
	Cycle over error occurrence[*8]				
	Moderate error or major error of the motion system occurs				
5	Software stroke limit upper/lower limit error occurrence	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit))
6	Axis error detection[*4]	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General))
7	Execution command (Execute) of MC_Stop (Forced Stop) is TRUE	Each axis	2: Decelerating to stop (Stopping)	2: Decelerating to stop (Stopping)[*5]	Deceleration stop/immediate stop (Follows the deceleration (Deceleration) set in the FB)
8	"Stop Signal (STOP)" of external input signal is TRUE	Each axis	No change	4: Standby (Standstill)	Deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General))

*1 For each operation of the stop process, refer to the following.
☞ Page 586 Stop processes for single axis

*2 The servo turns off on the drive unit side and immediate stop is performed, and also the motion system side command is stopped.

*3 Operation differs depending on the setting value selected in Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.
☞ Page 592 Stop causes by Servo ON request (ServoON) input of MC_Power (Operation Available)

*4 If an axis error (the error that transits the status into the "1: Stopping on error (ErrorStop)" status) occurs in the buffering FB, deceleration stop will be performed from the error occurrence.

*5 When Execution command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".
*6 Immediately stops the motion system side command, and follow up on the current position.
*7 Deceleration stop may be independently performed on the drive unit side depending on the drive unit specifications. For details, check the drive unit specifications.
*8 When Cycle over (error code: 1A00H, 3402H) occurs while different operation cycles coexist, only the axis operating in the cycle over operation cycle stops.

Precautions

Provide the emergency stop circuits outside the servo system to prevent cases where danger may result from abnormal operation of the entire system in the event of an external power supply fault or servo system failure.

Stop causes during axes group operation

The following shows stop causes during axes group operation and the process when each cause occurs.

Cause No.	Stop cause		Stop axis	Axes Group Status (AxesGroupName.Md.GroupStatus)		Stop process*1	
				During deceleration stop	After stop		
1	Stop cause occurrence in the configuration axis	Axis error detection	Axes group	1: Stopping on error (GroupErrorStop)	1: Stopping on error (GroupErrorStop)	Stop cause occurrence axis	Axes group deceleration stop/immediate stop*2 (For axes group deceleration stop, it follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).)
						Other configuration axes	Axes group deceleration stop/immediate stop (For axes group deceleration stop, it follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).)*3
2		External input signal "Stop Signal (STOP)" is TRUE	Axes group	No change	4: Standby (GroupStandby)	Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))	
3	Axes group error detection*4		Axes group	1: Stopping on error (GroupErrorStop)	1: Stopping on error (GroupErrorStop)	Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))	
4	Execution command (Execute) of MC_GroupStop (Group Forced Stop) is TRUE		Axes group	2: Decelerating to stop (GroupStopping)	2: Decelerating to stop (GroupStopping)*5	Axes group deceleration stop/immediate stop (Follows the deceleration (Deceleration) set in the FB)	

*1 For each operation of the stop process, refer to the following.
☞ Page 588 Stop processes for axes group
*2 The servo turns off on the drive unit side and an immediate stop is performed, and also the motion side command is stopped.
*3 When the stop cause occurrence axis is immediately stopped by servo OFF, operation differs depending on the setting selected in Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup). For details, refer to the following.
☞ Page 600 Stop cause occurrence in the configuration axis
*4 If an axes group error (the error that transits the status into the "1: Stopping on error (GroupErrorStop)" status) occurs in the FB which can be linked by the buffer mode, automatic deceleration will be performed from the axes group error occurrence.
*5 When Execution command (Execute) of MC_GroupStop (Group Forced Stop) is FALSE at stop completion, Axes Group Status (AxesGroupName.Md.GroupStatus) after stop will be "4: Standby (GroupStandby)".

Types of stop processes

This section describes types of stop processes for a single axis and an axes group.
Stop operation by Stop Selection at Stop Cause Occurrence (AxisName(AxesGroupName).Pr.StopMode_General) and Deceleration at Stop (AxisName(AxesGroupName).Pr. StopMode_Deceleration) is explained in this section.
For the stop operation by MC_Stop (Forced Stop) or MC_GroupStop (Group Forced Stop), refer to the following.
☞ Page 596 MC_Stop (Forced Stop)
☞ Page 606 MC_GroupStop (Group Forced Stop)

Stop processes for single axis

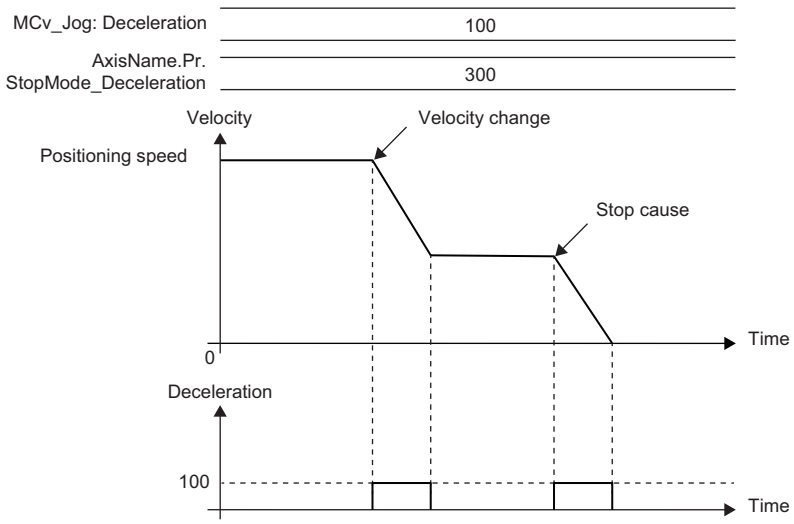
■Deceleration stop

The operation decelerates from the speed during operation to speed 0. The deceleration differs depending on Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).

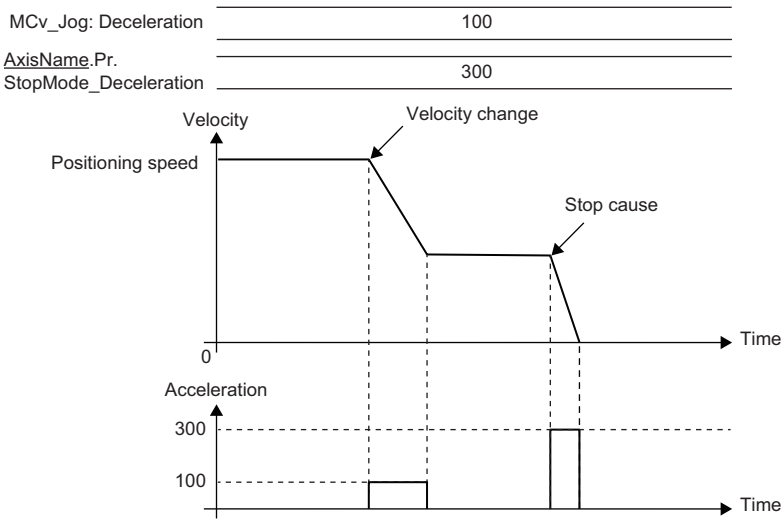
Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) setting value	Deceleration at Stop
2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)	Deceleration at instruction during operation
3: Alternative Acceleration/Deceleration (AlternativeAcc)	Deceleration at Stop (AxisName.Pr. StopMode_Deceleration)

The acceleration/deceleration method and the jerk setting of deceleration stop take over the setting value of the FB which was being executed when stop cause occurred. FBs whose acceleration/deceleration method cannot be set decelerates using trapezoidal acceleration/deceleration.
For details on each stop method, refer to the following.
☞ Page 1078 Acceleration/Deceleration Processing Function

- When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) (When the instruction in operation is MCv_Jog (JOG Operation))



- When "3: Alternative Acceleration/Deceleration (AlternativeAcc)" is set to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) (When the instruction in operation is MCv_Jog (JOG Operation))

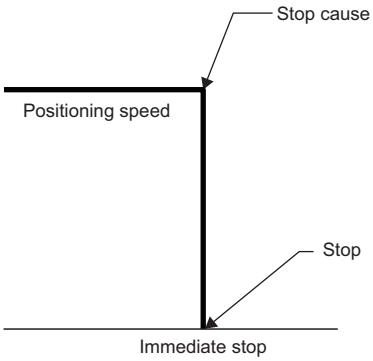


■Immediate Stop

The operation does not decelerate and immediately stops the command.

For the stop method of the drive unit, refer to each drive unit manual.

For MR-J5(W)-G: 📖MR-J5 User's Manual (Function)



Stop processes for axes group

■Deceleration stop

The operation decelerates from the interpolation speed during operation to the interpolation speed 0. The deceleration differs depending on Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).

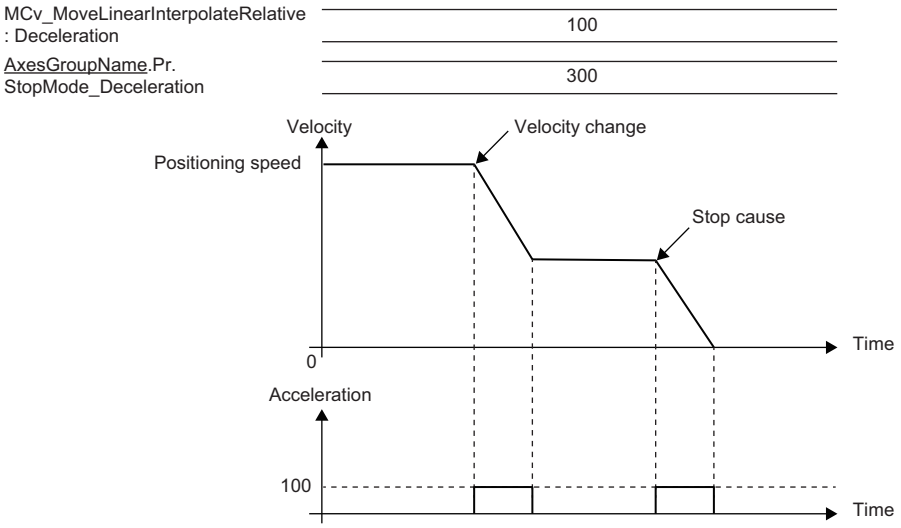
Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General) setting value	Deceleration at Stop
2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)	Deceleration at instruction during operation
3: Alternative Acceleration/Deceleration (AlternativeAcc)	Deceleration at Stop (AxesGroupName.Pr. StopMode_Deceleration)

The acceleration/deceleration method and the jerk setting of deceleration stop take over the setting value of the FB which was being executed when stop cause occurred.

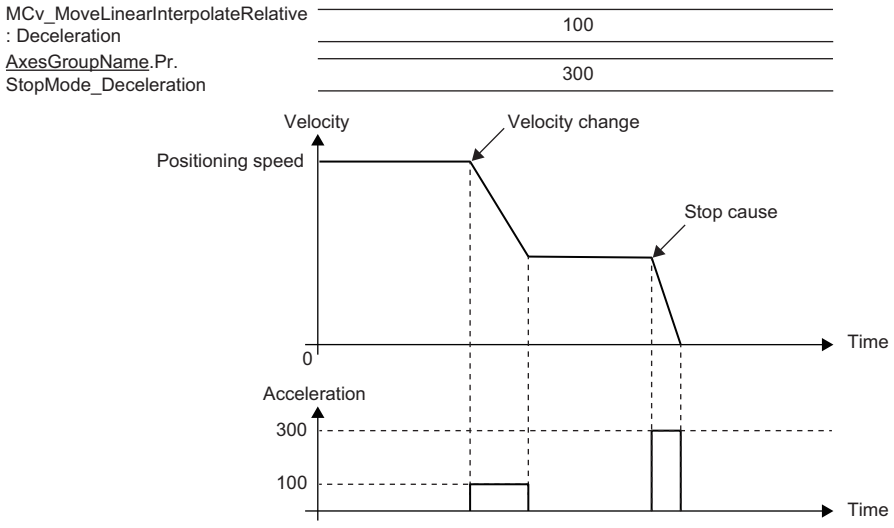
For specifications of each stop method, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

- When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set to Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General) (When the instruction in operation is MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))



- When "3: Alternative Acceleration/Deceleration (AlternativeAcc)" is set to Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General) (When the instruction in operation is MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))

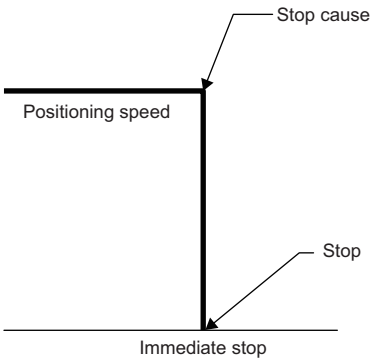


■Immediate Stop

The operation does not decelerate and immediately stops the command of the configuration axis.

For the stop method of the drive unit, refer to each drive unit manual.

For MR-J5(W)-G: MR-J5 User's Manual (Function)



Order of priority for stop process

This section describes the processes when multiple stop causes occur.

The order of priority is as shown below based on the stop process of occurred stop cause.

Priority	Stop method
1	Immediate stop
2	Deceleration stop

When a deceleration stop cause occurs again during deceleration stop (including a stop cause and automatic deceleration), the deceleration process differs depending on the following parameter settings for a single axis or an axes group.

Item	Parameter	Setting value
Single axis	Stop Selection at Deceleration to Stop (AxisName.Pr.StopMode_DecelerationCurve)	1: Recreate Deceleration Curve (OverrideCurve)
Axes group	Stop Selection at Deceleration to Stop (AxesGroupName.Pr.StopMode_DecelerationCurve)	

Deceleration curve re-processing

■1: Recreate Deceleration Curve (OverrideCurve)

A deceleration curve is re-processed from the deceleration of the new stop cause.

During single axis operation, the stop position can be overrun depending on the deceleration and the jerk setting. To avoid overrun, set "1: Immediate Stop (ImmediateStop)" in Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

For operation details, refer to the following.

☞ Page 591 Overrun at stop cause occurrence

Overrun at stop cause occurrence

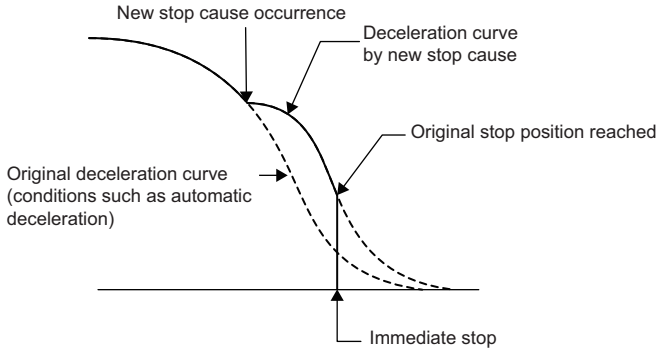
This function selects operation for the case that the positioning address of an instruction which was executed before a stop cause occurs is reached during deceleration stop and immediate stop process.
This function is enabled only when the target position exists at stop cause occurrence.
The following parameters for a single axis or an axes group need to be set in this function.

Item	Parameter	Setting value
Single axis	Operation Setting at Overrun (AxisName.Pr.OverrunOperation)	1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)
Axes group	Operation Setting at Overrun (AxesGroupName.Pr.OverrunOperation)	1: Immediate Stop (ImmediateStop)

Immediate Stop

■1: Immediate Stop (ImmediateStop)

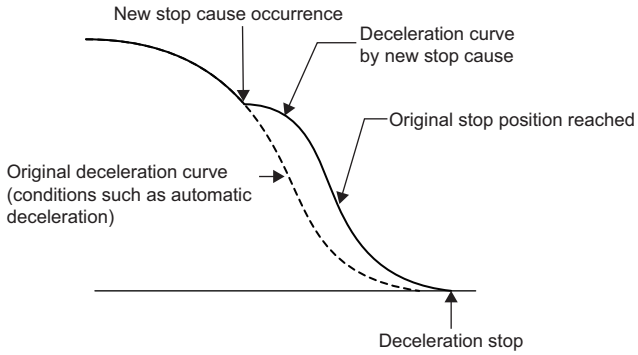
The operation is immediately stopped when reaching the original positioning address during deceleration by a stop cause. In this case, the operation does not exceed the positioning address set in the under-control FB.



Keep current acceleration/deceleration (Only for a single axis)

■2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Deceleration continues even though the operation reached the original deceleration stop position during deceleration by a stop cause. In this case, there is no guarantee that it stops before the positioning address set in the under-control FB.



Stop during single axis operation

This section describes each stop cause.

Stop causes of immediate stop with no condition

When the following stop causes occur, the servo OFF is executed in the drive unit and the axis stops immediately.
For how to stop the drive unit, refer to each drive unit manual.
For MR-J5(W)-G: 📖MR-J5 User's Manual (Function)

- "Forced stop input" is turned off from an external device.*1
- Drive unit power supply OFF
- Drive unit network disconnection detection
- Drive unit error
- Forced stop input to the drive unit
- "Enable (Enable)" of MC_Power (Operation Available) is FALSE

*1 The forced stop input is set in Forced Stop Signal (AxisName.Pr.ForcedStop_Signal). For operation details, refer to the following.
☞ Page 609 Forced Stop

Stop causes by Servo ON request (ServoON) input of MC_Power (Operation Available)

■Process selection at servo OFF command during operation

When Servo ON request (ServoON) of MC_Power (Operation Available) is set to FALSE, the stop operation differs depending on the setting of Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) has the following three functions.

Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff)*1	Description
0: Ignore (Ignore)	During operation, this function ignores the servo OFF command even though it is input and continues on-going operation. If Servo ON request (ServoON) of MC_Power (Operation Available) is set to FALSE when Axis Status (AxisName.Md.AxisStatus) of the operation completion axis turns to "4: Standby (Standstill)", servo OFF will be executed. (The axis will not stop.)
4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)	During operation, the command is immediately stopped by Immediate stop by servo OFF (error code: 1AAAH), and a servo OFF is issued to the drive unit.
5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)	During operation, when receiving the servo OFF command input, Deceleration stop by servo OFF during operation (error code: 1AA9H) occurs and deceleration stop is executed. If Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE when the operation has reached speed 0, servo OFF will be executed.

*1 The axis type which does not have Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) operates "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)".

■Axis state transition

The axis state changes based on the input combination of Enable (Enable) and Servo ON request (ServoON) of MC_Power (Operation Available).

Axis status before input operation (AxisName.Md.AxisStatus)	Input		Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff)	Axis Status (AxisName.Md.AxisStatus) after input operation
	Enable (Enable)	Servo ON request (ServoON)		
4: Standby (Standstill) 0: Axis disabled (Disabled)	TRUE	TRUE	Independent of the setting	4: Standby (Standstill)
		FALSE		0: Axis disabled (Disabled)
	FALSE	TRUE		
		FALSE		
1: Stopping on error (ErrorStop)	TRUE	TRUE		1: Stopping on error (ErrorStop)
		FALSE		
	FALSE	TRUE		
		FALSE		
Others	TRUE	TRUE		No transition
		FALSE	0: Ignore (Ignore)	No transition*1*2
			4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)	1: Stopping on error (ErrorStop)*4
			5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)	1: Stopping on error (ErrorStop)*3
	FALSE	TRUE	Independent of the setting	1: Stopping on error (ErrorStop)*4
		FALSE		

*1 It is "0: Axis disabled (Disabled)" when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" or "2: Decelerating to stop (Stopping)" after deceleration stop.

*2 Axis Status (AxisName.Md.AxisStatus) will not transit if Axis Status (AxisName.Md.AxisStatus) is "1: Stopping on error (ErrorStop)" after deceleration stop.

*3 If Servo ON request (ServoON) becomes FALSE during operation, Deceleration stop by servo OFF during operation (error code: 1AA9H) will occur.

*4 When Enable (Enable)/Servo ON request (ServoON) becomes FALSE, Immediate stop by servo OFF during operation (error code: 1AAAH) occurs. In this case, the under-control FB will be completed or stop immediately, and servo OFF will be executed.

Hardware stroke limit upper/lower limit error occurrence

When the hardware stroke limit upper/lower limit error occurs, the operation stops according to the process selected by Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit).

For details, refer to the following.

☞ Page 1069 Hardware Stroke Limit

Occurrence of a moderate or major error of the controller

When the stop error occurs in the control CPU module, PLC READY (MotionSystem.Cd.SequenceReady) holds on, and the motion side will be STOP status.

PLC Ready (MotionSystem.Cd.SequenceReady) off

When the PLC READY (MotionSystem.Cd.SequenceReady) is turned off, the operation stops according to the process selected by Stop Selection at All Axes Stop Cause Occurrence (MotionSystem.Pr.StopMode_All).

Cycle over error occurrence

When the cycle over error occurs in operation cycle processing, the operation stops according to the process selected by Stop Selection at All Axes Stop Cause Occurrence (MotionSystem.Pr.StopMode_All).

According to the set values of Cycle Setting (MotionSystem.PrConst.OperationCycle[].CycleOverErrorType), a different error code is output in every axis.

Cycle over error assignment selection	System error code to be output	Axis error code to be output
2: Minor Error (MinorError)	Cycle over (error code: 1A00H)	Cycle over (error code: 1A00H)
3: Moderate Error (ModerateError)	Cycle over (error code: 3402H)	Module error during operation (error code: 1B00H)*1

*1 It causes the operation stop as the stop cause at the motion system moderate error or major error occurrence.

Software stroke limit upper/lower limit error occurrence

When the software stroke limit upper/lower limit error occurs, the operation stops according to the process selected by Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit).

For details, refer to the following.

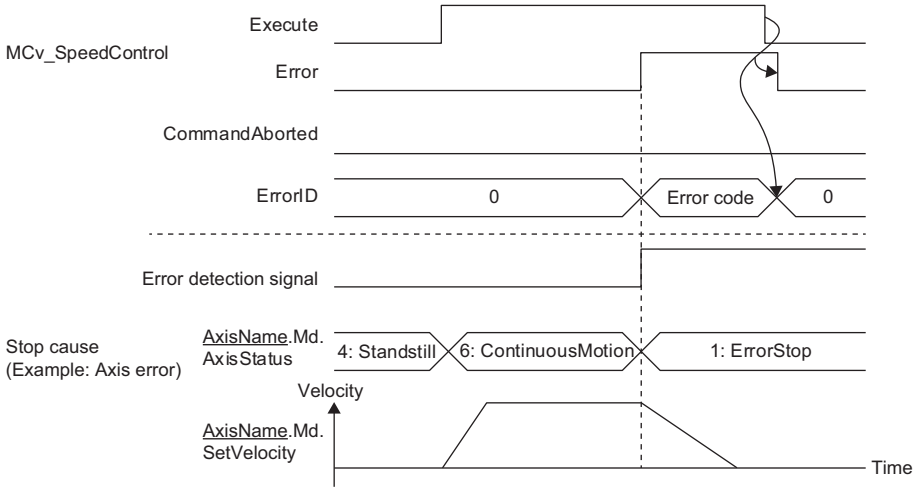
☞ Page 1061 Software Stroke Limit

Axis error detection

When an axis error other than the errors below is detected, the operation stops according to the process selected by Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General). In this case, Axis Status (AxisName.Md.AxisStatus) transits to "1: Stopping on error (ErrorStop)".

- Hardware stroke limit upper/lower limit error
- Controller error
- PLC READY (MotionSystem.Cd.SequenceReady) OFF error
- Cycle over (error code: 1A00H, 3402H)
- Software stroke limit upper/lower limit error
- Drive unit error

- Operation of the FB that received a stop cause by axis error occurrence



■Driver command discard detection

This function stops commands from the motion system in response to detection operations such as limit detection or forced stop of the drive unit.

In the drive unit, when a command received from the motion system is discarded and operation continues, such as when limit detection or a forced stop occurs, Statusword (Bit 12) changes from on to off. At this time, if the controller is operating a real drive axis, it will output Driver command discard detection (error code: 1B18H) and stop the command.

Point

Before or after Driver command discard detection (error code: 1B18H) occurs, an alarm that caused the command to be discarded may occur in the drive unit. If a drive unit alarm occurs, perform troubleshooting according to the drive unit manual.

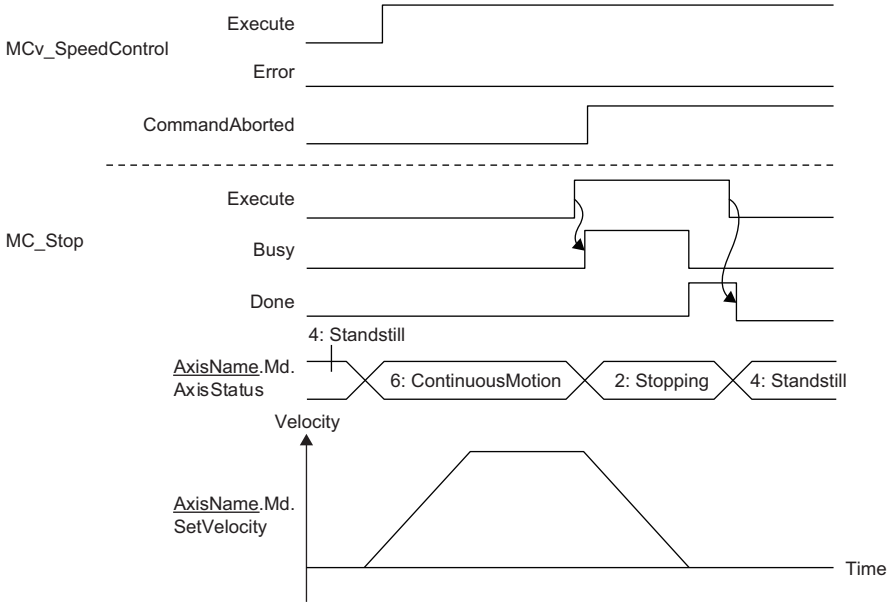
Driver command discard detection can be enabled or disabled for each axis by setting Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored). (Initial state: Enabled)

If Driver Command Discard Detection Setting is disabled, commands from the motion system will continue regardless of Statusword (Bit12). Also, Driver command discard detection (error code: 1B18H) is not detected.

MC_Stop (Forced Stop)

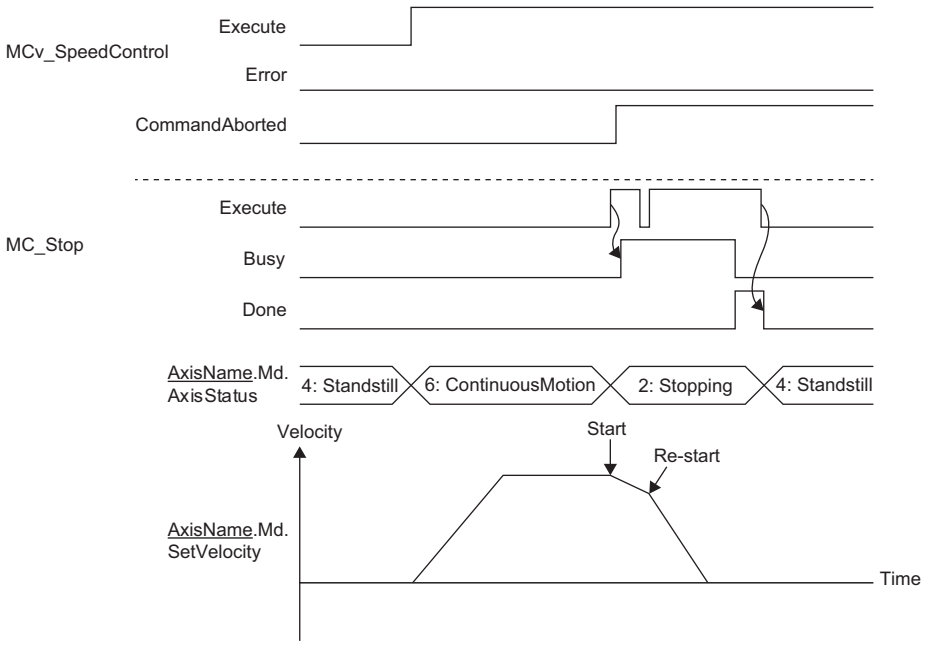
In MC_Stop (Forced Stop), Deceleration (Deceleration) is set and the under-control FB is decelerated to stop.
When MC_Stop (Forced Stop) is executed, Abortion of execution (CommandAborted) of the on-going FB becomes TRUE and Axis Status (AxisName.Md.AxisStatus) transits to the "2: Decelerating to stop (Stopping)" status. While Execution command (Execute) is TRUE or while the speed does not reach 0.0, the "2: Decelerating to stop (Stopping)" status is maintained. When Execution completion (Done) becomes TRUE and Execution command (Execute) becomes FALSE at stop completion, the axis status changes to the "4: Standby (Standstill)" status.

■MCv_Stop (Forced Stop) execution during MC_SpeedControl (Speed Control (Including Position Loop))

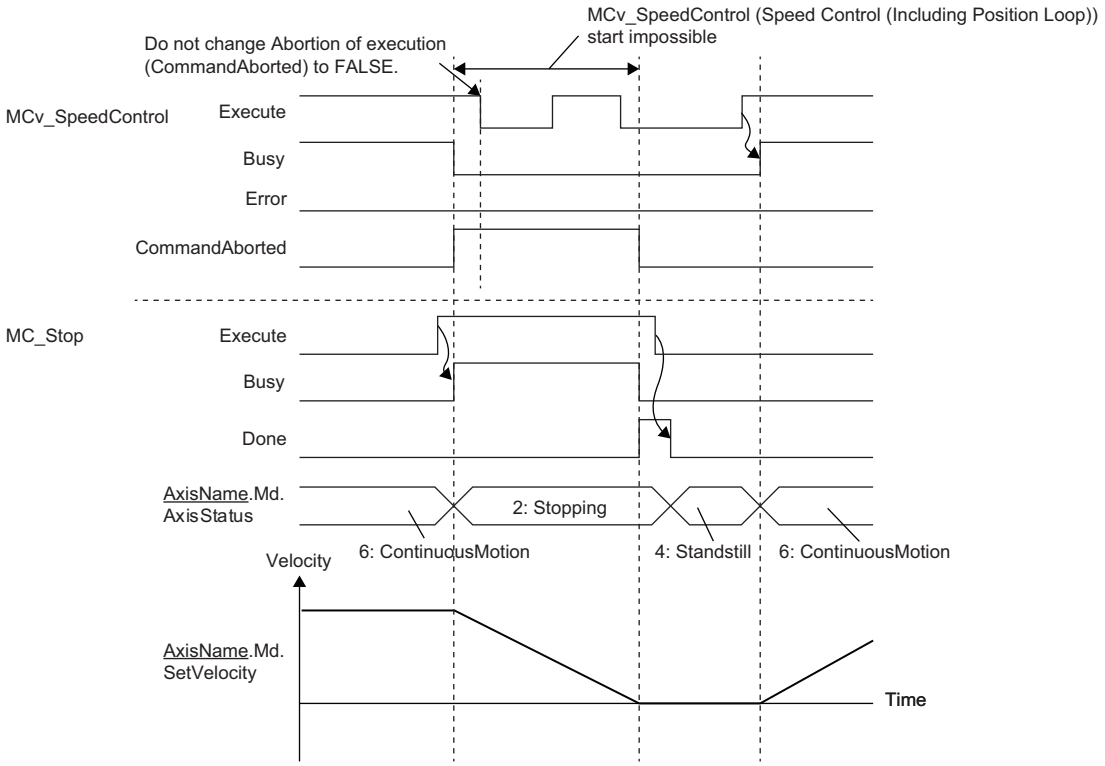


■Operation description

- During deceleration to stop by this FB and while Execution command (Execute) of the input variable is TRUE, any operation command other than MC_Stop (Forced Stop) is not accepted.
- If the deceleration is set to 0.0 or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the control being executed and deceleration is performed.
- If MC_GroupStop (Group Forced Stop) is executed during single axis synchronous control, synchronization to the master axis will be canceled.
- When the setting value of Deceleration (Deceleration) is changed and MC_Stop (Forced Stop) is restarted, deceleration stop is executed from the restart point based on Deceleration (Deceleration) set in MC_Stop (Forced Stop).



- When an FB that operates axes other than MC_Stop (Forced Stop) is executed while Axis Status (AxisName.Md.AxisStatus) is the "2: Decelerating to stop (Stopping)" status, Start not possible (error code: 1AFCH) occurs and Error of MC_Stop (Forced Stop) becomes TRUE, and then Axis Status (AxisName.Md.AxisStatus) changes to "1: Stopping on error (ErrorStop)".
- After the axis stops, the axis status can be transited to "4: Standby (Standstill)" by executing Axis Error Reset (AxisName.Cd.ErrorReset).
- Even if Execution command (Execute) of command aborted FB by MC_Stop (Forced Stop) set to FALSE, once the stop operation is started, TRUE of Abortion of execution (CommandAborted) will be continued until it is completed. After it stops completely, Abortion of execution (CommandAborted) is changed to FALSE if Execution command (Execute) of command aborted FB is FALSE.

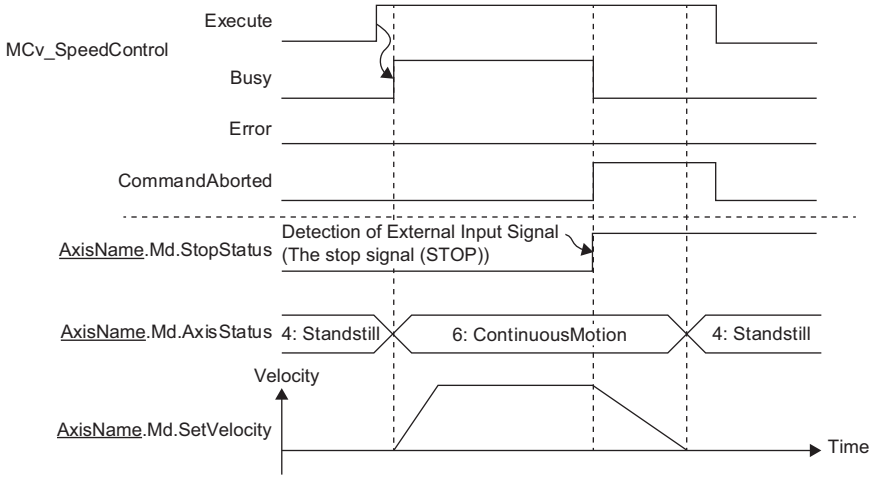


"Stop Signal (STOP)" of external input signal is TRUE

The under-control FB is stopped by setting the stop signal (STOP) set by Stop Signal (AxisName.Pr.StopSignal) to TRUE.

- The operation stops by the operation set in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).
- The under-control FB sets Abortion of execution (CommandAborted) to TRUE by changing the stop signal (STOP) to TRUE.

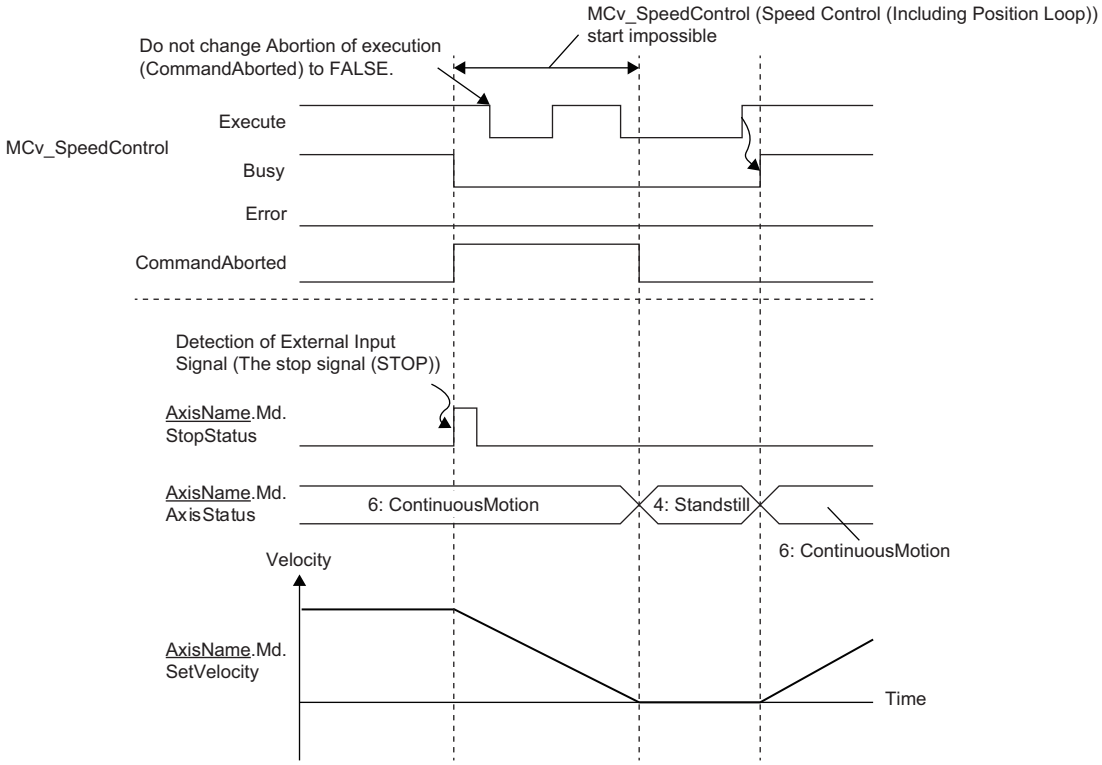
  When the speed reaches 0, Axis Status (AxisName.Md.AxisStatus) transits to "4: Standby (Standstill)".



Point

- When the process is stopped by TRUE of Stop Signal (AxisName.Pr.StopSignal), Axis Status (AxisName.Md.AxisStatus) after stop will not change.
- The deceleration can be changed by executing MC_Stop (Forced Stop) while the stop processing is executed by TRUE of Stop Signal (AxisName.Pr.StopSignal).
- The deceleration can be changed when Stop Signal (AxisName.Pr.StopSignal) is TRUE during MC_Stop (Forced Stop) execution. In this case, Axis Status (AxisName.Md.AxisStatus) after deceleration stop will not change.

- Even if Execution command (Execute) of command aborted FB is set to FALSE by changing the stop signal (STOP) to TRUE, once the stop operation is started, TRUE of Abortion of execution (CommandAborted) will be continued until it is completed. After it stops completely, Abortion of execution (CommandAborted) is changed to FALSE if Execution command (Execute) of command aborted FB is FALSE.



Stop during axes group operation

This section describes each stop cause.

Stop cause occurrence in the configuration axis

The following describes the axes group operation when a stop cause of the configuration axis occurs.

Stop cause occurrence axis				Axes group	
Cause No.	**Stop cause**	**Axis Status (AxisName.Md.AxisStatus) at stop cause occurrence**	**Stop process**	**Axes Group Status (AxesGroupName.Md.GroupStatus)**	**Stop process**
1	"Forced stop input" is off	1: Stopping on error (ErrorStop)	Immediate Stop*1	1: Stopping on error (GroupErrorStop)	■Stop cause occurrence axis Immediate stop ■Other configuration axes Axes group deceleration stop/immediate stop (Follows Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup))
2	Drive unit power supply is off	1: Stopping on error (ErrorStop)			
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable (Enable) of MC_Power (Operation Available) is FALSE				
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)")				

Stop cause occurrence axis				Axes group	
Cause No.	**Stop cause**	**Axis Status (AxisName.Md.AxisStatus) at stop cause occurrence**	**Stop process**	**Axes Group Status (AxesGroupName.Md.GroupStatus)**	**Stop process**
3	Hardware stroke limit upper/lower limit error occurrence in the configuration axis	1: Stopping on error (ErrorStop)	Based on the axes group stop process	1: Stopping on error (GroupErrorStop)	Operation differs depending on the setting value of Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit) of the configuration axis. ■When the configuration axis has an axis set to "1: Immediate Stop (ImmediateStop)": Immediate Stop ■When the configuration axis does not have an axis set to "1: Immediate Stop (ImmediateStop)" Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))
4	Occurrence of a moderate or major error of the controller	1: Stopping on error (ErrorStop)			Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))
	PLC READY (MotionSystem.Cd.SequenceReady) is off.				
	Cycle over error occurrence				
5	Software stroke limit upper/lower limit error occurrence in the configuration axis	1: Stopping on error (ErrorStop)			Operation differs depending on the setting value of Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit) of the configuration axis. ■When the configuration axis has an axis set to "1: Immediate Stop (ImmediateStop)": Immediate Stop ■When the configuration axis does not have an axis set to "1: Immediate Stop (ImmediateStop)" Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))
6	Axis error detection	1: Stopping on error (ErrorStop)			Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General))
7	Execution command (Execute) of MC_Stop (Forced Stop) is TRUE	1: Stopping on error (ErrorStop)*2			
8	"Stop Signal (STOP)" of external input signal is TRUE	No change		No change	

*1 The servo turns off on the drive unit side and an immediate stop is performed, and also the motion side command is stopped.

*2 If a single axis FB is executed during axes group operation, an axis error will occur and the single axis FB will be disabled. For details, refer to the following.

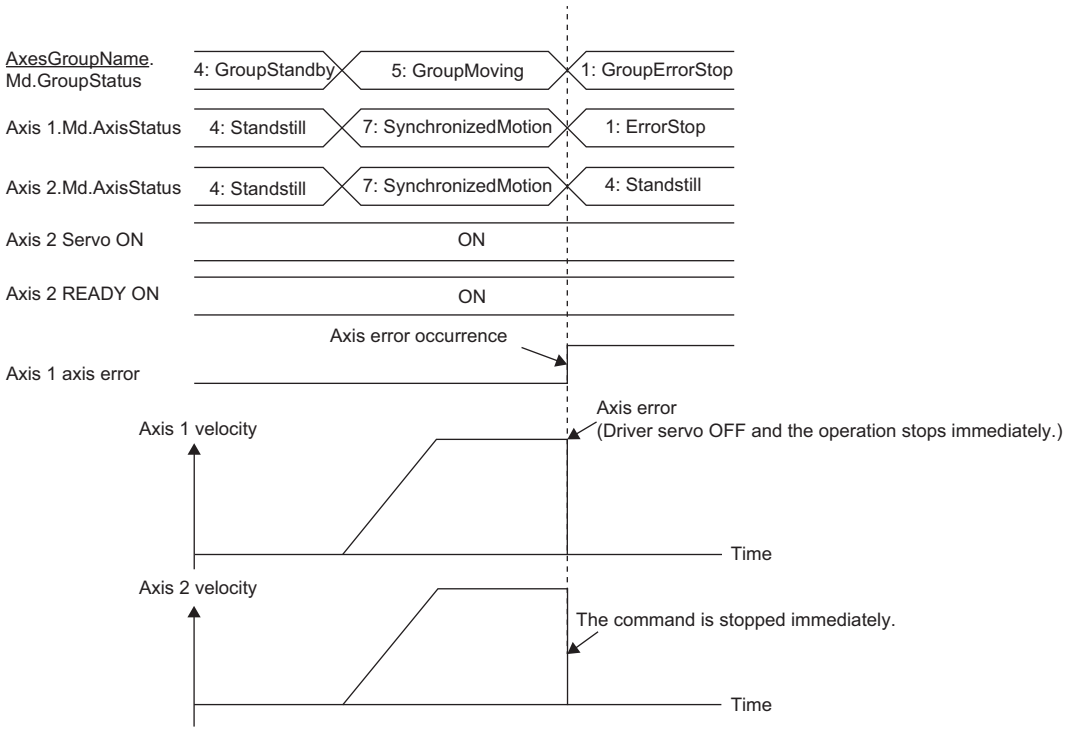
☞ Page 603 Axis error

When a stop cause has occurred in a configuration axis of the axes group, operation differs depending on the following four patterns.

■For an axis error (drive unit servo OFF and immediate stop)

Stop Cause of Axes group configuration axis (error code: 1AABH) occurs in the axes group.
Also, if the drive unit of the configuration axis on which the stop cause occurred turns the servo off and stops immediately, the other configuration axis will follow the stop process selected in Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup).
When a stop cause has occurred in a configuration axis during the axes group operation, the following methods show how to stop the other configuration axes.

- Immediate Stop (ImmediateStop)
  In the axes group configuration axes other than the axis which an axis error has occurred in, a command to the drive unit is stopped.



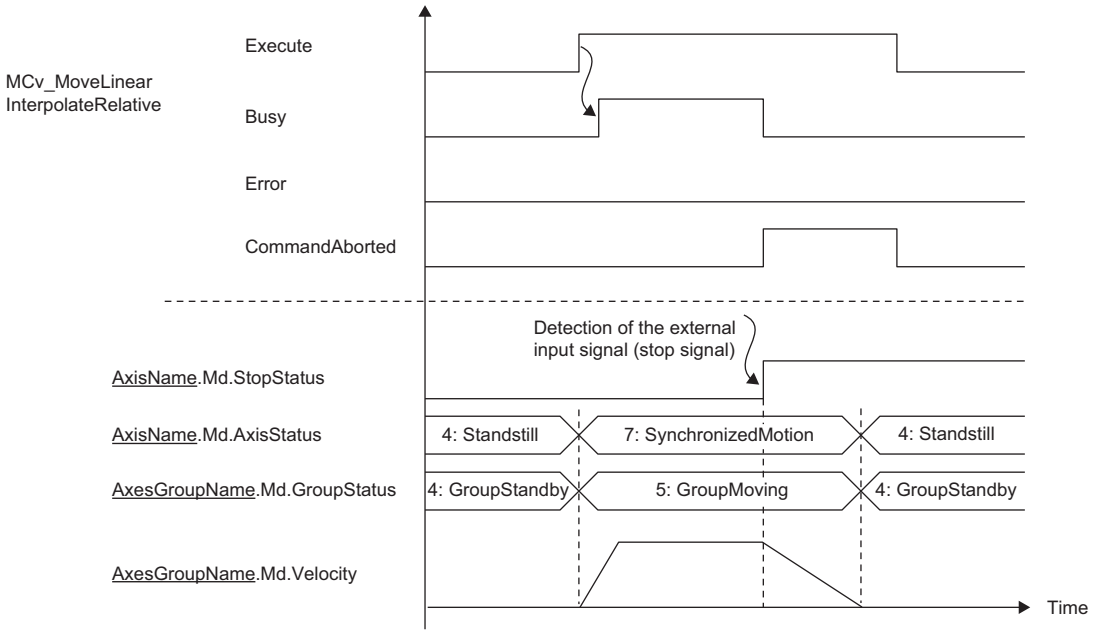
■Axis error

If an axis error has occurred in the configuration axis, Stop cause of axes group configuration axis (error code: 1AABH) will occur in the axes group. In this case, the axes group will pass through the path and stop according to the setting of Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).
If a single axis control FB is executed to the configuration axis being operated in the axes group, an error will occur in the single axis control FB and Start not possible (error code: 1AFCH) or Motion FB issue error to the axis during axes group operating (error code: 1AE2H) will occur on the specified axis, resulting in the "1: Stopping on error (ErrorStop)" status.
By an error occurrence in the configuration axis, Stop cause of axes group configuration axis (error code: 1AABH) occurs in the axes group, and the axes group will stop according to the process selected in Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).

■"Stop Signal (STOP)" of external input signal is TRUE

The under-control FB is stopped by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE for any of the configuration axes.

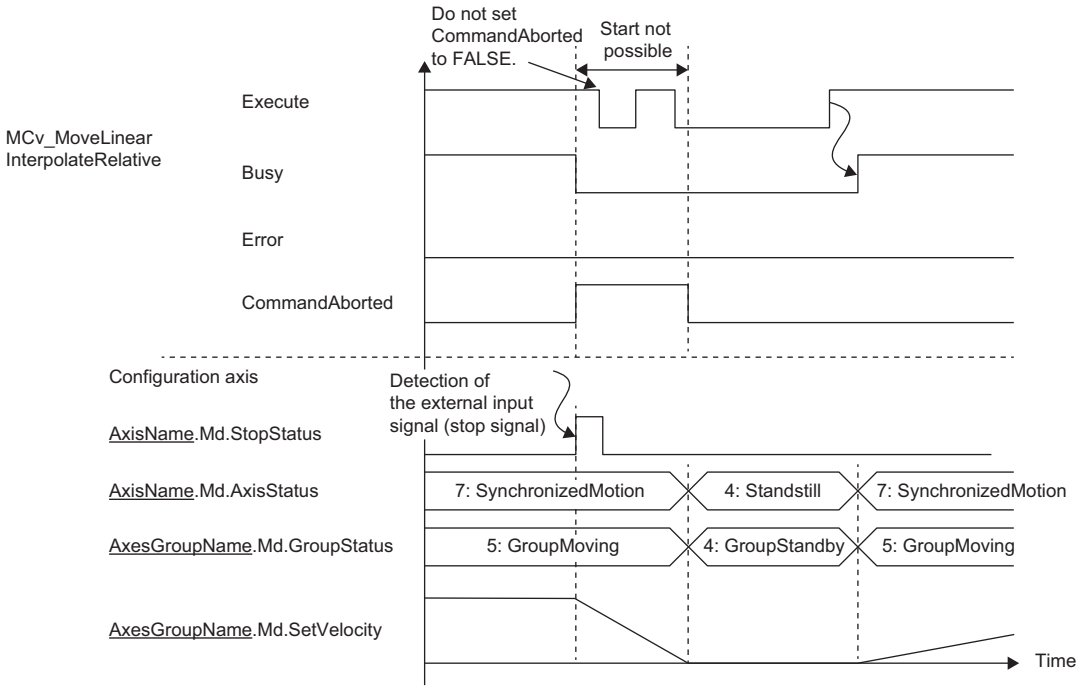
- The operation stops by the operation set in Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).
- The axes group will pass through the path and decelerate to a stop.
- The under-control FB sets Abortion of execution (CommandAborted) to TRUE by changing Stop Signal (AxisName.Pr.StopSignal) to TRUE.
- When the speed reaches 0, Axes Group Status (AxesGroupName.Md.GroupStatus) will transit to "4: Standby (GroupStandby)". The value set in Deceleration at Stop (AxesGroupName.Pr.StopMode_Deceleration) will be used for the deceleration at this time.



Point

- When stopping by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE, Axes Group Status (AxesGroupName.Md.GroupStatus) after stop will not change.
- When the stop processing is being executed by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE, the deceleration can be changed by executing MC_GroupStop (Group Forced Stop).
- The deceleration can be changed by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE during MC_GroupStop (Group Forced Stop) execution. In this case, Axes Group Status (AxesGroupName.Md.GroupStatus) after the deceleration stop will not change.

- Even if Execution command (Execute) of command aborted FB is set to FALSE by changing Stop Signal (AxisName.Pr.StopSignal) to TRUE, once the stop operation is started, TRUE of Abortion of execution (CommandAborted) will be continued until it is completed. After it stops completely, Abortion of execution (CommandAborted) is changed to FALSE if Execution command (Execute) of command aborted FB is FALSE.



■Hardware stroke limit error/Software stroke limit error

When any of the following conditions is satisfied, the axes group will immediately stop regardless of the axes group setting. In this case, Stop cause of axes group configuration axis (error code: 1AABH) occurs in the axes group and its status changes to "1: Stopping on error (GroupErrorStop)".

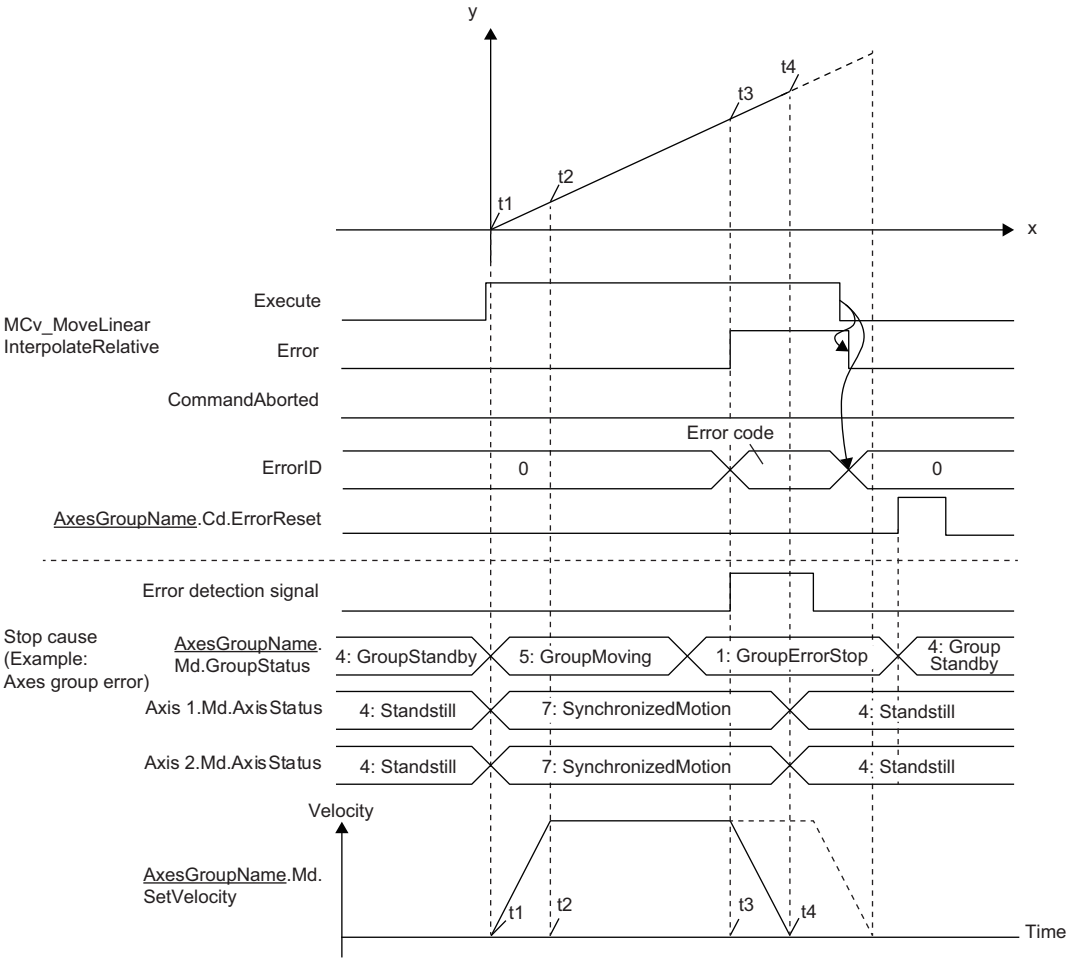
- When the stop cause "Hardware stroke limit error" is occurring in any axis of configuration axes, "1: Immediate Stop (ImmediateStop)" is set to Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit) in one or more axes.
- When the stop cause "Software stroke limit error" is occurring in any axis of configuration axes, "1: Immediate Stop (ImmediateStop)" is set to Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit) in one or more axes.

Hardware stroke limit error	Software stroke limit error
• FLS signal detection (at start) (error code: 1A9EH) • RLS signal detection (at start) (error code: 1A9FH) • FLS signal detection (controlling) (error code: 1AA0H) • RLS signal detection (controlling) (error code: 1AA1H)	• Software stroke limit over (target position) (error code: 1A80H) • Software stroke limit over (start position) (error code: 1A81H) • Software stroke limit over (forward direction) (error code: 1A83H) • Software stroke limit over (reverse direction) (error code: 1A84H)

Axes group error detection

When an axes group error other than the "Stop cause occurrence in the configuration axis" is detected, the operation will be stopped according to the process selected by Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General). The value set in Deceleration at Stop (AxesGroupName.Pr.StopMode_Deceleration) will be used for the deceleration at this time.

• Operation of the FB that received a stop cause by axes group error occurrence

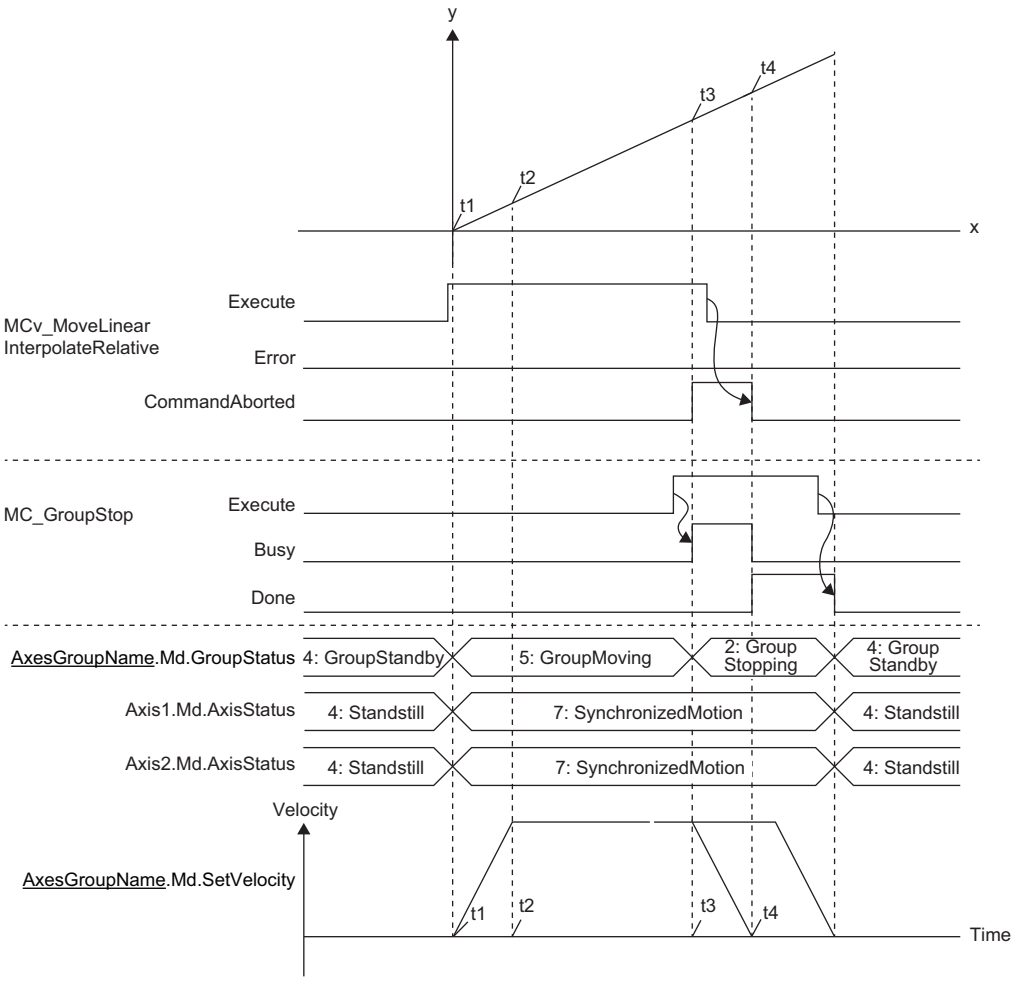


MC_GroupStop (Group Forced Stop)

In MC_GroupStop (Group Forced Stop), Deceleration (Deceleration) is set and the under-control FB is decelerated to stop. The axes group passes through the previous operation path and decelerates to a stop.

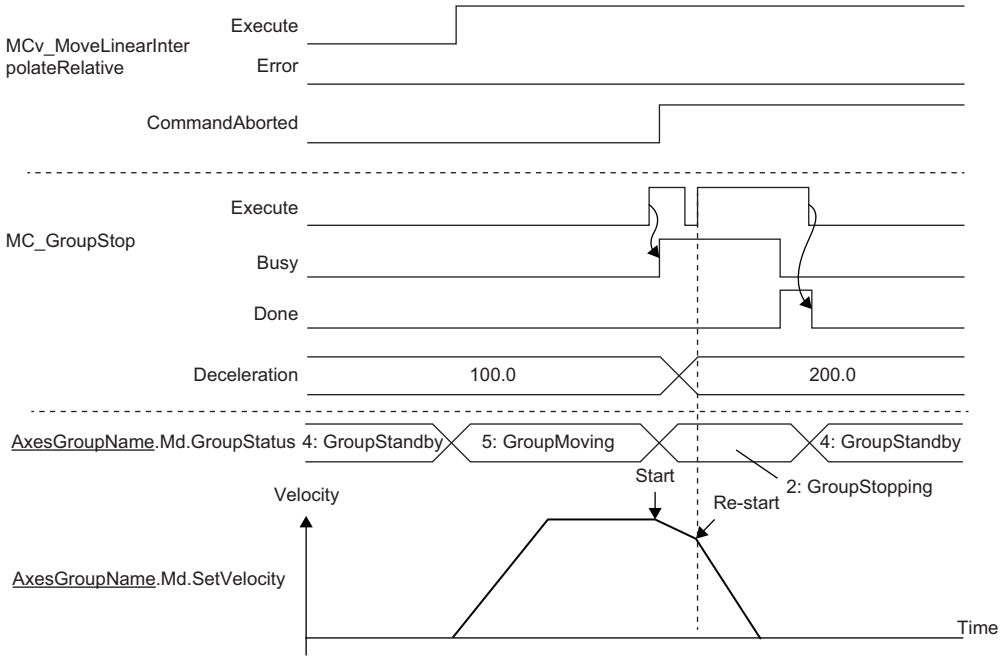
When MC_GroupStop (Group Forced Stop) is executed, Abortion of execution (CommandAborted) of the on-going FB becomes TRUE and Axes Group Status (AxesGroupName.Md.GroupStatus) transits to the "2: Decelerating to stop (GroupStopping)" status. While Execution command (Execute) is TRUE or while the speed does not reach 0, the "2: Decelerating to stop (GroupStopping)" status is maintained. When Execution completion (Done) becomes TRUE and Execution command (Execute) becomes FALSE at stop completion, the axes group status changes to the "4: Standby (GroupStandby)" status.

■MC_GroupStop (Group Forced Stop) execution during MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)



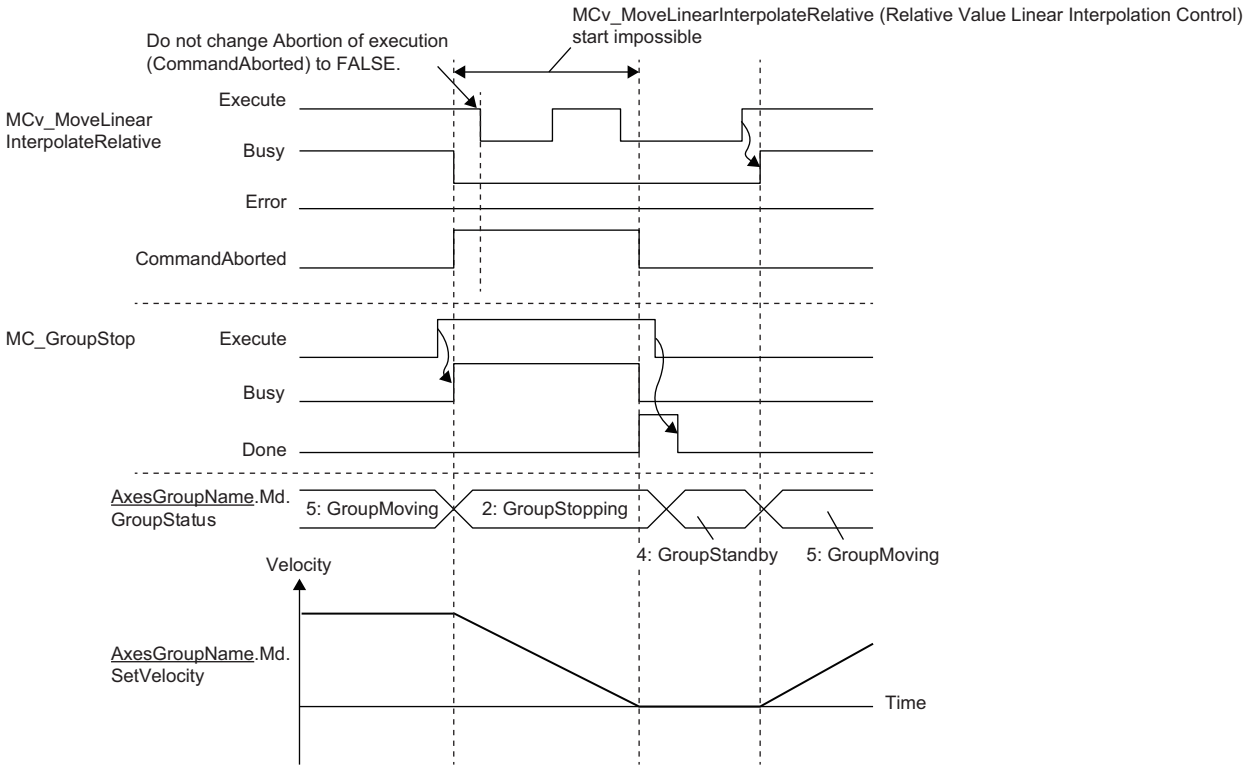
■Operation description

- During deceleration stop by this FB and while Execution command (Execute) of the input variable is TRUE, any operation command other than MC_GroupStop (Group Forced Stop) is not accepted.
- If Deceleration (Deceleration) is set with 0 or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the on-going control and deceleration is performed.
- When the setting value of Deceleration (Deceleration) is changed and MC_GroupStop (Group Forced Stop) is restarted, deceleration stop is executed from the restart point based on Deceleration (Deceleration) set in MC_GroupStop (Group Forced Stop) and Jerk (Jerk) used in the under-control FB.



- When an FB that operates axes other than MC_GroupStop (Group Forced Stop) is executed while Axes Group Status (AxesGroupName.Md.GroupStatus) is the "2: Decelerating to stop (GroupStopping)" status, Start Not Possible (error code: 1AFCH) occurs and Error of MC_GroupStop (Group Forced Stop) becomes TRUE, and then Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "1: Stopping on error (GroupErrorStop)".

- Even if Execution command (Execute) of command aborted FB is set to FALSE by MC_GroupStop (Group Forced Stop), once the stop operation is started, Abortion of execution (CommandAborted) will remain TRUE until it is completed. After it stops completely, Abortion of execution (CommandAborted) is changed to FALSE if Execution command (Execute) of command aborted FB is FALSE.



Precautions

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- ExternalSignal*1
- MotionControl_General*2
- ServoDriver_CANopen*3

*1 For using the stop signal, the forced stop signal, the all axes forced stop signal, and the upper/lower limit signal

*2 For using the following FBs

· MC_Stop (Forced Stop)

· MC_GroupStop (Group Forced Stop)

*3 For using the real drive axis or the real encoder axis

System memory usage

■Backup RAM usage

Backup RAM is not used.

26.5 Forced Stop

This function stops axes by the forced stop signal.

The axis types which the forced stop is valid are as follows

- The forced stop signal is valid for the following axis types which support Forced Stop Signal (AxisName.Pr.ForcedStop_Signal).
  - Real Drive Axis
  - Virtual Drive Axis
- All axes forced stop signal is effective for the following axis types, including the types which do not support Forced Stop Signal (AxisName.Pr.ForcedStop_Signal).
  - Real Drive Axis
  - Virtual Drive Axis
  - Virtual Linked Axis
- For details on the operation of the drive unit after the forced stop signal is sent, refer to each drive unit manual.

⚠WARNING

- When the forced stop is required to be wired, ensure to wire it in the negative logic, and normally closed contact is recommended.
- When using the forced stop function, check the wiring and the settings, and check whether the function works or not at startup.

Point

The forced stop function immediately stops the instruction. It issues "Quick Stop" to the device station whose axis assignment has been executed at the same time. For operation when "Quick Stop" is issued, refer to the manual of the device station.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○*1
RUN	○
Moderate error	○*2
Major error	○*2

*1 Forced Stop Signal (AxisName.Pr.ForcedStop_Signal) cannot be imported, so the operation cannot be performed if the status has never been set to RUN.

*2 "QuickStop" may not be issued depending on the error.
When a moderate or major error occurs, the motion system notifies the device station that an error has been detected in the CPU operating status.
For operation of the device station when an error is detected, refer to the manual for each device station.

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
ForcedStop_Signal	Forced Stop Signal	Sets a signal using the each axis forced stop. Forced Stop Signal (ForcedStop_Signal) is the structure of SIGNAL_SELECT type. The fetch timing of the setting is at Ready ON, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure It may be regarded as signal detection, depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following. ☞ Page 1154 EXTERNAL SIGNAL SELECTION The specific setting and the operation of this signal are shown below. ■I/O Number (StartIO) Ignores the input value. ■Target (Target) When the specification is not set, signal disabled is determined and the signal not detecting status is always set. Only [VAR], [DEV], and [CONST] can be specified for the data type. * If an unavailable value is set, Out of parameter range (axis) (error code: 1A60H) occurs. The error cause can be checked with the following detail codes. • An incorrect string was set (detail code: 0001H) • An unavailable data type was set (detail code: 0002H) • An unavailable type was specified (detail code: 0003H) • A type other than the numerical value type was specified at label specification (detail code: 0004H) • A signal that does not exist was set (detail code: 0005H) • A global label where access from an external device is disabled was set (detail code: 0005H) • The number of characters exceeded the upper limit (detail code: 0007H). • "Asynchronous" was set in the network synchronous communication setting of the device station being referred to (detail code: 8002H) • An unsupported device was set (detail code: 8002H) • A device number out of range was set (detail code: 8002H) ■Signal Detection Method (Detection) The specification is allowed at the following level detection only. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel) * When edge detection specification is set, Out of parameter range (axis) (error code: 1A60H) (detail code: 8003H) occurs. ■Compensation Time (CompensationTime) Ignores the input value. ■Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. * When a value outside the range is set, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs and the axis operates with 0.0 of the filter time.

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	During operation in the axes group, when the drive unit servo is turned off on the configuration axis and an immediate stop axis error occurs, it sets the operation of the axes on which the axis error has not occurred. 1: Immediate Stop (ImmediateStop) (Initial value)

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
ForcedStop_Released	Forced Stop Cancelling	Displays the forced stop cancel status. • FALSE: Forced stop input TRUE (Forced stop) • TRUE: Forced stop input FALSE (Forced stop release)
ForcedStop_Signal	Forced Stop Signal	Displays the input status of forced stop signal. Forced Stop Signal (ForcedStop_Signal) is the structure of SIGNAL_SELECT type. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure The specific output of this signal is shown below. ■I/O Number (StartIO) "0" is always displayed. ■Target (Target) The fetch result of the parameter is displayed. ■Signal Detection Method (Detection) The fetch result of the parameter is displayed. ■Compensation Time (CompensationTime) "0.0" is always displayed. ■Filter Time (FilterTime) The fetch result of the parameter is displayed.

System parameter (MotionSystem.Pr.)

Variable/structure name	Name	Details
ForcedStop_Signal	All Axes Forced Stop Signal	Sets a signal using the all axes forced stop. All Axes Forced Stop Signal (ForcedStop_Signal) is the structure of SIGNAL_SELECT type. The fetch timing of the setting is at Ready ON, the detection timing of the signal is the first operation cycle, and the timing to start the stop processing is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure For precautions when multiple operation cycles coexist, refer to the following. ☞ Page 535 Operation Cycle Coexistence It may be regarded as signal detection, depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following. ☞ Page 1154 EXTERNAL SIGNAL SELECTION The specific setting and the operation of this signal are shown below. ■I/O Number (StartIO) Ignores the input value. ■Target (Target) When the specification is not set, signal disabled is determined and the signal not detecting status is always set. Only [VAR], [DEV], and [CONST] can be specified for the data type. * When an unavailable data type is set, Out of parameter range (system) (error code: 1A62H) occurs. Out of parameter range (system) (error code: 1A62H) occurs if "Asynchronous" is set for the network synchronous communication setting of the device station being referred to when [VAR] or [DEV] is specified. ■Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, Out of parameter range (system) (error code: 1A62H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) ■Compensation Time (CompensationTime) Ignores the input value. ■Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. * When a value outside the range is set, Out of Filter Time Setting Range of System Signal Warning (event code: 00F0FH) occurs and the axis operates with 0.0 of the filter time.

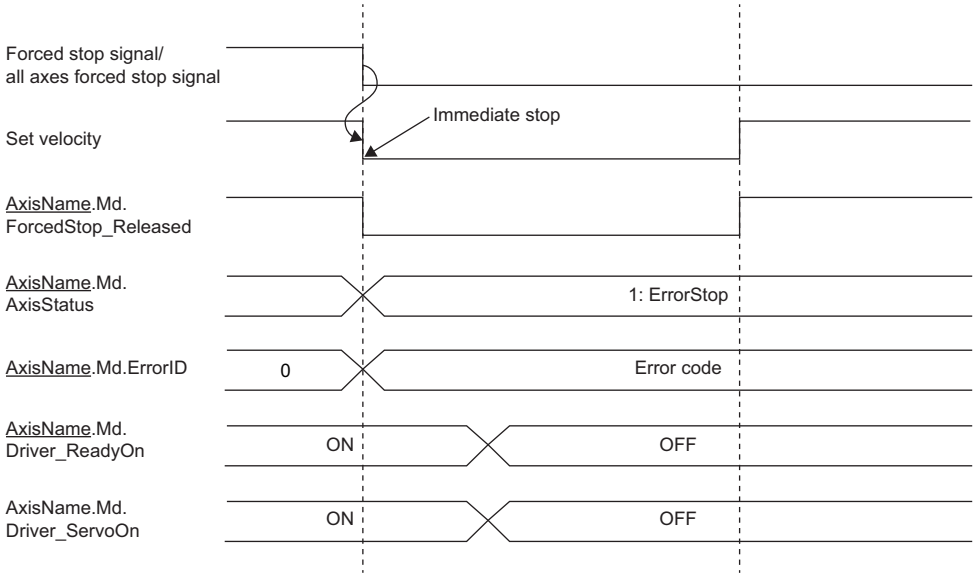
System Monitor Data (MotionSystem.Md.)

Variable/structure name	Name	Details
ForcedStop_Released	Forced Stop Cancelling	Displays the forced stop cancel status. • FALSE: All axes forced stop input TRUE (Forced stop) • TRUE: All axes forced stop input FALSE (Forced stop release)
ForcedStop_Signal	All Axes Forced Stop Signal	Displays the input status of all axes forced stop signal. All Axes Forced Stop Signal (ForcedStop_Signal) is the structure of SIGNAL_SELECT type. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure The specific output of this signal is shown below. ■I/O Number (StartIO) "0" is always displayed. ■Target (Target) The fetch result of the parameter is displayed. ■Signal Detection Method (Detection) The fetch result of the parameter is displayed. ■Compensation Time (CompensationTime) "0.0" is always displayed. ■Filter Time (FilterTime) The fetch result of the parameter is displayed.

Operation at the forced stop occurrence

This section describes the operation when a forced stop has occurred.
An example of a device station on which servo OFF is executed when "Quick Stop" is issued is connected as shown below.

During axis operation



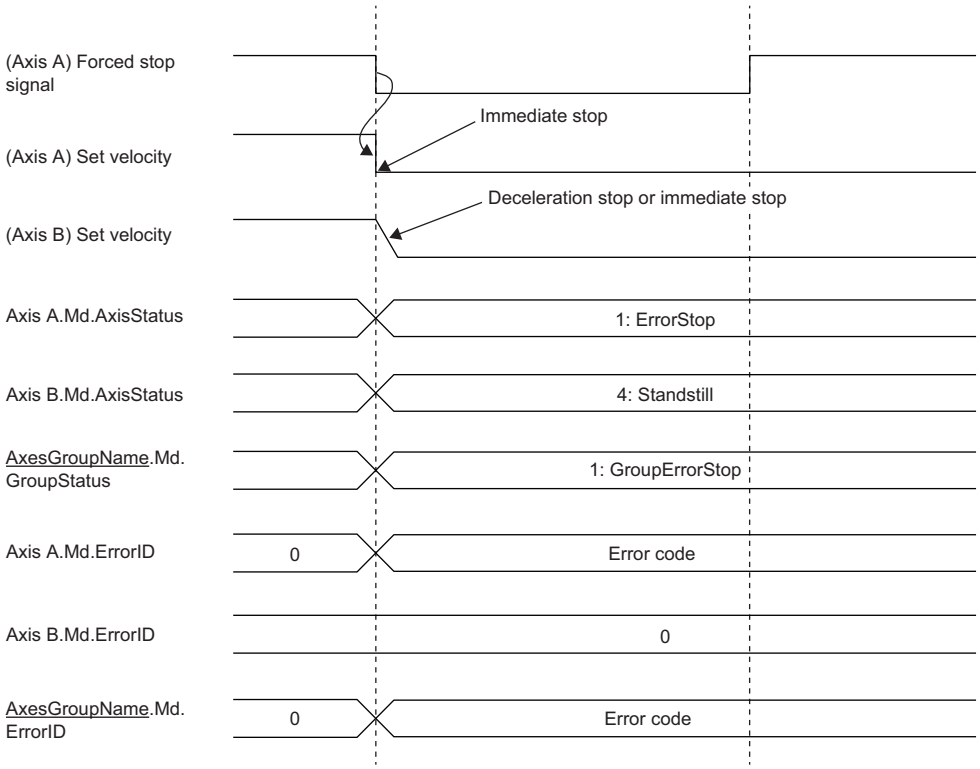
- In the axis on which a forced stop occurred, servo OFF is executed. The servo ON will not be executed until the forced stop is released. The error is not output when the axis is not operated.
- Regardless of whether during positioning or stop, "Forced stop detection" is registered in the event history. Forced stop status (error code: 1AC4H) is also registered in positioning.
- When the axis is in the forced stop status at start, the command will not be issued, and it will be in the same "1: Stopping on error (ErrorStop)" status as the forced stop that is in operation.

During stop

When the axis the forced stop occurred in is during stop, Forced stop status (error code: 1AC4H) will not occur. Axis Status (AxisName.Md.AxisStatus) transits according to the drive unit operation that received the forced stop signal of the controller.

During axes group operation

The following shows the operation when a forced stop has occurred to the axis A while an axes group configured with the axis A and B is being operated.



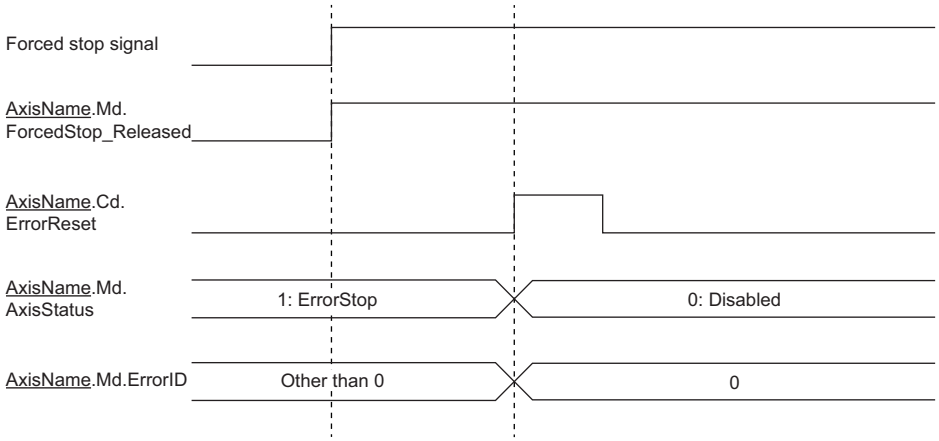
The stop method of the axis B can be set in Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup). For the operation of each setting, refer to the following.

☞ Page 600 Stop cause occurrence in the configuration axis

Operation at the forced stop release

The operation the forced stop is released from the forced stop occurrence status is shown below.

Single axis



1. Release the forced stop.

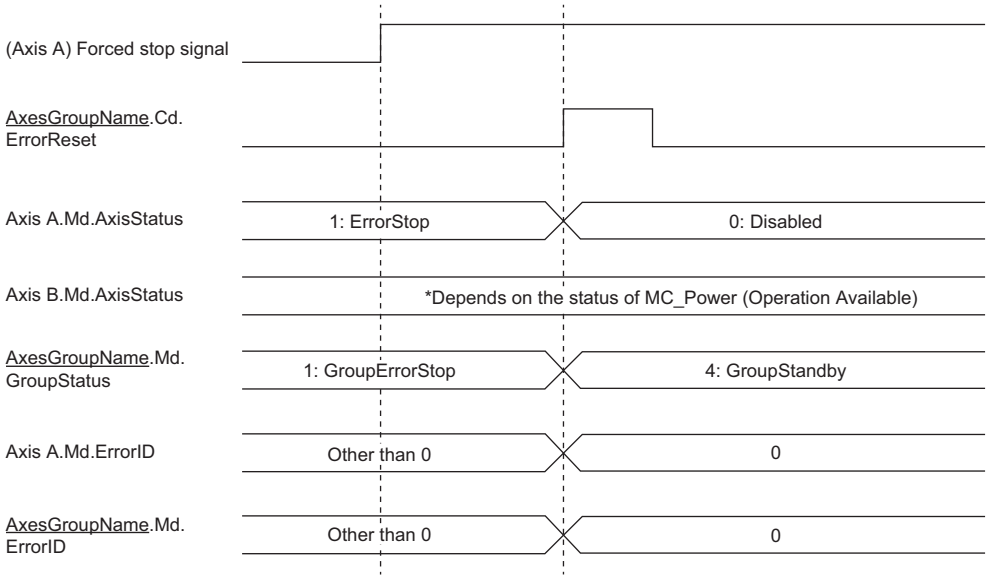
- The forced stop input changes to "1".
- Axis Status (AxisName.Md.AxisStatus) is still "1: Stopping on error (ErrorStop)".

2. Execute the axis error reset.

- Axis Status (AxisName.Md.AxisStatus) changes to "0: Axis disabled (Disabled)".

Axes group

The following shows the release operation when a forced stop has occurred to the axis A while an axes group configured with the axis A and B is being operated.



1. Release the forced stop.

- The forced stop input changes to "1".
- Axes Group Status (AxesGroupName.Md.GroupStatus) is still "1: Stopping on error (GroupErrorStop)".

2. Execute the axes group error reset.

- Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "4: Standby (GroupStandby)", and the error Nos. are cleared in both axis A and the axes group.

Point

When the forced stop is issued, the servo ON command of MC_Power (Operation Available) continues.

Check method

Whether the forced stop input is in the TRUE/FALSE status can be checked with Forced Stop Cancelling (AxisName.Md.ForcedStop_Released).

Precautions

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- ExternalSignal

27 HOMING

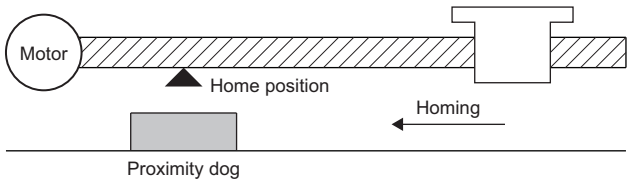
In homing, a position is established as the starting (or "home position") when carrying out positioning control, and positioning is carried out toward that start point.
This control function is used to return a machine system at any position other than the home position to the home position when the motion system issues a homing request with the power turned on or others, or after a positioning stop.
The address information stored in the motion system cannot be guaranteed while the Homing Request (AxisName.Md.Homing_Request) is TRUE.
Homing Request (AxisName.Md.Homing_Request) is FALSE and Homing Completed (AxisName.Md.Homing_Complete) is TRUE if the homing is executed and is completed normally.

⚠WARNING

- When using an absolute position system, execute a homing always at the following cases: on starting up and when the controller or absolute position motor has been replaced. Check the homing request signal using the sequence program or others before performing the positioning control. Failure to observe this could lead to an accident such as a collision.

27.1 Overview

In homing, a machine home position is established.
None of the address information stored in the motion system or drive unit is used at this time.
The position mechanically established after the homing is regarded as the "home position" to be the start point for positioning control.



The following homing methods are available.

Item	Description	Reference
Driver homing method	Switches the drive unit to Homing mode, and executes homing based on the positioning pattern set on the drive unit side.	Page 620 Driver homing method
Data set homing method	Executes the homing to a virtual axis and a real axis that does not have the home position information in the device station side. It is completed in the motion system, and external signals or others are not used.	Page 623 Data set homing method

Homing method at homing starts is "driver homing method" when all of the following conditions are satisfied, or "data set homing method" when the following conditions are not satisfied.

- Axis type is real drive axis
- Drive unit supports Homing mode.
- "HomeOffset (607CH)" is set in object data.

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Homing_Status	Homing Operation Status	Stores the homing status of the drive unit.*1
Homing_Request	Homing Request	Becomes TRUE when homing is required and becomes FALSE when it is completed. For details, refer to the following. ☞ Page 619 Homing request
Homing_Complete	Homing Completed	Becomes TRUE when homing is normally completed, and it becomes FALSE when operation starts and homing is required.

*1 The following value of homing operation status is stored.

Stored value	Status	Statusword		
		Bit 13	Bit 12	Bit 10
FFFFH	Homing procedure is not in progress	—		
0000H	Homing procedure is in progress	0	0	0
0001H	Homing procedure is interrupted or not started	0	0	1
0002H	Homing is attained, but target is not reached	0	1	0
0003H	Homing procedure is completed successfully	0	1	1
0004H	Homing error occurred, velocity is not 0	1	0	0
0005H	Homing error occurred, velocity is 0	1	0	1

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_Home	OPR	Executes homing of the specified axis.

Homing request

Homing request indicates that homing must be executed when Homing Request (AxisName.Md.Homing_Request) becomes TRUE.

Point

The reason why Homing Request (AxisName.Md.Homing_Request) became TRUE is recorded in event history.

For causes of which Homing Request (AxisName.Md.Homing_Request) becomes TRUE, refer to the following.

☞ Page 514 Homing request

Homing Request (AxisName.Md.Homing_Request) becomes FALSE at homing completion.

When homing is not required

Execute a homing request clear in systems that do not require homing. Homing Request (AxisName.Md.Homing_Request) becomes FALSE by performing Homing Request Clear. For details, refer to the following.

☞ Page 625 Operation Setting for Incompletion of Homing

Precautions

Directly rewriting Homing Request (AxisName.Md.Homing_Request) to FALSE with a program or others will not clear the homing request in the motion system. Be sure to use Homing Request Clear to set Homing Request (AxisName.Md.Homing_Request) to FALSE.

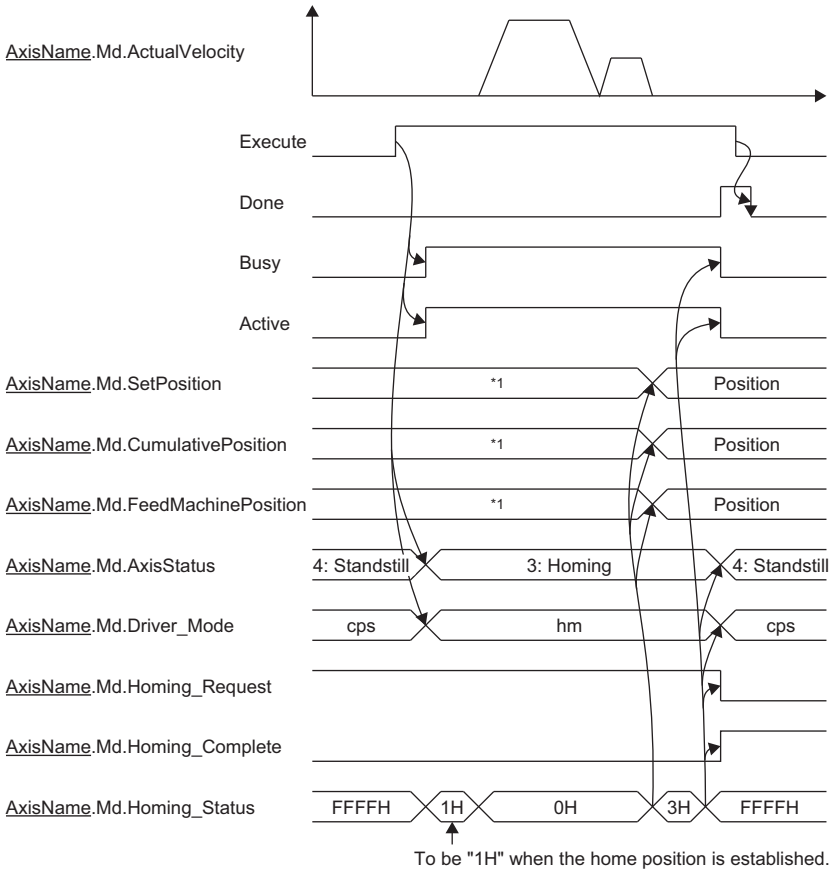
Driver homing method

The drive unit is switched to Homing mode, and homing is executed based on the positioning pattern set on the drive unit side. Change the homing data of the drive unit with MC_WriteParameter (Parameter Write) to change the homing method or each parameter.

Refer to the manual for the drive unit because the homing operation and settable parameters depend on the specifications of the drive unit.

Timing chart

■Normal operation



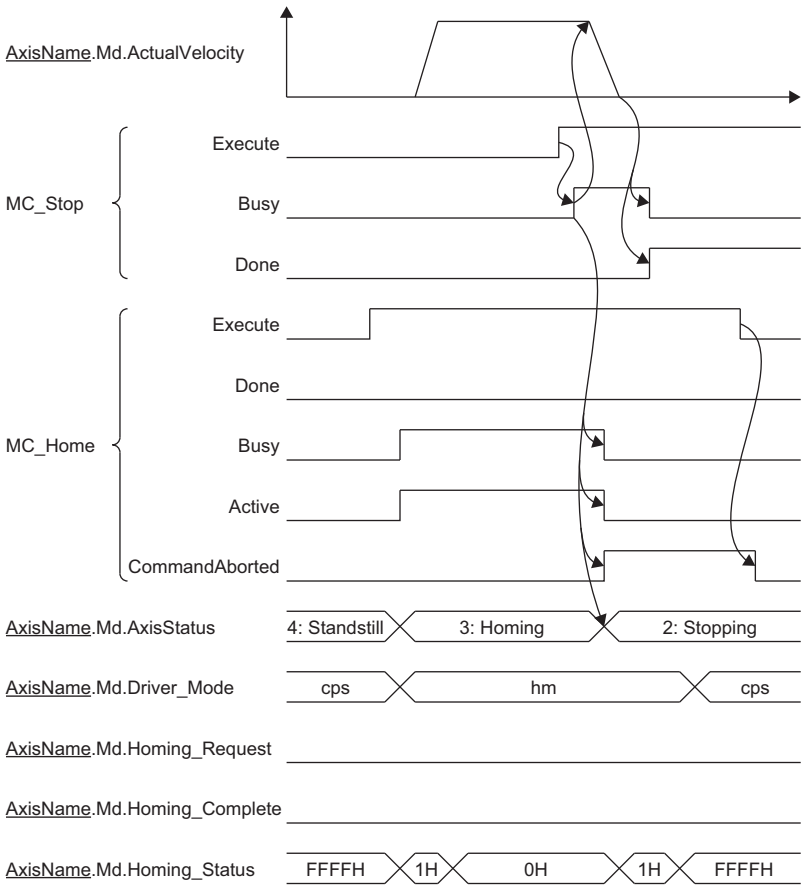
*1 When Follow-up enabled/disabled selection (Options (Options): bit 16) is set to "0: Follow-up disabled", it will not update during homing. When set to "1: Follow-up enabled", it will update with the current position changes during homing.

■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type Motion control FBs" in the following.

MELSEC MX Controller MX-R Model Programming Manual

■When MC_Stop (Forced Stop) is executed



- When MC_Stop (Forced Stop) is set to TRUE at homing, the "HALT" signal is sent to the drive unit. When using a drive unit that does not support HALT, use the forced stop because it does not stop with this signal.
- Stop processing at homing depends on the specifications of the drive unit. Therefore, Deceleration (Deceleration) and Jerk (Jerk) of MC_Stop (Forced Stop) are ignored.

Relevant object data

If no object data is set or no object exists in the device station, there will be errors and restrictions in the following function. For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

○: Recommended

Instruction/function	Required object data (SDO)	Object required or not	Operation with no object
Driver homing method	Home offset	○	Operates with data set method. For details, refer to the following. ☞ Page 623 Data set homing method

Precautions

- The homing cannot be started during servo-off. Thus, the drive unit homing method, Homing method 35 and 37 (Data set method), cannot be executed during servo OFF.
- When the external signals (the hardware stroke limit specified with axis variables and the proximity dog specified with Home position switch (AbsSwitch)) are assigned to the motion system, the external signals are transmitted to the drive unit. However, when the position accuracy is required in the proximity dog signal based (not Z-phase based) method, using the drive unit built-in DI is recommended.
- Immediately before homing is completed, monitor data such as feedback position (AxisName.Md.ActualPosition) may change rapidly regardless of the actual motor operation. Even if this phenomenon occurs, the monitor data after homing is not affected.
- When "0: Follow-up disabled" is selected in Follow-up enabled/disabled selection (Options (Options): bit 16), the follow up of set position is not performed during driver homing method. In this case, do not perform synchronous control with the axis during homing set as the master axis. Doing this may cause a Velocity range over during controlling (error code: 1B1AH) to occur in the slave axis.
- When "1: Follow-up enabled" is selected in Follow-up enabled/disabled selection (Options (Options): bit 16) and synchronous control is performed with the axis during homing set as the master axis, the slave axis operation is as follows depending on Master axis data source selection (MasterValueSource).

Master axis data source selection (MasterValueSource)	Slave axis operation during synchronous control
1: Set Value (mcSetValue) 101: Latest Set Value (mcLatestSetValue)	Continues synchronous control after homing completion.
2: Actual Value (mcActualValue) 102: Latest Actual Value (mcLatestActualValue)	Although the slave axis synchronizes to the master axis until homing is completed, the motor is suddenly accelerated or an excessive command is input without the synchronization control upon operation completion. This may cause an error or alarm on the drive unit side. For details, refer to the manuals for each drive unit. Example: For the MR-J5, the servo alarm [AL. 031.1_Servo motor speed error] or the servo alarm [AL. 035.1_Command frequency error] may occur.

- If the stop cause occurs when Homing Operation Status (AxisName.Md.Homing_Status) is set to "0002H: Homing completed (target is not reached to the target position)", the followed-up set position changes significantly. Therefore, an error, the servo alarm [AL. 031.1_Servo motor speed error], or the servo alarm [AL. 035.1_Command frequency error] may occur on the drive unit side even if "1: Set Value (mcSetValue)" or "101: Latest Set Value (mcLatestSetValue)" is selected in Master axis data source selection (MasterValueSource).
  For details, refer to the manuals for each drive unit.
- If the following items are not mapped, backup is not guaranteed.
  - Home cycle counter (2D3DH)
  - Home ABS counter (2D3EH)
- DOG signal inputted in the servo amplifier at MR-J5(W)-G connection can be specified as a home position switch signal. For details on the setting method, refer to the following.

☞ Page 2155 How to use

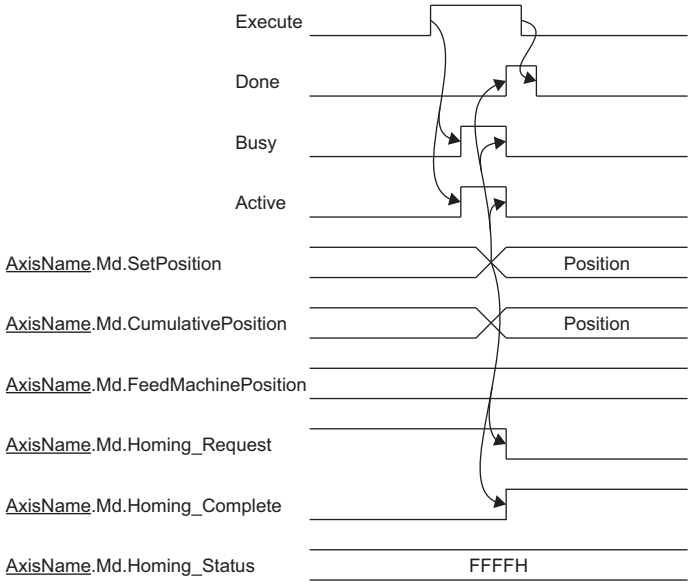
- The hardware stroke limit signal detection is performed during homing in the controller. When the signal is detected, the "HALT" signal is sent to the drive unit. To perform homing by using the hardware stroke limit signal, make the hardware stroke limit check of the controller side invalid temporarily by turning Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) to DISABLE (Check disabled).
- If ONLY_INSIDE (Check disabled for movement returning to the range) is set in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) at homing start, Start not possible (error code: 1AFCH) occurs and the homing start is not carried out.
- When homing is performed with a drive unit other than the MELSERVO, set the parameters of the drive unit so that Home offset is 0. If a value other than 0 is set, an unintended operation may occur when the homing is completed.

Data set homing method

The data set homing method executes the homing to a virtual axis and a real axis that does not have the home position information in the device station side. It is completed in the motion system, and external signals or others are not used. Target position (Position) (home position address) at homing is registered in the motion system as the home position, and Set Position (AxisName.Md.SetPosition) and Cumulative Current Position (AxisName.Md.CumulativePosition) are rewritten to Target position (Position) (home position address).

Timing chart

■Normal operation



■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type Motion control FBs" in the following.

MELSEC MX Controller MX-R Model Programming Manual

Precautions

- FBs other than MC_Stop (Forced Stop) cannot start during homing.
- The software stroke limit check for Target position (Position) (home position address) at homing start is shown below.

Home position return method	Description
Driver homing method	The software stroke limit check is not performed.
Data set homing method	The software stroke limit check is performed.

- The software stroke limit check of the start position is not performed at homing start.
- The software stroke limit is not checked during homing.
- The movement direction at homing completion is in positive direction.
- Homing does not support the velocity bias function. Set the minimum motor speed of the driver homing method by the drive unit.

Error

Check that Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" at MC_Home (Homing) execution. If the status is other than "4: Standby (Standstill)", an error will occur and the control during operation will stop.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- MotionControl_General
- NetworkDriver_CCIETSN (When using the real axis)
- ServoDriver_CANopen (When using the real axis)
- SignalIO (When using AbsSwitch)

27.2 Operation Setting for Incompletion of Homing

The operation setting for incompletion of homing is provided to select whether the axis is started or not when Homing Request (AxisName.Md.Homing_Request) is TRUE.

When starting the axis at homing incompletion, whether the axis can start up or not is determined by the executed FB and Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed).

○: Axis start possible, ×: Axis start impossible

FB	Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed)	
	"TRUE: Allow" and the homing request (AxisName.Md.Homing_Request) is TRUE.	"FALSE: Not allowed" and the homing request (AxisName.Md.Homing_Request) is TRUE.
FBs that can be started if homing is incompletion	○*1	○*1
The motion FBs other than the above	○*1	×

*1 There may be restrictions in the operation for incompletion of homing depending on the setting or specifications of the drive unit. For details, refer to each drive unit manual.
For MR-J5(W)-G: MR-J5 User's Manual (Function)

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
StartableAtUnhomed	Start Permission at Homing Uncompleted	Sets whether axis start is allowed or not when homing is incomplete. • FALSE: Not allowed • TRUE: Allowed

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Homing_Request	Homing Request	Becomes TRUE when homing is required and becomes FALSE when it is completed. For details, refer to the following. ☞ Page 619 Homing request

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
Homing_ClearRequest	Homing Request Clear	Sets the homing request to FALSE forcibly. After the homing request is set to FALSE, FALSE is set in this variable automatically. • FALSE: Not execute • TRUE: Executes Homing Request Clear

FBs that can be started when homing is incomplete

The following FBs can start the axis regardless of Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed) and Homing Request (AxisName.Md.Homing_Request) status.

FBs that can be started when homing is incomplete
MC_Home (Homing)
MCv_Jog (JOG operation)
MC_Stop (Forced stop)
MC_GroupStop (Group forced stop)
FBs other than the motion FBs

The axis start other than the above cannot start the axis when Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed) is FALSE and Homing Request (AxisName.Md.Homing_Request) is TRUE, and Start at homing incompletion (error code: 1A99H) occurs.

Homing request clear

When Homing Request (AxisName.Md.Homing_Request) is TRUE, Homing Request (AxisName.Md.Homing_Request) can be changed to FALSE forcibly by setting Homing Request Clear (AxisName.Cd.Homing_ClearRequest) to TRUE.

Precautions

- In Homing Request Clear (AxisName.Cd.Homing_ClearRequest), when turning Homing Request (AxisName.Md.Homing_Request) to FALSE and starting the axis, it is operated not based on the home position but based on the current coordinate system.
- Do not turn Homing Request Clear (AxisName.Cd.Homing_ClearRequest) to TRUE during homing.

28 AXIS CONTROL FUNCTIONS

The axis control function has the following items.

Item	Description	Reference
Single axis positioning control	Executes positioning to the specified position by using address information.	Page 627 Single Axis Positioning Control
Single axis speed control	Executes the speed control for the specified axis with the specified speed.	Page 629 Single Axis Speed Control
Single axis manual control	Executes any positioning operation by inputting a signal from the outside.	Page 631 Single Axis Manual Control
Multiple axes positioning control	Uses address information and executes positioning to the specified position using interpolation control.	Page 636 Multiple Axes Positioning Control
Multiple axes positioning data operation	Executes positioning for the axes group with the specified positioning method and speed to the preset passing point in one start.	Page 665 Multiple Axes Positioning Data Operation

28.1 Single Axis Positioning Control

This function executes positioning to the specified position by using address information.

Relevant FBs

For details on motion control FBs, refer to the following.

📖MELSEC MX Controller MX-R Model Programming Manual

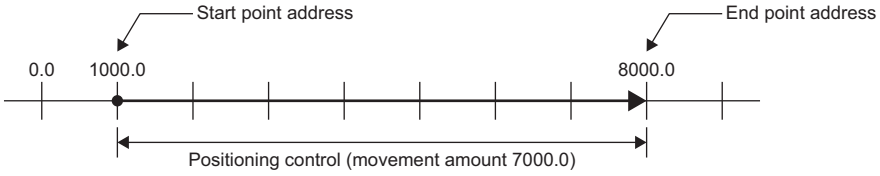
Motion control FB	Name	Description
MC_MoveAbsolute	Absolute value positioning	Executes positioning after specifying the target position of the absolute position.
MC_MoveRelative	Relative value positioning	Executes positioning after specifying the movement amount of the relative position.

Absolute value positioning control

In MC_MoveAbsolute (Absolute Value Positioning), Target position (Position), Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), Direction selection (Direction), Buffer mode (BufferMode), and Options (Options) can be set, and positioning is executed from the current position at start (start point address) to the address (end point address) set in Target position (Position).

Ex.

When the start point address is 1000.0, and Target position (Position) is 8000.0, positioning is carried out in the positive direction for a movement amount of 7000.0 (8000.0 - 1000.0).



Required object data

When using MC_MoveAbsolute (Absolute Value Positioning), map the object assigned to the following object data to PDO.

- Target position (607AH)

If the above object is not mapped to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.

For details on the object data settings, refer to the following.

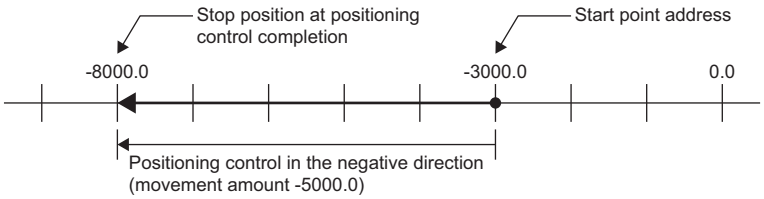
☞ Page 466 Axis Assignment

Relative value positioning control

In MC_MoveRelative (Relative Value Positioning), Movement amount (Distance), Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode) can be set, and positioning of movement amount set in Movement amount (Distance) is executed from the current position at start (start point address). The movement direction is determined by the sign of the movement amount. Axis Status (AxisName.Md.AxisStatus) becomes "5: During positioning operation (DiscreteMotion)".

Ex.

When the start point address is -3000.0, and the movement amount is -5000.0, positioning is carried out to -8000.0.



Required object data

When using MC_MoveRelative (Relative Value Positioning), map the object assigned to the following object data to PDO.

- Target position (607AH)

If the above object is not mapped to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

Precautions

- Even if a restart or continuous update is performed, the current position where this FB was started for the first time is the starting address.
- Since it is processed with the floating point type, if the relative value positioning control is repeatedly executed, the movement amount specified may not be reached due to the calculation error.

28.2 Single Axis Speed Control

This function executes the speed control for the specified axis with the specified speed.

For speed control excluding position loop, refer to the following.

☞ Page 715 Velocity Control

Relevant FBs

For details on motion control FBs, refer to the following.

📖MELSEC MX Controller MX-R Model Programming Manual

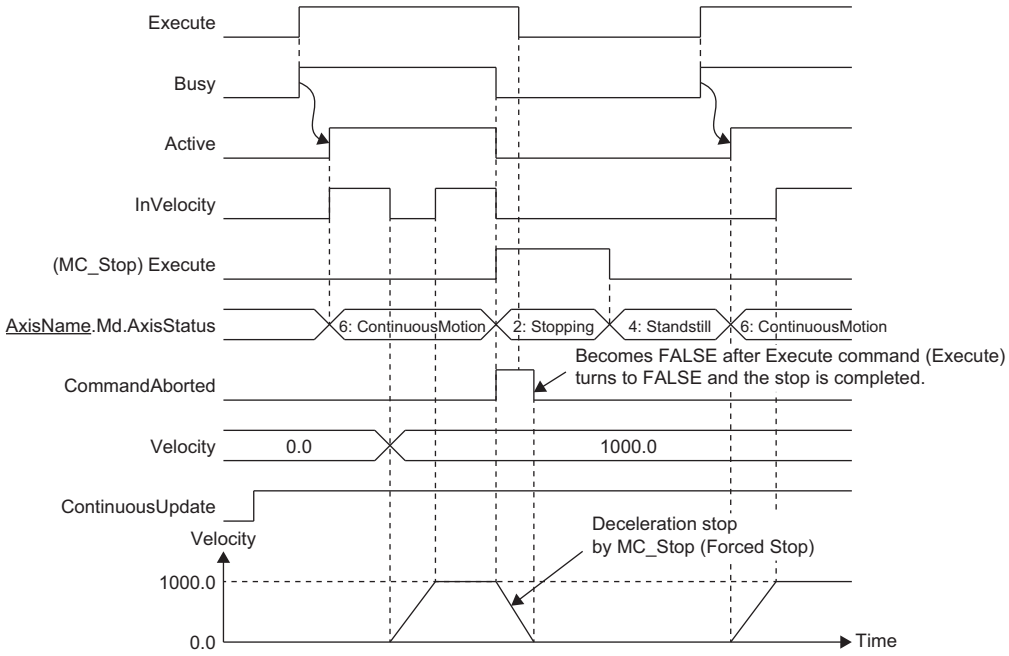
Motion control FB	Name	Description
MCv_SpeedControl	Speed control (including position loop)	Executes the speed control including position loop.

Control details

Set the control mode of the drive unit side to cyclic synchronous position mode (csp) and perform speed control for the specified axis with the specified speed. MCv_SpeedControl (Speed Control (Including Position Loop)) is used to execute. To stop the axis, use MC_Stop (Forced Stop) or start another motion FB.

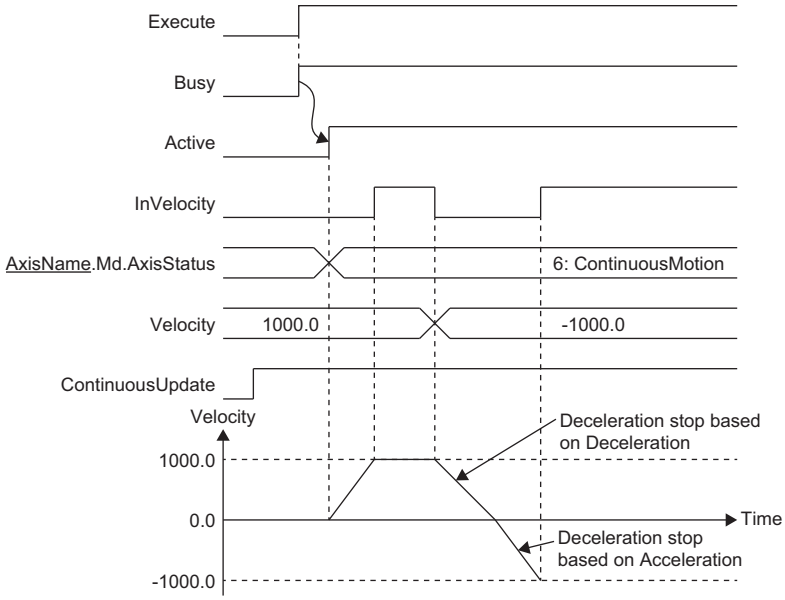
To perform speed control with the control mode of the drive unit side set to the cyclic synchronous velocity mode (csv), use an FB such as MC_MoveVelocity (Speed Control).

Timing chart at start and the stop cause occurrence



Timing chart when the operation direction is changed

If the sign of Velocity (Velocity) is reversed and the operation direction is changed when Continuous update (ContinuousUpdate) is TRUE, the axis accelerates toward the target velocity once after the deceleration stop.



BufferMode

Select a buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh can be set.
For details on the operation, refer to the following.
☞ Page 548 Buffer mode type

Required object data

When using Speed Control (Including Position Loop) for a single axis, map the object assigned to the following object data to PDO.

- Target position (607AH)

If the above object data is not mapped to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.
For details on the object data settings, refer to the following.
☞ Page 466 Axis Assignment

28.3 Single Axis Manual Control

This function executes any positioning operation by inputting a signal from the outside.

Relevant variables

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
SwStrokeLimit_Override	Software Stroke Limit Override	Temporarily switches valid/invalid of the software stroke limit check. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)
HwStrokeLimit_Override	Hardware Stroke Limit Override	Temporarily switches valid/invalid of the hardware stroke limit check. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

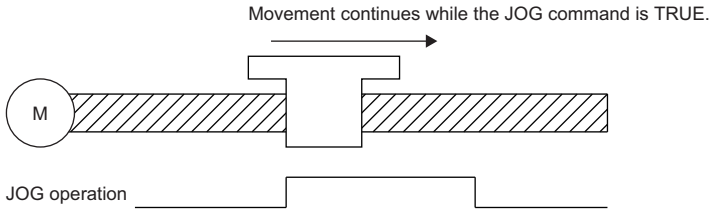
Motion control FB	Name	Description
MCv_Jog	JOG operation	Executes JOG operation according to the command velocity.

Types of manual control

There is the following type of manual control.

JOG operation

JOG operation is a control method in which the machine is moved by only a movement amount (commands are continuously output while the JOG command is TRUE).



JOG operation

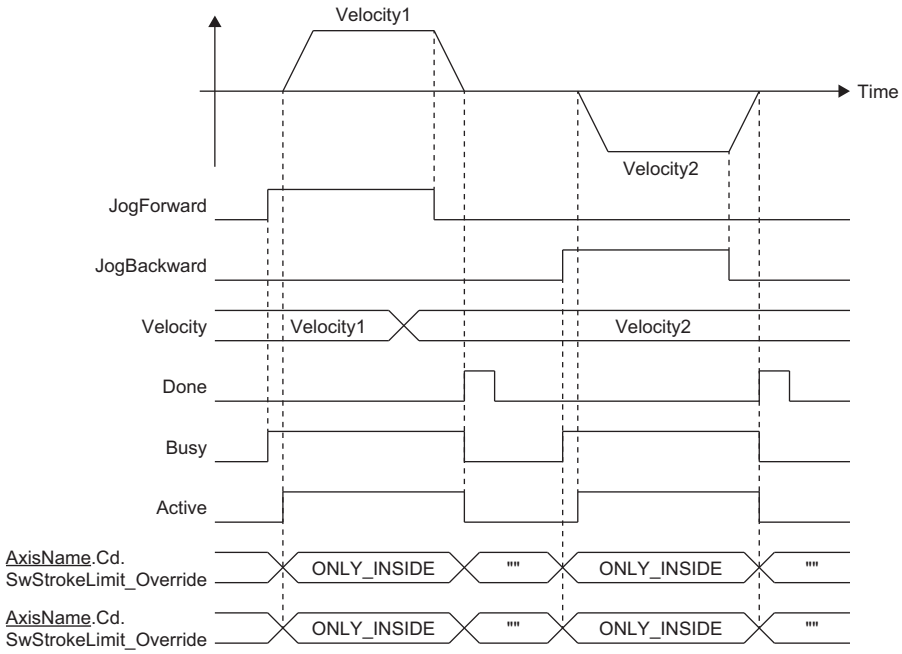
In JOG operation, the command is output from the motion system to the axis while the positive/reverse rotation JOG command is input by using MCv_Jog (JOG Operation), and then the axis operates in the specified direction.

Point

- JOG operation can be executed even when the homing is not completed.
- JOG operation can be started from outside to inside of the software stroke limit range. (If the JOG operation is started in the outside direction of the software stroke limit range, an error will occur.)
- JOG operation can be started from outside to inside of the hardware stroke limit range. (If the JOG operation is started in the outside direction of the hardware stroke limit range, an error will occur.)

Ex.

When a reverse rotation JOG operation is executed after a positive rotation JOG operation



Control details

- JOG operation is carried out with MCv_Jog (JOG Operation).
- The target axis is moved in the specified direction during TRUE, by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to TRUE.
- Axis Status (AxisName.Md.AxisStatus) during JOG operation is "6: During continuous operation (ContinuousMotion)".
- A deceleration stop is executed by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to FALSE. Axis Status (AxisName.Md.AxisStatus) changes to "4: Standby (Standstill)" after the deceleration stop is completed.
- When Error (Error) becomes TRUE during the deceleration by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to FALSE, Error (Error) becomes TRUE until Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) is changed TRUE.
- When another operation instruction is started during a JOG operation, the operation is carried out based on the Buffer mode (BufferMode) setting.
- When a JOG operation is started during another operation instruction, the start request will be ignored and Start during Operation Warning (event code: 00D01H) will occur. Start a JOG operation when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
- Use velocity change by the override function to change the velocity during JOG operation.

For details on the override function, refer to the following.

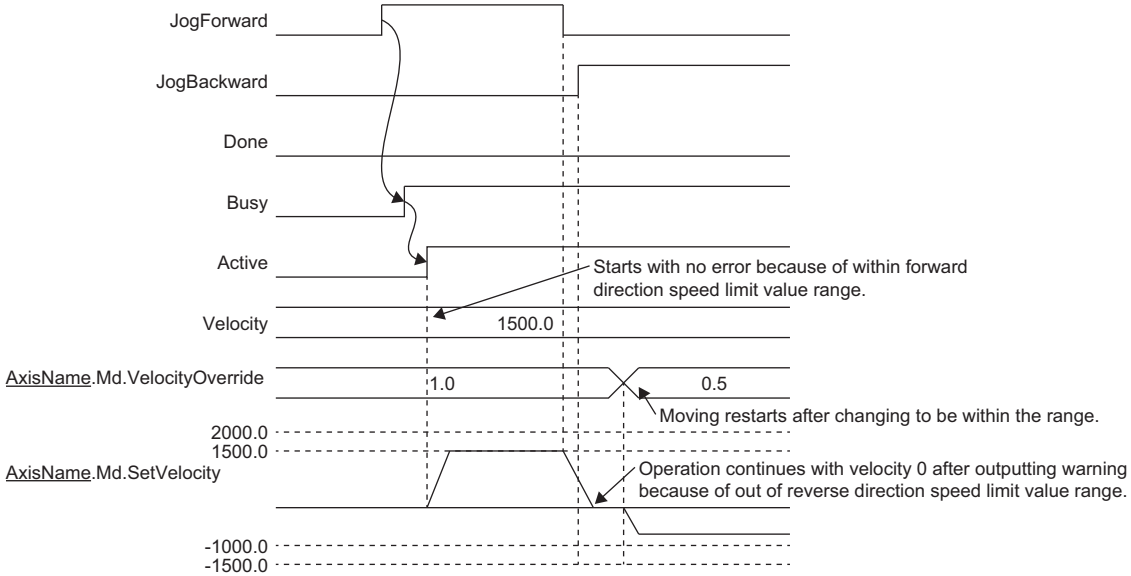
☞ Page 1116 Override Function

Precautions

- For safety, set a small value in Velocity (Velocity) first and check the movement, and then gradually increase the value.
- Use the hardware stroke limit function when carrying out JOG operation near the upper or lower limits. If the hardware stroke limit function is not used, the workpiece may exceed the moving range and cause an accident.
- When the software stroke limit function is valid and Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) is other than DISABLE (Check disabled) or ONLY_INSIDE (Check disabled for movement returning to the range), Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) is rewritten into ONLY_INSIDE (Check disabled for movement returning to the range) during MCv_Jog (JOG Operation) execution, and it is rewritten into "" when the JOG operation is completed.
- When the hardware stroke limit function is valid and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is other than DISABLE (Check disabled) or ONLY_INSIDE (Check disabled for movement returning to the range), Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is rewritten into ONLY_INSIDE (Check disabled for movement returning to the range) during MCv_Jog (JOG Operation) execution, and it is rewritten into "" when the JOG operation is completed.
- Do not change Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and Hardware Stroke Limit Override (AxisName.Cd. HwStrokeLimit_Override) during MCv_Jog (JOG Operation) execution.
- Note that the values of Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and Hardware Stroke Limit Override (AxisName.Cd. HwStrokeLimit_Override) are retained to the next instruction during multiple start because the next instruction is analyzed during operation when multiple start is executed during JOG operation.
- When moving in the reverse direction against the direction at start after deceleration stop during JOG operation, if the target velocity exceeds the velocity limit value, Velocity Limit Value Over Warning on Direction Change (event code: 00D20H) occurs. In addition, when the acceleration time exceeds 8400.0 [s], Acceleration Time Over Warning on Direction Change (event code: 00D32H) occurs. (The operation continues with velocity 0.) The movement starts after changing control to remove the cause.

Ex.

When setting Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) to "2000.0", and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) to "1000.0"



Required object data

When using JOG operation, map the object assigned to the following object data to PDO.

- Target position (607AH)

If the above object is not mapped to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

28.4 Multiple Axes Positioning Control

This function uses address information and executes positioning to the specified position using interpolation control.

Relevant variables

Axes group information (AxesGroupName.AxesGroupRef.)

Variable/structure name	Name	Details
GroupNo	Axes Group No.	Indicates axes group No. • 0: Not set • 1 to 10000: Set axes group No.

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.
VelocityLimit	Velocity Limit Value	Sets the velocity limit value.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
NumberOfAxes	Number of Configuration Axes	Displays the number of configuration axes of the axes group.
InterpolationAxes	Interpolation Axes	Displays the configuration axis that is executing the interpolation control of the axes group in bits.
SetVelocity	Set Velocity	Displays the set output velocity of the axes group.

Monitor data in multiple axes positioning control

Configuration axes of the axes group that are used for the multiple axes positioning control can be checked in Interpolation Axes (AxesGroupName.Md.InterpolationAxes).

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_MoveLinearInterpolateAbsolute	Absolute value linear interpolation control	Specifies the target position of the absolute position of specified axes group, and executes positioning by linear interpolation control.
MCv_MoveLinearInterpolateRelative	Relative value linear interpolation control	Specifies the movement amount of the relative position of specified axes group, and executes positioning by linear interpolation control.
MCv_MoveCircularInterpolateAbsolute	Absolute value circular interpolation control	Executes positioning by 2-axis circular interpolation by using configuration axes of set axes group, and by specifying the end point and the sub point of the absolute position.
MCv_MoveCircularInterpolateRelative	Relative value circular interpolation control	Executes positioning by 2-axis circular interpolation by using configuration axes of set axes group, and by specifying the relative position from the current position at start to the end point and the sub point.

Multiple axes positioning control types

There are the following types of multiple axes positioning controls.

Classification of positioning control	Classification of multiple axes	Classification of interpolation	Classification of control
Multiple axes positioning control	Multiple axes interpolation control	Linear interpolation control	Absolute value linear interpolation control
			Relative value linear interpolation control
		Circular interpolation control	Absolute value circular interpolation control
			Relative value circular interpolation control

Operation in multiple axes positioning control

- In the multiple axes positioning control, the positioning control with multiple axes using an axes group can be executed.
- To execute the multiple axes positioning control, axes group settings and enabling are required. For details, refer to the following.

☞ Page 478 Axes Group
☞ Page 487 Axes Group Assignment

- In multiple axes positioning control, specify axes (interpolation axes) to be used for interpolation control in the configuration axis of the axes group. Up to 4 interpolation axes can be specified.

Positioning speed in multiple axes positioning control

Positioning speed at multiple axes positioning control can be set in Velocity (Velocity) of the motion control FB. In positioning control, a control target is controlled at the specified positioning speed.

Linear interpolation control

To specify the positioning speed for the linear interpolation control, the following three methods can be used.

- Vector velocity specification
- Long axis velocity specification
- Reference axis velocity specification

The motion system control methods for each set method are described in the following.

■Vector velocity specification

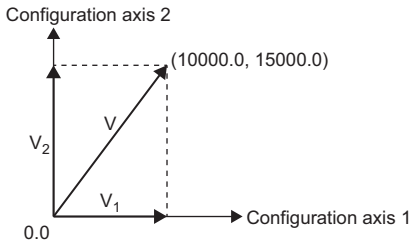
The positioning speed of each interpolation axis is calculated from the movement amount of each interpolation axis by the motion system based on the positioning speed of the set control target.

The positioning speed of the control target is called the vector velocity.

Set each input in the motion control FB: Linear interpolation axes (LinearAxes) as the interpolation axes, Target position (Position) or Movement amount (Distance) as the movement amount of each interpolation axis, and Velocity (Velocity) as the vector velocity.

Ex.

For 2-axis linear interpolation control



Setting item	Setting value
Linear interpolation axes	Configuration axis 1, Configuration axis 2
Configuration axis 1 movement amount (D_1)	10000.0 [pulses]
Configuration axis 2 movement amount (D_2)	15000.0 [pulses]
Velocity unit of axes group	[s]
Vector velocity (V)	7000.0 [pulses/s]

For the above conditions, the positioning speed of each axis is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = V \times D_1 / \sqrt{(D_1^2 + D_2^2)}$
Configuration axis 2 positioning speed	$V_2 = V \times D_2 / \sqrt{(D_1^2 + D_2^2)}$

Point

For the vector velocity specification, the set velocity limit value is valid to the Velocity (Velocity) which is as the vector velocity. For details, refer to the following.

☞ Page 1112 Velocity Limit

■Long axis velocity specification

The control is carried out based on the positioning speed (the long axis velocity) of interpolation axes whose movement amount is the largest in the addresses set in each interpolation axis.

The positioning speed of the other interpolation axes is calculated by the motion system from the movement amount of each interpolation axis.

Set each input in the motion control FB: Linear interpolation axes (LinearAxes) as the interpolation axes, Target position (Position) or Movement amount (Distance) as the movement amount of each interpolation axis, and Velocity (Velocity) as the long axis velocity.

Ex.

For 4-axis linear interpolation control

Setting item	Setting value
Linear interpolation axes	Configuration axis 1, Configuration axis 2, Configuration axis 3, Configuration axis 4
Configuration axis 1 movement amount (D_1)	10000.0 [pulses]
Configuration axis 2 movement amount (D_2)	15000.0 [pulses]
Configuration axis 3 movement amount (D_3)	5000.0 [pulses]
Configuration axis 4 movement amount (D_4)	20000.0 [pulses]
Configuration axis 4 velocity unit	[s]
Long axis velocity (V)	7000.0 [pulses/s]

In the above case, the long axis is the configuration axis 4 whose movement amount is the largest, and the control is carried out by long axis velocity to the configuration axis 4. The positioning speed of the other interpolation axes is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = D_1 / D_4 \times V$
Configuration axis 2 positioning speed	$V_2 = D_2 / D_4 \times V$
Configuration axis 3 positioning speed	$V_3 = D_3 / D_4 \times V$

Point

- For the long axis velocity specification, set velocity limit value is valid for the Velocity (Velocity) which is as the long axis velocity. For details, refer to the following.

☞ Page 1112 Velocity Limit

- Note that the vector velocity when specifying the long axis velocity may be larger than the velocity limit value. When setting a value like the following in the 2-axis linear interpolation, the vector velocity exceeds the velocity limit value.

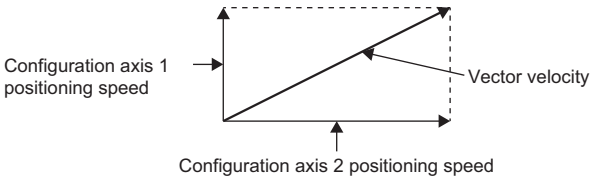
(Example)

When the setting items and the setting values are as follows.

- Linear interpolation axes: Configuration axis 1, Configuration axis 2
- Configuration axis 1 movement amount: 100 [pulses]
- Configuration axis 2 movement amount: 200 [pulses]
- Long axis velocity: 50 [pulses/s]
- Velocity limit value of configuration axis 2: 55 [pulses/s]

In the above case, the reference axis is configuration axis 2 whose movement amount is the largest, and the control is carried out based on the velocity limit value specified in configuration axis 2. The positioning speed and the vector velocity of each axis are shown below.

- Configuration axis 1 positioning speed: 100/200 × 50 = 25 [pulses/s]
- Configuration axis 2 positioning speed: 50 [pulses/s]
- Vector velocity: $\sqrt{(25^2 + 50^2)} = 55.9$ [pulses/s]



The vector velocity becomes a value that exceeds the velocity limit value "55" of configuration axis 2.

■Reference axis velocity specification

The motion system controls the positioning speed of other interpolation axes calculating from each interpolation axis movement amount based on the positioning speed of the set reference axis (the reference axis velocity), and carries out the control.

In the motion control FB, set Linear interpolation axes (LinearAxes) as interpolation axes to ensure that the reference axis is the first element of the array in Linear interpolation axes (LinearAxes). Also, set Target position (Position) or Movement amount (Distance) as the movement amount of each axis and set the Velocity (Velocity) as the reference axis speed.

- If "0.0" is set to the movement amount of the configuration axis specified as the reference axis, Reference axis movement amount 0 (error code: 1AFAH) occurs.

Ex.

For 4-axis linear interpolation control

Setting item	Setting value
Linear interpolation axes	Configuration axis 1, Configuration axis 2, Configuration axis 3, Configuration axis 4
Configuration axis 1 movement amount (D_1)	10000.0 [pulses]
Configuration axis 2 movement amount (D_2)	15000.0 [pulses]
Configuration axis 3 movement amount (D_3)	5000.0 [pulses]
Configuration axis 4 movement amount (D_4)	20000.0 [pulses]
Configuration axis 4 velocity unit	[s]
Reference axis velocity (V)	7000.0 [pulses/s]

In the above case, the reference axis is configuration axis 4, and control is carried out at the positioning speed specified in configuration axis 4.
The positioning speed of the other interpolation axes is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = D_1 / D_4 \times V$
Configuration axis 2 positioning speed	$V_2 = D_2 / D_4 \times V$
Configuration axis 3 positioning speed	$V_3 = D_3 / D_4 \times V$

Point

- For the reference axis velocity specification, the set velocity limit value works on Velocity (Velocity) as the reference axis velocity. For details, refer to the following.

☞ Page 1112 Velocity Limit

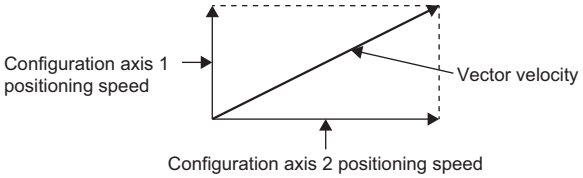
- Note that the positioning speed of the axis whose movement amount is larger than that of the reference axis is larger than the set reference axis velocity. When setting a value like the following in the 2-axis linear interpolation, the positioning speed and the vector velocity of the configuration axis 2 exceed the velocity limit value.

(Example)
When the setting items and the setting values are as follows.

- Linear interpolation axes: Configuration axis 1, Configuration axis 2
- Configuration axis 1 movement amount: 100 [pulses]
- Configuration axis 2 movement amount: 200 [pulses]
- Reference axis velocity: 50 [pulses/s]
- Velocity limit value of configuration axis 1: 55 [pulses/s]

In the above case, the reference axis is configuration axis 1, and control is carried out with the velocity limit value which is set in configuration axis 1. The positioning speed and the vector velocity of each configuration axis are shown below.

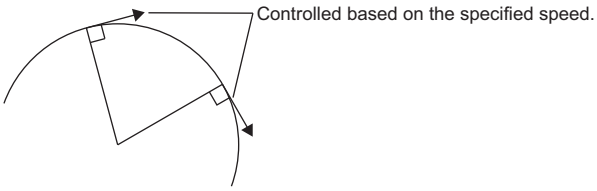
- Configuration axis 1 positioning speed: 50 [pulses/s]
- Configuration axis 2 positioning speed: 200/100 × 50 = 100 [pulses/s]
- Vector velocity: $\sqrt{(50^2 + 100^2)} = 111.8$ [pulses/s]



The positioning speed and the vector velocity of the configuration axis 2 become a value that exceeds the velocity limit value "55" of configuration axis 1.

Circular interpolation control

For the circular interpolation, the control is performed so that the positioning speed on the circular path becomes the specified speed.



During Blending of the multiple axes positioning control

Basic operation is based on Blending during multiple axes operation. For Blending during multiple axes operation, refer to the following.

☞ Page 561 Multiple start during multiple axes operation

This section describes operation when selecting BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh in Buffer mode (BufferMode) of the motion control FB and setting different speed mode to the Velocity mode (VelocityMode) of the first FB (FB1) and the second FB (FB2) in the multiple axes positioning control.

- Multiple start is possible even when Velocity mode (VelocityMode) is different between FB1 and FB2. However, during Blending, Multiple start velocity mode specified mismatch warning (error code: 0D11H) occurs.
- The control is carried out using the FB1 Velocity mode (VelocityMode) in FB1 and using the FB2 Velocity mode (VelocityMode) in FB2.
- During Blending of FB1 and FB2, the speed is not converted by the speed mode. The positioning speed value as the FB1 speed mode is used for Blending in the positioning speed as the FB2 speed mode.
- Note that the speed of each axis and the vector velocity may rapidly change when Velocity mode (VelocityMode) of FB1 and FB2 is different during Blending.

■Operation for BlendingPrevious

Blending from the reference axis velocity specification to the vector velocity specification is as shown below.
It operates so that the FB1 reference axis velocity becomes the speed set to Velocity (Velocity) of FB1 (the reference axis velocity) at the FB1 target position. The reference axis velocity when reaching the FB1 target position is read as the current vector velocity value of FB2 without unit conversion, and it accelerates/decelerates the vector velocity set in Velocity (Velocity) of FB2.

Ex.

When FB1 and FB2 are set to the following

- Axis setting, Axes group setting

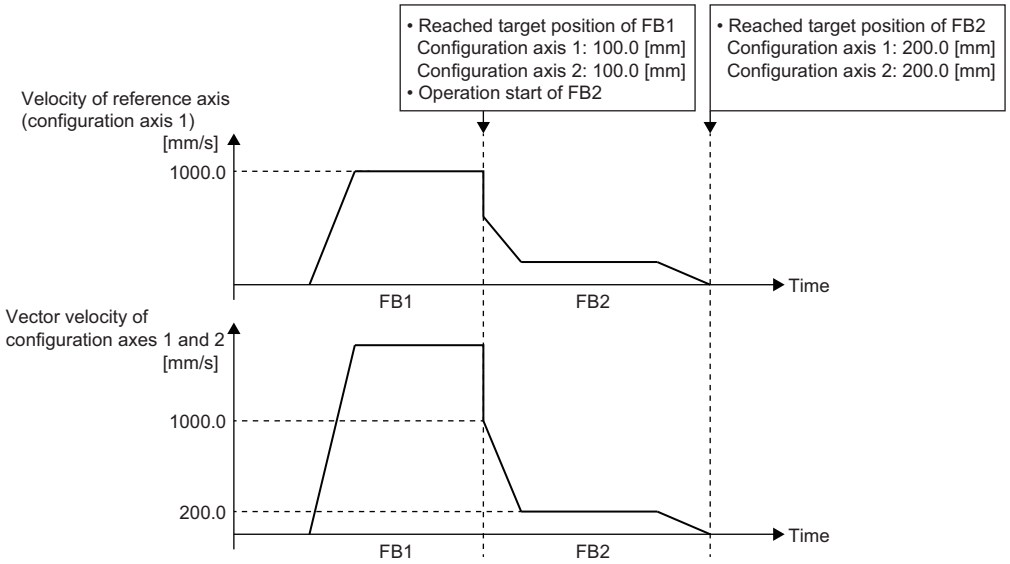
Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the axes group	mm/s

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100.0
Target position (Position[1])	100.0
Velocity (Velocity)	1000.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	200.0
Target position (Position[1])	200.0
Velocity (Velocity)	200.0
Velocity mode (VelocityMode)	0: Vector Velocity (VectorSpeed)
Buffer mode (BufferMode)	3: BlendingPrevious(mcBlendingPrevious)



- Reaches the target position of FB1 at a reference axis velocity of 1000.0 [mm/s] of configuration axis 1 that is the reference axis, and switches to FB2.
- FB2 starts operation at the vector velocity of 1000.0 [mm/s].
- Decelerates to the vector velocity of 200.0 [mm/s].
- Performs positioning to the target position of FB2.

■Operation for BlendingNext

FB1: Reference axis velocity → FB2: Vector velocity

It operates so that the FB1 reference axis velocity becomes the speed set to Velocity (Velocity) of FB2 (the vector velocity) at the FB1 target position.

The reference axis velocity when reaching the FB1 target position is read as the current vector velocity value of FB2 without unit conversion, and it accelerates/decelerates the vector velocity set in Velocity (Velocity) of FB2.

Ex.

When FB1 and FB2 are set to the following

- Axis setting, Axes group setting

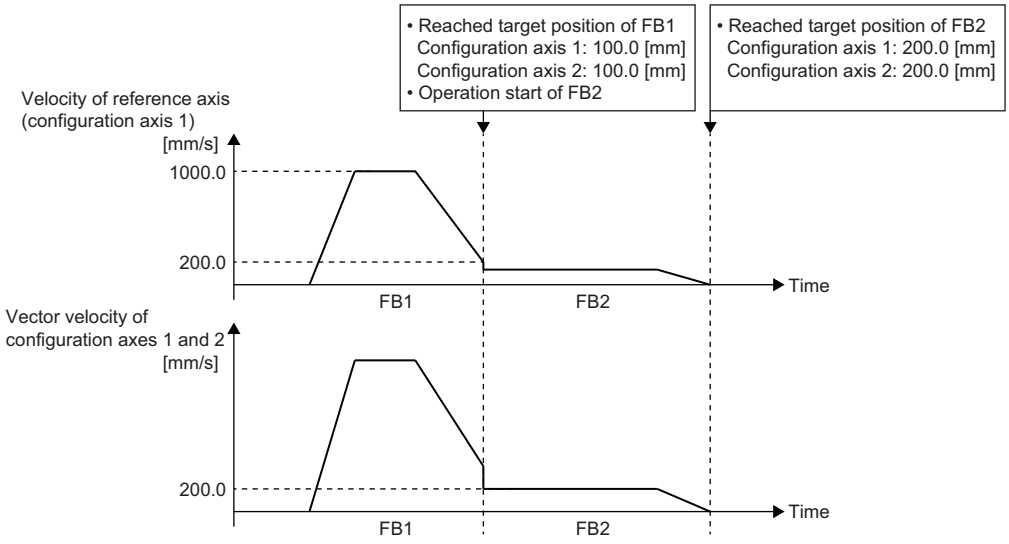
Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the axes group	mm/s

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100.0
Target position (Position[1])	100.0
Velocity (Velocity)	1000.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	200.0
Target position (Position[1])	200.0
Velocity (Velocity)	200.0
Velocity mode (VelocityMode)	0: Vector Velocity (VectorSpeed)
Buffer mode (BufferMode)	4: NextBlendingNext(mcBlending)



- Operates to the middle of positioning to the target position of FB1 at a reference axis velocity of 1000.0 [mm/s] of configuration axis 1.
- Configuration axis 1 as a reference axis reaches the target position of FB1 at a reference axis velocity of 200.0 [mm/s], and switches to FB2.
- FB2 starts operation at a vector velocity of 200.0 [mm/s].
- Performs positioning to the target position of FB2.

Command unit in the multiple axes positioning control

Command unit of the multiple axes positioning control

The command unit in the multiple axes positioning control differs depending on Velocity mode (VelocityMode) of the motion control FB. For details and precautions, refer to the following.

☞ Page 490 Units

☞ Page 561 Multiple start during multiple axes operation

During Blending of the multiple axes positioning control

Basic operation is based on Blending during multiple axes operation. For Blending during multiple axes operation, refer to the following.

☞ Page 561 Multiple start during multiple axes operation

This section describes operation when selecting BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh in Buffer mode (BufferMode) of the motion control FB, and the command unit is different between the first FB (FB1) and the second FB (FB2) in the multiple axes positioning control.

- Multiple start is possible even when the command unit of FB1 and FB2 is different. However, during Blending, Velocity command unit mismatch warning (error code: 0D1EH) occurs.
- The control is carried out using the FB1 command unit in FB1 and using the FB2 command unit in FB2.
- During Blending of FB1 and FB2, the speed is not converted by the command unit mode. The positioning speed value as the FB1 command unit is used for Blending in the positioning speed as the FB2 command unit.

■Operation for BlendingPrevious

During Blending, multiple start is possible even when the command unit of FB1 and FB2 is different. Unit conversion is not carried out, and the speed value of FB1 is given as the speed of FB2.

Ex.

When FB1 and FB2 are set to the following

- Axis setting

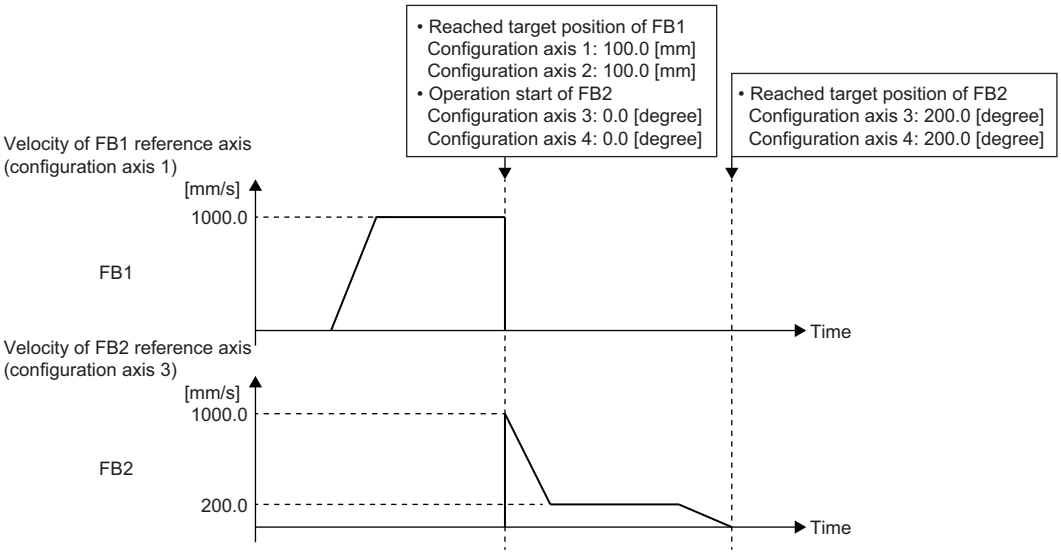
Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the configuration axis 3	degree/min
Position and velocity command unit of the configuration axis 4	degree/min

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s from the command unit of the configuration axis 1)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100.0
Target position (Position[1])	100.0
Velocity (Velocity)	1000.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: degree/min from the command unit of the configuration axis 3)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	3
Linear interpolation axes (LinearAxes[1])	4
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[2])	200.0
Target position (Position[3])	200.0
Velocity (Velocity)	200.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)
Buffer mode (BufferMode)	3: BlendingPrevious(mcBlendingPrevious)



- Configuration axis 1 as a reference axis reaches the target position of FB1 at a velocity of 1000.0 [mm/s], and switches to FB2.
- For FB2, configuration axis 3 as a reference axis starts operation at a velocity of 1000.0 [degrees/min].
- Configuration axis 3 as a reference axis decelerates to a velocity of 200.0 [degrees/min].
- Performs positioning to the target position of FB2.

■Operation for BlendingNext

During Blending, multiple start is possible even when the command unit of FB1 and FB2 is different. Unit conversion is not carried out, and the speed value of FB1 is given as the speed of FB2.

Ex.

When FB1 and FB2 are set to the following

- Axis setting

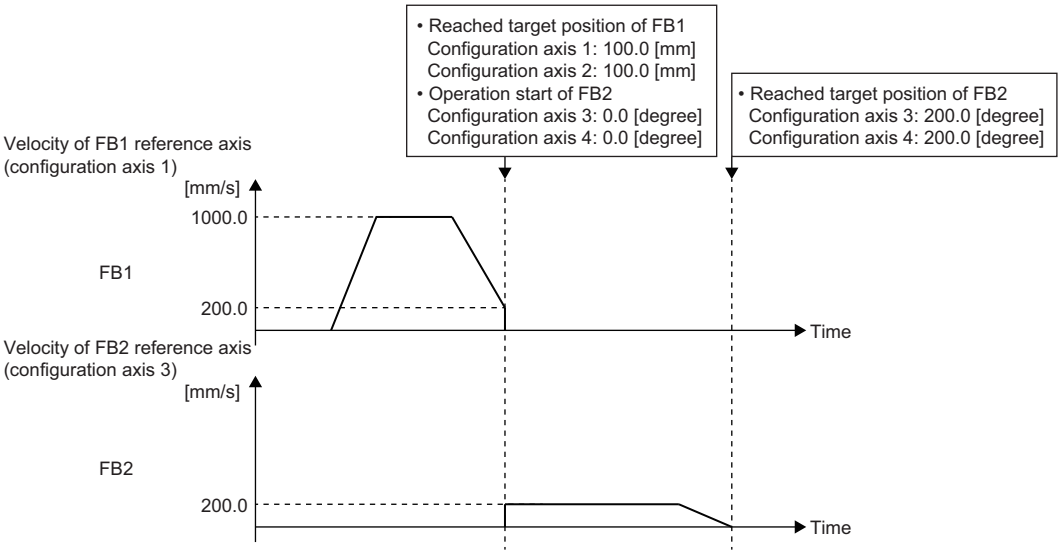
Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the configuration axis 3	degree/min
Position and velocity command unit of the configuration axis 4	degree/min

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100.0
Target position (Position[1])	100.0
Velocity (Velocity)	1000.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: degree/min)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	3
Linear interpolation axes (LinearAxes[1])	4
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[2])	200.0
Target position (Position[3])	200.0
Velocity (Velocity)	200.0
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)
Buffer mode (BufferMode)	4: NextBlendingNext(mcBlending)



- Configuration axis 1 as a reference axis operates to the middle of positioning to the target position of FB1 at a velocity of 1000.0 [mm/s].
- Configuration axis 1 as a reference axis reaches the target position of FB1 at a velocity of 200.0 [mm/s], and switches to FB2.
- For FB2, configuration axis 3 as a reference axis starts operation at a velocity of 200.0 [degrees/min].
- Performs positioning to the target position of FB2.

Acceleration/deceleration processing

Basic operation is based on the acceleration/deceleration processing function. For the acceleration/deceleration processing function, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

By Velocity mode (VelocityMode) of the motion control FB, the relationship between the positioning speed and the acceleration/deceleration processing is as shown below.

• 0: Vector Velocity (VectorSpeed)

The acceleration/deceleration processing is applied to the vector velocity.

• 1: Long Axis Velocity (LongAxisSpeed)

The acceleration/deceleration processing is applied to the long axis velocity.

• 2: Reference Axis Velocity (ReferenceAxisSpeed)

The acceleration/deceleration processing is applied to the reference axis velocity.

State transition in the multiple axes positioning control

Axes Group Status (AxesGroupName.Md.GroupStatus) of the axes group in the positioning control is "5: Operating (GroupMoving)". For Axes Group Status (AxesGroupName.Md.GroupStatus), refer to the following.

☞ Page 480 Axes group state transition

Linear interpolation control

Linear interpolation control specifies an axes group and performs interpolation control so that the path from the start point (move start point) to the end point becomes a straight line. In linear interpolation control, interpolation control using a maximum of 4 axes is performed.

Linear interpolation control includes the following two control methods.

Linear interpolation control	Description
Absolute value linear interpolation control	Specifies the target position of the absolute position, and executes linear interpolation control.
Relative value linear interpolation control	Specifies the relative movement amount from the current position, and executes linear interpolation control.

For motion control FBs that can perform each control, refer to the following.

☞ Page 636 Relevant FB

Linear interpolation control operation for each number of interpolation axes is shown below.

1-axis linear interpolation control

■1-axis linear interpolation control (absolute value)

1-axis linear interpolation is executed from the current position at start (start point address) to the address (end point address) set in Target position (Position).

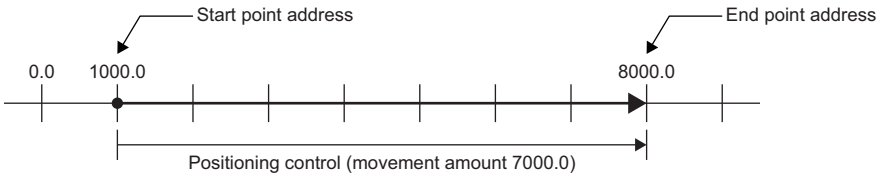
Ex.

When start point address of configuration axis 1 is "1000.0" and Target position (Position) is set to "8000.0"

LinearAxes[0]: 1

(LinearAxes[1]: 0)

Position[0]: 8000.0



■1-axis linear interpolation control (relative value)

1-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount.

Movement amount	Description
Positive (+)	Positioning in the positive direction (address increasing direction)
Negative (-)	Positioning in the negative direction (address decreasing direction)

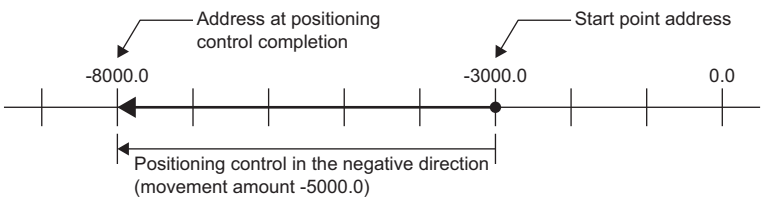
Ex.

When start point address of configuration axis 1 is "-3000.0" and Movement amount (Distance) is set to "-5000.0"

LinearAxes[0]: 1

(LinearAxes[1]: 0)

Distance[0]: -5000.0

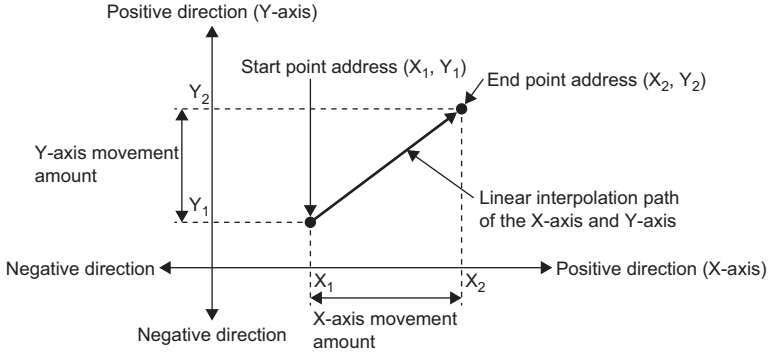


2-axis linear interpolation control

■2-axis linear interpolation control (absolute value)

2-axis linear interpolation is executed from the current position at start (start point address) to the address (end point address) set in Target position (Position).

The movement direction is determined by the start point address and the end point address of each axis.



Ex.

When the start point position is set to the configuration axis 1 "1000.0" and configuration axis 2 "1000.0" and Target position (Position) is set to the configuration axis 1 "10000.0" and configuration axis 2 "4000.0"

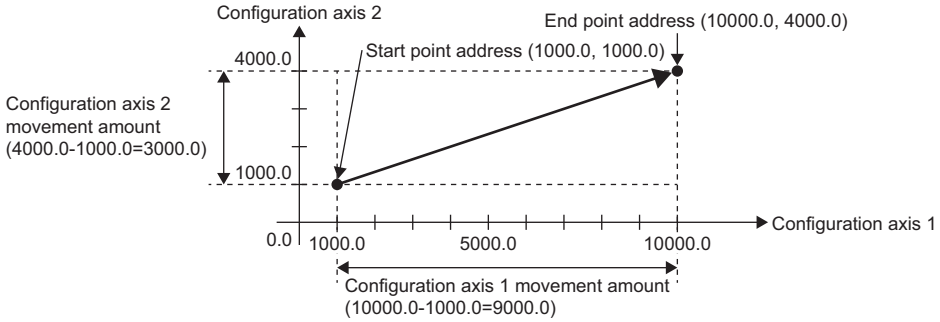
LinearAxes[0]: 1

LinearAxes[1]: 2

(LinearAxes[2]: 0)

Position[0]: 10000.0

Position[1]: 4000.0

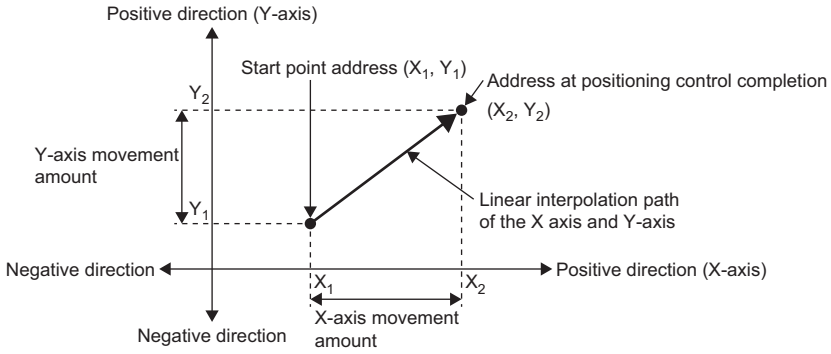


■2-axis linear interpolation control (relative value)

2-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount of each axis.

Movement amount	Description
Positive (+)	Positioning in the positive direction (address increasing direction)
Negative (-)	Positioning in the negative direction (address decreasing direction)



Ex.

When the start position is set to the configuration axis 1 "1000.0" and configuration axis 2 "4000.0" and Movement amount (Distance) is set to the configuration axis 1 "9000.0" and configuration axis 2 "-3000.0"

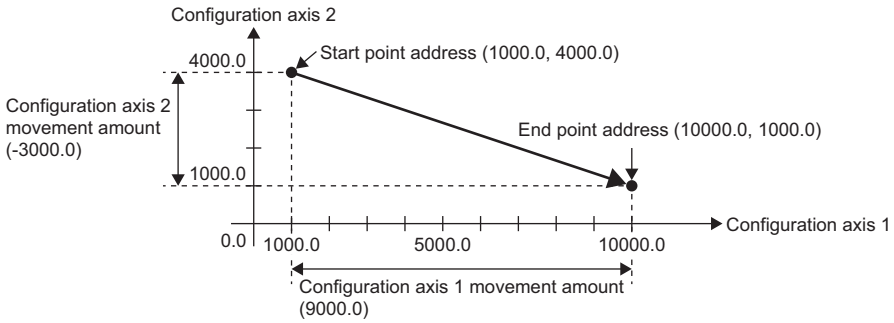
LinearAxes[0]: 1

LinearAxes[1]: 2

(LinearAxes[2]: 0)

Distance[0]: 9000.0

Distance[1]: -3000.0

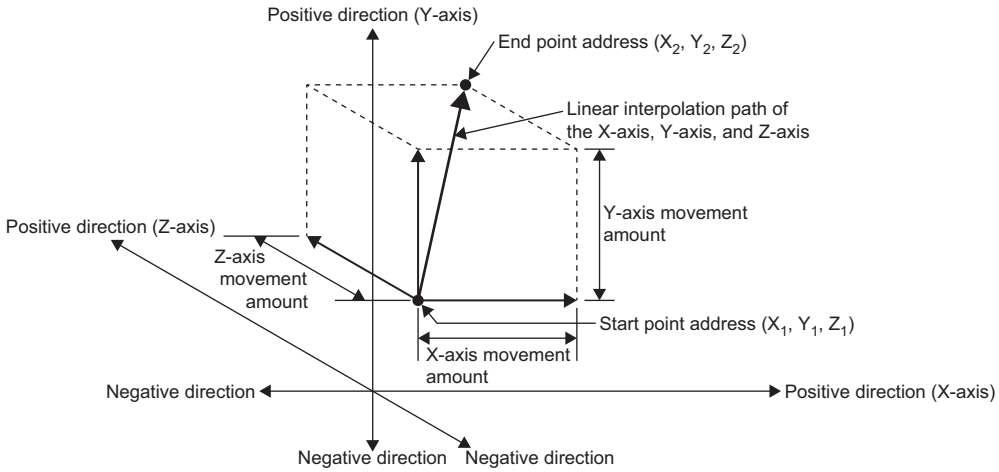


3-axis linear interpolation control

■3-axis linear interpolation control (absolute value)

3-axis linear interpolation is executed from the current position at start (start point address) to the commanded position (end point address) set in Target position (Position).

The movement direction is determined by the start point address and the end point address of each axis.



Ex.

When the start position is set to the configuration axis 1 "1000.0", configuration axis 2 "2000.0", and configuration axis 3 "1000.0" and Target position (Position) is set to the configuration axis 1 "7000.0", configuration axis 2 "8000.0", and configuration axis 3 "4000.0"

LinearAxes[0]: 1

LinearAxes[1]: 2

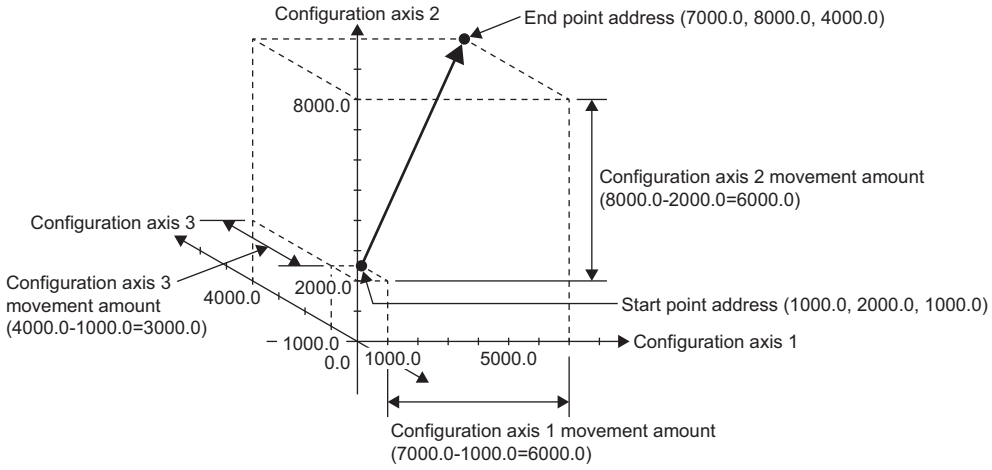
LinearAxes[2]: 3

(LinearAxes[3]: 0)

Position[0]: 7000.0

Position[1]: 8000.0

Position[2]: 4000.0

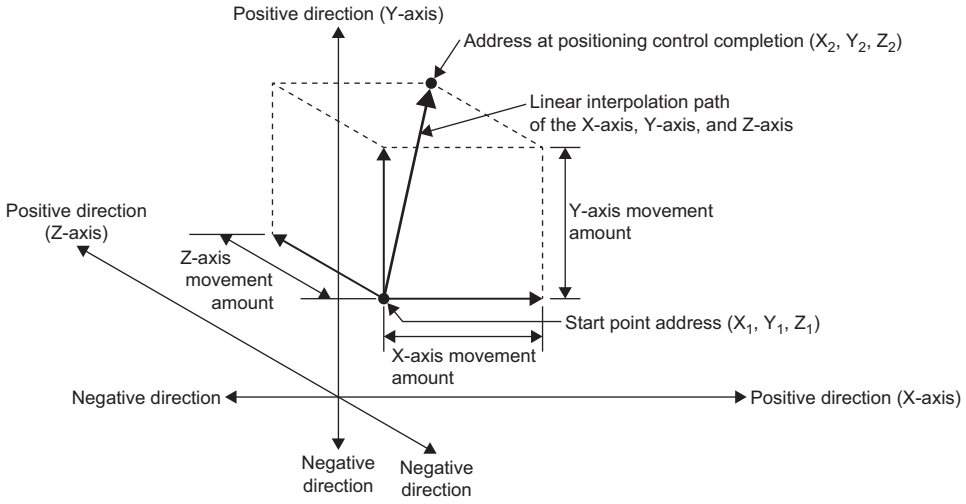


■3-axis linear interpolation control (relative value)

3-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount of each axis.

Movement amount	Description
Positive (+)	Positioning in the positive direction (address increasing direction)
Negative (-)	Positioning in the negative direction (address decreasing direction)



Ex.

When the start position is set to the configuration axis 1 "2000.0", configuration axis 2 "1000.0", and configuration axis 3 "1000.0" and Movement amount (Distance) is set to the configuration axis 1 "10000.0", configuration axis 2 "5000.0", and configuration axis 3: "6000.0"

LinearAxes[0]: 1

LinearAxes[1]: 2

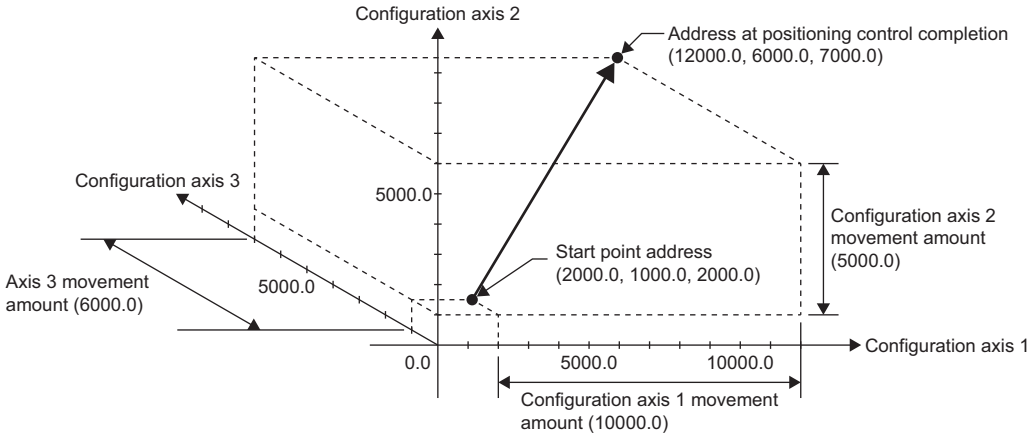
LinearAxes[2]: 3

(LinearAxes[3]: 0)

Distance[0]: 12000.0

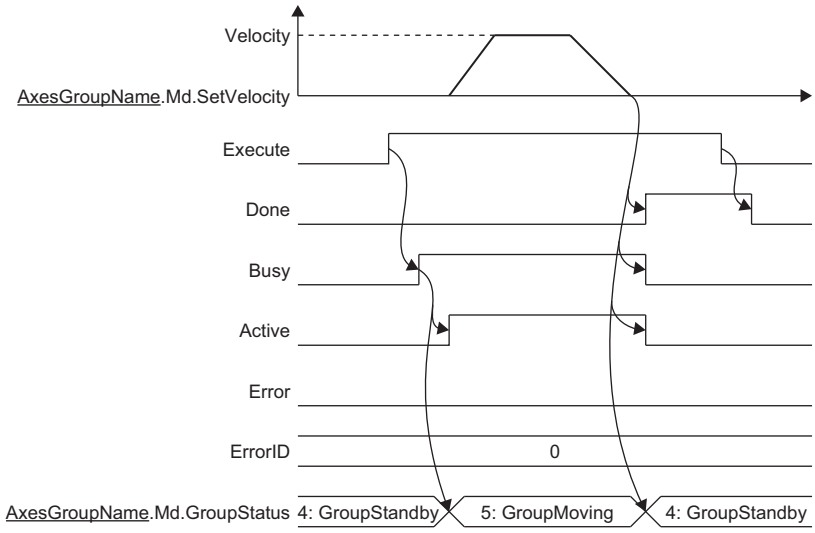
Distance[1]: 6000.0

Distance[2]: 7000.0



Timing chart

■When the operation completes normally



■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type motion control FBs" in the following manual.

MELSEC MX Controller MX-R Model Programming Manual

Circular interpolation control

Circular interpolation control specifies an axes group and performs interpolation control so that the path from the start point (move start point) to the end point becomes an arc to a linear axis which is arranged mechanically orthogonally.
In circular interpolation control, interpolation control can be performed using two arbitrary axes from the configuration axes set to the axes group.
Circular interpolation control includes the following two control methods.

Circular interpolation control	Description
Absolute value circular interpolation control	Specifies the end point and the sub point of the absolute position, and executes 2-axis circular interpolation control.
Relative value circular interpolation control	Specifies the end point and the movement amount of the sub point from the current position, and executes 2-axis circular interpolation control.

For motion control FBs that can perform each control, refer to the following.
☞ Page 636 Relevant FB
The following circular interpolation method can be specified with Circular interpolation mode (CircMode) for circular interpolation control.

Circular interpolation method	Description	Reference
Border point specification	Positioning control is carried out in an arc path passing through the specified border point by using two configuration axes specified in Circular interpolation axes (CircAxes).	Page 655 Border point specification
Central point specification	Two configuration axes specified in Circular interpolation axes (CircAxes) are used to perform positioning control in an arc path having the specified center point as a center point.	Page 657 Center point specification
Radius specification	Two configuration axes specified in Circular interpolation axes (CircAxes) are used to perform positioning control in an arc path having the specified radius.	Page 660 Radius specification

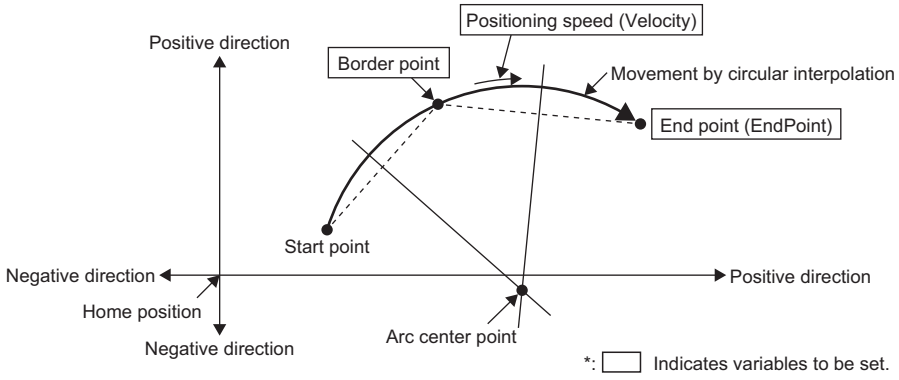
The operations of circular interpolation control with each circular interpolation mode are shown below.

Border point specification

Positioning control is carried out in an arc path passing through the specified border point by using two configuration axes specified in Circular interpolation axes (CircAxes).

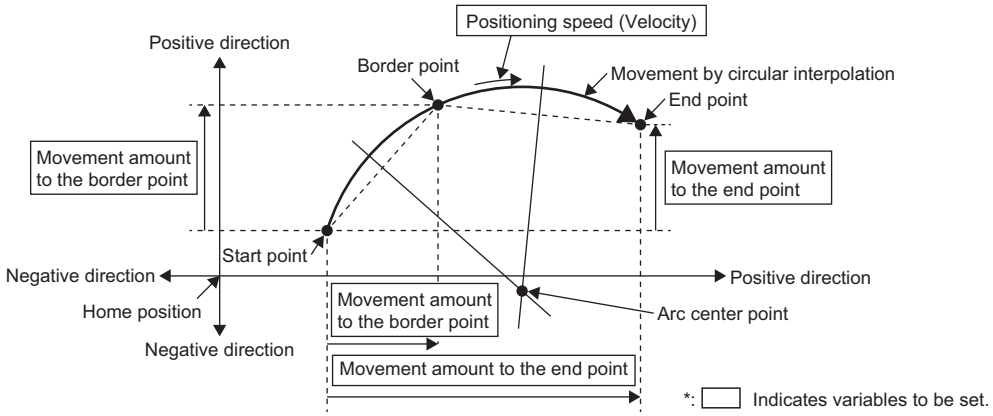
■Border point specification circular interpolation control (absolute value)

In absolute value circular interpolation control with border point specification, positioning is carried out from the current position at start (start point address) to the address (end point address) set in End point (EndPoint) in an arc path that passes through the address (border point address) set to Sub point (AuxPoint).
The resulting control path is an arc having as its center the intersection point of perpendicular bisectors of a straight line between the current position at start and the border point address, and a straight line between the border point address and the end point address. However, a perfect circle cannot be drawn with the border point specification.

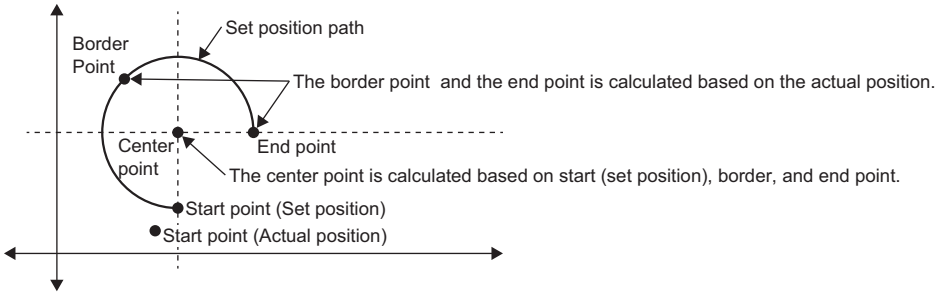


■Border point specification circular interpolation control (relative value)

In relative value circular interpolation control with border point specification, positioning is carried out from the current position at start (start point address) to the address of the movement amount (end point address) set in End point (EndPoint) in an arc path that passes through the address of the movement amount (border point address) set in Sub point (AuxPoint).
The resulting control path is an arc having as its center the intersection point of perpendicular bisectors of a straight line between the current position at start and the border point address, and a straight line between the border point address and the end point address.



- When "actual position" is selected in position selection during buffer mode (Options (Options): bit3) of relative value circular interpolation control, the border point and the end point are calculated based on the actual position. The center point is determined from the start point (set position), the border point, and the end point.



Restriction

2-axis circular interpolation control with border point specification cannot be set in the following cases.

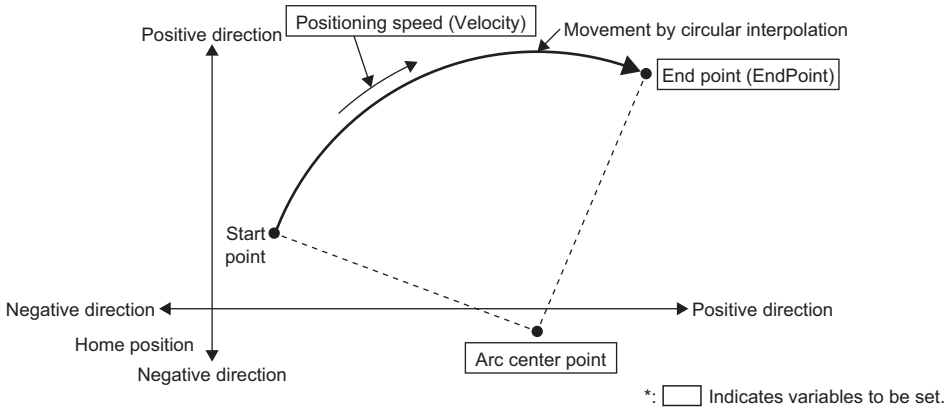
- When the radius exceeds "2147483647.0" (the maximum radius for which 2-axis circular interpolation control is possible): (Out of radius range (error code: 1AD4H))
- When the border point address exceeds positioning range: (Out of boundary point address range (error code: 1ACCH))
- When the end point address exceeds positioning range: (Out of end point address range (error code: 1AD5H))
- When the start point address, border point address, and end point address are in the same straight line: (Start point - Boundary point - End point address same straight line (error code: 1AD2H))
- When the start point address is the same as the end point address: (Start point - End point address same value (error code: 1ACEH))
- When the start point address is the same as the border point address: (Start point - Boundary point address same value (error code: 1AD0H))
- When the end point address is the same as the border point address: (End point - Boundary point address same value (error code: 1AD1H))

Center point specification

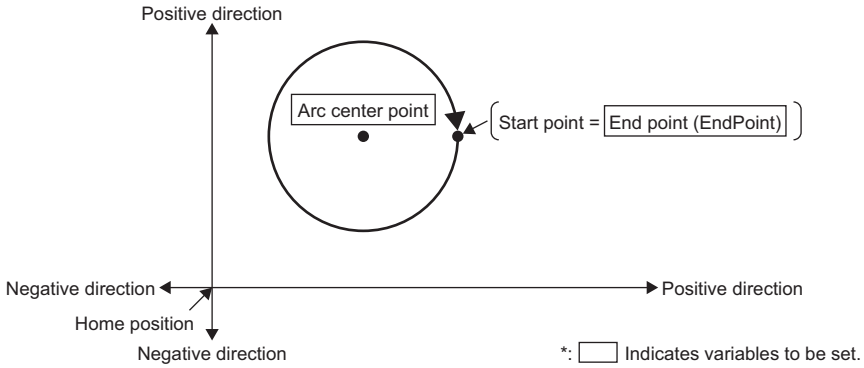
Two configuration axes specified in Circular interpolation axes (CircAxes) are used to perform positioning control in an arc path having the specified center point as a center point.

■Central point specification circular interpolation control (absolute value)

In absolute value circular interpolation control with center point specification, positioning is carried out from the current position at start (start point address) to the end position set in End point (EndPoint) in an arc path having the center point set in Sub point (AuxPoint) as its center. For absolute value circular interpolation control with center point specification, the path is set using Path selection (PathChoice). For details, refer to the following.



- To perform positioning for a perfect circle with a radius from the start point to the arc center point, set End point (EndPoint) the same as the start point. Setting the end point in End point (EndPoint) to the same value as the start point causes the end point and the start point to be identical.



Ex.

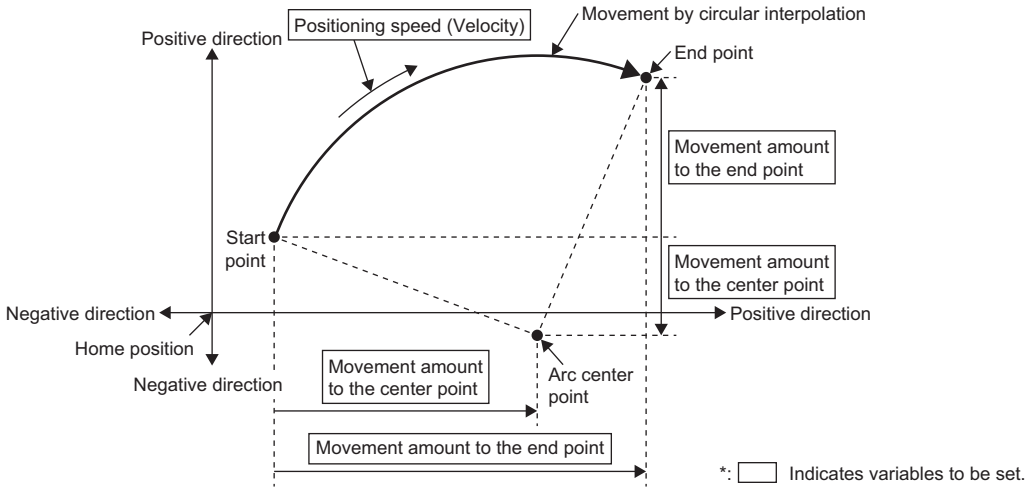
When End point (EndPoint) is set to the same value as the start point

```
AxesGroup001.Pr.Axis[1]:= Axis0001.AxisRef;
AxesGroup001.Pr.Axis[2]:= Axis0002.AxisRef;
EndPoint[0]:= Axis0001.Md.SetPosition;
EndPoint[1]:= Axis0002.Md.SetPosition;
```

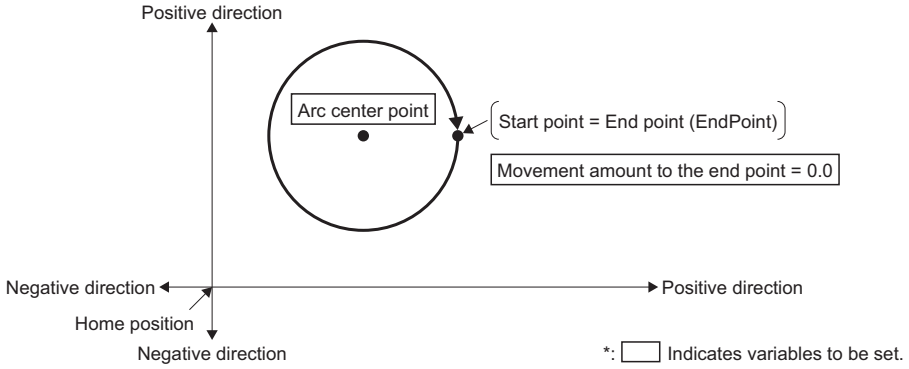
Specify the set position of the configuration axes to be used in circular interpolation to End point (EndPoint) as shown above.

■Central point specification circular interpolation control (relative value)

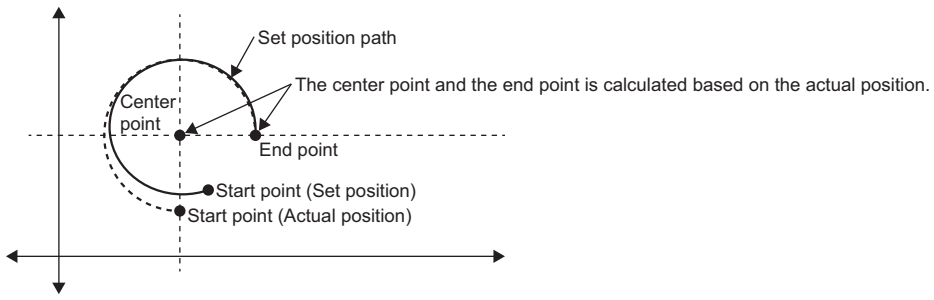
In relative value circular interpolation control with center point specification, positioning is carried out from the current position at start (start point address) to the address of the movement amount (end point address) set in End point (EndPoint) in an arc path having the address of the movement amount (center point address) set in Sub point (AuxPoint) as its center. For relative value circular interpolation control with center point specification, the path is set using Path selection (PathChoice). For details, refer to the following.



- Setting the movement amount to the end point as "0.0" in End point (EndPoint) causes the end point and the start point to be identical and performs positioning for a perfect circle with a radius from the start point to the arc center point.



- When "actual position" is selected in position selection during buffer mode (Options (Options): bit 3) of relative value circular interpolation control, the center point and the end point are calculated based on the actual position. The circular path may be ellipse.



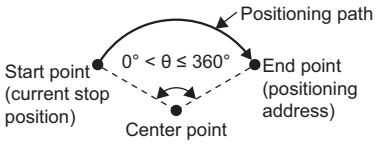
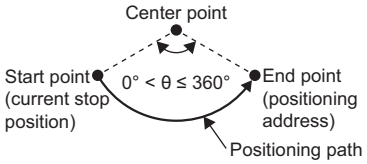
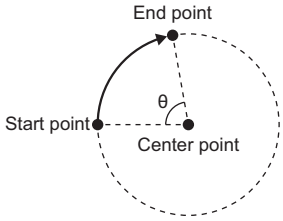
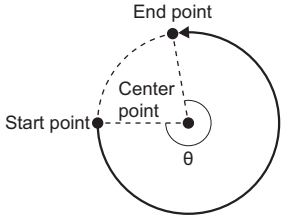
Restriction

2-axis circular interpolation control with center point specification cannot be set in the following cases.

- When the radius exceeds "2147483647.0" (the maximum radius for which 2-axis circular interpolation control is possible): (Out of radius range (error code: 1AD4H))
- When the center point address exceeds positioning range. (Out of center point address range (error code: 1AD3H))
- When the start point address is the same as the center point address. (Start point - Center point address same value (error code: 1ACDH))
- When the end point address is the same as the center point address. (End point - Center point address same value (error code: 1ACFH))

■Path of central point specification circular interpolation control

For circular interpolation control with center point specification, the path is set using Path selection (PathChoice). The setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice) are shown below.

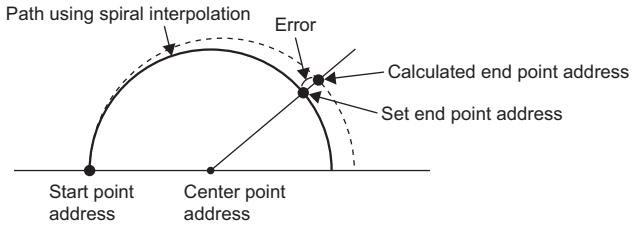
Setting value	Setting description	Arc center angle that can be controlled	Path
0: CW (mcCW)	CW	$0° < \theta \leq 360°$	
1: CCW (mcCCW)	CCW	$0° < \theta \leq 360°$	
2: Shortcut (mcShortWay)	Shortcut • When the start point, center point, and end point are on one straight line, the direction becomes CW. (A semicircle is drawn in the CW direction.) • When the start point is the same as the end point, Path choice setting incorrect (error code: 1B06H) occurs.	$0° < \theta \leq 180°$	
3: Detour (mcLongWay)	Detour • When the start point, center point, and end point are on one straight line, the direction becomes CW. (A semicircle is drawn in the CW direction.) • When the start point is the same as the end point, the direction becomes CW. (A perfect circle is drawn in CW direction.)	$180° \leq \theta \leq 360°$	

■Circular interpolation error tolerance

In central point specification circular interpolation control, the arc path calculated from the start position and center point position may deviate from the end position set in End point (EndPoint). Circular interpolation error tolerance (CircularErrorTolerance) sets allowable range of an error between the calculated arc path and the end position.

• Calculated error ≤ Circular interpolation error tolerance (CircularErrorTolerance)

Circular interpolation control to the set end point address is carried out while the error compensation is carried out by spiral interpolation.



• Calculated error > Circular interpolation error tolerance (CircularErrorTolerance)

At the positioning start, Circular interpolation error allowable value over (error code: 1AD9H) occurs and the control will not start. The machine will immediately stop if the error is detected during positioning control.

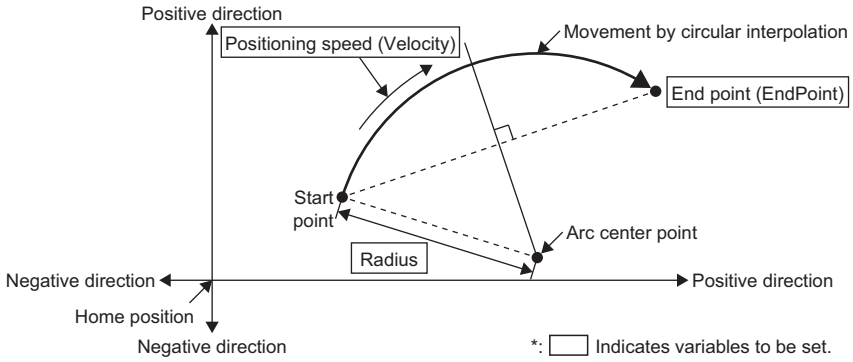
Radius specification

Two configuration axes specified in Circular interpolation axes (CircAxes) are used to perform positioning control in an arc path having the specified radius.

■Radius specification circular interpolation control (absolute value)

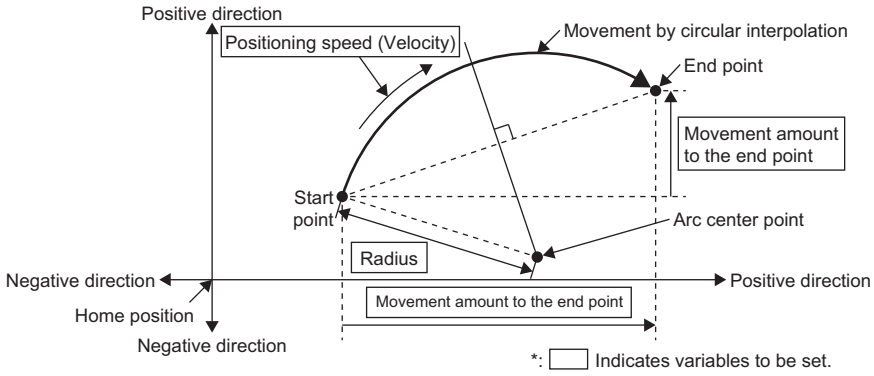
In absolute value circular interpolation control with radius specification, positioning is carried out from the current position at start (start point address) to the address (end point address) set in End point (EndPoint) in a path having the radius set in Sub point (AuxPoint). The resulting control path is an arc with the intersection of the perpendicular bisector of the current position at start and the end point address, and the specified radius as the center point.

For absolute value circular interpolation control with radius specification, the path is set using Path selection (PathChoice). For details, refer to the following.

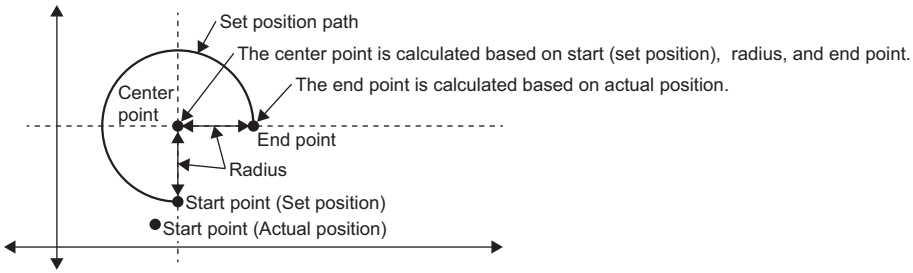


■Radius specification circular interpolation control (relative value)

In relative value circular interpolation control with radius specification, positioning is carried out from the current position at start (start point address) to the address of the movement amount (end point address) set in End point (EndPoint) in a path having the radius set in Sub point (AuxPoint). The resulting control path is an arc with the intersection of the perpendicular bisector of the current position at start and the end point address, and the specified radius as the center point.
For relative value circular interpolation control with radius specification, the path is set using Path selection (PathChoice). For details, refer to the following.



- When "actual position" is selected in position selection during buffer mode (Options (Options): bit 3) of relative value circular interpolation control, the end point is calculated based on the actual position. The center point is determined by the start point (set position), radius, and end point.



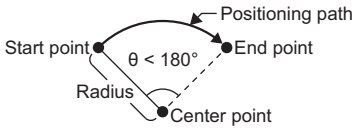
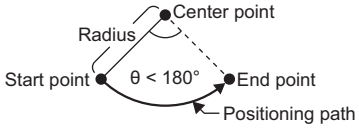
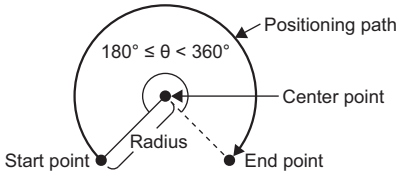
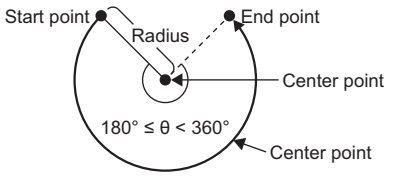
Restriction

2-axis circular interpolation control with radius specification cannot be set in the following cases.

- When the radius exceeds "2147483647.0" (the maximum radius for which 2-axis circular interpolation control is possible): (Out of radius range (error code: 1AD4H))
- When the end point address exceeds positioning range: (Out of end point address range (error code: 1AD5H))
- When the start point address is the same as the end point address: (Start point - End point address same value (error code: 1ACEH))
- When the distance between the start point address and the end point address is larger than the radius. (Radius setting error (error code: 1AD6H))

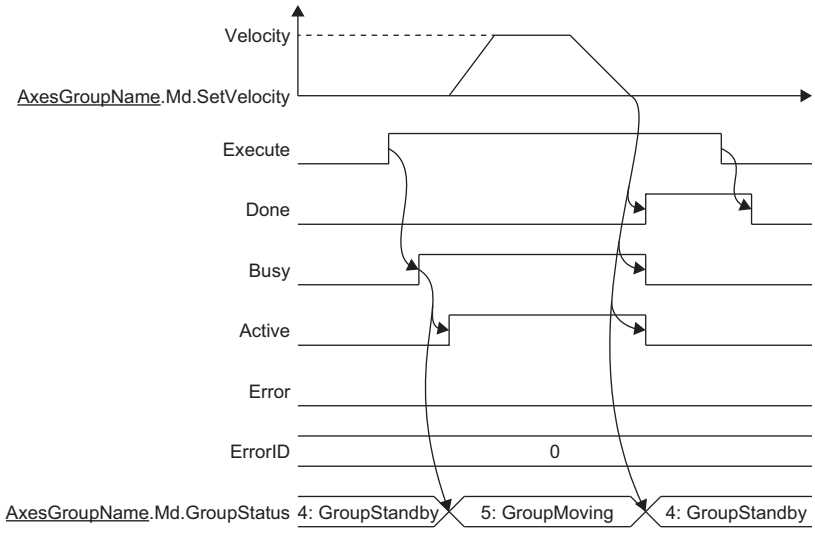
■Path of radius specification circular interpolation control

For circular interpolation control with radius specification, the path is set using Path selection (PathChoice). The setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice) are shown below.

Setting value	Setting description	Arc center angle that can be controlled	Path
0: CW (mcCW)	CW Shortcut • When the start point, center point, and end point are on one straight line, Path choice setting incorrect (error code: 1B06H) occurs.	0° < θ < 180°	
1: CCW (mcCCW)	CCW Shortcut • When the start point, center point, and end point are on one straight line, Path choice setting incorrect (error code: 1B06H) occurs.	0° < θ < 180°	
4: CW Detour (mcCWLongWay)	CW Detour • The start point, center point, and end point are on one straight line, a semicircle is drawn.	180° ≤ θ < 360°	
5: CCW Detour (mcCCWLongWay)	CCW Detour • The start point, center point, and end point are on one straight line, a semicircle is drawn.	180° ≤ θ < 360°	

Timing chart

■When the operation completes normally



■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type motion control FBs" in the following manual.

MELSEC MX Controller MX-R Model Programming Manual

Precautions

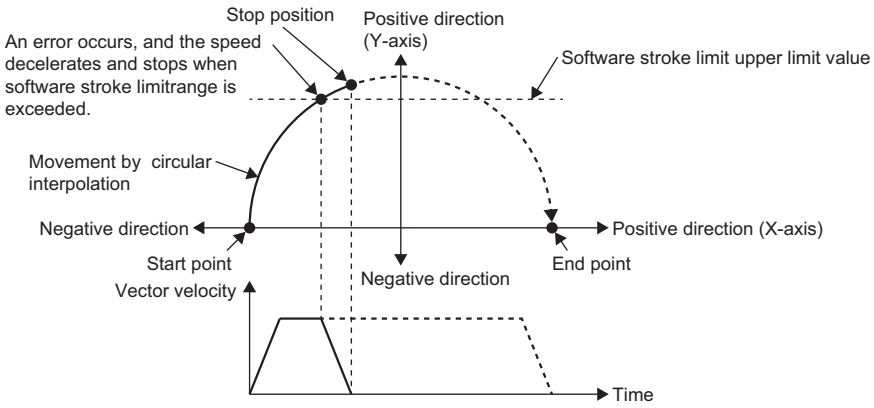
- Circular interpolation including an axis whose stroke limit is set to invalid cannot be carried out. Software stroke limit invalid at circular interpolation (error code: 1ADAH) occurs and the operation does not start.
- When the interpolation path exceeds the stroke limit range during interpolation operation, Software stroke limit over (forward direction) (error code: 1A83H) or Software stroke limit over (reverse direction) (error code: 1A84H) occurs and the operation will stop.

Ex.

When the upper limit of the software stroke limit is exceeded in the positive direction of the Y-axis

For an immediate stop, the operation stops at the same time that the error occurs.

For a deceleration stop, the operation decelerates to a stop along the arc path as shown below.



Required object data

When using multiple axes positioning control, map the object assigned to the following object data to PDO for all configuration axes in the specified axes group.

• Target position (607AH)

If there is a configuration axis that does not map the above object to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

28.5 Multiple Axes Positioning Data Operation

This function executes positioning for the axes group with the specified positioning method and speed to the preset passing point in one start. The positioning method and speed can be changed for each passing point.
Among the configuration axes of the axes group, interpolation operation of 1 to 4 axes can be executed.
The following parameters are set in the operation profile data (multiple axes positioning data format). For details on the operation profile data, refer to the following.
☞ Page 849 Multiple axes positioning data

- Set position address of passing point
- Control method from any passing point to the next passing point
- Velocity from any passing point to the next passing point

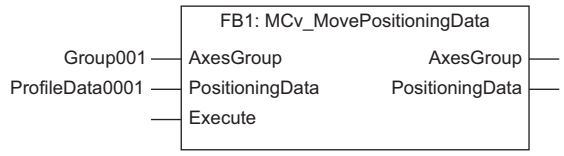
Point

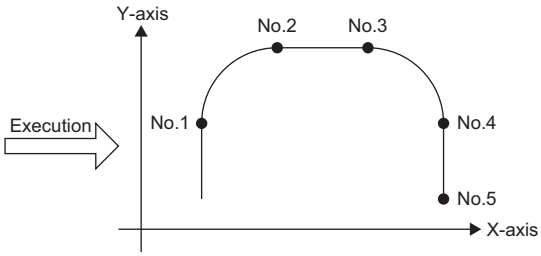
By using multiple axes positioning data operation, continuous multiple axes positioning operation can be executed without describing the user program that executes the positioning control FB with multiple start.

<Operation profile data (multiple axes positioning data format)>
ProfileData0001

Data No.	Operation pattern	Control method	· · ·
1	Continuous positioning	Absolute value linear interpolation	· · ·
2	Continuous positioning	Absolute value circular interpolation	· · ·
3	Continuous positioning	Absolute value linear interpolation	· · ·
4	Continuous positioning	Absolute value circular interpolation	· · ·
5	Positioning complete	Absolute value linear interpolation	· · ·

<User program>





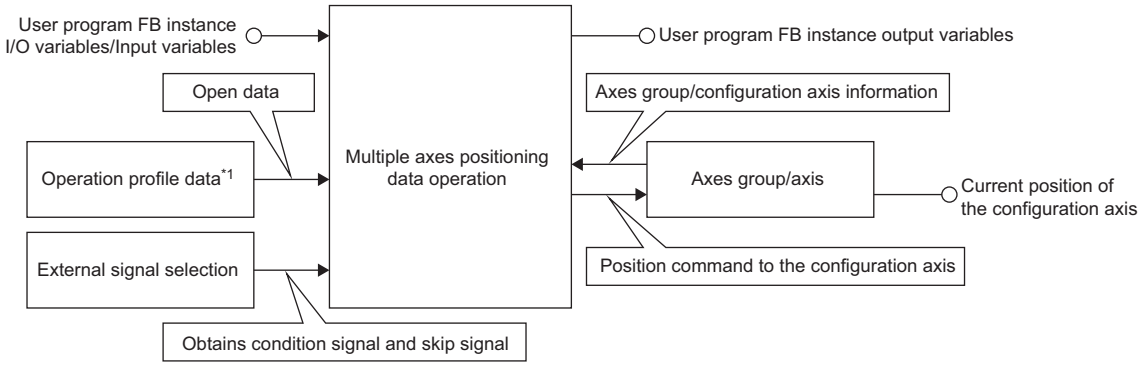
Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Overall block diagram

The relationship between the data used in multiple axes positioning data operation and other functions is shown below.



*1 For the relationship with operation profile data, refer to the following.
☞ Page 824 Overall block diagram

Relevant variable

MC_POSITIONING_DATA_ID

Variable/structure name	Name	Details
ProfileID	Profile ID	Sets the operation profile data ID. Profile ID (ProfileID) is PROFILE_ID structure.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_MovePositioningData	Multiple axes positioning data operation	Operates the axes group according to the specified positioning data.

Control details

- A function to execute continuous positioning operation specified in the operation profile data (multiple axes positioning data format) for the axes group.
- This function is executed by MCv_MovePositioningData (multiple axes positioning data operation).
- Before using this function, axes group needs to be set and enabled. For details, refer to the following.

☞ Page 478 Axes Group
☞ Page 487 Axes Group Assignment

- Before using this function, it is necessary to open the operation profile data of multiple axes positioning data format to the open area and set to a state where it can be controlled. For details on the operation profile data format and the operation of the operation profile data, refer to the following.

☞ Page 824 Operation Profile Data

- For multiple axes positioning data operation, the positioning data is read from the start positioning data No. (StartDataNo) in ascending order, and the multiple axes positioning operation is executed internally and continuously. For details, refer to the following.

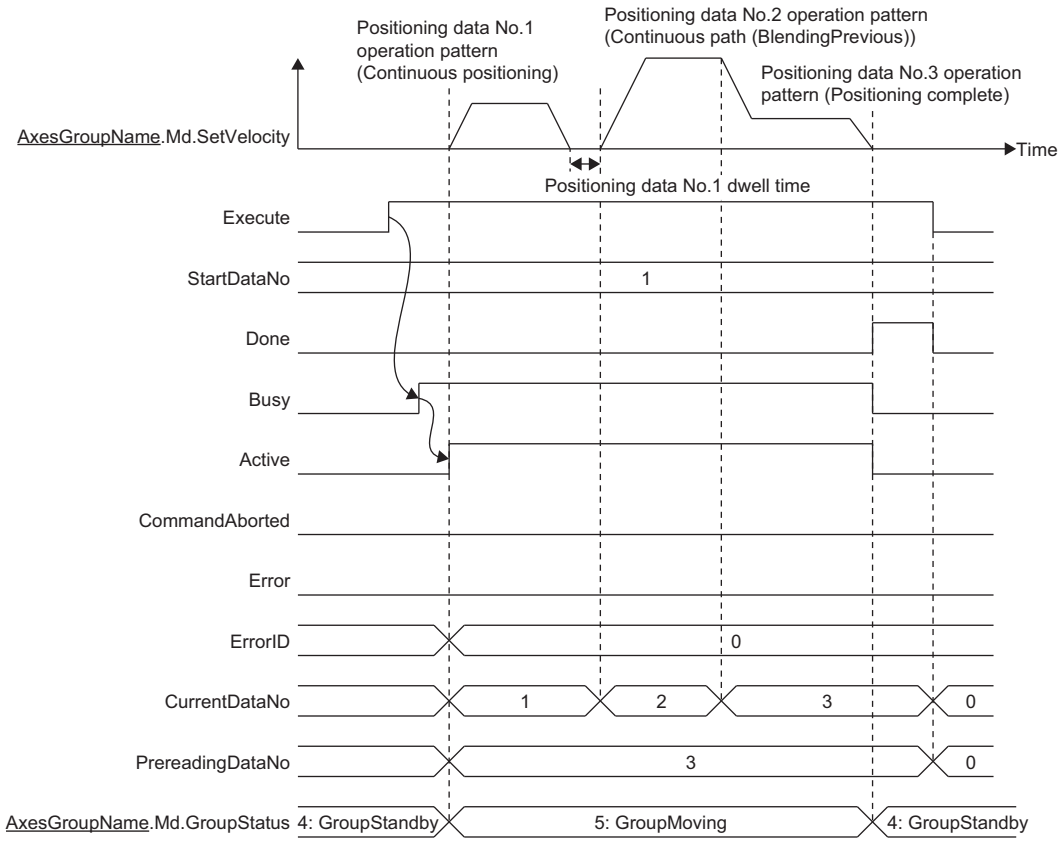
☞ Page 668 Positioning data setting

Timing chart

Axes Group Status (AxesGroupName.Md.GroupStatus) of the axes group during control is "5: Operating (GroupMoving)". For the axes group status, refer to the following.

☞ Page 480 Axes group state transition

■When the operation completes normally



■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type motion control FBs" in the following manual.

MELSEC MX Controller MX-R Model Programming Manual

Positioning data setting

This section describes the positioning operation of multiple axes positioning data operation by positioning data settings. The positioning data is set in the operation profile data (multiple axes positioning data format). For details on the operation profile data (multiple axes positioning data format), refer to the following.

☞ Page 849 Multiple axes positioning data

Positioning data to be set

The positioning data to be set differs depending on the Control method (ControlMethod). The positioning data that can be set is shown below.

◎: Setting required, ○: Setting as necessary, —: Setting not required (There is no problem if the value is within the setting range such as the initial value)

Variable name	Name	Control method (ControlMethod)					
		Linear interpolation	Circular interpolation	NOP	JUMP	LOOP	LEND
DataNo	Positioning data No.	◎	◎	◎	◎	◎	◎
OperationPattern	Operation pattern	◎	◎	—	—	—	—
ControlMethod	Control method	◎	◎	◎	◎	◎	◎
InterpolationAxis1 to InterpolationAxis4	Interpolation axis 1 to Interpolation axis 4	◎*1	◎*2	—	—	—	—
CircMode	Circular interpolation mode	—	◎	—	—	—	—
CircPathChoice	Path selection	—	◎	—	—	—	—
Position1 to Position4	Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4	◎*1	◎*2	—	—	—	—
Direction1 to Direction4	Direction selection 1 to Direction selection 4	○	—	—	—	—	—
CircAuxPoint1 to CircAuxPoint4	Sub point 1 to Sub point 4	—	◎*2	—	—	—	—
VelocityMode	Velocity mode	○	—	—	—	—	—
Velocity	Velocity	○	○	—	—	—	—
Acceleration	Acceleration	○	○	—	—	—	—
Deceleration	Deceleration	○	○	—	—	—	—
Jerk	Jerk	○	○	—	—	—	—
CircErrorTolerance	Circular interpolation error tolerance	—	○	—	—	—	—
DataOptions	Positioning data options	○	○	—	—	—	—
DwellTime	Dwell time	○	○	—	—	—	—
Mcode	M code	○	○	—	—	—	—
McodeOutput_Override	M code output timing override	○	○	—	—	—	—
JumpDestinationDataNo	Jump destination positioning data No.	—	—	—	◎	—	—
ConditionSignalNo	Condition signal No.	—	—	—	○	—	—
LoopCount	Number of LOOP to LEND repetitions	—	—	—	—	◎	—
SkipSignalNo	Skip signal No.	○	○	—	—	—	—
Pitch	Pitch	—	—	—	—	—	—

*1 It is as follows according to the number of axes of the configuration axis to be set.
◎: Setting required, —: Setting not required

Variable name	Name	1 axis	2 axes	3 axes	4 axes
InterpolationAxis1	Interpolation axis 1	◎	◎	◎	◎
InterpolationAxis2	Interpolation axis 2	—	◎	◎	◎
InterpolationAxis3	Interpolation axis 3	—	—	◎	◎
InterpolationAxis4	Interpolation axis 4	—	—	—	◎
Position1	Target position/Movement amount/End point 1	◎	◎	◎	◎
Position2	Target position/Movement amount/End point 2	—	◎	◎	◎
Position3	Target position/Movement amount/End point 3	—	—	◎	◎
Position4	Target position/Movement amount/End point 4	—	—	—	◎

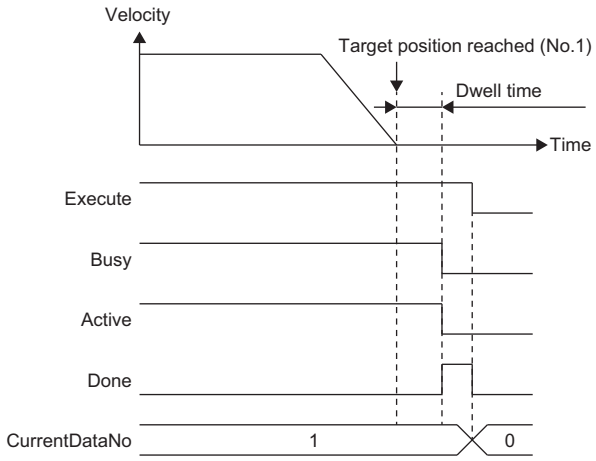
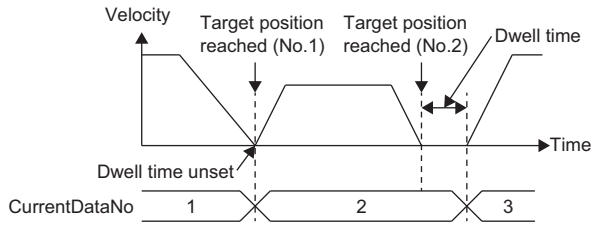
*2 Interpolation axis 3 (InterpolationAxis3), Interpolation axis 4 (InterpolationAxis4), Target position/Movement amount/End point 3 (Position3), Target position/Movement amount/End point 4 (Position4), Sub point 3 (CircAuxPoint3), and Sub point 4 (CircAuxPoint4) become "—: Setting not required".

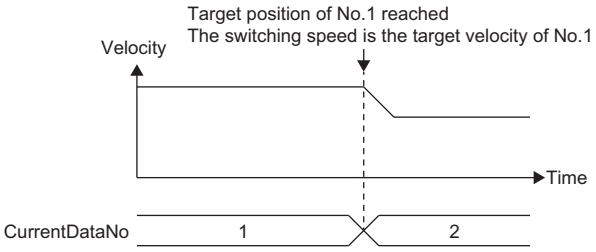
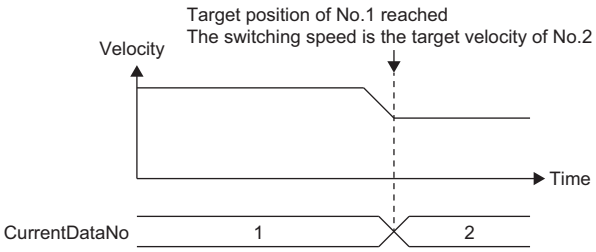
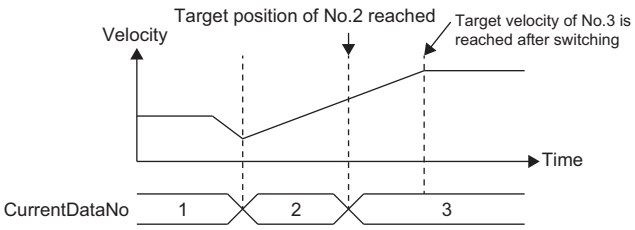
■Positioning data No. (DataNo)

- The positioning data No. sets the index number of the positioning data.
- MCv_MovePositioningData (multiple axes positioning data operation) executes the positioning data in the order of positioning data No. (DataNo). It sets the positioning data so that the positioning data No. (DataNo) is in ascending order.
- For multiple axes positioning data operation, the positioning data is read from the start positioning data No. (StartDataNo) in ascending order, and the multiple axes interpolation operation is executed internally and continuously.
- Set whether to execute or not to execute the next positioning data in the operation pattern. (☞ Page 670 Operation pattern (OperationPattern))
- In multiple axes positioning data operation, the empty (unset) positioning data No. cannot be used. If the unset positioning data No. is executed in multiple axes positioning data operation, Out of setting range of operation profile data in multiple axes positioning data format (error code: 1B35H) will occur at the time of reading the corresponding positioning data.
- The setting range is "1 to total number of positioning data".

■Operation pattern (OperationPattern)

- Set whether to execute the positioning data after the specified data continuously or not.
- In positioning continue data, the positioning data of the next data No. is automatically executed. The operation pattern (OperationPattern) of positioning data that is the final positioning operation is set to "0: Positioning complete (PositioningComplete)" to complete multiple axes positioning data operation.
- For positioning continue data, the operation is continued until it reaches the positioning complete data. Therefore, if there is no positioning complete data, the operation is executed up to the positioning data No. of the total number of positioning data, and the operation will be executed again from positioning data No.1.
- There are the following types of operation patterns (OperationPattern). The type that can be set differs depending on the Control method (ControlMethod).

Positioning continue/ complete	Setting value	Description
Complete	0: Positioning complete (PositioningComplete)	• The positioning of the specified one data is executed and multiple axes positioning data operation is completed when the target position is reached. • When the dwell time is set, the control is completed after the set time elapses. 
Continue	1: Continuous positioning (ContinuousPositioning)	• The positioning of the next positioning data No. is executed automatically. • The next positioning is executed sequentially after the target position is reached. When the target position is reached, the operation will decelerate automatically, and after the set velocity of axes group becomes 0, the next positioning is executed. • When the dwell time is set, the next positioning is executed after the set time elapses. • When the M code is set, the next positioning is executed after the M code is reset. For details, refer to the following. ☞ Page 700 M code output function 
Continue	2: Continuous path (BlendingLow) (ContinuousBlendingLow)	• The positioning of the next positioning data No. is executed automatically. • The next positioning is executed sequentially after the target position is reached. The operation does not stop between the positioning that is being executed and the next positioning. • When the dwell time is set, the operation is the same as the continuous positioning. • The smaller target velocity between the positioning that is being executed and the next positioning is used as the switching velocity. • When the velocity of the positioning that is being executed is smaller, the operation is the same as continuous path (BlendingPrevious), and when the velocity of the next positioning is smaller, the operation is the same as continuous path (BlendingNext).

Positioning continue/ complete	Setting value	Description
Continue	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	• The positioning of the next positioning data No. is executed automatically. • The next positioning is executed sequentially after the target position is reached. The operation does not stop between the positioning that is being executed and the next positioning. • When the dwell time is set, the operation is the same as the continuous positioning. • Operation is performed at the target velocity of the positioning that is being executed until the target position is reached. • When the positioning data is switched, the velocity change is executed to the target velocity of the next positioning. 
Continue	4: Continuous path (BlendingNext) (ContinuousBlendingNext)	• The positioning of the next positioning data No. is executed automatically. • The next positioning is executed sequentially after the target position is reached. The operation does not stop between the positioning that is being executed and the next positioning. • When the dwell time is set, the operation is the same as the continuous positioning. • Operation is performed so that the command velocity becomes the target velocity of the next positioning at the target position.  • Depending on the movement amount of the positioning that is being executed, the movement amount to execute the velocity change to the target velocity of the next positioning may be insufficient at the target position of the positioning that is being executed. In this case, the velocity change is started immediately, but the velocity cannot reach the target velocity of the next positioning at the target position of the positioning that is being executed. 
Continue	5: Continuous path (BlendingHigh) (ContinuousBlendingHigh)	• The positioning of the next positioning data No. is executed automatically. • The next positioning is executed sequentially after the target position is reached. The operation does not stop between the positioning that is being executed and the next positioning. • When the dwell time is set, the operation is the same as the continuous positioning. • The larger target velocity between the positioning that is being executed and the next positioning is used as the switching velocity. • When the velocity of the positioning that is being executed is larger, the operation is the same as continuous path (BlendingPrevious), and when the velocity of the next positioning is larger, the operation is the same as continuous path (BlendingNext).
Continue	— (No setting)	For the control method (NOP, JUMP, LOOP, and LEND) which does not require the setting of the operation pattern, positioning is continued, but the positioning data No. to be executed next differs depending on the control method. For details, refer to the following. ☞ Page 672 Control method (ControlMethod)

■Control method (ControlMethod)

- Set the control method of the positioning data.
- If the Control method (ControlMethod) of the positioning data specified in the positioning data No. (DataNo) is other (NOP, JUMP, LOOP, and LEND) when multiple axes positioning data operation is executed, the data is read sequentially from the start positioning data No. (StartDataNo) until the positioning data of the positioning operation (linear interpolation, circular interpolation) is read. The positioning data of the positioning operation read first becomes the positioning operation to be executed first. For the reading after the positioning data No., which executes the positioning operation first, refer to the following.

☞ Page 684 Pre-read

- There are the following types of control methods.

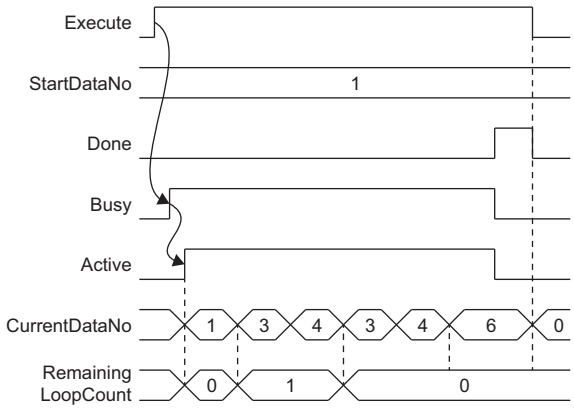
Positioning operation	Setting value	Description
Linear interpolation	0101H: Absolute value linear interpolation (LinearAbsolute)	The linear interpolation operation is executed by specifying the target position of the absolute position so that the path from the start point (move start point) to the end point becomes a straight line. For control details on the linear interpolation, refer to the following.*1 ☞ Page 649 Linear interpolation control
	0102H: Relative value linear interpolation (LinearRelative)	The linear interpolation operation is executed by specifying the relative movement amount from the current position so that the path from the start point (move start point) to the end point becomes a straight line. For control details on the linear interpolation, refer to the following.*1 ☞ Page 649 Linear interpolation control
Circular interpolation	0103H: Absolute value circular interpolation (CircularAbsolute)	2-axis circular interpolation operation is executed by specifying the absolute position end point and sub point so that the path from the start point (move start point) to the end point becomes an arc with respect to 2 linear axes which are orthogonally arranged mechanically. For control details on the circular interpolation, refer to the following.*1 ☞ Page 655 Circular interpolation control
	0104H: Relative value circular interpolation (CircularRelative)	2-axis circular interpolation operation is executed by specifying the end point and the movement amount of sub point from the current position so that the path from the start point (move start point) to the end point becomes an arc with respect to 2 linear axes which are orthogonally arranged mechanically. For control details on the circular interpolation, refer to the following.*1 ☞ Page 655 Circular interpolation control

Positioning operation	Setting value	Description
Others	0080H: NOP (NOP)	Move to the next positioning data No. without processing. ■NOP application example In the middle of the positioning between two points, if there is a possibility of velocity switching or temporary stop (automatic deceleration) in the future, the positioning operation can be changed by simply replacing the control method after reserving the data by NOP.
	0082H: JUMP (JUMP)	The JUMP positioning data jumps to the specified positioning data No. There are the following types of JUMP. ■JUMP with no condition • The JUMP execution conditions are not set. • Jump to the positioning data No. set to the jump destination positioning data No. (JumpDestinationDataNo) of the positioning data. • Set the condition signal No. (ConditionSignalNo) of the positioning data to "0" or omit the setting. ■Condition JUMP • The JUMP execution conditions are set. • Use the condition signal set to the condition signal No. (ConditionSignalNo) of the positioning data as the execution condition. • The execution condition uses the Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10) of the operation profile data (multiple axes positioning data format). Set the external signal (bit input signal) to the condition signal. For details on the setting, refer to the following. ☞ Page 691 Condition signal setting • Set the number used for each positioning data from the condition signals as the condition signal No. (ConditionSignalNo). For example, set the condition signal No. (ConditionSignalNo) to "2" when the condition signal 2 (ConditionSignal2) is used. • If the condition signal set in the condition signal No. (ConditionSignalNo) is in signal input status, execution conditions are determined to be satisfied, and if the condition signal is not in signal input status, execution conditions are determined to be not satisfied. • When the execution condition is satisfied, jump to the positioning data No. set to the jump destination positioning data No. (JumpDestinationDataNo) of the positioning data. When the execution condition is not satisfied, execute the next positioning data No. without jumping. • The execution condition is determined when the corresponding positioning data whose Control method (ControlMethod) is "0082H: JUMP (JUMP)" is pre-read.
	0083H: LOOP (LOOP)	Execute the loop control by repetition (LOOP to LEND).*2 Repeat the positioning data between LOOP and LEND loops according to the number of times set to the Number of LOOP to LEND repetitions (LoopCount) of the positioning data.
	0084H: LEND (LEND)	Return to the start of the repetition (LOOP to LEND) loop.*2 The loop terminates when the loop for the number of times of the Number of LOOP to LEND repetitions (LoopCount) set in LOOP is executed. Thereafter, the positioning data of the next positioning data No. is executed. To complete the control after the repetition of the number of times of the Number of LOOP to LEND repetitions (LoopCount) is executed, set it as follows. • Set the positioning data whose operation pattern (OperationPattern) is "1: Continuous positioning (ContinuousPositioning)" to the positioning data No. before LEND. • Set the dummy positioning data (for example, relative value linear interpolation with movement amount 0) to the next positioning data No. of LEND.

*1 The following specifications are different for positioning operations (linear interpolation, circular interpolation).

Function	Description
Control change function	There is no control change function by restart/continuous update. Use the override function when executing control change of the target velocity, acceleration/deceleration, or acceleration/deceleration time. For details on the override function, refer to the following. ☞ Page 690 Override function ☞ Page 1116 Override Function
Continuous execution of positioning data	There is no multiple start for the continuous execution of the positioning data. Use the operation pattern (OperationPattern) for the continuous execution of the positioning data.

*2 The following table lists the operation of the repetition loop with LOOP and LEND set.

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Number of LOOP to LEND repetitions (LoopCount)	Operation
1	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	The execution order is as follows: Positioning data No.1 → No.2 → No.3 → No.4 → No.5 → No.2 → No.3 → No.4 → No.5 → No.6. • Timing chart 
2	—	0083H: LOOP (LOOP)	2	
3	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	
4	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	
5	—	0084H: LEND (LEND)	—	
6	0: Positioning complete (PositioningComplete)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	

Precautions

- Set the positioning data No. of the positioning data in which the method other than JUMP is set in the jump destination positioning data No. (JumpDestinationDataNo). If the Control method (ControlMethod) of the jump destination is "0083H: JUMP (JUMP)", Multiple axes positioning data control method incorrect (error code: 1B36H) will occur when executing FB or during control.
- If the condition JUMP is used, the execution condition (signal status of condition signal) is determined when the corresponding positioning data whose Control method (ControlMethod) is "0082H: JUMP (JUMP)" is pre-read. Satisfy the execution condition before the pre-reading positioning data No. (PrereadingDataNo) passes through JUMP. If the condition is not satisfied before passing, the execution condition is regarded as not satisfied in the processing.

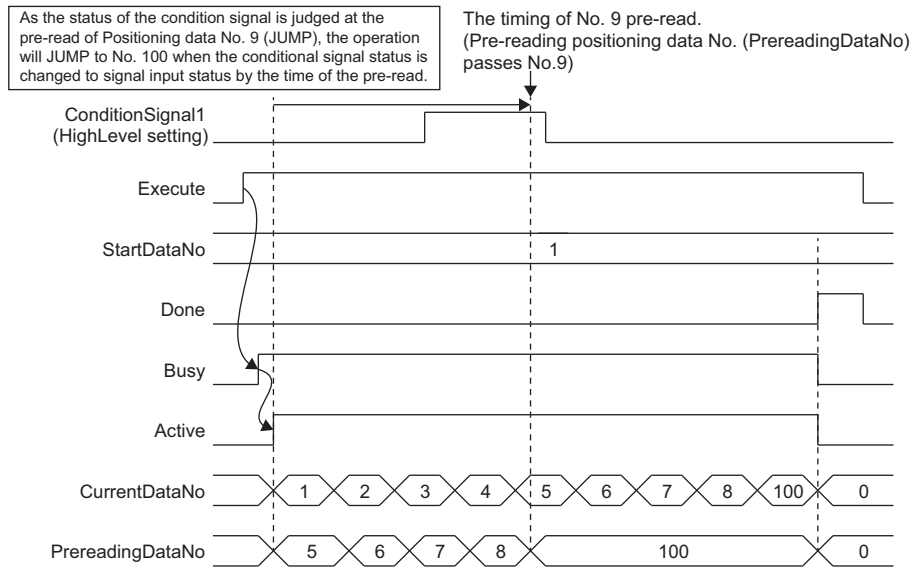
Ex.

When the following positioning data is set

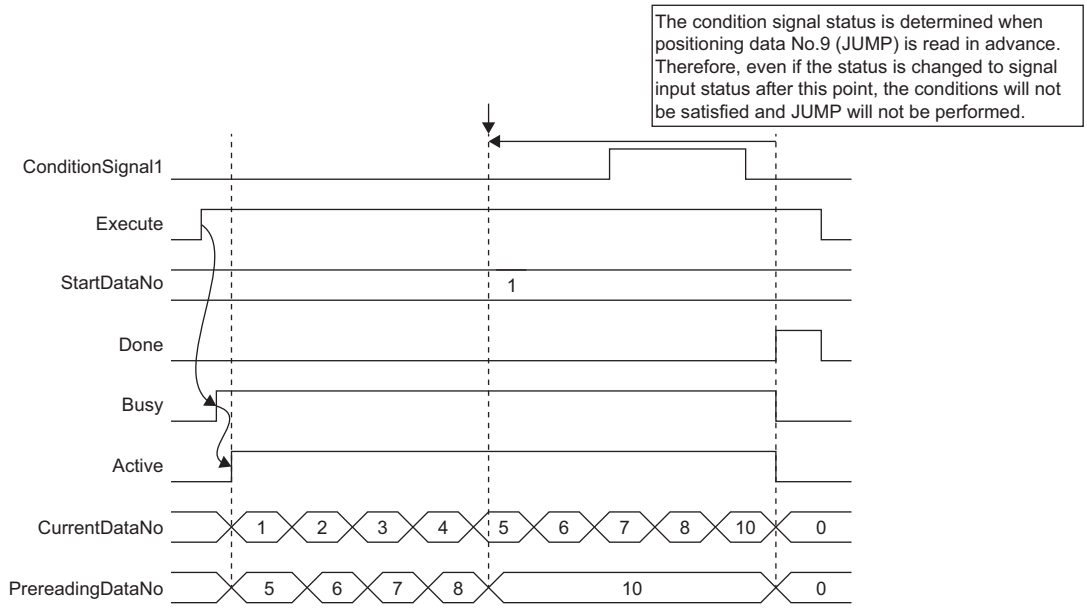
Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Jump destination positioning data No. (JumpDestinationDataNo)	Condition signal No. (ConditionSignalNo)
1	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
2	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
3	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
4	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
5	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
6	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
7	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Jump destination positioning data No. (JumpDestinationDataNo)	Condition signal No. (ConditionSignalNo)
8	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
9	—	0082H: JUMP (JUMP)	100	1
10	0: Positioning complete (PositioningComplete)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—
⋮	⋮	⋮	⋮	⋮
100	0: Positioning complete (PositioningComplete)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—

■When the condition signal is set to the signal input status before the condition JUMP is pre-read



■When the condition signal is set to the signal input status after the condition JUMP is pre-read



- An error does not occur even if there is no LEND after LOOP, but the loop control is not executed.
- LEND before LOOP execution is disabled.
- If there is positioning complete data between LOOP and LEND, the multiple axes positioning data operation is completed after executing the positioning data, and the loop control is not executed.

• LOOP and LEND cannot be nested between them. If nested, the loop control is executed only between the inner LOOP and LEND.

Ex.

When the loop control is executed only between the inner LOOP and LEND

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Number of LOOP to LEND repetitions (LoopCount)	Operation
1	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	• The execution order is as follows: Positioning data No.1 → No.2 → No.3 → No.4 → No.5 → No.6 → No.7 → No.4 → No.5 → No.6 → No.7 → No.8 → No.9. • The settings of LOOP for positioning data No.2 and LEND for positioning data No.8 will be disabled.
2	—	0083H: LOOP (LOOP)	3	
3	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	
4	—	0083H: LOOP (LOOP)	2	
5	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	
6	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	
7	—	0084H: LEND (LEND)	—	
8	—	0084H: LEND (LEND)	—	
9	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	

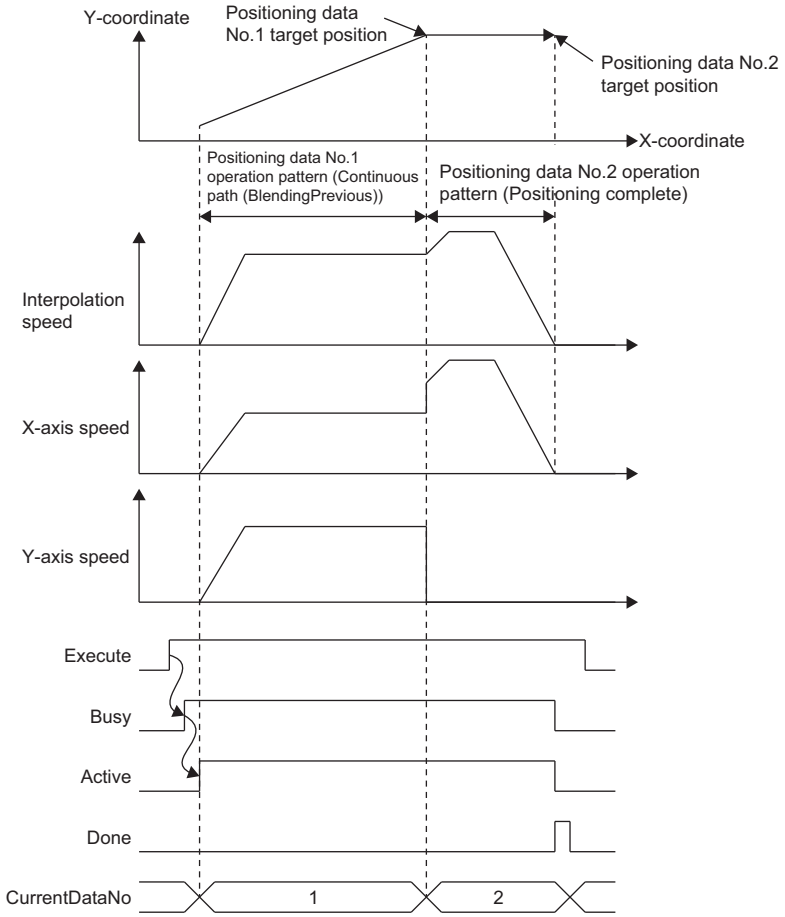
• Even if JUMP is set after LOOP, the loop control is executed if there is a LEND after JUMP destination positioning data No.

Ex.

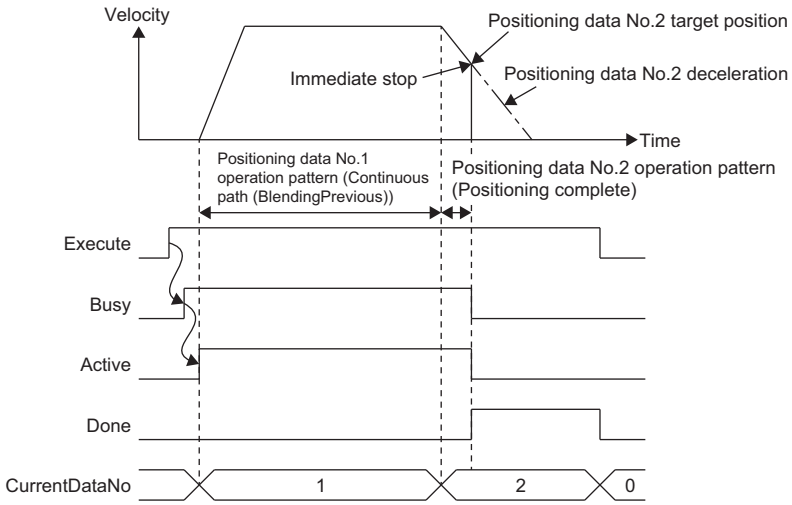
When LOOP to LEND and JUMP (JUMP with no condition) are combined

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Positioning data No. (DataNo)	Jump destination positioning data No. (JumpDestinationDataNo)	Operation
1	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—	• The execution order is as follows: Positioning data No.1 → No.2 → No.3 → No.4 → No.101 → No.102 → No.2 → No.3 → No.4 → No.101 → No.102 → No.103. • Even if there is a LOOP or LEND in positioning data No.5 to No.100, these settings are disabled because they are not in the execution order.
2	—	0083H: LOOP (LOOP)	2	—	
3	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—	
4	—	0082H: JUMP (JUMP)	—	101	
⋮	⋮	⋮	⋮	⋮	
101	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—	
102	—	0084H: LEND (LEND)	—	—	
103	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	—	

- When switching from the positioning data of multiple axes interpolation data and continuous path data to the next positioning data, the interpolation velocity at the time of switching is used as the switching velocity. Therefore, acceleration/deceleration may not be executed and a rapid velocity change may occur depending on the movement amount and movement direction of each axis for the next positioning data.



- When switching from the continuous path data to positioning complete data or continuous positioning data, the deceleration distance cannot be secured after switching at the switching velocity, and the target position may be overrun. In this case, the automatic deceleration operation is executed according to the setting of Operation Setting at Overrun (AxesGroupName.Pr.OverrunOperation).

Setting value	Operation
1: Immediate Stop (ImmediateStop)	The axis starts deceleration immediately, and it stops immediately at reaching the target position after outputting Overrun Warning. 

Point

When switching to continuous positioning data and decelerating due to insufficient movement amount, the positioning of the next positioning data No. is executed after stopping the axis.

- Other (NOP, JUMP, LOOP, and LEND) positioning data has an upper limit on the number of continuous executions. Set the positioning data so that it does not exceed the upper limit of the number of continuous executions. If the upper limit is exceeded when executing FB or during control, Multiple axes positioning data control method incorrect (error code: 1B36H) will occur.

Upper limit of the number of continuous executions
100 times

Ex.

When NOP is used in positioning data No.2 to No.102

In the following cases, errors can be avoided by setting the Control method (ControlMethod) of No.2 to "0082H: JUMP (JUMP)" and jump destination positioning data No. (JumpDestinationDataNo) to "103".

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Jump destination positioning data No. (JumpDestinationDataNo)	Operation
1	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	The upper limit value is exceeded in positioning data No.2 → ... → No.102, and an error will occur.
2	—	0080H: NOP (NOP)	—	
⋮	⋮	⋮	⋮	
102	—	0080H: NOP (NOP)	—	
103	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	

Ex.

For the standby operation that loops until conditions are satisfied only with condition JUMP

Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Jump destination positioning data No. (JumpDestinationDataNo)	Operation
1	—	0080H: NOP (NOP)	—	The upper limit is exceeded in positioning data No.1 → No.2 → No.1 → ... by repeating NOP and JUMP, and an error will occur.
2	—	0082H: JUMP (JUMP)	1	
3	1: Continuous positioning (ContinuousPositioning)	0101H: Absolute value linear interpolation (LinearAbsolute)	—	

Configure the user program to interlock the FB start when executing the standby operation before executing FB.

Use the M code output function when executing the standby operation with positioning data in the middle. For details on the M code output function, refer to the following.

☞ Page 700 M code output function

■Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4)

- Set interpolation axes from configuration axes of the axes group.
- The setting range is 1 to 16.
- The setting details differ depending on the settings of the Control method (ControlMethod).

Control method (ControlMethod)	Description
0101H: Absolute value linear interpolation (LinearAbsolute)	Set the linear interpolation axes (LinearAxes) of the linear interpolation. For details, refer to the following. ☞ Page 649 Linear interpolation control However, read Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4) as the linear interpolation axes (LinearAxes[0] to LinearAxes[3]).
0102H: Relative value linear interpolation (LinearRelative)	
0103H: Absolute value circular interpolation (CircularAbsolute)	Set the circular interpolation axes (CircAxes[0], CircAxes[1]) of the circular interpolation to Interpolation axis 1 (InterpolationAxis1) and Interpolation axis 2 (InterpolationAxis2). For details, refer to the following. ☞ Page 655 Circular interpolation control Interpolation axis 3 (InterpolationAxis3) and interpolation axis 4 (InterpolationAxis4) are not used. The setting is disabled.
0104H: Relative value circular interpolation (CircularRelative)	

- Regarding configuration axes specified as interpolation axes, a different configuration axis and the number of interpolation axes can be set for each positioning data. However, note that if the specified configuration axis or the number of interpolation axes is different between continuous path data and the next positioning data, each axis velocity may rapidly change when switching the positioning data. For the positioning speed, refer to the following.

☞ Page 686 Positioning speed

☞ Page 638 Positioning speed in multiple axes positioning control

■Circular interpolation mode (CircMode)

Set the circular interpolation method (border point specification, center point specification, and radius specification) for executing the circular interpolation control.

For details on the circular interpolation mode (CircMode), refer to the following.

☞ Page 655 Border point specification

☞ Page 657 Center point specification

☞ Page 660 Radius specification

■Path selection (CircPathChoice)

Set the rotation direction of the circular interpolation control (CW, CCW, shortcut, detour, CW detour, CCW detour).

The path selection (CircPathChoice) that can be set differs depending on the circular interpolation mode (CircMode).

For details, refer to the following.

☞ Page 659 Path of central point specification circular interpolation control

☞ Page 662 Path of radius specification circular interpolation control

■Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4)

The setting details differ depending on the settings of the Control method (ControlMethod).

Control method (ControlMethod)	Description
0101H: Absolute value linear interpolation (LinearAbsolute)	• Set the target position of the absolute position. • Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4) indicate the target position of the configuration axis set by Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4). • Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4) corresponding to "0" or omitted Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4) can be omitted. • For the setting value, refer to MC_MoveAbsolute (Absolute Value Positioning) in the following manual. MELSEC MX Controller MX-R Model Programming Manual
0102H: Relative value linear interpolation (LinearRelative)	• Set the movement amount from the current position when the positioning data is executed. • Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4) indicate the movement amount of the configuration axis set by Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4). • Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4) corresponding to "0" or omitted Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4) can be omitted. • The setting value is "-10000000000.0 to 10000000000.0".
0103H: Absolute value circular interpolation (CircularAbsolute)	• Set the end position of the absolute position. • Target position/Movement amount/End point 1 (Position1) and Target position/Movement amount/End point 2 (Position2) indicate the target position of the configuration axis set by Interpolation axis 1 (InterpolationAxis1) and Interpolation axis 2 (InterpolationAxis2). • Target position/Movement amount/End point 3 (Position3) and Target position/Movement amount/End point 4 (Position4) can be omitted. (The setting is disabled.) • The setting value is "-10000000000.0 ≤ Setting value < 10000000000.0". * When the ring counter is enabled, it becomes the ring counter range.
0104H: Relative value circular interpolation (CircularRelative)	• Set the movement amount from the current position to the end point when the positioning data is executed. • Target position/Movement amount/End point 1 (Position1) and Target position/Movement amount/End point 2 (Position2) indicate the movement amount of the configuration axis set by Interpolation axis 1 (InterpolationAxis1) and Interpolation axis 2 (InterpolationAxis2). • Target position/Movement amount/End point 3 (Position3) and Target position/Movement amount/End point 4 (Position4) can be omitted. (The setting is disabled.) • The setting value is "-10000000000.0 to 10000000000.0".

■Direction selection 1 to Direction selection 4 (Direction1 to Direction4)

Set the direction (positive direction, negative direction, and shortest path) to be moved by linear interpolation control.

The setting details differ depending on the settings of the Control method (ControlMethod).

Control method (ControlMethod)	Description
0101H: Absolute value linear interpolation (LinearAbsolute)	• Set the movement direction (positive direction, negative direction, and shortest path) from the current position to the target position. • Direction selection 1 to Direction selection 4 (Direction1 to Direction4) indicate the direction selection of the configuration axis set by Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4). • The setting value is disabled for interpolation axes with software stroke limit enabled. • The array elements of Direction selection 1 to Direction selection 4 (Direction1 to Direction4) corresponding to "0" or omitted Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4) can be omitted. • For details on each direction selection, refer to MC_MoveAbsolute (Absolute Value Positioning) in the following manual. MELSEC MX Controller MX-R Model Programming Manual
0102H: Relative value linear interpolation (LinearRelative)	No setting is required. The setting value is disabled.

■Sub point 1 to Sub point 4 (CircAuxPoint1 to CircAuxPoint4)

Set the position of the sub point (boundary point, center point, and radius) to execute the circular interpolation control.
The setting details differ depending on the settings of the circular interpolation mode (CircMode).

Circular interpolation mode (CircMode)	Description
0: Border point specification (mcBorder) 1: Center point specification (mcCenter)	• Sub point 1 (CircAuxPoint1) and Sub point 2 (CircAuxPoint2) indicate the boundary point/center point of the configuration axis set by Interpolation axis 1 (InterpolationAxis1) and Interpolation axis 2 (InterpolationAxis2). Set in absolute value or relative value. • Sub point 3 (CircAuxPoint3) and Sub point 4 (CircAuxPoint4) can be omitted. (The setting is disabled.) • According to the set control method (ControlMethod), the setting range is shown below. ■0103H: Absolute value circular interpolation (CircularAbsolute) -10000000000.0 ≤ Setting value < 10000000000.0 * When the ring counter is enabled, it becomes the ring counter range. ■0104H: Relative value circular interpolation (CircularRelative) -10000000000.0 to 10000000000.0
2: Radius specification (mcRadius)	• Sub point 1 (CircAuxPoint1) indicates the radius of the arc. • Sub point 2 to Sub point 4 (CircAuxPoint2 to CircAuxPoint4) can be omitted. (The setting is disabled.) • The setting range is "0.000001 to 2147483647.0".

■Velocity mode (VelocityMode)

Set the velocity mode (vector velocity, long axis velocity, and reference axis velocity) of linear interpolation control.

The setting details differ depending on the settings of the circular interpolation mode (CircMode).

For details on the Velocity mode (VelocityMode), refer to the following.

☞ Page 638 Vector velocity specification

☞ Page 639 Long axis velocity specification

☞ Page 640 Reference axis velocity specification

■Velocity (Velocity)

Set the positioning speed for multiple axes interpolation. For details, refer to the following.

☞ Page 638 Positioning speed in multiple axes positioning control

The setting range is "0, 0.0001 to 2500000000.0".

■Acceleration (Acceleration)

Set the acceleration for multiple axes interpolation.

The setting details differ depending on the settings of acceleration/deceleration method setting (bit 0 to 2) for positioning data options (DataOptions).

For details on the acceleration/deceleration method, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

■Deceleration (Deceleration)

Set the deceleration for multiple axes interpolation.

The setting details differ depending on the settings of acceleration/deceleration method setting (bit 0 to 2) for positioning data options (DataOptions).

For details on the acceleration/deceleration method, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

■Jerk (Jerk)

Set the jerk for multiple axes positioning control.

The setting details differ depending on the settings of acceleration/deceleration method setting (bit 0 to 2) for positioning data options (DataOptions).

For details on the acceleration/deceleration method, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

■Circular interpolation error tolerance (CircErrorTolerance)

Set the circular interpolation error tolerance when executing the circular interpolation control of center point specification.

The setting details differ depending on the settings of the Control method (ControlMethod).

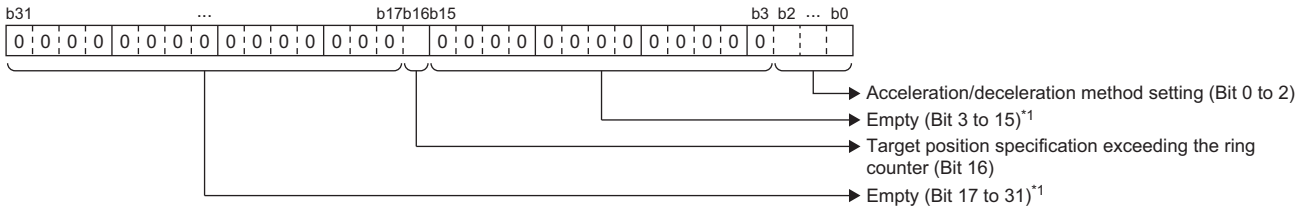
For details on the circular interpolation error tolerance (CircErrorTolerance), refer to the following.

☞ Page 660 Circular interpolation error tolerance

The setting range is "0.000001 to 100000.0".

■Positioning data options (DataOptions)

Set the function options of linear interpolation control and circular interpolation control by bit specification.



*1 Set "0" to the empty space. When setting other than "0", Out of options range (error code: 1ABBH) occurs.

Bit	Name	Description
0 to 2	Acceleration/deceleration method setting	Sets the acceleration/deceleration method to execute control. • 0: Acceleration/deceleration specification method (mcAccDec) • 1: Acceleration/deceleration time-fixed method (mcFixedTime) * For details on the acceleration/deceleration method, refer to the following. ☞ Page 1078 Acceleration/deceleration method
16	Target position specification exceeding the ring counter	Sets whether the target position that exceeds the ring counter upper limit value and the ring counter lower limit value is allowed or not when the software stroke limit is disabled. Sets when "0101H: Absolute value linear interpolation (LinearAbsolute)" is set in Control method (ControlMethod). • 0: Not allowed • 1: Allow

■Dwell time (DwellTime)

Set the dwell time.

The setting range is shown below.

• 0.0 [s]: Dwell function disabled

• 0.000001 [s] to 8400.0 [s]: Dwell function enabled

*1 When a positive number less than 0.000001 is set, the value is imported as "0.0 [s]".

■M code (Mcode)

Set the M code for each positioning data.

Set "0 (initial value)" when the M code is not output.

The setting range is "1 to 65535".

■M code output timing override (McodeOutput_Override)

Set the M code output timing for each positioning data.

For details on the M code output timing, refer to the following.

☞ Page 700 M code output function

Setting value	Description
0: Use FB options (UseFbOptions)	Use the setting value of M code output timing (Options (Options): bit 16) for MCv_MovePositioningData (multiple axes positioning data operation).
1: WITH mode (WithMode)	At the start of positioning of the positioning data, the M strobe (Mstrobe) is set to TRUE, and the M code (Mcode) of the positioning data is stored in a valid M code (ValidMcode).
2: AFTER mode (AfterMode)	At the time of reaching the target position (after the set time elapses if dwell time is set), the M strobe (Mstrobe) is set to TRUE, and the M code of the positioning data is stored in the M code (Mcode).

■Jump destination positioning data No. (JumpDestinationDataNo)

Set the positioning data No. of the jump destination in JUMP.

Set the positioning data No. (DataNo) for the positioning data whose Control method (ControlMethod) is other than "0082H: JUMP (JUMP)".

The setting range is "1 to total number of positioning data".

■Condition signal No. (ConditionSignalNo)

Set the condition signal No.

Set "0 (initial value)" when the condition signal is not used.

The setting range is "1 to 10".

■Number of LOOP to LEND repetitions (LoopCount)

Set the number of repetitions of loop control.

The setting range is "1 to 65535".

■Skip signal No. (SkipSignalNo)

Set the skip signal No.

■Pitch (Pitch)

Set "0".

Pre-read

In MCv_MovePositioningData (multiple axes positioning data operation), the motion system pre-reads positioning data ahead from the positioning data that is being executed from the open area of the operation profile data and imports it.

- When executing FB, the multiple axes interpolation data up to 4 ahead from the start positioning data No. (StartDataNo) is pre-read. When executing FB, if the positioning continues even after the pre-read multiple axes interpolation data, the pre-reading is executed while the FB is executed. The pre-reading is executed when the positioning data is switched so that the multiple axes interpolation data up to 4 ahead from the positioning data that is being executed is pre-read.
- The end positioning data No. of the pre-read multiple axes interpolation data is stored in the pre-read positioning data No. (PrereadingDataNo) during FB execution.

Precautions

If the positioning data with a short movement amount is executed continuously, the positioning data in the middle may be waiting for pre-reading.

When waiting for pre-reading in the continuous path data, the set velocity is rapidly changed to "0" in one operation cycle when the target position is reached. After that, the pre-reading is executed and if the data is switched to the positioning data one ahead, the set velocity is rapidly changed to a switching velocity in one operation cycle.

To avoid rapid changes in velocity due to the pre-reading waiting, increase the movement amount of each positioning data or reduce the target velocity.

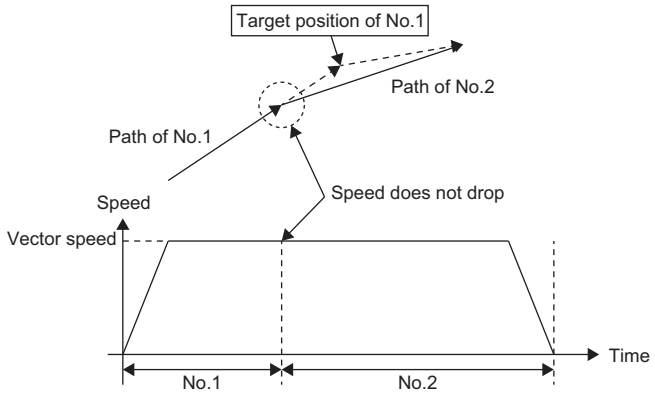
Near pass

For continuous path data, the operation of near pass is executed to suppress machine vibration which occurs at switching of the positioning data of one ahead.

Near pass passes the remainder of the movement amount which occurs at the end of the positioning to the positioning of one ahead. As the alignment is not carried out for each positioning, drops in command velocity can be eliminated and machine vibration which occurs by the velocity change can be suppressed. Since the alignment is not executed for each positioning, the operation is controlled in a path that passes near the target position of the positioning data.

Ex.

When the 2-axis linear interpolation is executed with continuous path (operation pattern of No.1 set as continuous path and continued to No.2)



Precautions

When executing multiple axes interpolation operation with continuous path data, if the movement mount of the multiple axes interpolation operation is small, the command velocity may not reach the target velocity.

Combination with other functions

This section describe the content when the positioning data is executed in the operation pattern for positioning continue.

■Software stroke limit

Basic operation is based on the software stroke limit specifications for the motion FB. For details, refer to the following.

☞ Page 1061 Software Stroke Limit

- Returning from outside the software stroke limit range: While the software stroke limit is disabled in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) for the axes group configuration axis, Start when SW stroke limit is disabled (event code: 07F5H) is recorded in the event history even when positioning data is pre-read in addition to the case of start or multiple start.
- Checking the software stroke limit enabled/disabled
  - By the Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override) of each axes group configuration axis, the software stroke limit check enabled/disabled status can be checked.
  - In addition to start or multiple start, when the positioning data is pre-read, the Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) of the axes group configuration axis is imported and the Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override) is updated. For details on the import value and updating value, refer to the following.

  ☞ Page 1067 Checking the software stroke limit enabled/disabled
- Software stroke limit check specifications: For MCv_MovePositioningData (multiple axes positioning data operation), the check is added for each positioning data.

Check timing	Check details	Processing when an error occurs
When executing FB or during control (When pre-reading positioning data)	An error shall occur if the target position of the positioning data is outside the software stroke limit range.	Software Stroke Limit Over (Target Position) (error code: 1A80H) occurs and the axis control is not executed.
	An error shall occur if the position at the time of executing the positioning data is outside the software stroke limit range.	Software Stroke Limit Over (Start Position) (error code: 1A81H) occurs and the axis control is not executed.
During control	An error shall occur if the current position is outside the software stroke limit range in the middle of control.	Software Stroke Limit Over (Forward Direction) (error code: 1A83H) or Software Stroke Limit Over (Reverse Direction) (error code: 1A84H) occurs and the stop processing is executed.*1

*1 The error occurs when a command to a position outside the software stroke limit range is detected, and the stop processing is executed. To stop within the software stroke limit range, set to "Immediate Stop".

■Hardware stroke limit check

Basic operation is based on the hardware stroke limit specifications for the motion FB. For details, refer to the following.

☞ Page 1069 Hardware Stroke Limit

- Returning from outside the hardware stroke limit range: While the hardware stroke limit is disabled in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) for the axes group configuration axis, Start when HW stroke limit is disabled (event code: 07F6H) is recorded in the event history even when positioning data is pre-read in addition to the case of start or multiple start.
- Checking the hardware stroke limit enabled/disabled
  - By the Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) of each axes group configuration axis, the hardware stroke limit check enabled/disabled status can be checked.
  - In addition to start or multiple start, when the positioning data is pre-read, the Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) of the axes group configuration axis is imported and the Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) is updated. For details on the import value and updating value, refer to the following.

  ☞ Page 1075 Checking whether the hardware stroke limit is enabled/disabled

■Positioning speed

Basic operation is based on the positioning speed specifications in multiple axes positioning control. For details, refer to the following.

☞ Page 638 Positioning speed in multiple axes positioning control

- Operation when specifying velocity 0
  - If the Velocity (Velocity) of the positioning data to be positioned first is set to "0.0" and the MCv_MovePositioningData (multiple axes positioning data operation) is started, Out of velocity range (error code: 1ABAH) will occur. Use the override function when starting the positioning with a target velocity of "0.0" and executing the velocity change during control. For details on the override function, refer to the following.

  ☞ Page 1116 Override Function

  - For details on the override function in multiple axes positioning data operation, refer to the following.

  ☞ Page 690 Override function

  - If the Velocity (Velocity) of the positioning data to be positioned first is set to "0.0" and the multiple start is executed for MCv_MovePositioningData (multiple axes positioning data operation), the following is the operation according to the commanded velocity of the previous FB.
    - 0.0: Out of velocity range (error code: 1ABAH) will occur when multiple start is executed.
    - Other than 0.0: Take over and use the commanded velocity of the previous FB.
  - If the Velocity (Velocity) of the positioning data in the middle is set to "0.0", the commanded velocity of the previous positioning data is taken over and used.
- During continuous path: This section describes the operation when selecting "2: Continuous path (BlendingLow) (ContinuousBlendingLow)", "3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)", "4: Continuous path (BlendingNext) (ContinuousBlendingNext)", and "5: Continuous path (BlendingHigh) (ContinuousBlendingHigh)" in the operation pattern (OperationPattern) of the first positioning data (No.1), and setting a different velocity mode to the Velocity mode (VelocityMode) of the first positioning data (No.1) and the second positioning data (No.2) in the multiple axes positioning data operation.
  - The positioning continue for positioning data (No.1) and positioning data (No.2) can be executed even if the Velocity mode (VelocityMode) of the positioning data (No.1) and positioning data (No.2) is different. However, Multiple start velocity mode specified mismatch warning (event code: 0D11H) occurs when positioning data (No.2) is pre-read.
  - Positioning data (No.1) uses the Velocity mode (VelocityMode) of the positioning data (No.1) to execute positioning operations and positioning data (No.2) uses the Velocity mode (VelocityMode)of the positioning data (No.2) to execute positioning operations.
  - When switching the positioning data between positioning data (No.1) and positioning data (No.2), the velocity is not converted by the velocity mode. The positioning speed value observed in the velocity mode of the positioning data (No.1) is switched to the positioning speed observed in the velocity mode of the positioning data (No.2).
  - Note that the velocity of each axis and the vector velocity may rapidly change when switching the positioning data if the Velocity mode (VelocityMode) between positioning data (No.1) and positioning data (No.2) is different.

Ex.

For "3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)"

The positioning data switching from the reference axis velocity specification to the vector velocity specification is as shown below.

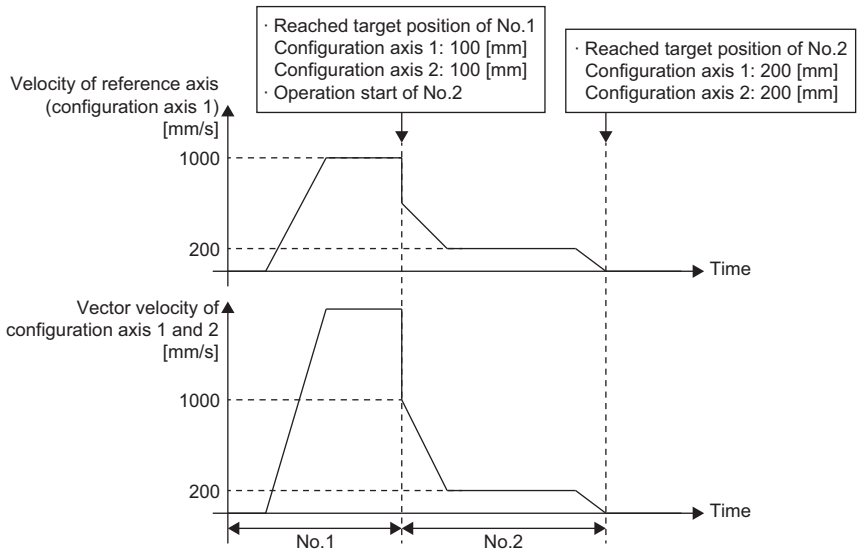
It operates so that the No.1 reference axis velocity becomes the value of the velocity (reference axis velocity) set in Velocity (Velocity) of No.1 at the No.1 target position. The reference axis velocity when reaching the No.1 target position is read as the current vector velocity value of No.2 without unit conversion, and it accelerates/decelerates the vector velocity set to Velocity (Velocity) of No.2.

• Axis setting, Axes group setting

Setting item	Setting value
Position/Velocity command unit of configuration axis 1	mm/s
Position/Velocity command unit of configuration axis 2	mm/s
Position/Velocity command unit of the axes group	mm/s

• Setting of No.1 (command unit: mm/s) and No.2 (command unit: mm/s)

Setting item	Setting value	
	No.1	No.2
Operation pattern (OperationPattern)	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	1: Continuous positioning (ContinuousPositioning)
Control method (ControlMethod)	0101H: Absolute value linear interpolation (LinearAbsolute)	0101H: Absolute value linear interpolation (LinearAbsolute)
Interpolation axis 1 (InterpolationAxis1)	1	1
Interpolation axis 2 (InterpolationAxis2)	2	2
Interpolation axis 3 (InterpolationAxis3)	0	0
Target position/Movement amount/End point 1 (Position1)	100	200
Target position/Movement amount/End point 2 (Position2)	100	200
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)	0: Vector Velocity (VectorSpeed)
Velocity (Velocity)	1000	200



■Operation example

(1) Reaches the target position of No.1 at a reference axis velocity of 1000 [mm/s] of configuration axis 1 that is the reference axis, and switches to No.2.

(2) No.2 starts operation at a vector velocity of 1000 [mm/s].

(3) Decelerates to a vector velocity of 200 [mm/s].

(4) Performs positioning to the target position of No.2.

■Command unit

Basic operation is based on the command unit specifications during multiple axes positioning control. For details, refer to the following.

☞ Page 645 Command unit in the multiple axes positioning control

- Position command unit: When the combination of the position command unit between the axes group and the interpolation axes set in the positioning data is different, Position command unit mismatch warning (event code: 0D08H) occurs at start or pre-reading.
- Velocity command unit during continuous path: This section describes the operation when selecting "2: Continuous path (BlendingLow) (ContinuousBlendingLow)", "3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)", "4: Continuous path (BlendingNext) (ContinuousBlendingNext)", and "5: Continuous path (BlendingHigh) (ContinuousBlendingHigh)" in the operation pattern (OperationPattern) of the first positioning data (No.1), and the velocity command unit of the first positioning data (No.1) and the second positioning data (No.2) is different in the multiple axes positioning data operation.
  - The positioning continue for positioning data (No.1) and positioning data (No.2) can be executed even if the command unit of the positioning data (No.1) and positioning data (No.2) is different. However, Position command unit mismatch warning (event code: 0D08H) occurs when positioning data (No.2) is pre-read.
  - Positioning data (No.1) uses the command unit of the positioning data (No.1) to execute positioning operations and positioning data (No.2) uses the command unit of the positioning data (No.2) to execute positioning operations.
  - When switching the positioning data between positioning data (No.1) and positioning data (No.2), the velocity is not converted by the command unit mode. The positioning speed value observed in the command unit of the positioning data (No.1) is switched to the positioning speed observed in the command unit of the positioning data (No.2).

Ex.

For "3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)"

Even if the command unit of No.1 and No.2 is different, the operation pattern of No.1 can be set as continuous path to continue positioning with No.2. Unit conversion is not carried out, and the speed value of No.1 is given as the speed of No.2.

- Axis setting

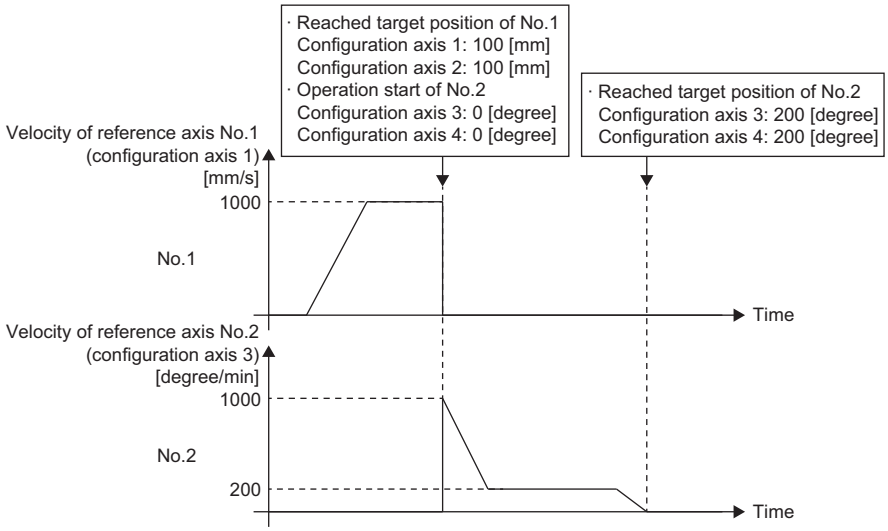
Setting item	Setting value
Position/Velocity command unit of configuration axis 1	mm/s
Position/Velocity command unit of configuration axis 2	mm/s
Position/Velocity command unit of configuration axis 3	degree/min
Position/Velocity command unit of configuration axis 4	degree/min

• Setting of No.1 and No.2

Setting item	Setting value	
	No.1*1	No.2*2
Operation pattern (OperationPattern)	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	1: Continuous positioning (ContinuousPositioning)
Control method (ControlMethod)	0101H: Absolute value linear interpolation (LinearAbsolute)	0101H: Absolute value linear interpolation (LinearAbsolute)
Interpolation axis 1 (InterpolationAxis1)	1	3
Interpolation axis 2 (InterpolationAxis2)	2	4
Interpolation axis 3 (InterpolationAxis3)	0	0
Target position/Movement amount/End point 1 (Position1)	100	200
Target position/Movement amount/End point 2 (Position2)	100	200
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)	2: Reference Axis Velocity (ReferenceAxisSpeed)
Velocity (Velocity)	1000	200

*1 The command unit of No.1 will be changed to "mm/s" as it is the command unit of configuration axis 1.

*2 The command unit of No.2 will be changed to "degree/min" as it is the command unit of configuration axis 3.



■Operation example

(1) Reaches the target position of No.1 at a reference axis velocity of 1000 [mm/s] of configuration axis 1 that is the reference axis, and switches to No.2.

(2) No.2 starts operation at a reference axis (configuration axis 3) velocity of 1000 [degrees/min].

(3) Decelerates to a reference axis (configuration axis 3) velocity of 200 [degrees/min].

(4) Performs positioning to the target position of No.2.

■Velocity limit

Basic operation is based on the velocity limit specifications during interpolation control. For details, refer to the following.

☞ Page 1112 Velocity Limit

Execute the velocity limit for each positioning data.

If the target velocity of the positioning data in the middle exceeds the velocity limit, the operation will be the same as when starting.

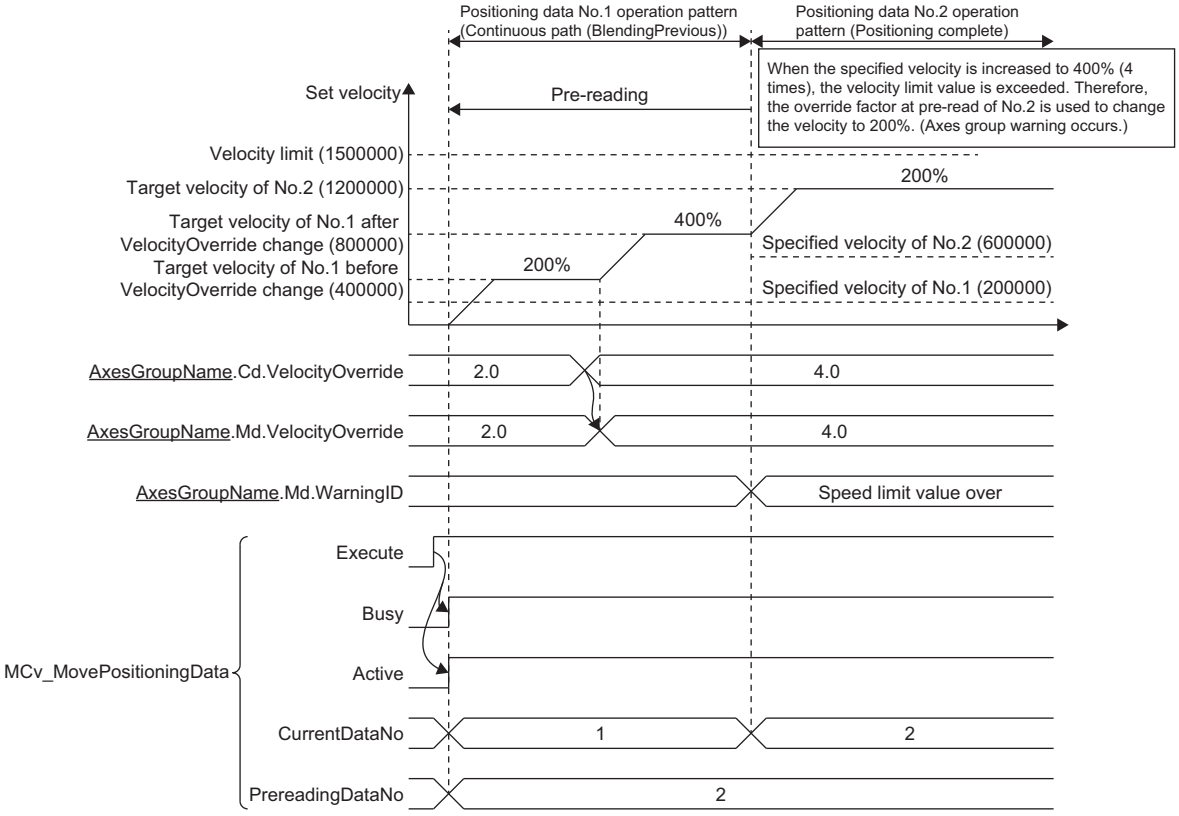
Velocity limit value over (error code: 1A87H) is output at the time of startup or pre-reading during control.

■Override function

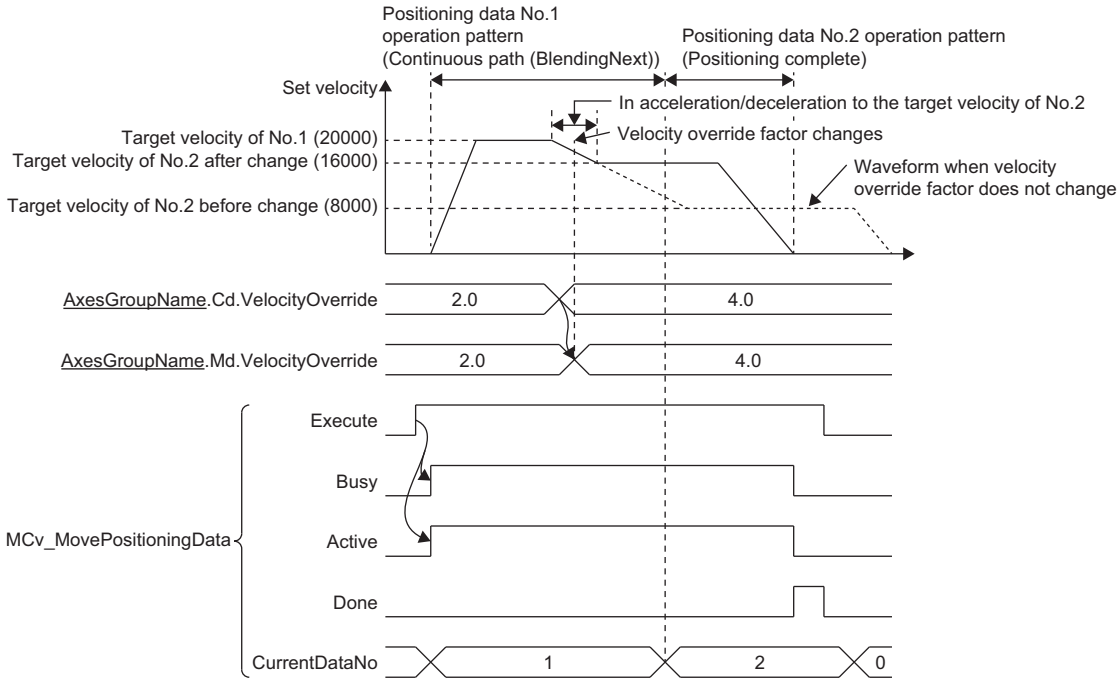
Basic operation is based on the override function specifications. For details, refer to the following.

☞ Page 1116 Override Function

- Operation when velocity/acceleration/deceleration limit value over occurs by override: The operation when velocity/acceleration/deceleration limit value over occurs at positioning data switching is shown below.
  - The control change of the next positioning data is executed at switching.
  - When the control is changed at switching, velocity/acceleration/deceleration limit value over may occur. When velocity/acceleration/deceleration limit value over occurs, the override factor at pre-reading is used to control.
  - Also when velocity/acceleration/deceleration limit value over occurs at switching, the import of override factor is executed. If the limit value is not exceeded at the next control change, the override factor after change will be used for operation.



• Target velocity change during acceleration/deceleration with "4: Continuous path (BlendingNext) (ContinuousBlendingNext)": The operation when the target velocity is changed during acceleration/deceleration until the next positioning target velocity while the positioning data whose operation pattern is "4: Continuous path (BlendingNext) (ContinuousBlendingNext)" is being executed is shown below.



Condition signal setting

This section describes the setting items for Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10) when used in multiple axes positioning data operation.

• The condition signal is used to set the JUMP execution condition to the positioning data whose Control method (ControlMethod) is "0082H: JUMP (JUMP)". For details, refer to the following.

☞ Page 672 Control method (ControlMethod)

• The setting ranges and descriptions for each item are shown below.

Setting item	Setting range	Description
I/O number (StartIO)	—	Not used. The setting is disabled.
Target (Target)	• ""*1 ■Data type • [OBJ]*2*3 • [VAR] • [DEV] ■Type • BOOL * For details on the string format to be set, refer to the following. ☞ Page 1158 TARGET_REF Structure	Sets the signal to be used. ■Setting examples [VAR]AxisName.Md.InVelocity [OBJ] (WORD) 0x60FD0020.0@192.168.4.1
Signal detection method (Detection)	• 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel)	Sets the signal logic.
Compensation Time (CompensationTime)	0.0	Set to "0.0".
Filter Time (FilterTime)	0.0	Set to "0.0".

*1 If the target (Target) is "" (string that has a length of 0), the corresponding condition signal is considered as no setting.

*2 If [OBJ] is set, the target modification cannot be omitted. If the setting is complete with the target modification omitted, Condition signal setting incorrect (error code: 1B37H) will occur.

*3 The MELSEC MX Controller supports specifying "[OBJ]". However, this data type cannot be set in the setting window of GX Works3 version 1.115V. Alternatively, create a network label corresponding to the object to be specified with "[OBJ]", and specify it as "[VAR]". (☞ Page 108 Network labels)

• If a value outside the range is set, Condition signal setting incorrect (error code: 1B37H) will occur when executing FB.

Skip signal setting

This section describes the setting items for Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10) when used in multiple axes positioning data operation.

- The skip signal is set when the skip function is used. For details, refer to the following.

☞ Page 695 Skip function

- The setting ranges and descriptions for each item are shown below.

Setting item	Setting range	Description
I/O number (StartIO)	—	Not used. The setting is disabled.
Target (Target)	• ""*1 ■Data type • [OBJ]*2 • [VAR] • [DEV] ■Type • BOOL * For details on the string format to be set, refer to the following. ☞ Page 1158 TARGET_REF Structure	Sets the signal to be used. ■Setting examples [VAR]AxisName.Md.InVelocity [OBJ] (WORD) 0x60FD0020.0@192.168.4.1
Signal detection method (Detection)	• 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel)	Sets the signal logic.
Compensation Time (CompensationTime)	0.0	Set to "0.0".
Filter Time (FilterTime)	0.0 to 5.0 [s]	Sets the filter time for removing chattering of the I/O signals in units of seconds.

*1 If the target (Target) is "" (string that has a length of 0), the corresponding skip signal is considered as no setting.

*2 If [OBJ] is set, the target modification cannot be omitted. If the setting is complete with the target modification omitted, Skip signal setting incorrect (error code: 1B38H) will occur.

- If a value outside the range is set, Skip signal setting incorrect (error code: 1B38H) will occur when executing FB.

Dwell function

After stopping the positioning, wait for the elapsed time to complete the positioning data.

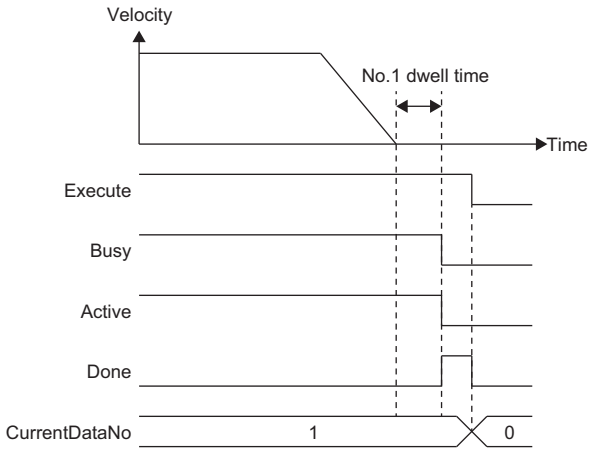
The dwell function is enabled when a value other than "0.0 [s]" is set to the dwell time.

The dwell time is set to the Dwell time (DwellTime) of the positioning data.

The following operations depend on the operation pattern.

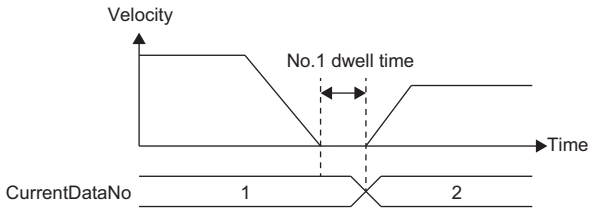
■When the operation pattern is positioning complete

The positioning data operation is completed after the dwell time elapses after positioning is stopped.



■When the operation pattern is continuous positioning

Move to the positioning operation of the next positioning data after the dwell time elapses after positioning is stopped.



■When the operation pattern is continuous path

The operation is the same as the one when the operation pattern is "Continuous positioning".

Specify "0.0 [s] (Disabled)" for dwell time when the operation of continuous path is executed without waiting for dwell time to elapse.

Precautions

- Setting the dwell time at the control cycle interval (a value obtained by multiplying the control cycle by an integer) of the axes group configuration axis is recommended. If it is not a control cycle interval, wait for the elapsed time as shown in the table below, depending on the relationship with one control cycle.

Setting value of Dwell time (DwellTime)	Waiting for dwell time to elapse
Less than one control cycle	Waiting time is only for one control cycle.*1
One control cycle or more	Waiting time is only for the time with the fractional part truncated by the scale of the control cycle.

*1 Set the Dwell time (DwellTime) to "0.0 [s]" when disabling waiting for dwell time to elapse.

Ex.
For the following

Example	Description
1	■When the dwell time is less than one control cycle When the control cycle is set to "0.001 [s] (1.0 [ms])", if "0.0005 (0.5 [ms])" is set in the Dwell time (DwellTime), the waiting time for the dwell time to elapse is only for "0.001 (1.0 [ms])".
2	■When the dwell time exceeds one control cycle When the control cycle is set to "0.001 [s] (1.0 [ms])", if "0.0025 (2.5 [ms])" is set in the Dwell time (DwellTime), the waiting time for the dwell time to elapse is only for "0.002 (2.0 [ms])".

Skip function

By setting a skip signal for each positioning data, the operation of the positioning data that is being executed is interrupted and the next positioning data is executed.

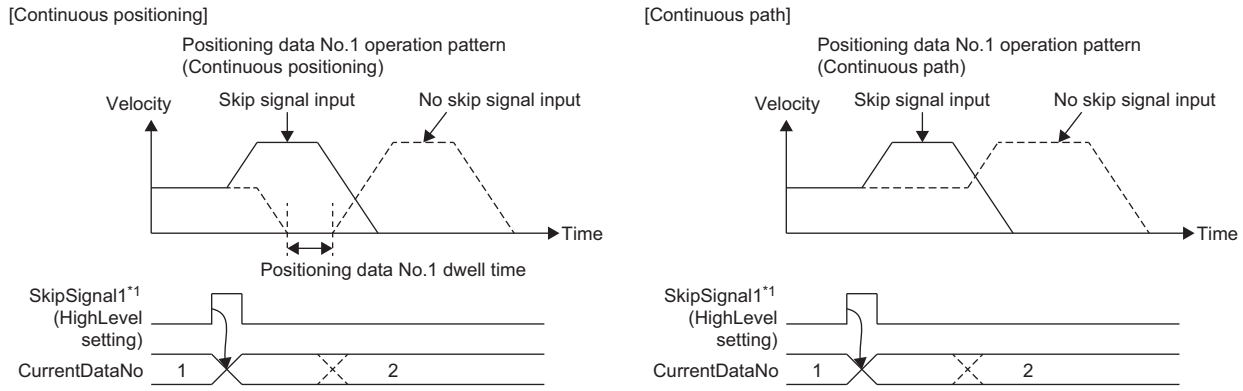
- The skip function uses the Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10) of the operation profile data (multiple axes positioning data format). The external signal (bit input signal) is set to the skip signal. For details on the setting, refer to the following.

☞ Page 692 Skip signal setting

- The skip signal is imported by the control cycle of the configuration axis for the axes group to be controlled.
- The number used for each positioning data is set from the skip signal as the Skip signal No. (SkipSignalNo).
- When "0" is set to the Skip signal No. (SkipSignalNo) of the positioning data, the skip function is disabled during the execution of the corresponding positioning data.
- If the skip signal set by the Skip signal No. (SkipSignalNo) of the positioning data being executed is input, the skipping is executed.
- The following operations depend on the operation pattern.

■When the operation pattern is continuous positioning or continuous path

Move to the next positioning data after interrupting the operation of the positioning data that is being executed by inputting a skip signal.

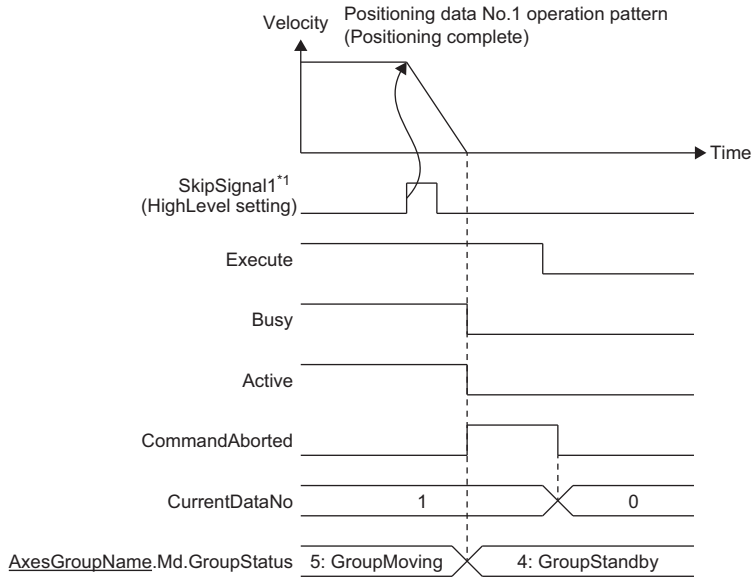


*1 Skip signal No. (SkipSignalNo) "1" of positioning data No.1 and Skip signal No. (SkipSignalNo) "0" of No.2

■When the operation pattern is positioning complete

By inputting a skip signal, a deceleration stop is executed.

- The acceleration/deceleration method and deceleration of the deceleration stop, and the jerk, take over the value of the skipped positioning data. When the command velocity reaches 0, the execution of MCv_MovePositioningData (multiple axes positioning data operation) during control is interrupted (Abortion of execution (CommandAborted) is TRUE), and Axes Group Status (AxesGroupName.Md.GroupStatus) will transit to "4: Standby (GroupStandby)".



*1 Skip signal No. (SkipSignalNo) "1" of positioning data No.1

- When skipping, the next positioning data (multiple axes interpolation data) uses the position at the time of inputting the skip signal as the start position for positioning. The setting examples of the positioning position when skipping are shown below.

■Setting example

The axes group with axis 1 of ring counter enabled and software stroke limit disabled as the configuration axis is as shown below.

• Setting of axis specified by configuration axis 1 (AxesGroupName.Pr.Axis[1])

Setting item	Setting value
Ring Counter Enabled Selection (AxisName.PrConst.RingCount_Enable)	TRUE
Ring Counter Lower Limit Value (AxisName.PrConst.RingCount_LowerValue)	0.0
Ring Counter Upper Limit Value (AxisName.PrConst.RingCount_UpperValue)	360.0
Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target)	-1: Invalid (Invalid)
Position Command Unit (AxisName.Pr.Unit_Position)	H00410000 (degree)

Under these conditions, if there is positioning data of absolute position specification after skipping, the set position at the time of execution completed (Done) rise is the same regardless of whether the skip signal is input or not. However, the cumulative current position (movement distance during operation) at the time of execution completion (Done) rise may be different. In addition, the movement direction may change by positioning data of absolute position specification depending on whether the skip signal is input or not.

■When all the positioning data after skipping is relative position specification

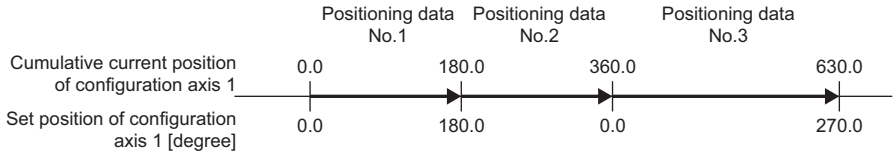
• Positioning data setting

—: No setting

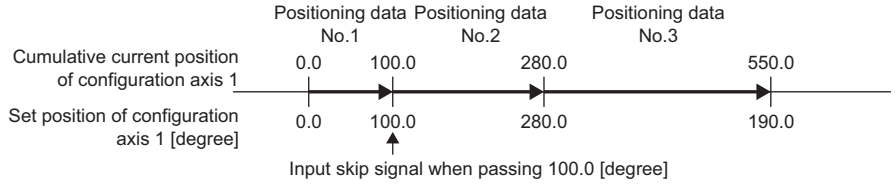
Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Interpolation axis 1 (InterpolationAxis1)	Target position/ Movement amount/End point 1 (Position1)	Direction selection 1 (Direction1)	Skip signal No. (SkipSignalNo)
1	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	180.0	—	1
2	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	180.0	—	—
3	0: Positioning complete (PositioningComplete)	0102H: Relative value linear interpolation (LinearRelative)	1	270.0	—	—

• Positioning operation

[When the skip signal is not input]



[When the skip signal is input]



■When the positioning data immediately after skipping is absolute position specification

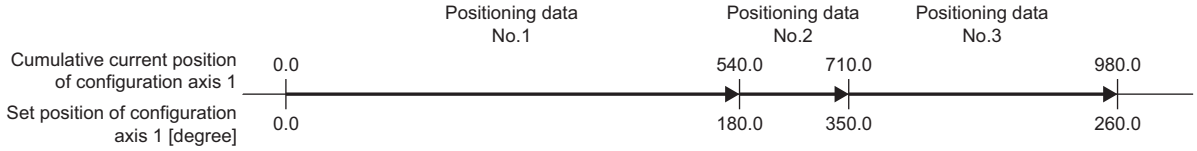
• Positioning data setting

—: No setting

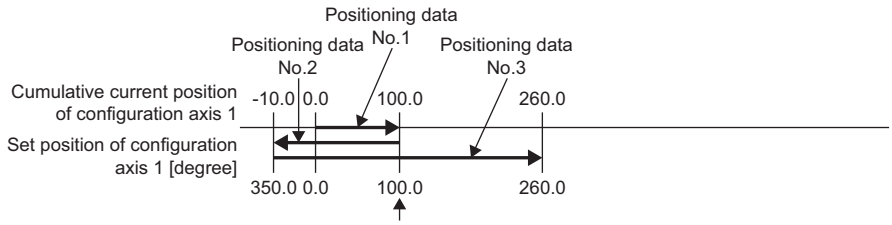
Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Interpolation axis 1 (InterpolationAxis1)	Target position/ Movement amount/End point 1 (Position1)	Direction selection 1 (Direction1)	Skip signal No. (SkipSignalNo)
1	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	540.0	—	1
2	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0101H: Absolute value linear interpolation (LinearAbsolute)	1	350.0	3: Shortest path (mcShortestWay)	—
3	0: Positioning complete (PositioningComplete)	0102H: Relative value linear interpolation (LinearRelative)	1	270.0	—	—

• Positioning operation

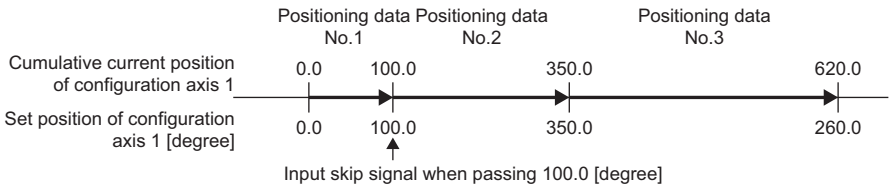
[When the skip signal is not input]



[When the skip signal is input]



* In the above cases (the Direction selection 1 (Direction1) of positioning data No.2 is "3: Shortest path (mcShortestWay)"), the positioning is executed in the positive direction with positioning data No.2 even if the skip signal is input while positioning data No.1 is executed by setting the Direction selection 1 (Direction1) of positioning data No.2 to "1: Positive direction (mcPositiveDirection)".



■When the positioning data immediately after skipping is relative position specification, and there is absolute position specification after that

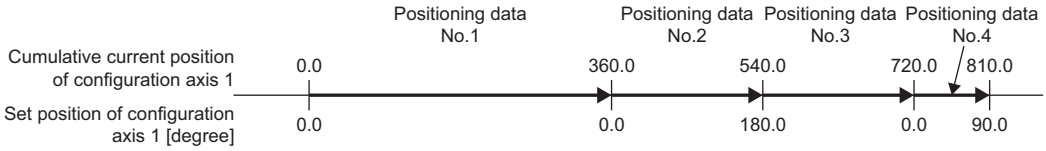
• Positioning data setting

—: No setting

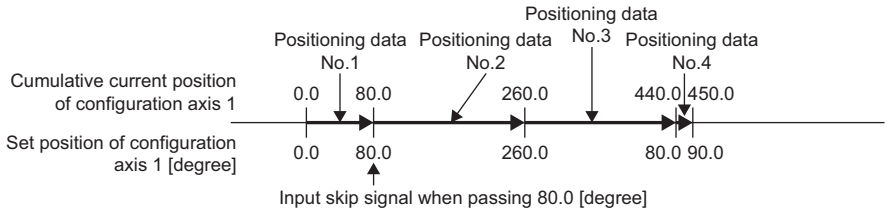
Positioning data No. (DataNo)	Operation pattern (OperationPattern)	Control method (ControlMethod)	Interpolation axis 1 (InterpolationAxis1)	Target position/ Movement amount/End point 1 (Position1)	Direction selection 1 (Direction1)	Skip signal No. (SkipSignalNo)
1	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	360.0	—	1
2	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	180.0	—	—
3	3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious)	0102H: Relative value linear interpolation (LinearRelative)	1	180.0	—	—
4	0: Positioning complete (PositioningComplete)	0101H: Absolute value linear interpolation (LinearAbsolute)	1	90.0	3: Shortest path (mcShortestWay)	—

• Positioning operation

[When the skip signal is not input]



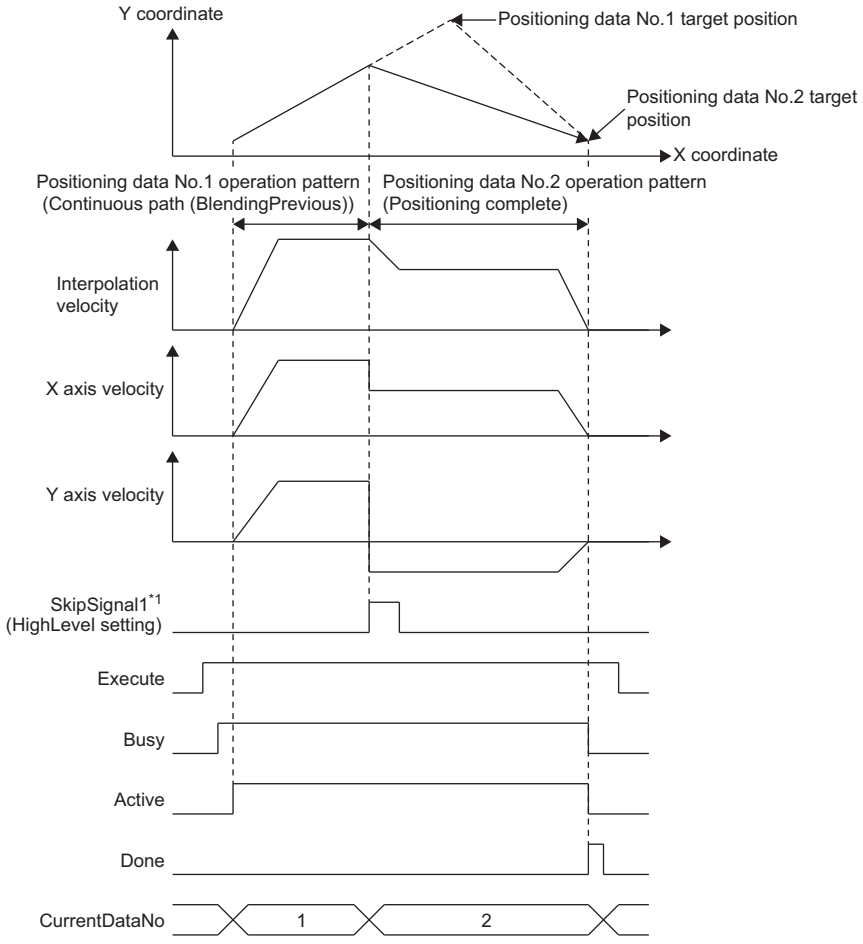
[When the skip signal is input]



Precautions

- The skip function interrupts positioning data being executed and does not omit pre-reading and execution even if a skip signal is input for the positioning data before execution. If the skip signal is set to the input status before the positioning data is executed, the skipping is executed when the positioning data is executed. Therefore, it takes one control cycle from the start of execution to the next positioning data switching.
- If the same skip signal is set and the positioning data to be executed is skipped continuously over several operation cycles, waiting for the pre-reading may occur. When waiting for the pre-reading due to skipping, the set velocity rapidly changes to 0 in one operation cycle at the time of inputting the skip signal. After that, the pre-reading is executed and if the data is switched to the next positioning data, the set velocity is rapidly changed to a switching velocity in one operation cycle. To avoid rapid changes in velocity due to waiting for the pre-reading, review the positioning data settings to avoid continuous skipping operations.

- If the Control method (ControlMethod) is set to "0103H: Absolute value circular interpolation (CircularAbsolute)" in the positioning data after the positioning data for which the skip signal is set, set the positioning data of "0101H: Absolute value linear interpolation (LinearAbsolute)" between them. Furthermore, configure the settings so that the interpolation axis of the positioning data of "0103H: Absolute value circular interpolation (CircularAbsolute)" is included in the interpolation axis of the positioning data of "0101H: Absolute value linear interpolation (LinearAbsolute)". Failure to do so will generate Incorrect control method after skipping (error code: 1B34H) after the skip signal is input and the operation will stop.
- If the Control method (ControlMethod) is set to "0101H: Absolute value linear interpolation (LinearAbsolute)" in the positioning data after the positioning data for which the skip signal is set, set the Velocity mode (VelocityMode) to the one other than "1: Long axis velocity (LongAxisSpeed)". If the positioning data whose Control method (ControlMethod) is set to "0101H: Absolute value linear interpolation (LinearAbsolute)" and Velocity mode (VelocityMode) is set to "1: Long axis velocity (LongAxisSpeed)" is pre-read when the skip signal is input, Incorrect control method after skipping (error code: 1B34H) will occur and the operation will stop.
- If skipping is executed while waiting for the dwell time to elapse, the waiting for elapse is ignored and the operation will be moved to the next positioning data.
- If skipping is executed during M code output (while M strobe (Mstrobe) is TRUE), M strobe (Mstrobe) will be FALSE and the M code reset will not be waited.
- For the positioning data for which M code output timing is "AFTER mode", when skipping is executed before the M code output, the operation is moved to the next positioning data without outputting the M code. (In this case, the M strobe (Mstrobe) does not rise during the execution of the corresponding positioning data, and the M code is not stored in the valid M code (ValidMcode).)
- When switching to the next positioning data by inputting the skip signal, the interpolation velocity at the time of switching is used as the switching velocity. Therefore, acceleration/deceleration may not be executed and a rapid velocity change may occur depending on the movement amount and movement direction of each axis for the next positioning data.

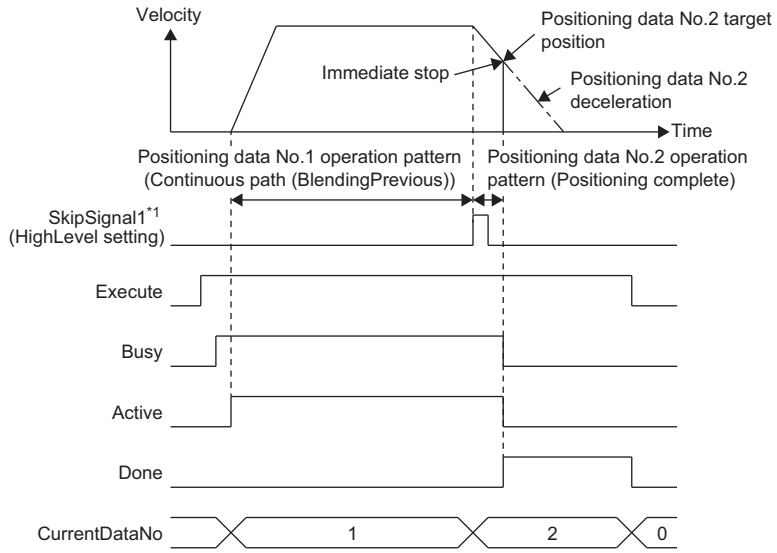


*1 Skip signal No. (SkipSignalNo) of positioning data No.1 is "1" and Skip signal No. (SkipSignalNo) of positioning data No.2 is "0"

- When switching to the next positioning complete data or continuous positioning data by inputting the skip signal, the deceleration distance cannot be secured after switching at the switching velocity, and the target position may be overrun. In this case, the automatic deceleration operation is executed based on Operation Setting at Overrun (AxesGroupName.Pr.OverrunOperation).

Ex.

When "1: Immediate Stop (ImmediateStop)" is set, the axis starts deceleration immediately as follows, and it stops immediately at reaching the target position after outputting overrun warning.



*1 Skip signal No. (SkipSignalNo) of positioning data No.1 is "1" and Skip signal No. (SkipSignalNo) of positioning data No.2 is "0"

Point

When switching to continuous positioning data and decelerating due to insufficient movement amount, the positioning of the next positioning data No. is executed after stopping the axis.

- During the deceleration stop of the positioning complete data by inputting the skip signal, the change by the override function is not immediately reflected in the operation that is being executed. It is reflected at the timing when another stop cause occurs.
- If skipping is executed during acceleration/deceleration of continuous positioning data, acceleration (deceleration) is not taken over when switching positioning data even when switching "from the jerk acceleration/deceleration to another jerk acceleration/deceleration".
- If the refresh cycle of the signal set for the skip signal is different from the control cycle of the configuration axis for the axes group to be controlled, the signal may be lost. Maintain the signal status until CurrentDataNo is switched to the next positioning data No.

M code output function

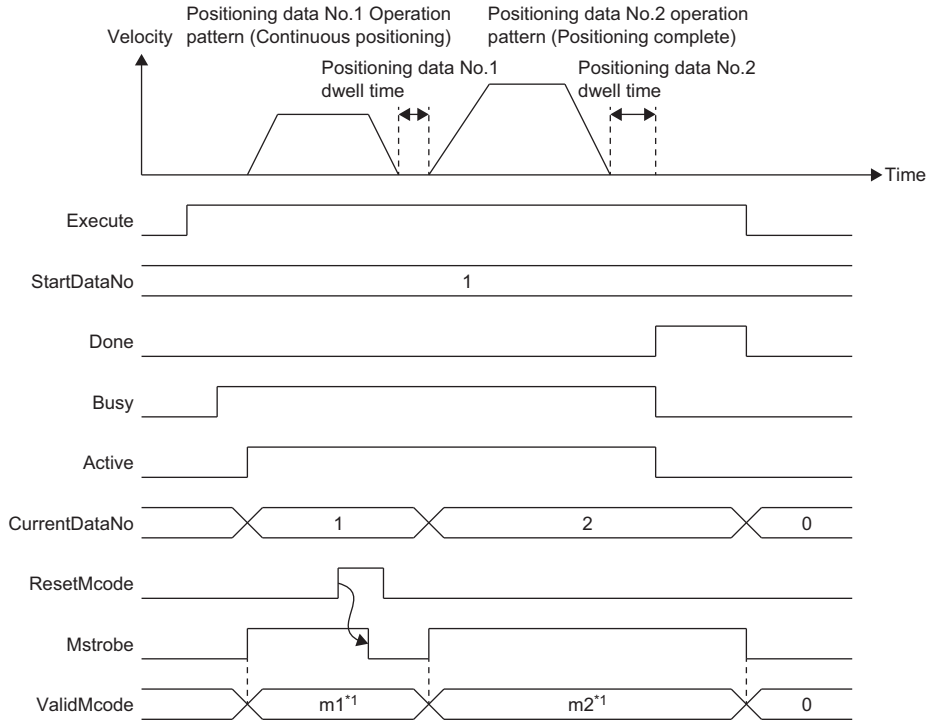
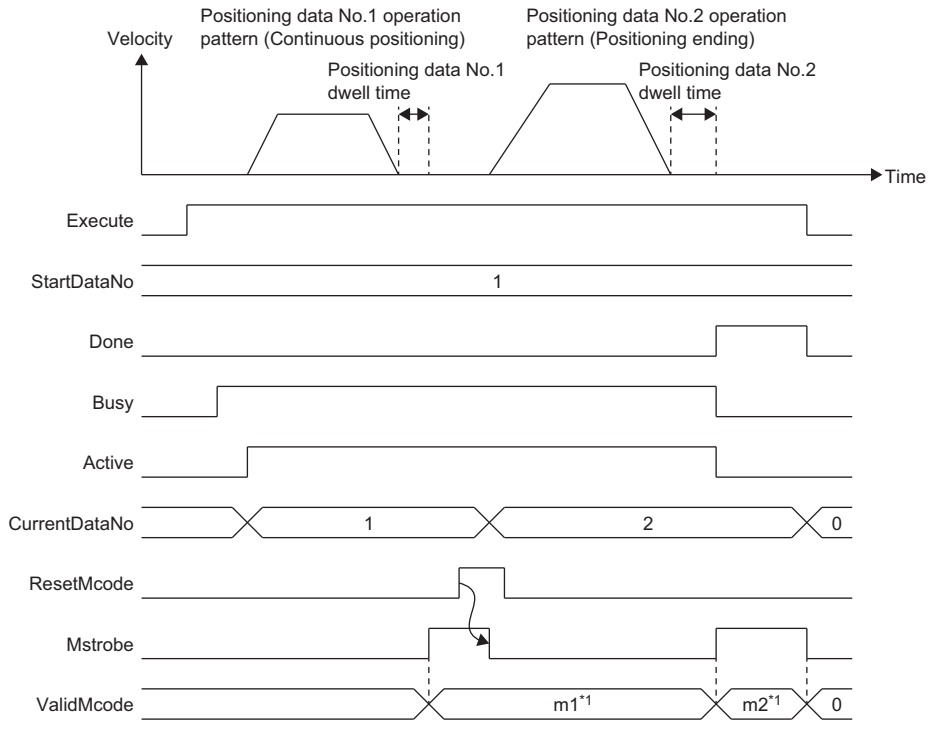
A function to execute the command of the auxiliary work (such as clamp, drill rotation, and tool replacement) related to positioning data that is being executed.

The M code can be set for each positioning data. The timing to output (store) the M code can also be set.

- This function is enabled when a value other than "0" is set to the M code.
- The M code is set to the M code (Mcode) of the positioning data.
- When executing each positioning data for multiple axes positioning data operation, the M strobe (Mstrobe) is set to TRUE at the set output timing, and the M code is stored in a valid M code (ValidMcode).

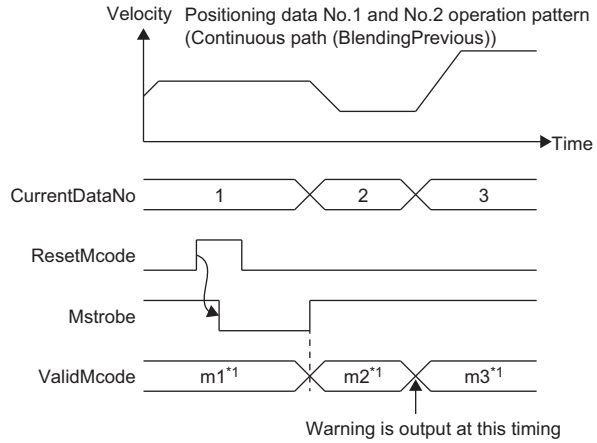
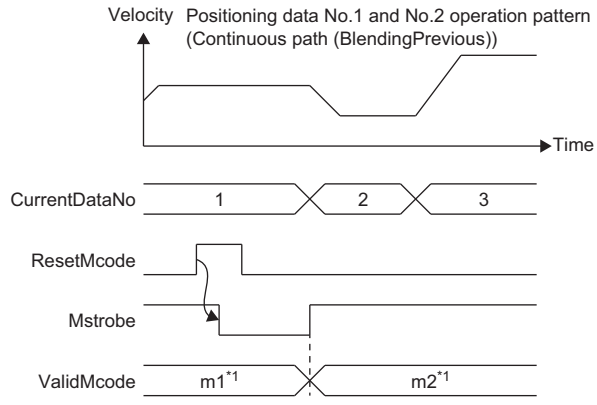
■M code output timing

- The M code output timing is set to the M code output timing (Options (Options): bit 16) for MCv_MovePositioningData (multiple axes positioning data operation). In addition, the M code output timing can be set for each positioning data by M code output timing override (McodeOutput_Override) of the positioning data.
- The timing for outputting the M code includes "WITH mode" and "AFTER mode".

Output timing	Description
WITH mode	At the start of positioning of the positioning data, the M strobe (Mstrobe) is set to TRUE, and the M code (Mcode) of the positioning data is stored in a valid M code (ValidMcode).  *1 m1 and m2 indicate the M code (Mcode) set for each positioning data No.
AFTER mode	At the time of reaching the target position (after the set time elapses if dwell time is set), the M strobe (Mstrobe) is set to TRUE, and the M code of the positioning data is stored in the M code (Mcode).  *1 m1 and m2 indicate the M code (Mcode) set for each positioning data No.

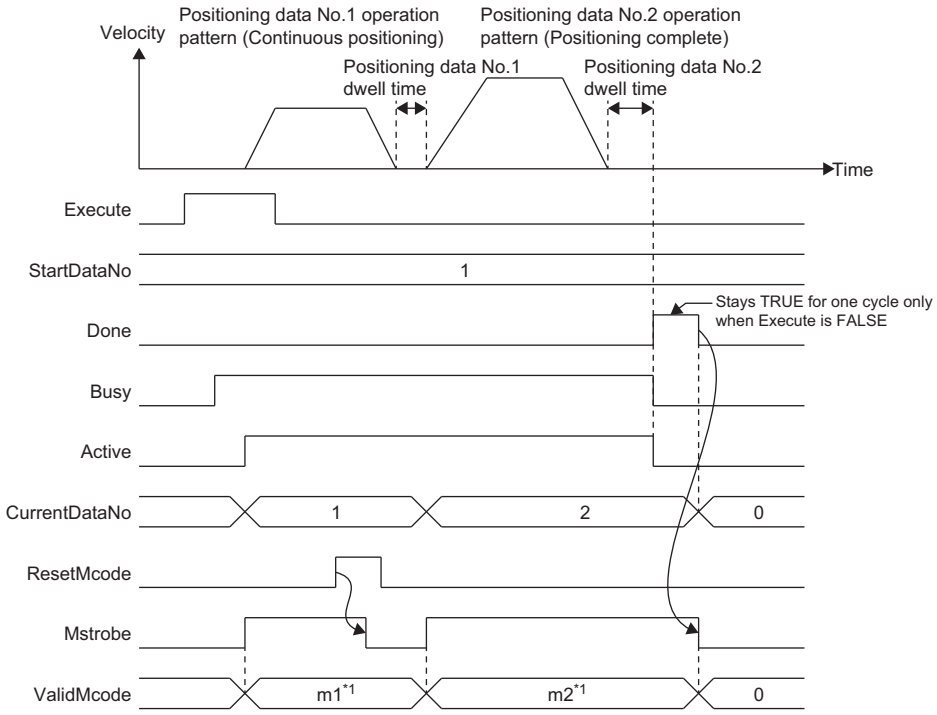
■Function of waiting for M code reset

- During M code output (while M strobe (Mstrobe) is TRUE), wait for the processing of positioning data to be completed until M code reset is executed. The multiple axes positioning data operation is continued under control even during the wait state.
- M code reset is executed by starting the M code reset (ResetMcode). M strobe (Mstrobe) becomes FALSE due to M code reset.
- The following operations depend on the operation pattern.

Operation pattern	Description
Positioning complete	Do not wait for M code reset. Even if the M strobe (Mstrobe) is TRUE, FB is completed.
Continuous positioning	While M strobe (Mstrobe) is TRUE, wait to move to the next positioning data.
Continuous path	Do not wait for M code reset. Even if the M strobe (Mstrobe) is TRUE, the next positioning operation is executed. ■When the M code is set for the following positioning data Operation profile data control profile ID setting incorrect warning (event code: 0D48H) will occur.  *1 m1, m2, and m3 indicate the M code (Mcode) set for each positioning data No. ■When the M code is not set for the following positioning data No warning will be output, but M code output will continue.  *1 m1 and m2 indicate the M code (Mcode) set for each positioning data No. (M code (Mcode) of positioning data No.3 is "0 (no setting)")

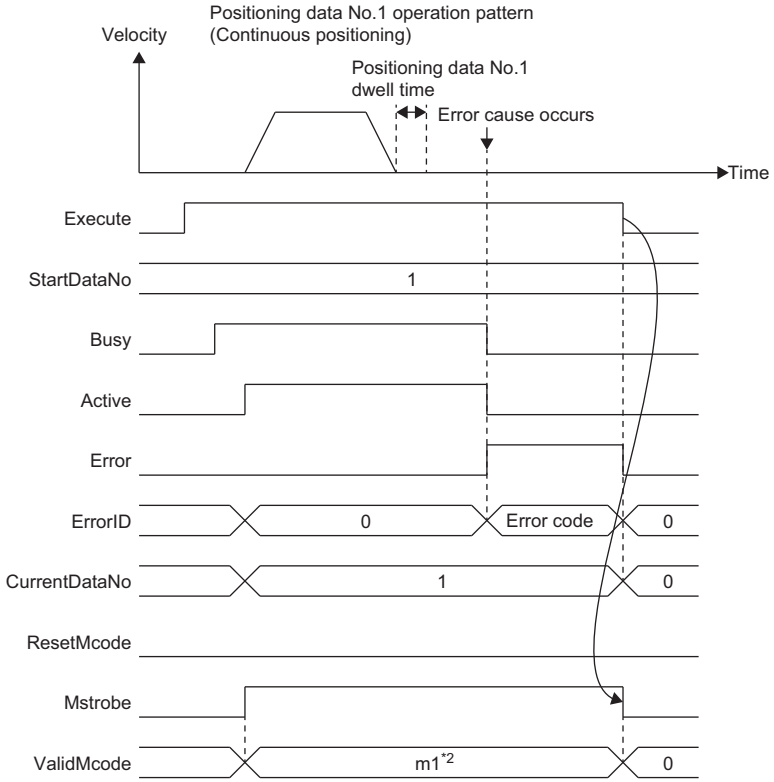
Precautions

- If "0" is set for M code (Mcode), M code will not be output. (At M code output timing, M strobe (Mstrobe) is not TRUE and the valid M code (ValidMcode) is not updated.)
- M code reset is executed by starting the M code reset (ResetMcode). Even if the M code reset (ResetMcode) is set to TRUE in advance before the M strobe (Mstrobe) becomes TRUE, it will not be reset. To avoid starting an M code reset (ResetMcode) while the M strobe (Mstrobe) is FALSE, execute the mutual exclusion in the user program.
- For the continuous path, if the positioning operation time is short, the time to execute the M code reset may not be taken, and Operation profile data control profile ID setting incorrect warning (event code: 0D48H) may occur. In this case, the warning can be avoided without outputting the M code by setting "0" for the M code (Mcode) of the positioning data for the warning part.
- The valid M code (ValidMcode) and M strobe (Mstrobe) are reset upon completion if the execution command (Execute) is FALSE upon completion. They are reset when the execution command (Execute) is FALSE if the execution command (Execute) is TRUE upon completion.



*1 m1 and m2 indicate the M code (Mcode) set for each positioning data No.

• During the waiting for M code reset, if an error occurs or the execution is interrupted, the M strobe (Mstrobe) remains TRUE and the state of waiting for reset is released.



*2 m1 indicates the M code (Mcode) set for each positioning data No.

Step function

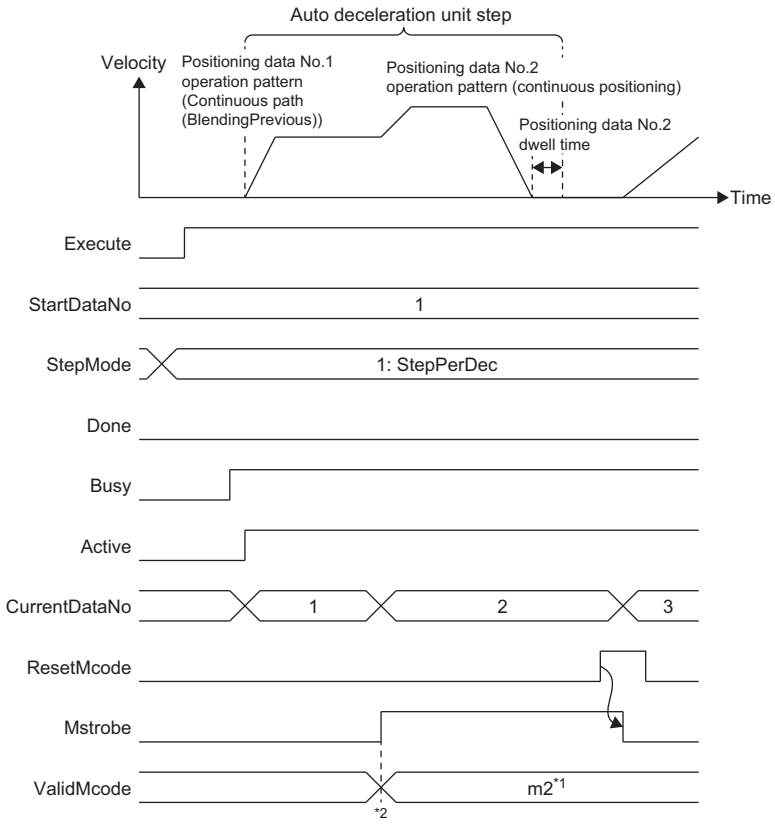
A function to check the positioning operation one by one. Use it for debugging work.
Multiple axes positioning data operation with "Step function" enabled is called "Step operation".
In step operation, the timing to pause the operation can be set. It is called "Step mode". (The multiple axes positioning data operation continues under control even during the pause.)

- To execute the step operation, set the Step mode (StepMode) to "1: Deceleration unit step (StepPerDec)" or "2: Positioning data unit step (StepPerPositioningData)" and execute MCv_MovePositioningData (multiple axes positioning data operation).
- In the positioning data to be paused in the step operation, execute the waiting for M code reset. In the positioning data whose M code output with "0" set in M code (Mcode) is invalid, M strobe (Mstrobe) becomes TRUE and waits for the M code reset. (The valid M code (ValidMcode) is not updated.)
- During M code output (while M strobe (Mstrobe) is TRUE), wait for the next step to continue.

■Step mode

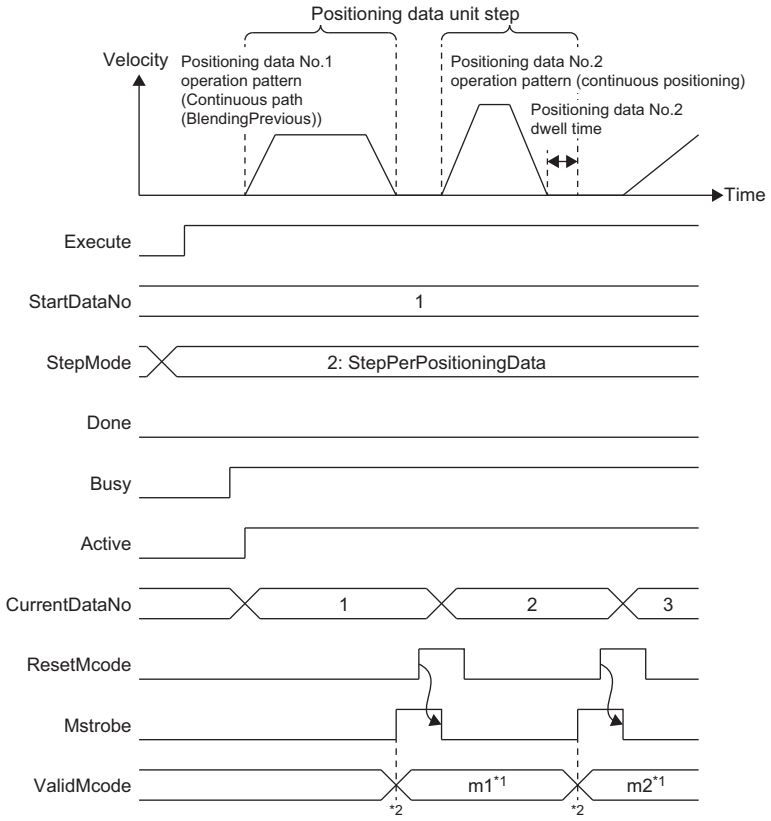
There are two types of "Step mode": "Deceleration unit step" and "Positioning data unit step".
In both modes, to release the pause and continue the next one step, set the M code reset (ResetMcode) to TRUE during M code output. In addition, as with normal operation, the multiple axes positioning data operation is completed after the processing of the positioning complete data is completed.

- "1: Deceleration unit step (StepPerDec)": Pause with continuous positioning data. Normal operation is executed for continuous path data and positioning complete data.



*1 m2 indicates the M code (Mcode) set for each positioning data No. (When M code (Mcode) is "0 (no setting)", it will not be updated.)
*2 When the M code output timing for each positioning data No. is "WITH mode"

• "2: Positioning data unit step (StepPerPositioningData)": Automatically decelerate and pause for each positioning data. Even for the continuous path data, it is forced to automatically decelerate and pause.

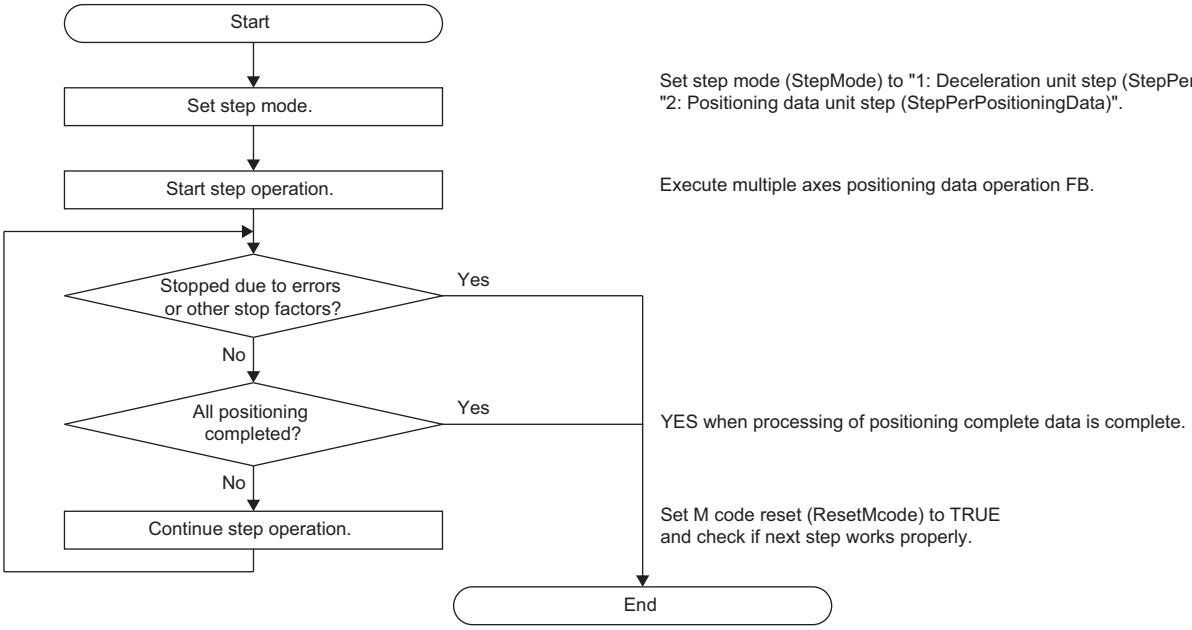


*1 m1 and m2 indicate the M code (Mcode) set for each positioning data No. (When M code (Mcode) is "0 (no setting)", it will not be updated.)

*2 When the M code output timing for each positioning data No. is "AFTER mode"

■How to use step operation

The procedure for checking the positioning data using step operation is shown below.



■Precautions

- As with normal operation, the skip function is also enabled in step operation. In the positioning data to be paused in the step operation, when skipping is executed before the pause, the next one step is continued without pausing. (During M code output, M strobe (Mstrobe) becomes FALSE.) In addition, if skipping is executed during the pause, the M strobe (Mstrobe) becomes FALSE, the pause is released and the next one step is continued.

Precautions

- In MCv_MovePositioningData (multiple axes positioning data operation), the operation profile data analysis such as pre-reading and external signal setting may extend the time required for start and multiple start (Aborting).
- If an error is detected during the control of multiple axes positioning data operation, MCv_MovePositioningData instruction error (error code: 1BD1H) is output along with the error indicating the error definition. Detailed information such as detected positioning data No. is recorded in the event history as the information of MCv_MovePositioningData instruction error (error code: 1BD1H).
- The timing of importing from the open area of operation profile data (multiple axes positioning data format) is different for each item. The following table lists the import timing for each item.

—: No import

Setting item	Import timing
Profile ID	When executing FB
Periodic	—
Input absolute coordinate	—
Output absolute coordinate	—
Operation profile data format	When executing FB
Profile data type	When executing FB
Interpolation method specification	—
Resolution/number of coordinates	—
Start point	—
Initial stroke amount	—
Initial velocity	—
Initial acceleration	—
Options	—
Number of positioning data settings	When executing FB
Total number of positioning data	When executing FB
Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10)	When executing FB
Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10)	When executing FB
Positioning data	When executing FB or during control (when pre-reading positioning data)
Length per cycle	—
Length unit setting per cycle	—
Length unit string per cycle	—
Minimum value per cycle	—
Maximum value per cycle	—
Time per cycle	—
Stroke amount	—
Stroke amount unit setting	—
Stroke amount unit string	—

Required object data

When using MCv_MovePositioningData (multiple axes positioning data operation), map the object assigned to the following object data to PDO for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a configuration axis that does not map the above object to PDO, Required object data unset (error code: 1AF7H) will occur and the operation will not start.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

Relevant add-ons

The following add-ons are required to use this function.

- MotionEngine
- MotionControl_General
- ProfileControl
- SignalIO*1

*1 When setting any of Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10) and Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10) of the operation profile data (multiple axes positioning data format)

29 DIRECT CONTROL

Direct control includes absolute position follow-up control, velocity control, torque control, and pressure control. The operation details of each control are as shown below.

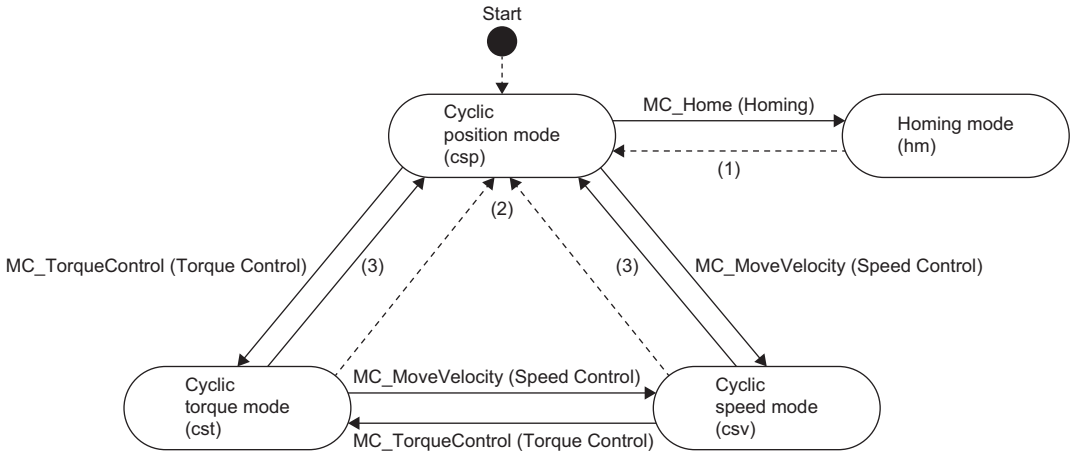
Control name	Driver control mode	Applicable instruction	Operation details	Reference
Absolute position follow-up control	Cyclic synchronous position mode (csp)	MCv_PositionControl (Absolute Position Follow-up Control)	This function outputs the set position for each control cycle (Performs an operation with acceleration and deceleration)	Page 712 Absolute Position Follow-up Control
Velocity control	Cyclic synchronous position mode (csp)	MCv_SpeedControl (Speed Control (Including Position Loop))	This function outputs the set position based on the command velocity for each control cycle.	Page 715 Velocity Control
	Cyclic synchronous velocity mode (csv)	MC_MoveVelocity (Speed Control)	This function outputs the command velocity for each control cycle (excluding the position loop).	
Torque control	Cyclic synchronous torque mode (cst)	MC_TorqueControl (Torque Control)	This function outputs the command torque for each control cycle (excluding the position loop).	Page 726 Torque Control
Pressure control	Cyclic synchronous pressure mode (cspr)	MCv_PressureControl (Pressure Control)	This function outputs the command pressure for each control cycle (excluding the position loop).	Page 742 Pressure Control

Point

Creating a path, such as acceleration/deceleration for sending the target position, target velocity, and target torque to the drive unit, in the program is not required because the acceleration/deceleration function and torque ramp function exist. When the acceleration/deceleration function or torque ramp function is not used, refer to the motion cyclic control.

☞ Page 760 MOTION CYCLIC CONTROL

The control mode of the drive unit must be cyclic synchronous position mode (csp) when the unit is connected.
The switching of the drive unit control mode is simultaneously executed when the motion control FB is executed. The following shows the state transition.



No.	State transition description
(1)	Transits after the axis stops by homing completion or error occurrence.
(2)	Transits at stop completion or error occurrence.
(3)	Transits when Aborting or Buffered is executed to a motion control FB other than MC_MoveVelocity (Speed Control) and MC_TorqueControl (Torque Control).

Point

For usage such as pressing a workpiece using the MR-J5(W)-G, switch to the continuous operation to torque control mode (ct) by using torque control (MC_TorqueControl).
Using the continuous operation to torque control mode (ct) can switch the operation smoothly from the cyclic synchronous position mode or the cyclic synchronous velocity mode to the pressing operation. Therefore, reducing load to a machine and molding high in quality are provided as the velocity and torque do not change abruptly.
For details, refer to the following.
☞ Page 2165 Relevant functions

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

29.1 Absolute Position Follow-up Control

The target position of the absolute position is changed by restart/continuous update, and positioning control is performed without completing the instruction.

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SetPosition	Set Position	Stores the current position address.*1 The set position is a value where the cumulative current position is rounded within the ring counter range.
SetVelocity	Set Velocity	Stores the velocity calculated from the difference of the set position updated by the follow up.
SetAcceleration	Set Acceleration	Stores a value calculated from the difference of the set velocity.
SwStrokeLimit_Target	Software Stroke Limit Target	Displays the software stroke limit check method target.

*1 The stored value includes an error because a floating-point error occurs.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_PositionControl	Absolute position follow-up control	This function moves the specified axis to the target position as follows. • Limit velocity • Acceleration • Deceleration • Jerk After the command reaches the target position, the target position can be changed by restart/continuous update and the axis can be moved.

Control details

MCv_PositionControl (Absolute Position Follow-up Control) moves the specified axis to the target position as follows.

- Limit velocity
- Acceleration
- Deceleration
- Jerk

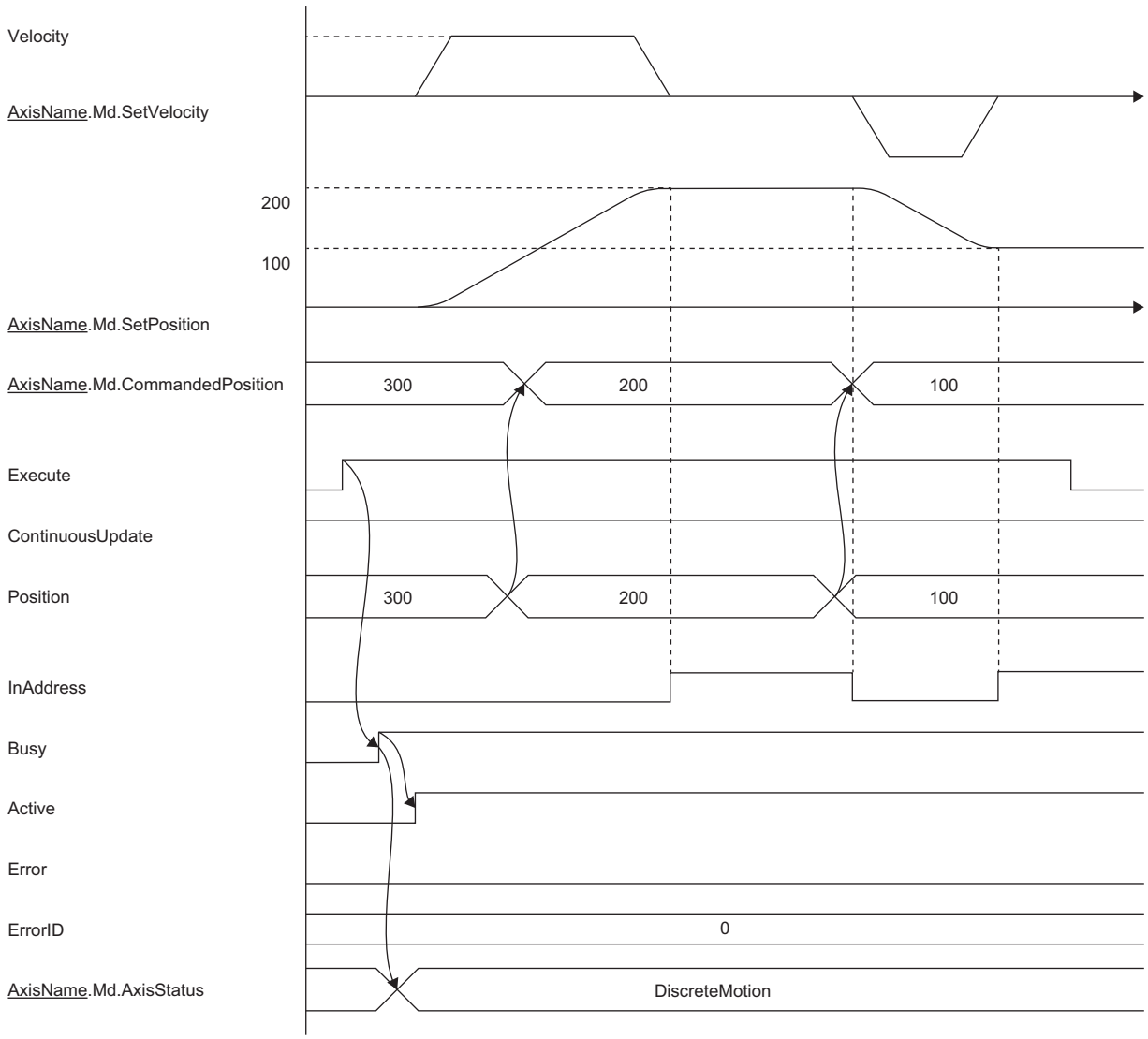
After the command reaches the target position, the target position can be changed by restart/continuous update and the axis can be moved.

If the target position is changed before reaching the target position, the previous target position is ignored and the axis starts to move to the new target position.

To finish this FB, start MC_Stop (Forced Stop) or the other operation instruction.

Timing chart

■When the processing is completed successfully



■When the processing is completed with an error

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type motion control FBs" in the following manual.

MELSEC MX Controller MX-R Model Programming Manual

Operation at stop cause occurrence

When a stop cause occurs during the axis operation, the axis will stop immediately or stop with deceleration depending on each cause. For details, refer to the following.

☞ Page 584 Stop causes during axis operation

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following function.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required

Instruction/function	Required object data	PDO mapping	Operation with no object
MCv_PositionControl (Absolute Position Follow-up Control)	Target position	◎	Required object data unset (error code: 1AF7H) occurs.

Precautions

If the target position (Position) and direction selection (Direction) are changed at the same time, data inconsistency may occur.

By changing the target position (Position) after changing the direction selection (Direction) first, both changes are applied when the target position (Position) is changed.

If the value of the target position (Position) and direction selection (Direction) must be changed at the same time, perform MCv_PositionControl (Absolute Position Follow-up Control) by fixed cycle program, or restart.

☞ Page 546 Retrigger/Continuous Update

29.2 Velocity Control

This control method switches the drive unit control mode to the cyclic synchronous velocity mode (csv), and performs the control excluding the position loop.

For speed control including position loop, refer to the following.

☞ Page 629 Single Axis Speed Control

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SetVelocity	Set Velocity	Stores the velocity calculated from the difference of the set position updated by the follow up.
SetAcceleration	Set Acceleration	Stores a value calculated from the difference of the set velocity.
TargetVelocity	Target Velocity	Stores the actual command velocity whose override and the velocity limit value are considered to Velocity (Velocity).
ActualVelocity	Actual Velocity	Stores the actual velocity (same as positioning control).
Io_TargetVelocity	Object Data_TargetVelocity	Displays the value of object data TargetVelocity. (The velocity command to send to devices)
Io_VelActualValue	Object Data_VelActualValue	Displays the value of object data_VelActualValue. (The actual velocity to be received from the device)
InVelocity	Target Velocity Reached	Indicates that Object Data_TargetVelocity (AxisName.Md.Io_TargetVelocity) has reached the target velocity.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_MoveVelocity	Speed Control	Switches the drive unit to the cyclic synchronous velocity mode (csv), and performs the velocity control based on the specified velocity.

Control details

MC_MoveVelocity (Speed Control) switches the drive unit control mode to the cyclic synchronous velocity mode (csv) and executes control. This function controls the command velocity based on the specified Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). To finish this FB, start MC_Stop (Forced Stop).

Velocity initial value selection

Set the speed initial value when switching control mode from the cyclic synchronous position mode (csp) to the cyclic synchronous velocity mode (csv) to Velocity initial value selection (Options (Options): bit 16, 17).

- Cyclic synchronous position mode (csp) → Cyclic synchronous velocity mode (csv)

Setting value	Description
0: Command velocity	The velocity during command (AxisName.Md.SetVelocity) is used as the velocity commanded to the drive unit immediately after switching.
1: Actual velocity	Motor speed (AxisName.Io_VelActualValue) received from the drive unit at switching is used.*1
2: Automatic selection	The lower velocity between "0: Command velocity" and "1: Actual velocity" is used as the velocity commanded to the drive unit immediately after switching.*2

*1 When object data "Velocity actual value (606CH)" is not mapped, motor speed received from the drive unit at switching is not used. (Speed initial value selection becomes "0".)

*2 When object data "Velocity actual value (606CH)" is not mapped, velocity commanded to the drive unit immediately after switching becomes "0: Command velocity".

Operation at stop cause occurrence

The following shows stop causes during the cyclic synchronous velocity mode (csv) and the process when each cause occurs.

Cause number	Stop cause	Axis Status (AxisName.Md.AxisStatus)		Stop process
		During deceleration stop	After stop	
1	"Forced stop input" is FALSE	—	1: Stopping on error (ErrorStop)	Immediate Stop[*1]
2	Drive unit power supply is FALSE Drive unit network disconnection detection Drive unit error Forced stop input to the drive unit Enable (Enable) of MC_Power (Operation Available) is FALSE Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)")[*2]	—	1: Stopping on error (ErrorStop)	Immediate Stop[*1]
3	Hardware stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit)) After stopping, the control mode switches to the cyclic synchronous position mode (csp).
4	Occurrence of a moderate or major error of the controller Occurrence of a moderate or major error of the built-in network function PLC READY (MotionSystem.Cd.SequenceReady) is off. Moderate error or major error of the motion system occurs Cycle over error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at All Axes Stop Cause Occurrence (MotionSystem.Pr.StopMode_All)) After stopping, the control mode switches to the cyclic synchronous position mode (csp).
5	Software stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit)) After stopping, the control mode switches to the cyclic synchronous position mode (csp).
6	Axis error detection[*3]	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General)) After stopping, the control mode switches to the cyclic synchronous position mode (csp).
7	Execution command (Execute) of MC_Stop (Forced Stop) is TRUE	2: Decelerating to stop (Stopping)	2: Decelerating to stop (Stopping)[*4]	Deceleration stop (Follows the deceleration speed set in the FB) After stopping, the control mode switches to the cyclic synchronous position mode (csp).
8	"Stop signal (STOP)" of external input signal is TRUE	No change	4: Standby (Standstill)	Deceleration stop/Immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General)) After stopping, the control mode switches to the cyclic synchronous position mode (csp).

*1 The servo turns off on the drive unit side and immediate stop is performed, and also the motion system side command is stopped.
*2 Operation differs depending on the setting of Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.
☞ Page 592 Stop causes by Servo ON request (ServoON) input of MC_Power (Operation Available)
*3 If an axis error (the error that transits the status into the "1: Stopping on error (ErrorStop)" status) occurs in the buffering FB, immediate stop will be performed upon the occurrence of the error.
*4 When Execution command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

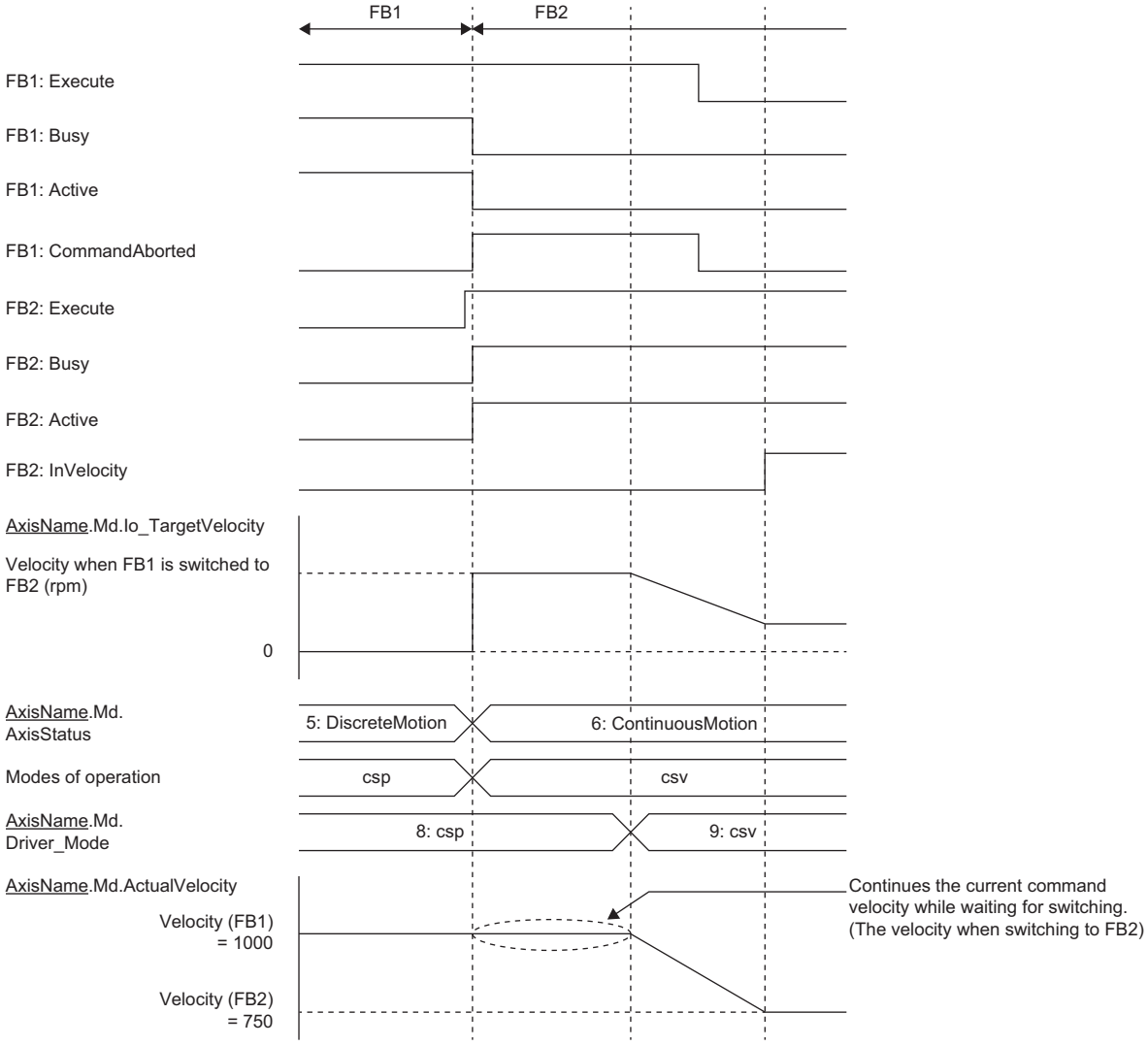
Buffer mode (BufferMode)

When starting this FB during another instruction execution

■Single axis position control (FB1) → Velocity control (FB2)

• 0: Aborting (mcAborting)

1. Input variables are analyzed, and a switching request to the cyclic synchronous velocity mode (csv) is issued to the drive unit.
2. Until the drive unit is switched, the axis is operated at the previous velocity with velocity control including the position loop.
3. When the drive unit switches to the cyclic synchronous velocity mode (csv), Target Velocity (TargetVelocity) is obtained based on the actual velocity and the acceleration/deceleration process is started again.

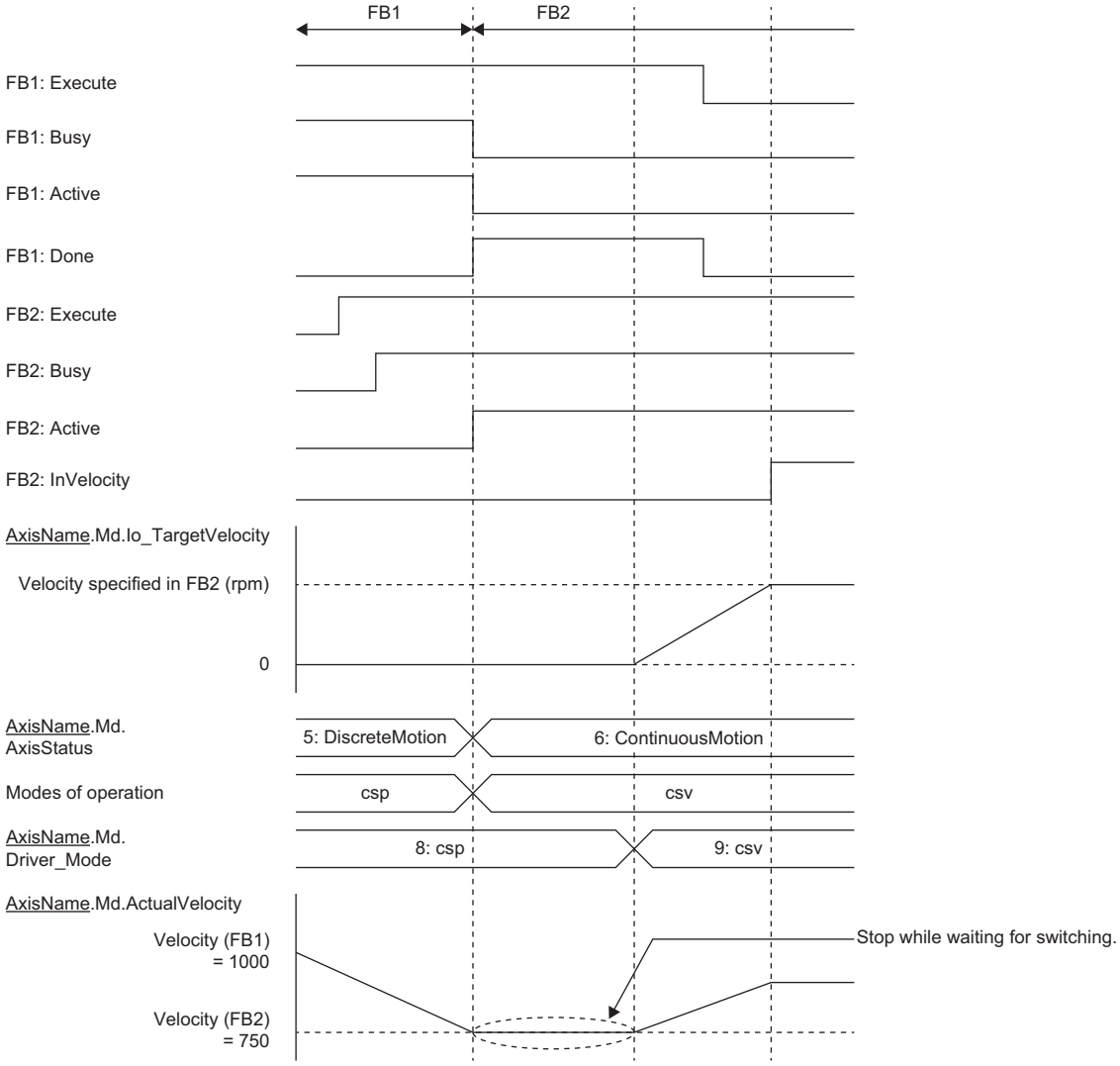


• 1: Buffered (mcBuffered)

1. Input variables are analyzed, and the axis waits until the previous instruction is completed.

2. When the previous instruction is completed, a switching request to the cyclic synchronous velocity mode (csv) is issued to the drive unit.

3. When the drive unit switches to the cyclic synchronous velocity mode (csv), the acceleration/deceleration process is started based on the settings of FB2.



When starting another instruction during this FB execution

While this FB is executed, only Aborting and Buffered are supported.

■Velocity control → Operation at positioning start

1. A switching request to the cyclic synchronous position mode (csp) is issued to the drive unit.
2. The positioning control FB that was started is analyzed, and the axis waits until the drive unit switches to the cyclic synchronous position mode (csp). (Even if a switching request to the cyclic synchronous position mode (csp) is executed during axis operation, switching may not be carried out depending on the drive unit specifications. If switching to the cyclic synchronous position mode (csp) is not completed within 1 [s], Control mode switching error (error code: 1A95H) occurs due to timeout and the axis stops.)
3. While waiting, velocity control is continued with the command velocity when Execution command (Execute) of FB2 is TRUE.
4. When the drive unit switches to the cyclic synchronous position mode (csp), the positioning control starts.

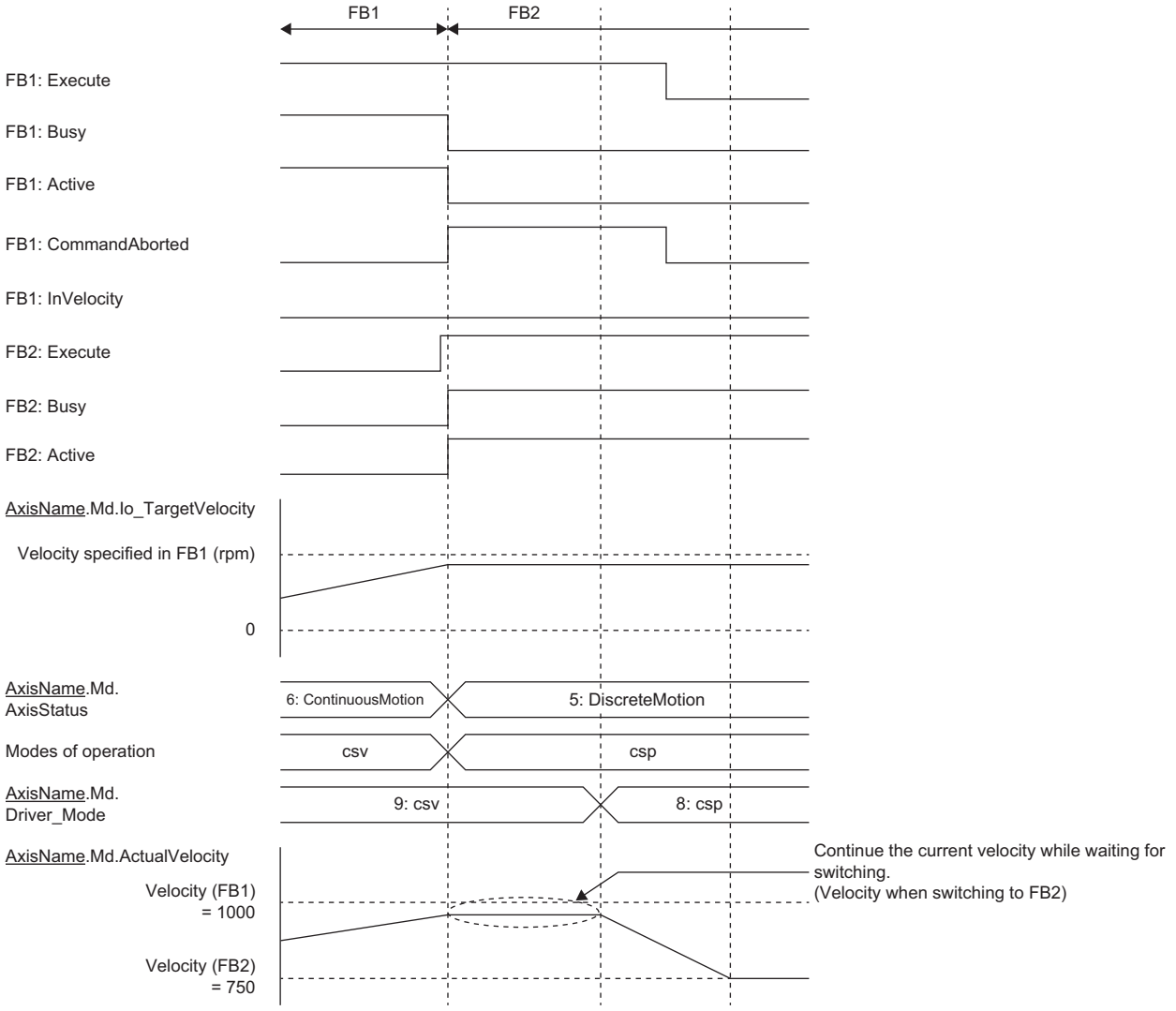
Point

- The deceleration distance may not be secured and the target position may be overrun depending on the travel distance switching from the cyclic synchronous velocity mode (csv) to the cyclic synchronous position mode (csp). In this case, the axis operates based on Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

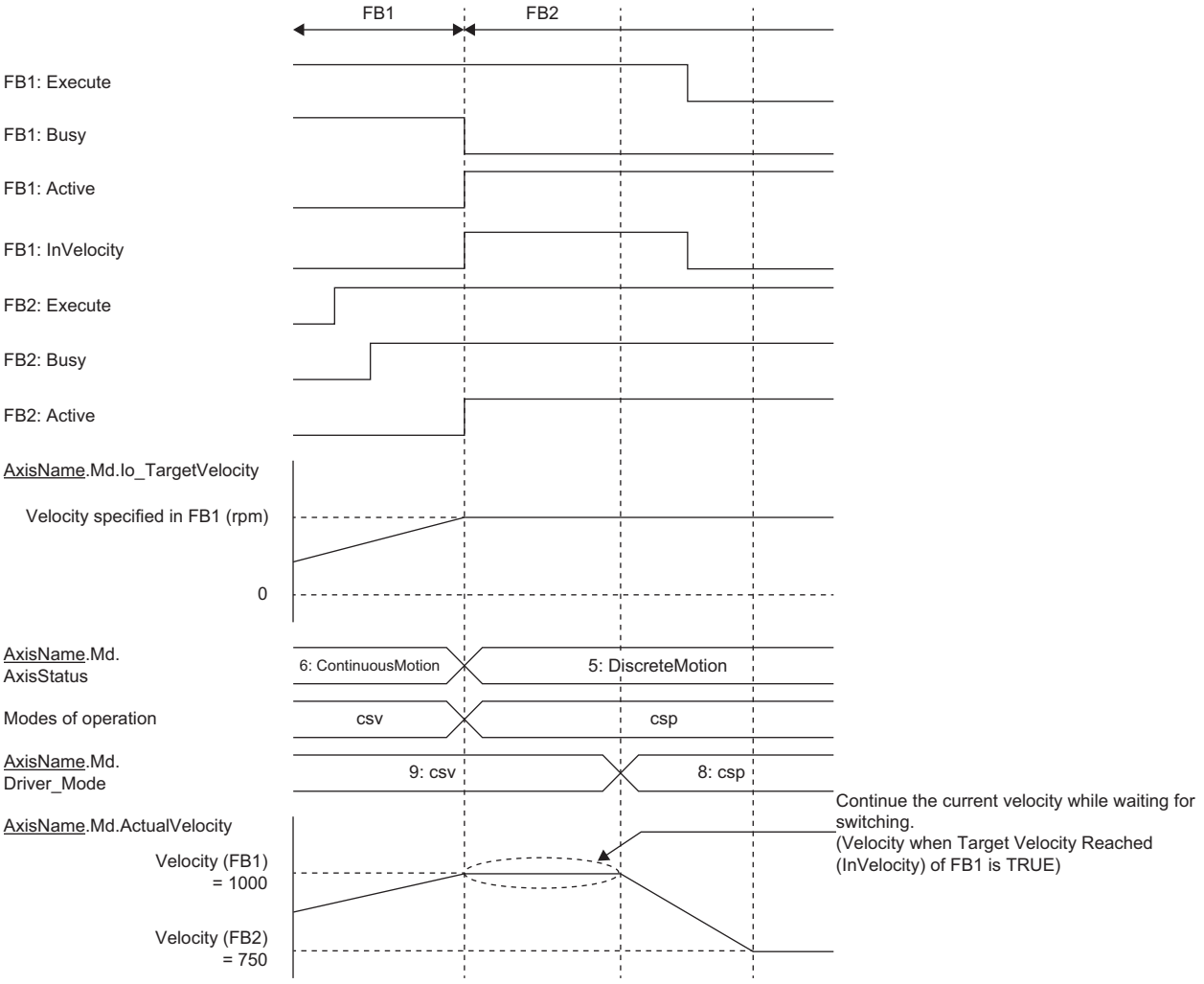
☞ Page 547 Multiple Start (Buffer Mode)

- If an overrun occurs while waiting for switching, Overrun error (error code: 1AE3H) will occur immediately after switching to the cyclic synchronous position mode (csp), and the motor will stop immediately, regardless of Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

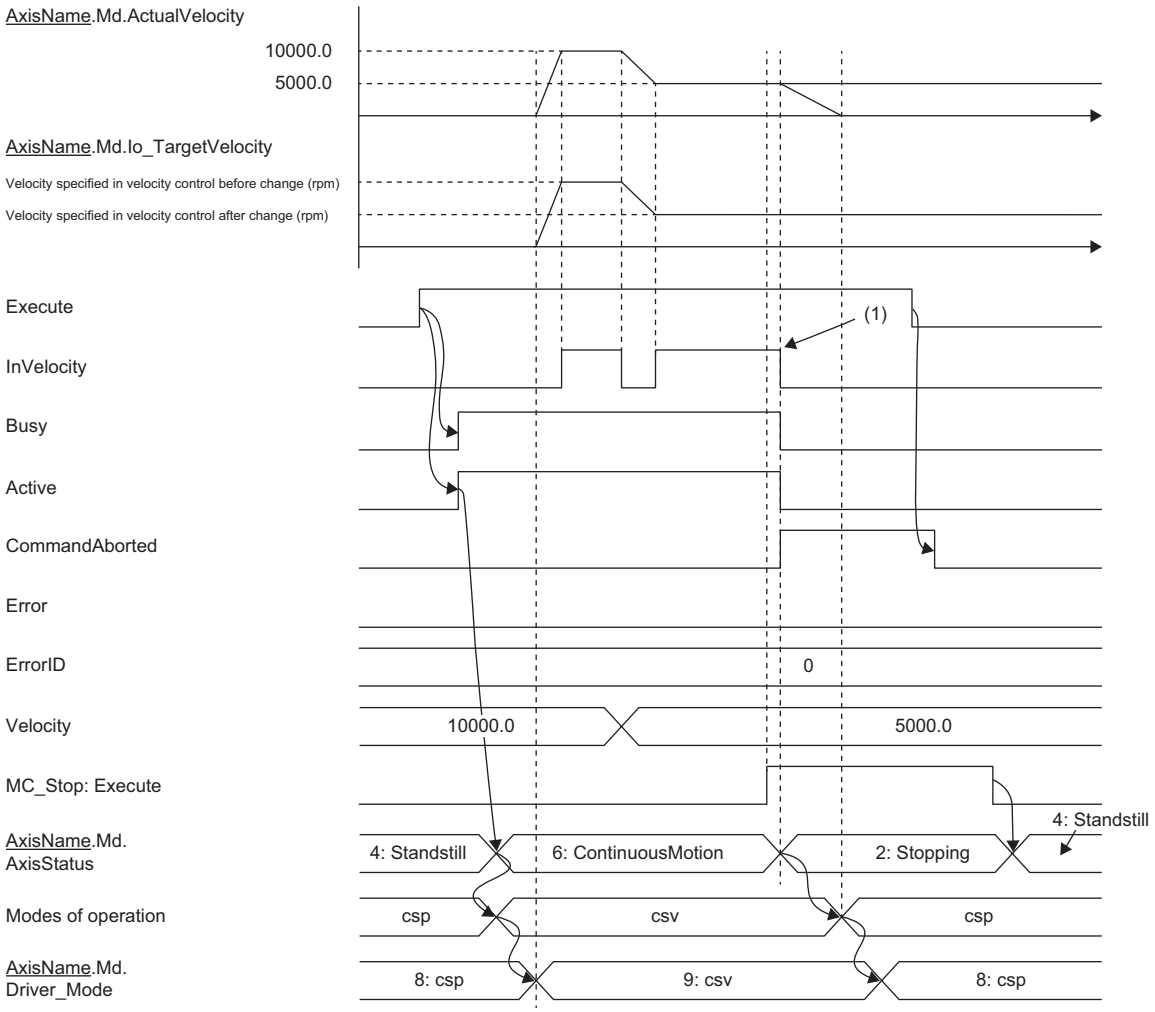
• 0: Aborting (mcAborting)



• 1: Buffered (mcBuffered)



■Speed control → Stop instruction (MC_Stop (Forced Stop))



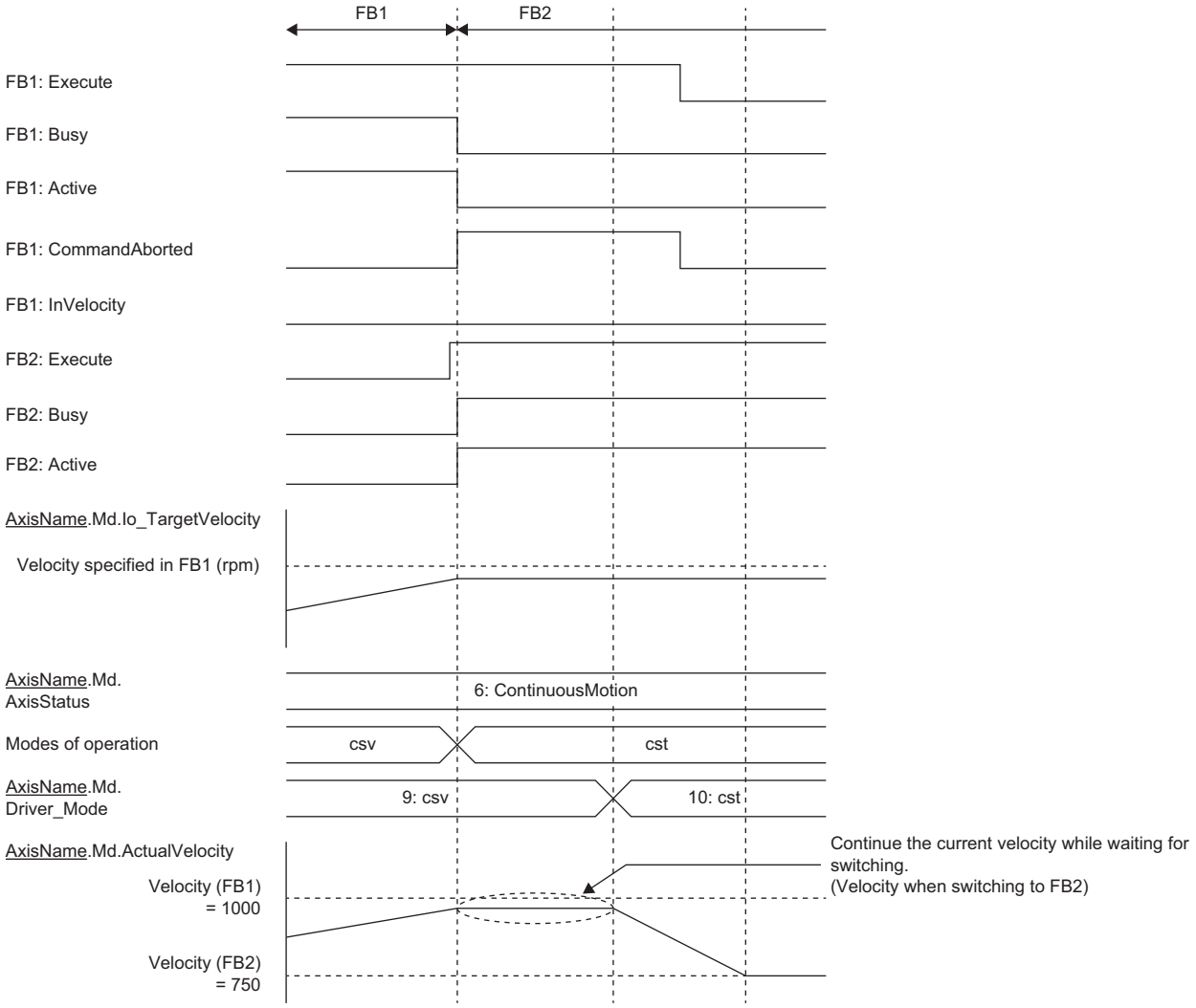
(1) MC_Stop (Forced Stop) is started.

■Speed control → Torque control

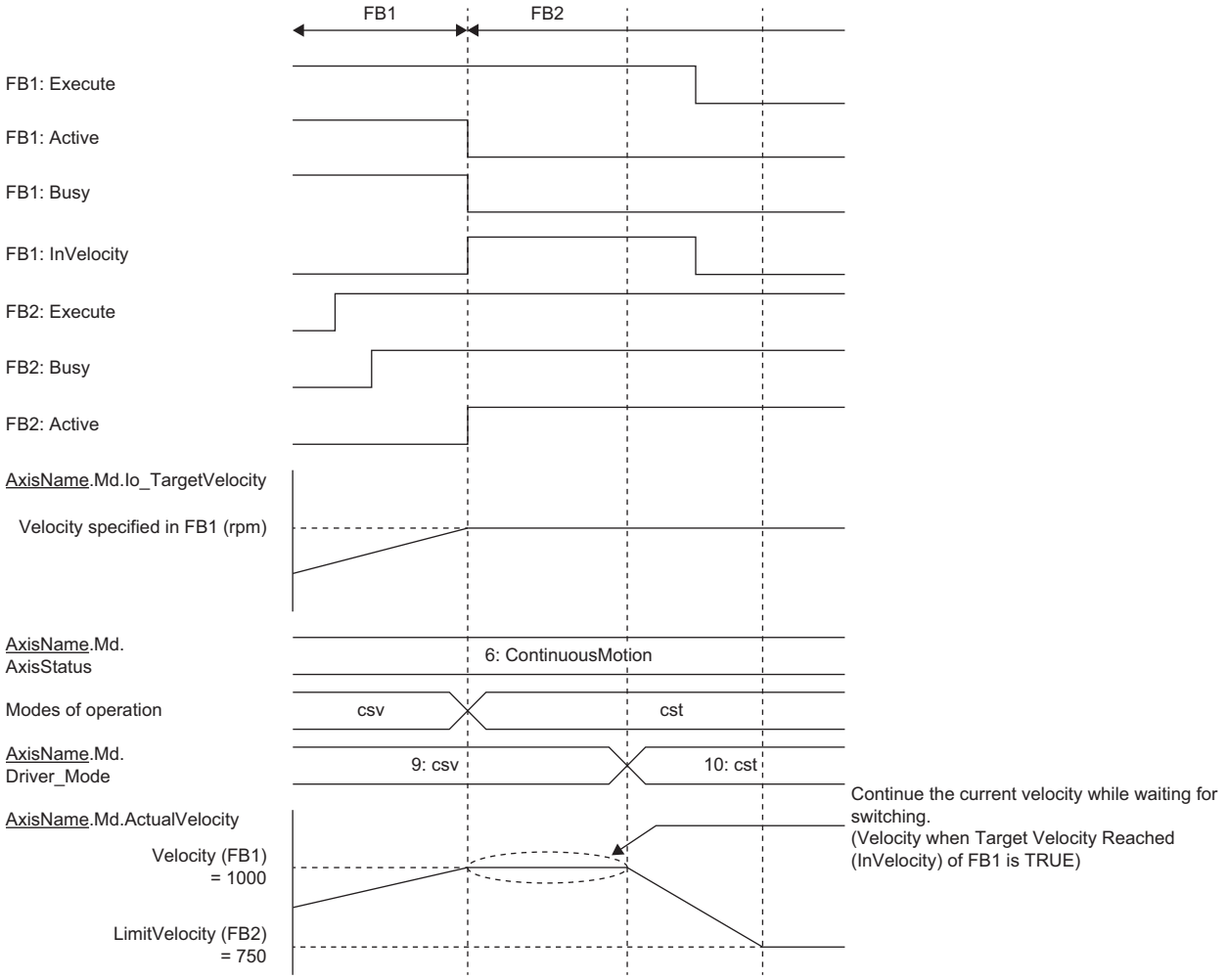
1. A switching request to the cyclic synchronous torque mode (cst) is executed to the drive unit.

2. The torque control that was started is analyzed, and the axis waits until the drive unit switches to the cyclic synchronous torque mode (cst).

• 0: Aborting (mcAborting)



• 1: Buffered (mcBuffered)



When the operation direction is reversed

When starting this FB and operation direction is reversed during another instruction execution, a deceleration stop is performed once.

After the deceleration stop is completed, operation is started in the changed direction.

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following function.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required, ○: Recommended

Instruction/function	Required object data	PDO mapping	Operation with no object
MC_MoveVelocity (Speed Control)	Target velocity	◎	Required object data unset (error code: 1AF7H) occurs.
	Velocity actual value	○	☞ Page 715 Velocity initial value selection

Precautions

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
- The set position and the machine feed value are updated by follow up.
- Time until the control mode is switched depends on the specifications of the drive unit.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start the positioning control FB during the control mode switching. Start the positioning control FB after checking that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "9: csv (Velocity Control) (csv)".
- When switching the control mode from the cyclic synchronous position mode (csp) to the cyclic synchronous velocity mode (csv), if a stop cause (axis error detection) occurs before the control mode is switched, follow-up may continue in cyclic synchronous position mode (csp) until the zero speed status is reached.
- When switching from the cyclic synchronous position mode (csp) to the cyclic synchronous velocity mode (csv) or from the cyclic synchronous velocity mode (csv) to the cyclic synchronous position mode (csp) without waiting for stop of the motor by using the MR-J5(W)-G, note the following.
  - Set the servo parameter (extension setting) "ZSP disabled selection at control switching (PC76.1)" to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
  - For the setting value of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following. ☞ Page 2152 Setting method

29.3 Torque Control

This control method switches the drive unit control mode to the cyclic synchronous torque mode (cst), and performs the control.

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SetVelocity	Set Velocity	Stores the velocity calculated from the difference of the set position updated by the follow up.
SetAcceleration	Set Acceleration	Stores a value calculated from the difference of the set velocity.
TargetVelocity	Target Velocity	Stores value set to the limit velocity (LimitVelocity) The value becomes 0 or more regardless of the movement direction. Stores 0 after the control is completed.
ActualVelocity	Actual Velocity	Stores the actual velocity (same as positioning control).
Cst_SetTorque	Set Torque at cst/ct	Stores the current command torque in the cyclic synchronous torque mode (cst) and the continuous operation to torque control mode (ct).
Cst_TargetTorque	Target Torque at cst/ct	Stores the target torque in the cyclic synchronous torque mode (cst) and the continuous operation to torque control mode (ct).
Cst_SetLimitVelocity	Set Limit Velocity at cst/ct/cspr	Stores the command limit velocity in the cyclic synchronous torque mode (cst), continuous operation to torque control mode (ct), and cyclic synchronous pressure mode (cspr).
Io_TorqueActualValue	Object Data_TorqueActualValue	Displays the value of object data_TorqueActualValue. (The actual torque to be received from the device)
Io_VelActualValue	Object Data_VelActualValue	Displays the value of object data_VelActualValue. (The actual velocity to be received from the device)
InVelocity	Target Velocity Reached	Stores FALSE in the cyclic synchronous torque mode (cst) and the continuous operation to torque control mode (ct).

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_TorqueControl	Torque control	Switches the drive unit to the cyclic synchronous torque mode (cst), and executes the torque control based on the specified target torque.

Control details

MC_TorqueControl (Torque Control) switches the drive unit control mode to the cyclic synchronous torque mode (cst) and executes control. This function controls the set torque based on the specified Torque positive direction ramp (TorquePositiveRamp) and Torque negative direction ramp (TorqueNegativeRamp). To finish this FB, start MC_Stop (Forced Stop).

Relation between torque generation direction of servo motor and set torque

When using the MR-J5(W)-G, it differs based on the settings of the servo parameter "Movement direction selection (PA14)" and "Torque POL reflection selection (PC29.3)".

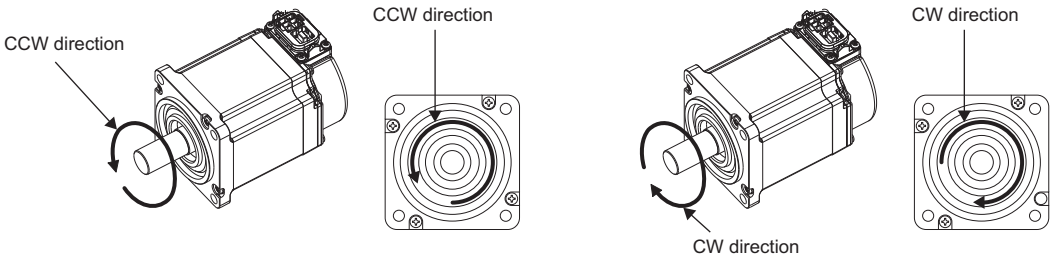
- When the servo parameter (extension setting) "Torque POL reflection selection (PC29.3)" is set to "0: Enabled"

Setting value of "Travel direction selection (PA14)"	Set torque	Torque generation direction of servo motor
0: Positioning address increasing CCW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1
1: Positioning address increasing CW rotation	Positive value (positive direction)	CW direction*1
	Negative value (negative direction)	CCW direction*1

- When the servo parameter (extension setting) "Torque POL reflection selection (PC29.3)" is set to "1: Disabled" (Initial value)

Setting value of "Travel direction selection (PA14)"	Set torque	Torque generation direction of servo motor
0: Positioning address increasing CCW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1
1: Positioning address increasing CW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1

*1 For details, refer to the following illustration.



Torque ramp function selection (Options (Options): bit 16, 17)

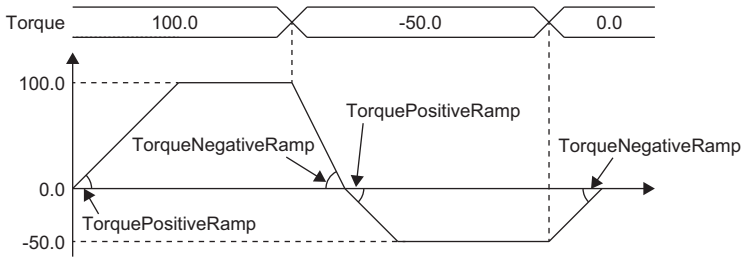
Set the method from set torque until the target torque is reached.

Torque positive direction ramp (TorquePositiveRamp) and Torque negative direction ramp (TorqueNegativeRamp) differ depending on the setting values.

■For "0: Ramp method"

Specify the ramp from the current set torque until the target torque is reached.

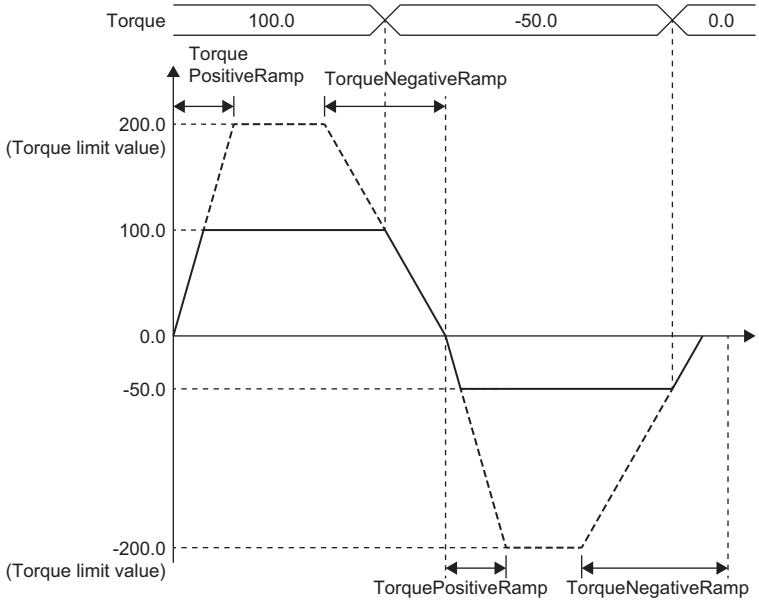
Setting range
0.0 to 1000.0 [%/s]



■For "1: Time constant method"

Set the time until the set torque reaches the positive/negative torque limit value from "0".

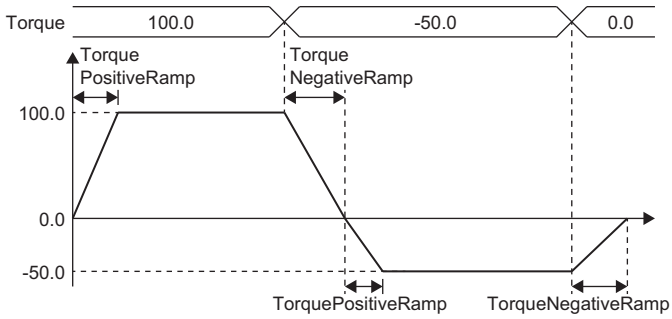
Setting range
0.0 to 8400.0 [s]



■For "2: Fixed time method"

Set the time from the current set torque until the target torque is reached.

Setting range
0.0 to 8400.0 [s]



When the output torque direction is changed due to the target torque change, the set torque becomes "0.0" based on the setting value of the torque negative direction ramp. After that, it becomes the target torque based on the setting value of the torque positive direction ramp.

When the torque positive direction ramp and the torque negative direction ramp are set to "0.0", the value reaches the target torque in one operation cycle.

Torque initial value selection (Options (Options): bit 18)

Set the torque initial value when switching to the cyclic synchronous torque mode (cst).

Setting value	Description
0: Target torque	Target torque (Torque) value at start is set as the set torque regardless of the value of torque positive direction ramp and torque negative direction ramp immediately after the control mode switching.
1: Actual torque	Torque actual value at switching is set as the set torque.*1

*1 When the object assigned to object data Torque actual value is not mapped to PDO, actual torque received from the drive unit at switching is not used. The torque initial value is 0.

Point

Normally, set this bit to "0: Target torque". Set "1: Actual torque" only when switching the control mode immediately after the command to the motor is completed without waiting for the servo motor to stop.

Operation at stop cause occurrence

The following shows stop causes during the cyclic synchronous torque mode (cst) and the process when each cause occurs.

Cause number	Stop cause	Axis Status (AxisName.Md.AxisStatus)	Stop process
		After stop	
1	"Forced stop input" is FALSE	1: Stopping on error (ErrorStop)	Immediate Stop[*1]
2	Drive unit power supply is FALSE	1: Stopping on error (ErrorStop)	Immediate Stop[*1]
	Drive unit network disconnection detection		
	Drive unit error		
	Forced stop input to the drive unit		
	Enable (Enable) of MC_Power (Operation Available) is FALSE		
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)" or "5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)")[*2]		
3	Hardware stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After stopping, the control mode switches to the cyclic synchronous position mode (csp).
4	Occurrence of a moderate or major error of the controller	1: Stopping on error (ErrorStop)	
	Occurrence of a moderate or major error of the built-in network function		
	PLC READY (MotionSystem.Cd.SequenceReady) is off.		
	Moderate error or major error of the motion system occurs		
	Cycle over error occurrence		
5	Software stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	
6	Axis error detection[*3]	1: Stopping on error (ErrorStop)	
7	Execution command (Execute) of MC_Stop (Forced Stop) is TRUE	2: Decelerating to stop (Stopping)[*4]	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After stopping, the control mode switches to the cyclic synchronous position mode (csp). (Not based on the deceleration of MC_Stop (Forced Stop))
8	"Stop signal (STOP)" of external input signal is TRUE	4: Standby (Standstill)	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After stopping, the control mode switches to the cyclic synchronous position mode (csp).

*1 The servo turns off on the drive unit side and immediate stop is performed, and also the motion system side command is stopped.

*2 Operation differs depending on the setting of Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.
☞ Page 579 Relevant variables

*3 If an axis error (the error that transits the status into the "1: Stopping on error (ErrorStop)" status) occurs in the buffering FB, immediate stop will be performed upon the occurrence of the error.

*4 When Execution command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

*5 The set torque value is not changed. Note that it may take time to reach velocity 0 depending on the torque command value that is currently specified.

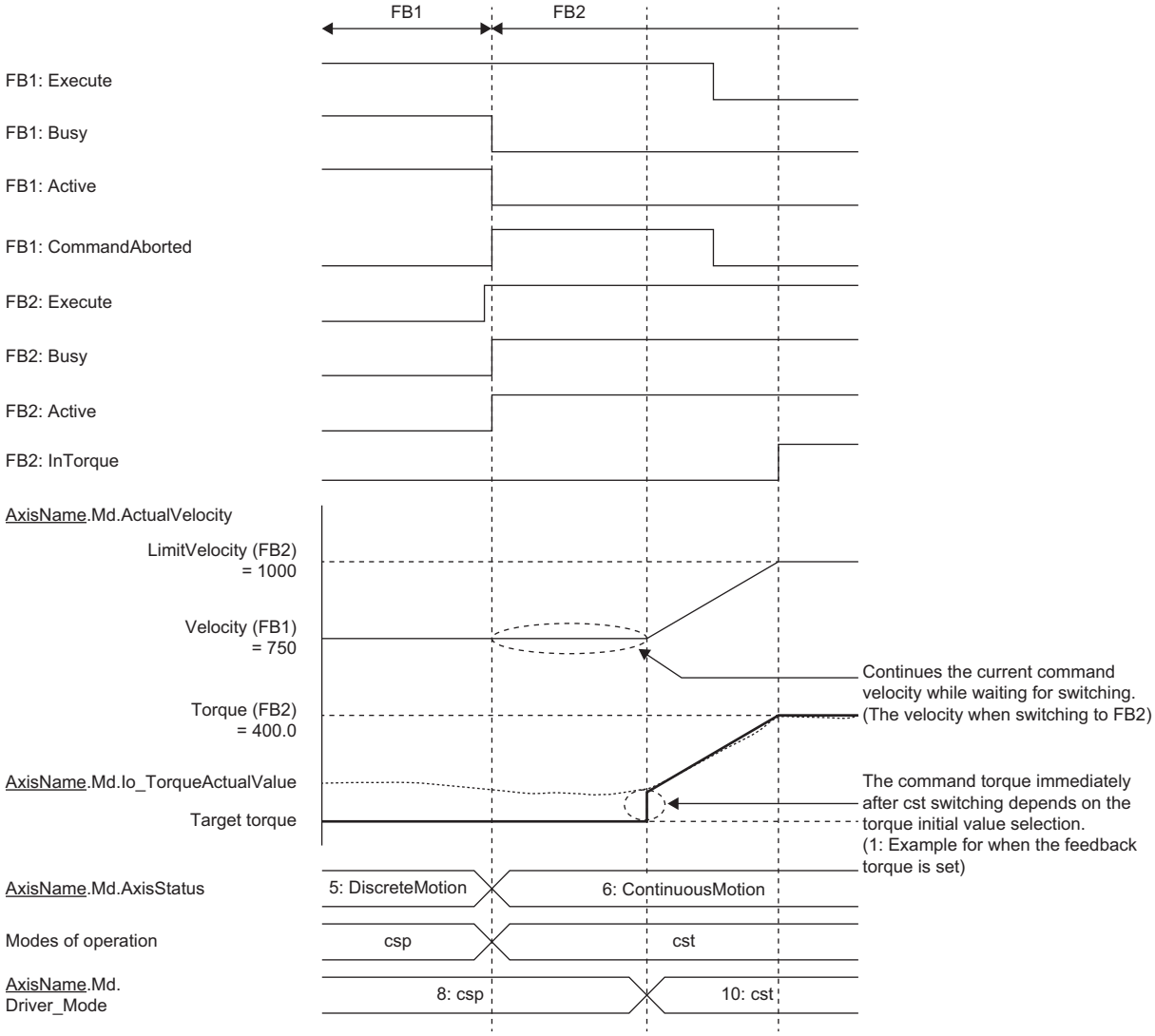
When starting this FB during another instruction execution

While this FB is executed, only Aborting and Buffered are supported.

■Position control (FB1) → Torque control (FB2)

- 0: Aborting (mcAborting)

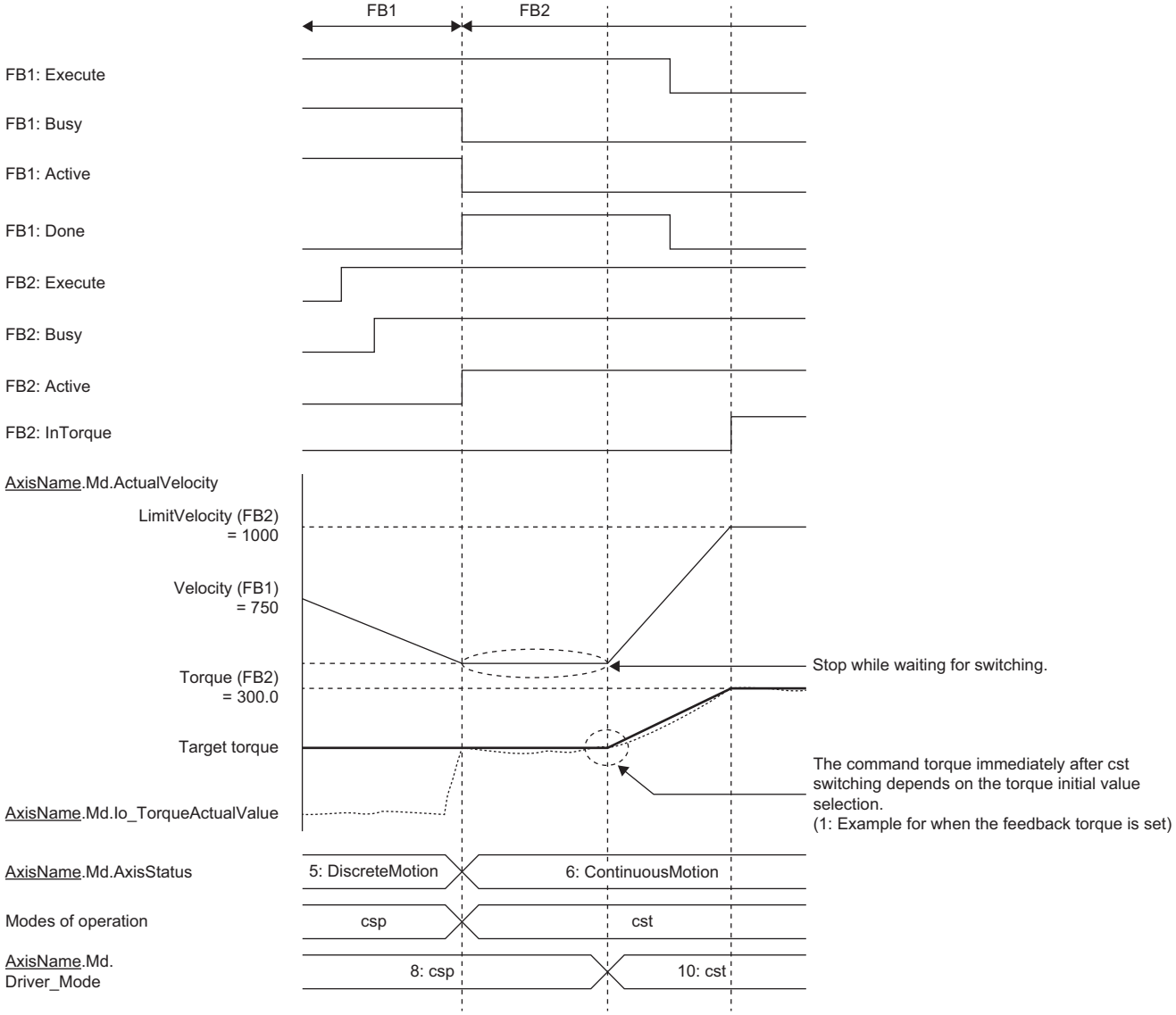
1. A switching request to the cyclic synchronous torque mode (cst) is issued to the drive unit.
2. Until the drive unit is switched, the axis is operated at the previous velocity with velocity control including the position loop.
3. When the drive unit switches to the cyclic synchronous torque mode (cst), the torque increase/decrease is started from the current actual torque, and the acceleration/deceleration process of the velocity limit value is started from the current command velocity.



• 1: Buffered (mcBuffered)

1. When the first instruction is completed, a cyclic synchronous torque mode (cst) change request is issued to the drive unit.

2. When the drive unit switches to the cyclic synchronous torque mode (cst), the acceleration/deceleration process of the torque and the velocity is started from the current actual torque and the command velocity.



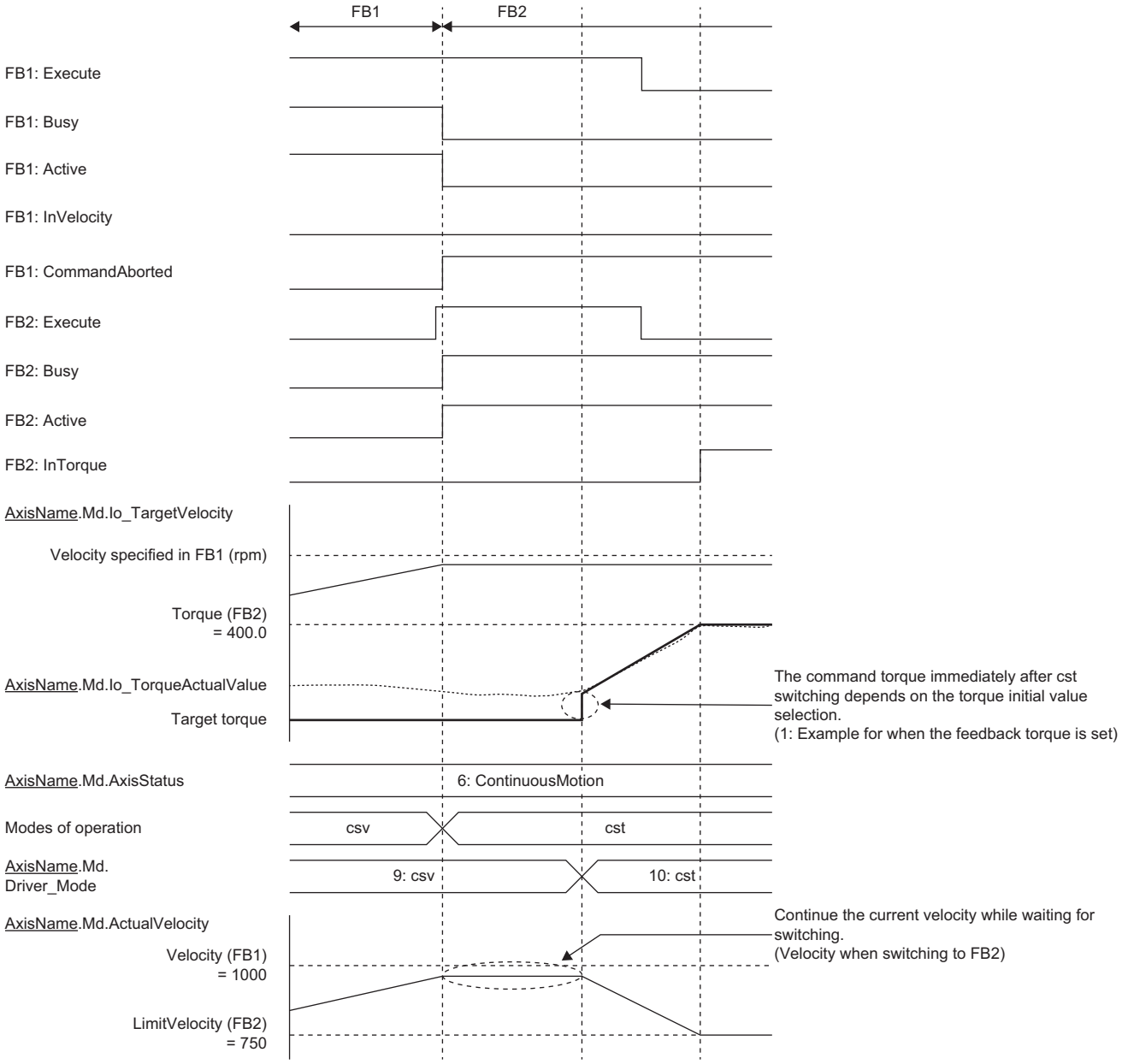
■Speed control (FB1) → Torque control (FB2)

1. A cyclic synchronous torque mode (cst) change request is issued to the drive unit.

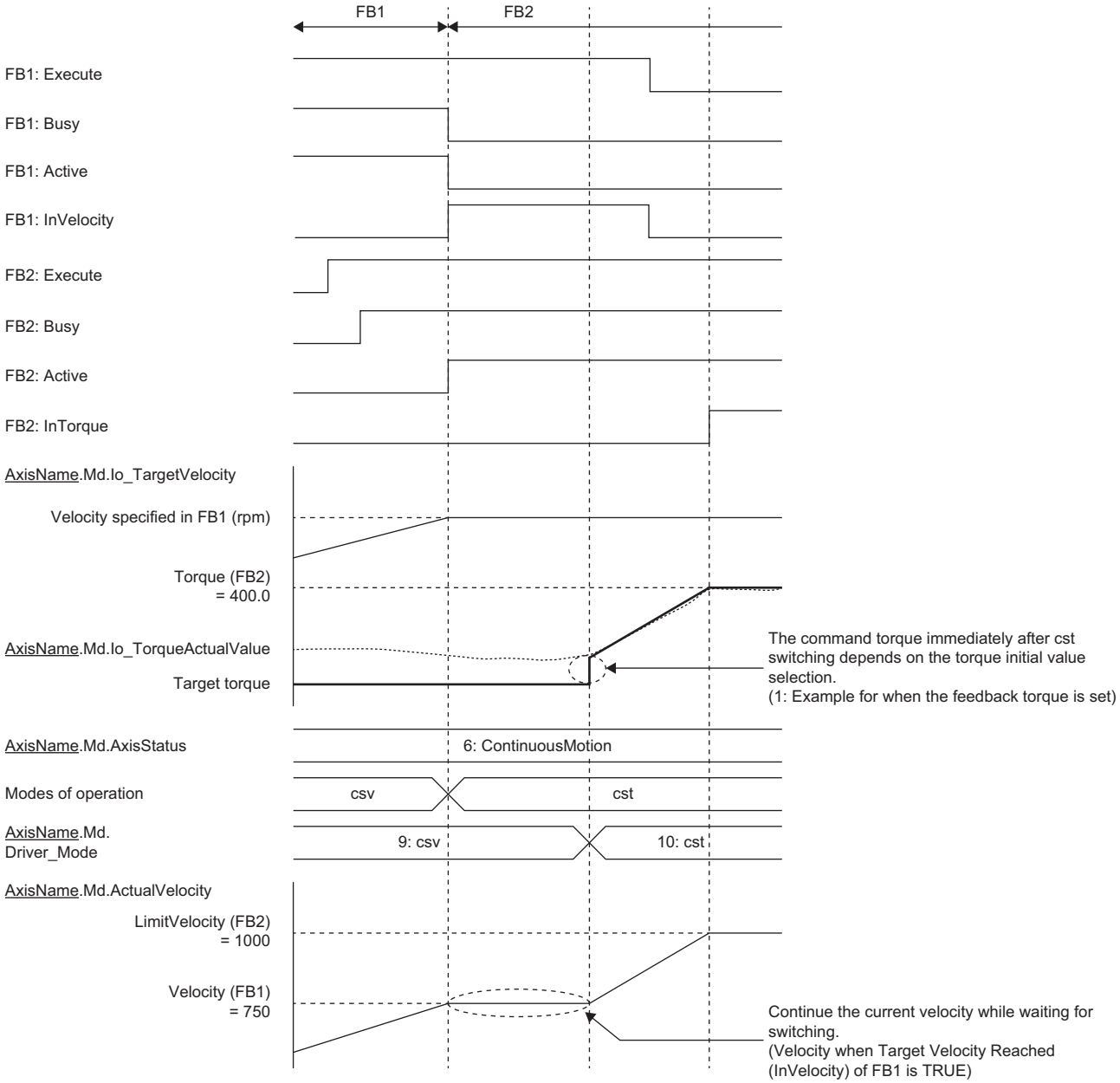
2. While waiting for change, the cyclic synchronous velocity mode (csv) is continued.

3. When the drive unit switches to the cyclic synchronous torque mode (cst), the torque increase/decrease is started from the current actual torque, and the acceleration/deceleration process of the velocity is started from the command velocity.

• 0: Aborting (mcAborting)

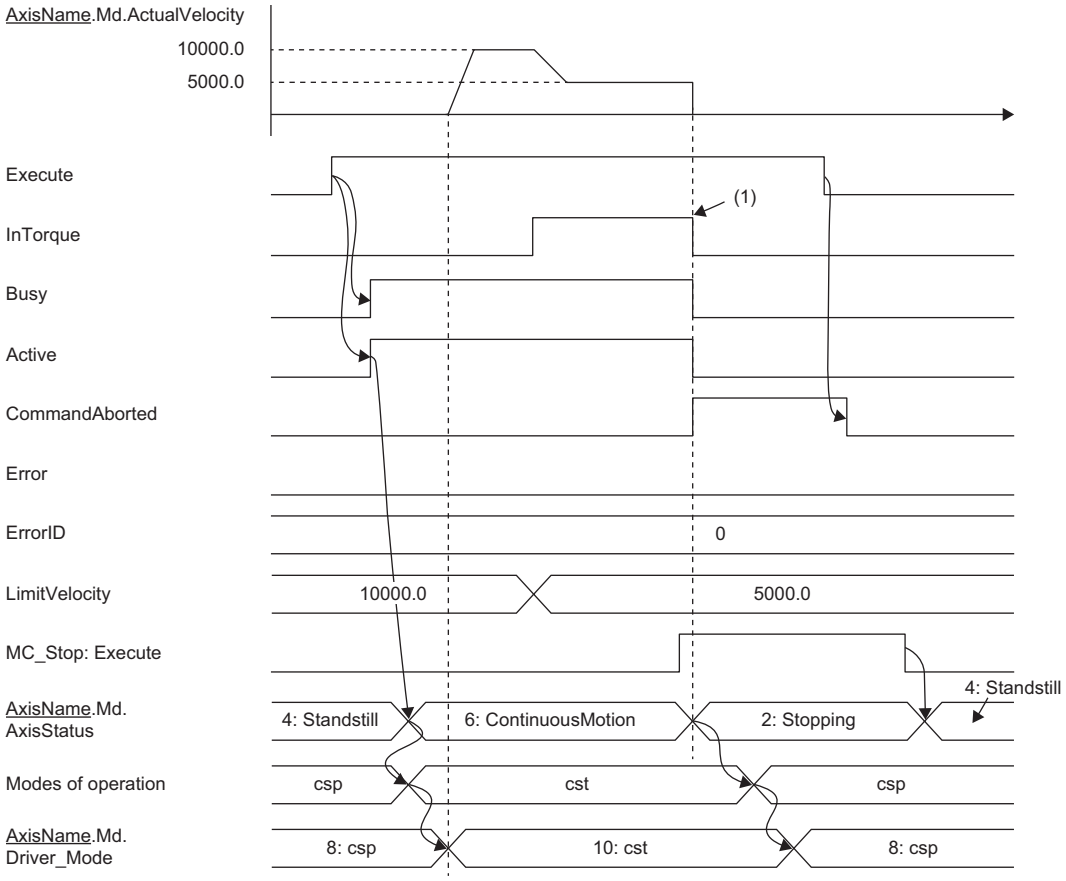


• 1: Buffered (mcBuffered)



When starting another instruction during this FB execution

■Torque control → Stop instruction (MC_Stop (Forced Stop))



(1) MC_Stop (Forced Stop) is started.

■Torque control → Positioning (Absolute value/Relative value positioning)

1. A switching request to the cyclic synchronous position mode (csp) is issued to the drive unit.
2. The positioning control FB that was started is analyzed, and the axis waits until the drive unit switches to the cyclic synchronous position mode (csp). (Even if a switching request to the cyclic synchronous position mode (csp) is executed during axis operation, switching may not be carried out depending on the drive unit specifications. If switching to the cyclic synchronous position mode (csp) is not completed within 1 [s], Control mode switching error (error code: 1A95H) occurs due to timeout and the axis stops.)
3. While waiting for switching, torque control is continued with the torque and the limit velocity at switching.
4. When the drive unit switches to the cyclic synchronous position mode (csp), the positioning control starts.

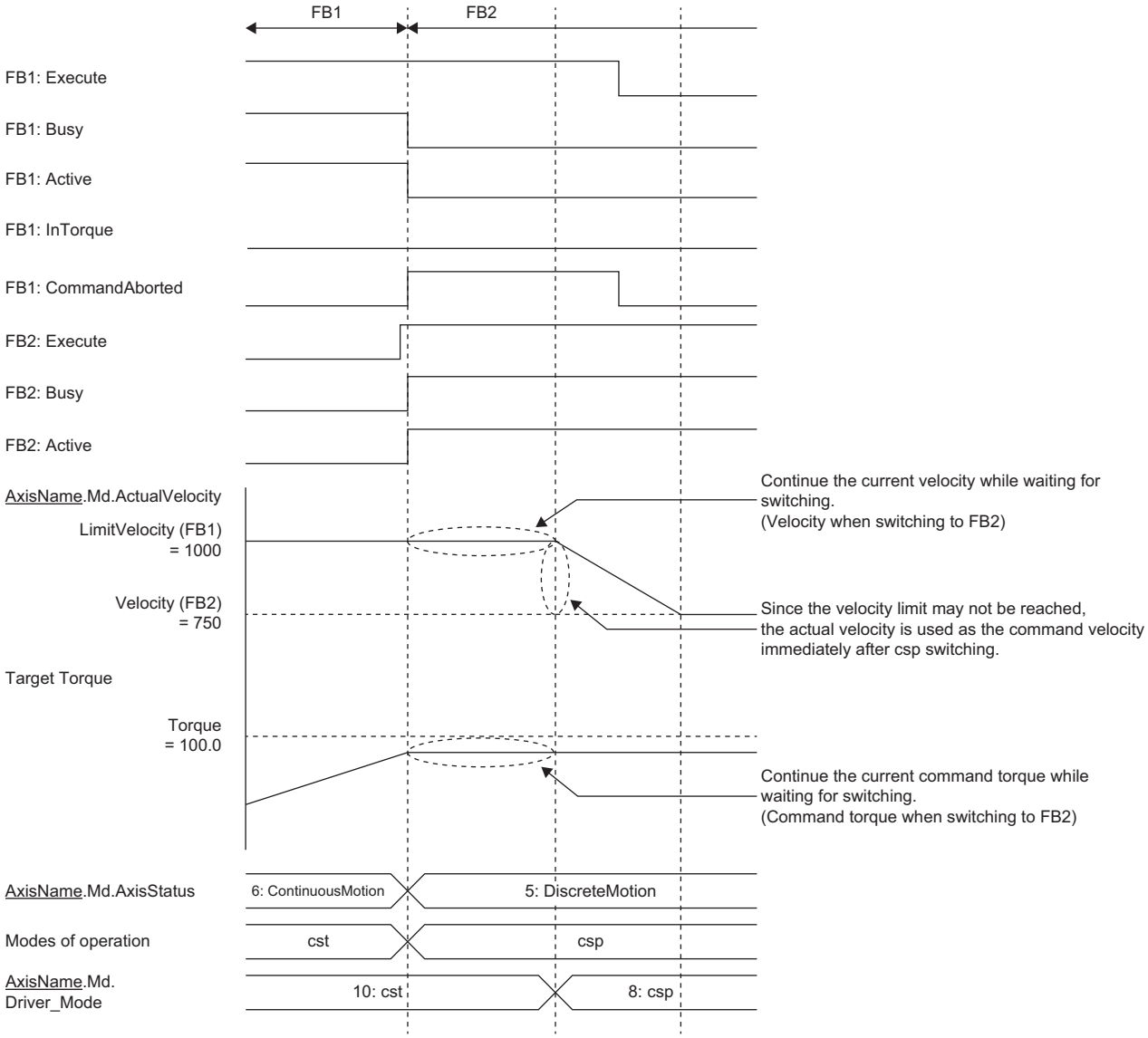
Point

- The deceleration distance may not be secured and the target position may be overrun depending on the travel distance switching from the cyclic synchronous torque mode (cst) to the cyclic synchronous position mode (csp). In this case, the axis operates based on Operation Setting at Overrun (AxisName.Pr.OverrunOperation). For the operation at the overrun occurrence, refer to the following.

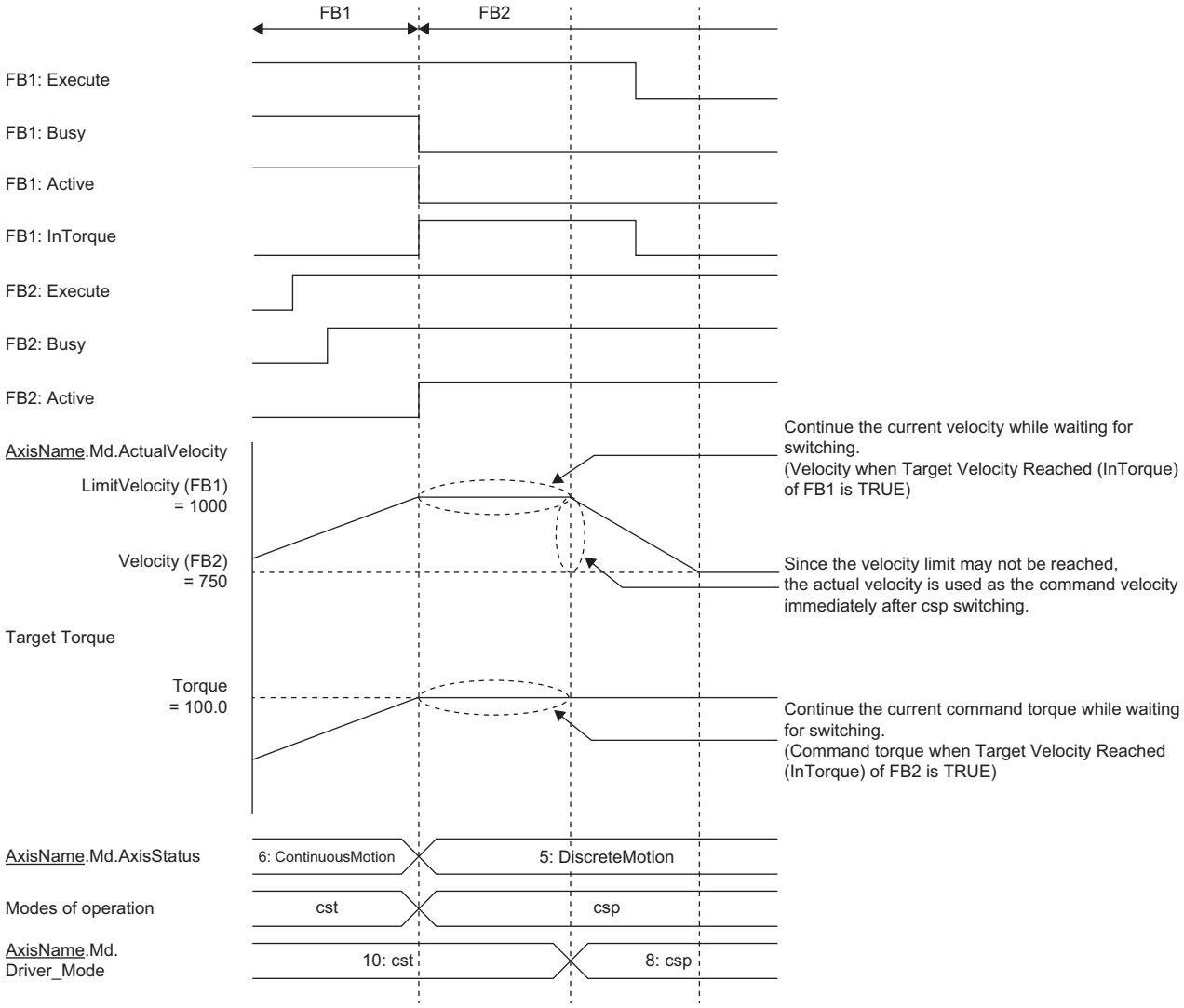
☞ Page 547 Multiple Start (Buffer Mode)

- If an overrun occurs while waiting for switching, Overrun error (error code: 1AE3H) will occur immediately after switching to the cyclic synchronous position mode (csp), and the motor will stop immediately, regardless of Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

• 0: Aborting (mcAborting)



• 1: Buffered (mcBuffered)



■Torque control (FB1) → Velocity control (FB2)

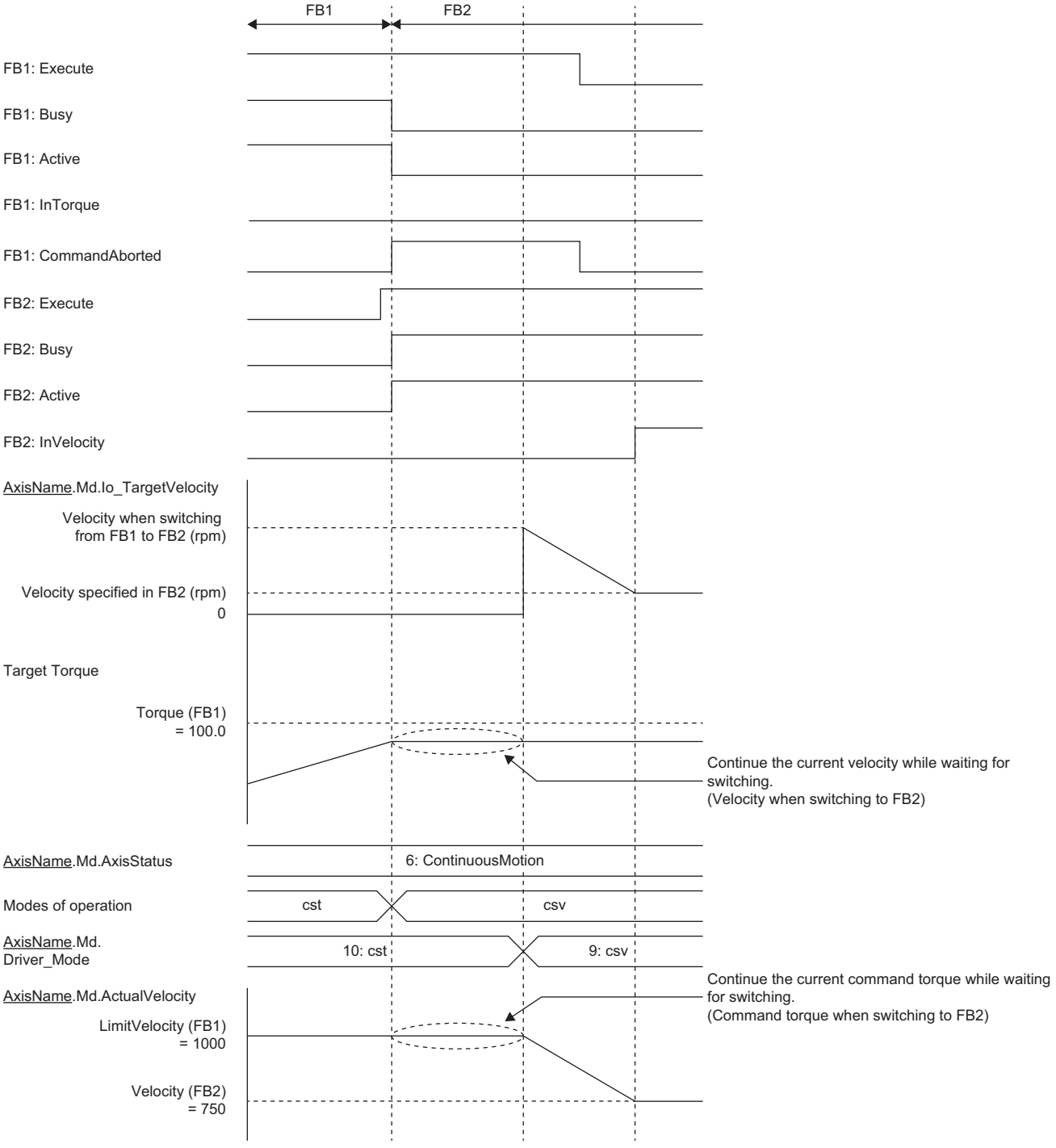
1. A switching request to the cyclic synchronous velocity mode (csv) is issued to the drive unit.

2. The positioning control FB that was started is analyzed, and the axis waits until the drive unit switches to the cyclic synchronous velocity mode (csv). (Even if a switching request to the cyclic synchronous velocity mode (csv) is executed during axis operation, switching may not be carried out depending on the drive unit specifications. If switching to the cyclic synchronous velocity mode (csv) is not completed within 1 [s], Control mode switching error (error code: 1A95H) occurs due to timeout and the axis stops.)

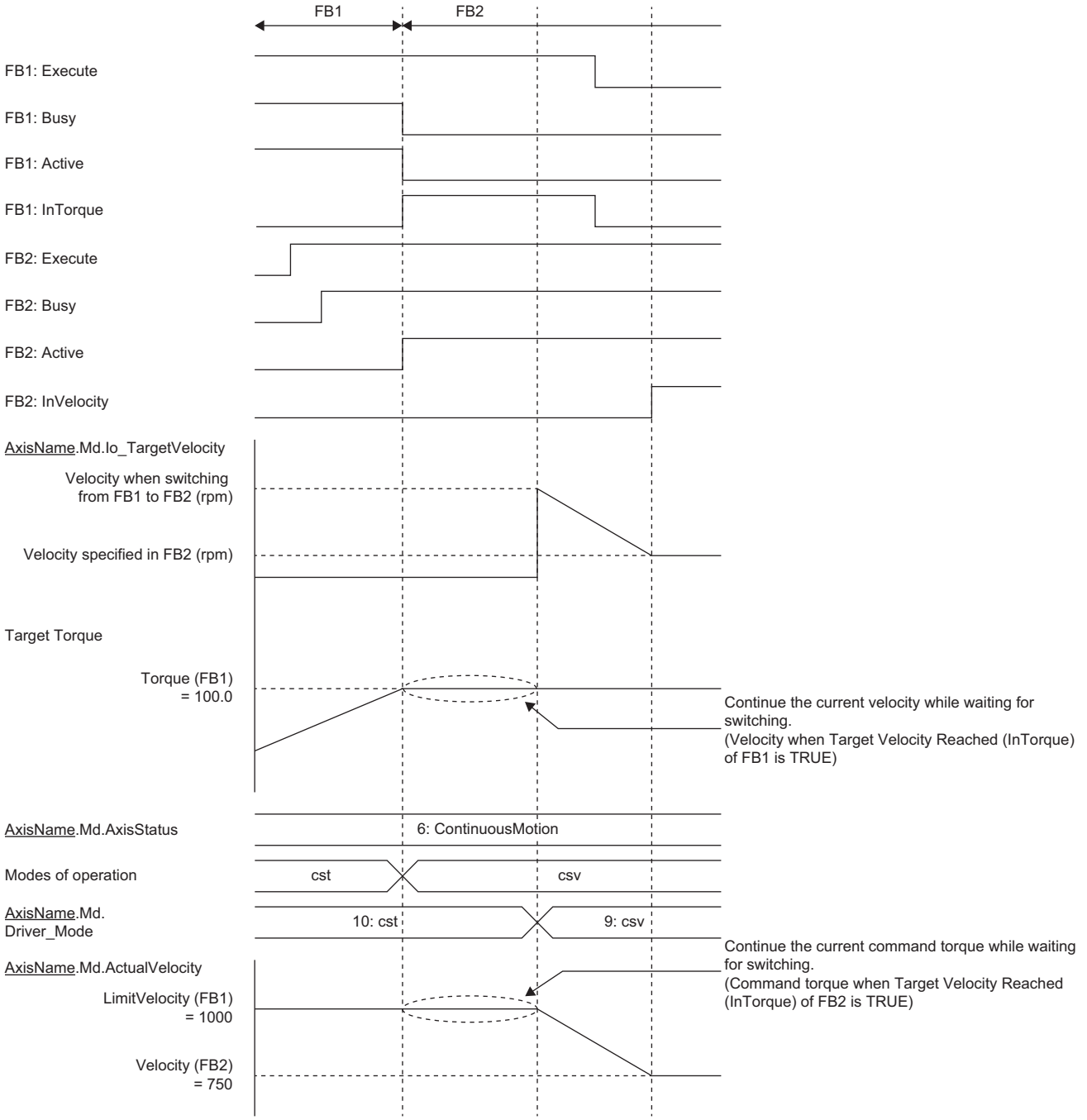
3. While waiting for switching, torque control is continued with the torque and the limit velocity at switching.

4. When the drive unit switches to the cyclic synchronous velocity mode (csv), the velocity control starts.

• 0: Aborting (mcAborting)



• 1: Buffered (mcBuffered)



When the operation direction is reversed

When starting this FB and operation direction is reversed during another instruction execution, reverse the set torque according to the torque positive direction ramp and the torque negative direction ramp.

When starting an FB operated in the cyclic synchronous position mode (csp) and operation direction is reversed during this instruction execution, set velocity at the cyclic synchronous position mode (csp) switching is set to 0. After that, the operation starts in the changed direction.

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following functions.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required, ○: Recommended

Instruction/function	Required object data	PDO mapping	Operation with no object
MC_TorqueControl (Torque Control) (Control mode switching*1: cst)	Target torque	◎	Required object data unset (error code: 1AF7H) occurs.
	Velocity limit value	○	Velocity limit in cst cannot be set using LimitVelocity.
	Torque actual value	○	☞ Page 729 Torque initial value selection (Options (Options): bit 18)
MC_TorqueControl (Torque Control) (Control mode switching*1: ct)	Target torque	◎	Required object data unset (error code: 1AF7H) occurs.
	Velocity limit value	◎	Required object data unset (error code: 1AF7H) occurs.
	Torque actual value	○	☞ Page 729 Torque initial value selection (Options (Options): bit 18)
	Velocity actual value	○	☞ Page 715 Velocity initial value selection

*1 It can be set by control mode switching selection (Options bit19).

Precautions

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
- The set position and the machine feed value are updated by follow up.
- Time until the control mode is switched depends on the specifications of the drive unit.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start the positioning control FB during the control mode switching. Start the positioning control FB after checking that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "10: cst (Torque Control) (cst)".
- When switching the control mode from the cyclic synchronous position mode (csp) to cyclic synchronous velocity mode (csv), if a stop cause (axis error detection) occurs before the control mode is switched, follow-up may continue in cyclic synchronous position mode (csp) until the zero speed status is reached.
- When switching from the cyclic synchronous position mode (csp) to the cyclic synchronous torque mode (cst) or from the cyclic synchronous torque mode (cst) to the cyclic synchronous position mode (csp) without waiting for stop of the motor by using the MR-J5(W)-G, note the following.
  - Set the servo parameter (extension setting) "ZSP disabled selection at control switching (PC76.1)" to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
  - For the setting value of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following.
    ☞ Page 2152 Setting method
- When Velocity limit value is not mapped, the set torque is changed to 0 at stop cause occurrence.

Torque limit change during the cyclic synchronous torque mode (cst)

At restart or continuous update, if the target torque is changed to a value bigger than the torque limit value (Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive), Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative)), Torque Limit Value Over Warning (event code: 00D12H) occurs and the axis operates at the value before change.

During torque control, if Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed to a value smaller than the target torque, the target torque will be changed to the torque limit value. In this case, the set torque is changed at one cycle.

29.4 Pressure Control

This control method switches the drive unit control mode to the cyclic synchronous pressure mode (cspr), and performs the control.
The pressure control compatible drive unit controls the pressure sensor (load cell) value.
The pressure ramp function and velocity limit acceleration/deceleration function adjust the slope of the command pressure and command limit velocity before sending them to the drive unit. Pressure control uses a drive unit that supports cyclic synchronous pressure mode (cspr). The following table lists the available drive unit and its firmware version.

Model name	Version
MR-J5-G-LL	"F0" or later

Restriction

Before using this function, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

Relevant variable

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
ActualPosition	Actual Position	Stores the actual position (same as positioning control).
ActualVelocity	Actual Velocity	Stores the actual velocity (same as positioning control).
Cst_SetLimitVelocity	Set Limit Velocity at cst/ct/cspr	Stores the command limit velocity in the cyclic synchronous torque mode (cst), continuous operation to torque control mode (ct), and cyclic synchronous pressure mode (cspr).
Cspr_SetPressure	Set Pressure at cspr	Stores the command pressure in cyclic synchronous pressure mode (cspr).
Cspr_ForwardSidePosition	Forward-side Position at cspr	Stores the forward end position in cyclic synchronous pressure mode (cspr).
Io_PressureActualValue	Object Data_PressureActualValue	Displays the value of "Pressure actual value (2E52H)" in the object data.*1
TargetVelocity	Target Velocity	• Stores the actual velocity limit, taking override into account, in the limit velocity (LimitVelocity). The value becomes "0" or more regardless of the movement direction. • Stores "0" after the control is completed.
InVelocity	Target Velocity Reached	Stores FALSE (Not reached) when in cyclic synchronous pressure mode (cspr).

*1 For details on the object data, refer to the following.
☞ Page 472 Object data list

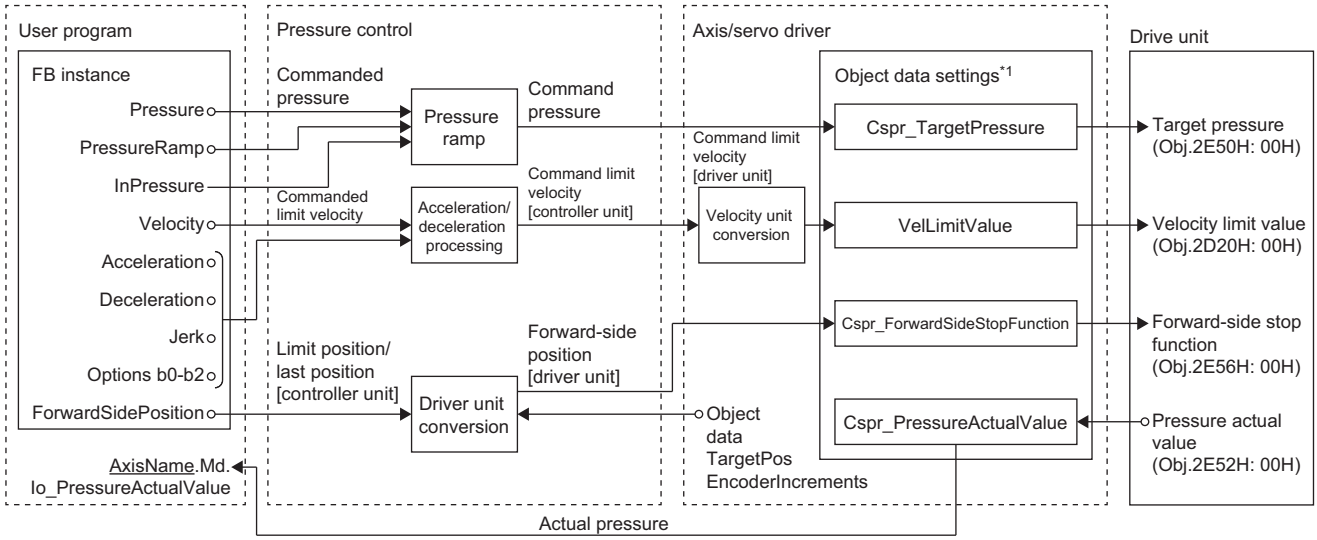
Relevant FB

For details on motion control FBs, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_PressureControl	Pressure Control	Switches the drive unit control mode to cyclic synchronous pressure mode (cspr), and performs pressure control according to the specified pressure.

Overall block diagram

The relationship between pressure control and other functions is shown below.



*1 For the initial value of the real drive axis

Control details

MCv_PressureControl (Pressure Control) is a function that switches the drive unit control mode to cyclic synchronous pressure mode (cspr) and performs pressure control.
To finish this FB, execute multiple start of MC_Stop (Forced Stop) or input an axis stop signal. Or, execute multiple start of another motion FB to switch to the cyclic synchronous position mode (csp).

Command pressure increase/decrease and servo motor movement direction

When using the MR-J5-G-LL, it differs according to the settings of the servo parameters "Selection of pressure increasing direction for positioning address (PW12.1)" and "Travel direction selection (PA14)".

- When "Selection of pressure increasing direction for positioning address (PW12.1)" is "0: The pressure increases as the positioning address decreases."

Setting value of Travel direction selection (PA14)	Command pressure	Servo motor movement direction
0: Positioning address increasing CCW rotation	Increase	Movement in the CW direction
	Decrease	Movement in the CCW direction
1: Positioning address increasing CW rotation	Increase	Movement in the CCW direction
	Decrease	Movement in the CW direction

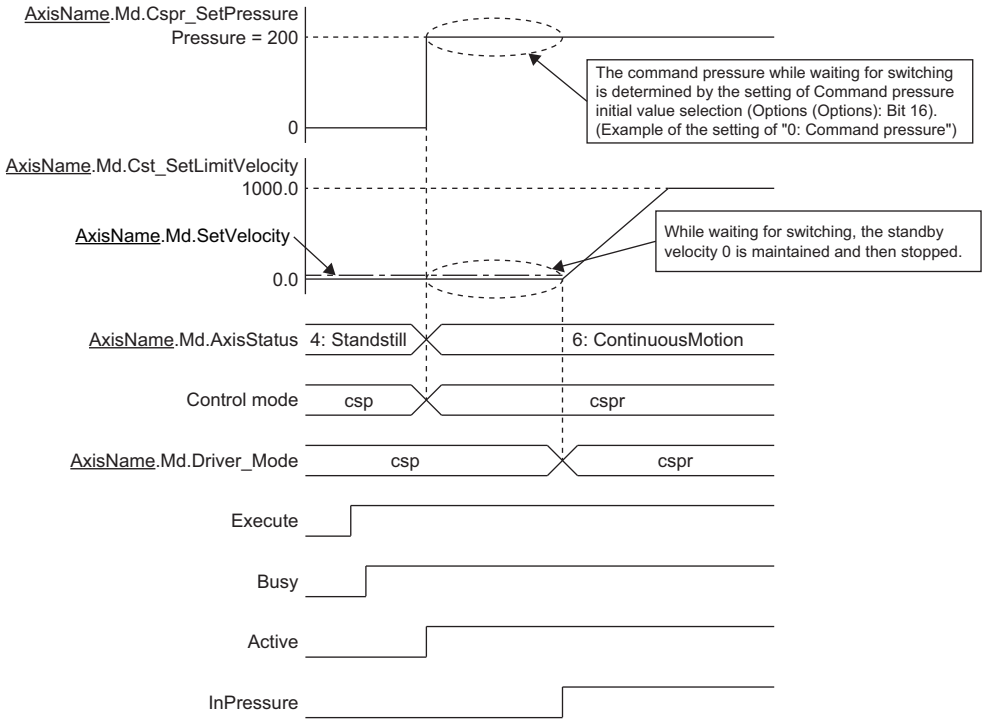
- When "Selection of pressure increasing direction for positioning address (PW12.1)" is "1: The pressure increases as the positioning address increases."

Setting value of Travel direction selection (PA14)	Command pressure	Servo motor movement direction
0: Positioning address increasing CCW rotation	Increase	Movement in the CCW direction
	Decrease	Movement in the CW direction
1: Positioning address increasing CW rotation	Increase	Movement in the CW direction
	Decrease	Movement in the CCW direction

Driver control mode switching

This section describes the operation in which the driver control mode becomes cyclic synchronous pressure mode (cspr).

1. At startup, a control mode switching request to the cyclic synchronous pressure mode (cspr) is issued to the drive unit.
2. The standby velocity remains at "0" and the command position stops until the drive unit control mode is switched. Also, the command pressure will be Command pressure initial value selection (Options (Options): Bit 16), and the command limit velocity will be the initial value set in Command limit velocity initial value selection (Options (Options): bit 18, bit 19).
3. After the drive unit control mode is switched, the pressure ramp and acceleration/deceleration process will start from each set value.



Operation at stop cause occurrence

The following shows stop causes during cyclic synchronous pressure mode (cspr) and the process when each cause occurs.

Cause number	Stop cause	Axis Status (AxisName.Md.AxisStatus)	Stop process
		After stop	
1	"Forced stop input" is off	1: Stopping on error (ErrorStop)	Immediate Stop*1
2	Drive unit power supply is off	1: Stopping on error (ErrorStop)	Immediate Stop*1
	Drive unit network disconnection detection		
	Drive unit error		
	Forced stop input to the drive unit		
	Enable (Enable) of MC_Power (Operation Available) is FALSE		
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)" or "5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)")*2		
	Drive unit control mode has switched to the control mode that is not supported by the motion system axis control.		
3	Hardware stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	The command limit velocity is changed to 0, and an immediate stop is performed.*5 After stopping, the control mode switches to the cyclic synchronous position mode (csp).
4	Occurrence of a moderate or major error of the controller	1: Stopping on error (ErrorStop)	
	PLC READY is off.		
	Motion system moderate or major error occurrence		
	Cycle over error occurrence		
5	Software stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	
6	Axis error detection*3	1: Stopping on error (ErrorStop)	
7	Execution command (Execute) of MC_Stop (Forced Stop) is TRUE	2: Decelerating to stop (Stopping)*4	The command limit velocity is changed to 0, and an immediate stop is performed.*5 After stopping, the control mode switches to the cyclic synchronous position mode (csp). (Not based on the deceleration of MC_Stop (Forced Stop))
8	"Stop signal (STOP)" of external input signal is TRUE	4: Standby (Standstill)	The command limit velocity is changed to 0, and an immediate stop is performed.*5 After stopping, the control mode switches to the cyclic synchronous position mode (csp).

*1 The servo turns off on the drive unit side and an immediate stop is performed, and also the motion system side command is stopped.

*2 Operation differs depending on the setting value selected in Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.
☞ Page 579 Relevant variables

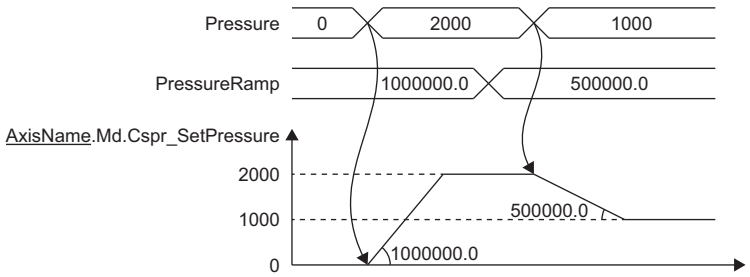
*3 If an axis error (the error that transits the status into the "1: Stopping on error (ErrorStop)" status) occurs in the buffering FB, immediate stop will be performed upon the occurrence of the error.

*4 When Execution command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

*5 The command pressure value is not changed. Note that it may take some time for the velocity to reach 0 depending on the command pressure when a stop cause occurs.

Pressure ramp function

- This function adjusts the slope of the command pressure to be sent to the drive unit.
- The command pressure is generated based on the pressure (Pressure) and pressure ramp (PressureRamp).



- If the generated result is not an integer, the value with the decimal portion truncated is used as the command pressure.
- If the pressure ramp (PressureRamp) is set to "0.0", the specified pressure is reached within one control cycle.
- When the control mode is switched from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr) at startup or multiple start, the command pressure set in Command pressure initial value selection (Options (Options): Bit 16) will be used as the initial value for operation. For details on startup and multiple start, refer to the following.

☞ Page 745 Driver control mode switching

Command pressure initial value selection (Options (Options): Bit 16)

Set the initial value of the command pressure when the control mode is switched from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr).

Setting value	Description
0: Specified pressure	The initial value of the command pressure is the pressure (Pressure).
1: Feedback pressure	The initial value of the command pressure is the feedback pressure (Object data _PressureActualValue(AxisName.Md.Io_PressureActualValue)). If the feedback pressure is a negative value, it will be set to "0". Also, if the value exceeds "30000", it will be set to "30000".*1

*1 When the object assigned to object data "Pressure actual value (2E52H)" is not PDO mapped, it will not be used as the feedback pressure. (The initial pressure value is "0".)

Precautions

- The time (pressure ramp time) required for the command pressure to reach the pressure (Pressure) is limited to 8400 [s]. The pressure ramp time calculated from the pressure (Pressure), the pressure ramp (PressureRamp), and the command pressure is limited. Set the pressure (Pressure) and the pressure ramp (PressureRamp) so that the pressure ramp time does not exceed 8400 [s].
- The pressure ramp time is calculated as follows.

Type	Item	Abbreviation	Description	Calculation formula
Specified value	Pressure (Pressure)	P	Sets the specified pressure.	—
	Pressure ramp (PressureRamp)	PR	Sets the ramp (slope) for reaching the pressure (Pressure) from the command pressure.	
Command current value	Command pressure	Pnow	Current pressure command value	
Calculated value	Pressure ramp time	—	Time to reach the pressure (Pressure) from the command pressure	| P - Pnow | ÷ PR

- At startup or when switching between FBs due to executing multiple start, if the command pressure has not yet reached the pressure (Pressure) and the pressure ramp time exceeds 8400 [s], Ramp time over (error code: 1B3FH) will occur.
- When the pressure (Pressure) or pressure ramp (PressureRamp) is changed during a restart/continuous update, if the command pressure has not yet reached the pressure (Pressure) and the pressure ramp time exceeds 8400 [s], the changed value will be ignored, and the operation will continue with the previous value. When changing the setting, Ramp Time Over Warning (event code: 00D53H) will occur.

Velocity limit acceleration/deceleration processing function

- Adjusts the slope of the command limit velocity to be sent to the drive unit.
- The command limit velocity is generated based on the limit velocity (LimitVelocity), acceleration (Acceleration), deceleration (Deceleration), and acceleration/deceleration method setting (Options (Options) bits 0 to 2). For details, refer to the following. (However, the variable velocity (Velocity) is to be interpreted as the limit velocity (LimitVelocity)).
  ☞ Page 1078 Acceleration/Deceleration Processing Function
- When the control mode is switched from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr) at startup or multiple start, the command limit velocity set in Command limit velocity initial value selection (Options (Options): bit 18, bit 19) operates from the initial value. For details on startup and multiple start, refer to the following.
  ☞ Page 745 Driver control mode switching

Command limit velocity initial value selection (Options (Options): bit 18, bit 19)

Set the initial value of the command limit velocity when the control mode is switched from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr).

Setting value	Description
0: Command velocity	The initial value of the command limit velocity is the absolute value of Set Velocity (AxisName.Md.SetVelocity). After switching, acceleration and deceleration occur toward the limit velocity (LimitVelocity).
1: Specified limit velocity	The command limit velocity initial value is the limit velocity (LimitVelocity).
2: Automatic selection	The command limit velocity initial value is the lower of "0: Command velocity" and "1: Commanded velocity". If "0: Command velocity" is lower, after switching, acceleration and deceleration occur toward the limit velocity (LimitVelocity).

When switching from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr) during axis movement, vibration or impact at the time of switching can be suppressed using the command limit velocity, by setting Command limit velocity initial value selection (Options (Options): bit 18, bit 19) and the limit velocity (LimitVelocity) as follows.

- Set Command limit velocity initial value selection (Options (Options): bit 18, bit 19) to "0: Command velocity".
- Set the limit velocity (LimitVelocity) to a value equal to or lower than the command velocity at the time of switching, and set Command limit velocity initial value selection to "1: Commanded limit velocity".

Precautions

- The command limit velocity and its acceleration/deceleration override function are enabled. For details on the override function, refer to the following. (However, "target velocity" is to be interpreted as "command limit velocity".)
  ☞ Page 1116 Override Function
- If multiple start was executed by specifying "0" for acceleration (Acceleration) or deceleration (Deceleration), the target acceleration or target deceleration of the previous FB will not be inherited. The operation is the same as when starting up.

Pressure control process

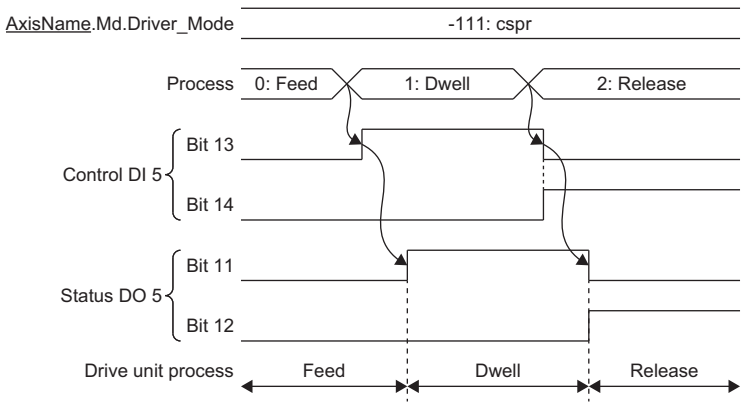
- Pressure control involves the feeding, pressure-holding, and pressure-release processes. Use MCv_PressureControl (Pressure Control) to create a user program that performs the following in each process.

Pressure control process (Process)	Process description	Process operation procedure
0: Feeding (Feed)	The process of bringing the tip of the machine that applies pressure into contact with the workpiece and gradually moving it to the pressure-holding start position	1. The tip of the machine approaches the workpiece at a low velocity. 2. The tip of the machine contacts the workpiece. After contact, the load cell pressure (feedback pressure) begins to increase. 3. Specify the velocity limit and pressure, and gradually move to the pressure-holding start position. 4. Switch to pressure holding.
1: Pressure holding (Dwell)	The process of applying pressure to the workpiece	5. Set the pressure and apply various levels of pressure to the workpiece. <Example> Light pressure → Strong pressure → Medium pressure
2: Pressure release (Release)	The process of releasing pressure applied to the workpiece	6. Set the pressure or the final position to reduce the pressure applied to the workpiece. This reduces the feedback pressure. 7. Once the feedback pressure has sufficiently decreased, end the pressure-release process.

- Set the pressure control process (Process) to send the pressure control process to the drive unit. When using the MR-J5-G-LL, the servo parameter "Pressure model adaptive control selection (PW34.0)" is used to enable or disable the pressure model adaptive control during pressure holding or pressure release.

Pressure model adaptive control selection (PW34.0) setting value	Pressure control process	
	Pressure holding	Pressure release
0	Disable	Disable
1	Enable	
2	Disable	Enable
3	Enable	

- When the servo parameter "Pressure model adaptive control selection (PW34.0)" is set to a value other than "0" and pressure model adaptive control is enabled for pressure holding or pressure release, set the pressure control process (Process) according to the content to be executed in the user program. If the pressure model adaptive control is not enabled, the pressure control process (Process) remains at its initial value (0: Feed), and no further settings are required. For details on the pressure model adaptive control, refer to the manuals for the MR-J5-G.
- To send to the drive unit, use "Bit 13 (C_ATHO): Pressure control Dwelling command" and "Bit 14 (C_ATRE): Pressure control Depressurization command" of "Control DI 5 (2D05H)" in the object data. To check the drive unit process, monitor "Bit 11 (S_ATHO): Pressure control Dwelling in progress" and "Bit 12 (S_ATRE): Pressure control Depressurization in progress" in "Status DO 5 (2D15H)" of the network-labeled object data.

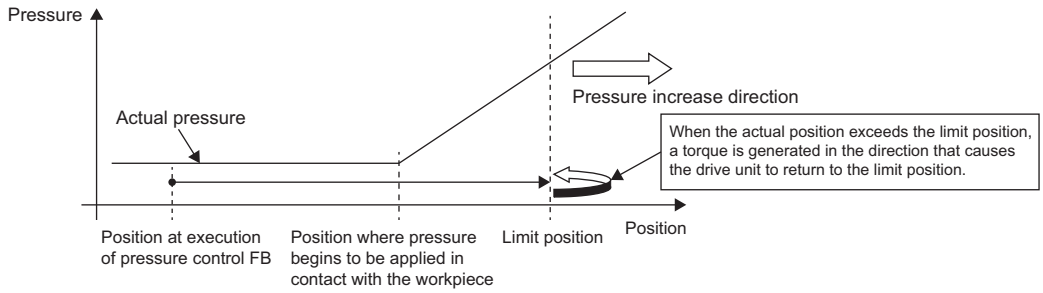
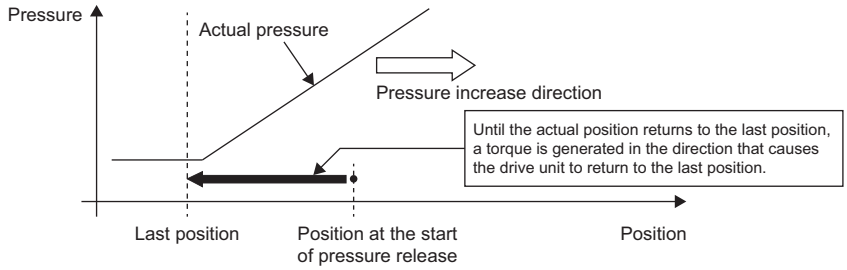


Precautions

- If the feedback velocity at the start of feeding has not reached the limit velocity, increase the command pressure at the start of feeding. (The command pressure at the start of pressure holding does not need to be changed.)
- If the feedback pressure overshoots during the switch from feeding to pressure holding, set the acceleration (Acceleration) and deceleration (Deceleration) so that the acceleration/deceleration at the start of pressure holding is reduced.

Limit position / final position (forward end position)

By setting the forward end position (ForwardSidePosition), the following operations occur for each pressure control process.

Pressure control process	Operation
Feeding / pressure holding	Limit the range of movement in the direction of increasing pressure. Set the range limit position at the forward end position (ForwardSidePosition). 
Pressure release	Specify the final position where the feedback pressure decreases, and perform the pressure-release operation. Set the final position at the forward end position (ForwardSidePosition). 

- MCv_PressureControl (pressure control) converts the forward end position (ForwardSidePosition) into driver units and generates the forward end position to be sent to the drive unit. To send to the drive unit, use the object data "Forward-side stop function (2E56H)".
- During cspr, Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) can be used to check the forward end position sent to the drive unit in position command units.
- Regardless of the pressure control process, if the current position exceeds the limit position/final position (forward end position) in the direction of increasing pressure, the drive unit's forward end stop function generates torque in the direction of returning to the forward end position.

Precautions

- There are restrictions on the effective range of the forward end position (ForwardSidePosition) and the movement range during control. Use them within the restricted range. The upper limit of the range is shown below.

Upper limit of the range
(2147483648[*1] - 10 × Encoder resolution [*2] / Electronic gear[*3]) × Driver unit conversion denominator / Driver unit conversion numerator

*1 "2147483648" = "2^{31}"
*2 Encoder resolution obtained from the drive unit (object data "Encoder increments (608FH)")
*3 This electronic gear (Gear ratio) is obtained from the drive unit. When using the MR-J5-G-LL, this value reflects the settings of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)".

■Effective range of the forward end position (ForwardSidePosition)

Restriction	Timing	Processing when out of range
Set Position (AxisName.Md.SetPosition) at the time of the control mode switching request[*1] to the cyclic synchronous pressure mode (cspr) is set as the reference position, and the forward end position (ForwardSidePosition) is set within the range where the absolute value of the difference from the reference position does not exceed the upper limit.	When control begins	Forward End Position Incorrect (error code: 1B3EH) occurs.
Set Position (AxisName.Md.SetPosition) at the time of the control mode switching request[*1] to the cyclic synchronous pressure mode (cspr) is set as the reference position, and the forward end position (ForwardSidePosition) is changed within the range where the absolute value of the difference from the reference position does not exceed the upper limit.	When control changes	The changed value will be ignored and the operation will continue with the previous value. When the change is made, Forward End Position Incorrect Warning (event code: 00D51H) occurs.
During cspr, the forward end position (ForwardSidePosition) is changed within the range where the absolute value of the difference from Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) does not exceed the upper limit.		

*1 If the pressure control FB is called from a program with the same cycle as the axis control cycle, its behavior is the same as at rising during control (Active).

■Movement range during control

Restriction	Timing	Processing when out of range
The absolute value of the difference between Set Position (AxisName.Md.SetPosition) and Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) during cspr is used within the range that does not exceed the upper limit.	During control	Forward end position error (error code: 1B40H) occurs.

- By setting the electronic gear and driver unit conversion so that the encoder resolution of driver units is reduced, it is possible to expand the effective range of the forward end position (ForwardSidePosition) and the movement range during control. For details on the electronic gear setting of the drive unit, refer to the following.
☞ Page 2152 MR-J5(W)-G (cyclic synchronous mode) connection method

Ex.

When performing pressure control using the MR-J5-G-LL and a rotary servo motor

In settings A and B, the relationship between the units of the motion system and the servo motor end is the same.

If the range of restrictions is a problem with setting A, changing to setting B can expand the range while maintaining the relationship between the units of the motion system and the servo motor end.

■Setting

- Motion system

Setting item	Setting value	
	Setting A	Setting B
Position Command Unit (AxisName.Pr.Unit_Position)	HFA010000 (μm)	
Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum)	67108864 [pulse]	4194304 [pulse]
Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen)	20000 [μm]	

- MR-J5-G-LL

Setting item	Setting value	
	Setting A	Setting B
Electronic gear numerator (PA06)	1	16
Electronic gear denominator (PA07)	1	
Motor encoder resolution	67108864 [pulse/rev]	

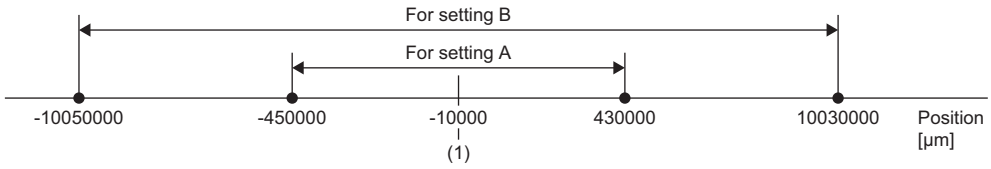
■Upper limit of the range

$(2^{31}$ - 10 × Encoder resolution / Electronic gear) × Driver unit conversion denominator / Driver unit conversion numerator

$=(2^{31}$ - 10 × Encoder resolution / (Electronic gear numerator (PA06) / Electronic gear denominator (PA07))) × Driver unit conversion denominator / Driver unit conversion numerator

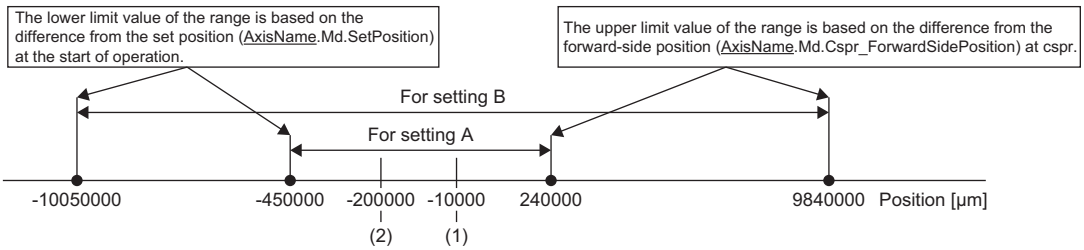
Setting	Upper limit of the range
Setting A	(2147483648 - 10 × 67108864 / (1 / 1)) × 20000 / 67108864 = 440000[μm]
Setting B	(2147483648 - 10 × 67108864 / (16 / 1)) × 20000 / 4194304 = 10040000[μm]

- When the pressure control FB is started with Set Position (AxisName.Md.SetPosition) set to "-10000 [μm]", the effective range of "Forward-side position at start (ForwardSidePosition)" is as follows.



(1) Set Position (AxisName.Md.SetPosition) at startup

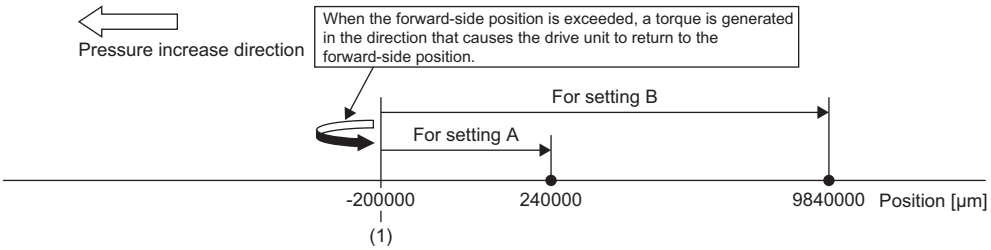
• If the pressure control FB is started with Set Position (AxisName.Md.SetPosition) set to "-10000[μm]", and Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) during cspr is "-200000[μm]", the effective range of the forward end position (ForwardSidePosition) when control is changed is as follows.



(1) Set Position (AxisName.Md.SetPosition) at startup

(2) Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) during cspr

• When Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) during cspr is "-200000[μm]", the movement range during control of the pressure control FB is as follows.



(1) Forward End Position (AxisName.Md.Cspr_ForwardSidePosition) during cspr

• To enable the limit position/final position, perform PDO mapping on the object assigned to the object data "Forward-side stop function (2E56H)". If PDO mapping is not performed, the forward end position (ForwardSidePosition) setting will be ignored and the limit position/final position will be disabled.
When using the MR-J5-G-LL, the following PDO mapping and servo parameter settings are recommended.

Limit position/final position	Setting of PDO mapping of the object assigned to the object data "Forward-side stop function (2E56H)"	Setting of the servo parameter "Forward/reverse-side stop function (PW12.2)"
Enable	Perform PDO mapping.	1h (Forward-end stop: Enabled, Backward-end stop: Disabled)
Disable*1	Do not perform PDO mapping.*2	2h (Forward-end stop: Disabled, Backward-end stop: Disabled)

*1 The forward end stop function is disabled. To limit the range of movement in the direction of increasing pressure, set the software stroke limit.

*2 Either set the "Forward-side stop function (2E56H)" not to be PDO mapped, or set the object data (AxisName.PrConst.SlaveObject.vCspr_ForwardSideStopFunction) to "" (string of length 0).

• When performing pressure control with the limit position/final position enabled, enable the software stroke limit function. If the software stroke limit function is disabled, executing the FB will result in Start when software stroke limit is disabled (error code: 1B3DH).

Multiple start (buffer mode)

When multiple start was executed for the pressure control FB while a previous motion FB is still in control

■Cyclic synchronous position mode (csp) → Cyclic synchronous pressure mode (cspr)

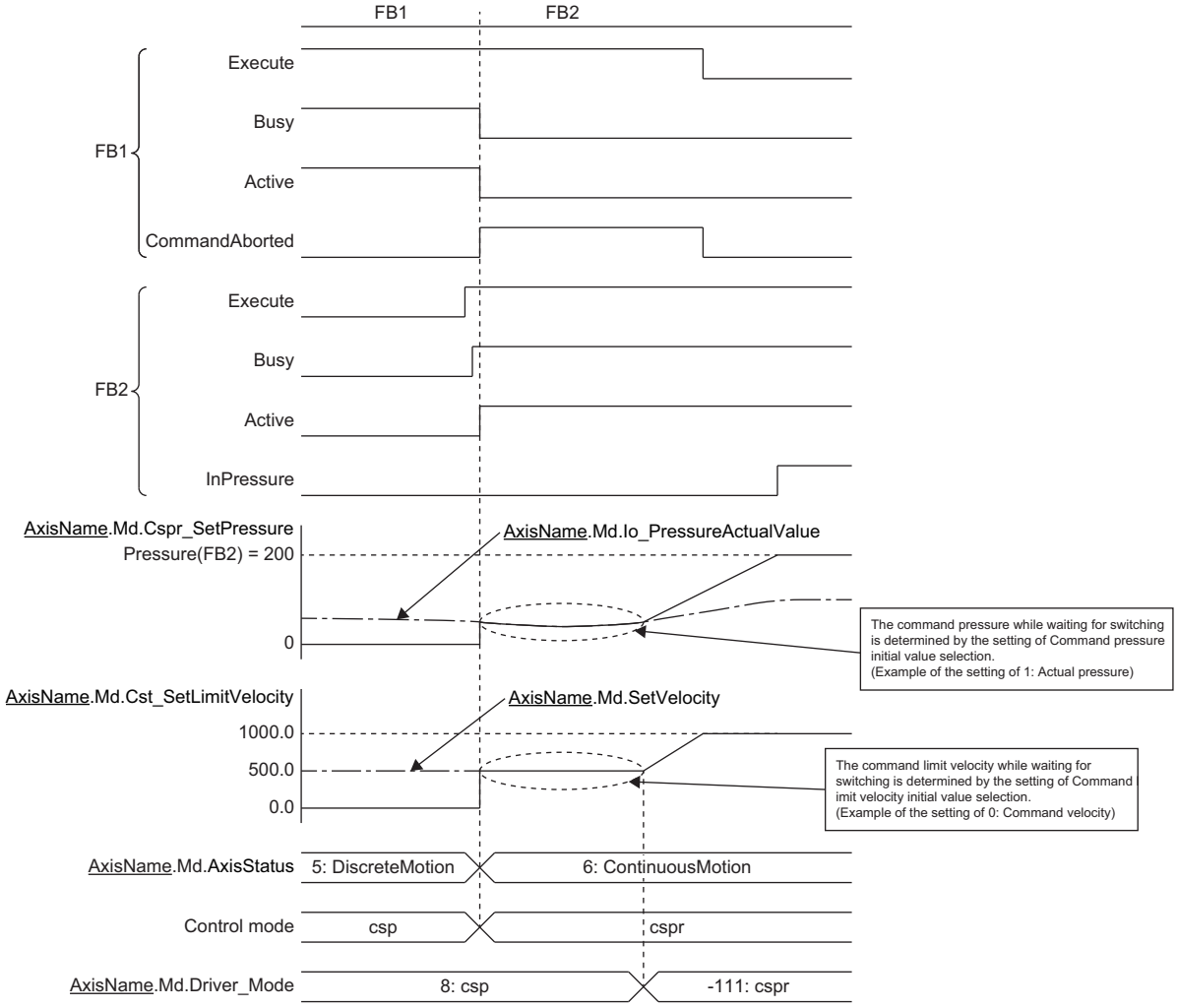
1. When switching FBs due to multiple start, a control mode switching request to the cyclic synchronous pressure mode (cspr) is issued to the drive unit.

2. Position control continues at the velocity of the previous motion FB until the drive unit control mode is switched. Also, the command pressure and command limit velocity will be set to their initial values[*1].

*1 The initial values of the command pressure and command limit velocity are set as follows.
· Command pressure initial value selection (Options (Options): bit 16)
· Command limit velocity initial value selection (Options (Options): bit 18, bit 19)

3. After the drive unit control mode is switched, the pressure ramp and acceleration/deceleration process will start from each set value.

• For 0: Aborting (mcAborting)



■If the previous motion FB is a pressure control FB

If the previous motion FB is a pressure control FB, refer to the following.

☞ Page 757 When multiple start was executed for another pressure control FB while the pressure control FB is still in control

When multiple start was executed for the next motion FB while the pressure control FB is still in control

■Cyclic synchronous pressure mode (cspr) → Cyclic synchronous position mode (csp)

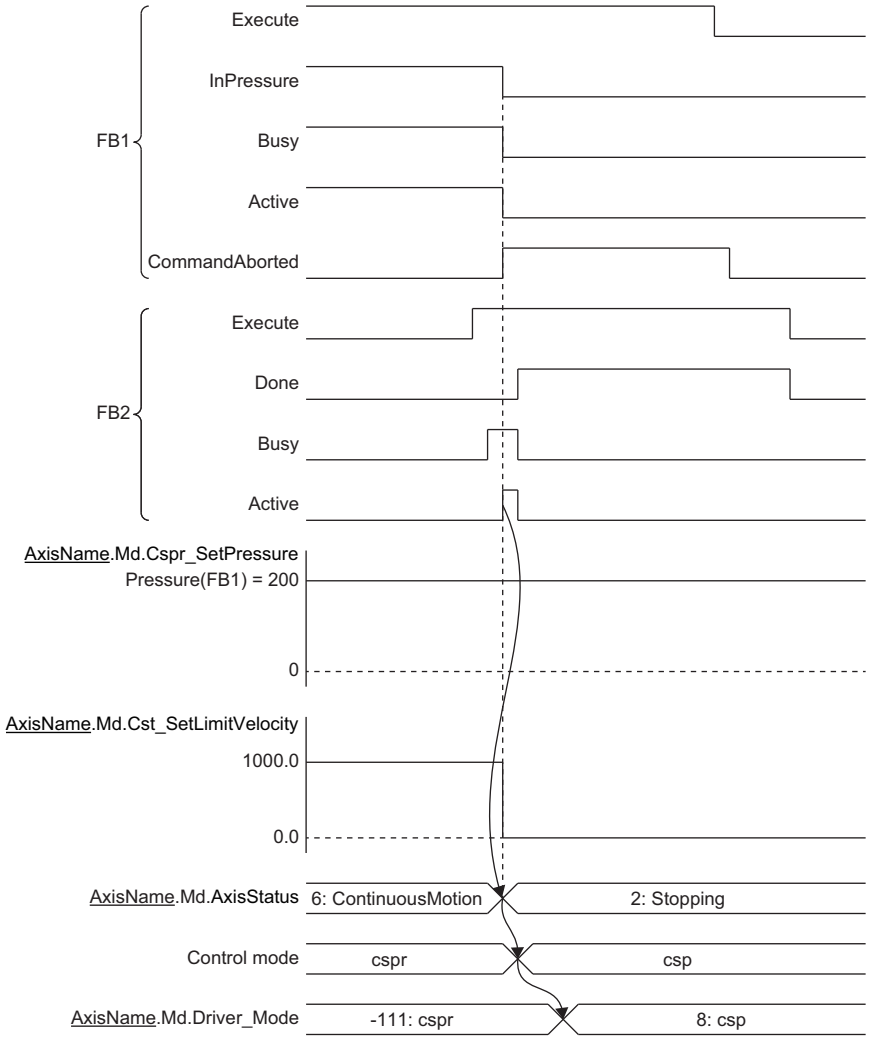
- When the next motion FB is MC_Stop (Forced Stop)

1. When switching FBs due to multiple start, a control mode switching request to the cyclic synchronous position mode (csp) is issued to the drive unit. Also, the command limit velocity is set to "0".

2. Until the drive unit control mode is switched, pressure control continues with the command limit velocity set to "0" and with the command pressure set at the time the request was issued.

3. Once the drive unit control mode has been switched, MC_Stop (Forced Stop) is complete.

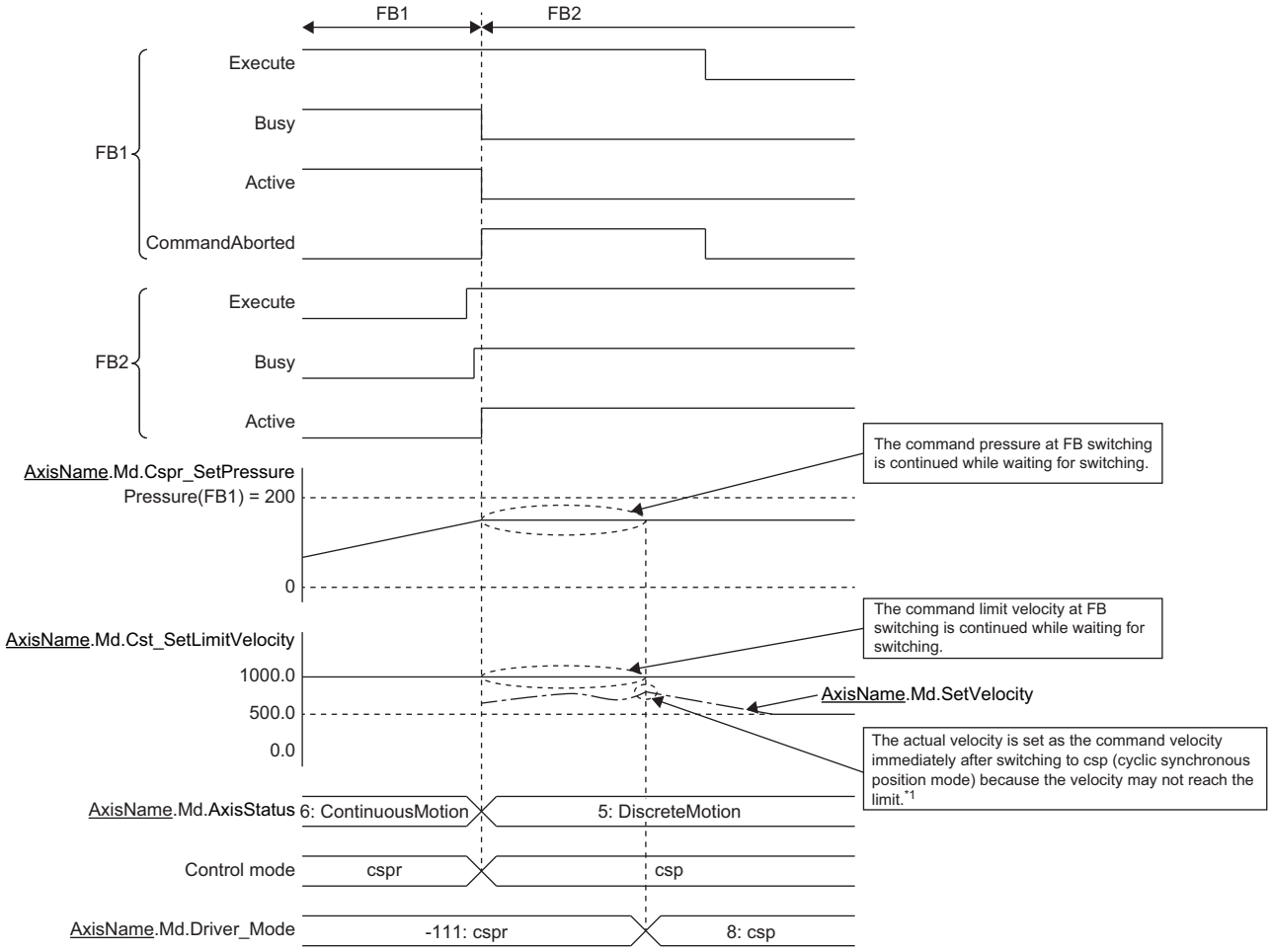
- MC_Stop (Forced Stop) 0: Aborting (mcAborting)



• When the next motion FB is not MC_Stop (Forced Stop)

1. When switching FBs due to multiple start, a control mode switching request to the cyclic synchronous position mode (csp) is issued to the drive unit.
2. Until the drive unit control mode is switched, pressure control continues with the command pressure and command limit velocity at the time the request was issued.
3. Once the drive unit control mode is switched, position control begins.

• Positioning control FB 0: Aborting (mcAborting)



*1 When the operation direction differs between the pressure control FB and the next motion FB, the set velocity immediately after switching to the cyclic synchronous position mode (csp) is set to "0". After that, position control starts in the direction of the next motion FB.

Point

When the next motion FB is a positioning control FB, depending on the distance moved before the control mode of the drive unit is switched, the deceleration distance may not be secured and the target position may be overrun. In this case, immediately after switching to the cyclic synchronous position mode (csp), the axis operates based on Operation Setting at Overrun (AxisName.Pr.OverrunOperation). For the operation at the overrun occurrence, refer to the following.

☞ Page 547 Multiple Start (Buffer Mode)

However, if overrun occurs while waiting for switching, regardless of Operation Setting at Overrun (AxisName.Pr.OverrunOperation), Overrun error (error code: 1AE3H) will occur immediately after switching to the cyclic synchronous position mode (csp), and the axis will stop immediately.

■When the next motion FB is a pressure control FB

When the next motion FB is a pressure control FB, refer to the following.

☞ Page 757 When multiple start was executed for another pressure control FB while the pressure control FB is still in control

When multiple start was executed for another pressure control FB while the pressure control FB is still in control

Do not execute multiple start of another pressure control FB while the pressure control FB is still in control.
Otherwise, BufferMode specification disabled (error code: 1AE5H) will occur.

Precautions

- Follow-up is performed during the cyclic synchronous pressure mode (cspr). For details on follow-up, refer to the following.
  ☞ Page 504 Follow Up
- Time until the control mode is switched depends on the specifications of the drive unit.
- Do not execute multiple start of the positioning control FB until the control mode is switched from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr). Execute multiple start of the positioning control FB after checking that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "-111: Cyclic synchronous pressure mode (cspr)".
- An actual motor velocity may not reach the limit velocity depending on the machine load during the cyclic synchronous pressure mode (cspr).
- When switching the control mode from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr), or from the cyclic synchronous pressure mode (cspr) to the cyclic synchronous position mode (csp), it is recommended to switch after changing the motor to stop status (zero speed status). The zero speed status can be monitored by network labeling Status DO2 (2D12H).
- When switching the control mode from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr), if a stop cause (axis error detection) occurs before the control mode is switched, follow-up may continue in the cyclic synchronous position mode (csp) until the zero speed status is reached.
- When switching from the cyclic synchronous position mode (csp) to the cyclic synchronous pressure mode (cspr), or from the cyclic synchronous pressure mode (cspr) to the cyclic synchronous position mode (csp), without waiting for the motor to stop, set "ZSP disabled selection at control switching (PC76.1)" of the servo parameter to "1: Disabled" and disable monitoring of the zero speed status. However, note that it may cause vibration or impact at control mode switching.
- During the cyclic synchronous pressure mode (cspr), driver command discard detection is not performed regardless of Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored). If the servo parameter "Limit switch enabled status selection (PD41.2)" is set to "0: Limit switch always enabled" and limit detection is performed on the drive unit side, when stopping due to limit detection, switch to the cyclic synchronous position mode (csp) using MC_Stop (Forced Stop) or an axis stop signal.
- Wire the load cell amplifier output to the analog input of the drive unit. For details, refer to the manual of the connected device.
- For information about drive unit functions that cannot be used in the cyclic synchronous pressure mode (cspr), refer to the manual of the connected device.
- During pressure control, a load cell detector error or variations in load cell pressure may cause the axis to continue moving backward. Therefore, set the software stroke limit.
- When limiting the command pressure, change the object data "Positive pressure limit value (2E5BH)" using one of the following methods. For details on the "Positive pressure limit value (2E5BH)", refer to the manual for the connected device used.
  - Use MC_WriteParameter (Parameter Write) to change the object data "Positive pressure limit value (2E5BH)". For details on MC_WriteParameter (Parameter Write), refer to the following.
    MELSEC MX Controller MX-R Model Programming Manual
  - Map the object data "Positive pressure limit value (2E5BH)" to RPDO and create a network label. Change the value of that label. For details on network labels or PDO mapping settings, refer to the following.
    ☞ Page 108 Creation procedure for network labels
    ☞ Page 165 PDO mapping setting

Relevant object data

The following cases will result in errors and functional restrictions.

- Object data is not set.
- PDO is not mapped.
- There is no object in the device station.

For details on the object data settings, refer to the following.

☞ Page 469 Object data settings

■PDO

◎: PDO mapping is required, ○: PDO mapping is recommended

Motion control FB/function	Required object data	Mapping availability	Operation when no object is set
MCv_PressureControl (Pressure Control)	Control DI 5 (2D05H)	◎	At startup or multiple start, Necessary object data unset (error code: 1AF7H) occurs.
	Velocity limit value (2D20H)		
	Target pressure (2E50H)		
	Forward-side stop function (2E56H)	○	Refer to "Precautions" shown below. ☞ Page 750 Limit position / final position (forward end position)
	Pressure actual value (2E52H)		Refer to the following. ☞ Page 747 Command pressure initial value selection (Options (Options): Bit 16)

■SDO

Not available

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- MotionControl_General
- NetworkDriver_CCIETSN*1
- ServoDriver_CANopen*1

*1 When using the real axis

29.5 Precautions on Direct Control

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- MotionControl_General
- NetworkDriver_CCIETSN (When using the real axis)
- ServoDriver_CANopen (When using the real axis)

30 MOTION CYCLIC CONTROL

The motion cyclic control is a function that sends the position, velocity, and torque to the drive unit.
The motion cyclic control includes the following controls.

Control name	Driver control mode	Applicable instruction	Operation details	Reference
Motion cyclic positioning control	Cyclic synchronous position mode (csp)	MCv_CyclicPosition (position control)	Switches the control mode of the drive unit to the cyclic synchronous position mode (csp), and sends the target position.	Page 761 Motion Cyclic Positioning Control
Motion cyclic velocity control	Cyclic synchronous velocity mode (csv)	MCv_CyclicVelocity (velocity control)	Switches the control mode of the drive unit to the cyclic synchronous velocity mode (csv), and sends the target velocity.	Page 768 Motion Cyclic Velocity Control
Motion cyclic torque control	Cyclic synchronous torque mode (cst)	MCv_CyclicTorque (torque control)	Switches the control mode of the drive unit to the cyclic synchronous torque mode (cst), and sends the target torque.	Page 774 Motion Cyclic Torque Control

Point

A path such as acceleration/deceleration for sending the target position, target velocity, and target torque to the drive unit must be created in the program because no acceleration/deceleration function or torque ramp function exists. When using the acceleration/deceleration function or torque ramp function, refer to the DIRECT CONTROL.
☞ Page 710 DIRECT CONTROL

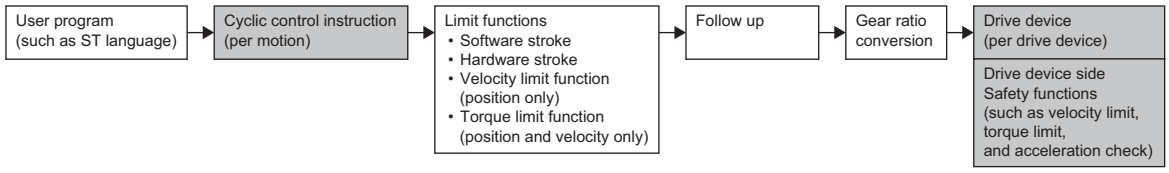
Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Overall block diagram

The following diagram shows the relationship between the data used in the motion cyclic control and other functions.



30.1 Motion Cyclic Positioning Control

This function switches the control mode of the drive unit to the cyclic synchronous position mode (csp), and sends the target position.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
RingCount_Enable	Ring counter enabled selection	Sets the ring counter enable/disable. • FALSE: Disabled • TRUE: Enabled
RingCount_UpperValue	Ring counter upper limit value	Sets the ring counter upper limit value.*1 • -10000000000.0 to 10000000000.0
RingCount_LowerValue	Ring counter lower limit value	Sets the ring counter lower limit value.*1 • -10000000000.0 to 10000000000.0

*1 The value is not fetched when the ring counter is disabled.

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
StopMode_SwStrokeLimit	Software stroke limit stop selection	Sets the operation when the software stroke limit error occurs.*1 • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc)
SwStrokeLimit_Upper	Software stroke limit upper value	Sets the software stroke limit upper value. • -10000000000.0 to 10000000000.0
SwStrokeLimit_Lower	Software stroke limit lower value	Sets the software stroke limit lower value. • -10000000000.0 to 10000000000.0
StopMode_General	Stop selection at stop cause occurrence	Displays input status of the stop selection at stop cause occurrence. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc)
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Sets the operation when a stop cause occurs during deceleration (including a stop cause and automatic deceleration). • 1: Recreate Deceleration Curve (OverrideCurve)
StopMode_HwStrokeLimit	Hardware stroke limit stop selection	Sets the operation when the hardware stroke limit error occurs.*1 • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc)
VelocityLimit_Positive	Positive direction velocity limit value	Specifies the address increasing direction velocity limit value. • 0.0001 to 2500000000.0
VelocityLimit_Negative	Negative direction velocity limit value	Specifies the address decreasing direction velocity limit value. • 0.0001 to 2500000000.0
VelocityLimit_OverOperation	Operation setting at velocity limit value exceeded	Sets the operation when the velocity limit value during control is exceeded. • 0: Ignore (Ignore)*2 • 3: Immediate Stop (ImmediateStop)*3

*1 Immediate stop will be executed when executing an FB without deceleration specification.

*2 For "0: Ignore (Ignore)", if the command velocity exceeding the velocity limit value is detected, "Velocity Limit Value Over Warning (event code: 00D03H)" occurs, and the command exceeding the velocity limit value is output as it is.

*3 For "3: Immediate Stop (ImmediateStop)", if the command velocity exceeding the velocity limit value is detected, Velocity Limit Value Over during Controlling (error code: 1AA4H) occurs, and the positioning control in execution stops.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
SetPosition	Set position	Stores the current position address.*1 The set position is a value where the cumulative current position is rounded within the ring counter range.
SetVelocity	Set velocity	Stores the set output velocity.*1 This velocity is calculated from the difference of the set position. The value is positive when moving in the positive direction (Address increase direction), and the value is negative when moving in the negative direction (Address decrease direction). Stores the set velocity of the configuration axis during the axes group operation.
SwStrokeLimit_Target	Stroke limit target	Displays the software stroke limit target. • -1: Invalid (Invalid) • 1: Set position (SetPosition) • 3: Machine feed value (FeedMachinePosition)
FeedMachinePosition	Machine feed value	Stores the current position address by the machine coordinate. The accumulative value from the homing completed position is set. The address is not changed even if the current position is changed. The ring address is "-10000000000.0 ≤ Machine feed value < 10000000000.0".

*1 The stored value includes an error because a floating-point error occurs.

System parameter (MotionSystem.Pr)

Variable/structure name	Name	Details
StopMode_All	Stop selection at all axes stop cause occurrence	Sets whether to stop immediately or decelerate to stop when an all axes stop cause occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc)

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

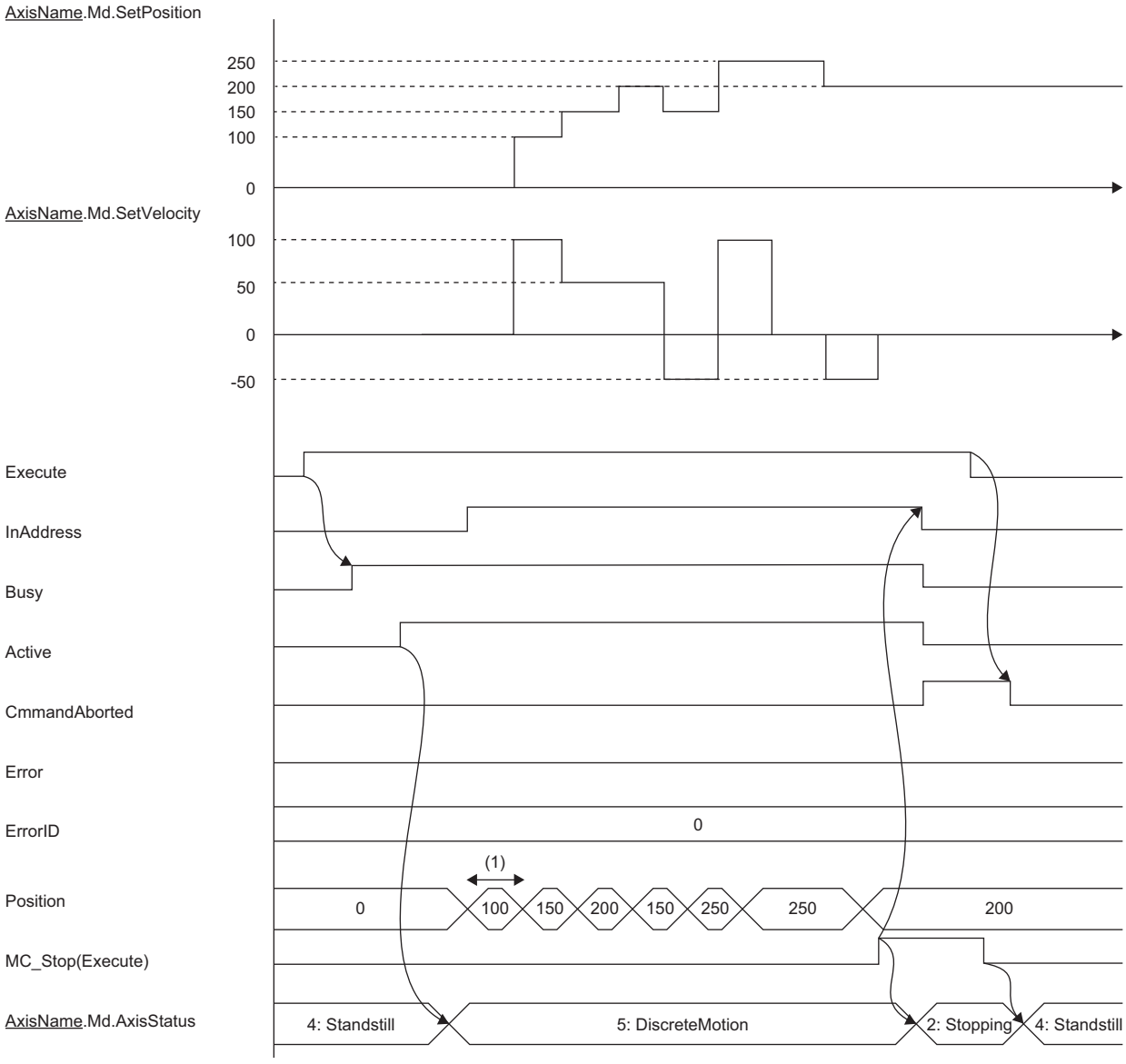
Motion control FB	Name	Description
MCv_CyclicPosition	Motion cyclic position control	Sends the target position to the drive unit according to the specified target position.

Control details

MCv_CyclicPosition (motion cyclic position control) switches the control mode of the drive unit to the csp (cyclic synchronous position mode) and executes control.
This function sends the set position without setting the acceleration, deceleration, and jerk.
To finish this FB, start MC_Stop (forced stop).

Timing chart of I/O signal

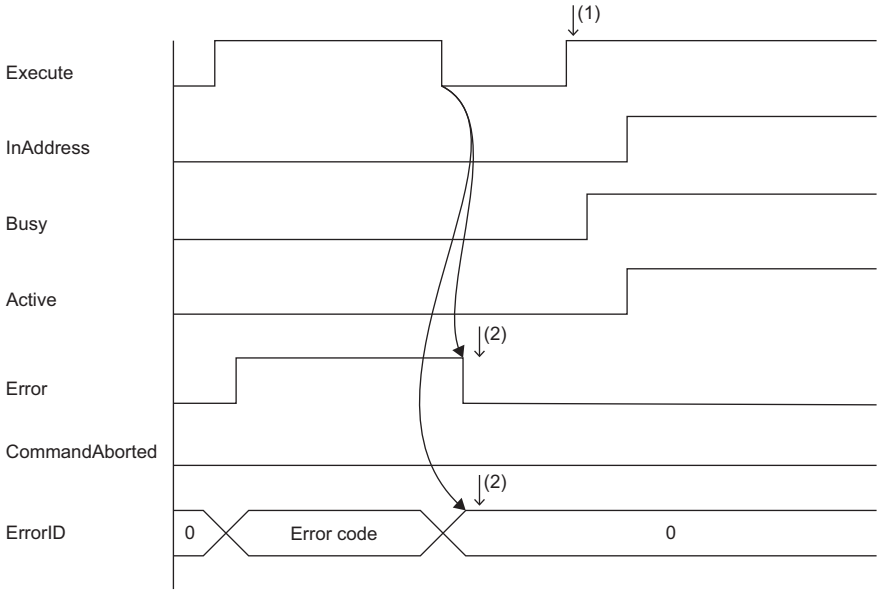
■When the processing is completed successfully



(1) One operation cycle

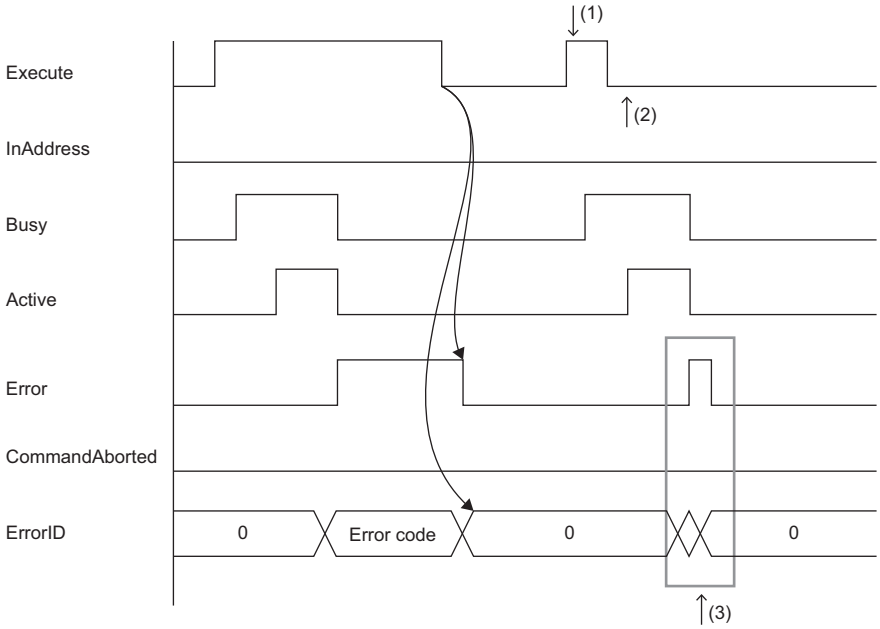
■When the processing is completed with an error

• When the I/O variables are abnormal



(1) Eliminate the error cause and restart.
(2) Clear when Execute falls.

• When the input variables are abnormal



(1) Eliminate the error cause and restart.
(2) Set to FALSE before error occurs.
(3) Output only one cycle.

Operation at stop cause occurrence

When a stop cause occurs during the axis operation, the axis will stop immediately or stop with deceleration depending on each cause.

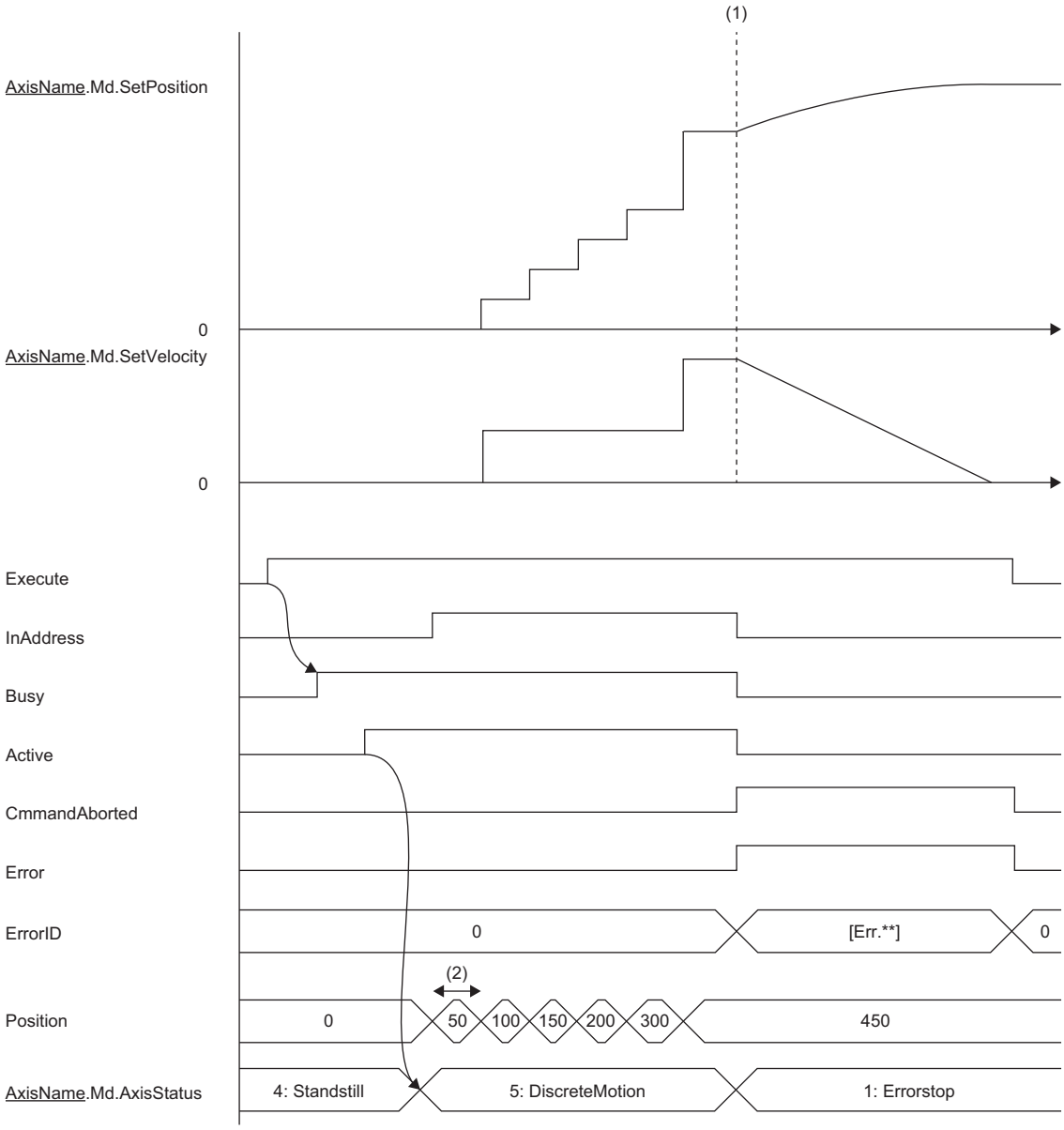
For the stop cause during axis operation, refer to the following.

☞ Page 584 Stop causes during axis operation

When decelerating to stop, the axis decelerates with the trapezoidal acceleration/deceleration from the velocity stored in the Set Velocity (AxisName.Md.SetVelocity) at stop cause occurrence.

When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set for the following, the axis stops immediately instead of decelerating to stop.

- Stop selection at stop cause occurrence (AxisName.Pr.StopMode_General)
- Stop selection at hardware stroke limit error occurrence (AxisName.Pr.StopMode_HwStrokeLimit)
- Stop selection at software stroke limit error occurrence (AxisName.Pr.StopMode_SwStrokeLimit)
- Stop selection at all axes stop cause occurrence (MotionSystem.Pr.StopMode_All)



(1) Stop cause occurrence (axis error detection)
(2) One operation cycle

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following function.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required

Instruction/function	Required object data	PDO mapping	Operation with no object
MCv_CyclicPosition (motion cyclic position control)	Target position (607AH)	◎	Required object data unset (error code: 1AF7H) occurs.

Precautions

- Motion cyclic position control does not set acceleration, deceleration, or jerk, and may cause sudden acceleration or deceleration when sending a command position. Therefore, set a value that takes safety into consideration for the velocity limit value (Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) for the positive direction or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) for the negative direction).
- When the set velocity exceeds the velocity limit value for each axis, the operation follows Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation). Also, if the absolute value of the set velocity exceeds the maximum velocity, Velocity range over during controlling (error code: 1B1AH) will occur and the operation will stop.
- When switching from a control mode other than csp to csp by executing multiple start of MCv_CyclicPosition (motion cyclic position control), check that the motor has stopped before switching. If the switching is performed without stopping the motor, the difference between the current position and MCv_CyclicPosition (motion cyclic position control) may be large, resulting in rapid operation.

Program example

In the motion cyclic position control, the user can send an arbitrary position command to the drive unit for each operation cycle.

The following shows the program example that calculates the target position from the set position of axis 2 by a user-defined arbitrary function (User_Function) by setting the control start (bExecute) to TRUE, and sends the calculated target position to the drive unit of axis 1 by the motion cyclic position control.

Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REAL	Axis 1
2	Axis0002	AXIS_REAL	Axis 2

Labels used

Label name	Data type	Comment
bExecute	Bit	Control start
bMC_MoveRelative_Execute	Bit	Relative positioning control start
MCv_CyclicPosition_1	MCv_CyclicPosition	Motion cyclic position control FB
MC_MoveRelative_1	MC_MoveRelative	Relative value positioning FB
User_Fuction_1	User_Fuction	• User-defined arbitrary function An FB defined by users. Convert the following in this program example. Target position (leUserOutput) = 10000.0 × SIN (set position (leUserInput))
leMCv_CyclicPosition	Double-precision real number	Position command calculated by the user arbitrary function

Program example

ST program

```
SET(MCv_CyclicPosition_1.Active, bMC_MoveRelative_Execute);

   User_Fuction_1(
   leUserInput:= Axis0002.Md.SetPosition ,
   leUserOutput=> leMCv_CyclicPosition
);

MCv_CyclicPosition_1(
   Axis:= Axis0001.AxisRef ,
   Execute:= bExecute,
   ContinuousUpdate:= TRUE ,
   Position := leMCv_CyclicPosition
   BufferMode:= MC_BUFFER_MODE__mcAborting ,
   Options:= 0
);

MC_MoveRelative_1(
   Axis:= Axis0002.AxisRef ,
   Execute:= bMC_MoveRelative_Execute,
   ContinuousUpdate:= TRUE ,
   Distance:= 360.0 ,
   Velocity:= 180.0 ,
   Acceleration:= 180.0 ,
   Deceleration:= 180.0 ,
   Jerk:= 0.0 ,
   BufferMode:= MC_BUFFER_MODE__mcAborting ,
   Options:= 0
);
```

30.2 Motion Cyclic Velocity Control

This function switches the control mode of the drive unit to the cyclic synchronous velocity mode (csv), and sends the target velocity.

Relevant variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Io_TargetVelocity	Object Data_TargetVelocity	Displays the value of object data TargetVelocity. (The velocity command to send to devices)
AxisStatus	Axis status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
Driver_Mode	Driver control mode	Displays the driver control mode status. • 6: Homing (hm) • 8: Position control (csp) • 9: Velocity control (csv) • 10: Torque control (cst) • -104: Continuous operation to torque control (ct)
SetPosition	Set position	Stores the current position address.*1 The set position is a value where the cumulative current position is rounded within the ring counter range.
SetVelocity	Set velocity	Stores the set output velocity.*1 This velocity is calculated from the difference of the set position. The value is positive when moving in the positive direction (Address increase direction), and the value is negative when moving in the negative direction (Address decrease direction). Stores the set velocity of the configuration axis during the axes group operation.

*1 The stored value includes an error because a floating-point error occurs.

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
RingCount_Enable	Ring counter enabled selection	Sets the ring counter enable/disable. • 0: Disable • 1: Enable
RingCount_UpperValue	Ring counter upper limit value	Sets the ring counter upper limit value.*1 • -10000000000.0 to 10000000000.0
RingCount_LowerValue	Ring counter lower limit value	Sets the ring counter lower limit value.*1 • -10000000000.0 to 10000000000.0

*1 The value is not fetched when the ring counter is disabled.

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
StopMode_General	Stop selection at stop cause occurrence	Sets the operation when a stop cause occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) * Immediate stop will be executed when executing an FB without deceleration specification.
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Sets the operation when a stop cause occurs during deceleration (including a stop cause and automatic deceleration). • 1: Recreate Deceleration Curve (OverrideCurve)
StopMode_HwStrokeLimit	Stop selection at hardware stroke limit error occurrence	Sets the operation when the hardware stroke limit error occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc) * Immediate stop will be executed when executing an FB without deceleration specification.
VelocityLimit_Positive	Positive direction velocity limit value	Sets the address increasing direction velocity limit value. • 0.0001 to 2500000000.0
VelocityLimit_Negative	Negative direction velocity limit value	Sets the address decreasing direction velocity limit value. • 0.0001 to 2500000000.0
VelocityLimit_OverOperation	Operation setting at velocity limit value exceeded	Sets the operation when the velocity limit value during control is exceeded. • 0: Ignore (Ignore) • 3: Immediate Stop (ImmediateStop) * For "0: Ignore (Ignore)", if the command velocity exceeding the velocity limit value is detected, Velocity Limit Value Over Warning (event code: 0D03H) occurs, and the command exceeding the velocity limit value is output as it is. * For "3: Immediate Stop (ImmediateStop)", if the command velocity exceeding the velocity limit value is detected, Velocity Limit Value Over during Controlling (error code: 1AA4H) occurs, and the positioning control in execution stops.

System parameter (MotionSystem.Pr)

Variable/structure name	Name	Details
StopMode_All	Stop selection at all axes stop cause occurrence	Sets whether to stop immediately or decelerate to stop when an all axes stop cause occurs. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) • 3: Alternative Acceleration/Deceleration (AlternativeAcc)

Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_CyclicVelocity	Motion cyclic velocity control	Sends the target velocity to the drive unit according to the specified target velocity.

Control details

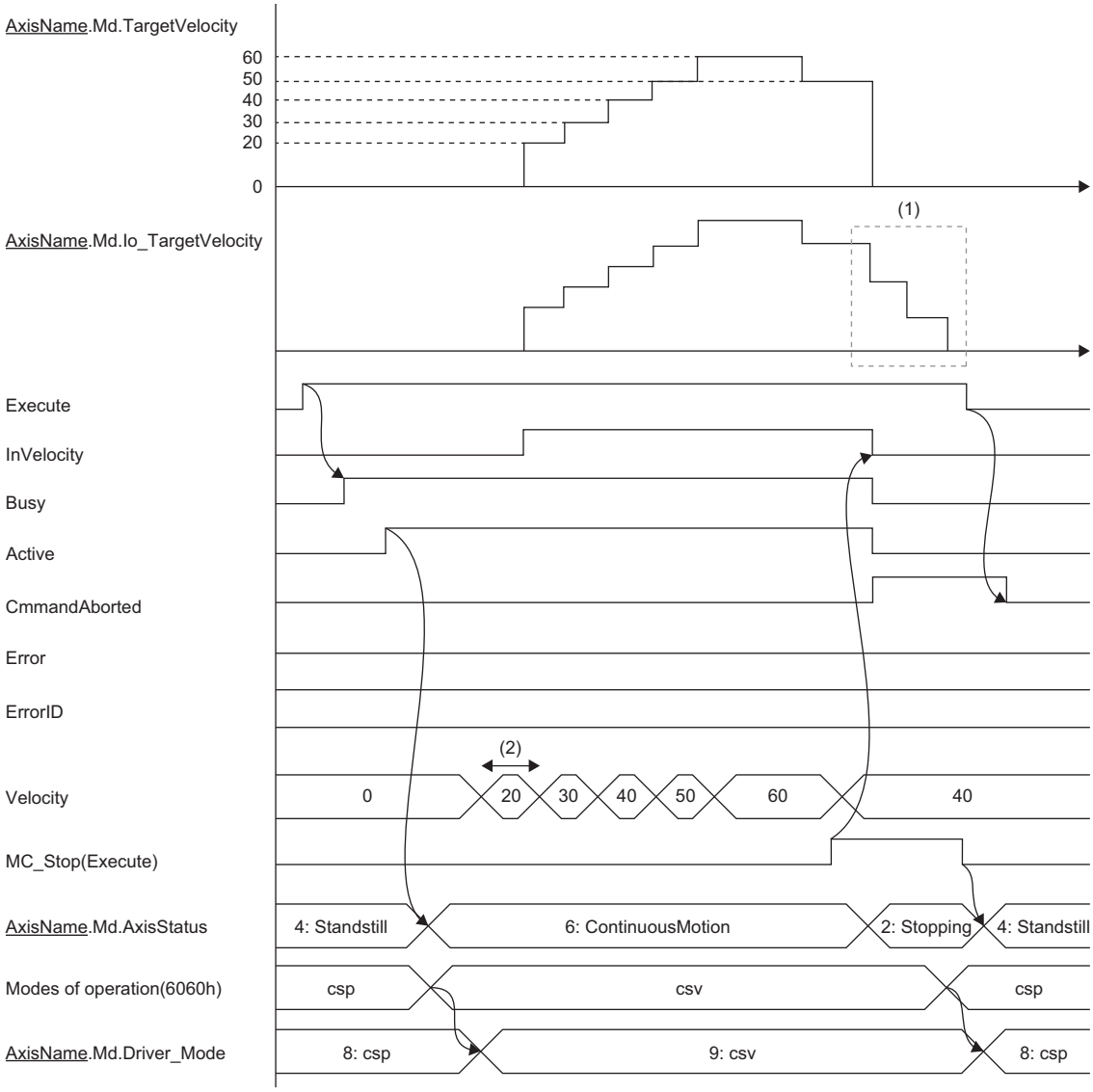
MCv_CyclicVelocity (motion cyclic velocity control) switches the control mode of the drive unit to the csv (cyclic synchronous velocity mode) and executes control.

This function controls only the command velocity without setting the acceleration, deceleration, and jerk.

To finish this FB, start MC_Stop (forced stop).

Timing chart of I/O signal

■When the processing is completed successfully



(1) Decelerate to stop by MC_Stop (forced stop)
(2) One operation cycle

■When the processing is completed with an error

Same as the operation of the motion cyclic position control.

☞ Page 764 When the processing is completed with an error

Operation at stop cause occurrence

For the stop cause during axis operation, refer to the following.

☞ Page 716 Operation at stop cause occurrence

When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set for the following, the axis stops immediately instead of decelerating to stop.

- Stop selection at stop cause occurrence (AxisName.Pr.StopMode_General)
- Stop selection at hardware stroke limit error occurrence (AxisName.Pr.StopMode_HwStrokeLimit)
- Stop selection at software stroke limit error occurrence (AxisName.Pr.StopMode_SwStrokeLimit)
- Stop selection at all axes stop cause occurrence (MotionSystem.Pr.StopMode_All)

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following function.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required

Instruction/function	Required object data	PDO mapping	Operation with no object
MCv_CyclicVelocity (motion cyclic velocity control)	Target velocity (60FFH)	◎	Required object data unset (error code: 1AF7H) occurs.

Precautions

- When setting the target velocity, set the value so that the difference between the current velocity and the target velocity is not large. If the difference is large, the axis may accelerate suddenly.
- The set position and the machine feed value are updated by follow-up.
- Time until the control mode is switched depends on the specifications of the drive unit.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start the positioning control FB during the control mode switching. Start the positioning control FB after checking that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "9: Velocity control (csv)".
- When switching from csp to csv or from csv to csp without waiting for stop of the motor with the MR-J5(W)-G, set "ZSP disabled selection at control switching (PC76.1)" of the servo parameter to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching. There are restrictions on the setting value of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)". For details, refer to the following.

☞ Page 2152 Connection to Servo Amplifier That Supports CC-Link IE TSN

Program example

In the motion cyclic velocity control, the user can send an arbitrary target velocity to the drive unit for each operation cycle. The following shows the program example that calculates the target velocity of axis 1 from the set position of axis 2 by a user-defined arbitrary function (User_Function) by setting the control start (bExecute) to TRUE, and sends the calculated target velocity to the drive unit of axis 1 by the motion cyclic velocity control.

Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REAL	Axis 1
2	Axis0002	AXIS_REAL	Axis 2

Labels used

Label name	Data type	Comment
bExecute	Bit	Control start
bMC_MoveRelative_Execute	Bit	Relative positioning control start
MCv_CyclicVelocity_1	MCv_CyclicVelocity	Motion cyclic velocity control FB
MC_MoveRelative_1	MC_MoveRelative	Relative value positioning FB
User_Fuction_1	User_Fuction	• User-defined arbitrary function An FB defined by users. Convert the following in this program example. Target velocity (leUserOutput) = 10000.0 × SIN (set position (leUserInput))
leMCv_CyclicVelocity	Double-precision real number	Target velocity calculated by the user arbitrary function

Program example

ST program

```
SET(MCv_CyclicVelocity_1.Active, bMC_MoveRelative_Execute);

    User_Fuction_1(
    leUserInput:= Axis0002.Md.SetPosition ,
    leUserOutput=> leMCv_CyclicVelocity
);

MCv_CyclicVelocity_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bExecute,
    ContinuousUpdate:= TRUE ,
    Velocity := leMCv_CyclicVelocity
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
    Options:= 0
);

MC_MoveRelative_1(
    Axis:= Axis0002.AxisRef ,
    Execute:= bMC_MoveRelative_Execute,
    ContinuousUpdate:= TRUE ,
    Distance:= 360.0 ,
    Velocity:= 180.0 ,
    Acceleration:= 180.0 ,
    Deceleration:= 180.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
    Options:= 0
);
```

30.3 Motion Cyclic Torque Control

This function switches the control mode of the drive unit to the cyclic synchronous torque mode (cst), and sends the target torque.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
SlaveObject	Object data	Sets the object data to the real drive axis.
vVelLimitValue	VelLimitValue	Sets the velocity limit value in the drive unit.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Cst_SetTorque	Set torque at cst/ct	Stores set torque at the cyclic synchronous torque mode.
Cst_SetLimitVelocity	Set limit velocity at cst/ct/cspr	Stores the command limit velocity in the cyclic synchronous torque mode (cst), continuous operation to torque control mode (ct), and cyclic synchronous pressure mode (cspr).
Io_TorqueActualValue	Object Data_TorqueActualValue	Displays the value of object data Torque actual value (6077H). (The actual torque to be received from the device station)
AxisStatus	Axis status	Displays the current axis status. • -1: Axis variable uninitialization/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)
Driver_Mode	Driver control mode	Displays the driver control mode status. • 6: Homing (hm) • 8: Position control (csp) • 9: Velocity control (csv) • 10: Torque control (cst) • -104: Continuous operation to torque control (ct)
TorqueLimit_Positive	Positive direction torque limit value	Displays the positive direction torque limit value that is currently valid.
TorqueLimit_Negative	Negative direction torque limit value	Displays the negative direction torque limit value that is currently valid.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_CyclicTorque	Cyclic torque control	Sends the target torque to the drive unit according to the specified target position.

Control details

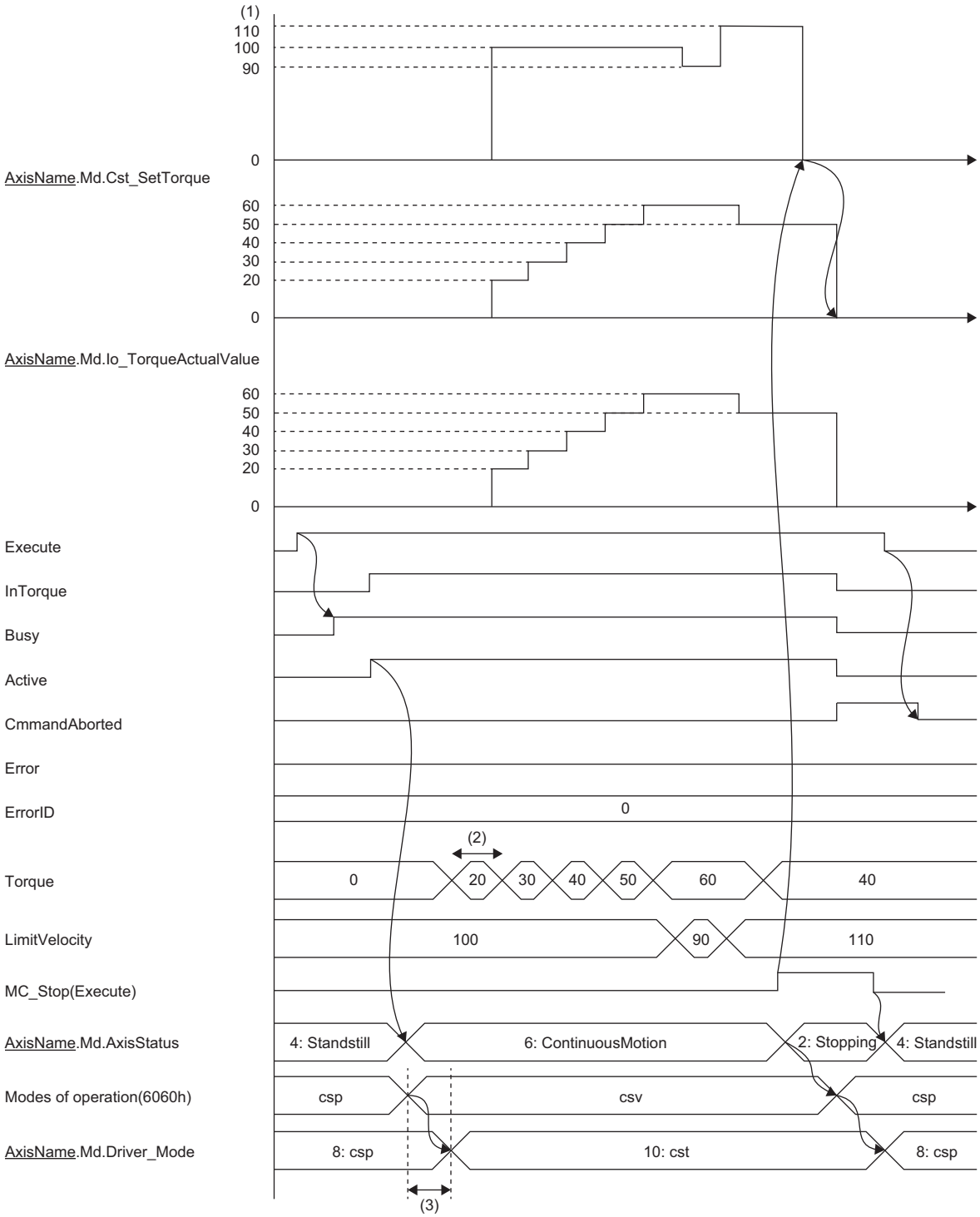
MCv_CyclicTorque (cyclic torque control) switches the control mode of the drive unit to the cst (cyclic synchronous torque mode) and executes control.

The velocity limit value and set torque are sent to the drive unit.

To finish this FB, start MC_Stop (forced stop).

Timing chart of I/O signal

■When the processing is completed successfully



(1) Velocity limit value of the drive unit
(2) One operation cycle
(3) Waiting for switching

■When the processing is completed with an error

Same as the operation of the motion cyclic position control.

☞ Page 764 When the processing is completed with an error

Operation at stop cause occurrence

Same as the operation of the MC_TorqueControl (torque control).

☞ Page 730 Operation at stop cause occurrence

Relation between torque generation direction of servo motor and set torque

Same as the operation of the MC_TorqueControl (torque control).

☞ Page 727 Relation between torque generation direction of servo motor and set torque

Relevant object data

If no object data is set, PDO mapping is not performed, or no object exists in the device station, there will be errors and restrictions in the following function.

For details on the object data settings, refer to the following.

☞ Page 466 Axis Assignment

◎: Required, ○: Recommended

Instruction/function	Required object data	PDO mapping	Operation with no object
MCv_CyclicTorque (cyclic torque control)	Target torque (6071H)	◎	Required object data unset (error code: 1AF7H) occurs.
	Velocity limit value (2D20H)	○	The velocity limit during cst (cyclic synchronous torque mode) by the LimitVelocity (limit velocity) cannot be used. If the difference between the current torque and the target torque is large, the velocity may increase rapidly, causing a dangerous situation depending on the mechanism and the load method. For details on the velocity limit, refer to MCv_CyclicTorque (cyclic torque control) in the following manual. 📖MELSEC MX Controller MX-R Model Programming Manual

Precautions

- The set position and the machine feed value are updated by follow-up.
- Time until the control mode is switched depends on the specifications of the drive unit.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start the positioning control FB during the control mode switching. Start the positioning control FB after checking that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "10: Torque control (cst)".
- When the torque set to the target torque is not sufficient, it may be dangerous because the torque is released rapidly depending on the mechanism and load. When the target torque is to be reduced, pay close attention to safety.
- When the axis is stopped, store the value in the limit velocity (LimitVelocity) after the control mode is switched. When the value is stored in the limit velocity (LimitVelocity) before switching, the velocity may increase rapidly, causing a dangerous situation.
- For the torque limit change during the cst (cyclic synchronous torque mode), at restart or continuous update, if the target torque is changed to a value larger than the torque limit value (Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive), Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative)), Torque Limit Value Over Warning (event code: 00D12H) occurs and the axis operates at the value before change. During torque control, if Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) or Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) is changed to a value smaller than the target torque, the target torque will be changed to the torque limit value. In this case, the set torque is changed in one operation cycle.

Program example

In the motion cyclic torque control, the user can send an arbitrary target torque to the drive unit for each operation cycle. The following shows the program example that calculates the target torque from the set position of axis 2 by a user-defined arbitrary function (User_Function) by setting the control start (bExecute) to TRUE, and sends the calculated target torque to the drive unit of axis 1 by the motion cyclic torque control.

Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REAL	Axis 1
2	Axis0002	AXIS_REAL	Axis 2

Labels used

Label name	Data type	Comment
bExecute	Bit	Control start
bMC_MoveRelative_Execute	Bit	Relative positioning control start
MCv_CyclicTorque_1	MCv_CyclicTorque	Motion cyclic torque control FB
MC_MoveRelative_1	MC_MoveRelative	Relative value positioning FB
User_Fuction_1	User_Fuction	• User-defined arbitrary function An FB defined by users. Convert the following in this program example. Target torque (leUserOutput) = 100.0 × SIN (set position (leUserInput))
leMCv_CyclicTorque	Double-precision real number	Target torque calculated by the user arbitrary function

Program example

ST program

```
SET(MCv_CyclicTorque_1.Active, bMC_MoveRelative_Execute);

    User_Fuction_1(
    leUserInput:= Axis0002.Md.SetPosition ,
    leUserOutput=> leMCv_CyclicTorque
);

MCv_CyclicTorque_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bExecute,
    ContinuousUpdate:= TRUE ,
    Torque := leMCv_CyclicTorque
    LimitVelocity:= 10000.0 ,
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
    Options:= 0
);

MC_MoveRelative_1(
    Axis:= Axis0002.AxisRef ,
    Execute:= bMC_MoveRelative_Execute,
    ContinuousUpdate:= TRUE ,
    Distance:= 360.0 ,
    Velocity:= 180.0 ,
    Acceleration:= 180.0 ,
    Deceleration:= 180.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcAborting ,
    Options:= 0
);
```

30.4 Precautions on Motion Cyclic Control

- A call program of motion control FB for motion cyclic position/motion cyclic velocity/motion cyclic torque control should match the Control Cycle Setting (AxisName.PrConst.OperationCycle) of the axis specified in the input variable Axis. Otherwise, unintended operation may occur. The recommended setting example is as shown below.

Ex.

When the control cycle setting of the axis set to MCv_CyclicPosition.Axis is "0: Automatic setting", and the communication period setting of the device station to be controlled is "Basic period"

The MCv_CyclicPosition (motion cyclic position control) should be executed in the programs set below.

Item	Setting
Program type	Event execution type
Trigger type of event execution type	Network communication period synchronization
Network communication period synchronization	Basic period

- For motion cyclic position/motion cyclic velocity/motion cyclic torque control, some functions are disabled. The controls of disabled functions are ignored.

Function	Motion cyclic position control	Motion cyclic velocity control	Motion cyclic torque control
Velocity override function	Disable	Disable	Disable
Acceleration override	Disable	Disable	Disable
Velocity limit value	Enable*1	Enable*2	Disable
Acceleration limit value/deceleration limit value	Disable	Disable	Disable
Jerk limit value	Disable	Disable	Disable
Bias velocity at start	Disable	Disable	Disable

*1 The velocity limit is not executed at start. During control, if the set velocity exceeds the velocity limit value (Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) for the positive direction and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) for the negative direction) of each axis, Velocity limit value over during controlling (error code: 1AA4H) will occur and the axis will stop immediately.
If the absolute value of the set velocity exceeds the maximum velocity, Velocity range over during controlling (error code: 1B1AH) will occur and the operation will stop.

*2 For the operation at velocity limit value exceeded, refer to the following.
☞ Page 1113 For single axis control

- The control change at the cycle where a stop cause such as MC_Stop occurs is ignored. An example is shown below.

Ex.

As shown in the following timing chart, even if the control of MCv_CyclicPosition.Position is changed at the same timing as the cycle in which the stop cause occurs, the new value is ignored.

☞ Page 765 Operation at stop cause occurrence

Relevant add-ons

The following add-ons are required to use this function.

- MotionControl_Cyclic
- MotionEngine
- MotionControl_General
- NetworkDriver_CCIETSN (When using a real axis)
- ServoDriver_CANopen (When using a real axis)

31 SYNCHRONOUS CONTROL

The synchronous control has the following items.

Item	Description	Reference
Cam operation	Operates by synchronizing the slave axis with the master axis based on cam table.	Page 784 Cam Operation
Gear operation	Sets the speed ratio between the master axis and the slave axis, and enters gear operation.	Page 816 Gear Operation
Addition/Subtraction positioning	Combines the movement amount of two axes and transmits.	Page 819 Addition/ Subtraction Positioning

31.1 Overview of Single Axis Synchronous Control FBs

Single axis synchronous control FBs enable to control mechanical systems such as gears, speed change gears, and cams with software by transmitting the position information (command) of Slave axis (Slave) that is synchronized with Master axis (Master).

FB	Control details
MC_CamIn (Cam Operation Start)	Executes cam operation.
MC_GearIn (Gear Operation Start)	Sets the speed ratio between the master axis and the slave axis, and enters gear operation.
MC_CombineAxes (Addition/Subtraction Positioning)	Combines operations of two axes by a selectable combination method, and outputs it to the third axis.
MCv_ChangeCycle (Current Value Change per Cycle)	Changes the current value per cycle to the specified value during MC_CamIn (Cam Operation Start) control. It is used to adjust the current value per cycle to any desired value.
MCv_BacklashCompensationFilter (Backlash Compensation Filter)	Performs the specific filter processing to input of Master axis (Master), and outputs the result to Slave axis (Slave). ☞ Page 1133 COMMAND FILTER
MCv_SmoothingFilter (Smoothing Filter)	
MCv_DirectionFilter (Moving Direction Restriction Filter)	
MCv_SpeedLimitFilter (Speed Limit Filter)	
MCv_AdvancedSync (Advanced Synchronous Control)	Starts synchronization control according to the specified advanced synchronization control settings. ☞ Page 889 ADVANCED SYNCHRONOUS CONTROL

31.2 Axis Configuration

The following shows axes that can be set to Master axis (Master) and Slave axis (Slave) in the single axis synchronous control FBs. For the specifications of each axis type, refer to the following.

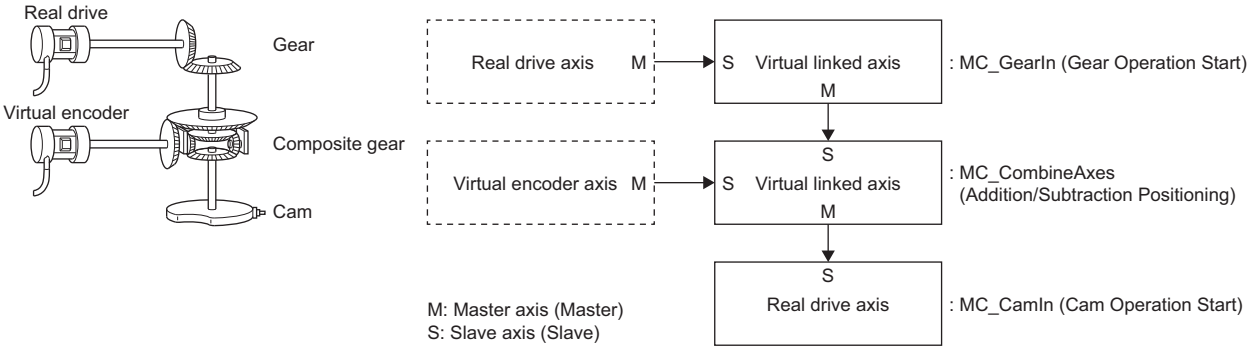
☞ Page 443 Axis
☞ Page 466 Axis Assignment

Axis type		Used for Master axis (Master)	Used for Slave axis (Slave)	Remark
Real axis	Real drive axis	○	○	When control for multiple motion FBs is required, create a configuration that executes function blocks for each virtual linked axis and transmits the result (command) to the real drive axis.
	Real encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), Necessary Object Data Unset (error code: 1AF7H) occurs and it does not start.
Virtual axis	Virtual drive axis	○	○	Commands can be mainly created by positioning control or others.
	Virtual encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), Necessary Object Data Unset (error code: 1AF7H) occurs and it does not start.
	Virtual linked axis	○	○	It is used as an intermediate axis to transmit a command to the real drive axis. When using multiple motion FBs such as gear, assign virtual linked axes.

To combine and execute controls such as gear and cam, use the virtual linked axis like the following example.

Ex.

To process gear following the instruction of the real drive axis and perform cam control adding the instruction from the virtual encoder



Position command unit of the master axis and the slave axis

Settings of position command unit of the master axis and the slave axis (Position Command Unit (AxisName.Pr.Unit_Position) and Position Command Unit String (AxisName.Pr.Unit_PositionString)) do not affect the control. The result of the calculation performed to the position information of the master axis which has no unit information is used as an instruction of the slave axis.

Ex.

To add each master axis by gear ratio 1:1 using MC_CombineAxes (Addition/Subtraction Positioning)

The slave axis moves 3.0 [degrees] with the following settings of position command unit of each axis when master axis 1 moves 1.0 [pulse] and master axis 2 moves 2.0 [mm].

- Position command unit of the master axis 1: pulse
- Position command unit of the master axis 2: mm
- Position command unit of the slave axis: degree

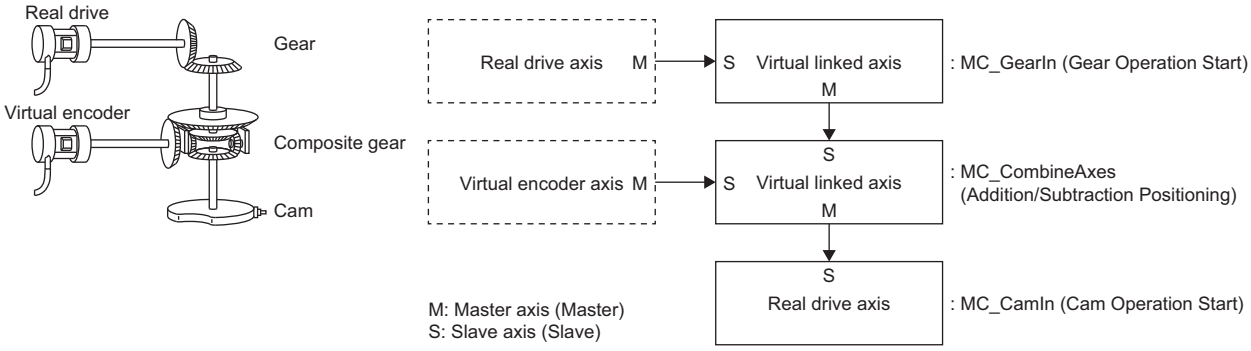
Current position change of the master axis

The set position of the slave axis does not change even when the current position change of the master axis is performed.

31.3 Master Axis Data Source Selection

In the single axis synchronous control FB, the position type of the master axis whose slave axis executes the single axis synchronous control can be selected by Master axis data source selection (MasterValueSource) of each FB.
When the actual value is specified for a virtual axis (axis which does not have Actual Position (AxisName.Md.ActualPosition)), the FB operates with the same value as the set value.
"101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" use a position of the master axis in the same operation cycle, and the others use a position of the master axis in the previous operation cycle.
Using "101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" can transmit the multiple motion control FB commands in the same operation cycle. In this case, set the first call order and linking order of the linked motion control FB to be the same.

Ex.
When transmitting the movement of the real drive axis and virtual encoder axis for cam control in the same operation cycle



When using the above combination of the single synchronous control FB (linked order), set the first call order as follows.

1. Motion control FB which moves the master axis (real drive axis) of MC_GearIn (Gear Operation Start)
2. MC_GearIn (Gear Operation Start)
3. MC_CombineAxes (Addition/Subtraction Positioning)
4. MC_CamIn (Cam Operation Start)

• Master axis data source selection (MasterValueSource) of each single axis synchronous control FB
"101: Latest Set Value (mcLatestSetValue)"

Point

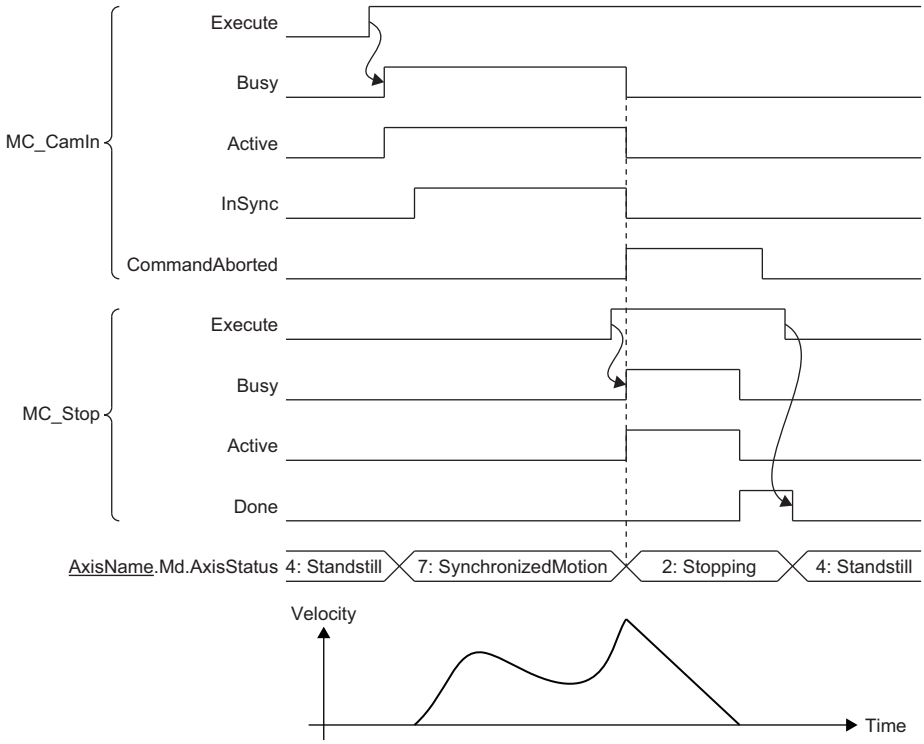
When Master axis data source selection (MasterValueSource) is set to "1: Set Value (mcSetValue)" or "101: Latest Set Value (mcLatestSetValue)" and the master axis becomes servo OFF or disconnected by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual value (mcActualValue)" or "102: Latest actual value (mcLatestActualValue)".

Master axis data source selection (MasterValueSource)	Description
1: Set Value (mcSetValue)	Uses the commanded position of the master axis in the previous operation cycle.
2: Actual Value (mcActualValue)	Uses the actual position of the master axis in the previous operation cycle.
101: Latest Set Value (mcLatestSetValue)	Uses the commanded position of the master axis in the current operation cycle.
102: Latest Actual Value (mcLatestActualValue)	Uses the actual position of the master axis in the current operation cycle.

31.4 Stop Operation

Slave axis (Slave) continues to control with the command transmitted by Master axis (Master) even if a stop cause occurs on the master axis during execution of the synchronous control FB. The axis status of the slave axis does not change.
When a stop cause occurs on the slave axis, the axis status transits and the slave axis immediately stops or stops with deceleration according to the stop cause and its stop process. For axis control when a stop cause occurs, refer to the following.
☞ Page 584 Stop causes during axis operation
The master axis is not affected even when the stop cause occurs on the slave axis.

Ex.
When a stop cause (MC_Stop (Forced Stop)) occurs during execution of the synchronous control FB



Point

When the master axis becomes servo OFF by the servo alarm or forced stop, stopping the operation of the synchronous control FB by using MC_Stop (Forced stop) is recommended because the slave axis may cause unexpected operation.

31.5 Required Object Data

The following shows the starting availability condition with or without PDO mapping when using it as the slave axis of the synchronous control FB.

PDO mapping necessary/not necessary		Starting availability
Target position	Position actual value	
Necessary	Not required	Starting is possible
Not necessary	Necessary	Starting is not possible*1
Not necessary	Not necessary	Starting is possible

*1 Necessary object data unset (error code: 1AF7H) occurs and it will not start.

31.6 Restrictions

- When Master axis (Master) and Slave axis (Slave) are specified to the same axis, Master axis and slave axis No. duplicated (error code: 1AACH) will occur.
- When connecting multiple axes in the synchronous control FB, if the master axis is set to Slave axis (Slave) of the latter FB or 257 or more synchronous control FBs are linked, Master axis and slave axis cyclic reference (error code: 1AADH) occurs.

31.7 Cam Operation

This function operates by synchronizing the slave axis with the master axis based on the cam table.
Before using this function, it is necessary to open the cam table to the open area and set to a state where it can be controlled.
For the open method to the open area, and for data types that can be controlled in cam operation, refer to the following.
☞ Page 863 Operating operation profile data
☞ Page 826 Operation profile data types

Relevant variable

Axis Monitor Data (AxisName.Md.)

Variable/structure name	Name	Details
ProfileID	Execution Profile ID No.	Stores the executing Cam table ID (CamTableID). The update timing is as follows. ■Stores the specified Cam table ID (CamTableID) • When MC_CamIn (Cam Operation Start) is executed (Timing when the slave axis status becomes "7: During synchronous operation (SynchronizedMotion)") • When changing Cam table ID (CamTableID) The timing differs depending on the setting value of Start mode (StartMode). ■Cleared to "0" • When Cam cycle completion (EndOfProfile) becomes TRUE with the setting in which Periodic (Periodic) is "FALSE: Non periodic" and Specifying operation after one cycle operation (Options (Options): bit 16) is "0: Complete" • When stop cause occurs

Relevant FB

For details on motion control FBs, refer to the following.
📖MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_CamIn	Cam operation start	Cam operation starts operation according to the specified cam table.

Control details

MC_CamIn (Cam Operation Start) sets Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), Master axis follow-up distance (MasterStartDistance), Master axis synchronization start position (MasterSyncPosition), Start mode (StartMode), Master axis data source selection (MasterValueSource), Cam table ID (CamTableID), and Buffer mode (BufferMode) and then executes the cam operation.
To stop the operation, execute MC_Stop (Forced Stop).

Starting cam operation

Synchronous timing of the cam operation and reflection timing of the cam control data can be selected by setting of Start mode (StartMode).
Start mode (StartMode) has the following setting values. Each setting value is used for the following applications.

Start mode (StartMode)	Applications	Reference
0: Immediate (mcImmediate)	• When performing MC_CamIn (Cam Operation Start) after performing initial position alignment • When it is not necessary to consider detailed positional relationships such as linear cams • When MC_CamIn (Cam Operation Start) is performed due to multiple start (buffering)	☞ Page 787 When Start Mode (StartMode) is "0: Immediate (mcImmediate)"
1: Absolute (mcAbsolute)	• When MC_CamIn (Cam Operation Start) is performed from the specified master axis position • When switching the cam table ID during control by MC_CamIn (Cam Operation Start)	☞ Page 792 When Start mode (StartMode) is "1: Absolute (mcAbsolute)"
2: Relative (mcRelative)	• When restarting from the current slave axis position after stopping synchronous control while the synchronous position relationship*1 is not broken	☞ Page 797 When Start mode (StartMode) is "2: Relative (mcRelative)"
3: Ramp In (mcRampIn)	• When performing MC_CamIn (Cam Operation Start) after automatic initial position alignment*2 • When restarting with automatic initial position alignment after the device has been forcibly stopped and the synchronous position relationship*2 has been broken	☞ Page 800 When Start mode (StartMode) is "3: Ramp In (mcRampIn)"

*1 If the cam starts operating while the synchronous position relationship is broken, the slave axis may move suddenly to the initial stroke position of the cam, causing a shock to the machine.

*2 The slave axis is controlled toward the slave axis position at the start of synchronization. For operation details, refer to the following.
☞ Page 800 When Start mode (StartMode) is "3: Ramp In (mcRampIn)"

■Cam operation synchronous timing

Settings of Start mode (StartMode) as well as related parameters (Master axis synchronization start position (MasterSyncPosition), and Master axis follow-up distance (MasterStartDistance)) decide the synchronous start timing of Current value per cycle (InputPerCycle), Reference value (Reference), and Output value (OutputData) as follows.

Start mode (StartMode)	Synchronous start timing	
	Current value per cycle (InputPerCycle), reference value (Reference)	Output value (OutputData)
0: Immediate (mcImmediate)	When executing MC_CamIn (Cam Operation Start) (Ignores Master axis synchronization start position (MasterSyncPosition) and Master axis follow-up distance (MasterStartDistance).)	
1: Absolute (mcAbsolute)	When the position of master axis*1 passes Master axis synchronization start position*2 (MasterSyncPosition) (Ignores Master axis follow-up distance (MasterStartDistance).)	
2: Relative (mcRelative)	When the position of the master axis*1 passes Master axis synchronization start position*2 (MasterSyncPosition)	When the position of the Master axis*1 passes Master axis synchronization start position (MasterSyncPosition) and then passes*2 "Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)"
3: Ramp In (mcRampIn)		When the position of the Master axis*3 passes Master axis synchronization start position (MasterSyncPosition) and then passes*2 "Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)"*3

*1 The position data to be used can be specified with Specifying target of Master axis synchronization start position pass check (Options (Options) bit 21) of MC_CamIn (Cam Operation Start).

*2 The position of the Master axis has crossed over Master axis synchronization start position (MasterSyncPosition) (or the Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)). When these values are the same, the Master axis is considered to have not passed, and should the Master axis move from this value, it will be considered to have passed.

*3 After the position of the Master axis passes Master axis synchronization start position (MasterSyncPosition), the slave axis is controlled to move toward the slave axis position at the start of synchronization until it passes "Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)". For details, refer to the following.

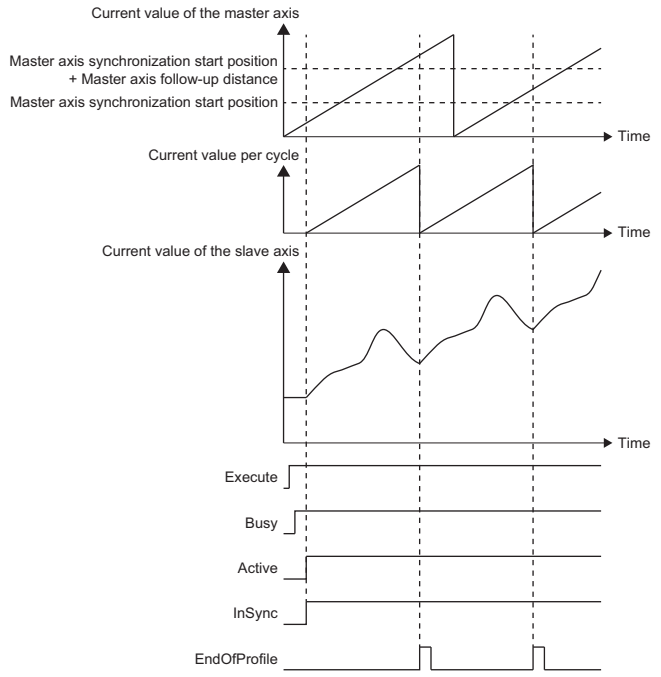
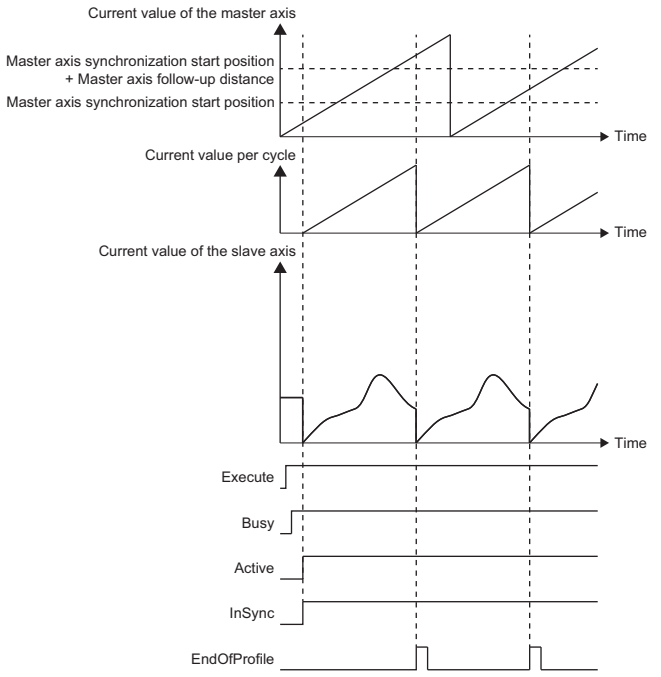
☞ Page 800 When Start mode (StartMode) is "3: Ramp In (mcRampIn)"

After MC_CamIn (Cam Operation Start) is executed, Controlling (Active) becomes TRUE after Current value per cycle (InputPerCycle) is synchronized, and then In synchronization (InSync) becomes TRUE after Output value (OutputData) is synchronized.

■When Start Mode (StartMode) is "0: Immediate (mcImmediate)"

The slave axis starts moving after start of Execution command (Execute).

The following explains the operation based on Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

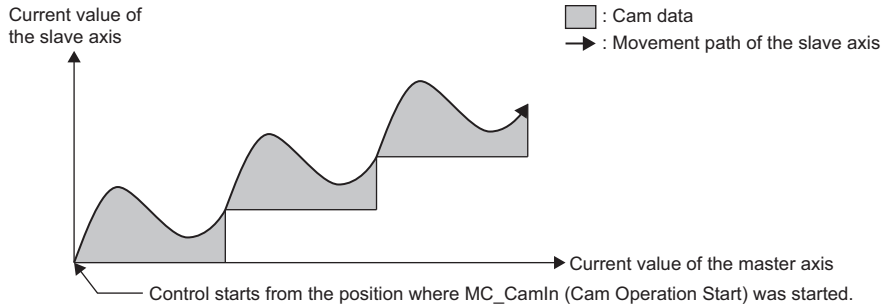
When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	

• An example program for performing MC_CamIn (Cam Operation Start) is shown below.

Ex.

When performing MC_CamIn (Cam Operation Start) after performing initial position alignment

■Operation



■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1

• Setting operation profile data (cam data)

Item		ProfileData0001
Interpolation method specification		Spline interpolation
Repetitive operation		Enable
Input absolute coordinate		Disable (Relative coordinate)
Output absolute coordinate		Disable (Relative coordinate)
Resolution		256
Length per Cycle Setting	Unit	degree
	Length per cycle	360.0
Stroke Amount Setting	Unit	pulse
	Stroke amount	10000.0
Initial stroke		0.0

• ProfileData0001

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]
1	0.0	90.0	10000.0
2	90.0	180.0	5000.0
3	180.0	270.0	2500.0
4	270.0	0.0	5000.0

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB
MCv_Jog_1	MCv_Jog	JOG operation FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
   bInitial:= TRUE;
   //All axes operation possible
   MCv_AllPower_1.Enable:= TRUE;
   MCv_AllPower_1.ServoON:= TRUE;
   //Homing control start
   bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
   MC_Home_1.Execute:= TRUE;
   MC_Home_2.Execute:= TRUE;
   //Change Execute to FALSE when done.
   IF MC_Home_1.Done AND MC_Home_2.Done THEN
      MC_Home_1.Execute:= FALSE;
      MC_Home_2.Execute:= FALSE;
      bMC_Home_Execute:= FALSE;
   END_IF;
END_IF;

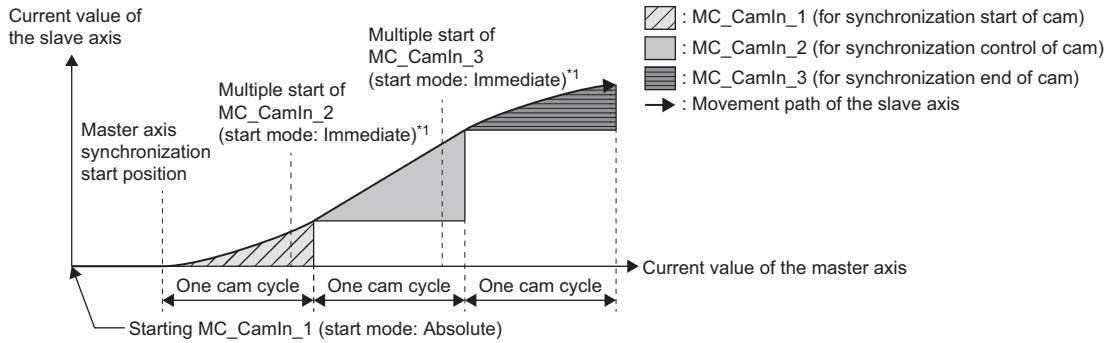
//-----Cam operation start control-----
IF bMC_CamIn_Start THEN
   IF MC_CamIn_1.Execute = FALSE THEN
      MC_CamIn_1.Execute:= TRUE;
      MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
      MC_CamIn_1.StartMode:= MC_START_MODE__mcImmediate;
   END_IF;
   //Wait for MC_CamIn start to complete before moving the master axis.
   IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
      MCv_Jog_1.JogForward:= TRUE;
   END_IF;
END_IF;

//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 0.0);
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
```

Ex.

When MC_CamIn (Cam Operation Start) is performed by multiple start (buffering)

■Operation



*1: Because MC_CamIn (Cam Operation Start) switches at the end of the next cycle, there is no problem with the timing of multiple start (buffering) of MC_CamIn (Cam Operation Start) as long as it is within one cycle of the cam to be switched.

■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1
2	ProfileData0002	MC_CAM_REF	Cam data 2
3	ProfileData0003	MC_CAM_REF	Cam data 3

• Setting operation profile data (cam data)

Item		ProfileData0001	ProfileData0002	ProfileData0003
Interpolation method specification		Section interpolation	Linear interpolation	Section interpolation
Repetitive operation		Enable	Enable	Disable
Input absolute coordinate		Disable (Relative coordinate)	Disable (Relative coordinate)	Disable (Relative coordinate)
Output absolute coordinate		Disable (Relative coordinate)	Disable (Relative coordinate)	Disable (Relative coordinate)
Resolution/number of coordinates		256	2	256
Length per Cycle Setting	Unit	degree	degree	degree
	Length per cycle	360.0	360.0	360.0
Stroke Amount Setting	Unit	pulse	pulse	pulse
	Stroke amount	10000.0	10000.0	10000.0
Initial stroke		0.0	—	0.0
Minimum value per cam cycle		—	0.0	—
Maximum value per cam cycle		—	360.0	—

• ProfileData0001

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]	Cam curve type	Curve applicable range	
					P1	P2
1	0.0	0.0	5000.0	Constant acceleration	0.00	0.50

• ProfileData0002

Point No.	Input value [degree]	Output value [pulse]
1	0.0	0.0
2	360.0	10000.0

• ProfileData0003

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]	Cam curve type	Curve applicable range	
					P1	P2
1	0.0	0.0	5000.0	Constant acceleration	0.50	1.00

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
bMC_CamIn_Stop	Bit	"Cam operation stop control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB (for cam synchronization start)
MC_CamIn_2	MC_CamIn	Cam operation start FB (for control)
MC_CamIn_3	MC_CamIn	Cam operation start FB (for cam synchronization end)
MCv_Jog_1	MCv_Jog	JOG operation FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
    bInitial:= TRUE;
    //All axes operation possible
    MCv_AllPower_1.Enable:= TRUE;
    MCv_AllPower_1.ServoON:= TRUE;
    //Homing control start
    bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
    MC_Home_1.Execute:= TRUE;
    MC_Home_2.Execute:= TRUE;
    //Change Execute to FALSE when done.
    IF MC_Home_1.Done AND MC_Home_2.Done THEN
        MC_Home_1.Execute:= FALSE;
        MC_Home_2.Execute:= FALSE;
        bMC_Home_Execute:= FALSE;
    END_IF;
END_IF;

//-----Cam operation start control-----
IF bMC_CamIn_Start THEN
    IF MC_CamIn_1.Execute = FALSE THEN
        MC_CamIn_1.Execute:= TRUE;
        MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
        MC_CamIn_1.StartMode:= MC_START_MODE__mcAbsolute;
        MC_CamIn_1.MasterSyncPosition:= 270.0;
    END_IF;
    //Wait for MC_CamIn start to complete before moving the master axis.
    IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
        MCv_Jog_1.JogForward:= TRUE;
        //Multiple start (buffering) of MC_CamIn for control
        MC_CamIn_2.Execute:= TRUE;
        MC_CamIn_2.CamTableID.ProfileID:= ProfileData0002.ProfileData.ID;
        MC_CamIn_2.StartMode:= MC_START_MODE__mcImmediate;
        MC_CamIn_2.BufferMode:= MC_BUFFER_MODE__mcBuffered;
    END_IF;
END_IF;

//-----Cam operation stop control-----
IF bMC_CamIn_Stop THEN
    bMC_CamIn_Start:= FALSE;
    IF MC_CamIn_2.Active THEN
        //Perform multiple start (buffering) of MC_CamIn for cam synchronization end.
        MC_CamIn_3.Execute:= TRUE;
        MC_CamIn_3.CamTableID.ProfileID:= ProfileData0003.ProfileData.ID;
        MC_CamIn_3.StartMode:= MC_START_MODE__mcImmediate;
        MC_CamIn_3.BufferMode:= MC_BUFFER_MODE__mcBuffered;
    END_IF;

    //Stop the master axis when the slave axis is no longer under synchronous control.
    IF Axis0002.Md.AxisStatus <> MC_AXIS_STATUS__SynchronizedMotion THEN
        MCv_Jog_1.JogForward:= FALSE;
    END_IF;
END_IF;

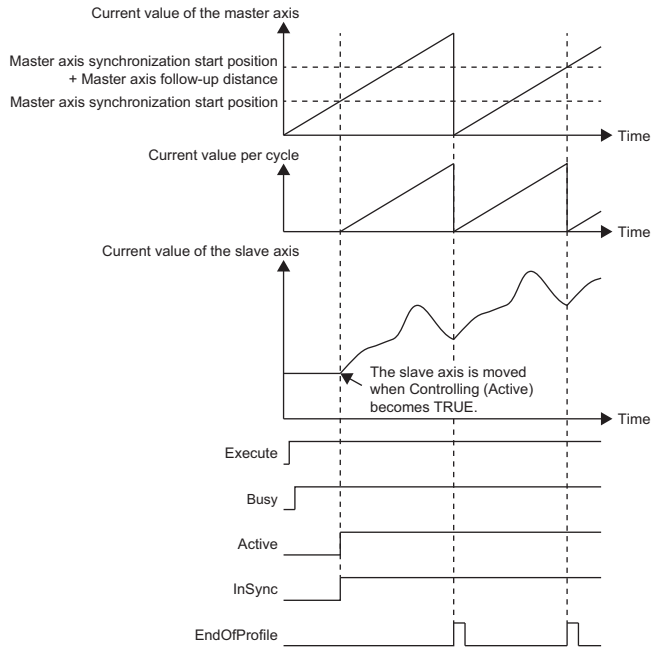
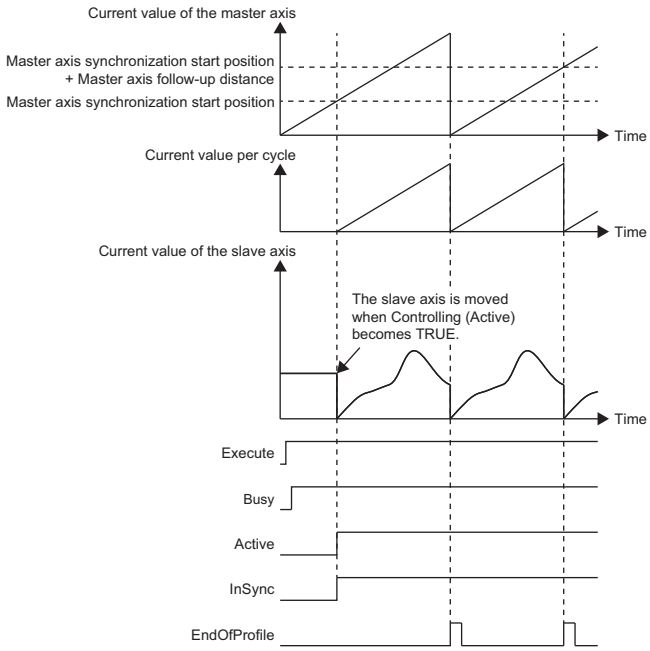
//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 0.0);
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
MC_CamIn_2(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
MC_CamIn_3(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
```

■When Start mode (StartMode) is "1: Absolute (mcAbsolute)"

After start of Execution command (Execute), the slave axis starts moving after the cumulative current position of the master axis passes Master axis synchronization start position (MasterSyncPosition).

Checking of whether the Master axis cumulative current position has passed the Master axis synchronization start position (MasterSyncPosition) begins at the point when the Slave axis status becomes "7: During synchronous operation (SynchronizedMotion)".

The following explains the operation based on Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

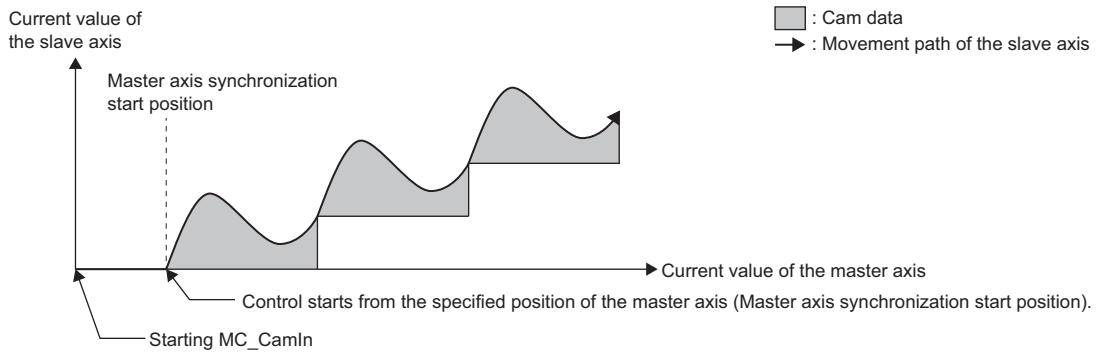
When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	

• An example program for performing MC_CamIn (Cam Operation Start) is shown below.

Ex.

When MC_CamIn (Cam Operation Start) is performed from the specified master axis position

■Operation



■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1

• Setting operation profile data (cam data)

Item		ProfileData0001
Interpolation method specification		Spline interpolation
Repetitive operation		Enable
Input absolute coordinate		Disable (Relative coordinate)
Output absolute coordinate		Disable (Relative coordinate)
Resolution		256
Length per Cycle Setting	Unit	degree
	Length per cycle	360.0
Stroke Amount Setting	Unit	pulse
	Stroke amount	10000.0
Initial stroke		0.0

• ProfileData0001

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]
1	0.0	90.0	10000.0
2	90.0	180.0	5000.0
3	180.0	270.0	2500.0
4	270.0	0.0	5000.0

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB
MCv_Jog_1	MCv_Jog	JOG operation FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
  bInitial:= TRUE;
  //All axes operation possible
  MCv_AllPower_1.Enable:= TRUE;
  MCv_AllPower_1.ServoON:= TRUE;
  //Homing control start
  bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
  MC_Home_1.Execute:= TRUE;
  MC_Home_2.Execute:= TRUE;
  //Change Execute to FALSE when done.
  IF MC_Home_1.Done AND MC_Home_2.Done THEN
    MC_Home_1.Execute:= FALSE;
    MC_Home_2.Execute:= FALSE;
  bMC_Home_Execute:= FALSE;
  END_IF;
END_IF;

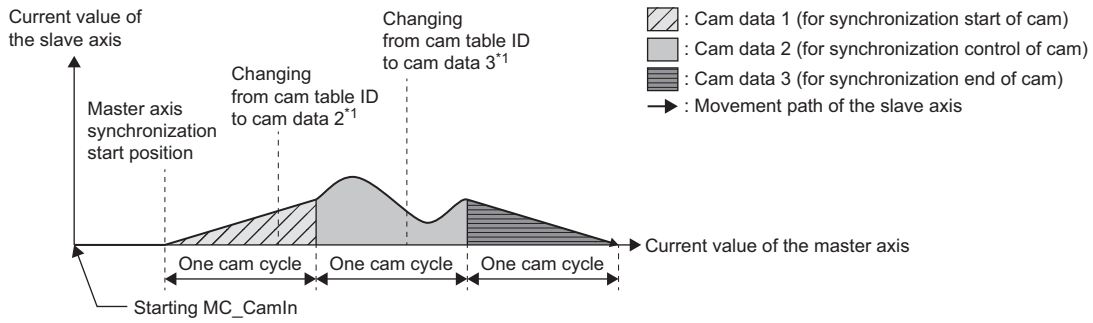
//-----Cam operation start control-----
IF bMC_CamIn_Start THEN
  IF MC_CamIn_1.Execute = FALSE THEN
    MC_CamIn_1.Execute:= TRUE;
    MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
    MC_CamIn_1.StartMode:= MC_START_MODE__mcAbsolute;
    MC_CamIn_1.MasterSyncPosition:= 270.0; //Master axis position to start cam operation
  END_IF;
  //Wait for MC_CamIn start to complete before moving the master axis.
  IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
    MCv_Jog_1.JogForward:= TRUE;
  END_IF;
END_IF;

//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 0.0);
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
```

Ex.

When switching the cam table ID during control by MC_CamIn (Cam Operation Start)

■Operation



*1: Because the cam data is switched at the end of one cycle, there is no problem with changing the cam table ID as long as it is within one cycle of the cam to be switched. If an invalid cam table ID is specified, "Out of Synchronous Control Variable Range Warning (warning code: 0D49H)" or "No Cam Table Warning (warning code: 0D44H)" occurs, and control continues with the previous cam table ID.

■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1
2	ProfileData0002	MC_CAM_REF	Cam data 2
3	ProfileData0003	MC_CAM_REF	Cam data 3
4	ProfileData0004	MC_CAM_REF	Cam data 4

• Setting operation profile data (cam data)

Item		ProfileData0001	ProfileData0002	ProfileData0003	ProfileData0004
Interpolation method specification		Linear interpolation	Spline interpolation	Linear interpolation	Linear interpolation
Repetitive operation		Enable	Enable	Enable	Disable
Input absolute coordinate		Disable (Relative coordinate)	Disable (Relative coordinate)	Disable (Relative coordinate)	Disable (Relative coordinate)
Output absolute coordinate		Enable (Absolute coordinate)	Enable (Absolute coordinate)	Enable (Absolute coordinate)	Enable (Absolute coordinate)
Resolution/number of coordinates		2	256	2	2
Length per Cycle Setting	Unit	degree	degree	degree	degree
	Length per cycle	360.0	360.0	360.0	360.0
Stroke Amount Setting	Unit	pulse	pulse	pulse	pulse
	Stroke amount	10000.0	10000.0	10000.0	10000.0
Initial stroke		—	5000.0	—	—
Minimum value per cam cycle		0.0	—	0.0	0.0
Maximum value per cam cycle		360.0	—	360.0	360.0

• ProfileData0001

Point No.	Input value [degree]	Output value [pulse]
1	0.0	0.0
2	360.0	5000.0

• ProfileData0002

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]
1	0.0	90.0	10000.0
2	90.0	180.0	5000.0
3	180.0	270.0	2500.0
4	270.0	0.0	5000.0

• ProfileData0003

Point No.	Input value [degree]	Output value [pulse]
1	0.0	5000.0
2	360.0	0.0

• ProfileData0004

Point No.	Input value [degree]	Output value [pulse]
1	0.0	0.0
2	360.0	0.0

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
bMC_CamIn_Stop	Bit	"Cam operation stop control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB
MCv_Jog_1	MCv_Jog	JOG operation FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
  bInitial:= TRUE;
  //All axes operation possible
  MCv_AllPower_1.Enable:= TRUE;
  MCv_AllPower_1.ServoON:= TRUE;
  //Homing control start
  bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
  MC_Home_1.Execute:= TRUE;
  MC_Home_2.Execute:= TRUE;
  //Change Execute to FALSE when done.
  IF MC_Home_1.Done AND MC_Home_2.Done THEN
    MC_Home_1.Execute:= FALSE;
    MC_Home_2.Execute:= FALSE;
    bMC_Home_Execute:= FALSE;
  END_IF;
END_IF;

//-----Cam operation start control (cam synchronization start control)-----
IF bMC_CamIn_Start THEN
  IF MC_CamIn_1.Execute = FALSE THEN
    MC_CamIn_1.Execute:= TRUE;
    MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
    MC_CamIn_1.StartMode:= MC_START_MODE__mcAbsolute;
    MC_CamIn_1.MasterSyncPosition:= 270.0; //Master axis position to start cam operation
    MC_CamIn_1.ContinuousUpdate:= TRUE; //Continuous update: Enable
  END_IF;
  //Wait for MC_CamIn start to complete before moving the master axis.
  IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
    MCv_Jog_1.JogForward:= TRUE;
    // Set the control cam data (applicable at the end of the next cycle).
    MC_CamIn_1.CamTableID.ProfileID:= ProfileData0002.ProfileData.ID;
  END_IF;
END_IF;

//-----Cam operation stop control (cam synchronization end control)-----
IF bMC_CamIn_Stop THEN
  bMC_CamIn_Start:= FALSE;
  IF MC_CamIn_1.Active THEN
    IF Axis0002.Md.ProfileID = ProfileData0002.ProfileData.ID.Number THEN
      //If the cam data during slave axis control is control cam data, set the cam data for cam synchronization end.
      MC_CamIn_1.CamTableID.ProfileID:= ProfileData0003.ProfileData.ID;
    ELSE
      //Otherwise, set the cam data for stopping (repeated action: disabled).
      MC_CamIn_1.CamTableID.ProfileID:= ProfileData0004.ProfileData.ID;
    END_IF;
  END_IF;
  //Stop the master axis when the slave axis is no longer under synchronous control.
  IF Axis0002.Md.AxisStatus <> MC_AXIS_STATUS__SynchronizedMotion THEN
    MCv_Jog_1.JogForward:= FALSE;
  END_IF;
END_IF;

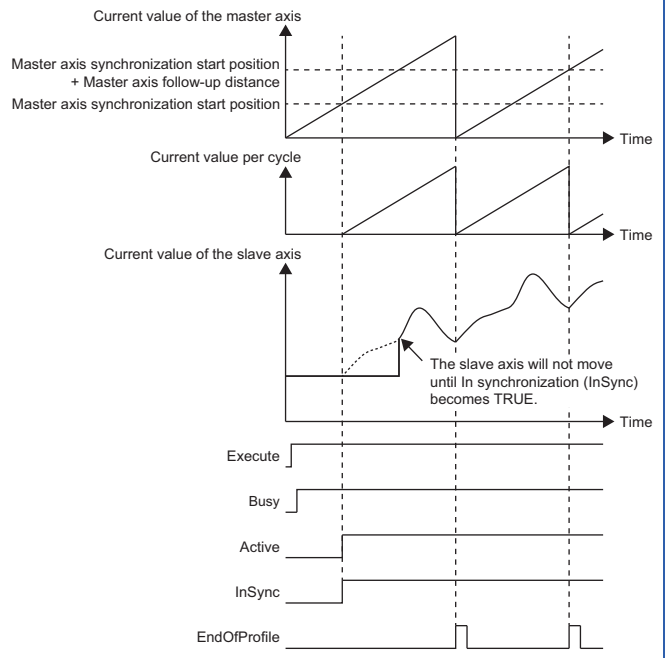
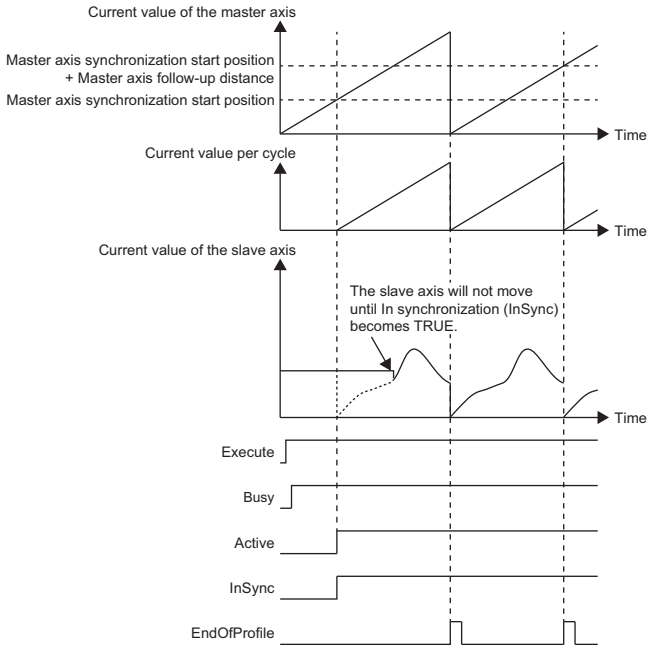
//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 0.0);
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
```

■When Start mode (StartMode) is "2: Relative (mcRelative)"

After start of Execution command (Execute), the cumulative current position of the master axis passes Master axis synchronization start position (MasterSyncPosition), and then Current value per cycle (InputPerCycle) is updated. From here, the cumulative current position of the master axis moves Master axis follow-up distance (MasterStartDistance), and then the slave axis starts moving according to the cam data.

Checking of whether the Master axis cumulative current position has passed the Master axis synchronization start position (MasterSyncPosition) begins at the point when the Slave axis status becomes "7: During synchronous operation (SynchronizedMotion)".

The following explains the operation based on Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

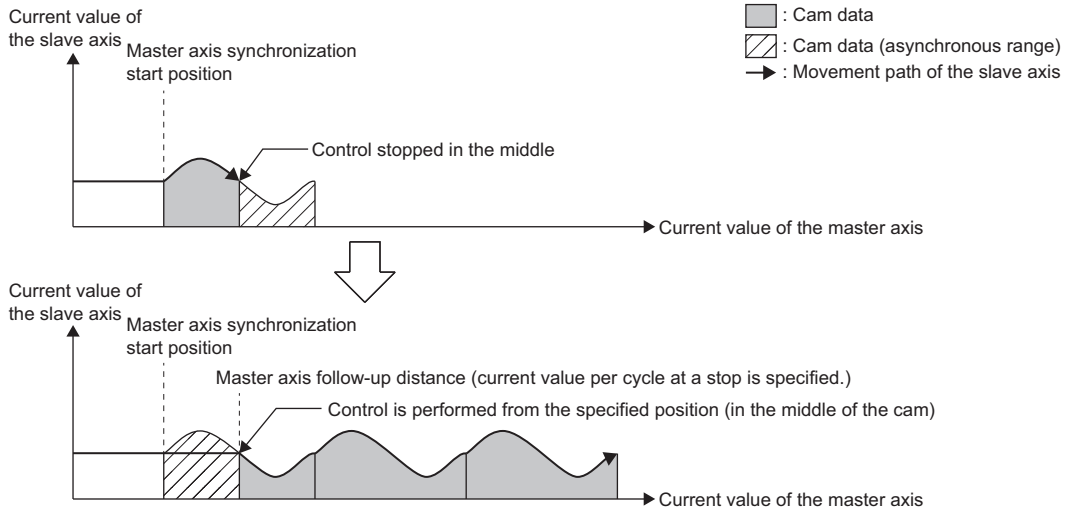
When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	

- An example program for performing MC_CamIn (Cam Operation Start) is shown below.

Ex.

When restarting from the current slave axis position after stopping synchronous control while the synchronous position relationship is not broken

■Operation



*: Specify an absolute coordinate for the output absolute coordinate.

■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1

• Setting operation profile data (cam data)

Item		ProfileData0001
Interpolation method specification		Spline interpolation
Repetitive operation		Enable
Input absolute coordinate		Disable (Relative coordinate)
Output absolute coordinate		Enable (Absolute coordinate)
Resolution		256
Length per Cycle Setting	Unit	degree
	Length per cycle	360.0
Stroke Amount Setting	Unit	pulse
	Stroke amount	10000.0
Initial stroke		5000.0

• ProfileData0001

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]
1	0.0	90.0	10000.0
2	90.0	180.0	5000.0
3	180.0	270.0	2500.0
4	270.0	0.0	5000.0

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
bMC_CamIn_Stop	Bit	"Cam operation stop control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB
MCv_Jog_1	MCv_Jog	JOG operation FB
MC_Stop_1	MC_Stop	Forced stop FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
   bInitial:= TRUE;
   //All axes operation possible
   MCv_AllPower_1.Enable:= TRUE;
   MCv_AllPower_1.ServoON:= TRUE;
   //Homing control start
   bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
   MC_Home_1.Execute:= TRUE;
   MC_Home_2.Execute:= TRUE;
   //Change Execute to FALSE when done.
   IF MC_Home_1.Done AND MC_Home_2.Done THEN
      MC_Home_1.Execute:= FALSE;
      MC_Home_2.Execute:= FALSE;
      bMC_Home_Execute:= FALSE;
   END_IF;
END_IF;

//-----Cam operation start control-----
IF bMC_CamIn_Start THEN
   IF MC_CamIn_1.Execute = FALSE THEN
      MC_CamIn_1.Execute:= TRUE;
      MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
      MC_CamIn_1.StartMode:= MC_START_MODE__mcRelative;
      MC_CamIn_1.MasterSyncPosition:= Axis0001.Md.CumulativePosition;
      MC_CamIn_1.MasterStartDistance:= MC_CamIn_1.InputPerCycle; //Specify the current value per cycle when stopped.
   END_IF;
   //Wait for MC_CamIn start to complete before moving the master axis.
   IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
      MCv_Jog_1.JogForward:= TRUE;
   END_IF;
END_IF;

//-----Cam operation stop control-----
IF bMC_CamIn_Stop THEN
   bMC_CamIn_Start:= FALSE;
   MCv_Jog_1.JogForward:= FALSE;
   //Stop MC_CamIn control when the master axis stops.
   IF MCv_Jog_1.Done THEN
      MC_Stop_1.Execute:= TRUE;
   END_IF;
   //Turn off the execution flag when MC_CamIn is stopped.
   IF MC_Stop_1.Done AND MC_CamIn_1.CommandAborted THEN
      MC_CamIn_1.Execute:= FALSE;
      MC_Stop_1.Execute:= FALSE;
      bMC_CamIn_Stop:= FALSE;
   END_IF;
END_IF;

//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 5000.0); //The home position of the slave axis is the same as the initial stroke position of the cam.
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
MC_Stop_1(Axis:= Axis0002.AxisRef, Deceleration:= 10.0, Jerk:= 0.0);
```

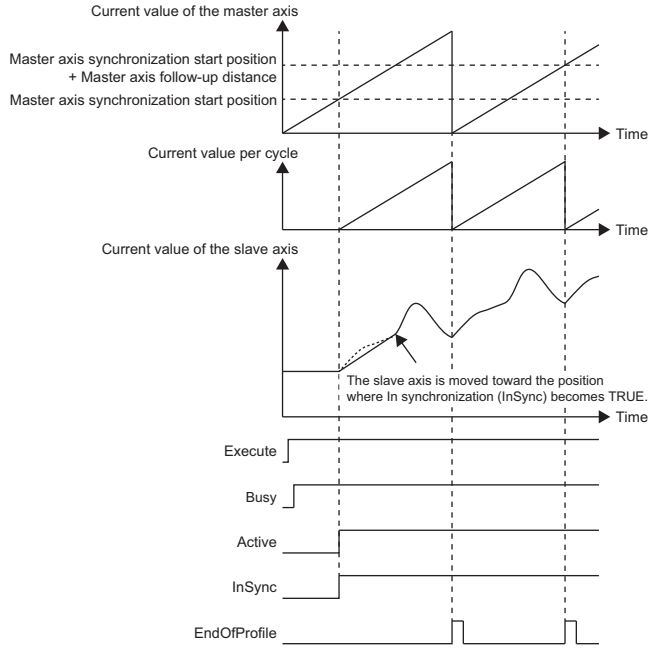
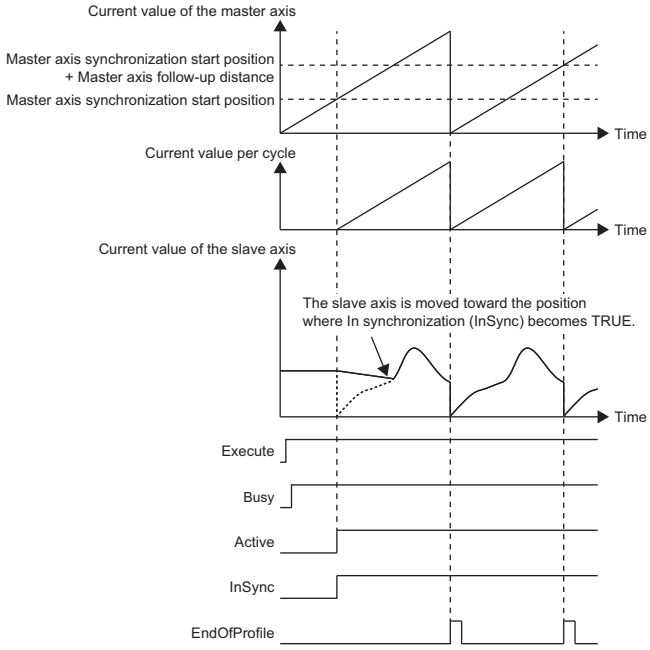
■When Start mode (StartMode) is "3: Ramp In (mcRampIn)"

After start of Execution command (Execute), the cumulative current position of the master axis passes Master axis synchronization start position (MasterSyncPosition), and then Current value per cycle (InputPerCycle) is updated. The slave axis starts moving toward the slave axis position at the start of synchronization.

From here, the cumulative current position of the master axis moves Master axis follow-up distance (MasterStartDistance), and then the slave axis starts moving according to the cam data.

Checking of whether the Master axis cumulative current position has passed the Master axis synchronization start position (MasterSyncPosition) begins at the point when the Slave axis status becomes "7: During synchronous operation (SynchronizedMotion)".

The following explains the operation based on Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

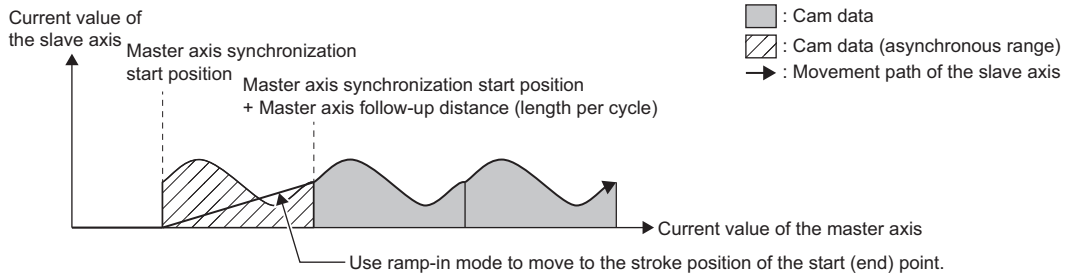
When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	

• An example program for performing MC_CamIn (Cam Operation Start) is shown below.

Ex.

When performing MC_CamIn (Cam Operation Start) after automatic initial position alignment

■Operation



■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REF	Axis 1
2	Axis0002	AXIS_REF	Axis 2

■Operation profile data

Profile ID	Label name	Data type	Comment
1	ProfileData0001	MC_CAM_REF	Cam data 1

• Setting operation profile data (cam data)

Item		ProfileData0001
Interpolation method specification		Spline interpolation
Repetitive operation		Enable
Input absolute coordinate		Disable (Relative coordinate)
Output absolute coordinate		Enable (Absolute coordinate)
Resolution		256
Length per Cycle Setting	Unit	degree
	Length per cycle	360.0
Stroke Amount Setting	Unit	pulse
	Stroke amount	10000.0
Initial stroke		5000.0

• ProfileData0001

Section No.	Start point [degree]	End point [degree]	Stroke [pulse]
1	0.0	90.0	10000.0
2	90.0	180.0	5000.0
3	180.0	270.0	2500.0
4	270.0	0.0	5000.0

■Local labels

Label name	Data type	Comment
bInitial	Bit	"Program initial settings and start control" execution control
bMC_Home_Execute	Bit	"Homing" execution control
bMC_CamIn_Start	Bit	"Cam operation start control" execution control
bMC_CamIn_Stop	Bit	"Cam operation stop control" execution control
MCv_AllPower_1	MCv_AllPower	All axes operation possible FB
MC_Home_1	MC_Home	Homing FB (for master axis)
MC_Home_2	MC_Home	Homing FB (for slave axis)
MC_CamIn_1	MC_CamIn	Cam operation start FB
MCv_Jog_1	MCv_Jog	JOG operation FB
MC_Stop_1	MC_Stop	Forced stop FB

■Program example

ST program

```
//-----Program initial settings and start control-----
IF bInitial = FALSE THEN
  bInitial:= TRUE;
  //All axes operation possible
  MCv_AllPower_1.Enable:= TRUE;
  MCv_AllPower_1.ServoON:= TRUE;
  //Homing control start
  bMC_Home_Execute:= TRUE;
END_IF;

//-----Homing control-----
IF bMC_Home_Execute THEN
  MC_Home_1.Execute:= TRUE;
  MC_Home_2.Execute:= TRUE;
  //Change Execute to FALSE when done.
  IF MC_Home_1.Done AND MC_Home_2.Done THEN
    MC_Home_1.Execute:= FALSE;
    MC_Home_2.Execute:= FALSE;
    bMC_Home_Execute:= FALSE;
  END_IF;
END_IF;

//-----Cam operation start control-----
IF bMC_CamIn_Start THEN
  IF MC_CamIn_1.Execute = FALSE THEN
    MC_CamIn_1.Execute:= TRUE;
    MC_CamIn_1.CamTableID.ProfileID:= ProfileData0001.ProfileData.ID;
    MC_CamIn_1.StartMode:= MC_START_MODE__mcRampIn;
    MC_CamIn_1.MasterSyncPosition:= Axis0001.Md.CumulativePosition;
  MC_CamIn_1.MasterStartDistance:= 360.0; //Specify the length of one cam cycle.
  END_IF;
  //Wait for MC_CamIn start to complete before moving the master axis.
  IF MC_CamIn_1.Busy AND Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion THEN
    MCv_Jog_1.JogForward:= TRUE;
  END_IF;
END_IF;

//-----Cam operation stop control-----
IF bMC_CamIn_Stop THEN
  bMC_CamIn_Start:= FALSE;
  MCv_Jog_1.JogForward:= FALSE;
  //Stop MC_CamIn control when the master axis stops.
  IF MCv_Jog_1.Done THEN
    MC_Stop_1.Execute:= TRUE;
  END_IF;
  //Turn off the execution flag when MC_CamIn is stopped.
  IF MC_Stop_1.Done AND MC_CamIn_1.CommandAborted THEN
    MC_CamIn_1.Execute:= FALSE;
    MC_Stop_1.Execute:= FALSE;
    bMC_CamIn_Stop:= FALSE;
  END_IF;
END_IF;

//-----Function block call-----
MCv_AllPower_1();
MC_Home_1(Axis:= Axis0001.AxisRef, Position:= 0.0);
MC_Home_2(Axis:= Axis0002.AxisRef, Position:= 0.0);
MCv_Jog_1(Axis:= Axis0001.AxisRef, Velocity:= 100.0, Acceleration:= 10.0, Deceleration:= 10.0, Jerk:= 0.0);
MC_CamIn_1(Master:= Axis0001.AxisRef, Slave:= Axis0002.AxisRef);
MC_Stop_1(Axis:= Axis0002.AxisRef, Deceleration:= 10.0, Jerk:= 0.0);
```

■Timing of control change by FB restart/continuous update

Timing of reflecting changed parameters by FB restart/continuous update onto the control varies depending on Start Mode (StartMode) as shown below.

Start mode (StartMode)	Timing for reflecting parameters
0: Immediate (mcImmediate)	Immediate
1: Absolute (mcAbsolute)	When the current value per cycle (InputPerCycle) passes the first point on the cam table
2: Relative (mcRelative)	
3: Ramp In (mcRampIn)	

When the changed values exceed the range, the error is output and the control is maintained by keeping the value before.

Parameter	Event
Master axis offset (MasterOffset)	Out of Synchronous Control Variable Range Warning (event code: 00D49H) (detail code 0001H: Out of master axis offset range)
Slave axis offset (SlaveOffset)	Out of Synchronous Control Variable Range Warning (event code: 00D49H) (detail code 0002H: Out of slave axis offset range)
Master axis scaling (MasterScaling)	Out of Synchronous Control Variable Range Warning (event code: 00D49H) (detail code 0003H: Out of master axis coefficient range)
Slave axis scaling (SlaveScaling)	Out of Synchronous Control Variable Range Warning (event code: 00D49H) (detail code 0004H: Out of slave axis coefficient range)
Cam table ID (CamTableID)	• When the Cam table ID (CamTableID) value is out of range Out of Synchronous Control Variable Range Warning (event code: 00D49H) (detail code 0005H: Out of cam table ID range) • When there is no Cam table ID (CamTableID) open area No Cam Table warning (event code: 00D44H)

Cam table

This section describes the cam data and the cam operation when MC_CamIn (Cam Operation Start) is executed.

○: Used for control, ×: Not used for control

Name	Variable name	Interpolation method specification (Interpolate)			Remark
		0: Linear interpolation	1: Section interpolation	2: Spline interpolation	
Repetitive operation	Periodic	○	○		The item set in the expand setting of the operation profile data or set in input variables of MC_CamTableSelect (Cam Table Selection) on the engineering tool
Master axis absolute coordinate	MasterAbsolute	○	○		
Slave axis absolute coordinate	SlaveAbsolute	○	○		
Interpolation method specification	Interpolate	○	○		The item related to control among the data expanded to open area from the operation profile data of cam data format/rotary cutter format
Length per cycle	CycleLength	○	○		
Stroke amount	Stroke	○	○		
Start point	StartPoint	×	×		
Initial stroke amount	StartStroke	×	○		

■Repetitive operation

Periodic (Periodic) can set the operation after one cycle operation to "FALSE: Non periodic" or "TRUE: Periodic".

The following explains the operation when executing MC_CamIn (Cam Operation Start).

• FALSE: Non periodic

Only one cycle operation is performed after Controlling (Active) becomes TRUE. The next operation is specified in Specifying operation after one cycle operation (Options (Options): bit 16).

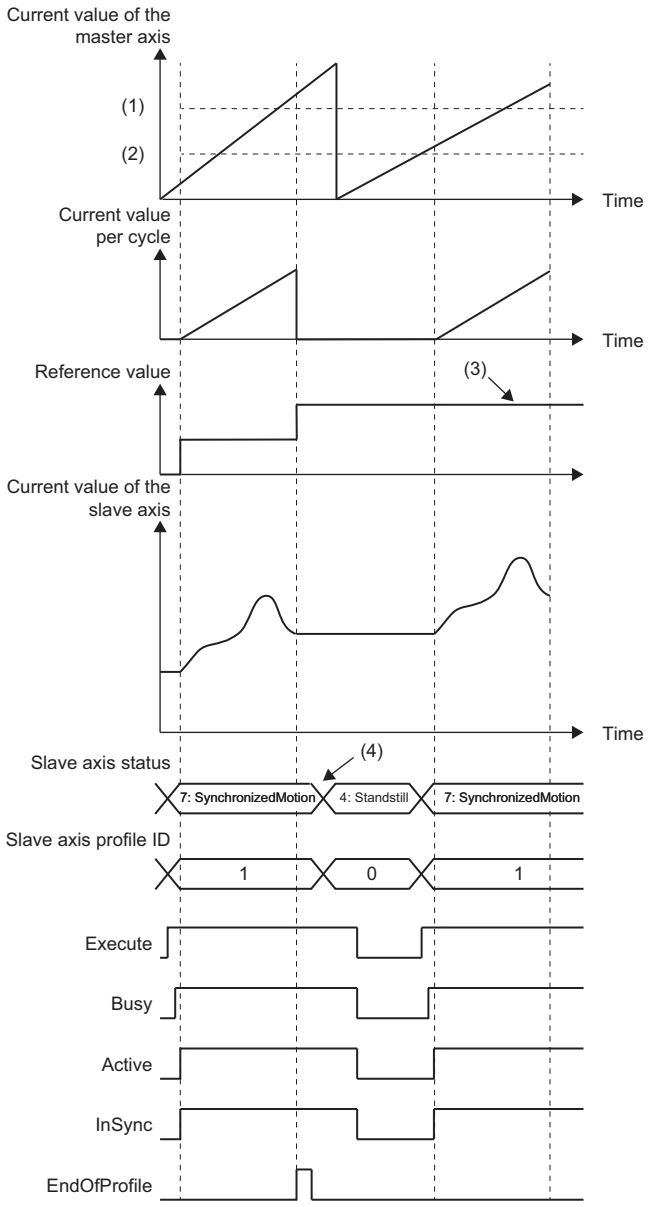
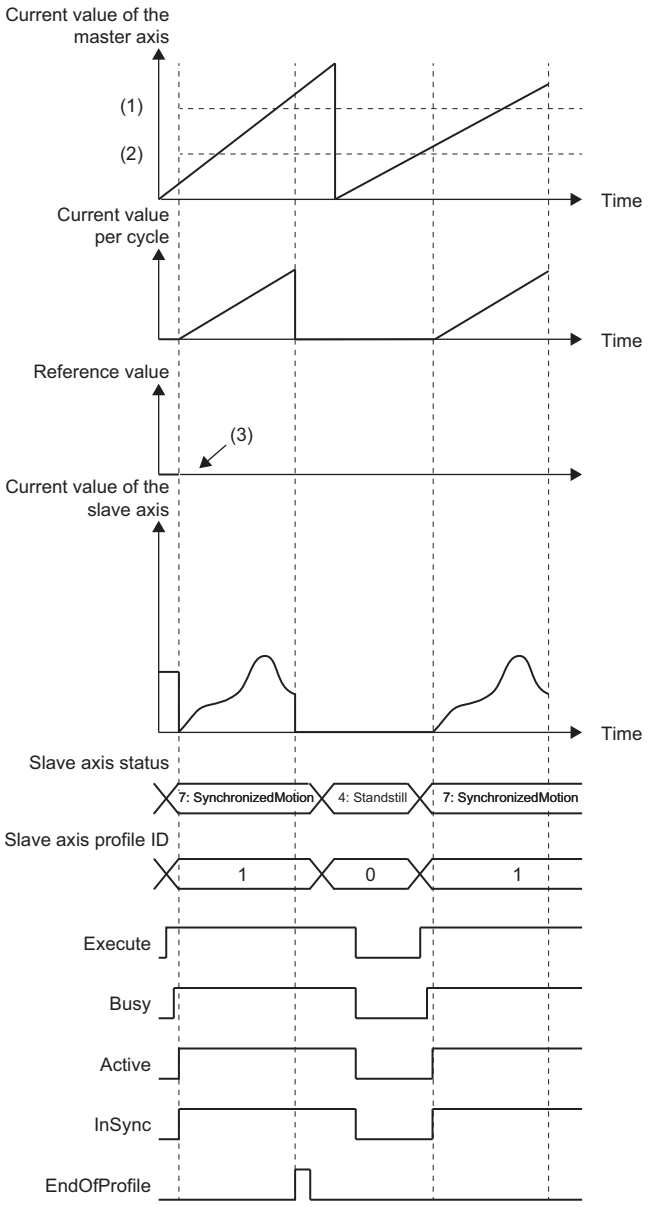
Specifying operation after one cycle operation (Options (Options): bit 16)	Operation after one cycle operation				Reference value (Reference), Output value (OutputData) at restart
	Executing (Busy)	Controlling (Active)	In synchronization (InSync)	Axis status (AxisName.Md.AxisStatus)	
0: Complete	FALSE			"4: Standby (Standstill)"	Initialized*1
1: Wait for restart	TRUE			"7: During synchronous operation (SynchronizedMotion)" is maintained.	Maintained

*1 For information on how to calculate the initial values of each monitor data, refer to the following.

☞ Page 813 Monitor data during cam operation

■When Specifying operation after one cycle operation (Options (Options): bit 16) is "0: Complete"

Synchronization status is canceled after one cycle. When Execution command (Execute) is started again, the status enters Synchronization status and the control of MC_CamIn (Cam Operation Start) starts.

When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	
(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The value is calculated from the current value per cycle that is started based on the set value where InSync becomes TRUE. (4): Synchronization status is canceled at the end of one cycle.	(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The initial value of the reference value is 0.0.

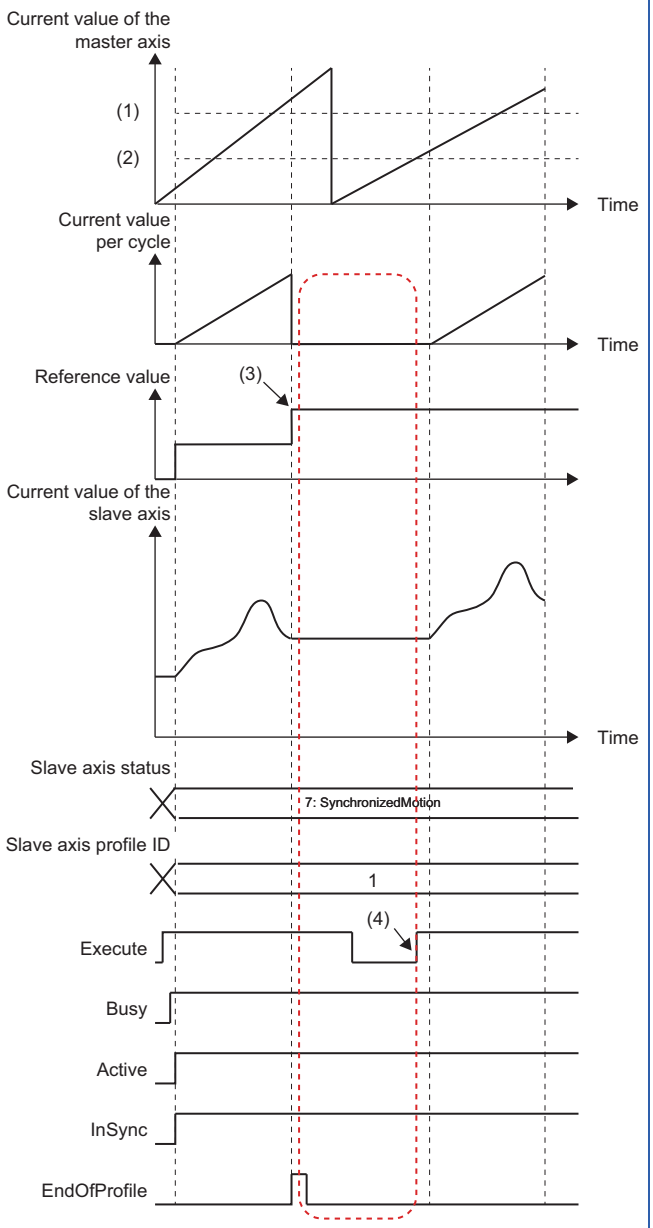
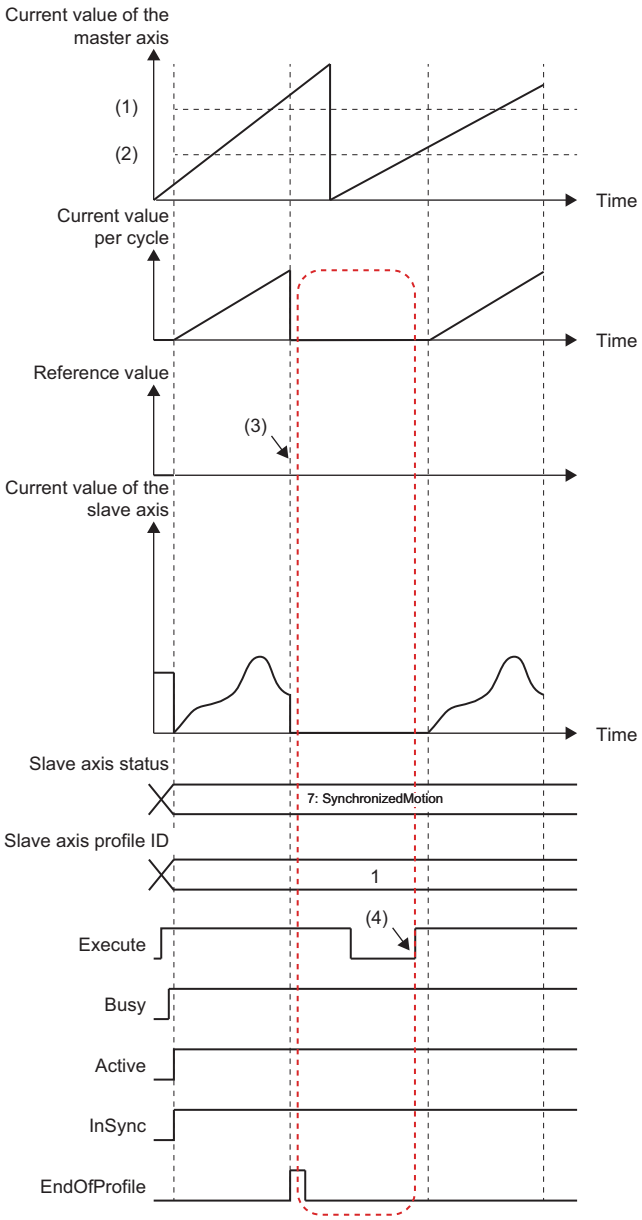
■When Specifying operation after one cycle operation (Options (Options): bit 16) is "1: Wait for restart"

Synchronization status is maintained even after one cycle. When Execution command (Execute) is started again, updating of the current value per cycle (InputPerCycle), reference value (Reference), and output value (OutputData) is started regardless of the Start mode (StartMode) settings.

Input stop cause to the slave axis to cancel synchronization status.

While waiting for a restart after one cycle has completed, even when values of input labels where continuous update is possible are changed, any input information will not be imported until Execution command (Execute) is restarted.

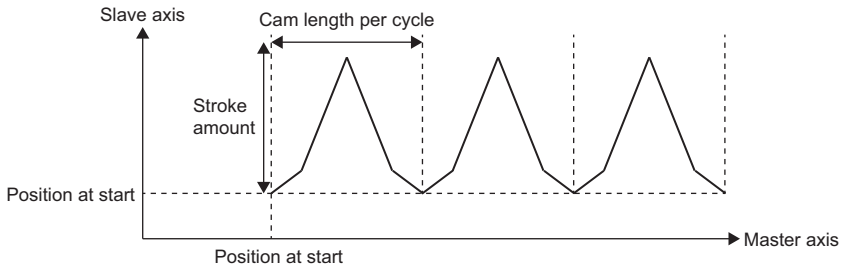
While waiting for a restart after one cycle has completed, if a change to the current value per cycle is executed, this will be valid from the next cycle.

When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	
(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The status after one cycle is maintained. (4): Execute is started again.	(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The status after one cycle is maintained. (4): Execute is started again.

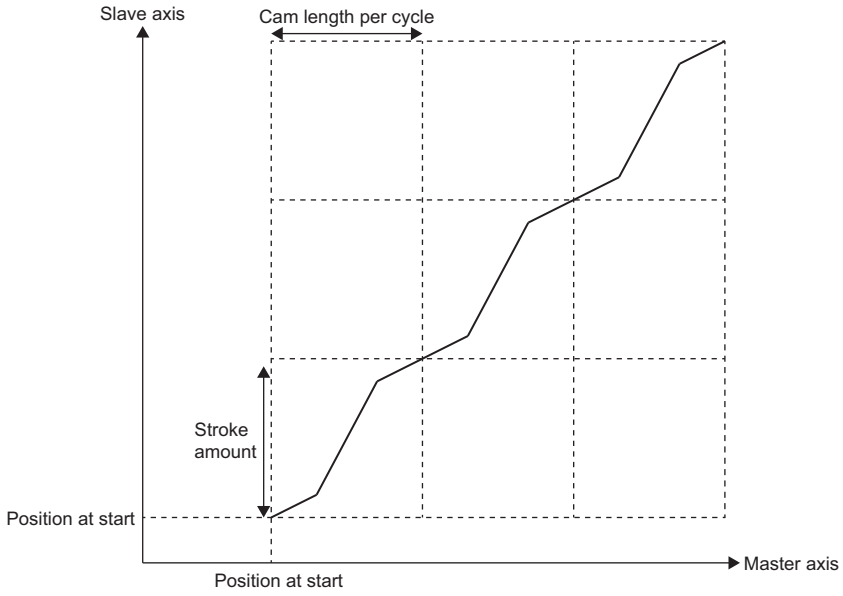
• TRUE: Periodic

Cam table execution is repeated continuously. When the positions of Slave axis (Slave) at the cam table start point are the same each time by repeating, cam is operated as a two-way cam. When the set positions at the start point and the end point are different, cam is operated as a feed cam.

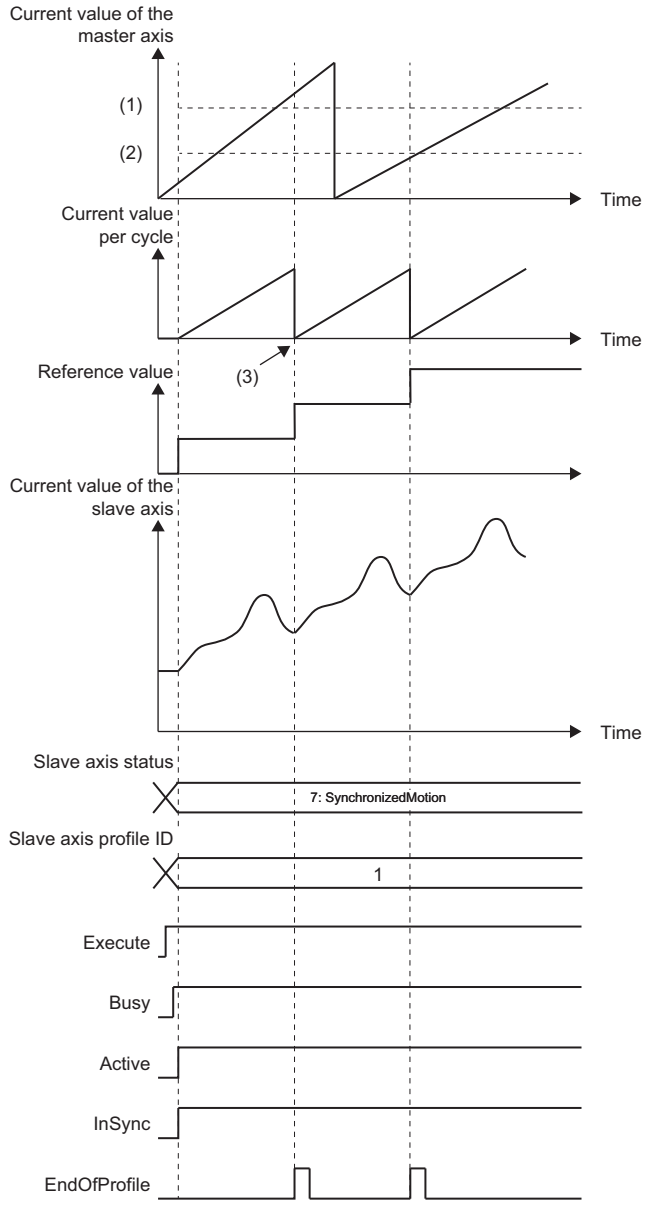
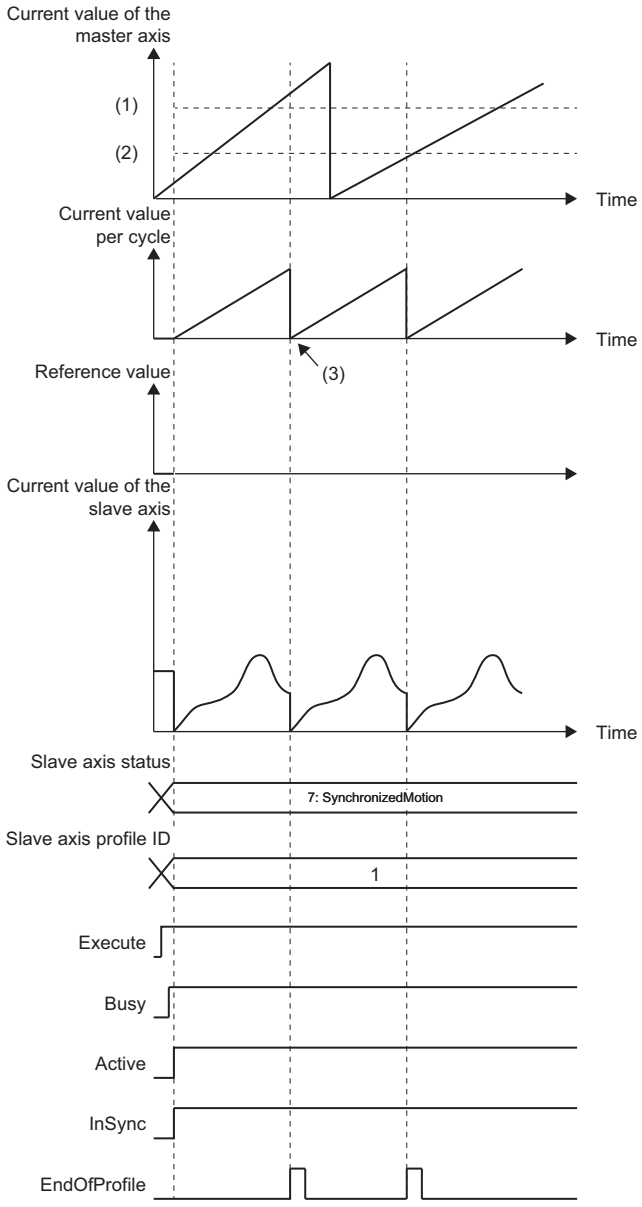
■Two-way cam operation



■Feed cam operation



The operation image of the repetitive operation is as shown below.

When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate"	When Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate"
	
(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The status is maintained even after one cycle.	(1): Master axis synchronization start position + Master axis follow-up distance (2): Master axis synchronization start position (3): The status is maintained even after one cycle.

■Master axis absolute coordinate

The following explains the cam operation based on Master axis absolute coordinate (MasterAbsolute) set by MC_CamTableSelect (Cam Table Selection).

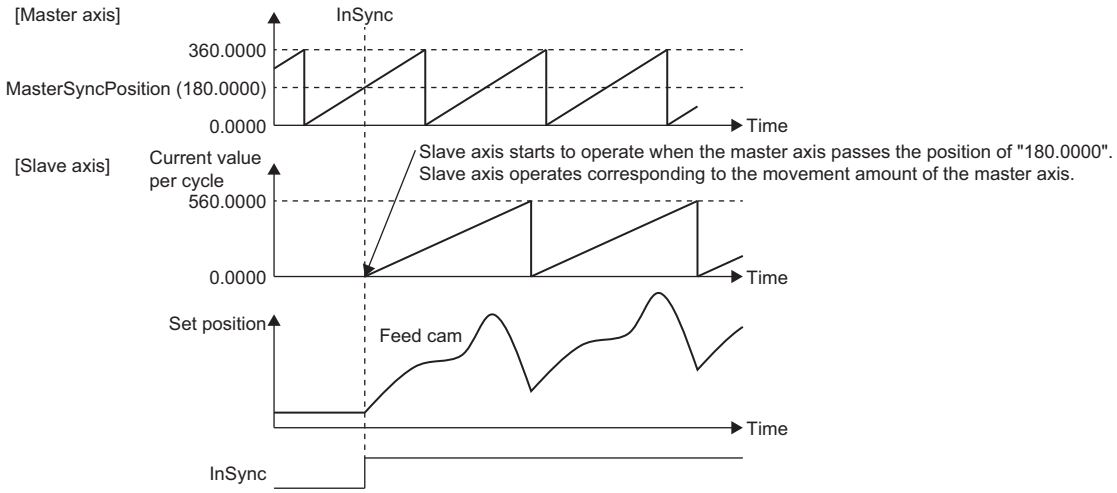
• "0: Relative coordinate" is specified to Master axis absolute coordinate (MasterAbsolute).

Master axis synchronization start position (MasterSyncPosition) becomes the start point of the cam table. When In synchronization (InSync) becomes TRUE, cam operation is executed corresponding to the relative movement amount of Master axis (Master). Cam operation is executed continuously, even when ring counters of Master axis (Master) and cam table are not matched.

Ex.

For the following settings.

- Master axis: Ring counter of the current value: 0.0000 to 360.0000 [degrees]
- Master axis synchronization start position (MasterSyncPosition): 180.0000 [degrees]
- Cam: Cam length per cycle: 540.0000 [degrees]

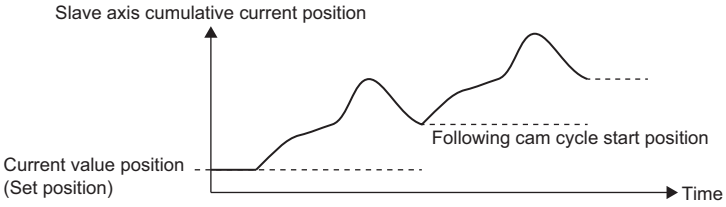


■Slave axis absolute coordinate

The following explains the operation based on Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

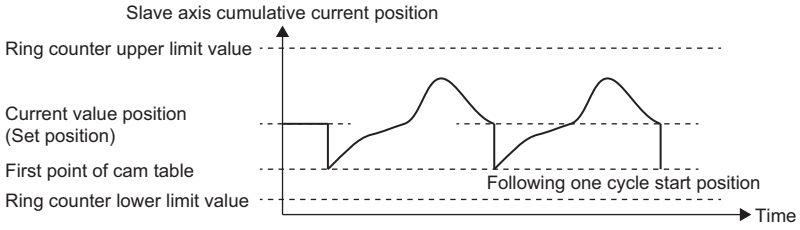
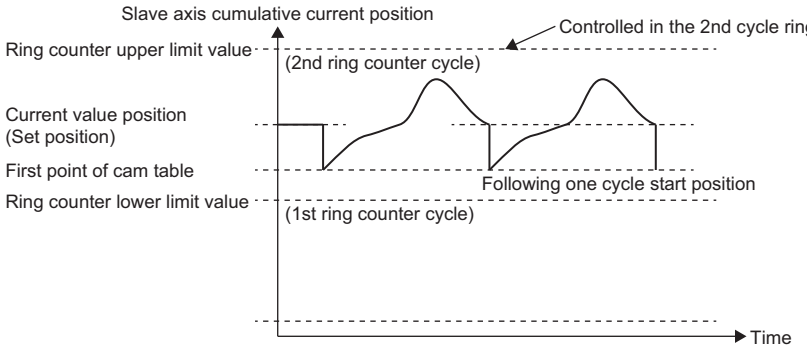
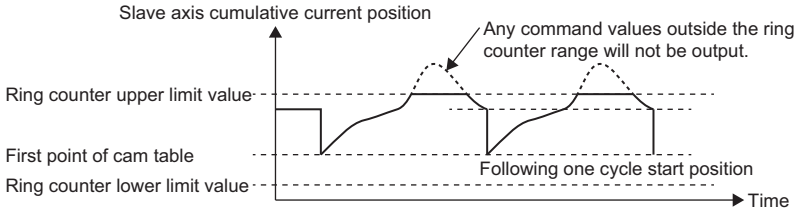
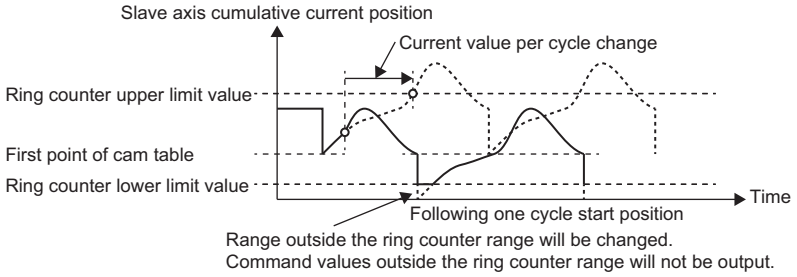
• "0: Relative coordinate" is specified to Slave axis absolute coordinate (SlaveAbsolute).

When In synchronization (InSync) becomes TRUE, the slave axis starts the operation of the cam table from the current position (set position). When Periodic (Periodic) of the cam table is set to "TRUE: Periodic", after one cycle of the cam table has completed, the next cycle starts from the stroke position (set position) where the last cycle completed.



• "1: Absolute coordinate" is specified to Slave axis absolute coordinate (SlaveAbsolute).

The cam is operated within the ring counter range including current values of Slave axis (Slave) at the point when In synchronization (InSync) becomes TRUE. The command is output in one operation cycle to return the set position of Slave axis (Slave) to the start point of the cam table when In synchronization (InSync) and Cam cycle completion (EndOfProfile) become TRUE. If the command at this time is too large, the position command and velocity command to the drive unit also become too large, causing the servo alarm [AL. 035_Command frequency error] for the MR-J5(W)-G. Values are output so that the set position of Slave axis (Slave) is always within the ring counter range.

Status	Operation
When the stroke range is within the ring counter range of slave axis	
When the stroke range is within the ring counter range of slave axis (Cam started on the second cycle)	
When the stroke range is outside the ring counter range of the slave axis	
When current value per cycle is changed	When changing the current value per cycle, to compensate the Reference value (Reference) so that the Slave axis (Slave) does not operate, any range outside of the ring counter range will be changed. When Slave axis (Slave) has moved and the current value per cycle has changed, change Master axis offset (MasterOffset). 

■Length per cycle

Set the input amount that is required for one cycle. For details, refer to the following.

☞ Page 813 Current value per cycle (InputPerCycle)

■Stroke amount

Set the stroke amount corresponding to its ratio 100%. For details, refer to the following.

☞ Page 814 Output value (MC_CamIn.OutputData)

■Start point and Initial stroke amount

Start point used for cam operation and the Initial stroke amount will differ depending on the interpolation method specification.

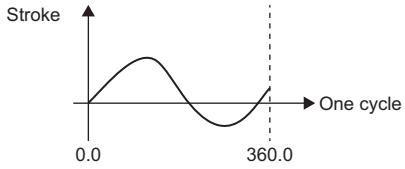
Interpolation method specification	Cam operation start point	Initial stroke amount for cam operation
0: Linear interpolation	Input value of the cam table first point	Output value of the cam table first point
1: Section interpolation	Start point (StartPoint) of the cam table first point	Initial stroke amount (StartStroke) of the cam table
2: Spline interpolation		

- Cam operation start point

Operates so that Current value per cycle (InputPerCycle) is "0".

- Cam table

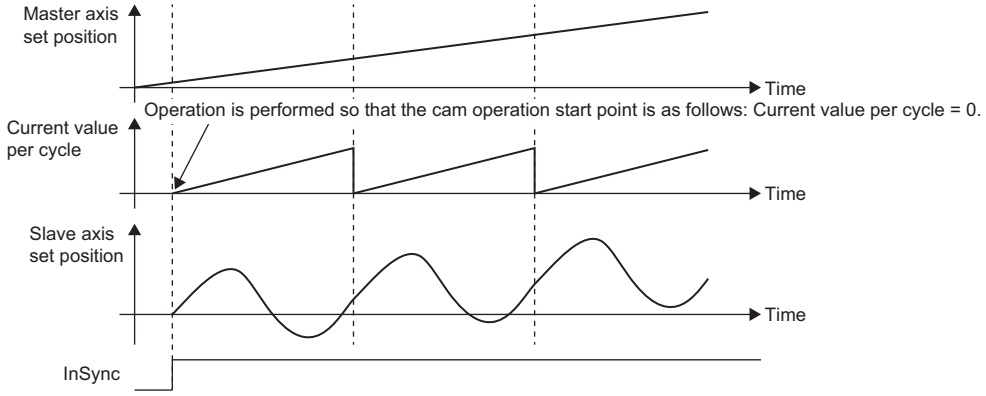
■Cam (1) (Cam operation start point "0.0")



- Interpolation method: Section interpolation
- Length per cycle: 360.0
- Start point: 0.0
- Initial stroke amount: 0.0

- Cam operation

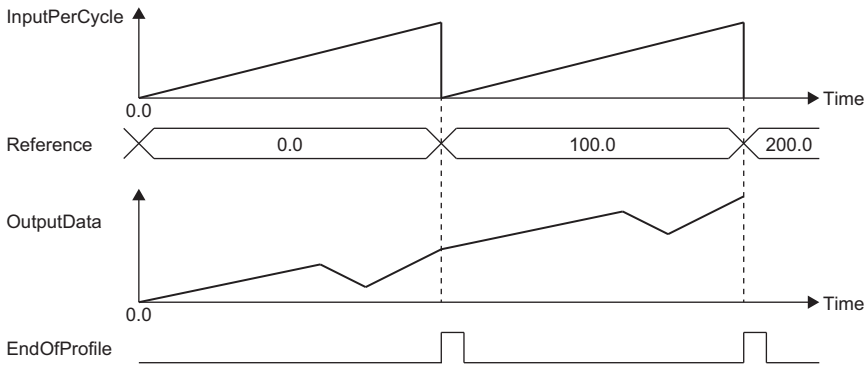
The operation is as follows.



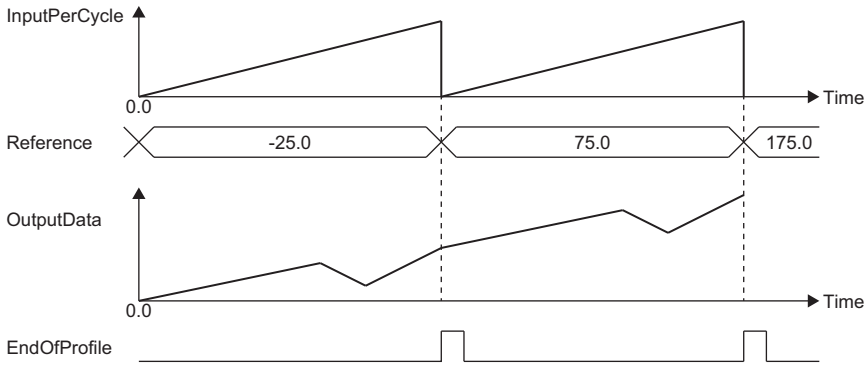
• Initial stroke amount for cam operation

Operates so that it becomes the Output value (OutputData) at the start of synchronization. Because the initial stroke amount of the cam operation stops the slave axis from operating, the initial stroke amount is subtracted from Reference value (Reference).

■When Initial stroke amount of cam operation is "0.0"



■Initial stroke amount of cam operation is "25.0"



Monitor data during cam operation

During MC_CamIn (Cam Operation Start) control, the current value per cycle, the reference value, and the output value can be monitored through Current value per cycle (InputPerCycle), Reference value (Reference), and Output value (OutputData).

Name	Variable name	Data type	Refresh cycle
Current value per cycle	InputPerCycle	LREAL	Execution cycle of POU (abbreviation for Program Organization Unit) that calls the FB
Reference value	Reference	LREAL	
Output value	OutputData	LREAL	
Instance ID	InstanceID	WORD(UINT)	

■Current value per cycle (InputPerCycle)

The initial value is "0".

The movement amount of Master axis (Master) is reflected after Controlling (Active) turns TRUE as follows.

Current value per cycle = (Cumulative movement amount of the master axis - Master axis offset + Current value change per cycle) MOD Length per cycle

The monitor value range is "0 ≤ Current value per cycle (MC_CamIn.InputPerCycle) < (Length per cycle × Master axis scaling)"

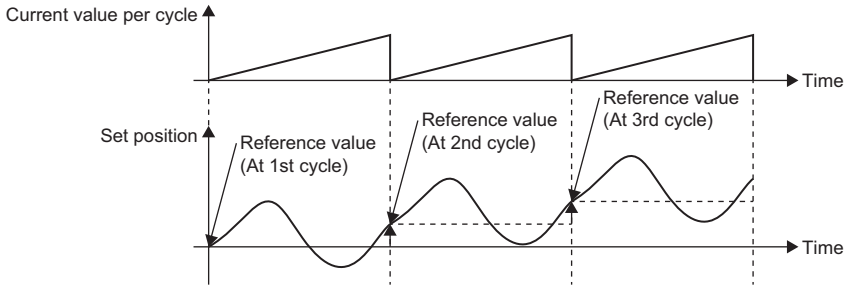
■Reference value (Reference)

When MC_CamIn (Cam Operation Start) is executed, the value is calculated from the cam position for start (current value per cycle) based on the set position where In synchronization (InSync) becomes TRUE. The formula for initial value is as follows because the Initial stroke amount during cam table is subtracted.

Slave axis absolute coordinate (SlaveAbsolute)	Calculation formula
FALSE: Relative coordinate	Reference value = Slave axis position when synchronization starts - (Stroke value based on the cam position (current value per cycle) when In Synchronization (InSync) changes to TRUE + the initial stroke amount) × Slave axis scaling
TRUE: Absolute coordinate	Reference value = The set position corresponding to the cumulative current position being 0 when In synchronization (InSync) changes to TRUE.

When Two-way cam operation, or Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate", the reference value is not updated. When Slave axis absolute coordinate (SlaveAbsolute) is "FALSE: Relative coordinate" with feed cam operation, the reference value is calculated as shown below.

Calculation formula
Reference value = (Original reference value + (Stroke value at the last point - Stroke value at the first point) × Slave axis scaling)



Reference value is updated at the following timing

Update timing	Calculation formula of reference value
When Current value per cycle (InputPerCycle) passes the last point of cam table in the address increasing direction	Original reference value + ((Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)
When Current value per cycle (InputPerCycle) passes the first point of cam table in the address decreasing direction	Original reference value - ((Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)
When changing current value per cycle (MCv_ChangeCycle (Current Value Change per Cycle) completion (Done) is TRUE.)	Original reference value - (Stroke value corresponding to current value per cycle after change × Slave axis scaling)

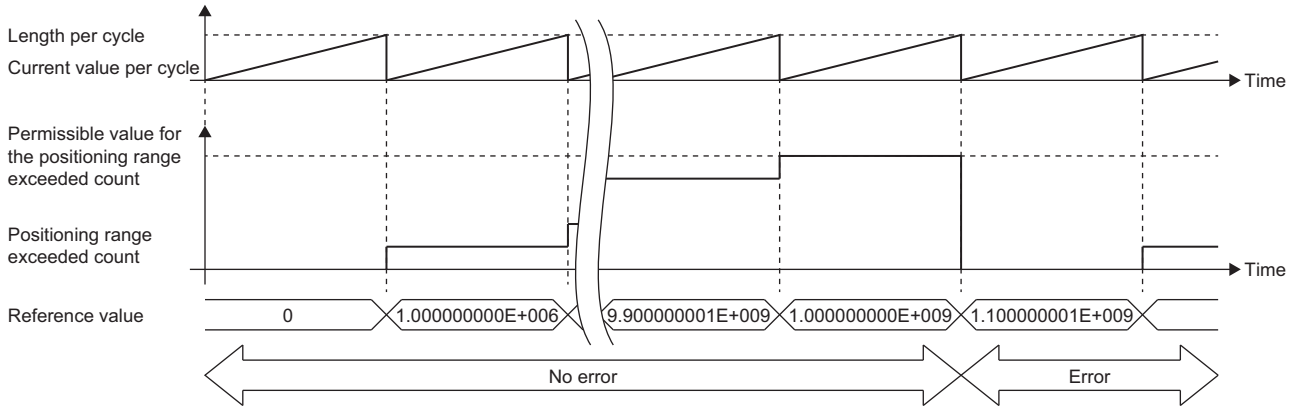
Restriction

<For the reference value error>

Any of the following operation may cause the error of reference value.

• Condition 1: If the number of times that TRUE is output for Cam cycle completion (EndOfProfile) exceeds the permissible value after In synchronization (InSync) becomes TRUE with feed cam

While an error does not occur if the positioning range exceeded count is less than the permissible value for the positioning range exceeded count, an error may occur if the permissible value is exceeded. (The operation is maintained regardless of the operation error occurrence or not.)



• Condition 2: When the following control parameter includes a decimal with feed cam

(1) Stroke value at the last point - Stroke value at the first point

(2) Slave axis coefficient

• Condition 3: When changing current value per cycle is repeated in relative specification

When the reference value error becomes too large, clear the synchronization status or reset it by executing current value change of absolute position specification.

For the error, refer to the following.

☞ Page 496 Positioning Range

The permissible value for the positioning range exceeded count is a variable value calculated with the following formula.

Permissible value for the positioning range exceeded count = Limit value for the positioning range exceeded count / ((Output value at the last point - Output value at the 1st point) /slave scaling)

* The limit value for the positioning range exceeded count is the upper limit value of the positioning range, "10000000000".

(Example)

When the output value at the 1st point is "0", the output value at the last point is "1000000", and the output coefficient is "10", the permissible value for the positioning range exceeded count becomes "100000".

The monitor value range is shown below.

• Ring counter lower limit value of the slave axis ≤ Reference value < Ring counter upper limit value of the slave axis

■Output value (MC_CamIn.OutputData)

The initial value is the initial stroke amount during cam table. For details, refer to the following.

☞ Page 811 Start point and Initial stroke amount

While In synchronization (InSync) is TRUE, the value is calculated as shown below.

Output value = Reference value + ((Stroke amount × Stroke ratio corresponding to the current value per cycle) × Slave axis scaling) + Slave axis offset

or

Output value = Reference value + (Output value corresponding to the current value per cycle) × Slave axis scaling) + Slave axis offset

The monitor value range is shown below.

• Ring counter lower limit value of the slave axis ≤ Output value < Ring counter upper limit value of the slave axis

Precautions

- Changing Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), and Cam table ID (CamTableID) may give impact to the machine because the slave axis moves suddenly at the start of control or at control change. It is important to carefully check the setting values and the change timing.
- When the axis being cam controlled is monitored with the engineering tool, the position, velocity, and other units are based on the unit setting of the axis. Units for the length per cycle and stroke amount set in the operation profile data are not used.

31.8 Gear Operation

This function sets the speed ratio between the master axis and the slave axis, and starts gear operation.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

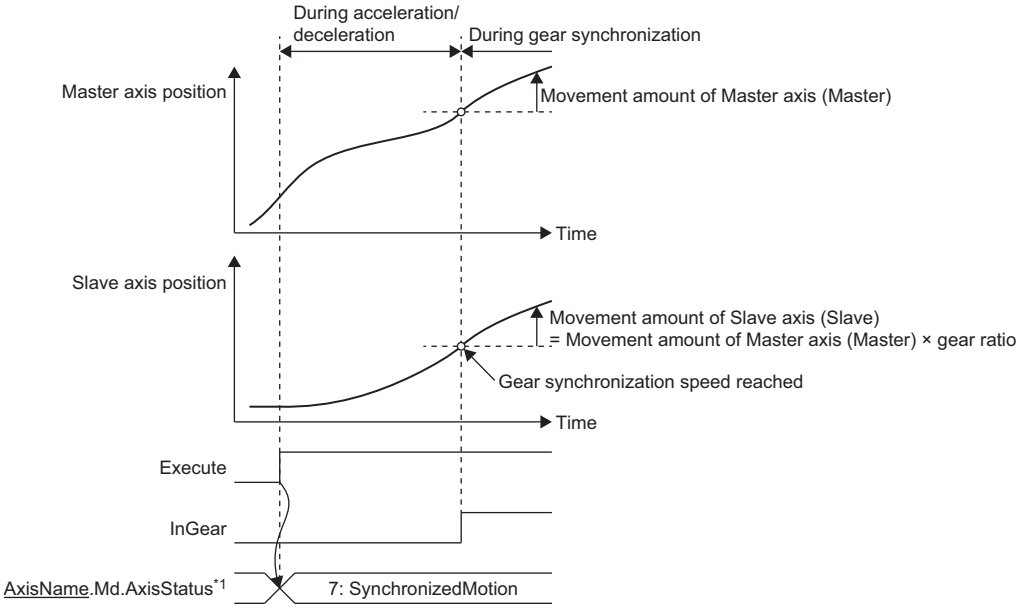
Motion control FB	Name	Description
MC_GearIn	Gear operation start	Gear operation starts according to the specified gear ratio.

Control details

In the MC_GearIn (Gear Operation Start), Gear ratio numerator (RatioNumerator), Gear ratio denominator (RatioDenominator), Master axis data source selection (MasterValueSource), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode) are set and the gear operation starts.

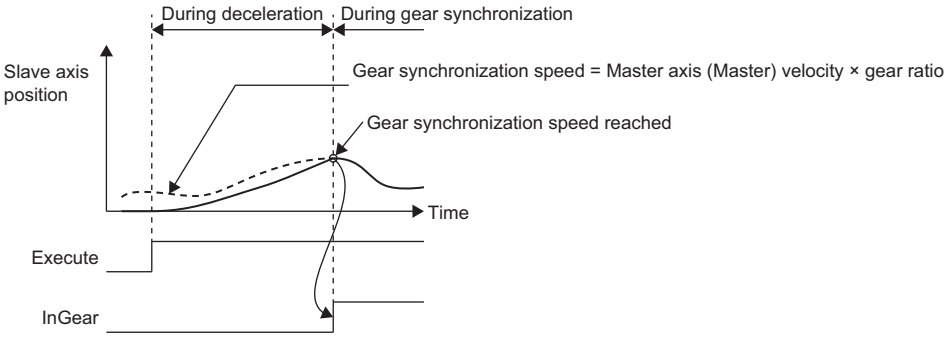
To stop the operation, execute MC_Stop (Forced Stop).

After executing this FB, Slave axis (Slave) performs acceleration/deceleration until reaching the gear synchronization speed, the value of which is the velocity of Master axis (Master) converted by the gear ratio. After reaching the gear synchronization speed, Gear ratio reached (InGear) becomes TRUE, and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.



*1 This is the state of Slave axis (Slave).

- When the speed of Master axis (Master) is changed during acceleration/deceleration, the gear synchronization speed is also updated.



Acceleration/deceleration until reaching the gear synchronization speed

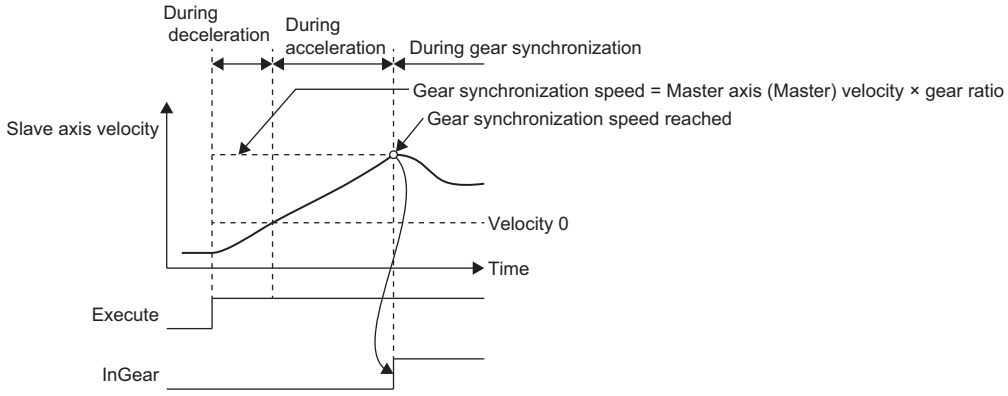
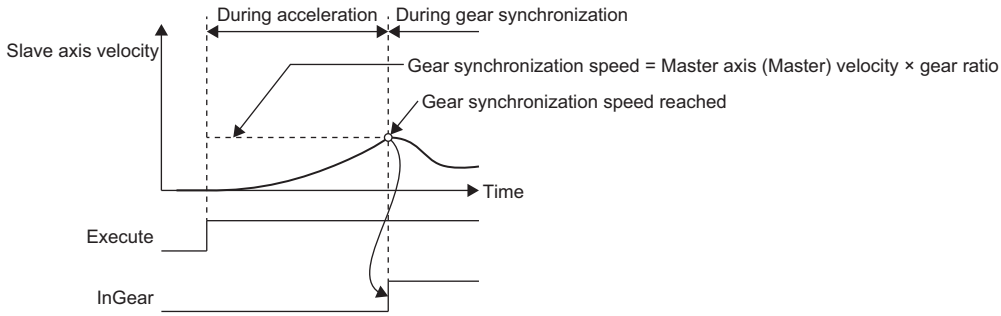
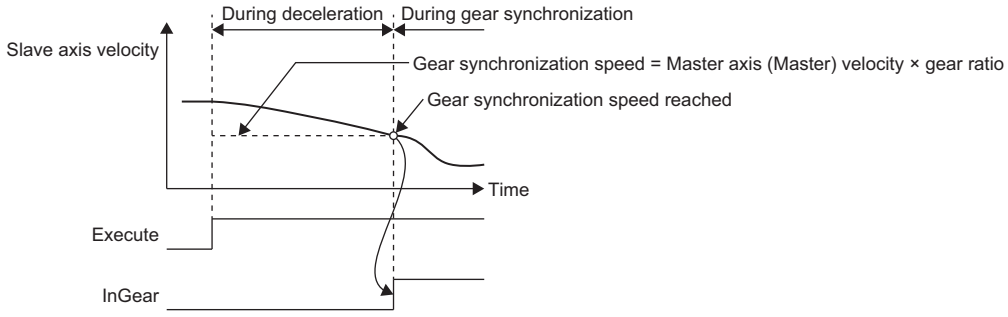
- The acceleration/deceleration method for MC_GearIn (Gear Operation Start) is the acceleration/deceleration specification method.

For details on the operation of the acceleration/deceleration specification method, refer to the following.

☞ Page 1078 Acceleration/Deceleration Processing Function

- Depending on the velocity of Slave axis (Slave) and the gear synchronization speed at operation start, one of the following four types of acceleration/deceleration is performed.

The type of acceleration/deceleration will not change even if the gear synchronization speed is updated during the acceleration/deceleration.

Velocity of Slave axis (Slave) and gear synchronization speed	Acceleration/deceleration operation
Velocity of Slave axis (Slave) < 0 < Gear synchronization speed or Velocity of Slave axis (Slave) > 0 > Gear synchronization speed	Deceleration is performed to velocity 0, then acceleration is performed from velocity 0 to the gear synchronization speed. 
Velocity of Slave axis (Slave) (Absolute value) < Gear synchronization speed (Absolute value)	Acceleration is performed until reaching the gear synchronization speed. 
Velocity of Slave axis (Slave) (Absolute value) > Gear synchronization speed (Absolute value)	Deceleration is performed until reaching the gear synchronization speed. 
Velocity of Slave axis (Slave) = Gear synchronization speed	Acceleration/deceleration is not performed. After operation is started, Gear ratio reached (InGear) becomes TRUE immediately and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.

Precautions

- When the gear ratio is changed, the speed of the slave axis is changed directly. To smooth the speed change, use with MCv_SmoothingFilter (Smoothing Filter).
- When the velocity of Master axis (Master) after conversion exceeds the acceleration/deceleration upper limit value during acceleration/deceleration operation, Acceleration Time Limit Over Warning (event code: 00D04H) or Deceleration Time Limit Over Warning (event code: 00D05H) will occur, the acceleration/deceleration operation is stopped, and the operation is restarted and continued at the velocity in the warning detection.

If the above warning occurs, adjust and set Master axis (Master) speed after conversion, Acceleration (Acceleration), or Deceleration (Deceleration) to not exceed the acceleration/deceleration upper limit value to restart the acceleration/deceleration operation.

31.9 Addition/Subtraction Positioning

This function combines the movement amount of two axes and transmits.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_CombineAxes	Addition/subtraction positioning	The value obtained by adding or subtracting the movement amount of the specified two master axes is set as the set position, and the positioning is executed.

Control details

In MC_CombineAxes (Addition/Subtraction Positioning), Addition/subtraction method selection (CombineMode), Master axis 1 gear ratio numerator (GearRatioNumeratorM1), Master axis 1 gear ratio denominator (GearRatioDenominatorM1), Master axis 2 gear ratio numerator (GearRatioNumeratorM2), and Master axis 2 gear ratio denominator (GearRatioDenominatorM2), Master axis 1 data source selection (MasterValueSourceM1), Master axis 2 data source selection (MasterValueSourceM2), and Buffer mode (BufferMode) are set and the addition/subtraction positioning is executed.

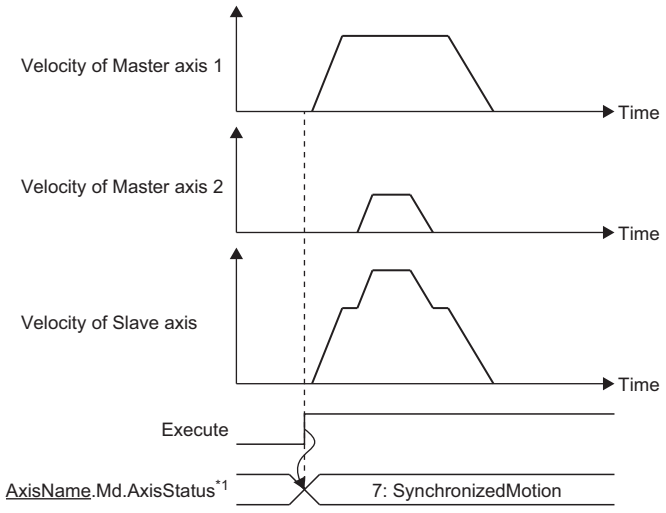
To stop the operation, execute MC_Stop (Forced Stop).

The movement amount of Master axis 1 (Master1) and Master axis 2 (Master2) is combined. Also, gear ratio can be set to each master axis.

Regarding the combined movement amount, addition or subtraction is performed on the value regardless of the unit of Master axis 1 (Master1) and Master axis 2 (Master2).

When CombineMode is set to "0: Add positions of 2 input axes (mcAddAxes)"

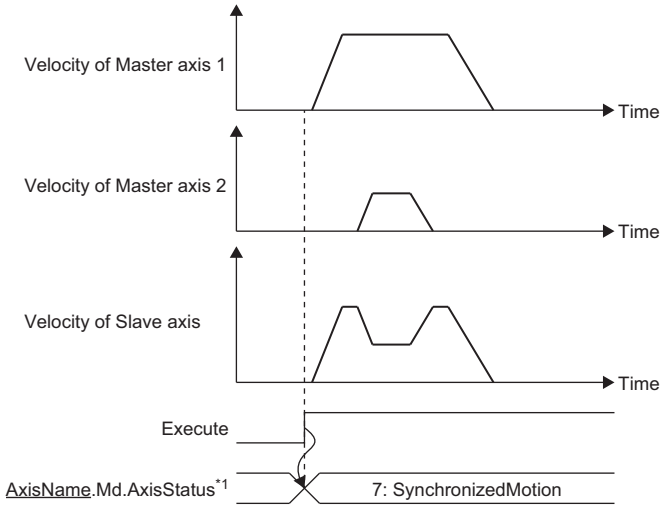
Movement amount of Slave axis (Slave) = Movement amount of Master axis 1 (Master1) + Master axis 2 (Master2)



*1 This is the state of Slave axis (Slave).

When CombineMode is set to "1: Subtract positions of 2 input axes (mcSubAxes)"

Movement amount of Slave axis (Slave) = Movement amount of Master axis 1 (Master1) - Master axis 2 (Master2)



*1 This is the state of Slave axis (Slave).

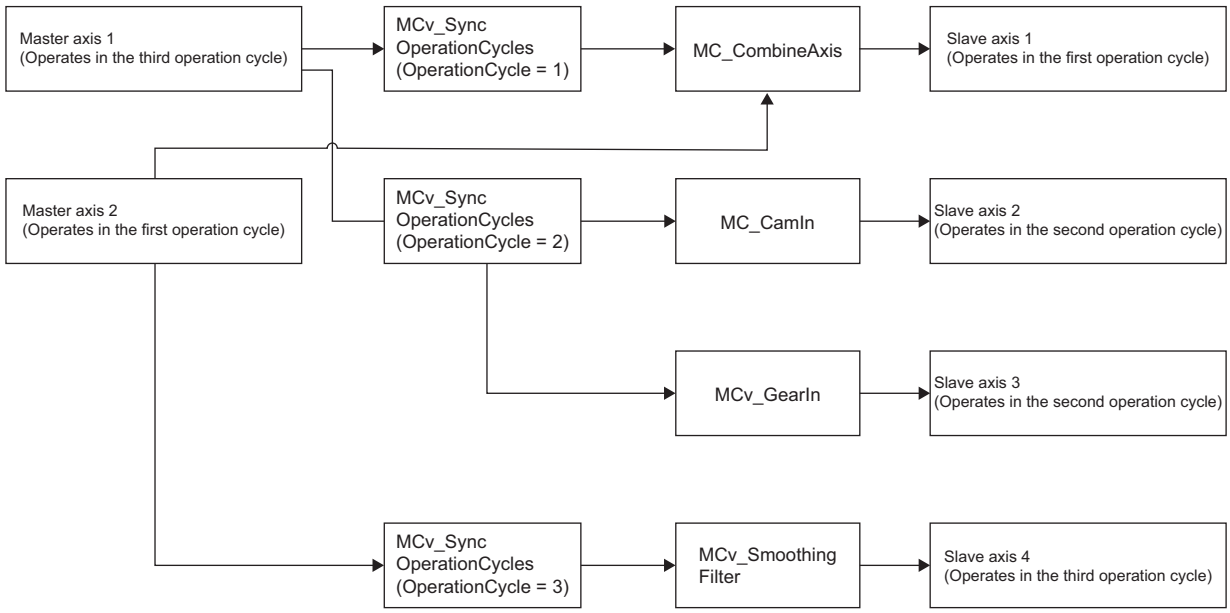
31.10 Precautions

When the operation cycle coexistence function is used, the following restrictions are applied if the control operation cycle settings for the master axis and slave axis are different.

- The control operation cycle of the master axis must be synchronized with that of the slave axis using Synchronize Control Operation Cycle (MCv_SyncOperationCycles) in addition to the synchronous control FB. If synchronous control is performed without using Synchronize Control Operation Cycle (MCv_SyncOperationCycles), Operation cycle mismatch (error code: 1B29H) occurs.
- Set the control operation cycle of the master axis to the Axis information (Axis) of Synchronize Control Operation Cycle (MCv_SyncOperationCycles), and the control operation cycle of the slave axis to Control Operation Cycle (OperationCycle). If the Control Operation Cycle (OperationCycle) settings and the control operation cycle of the slave axis are different, Operation cycle mismatch (error code: 1B29H) will occur when synchronous control is started.

Ex.

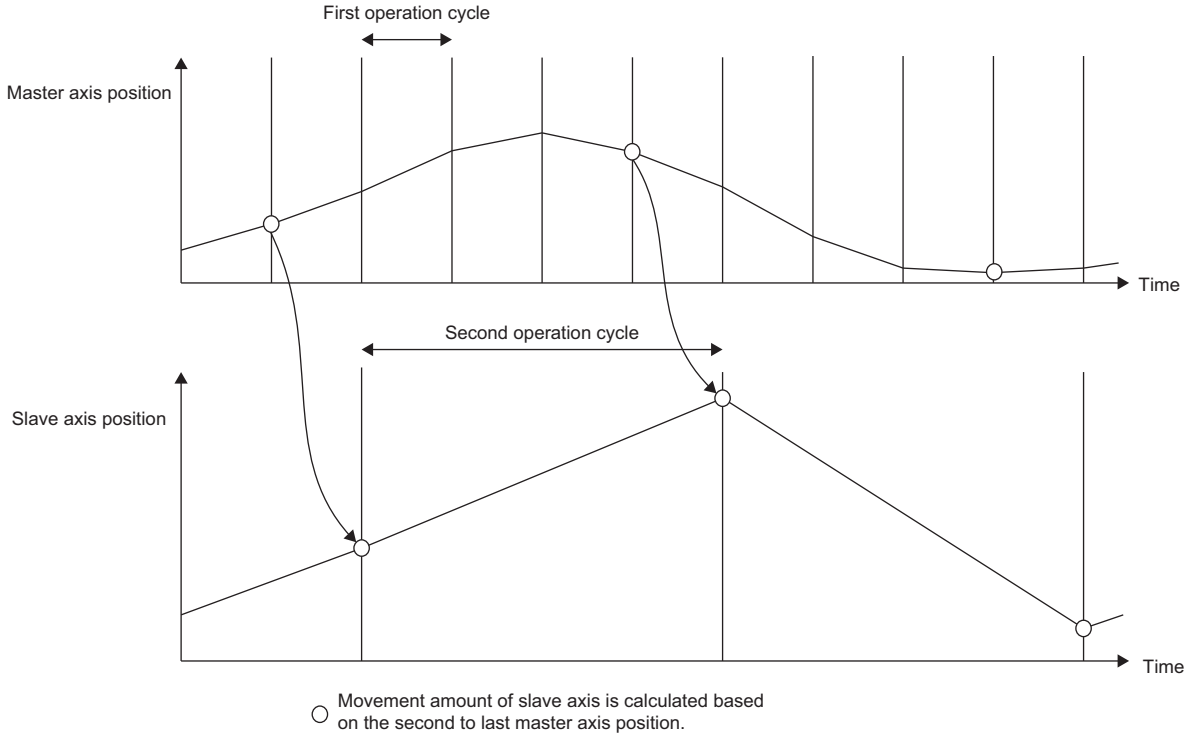
For synchronous control between the axes with different control operation cycles



- Enable Synchronize Control Operation Cycle (MCv_SyncOperationCycles) of the master axis before starting synchronous control. If synchronous control is started before Synchronize Control Operation Cycle (MCv_SyncOperationCycles) is enabled, the input values of the master axis will not be updated.
- Do not switch the enable/disable state of Synchronize Control Operation Cycle (MCv_SyncOperationCycles) of the master axis during synchronous control. If switched, the slave axis may stop suddenly or move abruptly. When not In synchronous control, Synchronize Control Operation Cycle (MCv_SyncOperationCycles) of the master axis can be disabled.
- Master axis data source selection (MasterValueSource) of the synchronous control FB cannot be set to "101: Latest Set Value (mcLatestSetValue)" or "102: Latest Actual Value (mcLatestActualValue)". Either set "1: Set Value (mcSetValue)" or "2: Actual Value (mcActualValue)". If any other value is set, Out of master axis data source range (error code: 1AB6H) occurs.
- When the synchronous control FB with axes having different operation cycles as input and output is connected, there will be a significant delay until the input of the master axis is transmitted to the output of the slave axis.
- If the operation cycle of the slave axis is slower than that of the master axis, the movement amount of the slave axis is calculated based on the operation result of the master axis from the previous cycle. The movement amount of the slave axis will be calculated as the time interval of the slower operation cycle.

Ex.

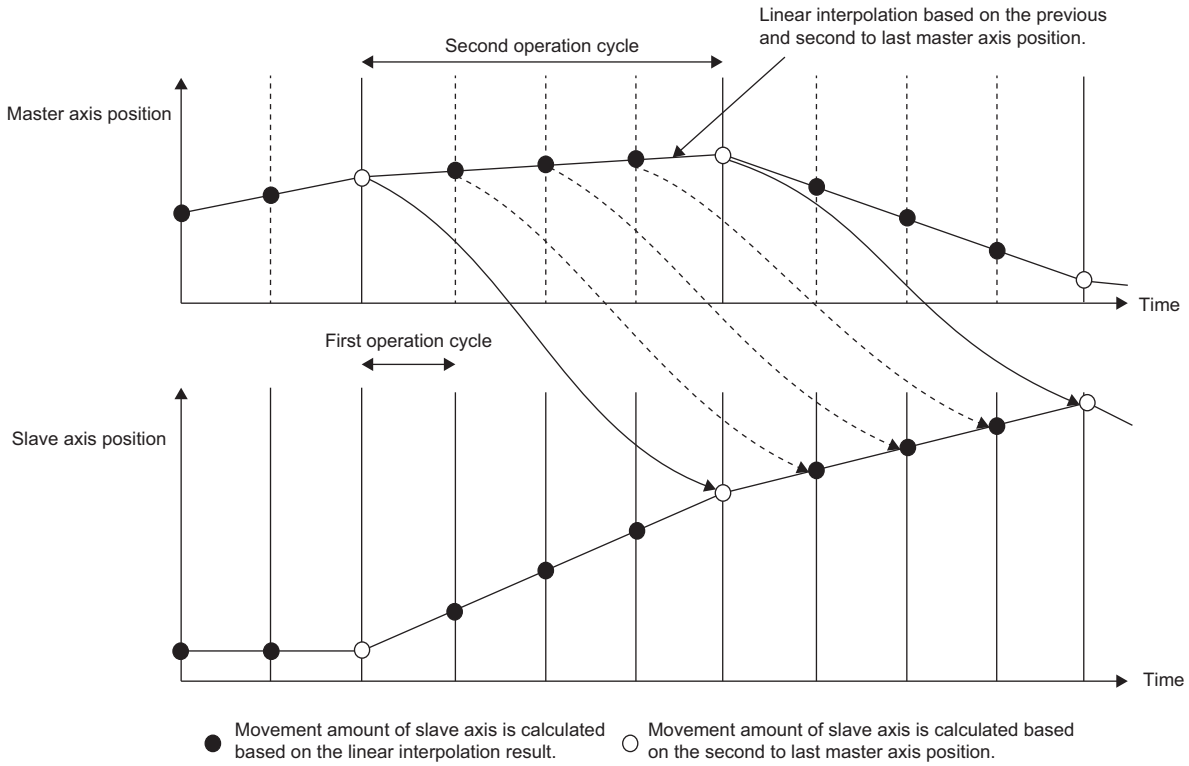
When MC_GearIn (Gear Operation Start) is executed



- If the operation cycle of the slave axis is faster than that of the master axis, the movement amount of the slave axis is calculated based on the operation result of the master axis from the previous cycle and the cycle before that. The movement amount of the slave axis will be calculated as the time interval of the faster operation cycle. To suppress the sudden speed changes in the slave axis, the operation results of the master axis are automatically linearly interpolated and input to the slave axis. There is a delay equivalent to the slower operation cycle before the input from the master axis is transmitted to the slave axis.

Ex.

When MC_GearIn (Gear Operation Start) is executed



Relevant add-ons

The following add-ons are required to use the synchronous control function.

- ProfileControl
- MotionControl_Sync
- MotionEngine
- Axis
- MotionControl_General

32 OPERATION PROFILE DATA FUNCTION

This function performs opening profile for the cam and reading/writing for the cam.

32.1 Operation Profile Data

Waveform data used for control is collectively called operation profile data.
This section describes how to create and use operation profile data.

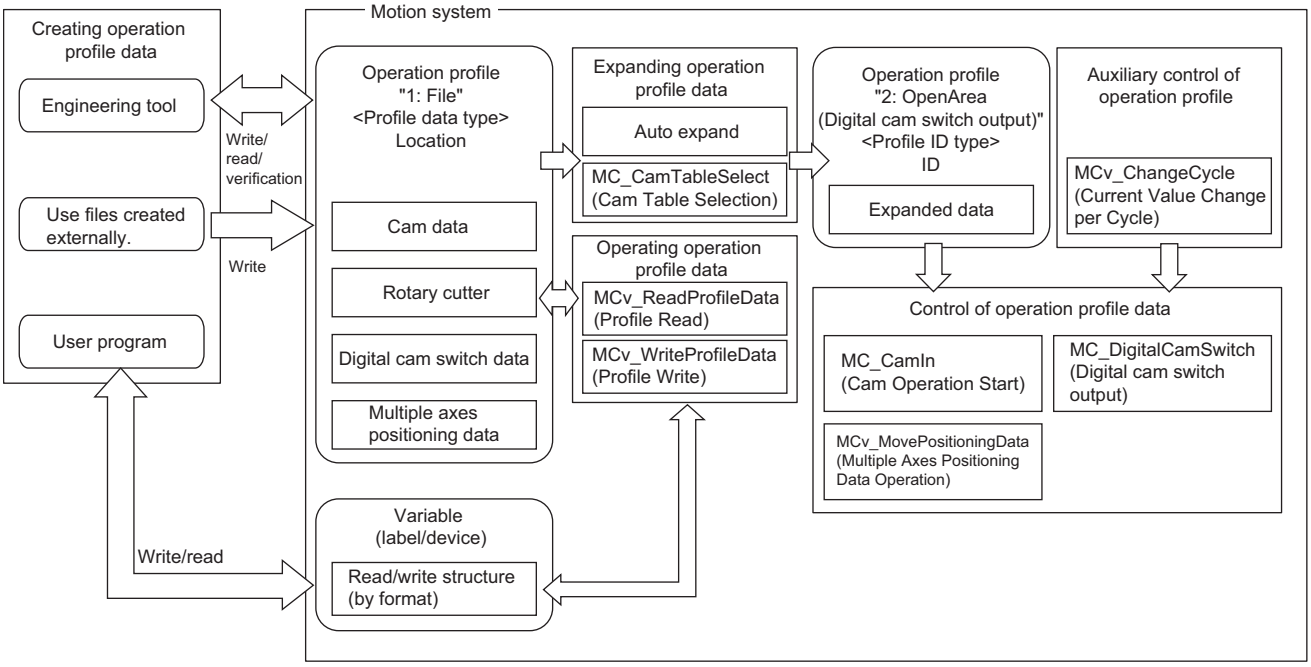
Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Overall block diagram

The following diagram shows the relevancy between the data from creating to using of operation profile data and the motion control FB about operation profile data used in various functions (e.g. the cam of single axis synchronous control).



Relevant variables

PROFILE_DATA

Variable/structure name	Name	Details
Location	Operation Profile Data Storage Location	Sets the file name and storage location of the operation profile data. FILE_LOCATION type
ID	Profile ID	Sets the number for the profile ID of the operation profile data. PROFILE_ID type

FILE_LOCATION

Variable/structure name	Name	Details
FileName	File Name	Specifies a file name. (63 characters including the extension can be set.)*1
Path	Folder Specification	Specifies the folder path in which the file is stored. (Up to 63 characters can be set.)*1*2

*1 Set a total of up to 127 characters (including null string) for File name (FileName) and Folder specification (Path).
*2 The root path when specifying the relative path is %CALC_PROFILE_ROOT%.

Point

- Make sure the folder path does not exceed the maximum number of characters for the folder path.
- Make sure the file name does not exceed the maximum number of characters for the file name.

PROFILE_ID

Variable/structure name	Name	Details
Number	Profile ID No.	Sets the Profile ID No. • 0 to 60000
StartIO	I/O number	Sets the I/O number.

INSTANCE_ID

Variable/structure name	Name	Details
Number	Instance ID No.	Sets the number for the instance ID

System Parameter Constant (MotionSystem.PrConst.)

Variable/structure name	Name	Details
ProfileRootDrive	Operation profile data root drive	Sets the drive to save the operation profile data.

Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_CamTableSelect	Cam table selection	Stores the specified operation profile data (cam data) in the open area.
MCv_ReadProfileData	Profile read	Reads the specified operation profile data from the open area or the file.
MCv_WriteProfileData	Profile write	Writes the specified operation profile data to the open area or the file.
MCv_ChangeCycle	Current value change per cycle	Changes the current value per cycle of the specified operation profile data control FB.

Operation profile data types

For the function to use operation profile data, there is an operation profile data format that supports the corresponding function. The following shows operation profile data format and I/O data that can be used for each function.

Function (Operation profile data control)	Operation profile data format	Input data	Output data	Operation profile data open
Cam operation (MC_CamIn (Cam Operation Start))	Cam data Rotary cutter	Master axis position (selected with MC_SOURCE)	Slave axis position	Auto expand*1 Write operation profile data*2 MC_CamTableSelect (Cam Table Selection)
Multiple axes positioning data operation (MCv_MovePositioningData (Multiple Axes Positioning Data Operation))	Multiple axes positioning data	Positioning data No.	Set position of axes group configuration axis	Auto expand*1 Write operation profile data*2
Digital cam switch output (MC_DigitalCamSwitch (Digital Cam Switch Output))	Digital cam switch data	Any data	Digital output (0 or 1)	Auto expand*1 Write operation profile data*2
Advanced synchronous control (MCv_AdvancedSync (Advanced Synchronous Control))	Cam data Rotary cutter	Master axis position, sub input axis, sub axis position (selected with MC_SOURCE)	Slave axis position	Auto expand*1 Write operation profile data*2 MC_CamTableSelect (Cam Table Selection)
Advanced synchronous control current position per cycle calculation (MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation))	Cam data Rotary cutter	• Ring counter upper limit • Cam start point • Length per cycle • Stroke amount • Current position per cycle • Cam reference position • Cam set position	Current position per cycle	Auto expand*1 Write operation profile data*2 MC_CamTableSelect (Cam Table Selection)
Advanced synchronous control cam set position calculation (MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation))	Cam data Rotary cutter	• Ring counter upper limit • Cam start point • Length per cycle • Stroke amount • Current position per cycle • Cam reference position • Cam set position	Cam set position	Auto expand*1 Write operation profile data*2 MC_CamTableSelect (Cam Table Selection)

*1 When "Auto Expand" is set with the engineering tool.

*2 The profile is open by executing MCv_ReadProfileData (Profile Read) (file specification), followed by executing MCv_WriteProfileData (Profile Write) (open area specification).

Cam data

The relationship of output values (slave axis position) to input values (master axis position) is defined as the cam data.
The following interpolation methods can be selected as the cam data.

Interpolation method specification (Interpolate)	Description
0: Linear interpolation	Create cam data that specifies the input value (master axis position) and the output value (slave axis position) of each point and interpolates each point with straight lines.
1: Section interpolation	Create cam data that specifies the input value (master axis position), stroke, and cam curve type of each point and interpolates each point with the specified curve line.
2: Spline interpolation	Create cam data that specifies the input value (master axis position) and stroke of each point and performs spline interpolation of each point.

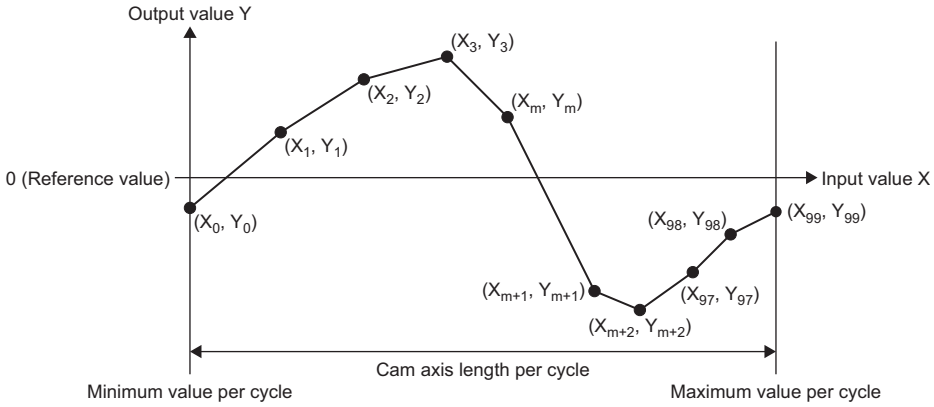
Required data for the setting differs depending on the selected interpolation method. Refer to the following.
◎: Necessary, ○: Optional, —: Unnecessary

Setting item		Interpolation method specification (Interpolate)		
		0: Linear interpolation	1: Section interpolation	2: Spline interpolation
Profile ID		○	○	○
Interpolation method specification		◎	◎	◎
Resolution/number of coordinates		◎	◎	◎
Input unit character string		○	○	○
Output unit character string		○	○	○
Start point		—	◎	◎
Initial stroke amount		—	◎	◎
Initial velocity		—	○	—
Initial acceleration		—	○	—
I/O data		◎	—	—
Parameter	Cam curve type	—	◎	—
	End point	—	◎	◎
	Stroke	—	◎	◎
	Curve applicable range	—	○	—
	Acceleration/ deceleration range compensation	—	○	—
	End point velocity	—	○	—
	End point acceleration	—	○	—
Length per cycle		◎	◎	◎
Minimum value per cycle		◎	—	—
Maximum value per cycle		◎	—	—
Time per cycle		—	○	—
Stroke amount		◎	◎	◎

■Interpolation method specification (Interpolate)

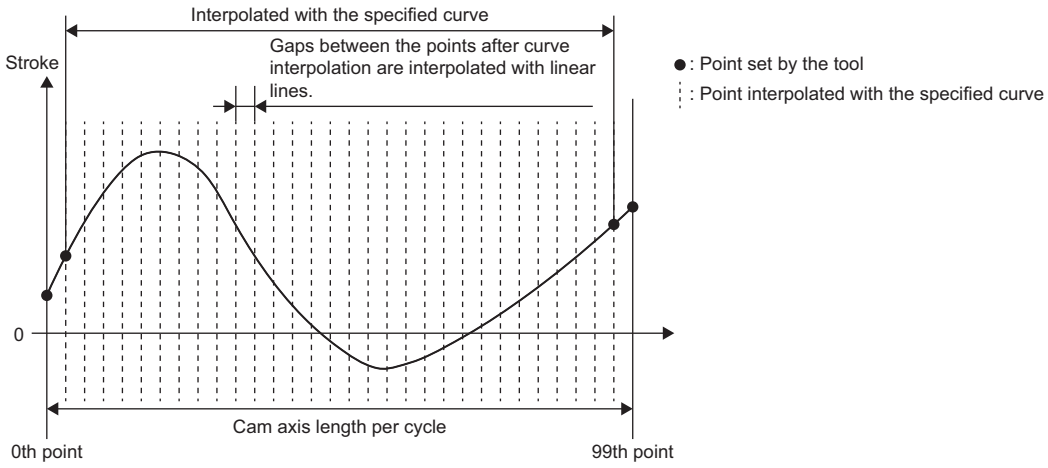
- 0: Linear interpolation

  The stroke data of each point data that is defined for a cam curve per cycle with two or more points (data of a pair of current value per cycle and stroke) is opened in the open area.



- 1: Section interpolation

  Gaps between the points are interpolated with the specified curve, and the stroke data that is defined after equally dividing a cam curve per cycle by points of the cam resolution (data of a pair of current value per cycle and stroke) is opened in the open area.



Point

If the number of I/O data is not enough for the set resolution, cam data that is equally divided after interpolating the data in shortage according to the line set by the curve specification will be created.

- 2: Spline interpolation

  Gaps between the points are spline interpolated, and the stroke data that is defined after equally dividing a cam curve per cycle by points of the cam resolution (data of a pair of current value per cycle and stroke) is opened in the open area.

■Profile ID

It is a unique ID assigned by an open instruction.

The ID opened by the MC_CamTableSelect (Cam Table Selection) can be used in the control instruction (MC_CamIn (Cam Operation Start)) as the MC_CAM_ID type. ID can be specified with an arbitrary No.

■Resolution/number of coordinates

Set the number of divisions for a cam curve for one cycle.

Set the number of data including the 0th point.

■Input/output unit character string

Set a unit of the input/output data with an arbitrary character string.

It is handled as a [pulse] when it is omitted. Also, when "%" is specified in the output unit character string, the control that the cam stroke amount is 100% is carried out.

Point

When a unit other than "%" is specified, it is not used in the control. It is used only in monitoring.

■Start point

Set "0.0".

When a value other than "0.0" is set, Operation profile data incorrect (error code: 1B8FH) occurs.

■Initial stroke amount

Set the stroke amount for the start point.

When the output unit character string is "%", it will be a value corresponding to the 100% of stroke ratio.

■Initial velocity/End point velocity

Set the velocity at the start point/end point.

Use when cam curve type is set to 5th Curve (Adj.).

The unit for setting value is [pulse/s] when output unit string is [pulse].

The unit for setting value is [output unit character string/min] when output unit string is other than [pulse].

Ex.

When output unit string is [degree]

The unit for setting value is [degree/min].

■Initial acceleration/End acceleration

Set the acceleration at the start point/end point.

Use when cam curve type is set to 5th Curve (Adj.).

The unit for setting value is [pulse/s^2] when output unit string is [pulse].

The unit for setting value is [output unit string/min^2] when output unit string is other than [pulse].

Ex.

When output unit string is [degree]

The unit for setting value is [degree/min^2].

■Length per cycle

Set the input amount that is required for one cycle.

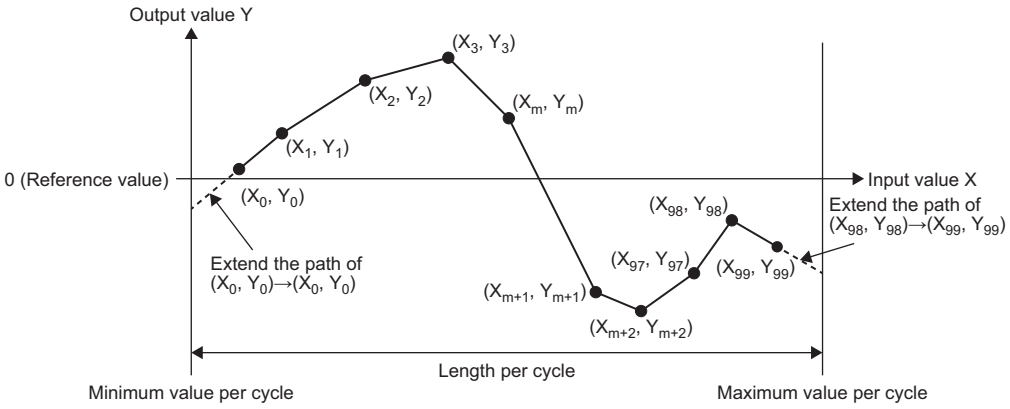
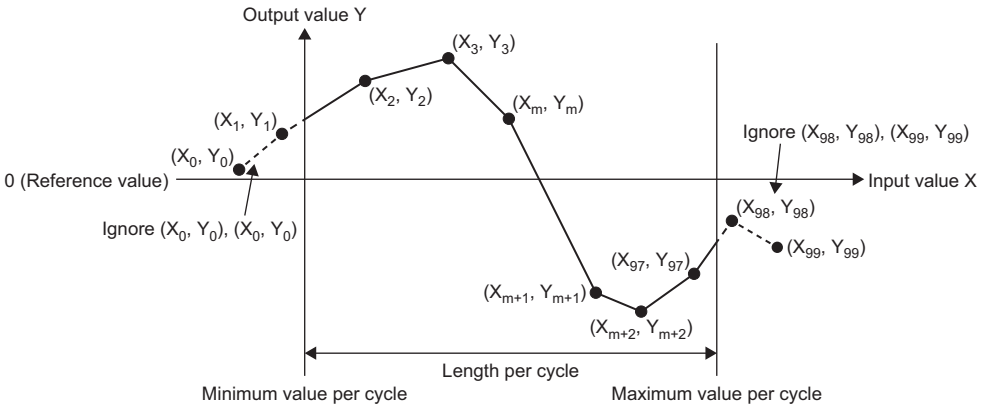
■Maximum value per cycle/Minimum value per cycle

Set the maximum/minimum value per cycle.

It is valid only when Interpolation Method Specification (Interpolate) is "0: Linear Interpolation".

Set "0" to minimum value per cycle. When a value other than "0" is set, Operation profile data incorrect (error code: 1B8FH) occurs.

When Interpolation Method Specification (Interpolate) is "0: Linear interpolation", the operation profile data is as follows depending on the coordinate data.

Coordinate data	Description
Minimum value per cycle < Minimum value of input Maximum value of input < Maximum value per cycle	The control is performed with a line segment created from the coordinates of the nearest two points. (Example) When the resolution is "100" 
Minimum value of input < Minimum value per cycle Maximum value per cycle < Maximum value of input	Ignores the coordinate data of outside range of minimum value per cycle to maximum value per cycle. (Example) When the number of point data is "100" 

■Time per cycle

Set time that is required for one cycle.

Use when cam curve type is set to 5th Curve (Adj.).

■Stroke amount

Set the stroke amount.

When the output unit character string is "%", it will be a value corresponding to the 100% of stroke ratio.

■I/O data

Set the I/O data.

The input data should be set in ascending order.

■End point

Set the end point of each section.

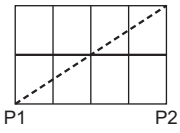
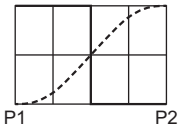
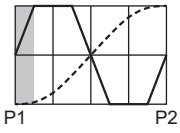
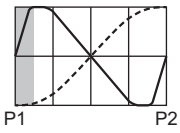
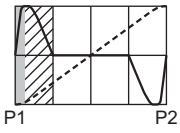
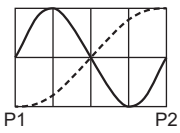
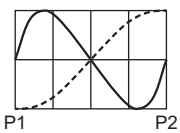
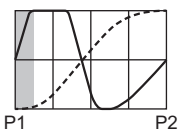
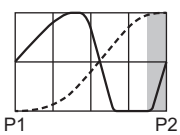
End point should be set in ascending order.

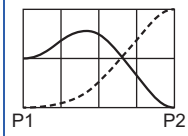
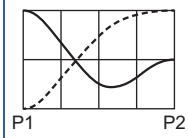
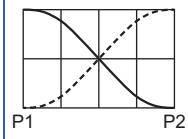
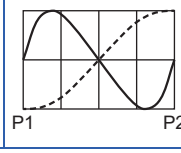
■Stroke

Set the stroke of each section.

■Cam curve types

A cam curve can be selected from the following curves.

Cam curve type (MC_CAM_CURVE_TYPE)			Acceleration curve shape*1	Curve applicable range (P1 to P2)	Acceleration/ deceleration range compensation ( ): Default value		End point velocity	End point acceleration
Setting value	Cam curve name				Range L1	Range L2		
ConstantSpeed(0)	Constant velocity	Discontinuous		0.0 to 1.0	—	—	—	—
ConstantAcceleration(1)	Constant acceleration			0.0 to 1.0	—	—	—	—
DistortedTrapezoid(2)	Distorted trapezoid	Two-dwelling symmetrical		0.0 to 1.0	0.0001 ≤ L1 < 0.2500 (0.125)	—	—	—
DistortedSine(3)	Distorted sine			0.0 to 1.0	0.0001 ≤ L1 < 0.5000 (0.125)	—	—	—
DistortedConstantSpeedt (4)	Distorted constant velocity			0.0 to 1.0	0.0001 ≤ L1 < 0.1250 (0.0625)	0.0001 < L2 < 0.5000 (0.25)	—	—
Cycloid(5)	Cycloid			0.0 to 1.0	—	—	—	—
FifthCurve(6)	5th Curve			0.0 to 1.0	—	—	—	—
Trapecloid(7)	Trapecloid	Two-dwelling asymmetrical		0.0 to 1.0	0.0001 ≤ L1 < 0.2500 (0.125)	—	—	—
ReverseTrapecloid(8)	Reverse trapecloid			0.0 to 1.0	0.0001 ≤ L1 < 0.2500 (0.125)	—	—	—

Cam curve type (MC_CAM_CURVE_TYPE)			Acceleration curve shape*1	Curve applicable range (P1 to P2)	Acceleration/ deceleration range compensation ( ): Default value		End point velocity	End point acceleration
Setting value	Cam curve name				Range L1	Range L2		
DoubleHypotenuse(9)	Double hypotenuse	One-dwelling		0.0 to 1.0	—	—	—	—
ReverseDoubleHypotenuse(10)	Reverse double hypotenuse			0.0 to 1.0	—	—	—	—
Single Hypotenuse(11)	Single hypotenuse	Non-dwelling		0.0 to 1.0	—	—	—	—
FifthCurve_SpeedDesignation(12)	5th Curve (Adj.)	Two-dwelling symmetrical		0.0 to 1.0	—	—	-2500000000.0 to 2500000000.0	-2147483647.0 to 2147483647.0

*1 ---- : Stroke ratio, —— : Acceleration, ▭ : Range 1, ▨ : Range 2

■Read/write data structure

This section describes read data 1/write data 1 (Data1) and read data 2/write data 2 (Data2) specified by MCv_ReadProfileData (Profile Read)/MCv_WriteProfileData (Profile Write) when executing read/write operation profile data.

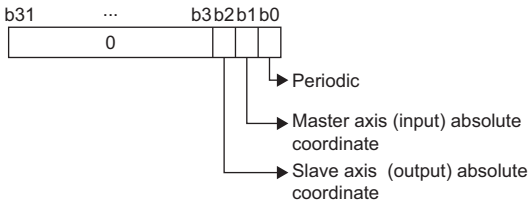
For details on each setting item, refer to the following.

☞ Page 827 Cam data

- Read data 1/Write data 1 (Data1)

  Specify the PROFILE_CAM_DATA type structure.

PROFILE_CAM_DATA			Device offset (Total size: 108 points)	Description
Variable name	Name	Data type		
Interpolate	Interpolation method specification	INT	+0	Set the interpolation method specification of the cam data. • 0: Linear interpolation • 1: Section interpolation • 2: Spline interpolation
Resolution	Resolution/number of coordinates	DWORD(UDINT)	+2	Set the resolution. Linear interpolation/specifying for each section/spline interpolation • 8 to 65535
InputUnitString	Input unit character string	WSTRING(31)	+4	Sets the unit for input data with a character string.
OutputUnitString	Output unit character string	WSTRING(31)	+36	Sets the unit for output data with a character string.
StartPoint	Start point*1	LREAL	+68	Set the start point. * Set "0.0".
StartStroke	Initial stroke amount*1	LREAL	+72	Set the stroke amount for the start point. (-Stroke amount (Stroke) ≤ Initial stroke amount (StartStroke) ≤ Stroke amount (Stroke))
StartVelocity	Initial velocity*2	LREAL	76	Set the velocity for the start point. (-2500000000.0 ≤ Initial velocity (StartVelocity) ≤ 2500000000.0)
StartAcceleration	Initial acceleration*2	LREAL	80	Set the acceleration for the start point. (-2147483647.0 ≤ Initial acceleration (StartAcceleration) ≤ 2147483647.0)

PROFILE_CAM_DATA			Device offset (Total size: 108 points)	Description
Variable name	Name	Data type		
CycleLength	Length per cycle*1	LREAL	+84	Set the input amount that is required for one cycle. (0.00000000000001 ≤ Length per cycle (CycleLength) ≤ 10000000000.0)
CycleMin	Minimum value per cycle	LREAL	+88	Set the minimum value per cycle. * Set "0.0".
CycleMax	Maximum value per cycle	LREAL	+92	Set the maximum value per cycle. (Minimum value per cycle (CycleMin) < Maximum value per cycle (CycleMax) ≤ 10000000000.0)
CycleTime	Time per cycle*2	LREAL	+96	Set time per cycle. (0.001 < Time per cycle (CycleTime) ≤ 100000.0)
Stroke	Stroke amount	LREAL	+100	Set the stroke amount. (0.00000000000001 ≤ Stroke amount (Stroke) ≤ 10000000000.0)
NumberOfSections	Number of sections*1	DWORD(UDINT)	+104	Sets the number of sections ■When set to "1: Section interpolation" • 1 to 360 ■When set to "2: Spline interpolation" • 3 to 360
Options	Options	DWORD(HEX)	+106	Specify options.  ■Periodic (bit 0) • 0: Non periodic • 1: Periodic For details, refer to the following. ☞ Page 804 Repetitive operation ■Master axis (input) absolute coordinate (bit 1) • 0: Relative coordinate For details, refer to the following. ☞ Page 809 Master axis absolute coordinate ■Slave axis (output) absolute coordinate (bit 2) • 0: Relative coordinate • 1: Absolute coordinate For details, refer to the following. ☞ Page 809 Slave axis absolute coordinate * For bits 3 to 31, specify "0".

*1 It is not used in the cam data format (Interpolation Method Specification (Interpolate) is "0: Linear Interpolation"). (It is ignored.)

*2 Used only when cam curve is 5th Curve (Adj.). (Ignore for other curve.)

Ex.

Setting example of Target (TARGET_REF.Target)

- [DEV](PROFILE_CAM_DATA)G11500000
- [VAR]CamData1 (CamData1 is a PROFILE_CAM_DATA type label.)
- Read data 2/Write data 2 (Data2)

  The structure to be specified differs depending on the setting of Read destination (Target)/Write destination (Target) and Interpolation Method Specification (Interpolate) of the target cam data. For details, refer to the following.

○: Supported, —: Not supported

FB	Read destination/ Write destination (Target)	Structure specified in Read data 2/Write data 2 (Data2)	Interpolation method specification (Interpolate)		
			0: Linear interpolation	1: Section interpolation	2: Spline interpolation
MCv_ReadProfileData (Profile Read)	0: Open area 2: Open area (Motion service processing)	LREAL[]	○	○*1	○*1
	1: File	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*2
MCv_WriteProfileData (Profile Write)	0: Open area 2: Open area (Motion service processing)	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*2
	1: File	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*2

*1 Read as the stroke data (a pair data of current value per cycle and stroke) expanded to the open area.
X of the first point data is the value set in the start point and Y of the first point data is the value set in the initial stroke amount.
The data of the second point or later is the stroke data divided by resolution.
Therefore, the number of read/write points in an open area is "Resolution + 1".

*2 Used only by end point and stroke

If the number of elements of the specified array is smaller than the resolution + 1/number of coordinates when reading/writing the entire operation profile data, Number of read/write data mismatch (error code: 1BACH) occurs.
The structures specified by Read data 2/Write data 2 (Data2) are shown below.

- LREAL type
  Specify LREAL type two-dimensional array as follows.
  LREAL[m..n, o..p]

Item	Description
The number of elements (n - m + 1)	Set the number of array elements to be equal to or greater than the number of points that are to be read. When reading/writing the entire operation profile data (Offset and Points are "0"), set it to be the resolution + 1/number of coordinates of the target cam data or more. However, an area larger than the resolution + 1/number of coordinates read by Read data 1 (Data1) is not updated when using MCv_ReadProfileData (Profile Read). Data of an area larger than the resolution + 1/number of coordinates specified by Write data 1 (Data1) is not used when using MCv_WriteProfileData (Profile Write).
The number of dimensions (p - o + 1)	Read/write the current position per cycle and stroke of each point. Set the number of array elements to be "2". If the number of array elements is set to "3" or more, reading/writing is possible, but as the intended result may not be obtained due to data being moved forward, make sure to set the number of array elements to be "2".

Ex.
When setting LREAL type with Specifying interpolation method (Interpolate)

Interpolation method specification (Interpolate)	Setting example
0: Linear interpolation	The following shows examples of setting the two-dimensional device/label coordinate number "100" to Target (Target) of the TARGET_REF structure. ■Device specification TARGET_REF.Target := "[DEV](LREAL[1..100,1..2])D0" ■Label specification TARGET_REF.Target := "[VAR]CamData2" * CamData2 declares the "LREAL[1..100,1..2]" label to data type and label name of the global label to "CamData2", and specifies the string for Target (Target). Reading/writing data is as follows. · CamData2[n,1]: Nth point current position per cycle · CamData2[n,2]: Nth point stroke
1: Section interpolation 2: Spline interpolation	The following shows examples of setting the two-dimensional device/label resolution "100" to Target (Target) of the TARGET_REF structure. ■Device specification TARGET_REF.Target := "[DEV](LREAL[1..101,1..2])D0" ■Label specification TARGET_REF.Target := "[VAR]CamData2" * CamData2 declares the "LREAL[1..101,1..2]" label to data type and label name of the global label to "CamData2", and specifies the string for Target (Target). Reading/writing data is as follows. CamData2[1,1]: Value set for the start point · CamData2[1,2]: Value set for the initial stroke amount · CamData2[n + 1,1]: Nth point current position per cycle · CamData2[n + 1,2]: Nth point stroke

Point

When executing MCv_WriteProfileData (Profile Write) whose Target (Target) is File in the LREAL type array, Interpolation Method Specification (Interpolate) of the cam data format is output to the file as "0: Linear interpolation".

- PROFILE_CAM_ELEMENT type
  Specify PROFILE_CAM_ELEMENT type structure array as follows.
  PROFILE_CAM_ELEMENT[m..n]

Item	Description
The number of elements (n - m + 1)	Set the number of array elements to be equal to or greater than the number of points that are to be read. When reading/writing the entire operation profile data (Offset and Points are set to "0"), set it to be Number of Sections (PROFILE_CAM_DATA.NumberOfSections) of the target cam data or more. However, an area larger than Number of Sections (PROFILE_CAM_DATA.NumberOfSections) read by Read data 1 (Data1) is not updated when using MCv_ReadProfileData (Profile Read). An area larger than Number of Sections (PROFILE_CAM_DATA.NumberOfSections) specified by Write data 1 (Data1) is not used when using MCv_WriteProfileData (Profile Write).

Specify the following PROFILE_CAM_ELEMENT type structures.

PROFILE_CAM_ELEMENT			Device offset (Total size: 36 points)	Description
Variable name	Name	Data type		
CurveType	Cam curve type	MC_CAM_CURVE_TYPE	+0	Set the cam curve. (When End point (EndPoint) is 0, it is invalid.) • 0: Constant Velocity (ConstantSpeed) • 1: Constant Acceleration (ConstantAcceleration) • 2: Distorted Trapezoid (DistortedTrapezoid) • 3: Distorted Sine (DistortedSine) • 4: Distorted Constant Velocity (DistortedConstantSpeed) • 5: Cycloid (Cycloid) • 6: 5th Curve (FifthCurve) • 7: Trapecloid (Trapecloid) • 8: Reverse Trapecloid (ReverseTrapecloid) • 9: Double Hypotenuse (DoubleHypotenuse) • 10: Reverse Double Hypotenuse (ReverseDoubleHypotenuse) • 11: Single Hypotenuse (SingleHypotenuse) • 12: 5th Curve (Adj.) (FifthCurve_SpeedDesignation)
EndPoint	End point*1	LREAL	+4	Set the position to the length per cycle (the current value per cycle). (0.0 < End point (EndPoint) ≤ Length per cycle)
Stroke	Stroke	LREAL	+8	Set the stroke position. (The absolute value of Stroke (Stroke) ≤ Stroke amount)
RangeP1	Curve applicable range (P1)	LREAL	+12	Set the curve applicable range (start point: P1, end point: P2) for the cam curve. • 0.0 to 1.0 Set within the range of "P1 < P2". However, for "P1 = P2 = 0", "P1 = 0" and "P2 = 1" are applied.
RangeP2	Curve applicable range (P2)	LREAL	+16	
RangeL1	Acceleration/ deceleration range compensation (Range L1)	LREAL	+20	Set the acceleration/deceleration range (L1, L2) of the cam curve. (0.0001 < L1, L2 < 1.0000) The range that can be set differs depending on the cam curve. For "L1 = L2 = 0.0000", the default value for each cam curve is applied. On the curve that does not use L1 or L2, the setting value is ignored.
RangeL2	Acceleration/ deceleration range compensation (Range L2)	LREAL	+24	
EndVelocity	End point velocity*2	LREAL	+28	Set the end point velocity of the cam curve. (-2500000000.0 < End point velocity (EndVelocity) < 2500000000.0)
EndAcceleration	End point acceleration*2	LREAL	+32	Set the end point acceleration of the cam curve. (-2147483647.0 < End point acceleration (EndAcceleration) < 2147483647.0)

*1 When the end point exceeds the length per cycle before reaching the final section, the section number at the time is determined as the final section number and the end point is overwritten with the length per cycle.

*2 Setting items used for read/write differ depending on Interpolation Method Specification (Interpolate) of the operation profile data. For details, refer to the following.

☞ Page 827 Cam data

Ex.

PROFILE_CAM_ELEMENT type

Interpolation method specification (Interpolate)	Setting example
0: Linear interpolation	The following shows examples of setting the device/label with the number of sections specified to "10" to Target (Target) of the TARGET_REF structure. ■Device specification TARGET_REF.Target := "[DEV](PROFILE_CAM_ELEMENT[1..10])D0" ■Label specification TARGET_REF.Target := "[VAR]CamData2" * CamData2 declares the "PROFILE_CAM_ELEMENT[1..10]" label to data type and label name of the global label to "CamData2", and specifies the string for Target (Target). Reading/writing data is as follows. · CamData2[n]: Nth point section data (PROFILE_CAM_ELEMENT type)

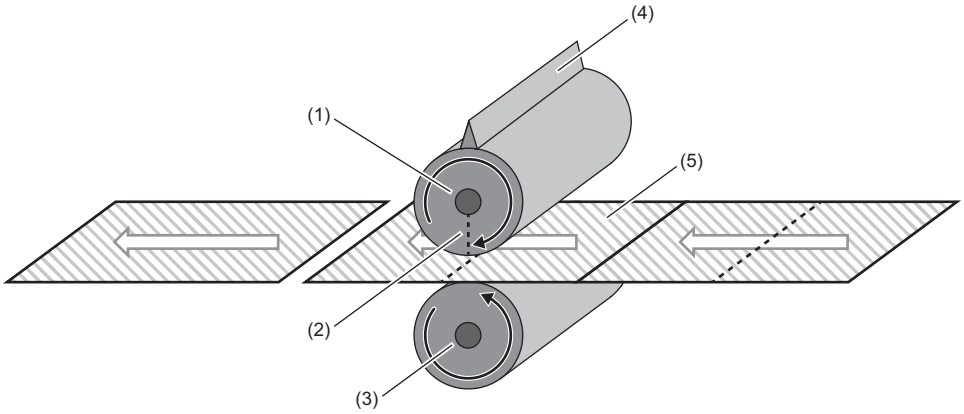
Rotary cutter

Generate cam data of the rotary cutter. The stroke data that is defined after equally dividing a cam pattern per cycle of rotary cutter by points of the resolution is opened in the open area.

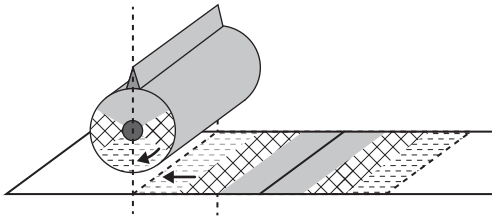
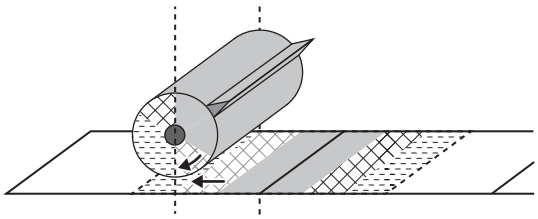
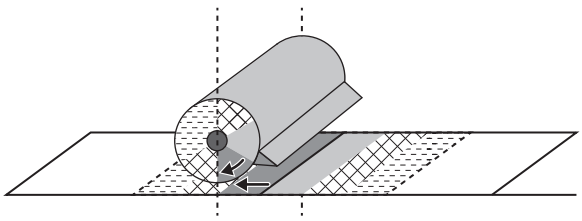
When using this operation profile data format, install add-on PackagingApp.

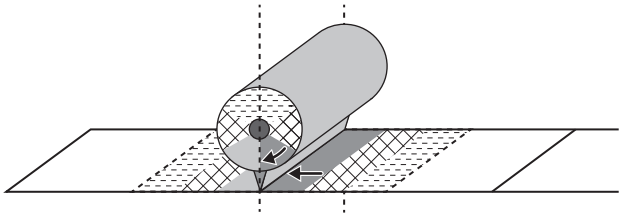
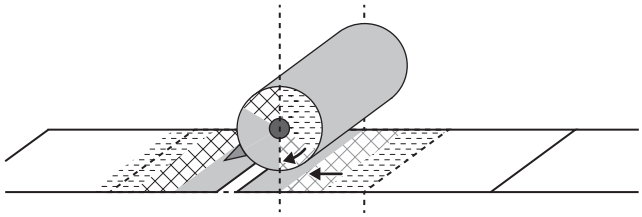
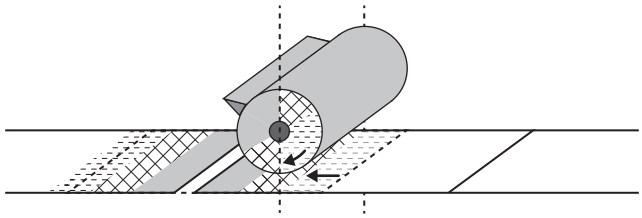
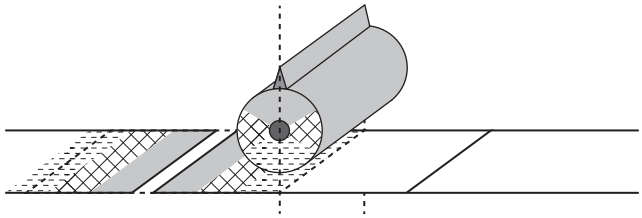
■Equipment image

An image of the rotary cutter equipment and its operation is shown below.



(1) Slave axis (synchronous axis)
(2) Cam data start position
(3) Master axis
(4) Cutter
(5) Sheet

No.	Operation image	Description
1	Master axis (sheet) start position (= Cam data start position) Master axis (sheet) asynchronous constant speed section (first half) 	The master axis (sheet) and slave axis (synchronous axis) move at a constant speed that is different for each axis until they reach the start position of the master axis (sheet) acceleration/deceleration section. The speeds are automatically calculated from the setting values.
2	Master axis (sheet) acceleration/deceleration section (first half) 	The slave axis (synchronous axis) accelerates (or decelerates) until the end position of the master axis (sheet) acceleration/deceleration section is reached. The slave axis (synchronous axis) acceleration is determined by the acceleration/deceleration method and the ratio between the length of the master axis (sheet length) and that of the slave axis (synchronous axis length). • Master axis > Slave axis: Acceleration • Master axis = Slave axis: Constant speed (Their velocity is also the same.) • Master axis < Slave axis: Deceleration
3	From the master axis (sheet) synchronous section start position until the center position 	The master axis (sheet) and slave axis (synchronous axis) move at the same speed from the master axis (sheet) synchronous section start position until the synchronous section center position.

No.	Operation image	Description
4	From the master axis (sheet) synchronous section center position until the end position 	The slave axis (synchronous axis) cutter moves to the lowest position and cuts the sheet. Then, the master axis (sheet) and slave axis (synchronous axis) move at the same speed until they reach the synchronous section end position.
5	Master axis (sheet) acceleration/deceleration section (second half) 	The slave axis (synchronous axis) decelerates (or accelerates) until the end position of the master axis (sheet) acceleration/deceleration section is reached. The slave axis (synchronous axis) acceleration is determined by the acceleration/deceleration method and the ratio between the length of the master axis (sheet length) and that of the slave axis (synchronous axis length). • Master axis > Slave axis: Deceleration • Master axis = Slave axis: Constant speed (Their velocity is also the same.) • Master axis < Slave axis: Acceleration
6	Master axis (sheet) asynchronous constant speed section (second half) 	The master axis (sheet) and slave axis (synchronous axis) move at a constant speed that is different for each axis until they reach the master axis (sheet) end position. The speeds are automatically calculated from the setting values.
7	Master axis (sheet) end position (= Cam data end position) 	When the master axis (sheet) has moved the distance of the sheet length, the slave axis (synchronous axis) moves one revolution, completing the operation of one cycle. The operation returns to the start of the next cycle (No.1).

■Setting items

For a necessary definition as cam data for the rotary cutter, refer to the following.

◎: Necessary, ○: Optional, —: Unnecessary

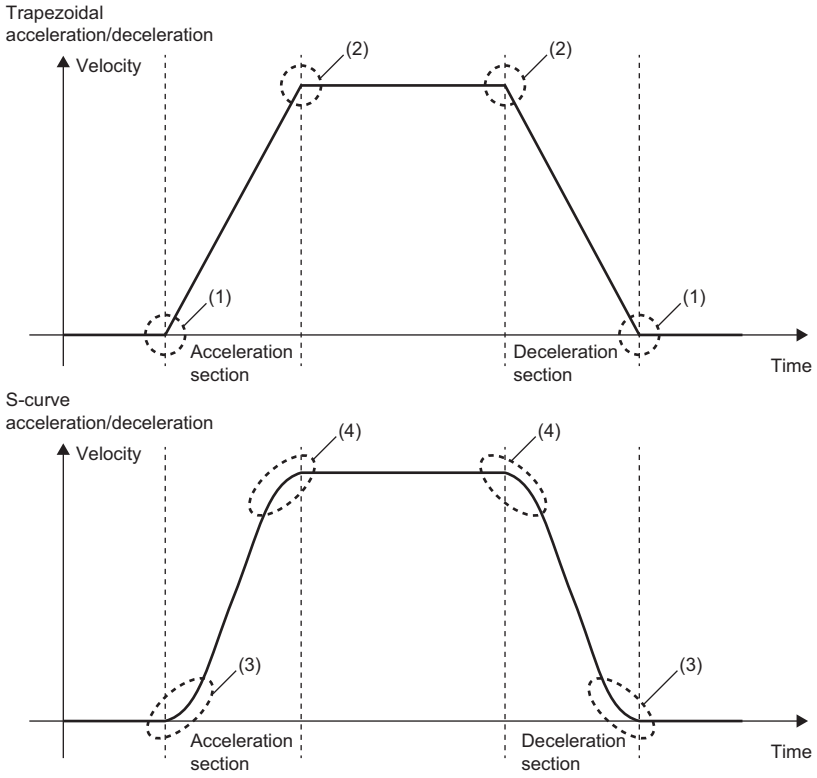
Setting item		Cam data for rotary cutter
Profile ID		○
Interpolation method specification		—
Resolution/number of coordinates		◎
Input unit character string		○
Output unit character string		—
Start point		—
Initial stroke amount		—
Initial velocity		—
Initial acceleration		—
Parameter	Auto-generation options	◎
	Synchronous section acceleration ratio	◎
	Sheet length	◎
	Sheet synchronization width	◎
	Synchronous axis length	◎
	Synchronous position adjustment	◎
	Acceleration/ deceleration width	◎
	Number of cutters	◎
Length per cycle		—
Minimum value per cycle		—
Maximum value per cycle		—
Time per cycle		—
Stroke amount		—(Fixed to 360)

■Auto-generation options

• Acceleration/deceleration method

Set the acceleration/deceleration method for the acceleration/deceleration section by using trapezoidal acceleration/deceleration or S-curve acceleration/deceleration.

The velocity changes by each method as shown below.



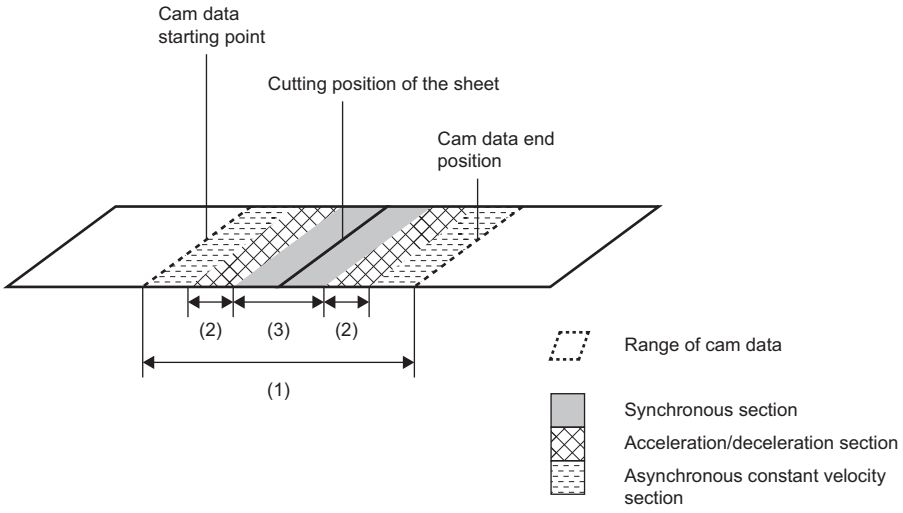
(1) Accelerates quickly.
(2) Decelerates quickly.
(3) Accelerates slowly.
(4) Decelerates slowly.

• Synchronous axis length setting

Set the setting method for the synchronous axis length by using the diameter or cycle length (circumference).

For differences in the setting methods, refer to the following.

☞ Page 841 Synchronous axis length



(1) Sheet length
(2) Acceleration/deceleration width
(3) Sheet synchronization width

■Sheet length

Set the sheet length.

■Acceleration/deceleration width

Set the sheet width (one side) of the acceleration/deceleration section.

When the acceleration/deceleration width is set to a negative value, the acceleration/deceleration width is automatically calculated to be the maximum.

■Sheet synchronization width

Set the sheet synchronization width (seal width).

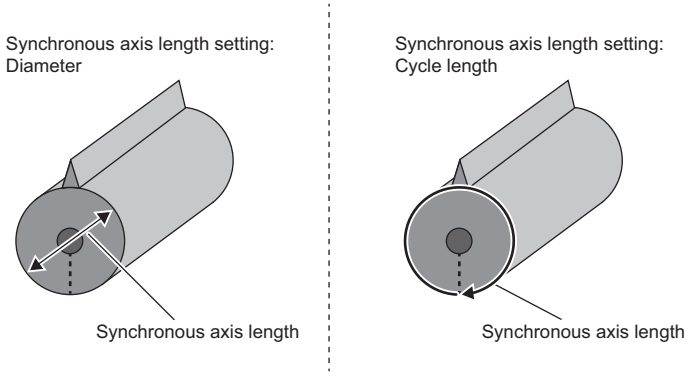
When the synchronous section for retracting operation is required in front of and behind the sheet synchronization width, add the retracting width.

■Synchronous axis length

Set the rotary cutter axis length.

When the synchronous axis length is set by diameter, the cycle length equals the setting value × the circle ratio (π).

When the synchronous axis length is set by cycle length, the cycle length equals the setting value.



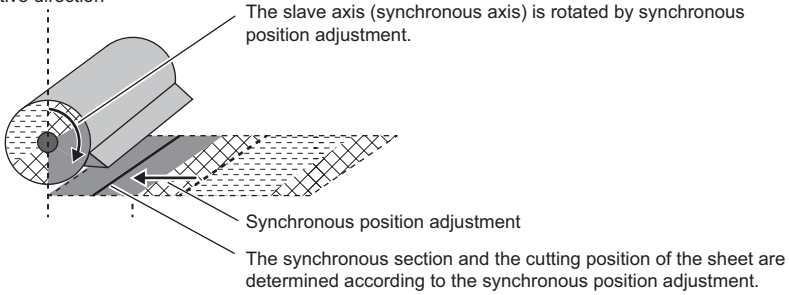
■Synchronous position adjustment

Set the position adjustment of the synchronous section. Set a value half the sheet length or shorter.

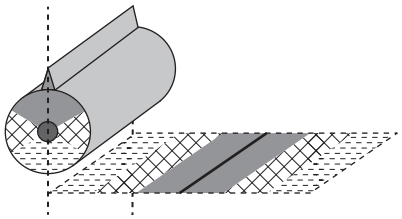
- Negative value: The synchronous section is adjusted to the sheet start side.
- 0: The synchronous section is at the sheet center position.
- Positive value: The synchronous section is adjusted to the sheet end side.

When the synchronous speed section for retracting operation is included in the synchronous section, adjust for the retracting width.

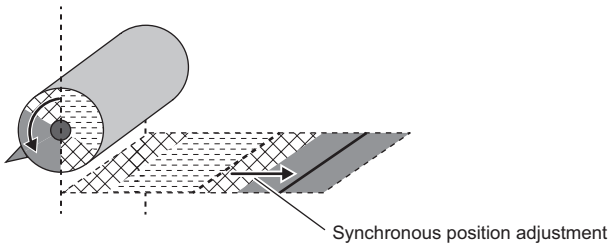
Synchronous position adjustment:
Negative direction



Synchronous position adjustment:
None



Synchronous position adjustment:
Positive direction

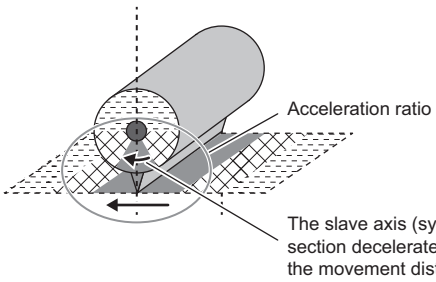


■Synchronous section acceleration ratio

Set when the synchronous speed in the synchronous section needs to be adjusted.

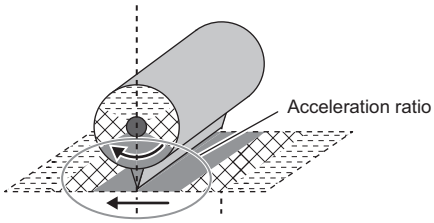
The speed is "Synchronous speed × (100% + Acceleration ratio)" in the synchronous section.

Acceleration ratio: -50.0%

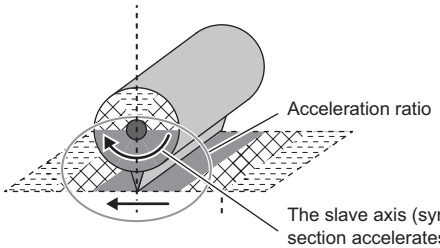


The slave axis (synchronous axis) in the synchronous section decelerates. (Because the axis moves slowly, the movement distance becomes shorter.)

Acceleration ratio: 0.0%



Acceleration ratio: +50.0%



The slave axis (synchronous axis) in the synchronous section accelerates. (Because the axis moves fast, the movement distance becomes longer.)

■Number of cutters

Set the number of rotary cutters.

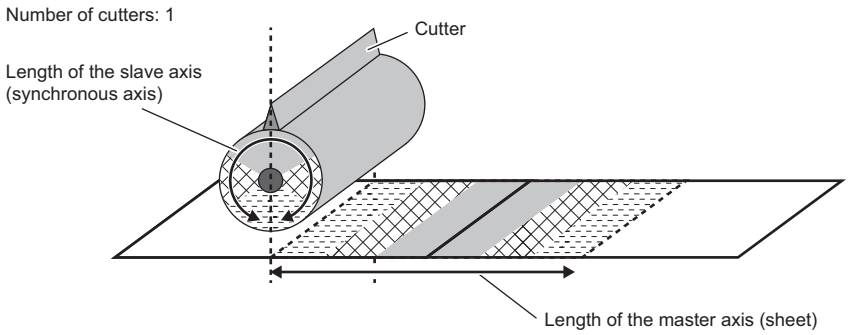
The length of each cutter will be shortened if the number of cutters is set to 2 or more. Adjust the stroke amount of the output axis.

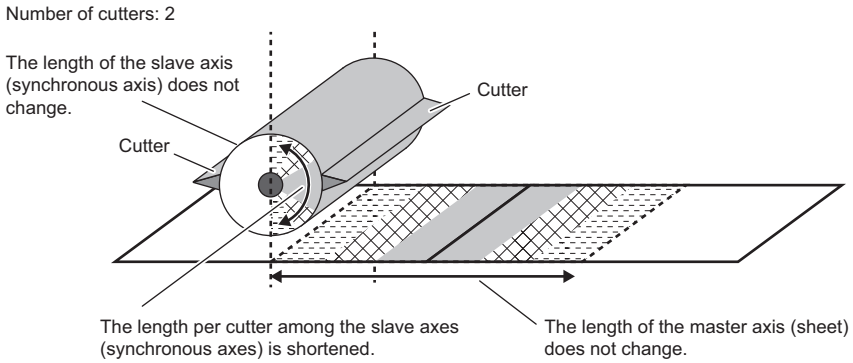
• Cam operation (MC_CamIn)

Set the slave axis scaling (MC_CamIn.SlaveScaling) to 1 ÷ the number of cutters.

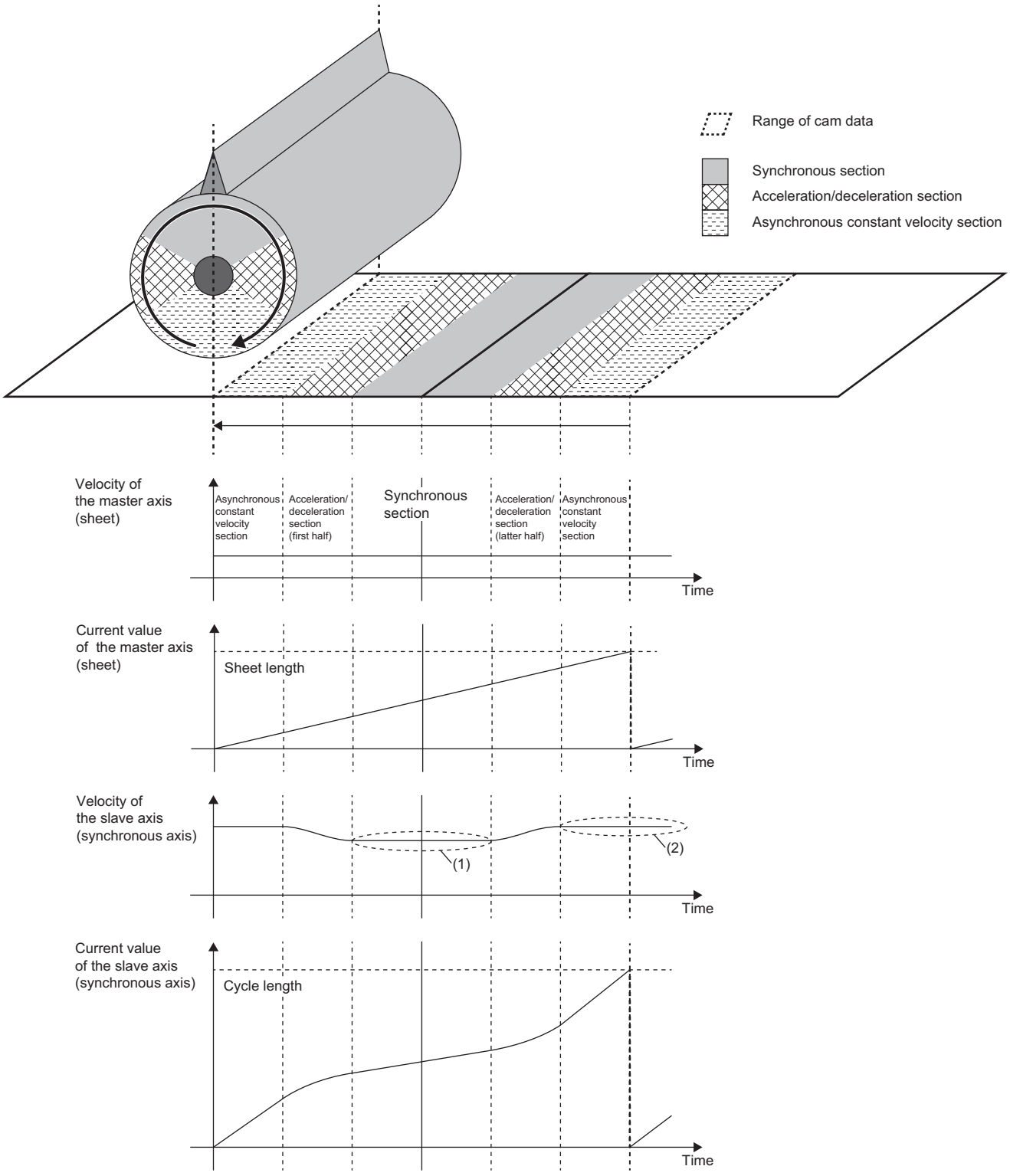
• Advanced synchronization (MCv_AdvancedSync)

Set the output axis cam stroke amount (ADV_OUTPUT.Pr.Cam.StrokeAmount) to the cycle length ÷ the number of cutters.





■Timing chart



(1) The speed in the synchronous section is the same as that of the master axis.
(2) The speed in the asynchronous constant speed section is automatically calculated.

■Read/write data structure

This section describes Read data 1/Write data 1 (Data1) specified by MCv_ReadProfileData (Profile Read)/ MCv_WriteProfileData (Profile Write) when reading/writing operation profile data.

Read data 2/Write data 2 (Data2) is not used when reading/writing operation profile data of rotary cutter.

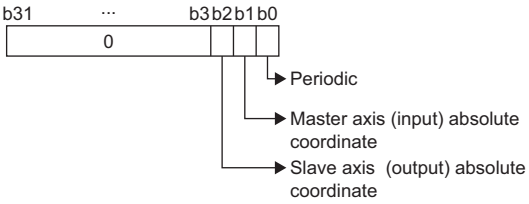
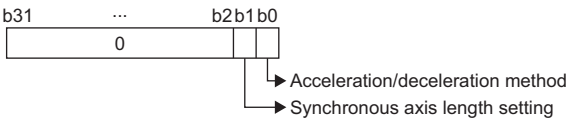
However, when reading the expanded cam data by using the cam data for rotary cutter from the open area again, set the cam data format (Interpolation Method Specification (Interpolate): "0: Linear interpolation"). For details on the data structure for read/write specified with cam data format, refer to the following.

☞ Page 832 Read/write data structure

■Rotary cutter (Specifying a double-precision real number)

• Read data 1/Write data 1 (Data1)

Specify the PROFILE_ROTARY_CUTTER type structure.

PROFILE_ROTARY_CUTTER			Device offset (Total size: 68 points)	Description
Variable name	Name	Data type		
Resolution	Resolution	DWORD(UDINT)	+0	Sets the resolution for generating the cam. • 8 to 32768
InputUnitString	Input unit character string	WSTRING(31)	+2	Sets the input unit character string.
Options	Options	DWORD(HEX)	+34	Specify options.  ■Periodic (bit 0) • 0: Non periodic • 1: Periodic For details, refer to the following. ☞ Page 804 Repetitive operation ■Master axis (input) absolute coordinate (bit 1) • 0: Relative coordinate For details, refer to the following. ☞ Page 809 Master axis absolute coordinate ■Slave axis (output) absolute coordinate (bit 2) • 0: Relative coordinate • 1: Absolute coordinate For details, refer to the following. ☞ Page 809 Slave axis absolute coordinate * For bits 3 to 31, specify "0".*1
AutoGenerationOptions	Auto-generation options	WORD(HEX)	+36	Sets the auto-generation options.  ■Acceleration/deceleration method (bit 0) • 0: Trapezoidal acceleration/deceleration • 1: S-curve acceleration/deceleration ■Synchronous axis length setting (bit 1) • 0: Diameter • 1: Cycle length * For bits 2 to 15, specify "0".
NumberOfCutter	Number of cutters	WORD(UINT)	+37	Set the number of cutters. • 1 to 256
SyncSectionAccRatio	Synchronous section acceleration ratio	LREAL	+40	Set when the synchronous speed in the synchronous section needs to be adjusted. The speed is "Synchronous speed × (100% + Acceleration ratio)" in the synchronous section. • -5000.0 to 5000.0 (in increments of 0.01%)
SheetLength	Sheet length	LREAL	+44	Set the sheet length. (0.0 < Sheet length (SheetLength) ≤ 10000000000.0)
SheetSyncWidth	Sheet synchronization width	LREAL	+48	Set the sheet synchronization width (seal width). When the synchronous speed section for retracting operation is required in front of and behind the sheet synchronization width, add the retracting width. (0.0 < Sheet synchronization width (SheetSyncWidth) < Sheet length (SheetLength)) (0.0 < Sheet synchronization width (SheetSyncWidth) < Cycle length / Number of cutters (NumberOfCutter))

PROFILE_ROTARY_CUTTER			Device offset (Total size: 68 points)	Description
Variable name	Name	Data type		
SyncAxisLength	Synchronous axis length	LREAL	+52	• Set the rotary cutter axis length. ■When Auto-generation options is set to "0: Diameter" It is calculated as "Cycle length = Setting value × π". ■When Auto-generation options is set to "1: Cycle length" It is calculated as "Cycle length = Setting value". (0.0 < Cycle length < 10000000000.0)
SyncPositionAdjustment	Synchronous position adjustment	LREAL	+56	Set the position adjustment of the synchronous section. • Negative value: The synchronous section is adjusted to the sheet start side. • 0: The center of the sheet is in the synchronous section. • Positive value: The synchronous section is adjusted to the sheet end side. (The absolute value of Synchronous position tuning (SyncPositionAdjustment) < Sheet length (SheetLength) / 2)
AccDecWidth	Acceleration/ deceleration width	LREAL	+60	Set the sheet width (one side) of the acceleration/deceleration area. When a negative value is set, the acceleration/deceleration width is calculated to be the maximum. (2 × Acceleration/deceleration width (AccDecWidth) ≤ Sheet length (SheetLength) - Sheet synchronization width (SheetSyncWidth))
AsyncSpd	Asynchronous velocity result	LREAL	+64	When the auto-generation is successfully completed, the asynchronous speed is stored as the ratio of the synchronous speed.

*1 If specifying other than "0", Out of option range (error code: 1BC3H) occurs, and the function will not start.

• Read data 2/Write data 2 (Data2)

Specifying is not required. (It is ignored.)

Multiple axes positioning data

For a necessary definition as positioning data, refer to the following table.

◎: Necessary, ○: Optional, —: Unnecessary

Setting item		Multiple axes positioning data
Profile ID		○
Periodic		—
Input absolute coordinate		—
Output absolute coordinate		—
Operation profile data format		◎
Profile data type		◎
Interpolation method specification		—
Resolution/number of coordinates		—
Start point		—
Initial stroke amount		—
Initial velocity		—
Initial acceleration		—
Options		○
Number of positioning data settings		○
Total number of positioning data		◎
Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10)	I/O number (StartIO)	—
	Target (Target)	○
	Signal detection method (Detection)	○
	Compensation time (CompensationTime)	○
	Filter time (FilterTime)	○
Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10)	I/O number (StartIO)	—
	Target (Target)	○
	Signal detection method (Detection)	○
	Compensation time (CompensationTime)	○
	Filter time (FilterTime)	○

Setting item		Multiple axes positioning data
Positioning data	Positioning data No. (DataNo)	◎
	Operation pattern (OperationPattern)	○*1
	Control method (ControlMethod)	◎
	Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4)	○*1
	Circular interpolation mode (CircMode)	○*1
	Path selection (CircPathChoice)	○*1
	Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4)	○*1
	Direction selection 1 to Direction selection 2 (Direction1 to Direction4)	○*1
	Sub point 1 to Sub point 4 (CircAuxPoint1 to CircAuxPoint4)	○*1
	Velocity mode (VelocityMode)	○*1
	Velocity (Velocity)	○*1
	Acceleration (Acceleration)	○*1
	Deceleration (Deceleration)	○*1
	Jerk (Jerk)	○*1
	Circular interpolation error tolerance (CircErrorTolerance)	○*1
	Positioning data options (DataOptions)	○*1
	Dwell time (DwellTime)	○*1
	M code (Mcode)	○*1
	M code output timing override (McodeOutput_Override)	○*1
	Jump destination positioning data No. (JumpDestinationDataNo)	○*1
	Condition signal No. (ConditionSignalNo)	○*1
	Number of LOOP to LEND repetitions (LoopCount)	○*1
	Skip signal No. (SkipSignalNo)	○*1
	Pitch (Pitch)	—
Length per cycle		—
Length unit setting per cycle		—
Length unit string per cycle		—
Minimum value per cycle		—
Maximum value per cycle		—
Time per cycle		—
Stroke amount		—
Stroke amount unit setting		—
Stroke amount unit string		—

*1 Whether the setting is required differs depending on the control method (ControlMethod). For details, refer to the following.
☞ Page 668 Positioning data to be set

■Profile ID

An unique ID to be assigned by expanding.

ID can be specified with any number.

■Operation profile data format

Set "multiple axes positioning data format" when using the operation profile data format.

■Profile data type

Set "multiple axes positioning data" when using the profile data type.

■Number of positioning data settings

Specify the number of positioning data to be set.

Set the number of positioning data settings so that it is equal to or less than the total count of positioning data.

During write processing, the motion system will automatically calculate the number of positioning data settings. Therefore, the settings are not required.

If the value is out of the setting range or the total number of positioning data, Operation profile data incorrect (error code: 1B8FH) will occur during expanding.

- Setting range: 0 to 5000

■Total number of positioning data

The total number of positioning data.

Specify the maximum value of positioning data No. to be set for expanding or writing.

If the value is out of the setting range, Operation profile data incorrect (error code: 1B8FH) will occur during expanding.

- Setting range: 1 to 5000

Point

The larger the total number of positioning data, the more positioning data can be set, but the data size increases accordingly. For details on the data size, refer to the following.

☞ Page 865 Capacity of operation profile data

■Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10)

Set execution conditions for JUMP when "0082H: JUMP (JUMP)" is set to the control method (ControlMethod). The following initial values are used if the settings of each item are omitted.

For details on each item and setting range, refer to the following.

☞ Page 691 Condition signal setting

Item	Initial value
I/O number (StartIO)	0
Target (Target)	"" (string of length 0)
Signal detection method (Detection)	0: Detection at TRUE (HighLevel)
Compensation time (CompensationTime)	0.0
Filter time (FilterTime)	0.0

■Skip signal (SkipSignal1 to SkipSignal10)

Set the skip signal to be used for operation profile data control.

For details on each item and setting range, refer to the following.

☞ Page 692 Skip signal setting

Item	Initial value
I/O number (StartIO)	0
Target (Target)	"" (string of length 0)
Signal detection method (Detection)	0: Detection at TRUE (HighLevel)
Compensation time (CompensationTime)	0.0
Filter time (FilterTime)	0.0

■Positioning data

Set the interpolation operation to perform in operation profile data control. The following initial values are used if the settings of each item are omitted.

For details on each item and setting range, refer to the following.

☞ Page 668 Positioning data to be set

Item	Initial value
Positioning data No. (DataNo)	Omission impossible
Operation pattern (OperationPattern)	0: Positioning complete (PositioningComplete)
Control method (ControlMethod)	Omission impossible
Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4)	0
Circular interpolation mode (CircMode)	0: Border point specification (mcBorder)
Path selection (CircPathChoice)	0: CW (mcCW)
Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4)	0.0
Direction selection 1 to Direction selection 2 (Direction1 to Direction4)	0
Sub point 1 to Sub point 4 (CircAuxPoint1 to CircAuxPoint4)	0.0
Velocity mode (VelocityMode)	0: Vector Velocity (VectorSpeed)
Velocity (Velocity)	0.0
Acceleration (Acceleration)	0.0
Deceleration (Deceleration)	0.0
Jerk (Jerk)	0.0
Circular interpolation error tolerance (CircErrorTolerance)	100.0
Positioning data options (DataOptions)	00000000H
Dwell time (DwellTime)	0.0
M code (Mcode)	0
M code output timing override (McodeOutput_Override)	0: Use FB options (UseFbOptions)
Jump destination positioning data No. (JumpDestinationDataNo)	0
Condition signal No. (ConditionSignalNo)	0
Number of LOOP to LEND repetitions (LoopCount)	0
Skip signal No. (SkipSignalNo)	0
Pitch (Pitch)	0

■Read/write data structure

This section describes Read data 1/Write data 1 (Data1) and Read data 2/Write data 2 (Data2) specified by MCv_ReadProfileData (Profile Read)/MCv_WriteProfileData (Profile Write) when reading/writing operation profile data.

- Read data 1/Write data 1 (Data1)

  Specify the PROFILE_POSITIONING_DATA type structure for Read data 1/Write data 1 (Data1).

PROFILE_POSITIONING_DATA			Device offset (Total size: 4 points)	Description
Variable name	Name	Data type		
NumberOfDataSettings	Number of positioning data settings	WORD (UINT)	+0	Set the number of positioning data to be set.*1 • 0 to 5000
TotalNumberOfData	Total number of positioning data	WORD (UINT)	+1	Set the total number of positioning data.*2 • 1 to 5000
Options	Options	DWORD(HEX)	+2	Set options. * Set "00000000H".

*1 During MCv_WriteProfileData (Profile Write) processing, the motion system will automatically calculate the number of positioning data settings (NumberOfDataSettings). Therefore, the settings are not required.

*2 When the expanded/written profile ID is specified and overwritten by MCv_WriteProfileData (Profile Write), if the total number of positioning data (TotalNumberOfData) does not match, the original expanded data is discarded.
When the number of write data (Points) is set to a value other than "0" and is partially overwritten by MCv_WriteProfileData (Profile Write), set the total number of positioning data (TotalNumberOfData) to match.

Ex.

When setting a device or label

Specification method	Setting example
Device	Data1.Target := "[DEV](PROFILE_POSITIONING_DATA)D0";
Label*1	Data1.Target := "[VAR]G_stPositioningData";

*1 The following labels are declared on the global label.

Label name	Data type
G_stPositioningData	PROFILE_POSITIONING_DATA

- Read data 2/Write data 2 (Data2)

  Specify the following structures for Read data 2/Write data 2 (Data2).

Structure	Description
PROFILE_POSITIONING_DATA_ELEMENT	• Specify when reading/writing positioning data. • The condition signal and skip signal are not read or written. *1
PROFILE_POSITIONING_DATA_EXTENDED	• Specify when reading/writing condition signal, skip signal, and positioning data. • The condition signal or skip signal can be specified to omit the reading/writing.*1 • The condition signal and skip signal can be read/written, but the processing time increases accordingly.

*1 When the expanded/written profile ID is specified and is overwritten by MCv_WriteProfileData (Profile Write), if the total number of positioning data is the same as the original expanded data, the data not to be written is held. (If the total number of positioning data is different, the data not to be written is discarded.)

■PROFILE_POSITIONING_DATA_ELEMENT type

- Specify the PROFILE_POSITIONING_DATA_ELEMENT (m..n) type structure.
- Set the number of specified array elements (n - m + 1) to be equal to or greater than the number of points that are to be read/written. When reading/writing entire operation profile data (Offset and Points are set to "0"), set the number of array elements to be the total number of positioning data (PROFILE_POSITIONING_DATA.TotalNumberOfData) or more. If the number of array elements is few, Number of read/write data mismatch (error code: 1BACH) will occur.

PROFILE_POSITIONING_DATA_ELEMENT [m..n]			Device offset (Total size: 88 points)	Description
Variable name	Name	Data type		
DataNo	Positioning data No.	WORD (UINT)	+0	Set the index number of positioning data. • 1 to total number of positioning data
OperationPattern	Operation pattern	MC_OPERATION_PATTERN	+1	Set the operation pattern.*1 • 0: Positioning complete (PositioningComplete) • 1: Continuous positioning (ContinuousPositioning) • 2: Continuous path (BlendingLow) (ContinuousBlendingLow) • 3: Continuous path (BlendingPrevious) (ContinuousBlendingPrevious) • 4: Continuous path (BlendingNext) (ContinuousBlendingNext) • 5: Continuous path (BlendingHigh) (ContinuousBlendingHigh)
ControlMethod	Control method	MC_CONTROL_METHOD	+2	Set the control method.*1 • 0080H: NOP (NOP) • 0082H: JUMP (JUMP) • 0083H: LOOP (LOOP) • 0084H: LEND (LEND) • 0101H: Absolute value linear interpolation (LinearAbsolute) • 0102H: Relative value linear interpolation (LinearRelative) • 0103H: Absolute value circular interpolation (CircularAbsolute) • 0104H: Relative value circular interpolation (CircularRelative)
InterpolationAxis1	Interpolation axis 1	WORD (UINT)	+3	Set the linear interpolation axes of linear interpolation and the circular interpolation axes of circular interpolation by the setting of control method (ControlMethod).*1 ☞ Page 679 Interpolation axis 1 to Interpolation axis 4 (InterpolationAxis1 to InterpolationAxis4)
InterpolationAxis2	Interpolation axis 2	WORD (UINT)	+4	
InterpolationAxis3	Interpolation axis 3	WORD (UINT)	+5	
InterpolationAxis4	Interpolation axis 4	WORD (UINT)	+6	
CircMode	Circular interpolation mode	MC_CIRC_MODE	+7	Set the specification method of circular interpolation.*1 • 0: Border point specification (mcBorder) • 1: Center point specification (mcCenter) • 2: Radius specification (mcRadius)
CircPathChoice	Path selection	MC_CIRC_PATHCHOICE	+8	Set the rotation direction of circular interpolation.*1 • 0: CW (mcCW) • 1: CCW (mcCCW) • 2: Shortcut (mcShortWay) • 3: Detour (mcLongWay) • 4: CW Detour (mcCWLongWay) • 5: CCW Detour (mcCCWLongWay)
Reserve1 [0..2]	Reserve 1	WORD (UINT)	+9	Not used. (For offset adjustment)
Position1	Target position/ Movement amount/ End point 1	LREAL	+12	Set the target position, movement amount, and end point by the setting of control method (ControlMethod).*1 ☞ Page 680 Target position/Movement amount/End point 1 to Target position/Movement amount/End point 4 (Position1 to Position4)
Position2	Target position/ Movement amount/ End point 2	LREAL	+16	
Position3	Target position/ Movement amount/ End point 3	LREAL	+20	
Position4	Target position/ Movement amount/ End point 4	LREAL	+24	
Direction1	Direction selection 1	MC_DIRECTION	+28	For the linear interpolation control, set the direction of movement from the current position to the target position.*1 • 1: Positive direction (mcPositiveDirection) • 2: Negative direction (mcNegativeDirection) • 3: Shortest path (mcShortestWay)
Direction2	Direction selection 2	MC_DIRECTION	+29	
Direction3	Direction selection 3	MC_DIRECTION	+30	
Direction4	Direction selection 4	MC_DIRECTION	+31	

PROFILE_POSITIONING_DATA_ELEMENT [m..n]			Device offset (Total size: 88 points)	Description
Variable name	Name	Data type		
CircAuxPoint1	Sub point 1	LREAL	+32	For the circular interpolation control, set the position from the current position at startup to the boundary point and the center point.*1 ■For "0: Border point specification (mcBorder)", "1: Center point specification (mcCenter)" -10000000000.0 to 10000000000.0 ■For "2: Radius specification (mcRadius)" 0.000001 to 2147483647.0
CircAuxPoint2	Sub point 2	LREAL	+36	
CircAuxPoint3	Sub point 3	LREAL	+40	
CircAuxPoint4	Sub point 4	LREAL	+44	
VelocityMode	Velocity mode	MC_INTERPOLATE_SPEED_MODE	+48	Set the velocity mode of linear interpolation control.*1 • 0: Vector Velocity (VectorSpeed) • 1: Long Axis Velocity (LongAxisSpeed) • 2: Reference Axis Velocity (ReferenceAxisSpeed)
Reserve2 [0..2]	Reserve 2	WORD (UINT)	+49	Not used. (For offset adjustment)
Velocity	Velocity	LREAL	+52	Set the positioning speed for multiple axes interpolation.*1 • 0.0, 0.0001 to 2500000000.0
Acceleration	Acceleration	LREAL	+56	Set the acceleration for multiple axes interpolation.*1 • 0.0000, 0.0001 to 2147483647.0
Deceleration	Deceleration	LREAL	+60	Set the deceleration for multiple axes interpolation.*1 • 0.0000, 0.0001 to 2147483647.0
Jerk	Jerk	LREAL	+64	Set the jerk for multiple axes positioning control.*1 • 0.0000, 0.0001 to 2147483647.0
CircErrorTolerance	Circular interpolation error tolerance	LREAL	+68	Set the allowable rang of circular interpolation error.*1 • 0.000001 to 100000.0
DataOptions	Positioning data options	DWORD (HEX)	+72	Set the options of linear interpolation or circular interpolation.*1 ☞ Page 683 Positioning data options (DataOptions)
Reserve3 [0..1]	Reserve 3	WORD (UINT)	+74	Not used. (For offset adjustment)
DwellTime	Dwell time	LREAL	76	Set the dwell time.*1 • 0.0 [s]: Dwell function disabled • 0.000001 [s] to 8400.0 [s]: Dwell function enabled
Mcode	M code	WORD (UINT)	+80	Set M code.*1 • 0 to 65535 * Set "0" when not using M code.
McodeOutput_Override	M code output timing override	MC_MCODE_OUTPUT_OVERRIDE	+81	Set M code output timing.*1 • 0: Use FB options (UseFbOptions) • 1: WITH mode (WithMode) • 2: AFTER mode (AfterMode)
JumpDestinationDataNo	Jump destination positioning data No.	WORD (UINT)	+82	Set the jump destination positioning data No.*1 • 1 to total number of positioning data (5000)
ConditionSignalNo	Condition signal No.	WORD (UINT)	+83	Set the condition signal No.*1 • 0 to 10 * Set "0" when not using the condition signal.
LoopCount	Number of LOOP to LEND repetitions	WORD (UINT)	+84	Set the number of repetitions of loop control.*1 • 1 to 65535
SkipSignalNo	Skip signal No.	WORD (UINT)	+85	Set the skip signal No.*1 • 0 to 10 * Set "0" when not using the skip signal.
Pitch	Pitch	WORD (UINT)	+86	Not used. * Set "0" when writing data.
Reserve4	Reserve 4	WORD (UINT)	+87	Not used. (For offset adjustment)

*1 When writing data, no error occurs due to the setting value. When the written open area is used by the operation profile data control FB, an error occurs if it is outside the setting range.

Ex.

When setting the device/label with the number of elements "10" in "Data2.Target"

Specification method	Setting example
Device	Data2.Target := "[DEV](PROFILE_POSITIONING_DATA_ELEMENT[1..10])D100";
Label*1	Data2.Target := "[VAR]G_st10PositioningDataElem";

*1 The following labels are declared on the global label.

Label name	Data type
G_st10PositioningDataElem	PROFILE_POSITIONING_DATA_ELEMENT [1..10]*2

*2 Reading/writing data is as follows.
G_st10PositioningDataElem [n]: The nth positioning data (PROFILE_POSITIONING_DATA_ELEMENT type)

■PROFILE_POSITIONING_DATA_EXTENDED type

- Specify the PROFILE_POSITIONING_DATA_EXTENDED type structure. Specify variables for each member (WSTRING type) to store the condition signal, skip signal, and positioning data. The condition signal (ConditionSignal), skip signal (SkipSignal), and positioning data (PositioningData) of the specification destination are the target of reading/writing.
- The target of the reading/writing section specified by offset (Offset) and number of read/write data (Points) is positioning data (PositioningData).

PROFILE_POSITIONING_DATA_EXTENDED			Device offset (Total size: 192 points)	Description
Variable name	Name	Data type		
ConditionSignal*1	Condition signal	WSTRING (63)	+0	Set the condition signal by TARGET_REF type string. For details, refer to the following. ☞ Page 1158 TARGET_REF Structure The following shows the setting range of string.*2 ■Data type • [VAR] • [DEV] ■Type • PROFILE_SIGNAL_SELECT_ELEMENT * When "" (no setting) is set, reading/writing is not performed.
SkipSignal*1	Skip signal	WSTRING (63)	+64	Sets skip signal by TARGET_REF type string. For details, refer to the following. ☞ Page 1158 TARGET_REF Structure The following shows the setting range of string.*2 ■Data type • [VAR] • [DEV] ■Type • PROFILE_SIGNAL_SELECT_ELEMENT * When "" (no setting) is set, reading/writing is not performed.
PositioningData	Positioning data	WSTRING (63)	+128	Set positioning data by TARGET_REF type string. For details, refer to the following. ☞ Page 1158 TARGET_REF Structure The following shows the setting range of the string. ■Data type • [VAR] • [DEV] ■Type • PROFILE_POSITIONING_DATA_ELEMENT * When "" (no setting) is set, Read/Write data type incorrect (error code: 1BAAH) will occur.

*1 Specify PROFILE_SIGNAL_SELECT_ELEMENT [o..p] type structure for the PROFILE_POSITIONING_DATA_EXTENDED type member condition signal (ConditionSignal) and skip signal (SkipSignal).
From the element of the start number "o", reading/writing is performed for Condition signal 1 to Condition signal 10 (ConditionSignal1 to ConditionSignal10) or Skip signal 1 to Skip signal 10 (SkipSignal1 to SkipSignal10) accordingly.

*2 When the specified type does not satisfy the request of each structure member, Read/Write data type incorrect (error code: 1BAAH) will occur. When the specified data type does not satisfy the request of each structure member, Read/Write data data type incorrect (error code: 1BA8H) will occur.

■PROFILE_SIGNAL_SELECT_ELEMENT [o..p] type

PROFILE_SIGNAL_SELECT_ELEMENT [o..p]*1			Device offset (Total size: 76 points)	Description*2
Variable name	Name	Data type		
StartIO	I/O number	WORD (HEX)	+0	Not used. Ignores the setting.
Reserve1	Reserve 1	WORD (UINT)	+1	Not used. (For offset adjustment)
Target	Target	WSTRING (63)	+2	Set the signal to be used by the string. For details, refer to the following. ☞ Page 1158 TARGET_REF Structure The following shows the setting range of the string. • ""*3 ■Data type • [OBJ]*4 • [VAR] • [DEV] ■Type • BOOL
Detection	Signal detection method	MC_SIGNAL_LOGIC	+66	Specify the logic of signal. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel)
Reserve2	Reserve 2	WORD (UINT)	+67	Not used. (For offset adjustment)
CompensationTime	Compensation time	LREAL	+68	Set "0.0".
FilterTime	Filter time	LREAL	+72	Set the filter time for removing chattering of the I/O signals in units of seconds. • 0.0 to 5.0 [s]

*1 If the number of elements (p - o + 1) is less than 10, reading/writing is performed only for the number of elements.
If the number of elements for the specified variable is more than 10, the 11th and subsequent elements are not used.

*2 When writing data, no error occurs due to the setting value. When the written open area is used by the operation profile data control FB, an error occurs if it is outside the setting range.

*3 If the target (Target) is "" (string that has a length of 0), the corresponding skip signal is considered as not set.

*4 If [OBJ] is set, the target modification cannot be omitted. If the setting is complete with the target modification omitted, Operation profile data control specification profile incorrect (error code: 1B2CH) will occur.

Ex.

When setting the device/label of the condition signal (ConditionSignal), skip signal (SkipSignal), and positioning data (PositioningData) (20 points) in "Data2.Target"

Specification method	Setting example
Device*1	G_stPositioningDataExt.ConditionSignal := "[DEV](PROFILE_SIGNAL_SELECT_ELEMENT[1..10])D1000"; G_stPositioningDataExt.SkipSignal := "[DEV](PROFILE_SIGNAL_SELECT_ELEMENT[1..10])D2000"; G_stPositioningDataExt.PositioningData := "[DEV](PROFILE_POSITIONING_DATA_ELEMENT[1..20])D3000"; Data2.Target := "[VAR]G_stPositioningDataExt";
Label*1	G_stPositioningDataExt.ConditionSignal := "[VAR]G_st10ConditionSignal"; G_stPositioningDataExt.SkipSignal := "[VAR]G_st10SkipSignal"; G_stPositioningDataExt.PositioningData := "[VAR]G_st20PositioningDataElem"; Data2.Target := "[VAR]G_stPositioningDataExt";

*1 The following labels are declared on the global label.

Label name	Data type
G_stPositioningDataExt	PROFILE_POSITIONING_DATA_EXTENDED
G_st10SkipSignal	PROFILE_SIGNAL_SELECT_ELEMENT [1..10]*2
G_st10ConditionSignal	PROFILE_SIGNAL_SELECT_ELEMENT [1..10]*2
G_st20PositioningDataElem	PROFILE_POSITIONING_DATA_ELEMENT [1..20]*2

*2 Reading/writing data is as follows.
· G_st10ConditionSignal [n]: The nth condition signal (PROFILE_SIGNAL_SELECT_ELEMENT type)
· G_st10SkipSignal [n]: The nth skip signal (PROFILE_SIGNAL_SELECT_ELEMENT type)
· G_st20PositioningDataElem [n]: The nth positioning data (PROFILE_POSITIONING_DATA_ELEMENT type)

Digital cam switch data

■Setting item

The following table lists definitions required for digital cam switch data.

◎: Necessary, ○: Optional, —: Unnecessary

Item		Necessary item
Profile ID		◎
Periodic		◎*1
Input absolute coordinate		◎*1
Output absolute coordinate		◎*1
Operation profile data format		◎
Profile data type		—
Interpolation method specification		—
Resolution/number of coordinates		—
Start point		—
Initial stroke amount		—
Initial velocity		—
Initial acceleration		—
Options		◎
Number of switches		◎
Reference velocity		○
Switch settings	FirstOnPosition	◎
	LastOnPosition	○
	Direction	◎
	CamSwitchMode	◎
	Duration	—
Length per cycle		—
Unit setting		○
Unit character string		○
Ring counter lower limit value		○
Ring counter upper limit value		○
Time per cycle		—
Stroke amount		—
Unit setting		—
Unit character string		—

*1 Set "1".

■Number of switches

Set the total number of switches. The number of switches can be set from 1 to 10000. Switch settings (FirstOnPosition, LastOnPosition, Direction, CamSwitchMode, Duration) can be defined for the number of switches.

■Switch settings

Set conditions to turn on the switches.

For details on the relationship between digital cam switch actions and each switch setting, refer to the following.

☞ Page 1179 Switch settings

• FirstOnPosition

When CamSwitchMode is set to 0: Switch disabled, this setting is ignored.

When CamSwitchMode is set to 1: Position-based, set the lower limit position of a section where the switches are to be turned on.

• LastOnPosition

When CamSwitchMode is set to 0: Switch disabled, this setting is ignored.

When CamSwitchMode is set to 1: Position-based, set the upper limit position of a section where the switches are to be turned on.

Point

In the motion system, the relationship between FirstOnPosition and LastOnPosition is not checked.

For actions when FirstOnPosition is greater than LastOnPosition, refer to the following.

☞ Page 1179 Switch settings

• Direction

Set the conditions to turn on the switches according to the input change direction.

Setting value	Direction specification	Operation pattern
0	Both directions	Turns on the switches regardless of the input change direction.
1	Positive direction	Turns on the switches only when the input change direction is in the positive direction.
2	Negative direction	Turns on the switches only when the input change direction is in the negative direction.

• CamSwitchMode

Set the method for specifying the conditions to turn on the switches.

Setting value	Specification method	Description
0	Switch disabled	Disables the switch.
1	Position-based	Specify the lower limit position at which the switches are to be turned on in FirstOnPosition. Specify the upper limit position at which the switches are to be turned on in LastOnPosition.

■Read/write data structure

Specify the following structures for Read data 1/Write data 1 (Data1) and Read data 2/Write data 2 (Data2) of MCv_ReadProfileData (Profile Read)/MCv_WriteProfileData (Profile Write).

Specify the sections to be controlled by using Offset (Offset) and Number of read/write data (Points).

• Read data 1/Write data 1 (Data1): Specify the PROFILE_CAMSWITCH_DATA type structure.

PROFILE_CAMSWITCH_DATA	Data type	Device offset (Total size: 80 points)	Description
InputUnitString	WSTRING (31)	+0	Sets the unit for input data with a character string.
NumberOfSwitches	DWORD (UDINT)	+32	Specify the number of switches. 1 to 10000
Options	DWORD (HEX)	+34	Specify options. ■Periodic (bit 0)*1 • 0: Non periodic • 1: Periodic For details, refer to the following. ☞ Page 804 Repetitive operation ■Input absolute coordinate (bit 1)*1 • 0: Relative coordinate • 1: Absolute coordinate For details, refer to the following. ☞ Page 809 Master axis absolute coordinate ■Output absolute coordinate (bit 2)*1 • 0: Relative coordinate • 1: Absolute coordinate For details, refer to the following. ☞ Page 809 Slave axis absolute coordinate * For bits 3 to 31, specify "0".
ReferenceSpeed	LREAL	+36	This setting is not used. Leave the default. (Default: 0.0)
ReferenceSpeedUnitString	WSTRING (31)	+40	This setting is not used. Leave the default. (Default: Empty)
RingCount_LowerValue	LREAL	+72	Set the ring counter lower limit value.
RingCount_UpperValue	LREAL	76	Set the ring counter upper limit value.

*1 Specify "1".

• Read data 2/Write data 2 (Data2): Specify the PROFILE_CAMSWITCH_ELEMENT type structure array.

PROFILE_CAMSWITCH_ELEMENT[m..n]*1	Data type	Device offset (Total size: 16 points)	Description
FirstOnPosition	LREAL	+0	Set the lower limit position at which the switches are to be turned on or the start position at which the switches are to be turned on. -10000000000.0 ≤ FirstOnPosition ≤ 10000000000.0
LastOnPosition	LREAL	+4	Set the upper limit position at which the switches are to be turned on. -10000000000.0 ≤ LastOnPosition ≤ 10000000000.0
Direction	INT	+8	Set the input direction in which the switches are to be turned on. • 0: Both directions • 1: Positive direction • 2: Negative direction
CamSwitchMode	INT	+9	Set how to specify the ON conditions. • 0: Switch disabled • 1: Position-based
Reserve	DINT	+10	Not used because this item is used for offset adjustment.
Duration	LREAL	+12	This setting is not used. The setting value is ignored.

*1 m and n will be any positive numbers that satisfy the following formula.
1 (Minimum number of switches) ≤ (n - m + 1)
When reading/writing the entire operation profile data (Offset and Points are set to 0), set it to be Number of switches (PROFILE_CAMSWITCH_DATA.NumberOfSwitches) of the target digital cam switch data or more.
However, an area larger than the number of switches read by Data1 is not updated when using MCv_ReadProfileData (Profile Read).
An area larger than the number of switches specified by Data1 is not used when using MCv_WriteProfileData (Profile Write).

Creating operation profile data

This section describes storage format and creating method of the operation profile data.

Storage format

The following storage format can be used as the operation profile data in the motion system.

Storage format	Description	Characteristics
Standard text format	Stores the operation profile data as a standard text file (csv file).	The data created in the engineering tool can be stored in this format.

Creating method when not using the engineering tool

When using the operation profile data in the control without using the engineering tool, execute the following procedures.

■When creating the operation profile data by a program

1. Store data (read/write data structure for each type) corresponding to the operation profile data format that will be created on the variables (labels and devices).
2. Set the profile data type (standard/function specific) label as needed. (When storing created operation profile data in the file, set the storage location in Operation profile data storage location (Location).)
3. When executing the operation profile data write FB, the control ID can be obtained in the profile ID type (standard/function specific) label.
4. Execute the control FB by using the profile ID type (standard/function specific) label.

■When using the operation profile data created outside

1. Store the operation profile data in an arbitrary place such as a user drive and an SD memory card.
2. Set the storage location in Operation profile data storage location (Location) of the profile data type (standard/function specific) label.
3. When executing the open FB, the control ID can be obtained in the profile ID type (standard/function specific) label.
4. Execute the control FB by using the profile ID type (standard/function specific) label.

Creating method when using the engineering tool

When the operation profile data is created in the engineering tool, the profile data type global label whose label name is the operation profile data name is automatically added, and it can be used in the program. The set description (storage location and ID) is reflected as the label initial value.
When a profile ID type whose profile data type is "function-specific" is included as a member, the setting details are reflected to the profile ID type of "function-specific" as the initial value.

Ex.
When the operation profile data of "name: ProfileData0001", "format: cam data", and "profileID: 1" is created, ProfileData0001.CamID.ProfileID initial value is "1". (Same as the initial value of ProfileData0001.ProfileData.ID.Number.)
The profile ID type of "function specific type" can be used as input/output parameters or an input parameter of the operation profile data control FB.

Point

- Profile data type labels created by the engineering tool cannot be edited on the global label editor. Be sure to create and edit it on the operation profile data create window.
- The default write destination for operation profile data created by the engineering tool is "/rom/$MELPRJ$/calc_profile_" or "/sdc/$MELPRJ$/calc_profile_". Files within this folder (including the sub folders) may be overwritten or deleted by the engineering tool operation. Therefore, store the operation profile data file created by the program in a location other than the folder above (including the sub folders).

■File batch online change and writing to the programmable controller

When operation profile data is added by file batch online change or writing to the programmable controller, it is not automatically expanded after completion. The added operation profile data is expanded at power-on.
Do not execute a file batch online change or writing to the programmable controller while the program is accessing the storage area. It may corrupt the file.

Operating operation profile data

Operation profile data uses files and open areas, and performs operation profile data manipulation and operation profile data controls.

Operation profile data related function		Description
Operation profile data manipulation	Operation profile data open	Performs open of operation profile data from "File" to "Open area".
	Operation profile data read/write	Performs read/write of operation profile data of "File" and "Open area". Uses read/write data structure.
	Operation profile data deletion	Deletes the operation profile data of "File".
Operation profile data control		Performs control by using operation profile data of "Open area".

Data type of operation profile data

The profile data type and the profile ID type can be used as the data type to perform operation profile data manipulation/ operation profile data controls.

- "File" is managed by the profile data type labels.
  Specify the file path and file name in Operation profile data storage location (PROFILE_DATA.Location).
- "Open area" is managed by the profile ID type labels.
  When writing operation profile data in the open area by the operation profile data manipulation (open/write), the ID is assigned in the open area by specifying arbitrary ID for Profile ID No. (PROFILE_ID.Number).
- Control can be carried out by specifying the label of profile ID type at the operation profile data controls.

Entity of operation profile data	Description	Data type for operation/control	Remarks
File	Written by the following operation. • Write from the engineering tool • Operation profile data write FB execution (The write destination is "File")	Profile data type • General type (PROFILE_DATA type) • Function specific type (MC_CAM_REF type or others)	Data is preserved even when the power turns off.
Open area	Written by the following operation. • Operation profile data expand execution (Auto expand/operation profile data expand FB execution) • Operation profile data write FB execution (The write destination is "Open area")	Profile ID type • General type (PROFILE_ID type) • Function specific type (MC_CAM_ID type or others)	Data actually used in the control is stored. The data is deleted when the power turns off.

Point

Even if the data in open area is changed by MCv_WriteProfileData (Profile Write) (open area specification) during operation, the change is deleted when the power turns off. To hold the change, write to the file by MCv_WriteProfileData (Profile Write) (file specification).

■Details of profile data type/profile ID type

The profile data type structure and the profile ID type structure include "general-purpose type" which does not limit functions and "function specific type" which is used for the specific functions (FB). "Function specific type" includes "general-purpose type" in the member. Furthermore, the profile data type of "function specific type" includes the profile ID type of "function specific type" as a member. Create instances of variable corresponding to the FB argument type to use.

Type name	General-purpose type	Function specific type	Description
Profile data type	PROFILE_DATA	• MC_CAM_REF • MC_POSITIONING_DATA_REF • MC_CAMSWITCH_REF	Indicates the operation profile data with the following configurations. • Operation profile data storage location (FILE_Location) • Profile ID (PROFILE_ID) • I/O number • Profile ID type of function specific type (MC_CAM_ID or others)
Profile ID type	PROFILE_ID	• MC_CAM_ID • MC_POSITIONING_DATA_ID • MC_CAMSWITCH_DATA_REF	Data type to specify the operation profile data to use in the operation profile data control FB (MC_CamIn (Cam Operation Start) or others) A unique identifiable No. is given by the operation profile data expand FB (MC_CamTableSelect (Cam Table Selection) or others) • Profile ID No. (Number) • I/O number • Flag in use

The following table shows data type and open FBs that can be used for each function.

Function (Operation profile data control)	Profile data type	Profile ID type	Open FB
Cam operation (MC_CamIn (Cam Operation Start))	MC_CAM_REF	MC_CAM_ID	MC_CamTableSelect (Cam Table Selection)
Multiple axes positioning data operation (MCv_MovePositioningData (Multiple Axes Positioning Data Operation))	MC_POSITIONING_DATA_REF	MC_POSITIONING_DATA_ID	—
Digital cam switch output (MC_DigitalCamSwitch (Digital Cam Switch Output))	MC_CAMSWITCH_REF	MC_CAMSWITCH_DATA_REF	—
Advanced synchronous control (MCv_AdvancedSync (Advanced Synchronous Control))	MC_CAM_REF	MC_CAM_ID	MC_CamTableSelect (Cam Table Selection)
Advanced synchronous control current position per cycle calculation (MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation))	MC_CAM_REF	MC_CAM_ID	MC_CamTableSelect (Cam Table Selection)
Advanced synchronous control cam set position calculation (MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation))	MC_CAM_REF	MC_CAM_ID	MC_CamTableSelect (Cam Table Selection)

■Operation profile data operation in the engineering tool

When operating from the engineering tool, the set operation profile data file reads, writes to, and verifies files. Operation profile data file cannot read, write to, or verify the open area.

■Capacity of operation profile data

Data size that created operation profile data file uses is as shown below.

Operation method	Operation profile data format	Open area
Create with the engineering tool/ Create with operation profile data manipulation function	Cam data	■When Interpolation Method Specification (Interpolate) is "0: Linear Interpolation": Management information (1K bytes) + Number of coordinates × 8 × 2 bytes ■When Interpolation Method Specification (Interpolate) is "1: Section interpolation" or "2: Spline interpolation": Management information (1K bytes) + Resolution × 8 bytes
	Rotary cutter	Management information (1K bytes) + Resolution × 8 bytes
	Digital cam switch data	Management information (1K bytes) + Total number of switches × 32 bytes
	Multiple axes positioning data	Management information (1K bytes) + 3200 bytes + Total number of positioning data × 176 bytes

In operation profile data open processing, the memory used is as follows: temporarily twice the data size of open area when cam data (Interpolation Method Specification (Interpolate) is "1: Section interpolation" or "2: Spline interpolation") and rotary cutter are used; and the same data size as that of open area for other cases.

Operation profile data expansion

This section describes auto expand and expand.

Expand the operation profile data created by "File" to "Open area" because operation profile data of "Open area" is used for operation profile data control.

The method to expand to "Open area" has the following two types.

- Auto expand
- Operation profile data expand FB execution

■Auto expand of operation profile data

Operation profile data, which is created using the engineering tool and set for auto expand, is expanded automatically when the controller is powered on. Therefore, it can be used for operation profile data control without executing an operation profile data expand FB.

The operation profile data satisfying all the following conditions can be used for its control without executing the operation profile data expand FB because it is also expanded automatically when the controller is powered on.

- Other than "0" is specified to the initial value of Profile ID No. (PROFILE_DATA.ID.Number).
- The operation profile data is stored in "%CALC_PROFILE_ROOT_DRIVE%/calc_profile_/".
- No error such as out of the setting range in the data to be expanded.

The operation profile data for automatic expansion is searched from both "%CALC_PROFILE_ROOT%/calc_profile_/" and "%CALC_PROFILE_ROOT_DRIVE%/calc_profile_/".

When operation profile data with the same ID is stored in both paths above, the operation profile data stored in "%CALC_PROFILE_ROOT_DRIVE%/calc_profile_/" has priority.

When automatically expanding operation profile data from a location other than the data memory (drive 4), change the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive).

Ex.

When automatically expanding operation profile data on the SD memory card, set the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive) to /sdc.

If the specified drive is not available, such as when an SD memory card is not inserted, no error occurs and no operation is performed.

The motion function section will not enter into RUN state until all operation profile data is automatically expanded. If there are many operation profile data, it may take time for the motion function section to enter into RUN state.

Point

- When auto expand is set, regarding Profile ID No. (PROFILE_DATA.ID.Number), Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) which can be specified in the operation profile data expand FB, the same parameters in the csv file are expanded.
- When there is operation profile data which does not meet the requirement above during auto expand, Details of the error are registered in the event history without automatically expanding the profile data. In this case, the operation continues until automatically expanding the remaining operation profile data, without ending because of error.

■Operation profile data expansion

Expands "File" specified in Operation Profile Data Storage Location (PROFILE_DATA.Location) to "Open area" by using MC_CamTableSelect (Cam Table Selection).

- Expanded data to "Open area" is assigned profile IDs expressed in the profile ID type.
- The operation profile data expand FB that can be used differs depending on the defined profile data type. For details, refer to the following.

  ☞ Page 826 Operation profile data types

  If an operation profile data expand FB that does not support the profile data type is executed, Operation profile data incorrect (error code: 1B8FH) occurs.
- When an error has occurred while expanding the operation profile data, "Open area" in processing is discarded.

When Operation profile data storage location (PROFILE_DATA.Location) is a relative path and the operation profile data is expanded from a location other than the data memory (drive 4), change the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive).

Ex.

When automatically expanding operation profile data on the SD memory card, set the operation profile data root drive (MotionSystem.PrConst.ProfileRootDrive) to /sdc.

Precautions

When rewriting "Open area" during control, the stroke value changes rapidly, and shock may be applied to the machine depending on the waveform pattern. Create operation profile data so that the waveform before and after change does not become discontinuous.

Point

- Expansion process of the operation profile data is performed with motion service processing. It may take time to open depending on the processing details and the operation profile data.
- When Profile ID No. (PROFILE_DATA.ID.Number), Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) are present as input arguments for the operation profile data expand FB, the value set in "File" is ignored and the expansion is performed while referencing the input argument settings. (The setting value of "File" is not overwritten.)

Read/write operation profile data

Performs read/write of operation profile data.

Performs read/write of file and operation profile data in open area by using MCv_ReadProfileData (Profile Read)/ MCv_WriteProfileData (Profile Write) according to data structure for read/write.

Read/write is available for operation profile data format to which the data structure for read/write is defined. For details on the data structure for read/write of each operation profile data format, refer to the following.

☞ Page 826 Operation profile data types

If an error occurs while operation profile data is being written, the open area and the file in processing are discarded.

Point

The number of data points that can be read/written at the same time is limited. If read/write is not completed in one time FB execution, perform it in several times.

■Read operation profile data

Operation profile data can be read by using the MCv_ReadProfileData (Profile Read).

- The file specified in Profile data (ProfileData) and Read destination (Target), or the operation profile data in open area are read for the number of points specified in Number of read data (Points) from data specified with Offset (Offset).
- To read the entire operation profile data, specify "0" in both Offset (Offset) and Number of read data (Points).
- Read data is stored in variables specified in Read data 1 (Data1) and Read data 2 (Data2).

■Write operation profile data

Performs write of operation profile data.

Operation profile data can be written by using the MCv_WriteProfileData (Profile Write).

- The file specified in Profile data (ProfileData) and Write destination (Target), or the operation profile data in open area are written for the number of points specified in Number of write data (Points) from data specified with Offset (Offset).
- To write the entire operation profile data, specify "0" in both Offset (Offset) and Number of write data (Points).
- Write data is specified with variables specified in Write data 1 (Data1) and Write data 2 (Data2).

Operation profile data deletion

Operation profile data can be deleted by file batch online change or writing to the programmable controller. When operation profile data has been deleted, the file is deleted during file batch online change or when writing to the programmable controller.

Control of operation profile data

Operation profile data is used for control of each function.

Control details

The input data of operation profile data control FB is the PROFILE_ID type and the control is executed based on the specified operation profile data. Before executing operation profile data control, open the operation profile data corresponding to each operation profile data control FB in the open area to enable this control.

For the operation profile data control FB corresponding to each operation profile data, refer to the following.

Operation profile data format	Operation profile data control FB	Details
Cam data Rotary cutter	• MC_CamIn (Cam Operation Start) • MCv_AdvancedSync (Advanced Synchronous Control) • MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation) • MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)	For details, refer to the following. ☞ Page 784 Cam Operation ☞ Page 889 ADVANCED SYNCHRONOUS CONTROL
Digital cam switch data	MC_DigitalCamSwitch (Digital Cam Switch Output)	For details, refer to the following. ☞ Page 1175 DIGITAL CAM SWITCH
Multiple axes positioning data	MCv_MovePositioningData (Multiple Axes Positioning Data Operation)	For details, refer to the following. ☞ Page 665 Multiple Axes Positioning Data Operation

Start mode

The following shows the operation when simultaneously executing various FBs (open, write, read, control) that access open areas of operation profile data to the same profile ID.

Execution mode (ExecutionMode)

For the operation profile data expand FB and the operation profile data write FB, the operation for simultaneous execution can be specified with Execution mode (ExecutionMode).

○: Execution possible, ×: Error

On-going FB	FB to be executed			
	Open/Write			Read/Control
	0: Execute Immediately (mcImmediately)	1: Execute at Completion of Previous One (mcQueued)	3: Execute Speculatively (mcSpeculatively)	
Open/Write	○	○	×	×
Read/Control	○	○	×	○

■0: Execute Immediately (mcImmediately)

The description in the open area is immediately changed by an open FB and a write FB. The change may affect the control in execution.

However, if the state falls under one of the following cases when executing open/write during FB execution, Operation profile data being operated (error code: 1B90H) occurs.

- The operation profile data format to open/write and the open area operation profile data format do not match.
- The operation profile data capacity to open/write and the open area capacity*1 do not match.

*1 For the open area capacity, refer to the following.
☞ Page 865 Capacity of operation profile data

■1: Execute at Completion of Previous One (mcQueued)

Waits execution completion of on-going FB. When multiple FBs are waiting, the FBs will be executed in high priority task. For the same priority, the FBs will be executed in the order of the start.

The status of execution completion of each FB is shown below.

FB	Status
MC_CamTableSelect (Cam Table Selection)	Execution completion (Done) = TRUE
MCv_ReadProfileData (Profile Read)	Execution completion (Done) = TRUE
MCv_WriteProfileData (Profile Write)	Execution completion (Done) = TRUE
MC_CamIn (Cam Operation Start)	Periodic (MC_CamTableSelect.Periodic) = TRUE: Abortion of execution (MC_CamIn.CommandAborted) = TRUE Periodic (MC_CamTableSelect.Periodic) = FALSE: Abortion of execution (MC_CamIn.CommandAborted) = TRUE, Cam cycle completion (MC_CamIn.EndOfProfile) = TRUE
MCv_AdvancedSync (Advanced Synchronous Control)	Executing (Busy) = FALSE
MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation)	Executing (Busy) = FALSE
MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)	Executing (Busy) = FALSE
MC_DigitalCamSwitch (Digital Cam Switch Output)	Executing (Busy) = FALSE
MCv_MovePositioningData (Multiple Axes Positioning Data Operation)	Busy = FALSE, and MCv_MovePositioningData (Multiple Axes Positioning Data Operation) running profile number (CurrentProfileNo) = 0

■3: Execute Speculatively (mcSpeculatively)

Operation profile data being operated (error code: 1B90H) occurs and the open area is not changed.

Point

When no FB is in execution, the FB is executed immediately regardless of specification of Execution mode (ExecutionMode).

While the FBs (open, write, read, control) that access open areas are in execution, Executing (Busy) of each FB is TRUE. Use this signal for the interlock as needed.

Sub function of operation profile data

Current value change per cycle function

Change the current value per cycle of an operation profile data control FB to an arbitrary value.

- Sets Instance ID (MC_CamIn.InstanceID) of the target operation profile data control FB (hereinafter called to as MC_CamIn) to Instance ID (InstanceID) of MCv_ChangeCycle (Current Value Change per Cycle).
- Public variables of MC_CamIn are shown below when current value change per cycle is performed.

Public variable	Updating value	Remarks
Current value per cycle (InputPerCycle)	Value specified in Current value per cycle (Cycle[])	—
Reference value (Reference)	Stroke value equivalent to Current value per cycle (Cycle[])	Reference value (MC_CamIn.Reference) is refreshed to fix Output value (MC_CamIn.OutputData).
Output value (OutputData)	Not updated	—

Point

Even if Slave axis absolute coordinate (MC_CamTableSelect.SlaveAbsolute) is TRUE (absolute coordinate), Reference value (Reference) is refreshed to fix Output value (OutputData) if current value change per cycle is performed.

- The method for current value change per cycle is as follows.

Method	Description
MCv_ChangeCycle (Current Value Change per Cycle)	Change it to the specified value at control execution.

- For specification of the current value per cycle to be changed, "absolute specification" or "relative specification" can be selected by Relative position selection (Relative).
- If Current value change per cycle is performed for an operation profile data control FB other than MC_CamIn, Current value change per cycle unsupported (error code: 1BAFH) occurs.

■Current value change per cycle

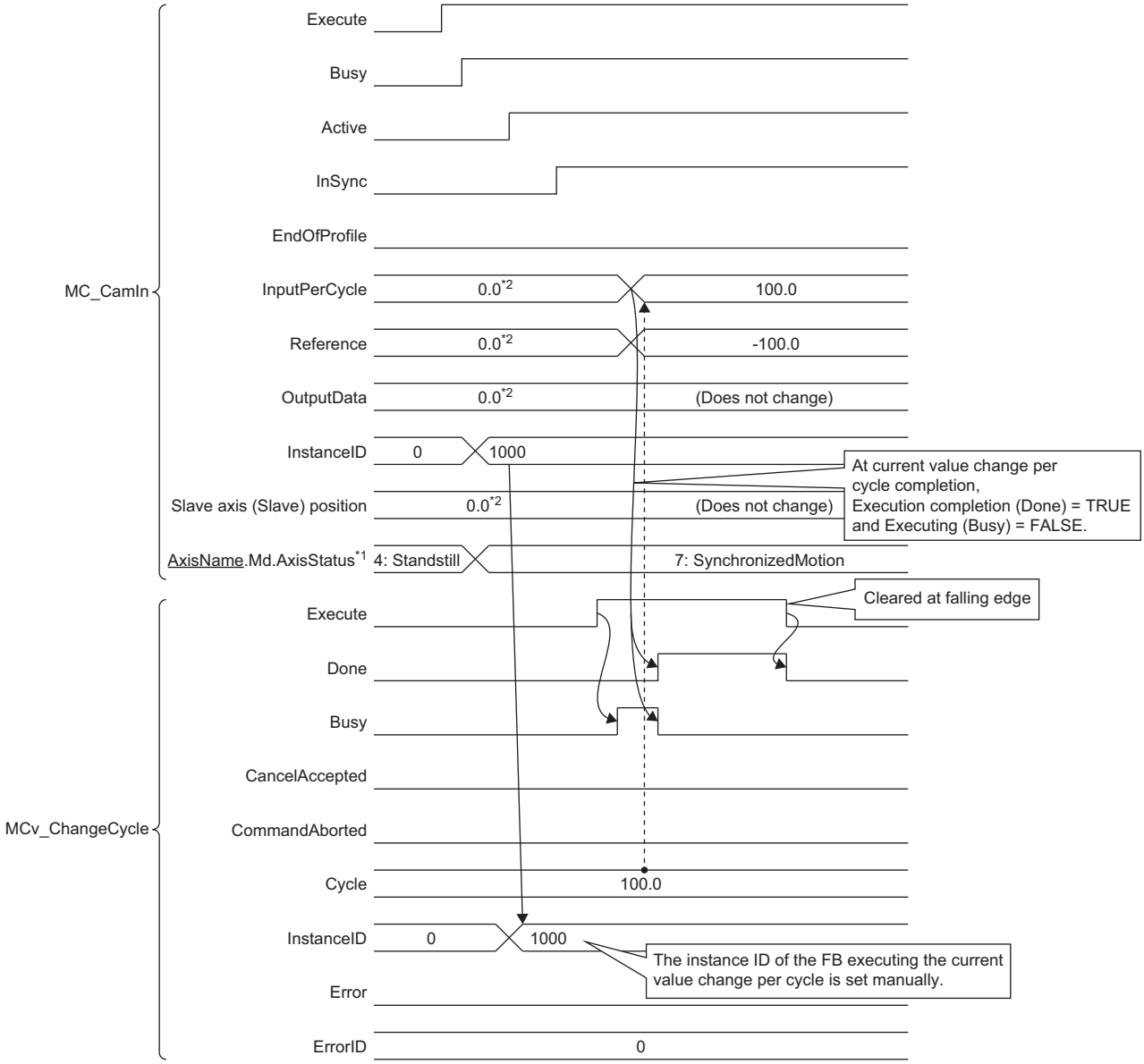
Uses MCv_ChangeCycle (Current Value Change per Cycle).

Changes the current value per cycle of the specified operation profile data control FB.

Executes current value change per cycle at rising edge detection of Execute command (Execute).

Ex.

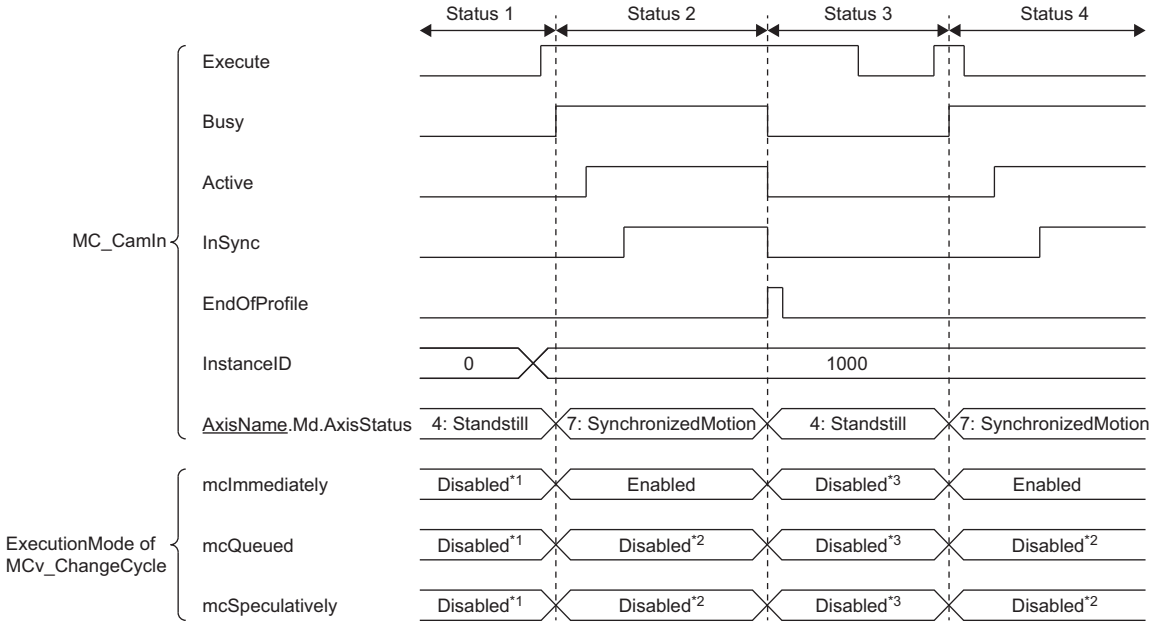
Sets Current value per cycle (Cycle) = 100.0 when Executing (MC_CamIn.Busy) = TRUE, and when executing current value change per cycle. (Current value of Master axis (Master) of MC_CamIn (Cam Operation Start) shall not change.)



*1 This is the state of Slave axis (Slave).

*2 Does not change because the master axis does not move.

Current value change per cycle timing by each value



*1 MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 000AH) occurs.

*2 MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 0002H) occurs.

Operation details for each status are shown below.

Status of FB of current value change per cycle target		Condition of state transition (Status change of the slave axis)		Operation of current value change per cycle
		Before transition	After transition	
Status 1	FB is not started	—(Initial state)	4: Standby (Standstill)	MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 000AH) occurs regardless of Execution mode (ExecutionMode).
Status 2	FB is starting	4: Standby (Standstill)	7: During synchronous operation (SynchronizedMotion)	Depending on Execution mode (ExecutionMode), the timing is as follows ■0: Execute Immediately (mcImmediately) Current value change per cycle can be executed. The current value is reflected at the execution cycle of the change target FB. ■1: Execute at Completion of Previous One (mcQueued) MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 0002H) occurs. ■3: Execute Speculatively (mcSpeculatively) MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 0002H) occurs.
Status 3	After completion of FB control	7: During synchronous operation (SynchronizedMotion)	4: Standby (Standstill)	Current value change per cycle cannot be executed regardless of Execution mode (ExecutionMode). MCv_ChangeCycle instruction error (error code: 1BB9H) (Detail Code: 000AH) occurs.
Status 4	After restart of FB	4: Standby (Standstill)	7: During synchronous operation (SynchronizedMotion)	The operation is the same as Status 2. Then, the cycle of Status 4 (Status 2) → Status 3 →, ··· will be repeated. Current value change per cycle operation is not affected even Execute command (Execute) has TRUE/FALSE differences in Status 2 and Status 4.

Precautions

Relevant add-ons

The following add-ons are required to use this function.

- ProfileControl
- PackagingApp (when using the rotary cutter)

System memory capacity

■RAM usage

Refer to the following.

☞ Page 865 Capacity of operation profile data

■Backup RAM usage

Backup RAM is not used.

32.2 Operation Profile Data Format

This section describes csv file format of operation profile data.

Point

- "//" comment lines are not counted among line Nos.
- 8 byte specification data is imported as the double-precision real number type.

Operation profile data details

The basic configuration of profile data is shown below.

Line No.	Description
1	Common header
2	Open information
3	Operation profile data format
4	Resolution/number of coordinates
5	Start point, initial stroke amount, options
6	Number of sections
7 or later	Defined for each operation profile data format
N-2*1	Length per cycle
N-1*1	Stroke amount
N*1	Common footer (EOF)
N+1*1	Common footer (CRC)

*1 "N" is calculated as shown below by Interpolation Method Specification (Interpolate) in the operation profile data format.

Operation profile data format	Interpolation method specification (Interpolate)	N
Cam data format	0: Linear interpolation	7 (start row of previous step) + (number of coordinates × 2) + 2 (length of 1 cycle, stroke amount)
	1: Section interpolation	7 (start row of previous step) + Number of sections + 2 (length of one cycle, stroke amount)
	2: Spline interpolation	
Multiple axes positioning data format	—	7 (start row of previous step) + 1 (row: total number of positioning data) + 1 (row: condition signal) + 1 (row: skip signal) + Number of sections + 2 (length of 1 cycle, stroke amount)
Digital cam switch data format	—	7 (start row of previous step) + Number of sections + 2 (length of one cycle, stroke length)

Common items

The common items as operation profile data are shown below.

○: Omission possible, ×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
1	1	Header tag	×	[HEADER]	String	Fixed string	0x0103
	2	File version	×	0x0103	Unsigned integer	Fixed value	0x0103
	3	For manufacturer 1	×	Arbitrary	Unsigned integer	To create a csv file externally, set 0.	0x0103
	4	For manufacturer 2	×	Arbitrary	String	To create a csv file externally, set 0.	0x0103
	5	For manufacturer 3	×	Arbitrary	Unsigned integer	To create a csv file externally, set 0.	0x0103
	6	For manufacturer 4	×	Arbitrary	Unsigned integer	To create a csv file externally, set 0.	0x0103
	7	For manufacturer 5	×	Arbitrary	Unsigned integer	To create a csv file externally, set 0.	0x0103

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
2	1	Profile ID	×	☞ Page 824 Operation Profile Data • Initial value: 0 (= automatic apply)	Unsigned integer	Specifies Profile ID. (Use only when carrying out automatic open when the power of the controller turns on.)	0x0103
	2	Periodic	○	☞ Page 824 Operation Profile Data	Integer	Specifies periodic.	0x0103
	3	Input absolute coordinate	○	☞ Page 824 Operation Profile Data	Integer	Specifies input absolute coordinate.	0x0103
	4	Output absolute coordinate	○	☞ Page 824 Operation Profile Data	Integer	Specifies output absolute coordinate.	0x0103
3	1	Operation profile data format	×	99: Cam data format 123: Cam data format for rotary cutter (Specifying a double-precision real number) 1000: Multiple axes positioning data format	Integer	Specifies operation profile data format.	0x0103
	2	Profile data type	○	1: Cam data • Initial value: 0 6: Digital output data 200: Multiple axes positioning data	Integer	Specifies the profile data type. ☞ Page 824 Operation Profile Data	0x0103
	3	Interpolation method specification	○	0: Linear interpolation 1: Section interpolation 2: Spline interpolation • Initial value: 0	Integer	Specifies the interpolation method between data.	0x0103
4	1	Resolution/number of coordinates	×	☞ Page 824 Operation Profile Data • Initial value: 0	Unsigned integer	Sets the resolution or the number of coordinates.	0x0103
5	1	Start point	○	*1 99: Valid for the cam data format (specified for each section, spline interpolation) • Initial value: 0	Real number	Specifies the start point.	0x0103
	2	Initial stroke amount	○	*1 99: Valid for the cam data format (specified for each section, spline interpolation) • Initial value: 0	Real number	Specifies the initial stroke amount.	0x0103
	3	Initial velocity	○	*1 99: Valid for the cam data format (specified for each section) • Initial value: 0	Real number	Specifies the initial velocity.	0x0103
	4	Initial acceleration	○	*1 99: Valid for the cam data format (specified for each section) • Initial value: 0	Real number	Specifies the initial acceleration.	0x0103
	5	Options	○	*2 • Initial value: 0	Unsigned integer	Defines for each operation profile data format.	0x0103
6	1	Number of sections	×	*2 • Initial value: 0	Unsigned integer	Specifies the number of sections for the data format that requires it. Specify "0" for the data format that does not require it.	0x0103

*1 Differs depending on the data format.

*2 Depends on the operation profile data format.

■(N-2)th line: Length per cycle

○: Omission possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
N-2	1	Length per cycle	○	0 or more*1	Real number	Specifies the length per cycle. Specify "0" for the data format that does not require it.	0x0103
	2	Unit setting	○	■Rules F: An arbitrary unit • Initial value: 0x0F	Unsigned integer	Specifies the unit of the length per cycle.	0x0103
	3	Unit character string	○	31 characters maximum • Initial value: "" ☞ Page 490 Units	String	Specifies an arbitrary character string when "an arbitrary unit" is set to the unit setting.	0x0103
	4	Minimum value per cycle (Ring counter lower limit value)*3	○	*2 • Initial value: 0.0	Real number	Defines for each operation profile data format. Specify "0" for the data format that does not require it.	0x0103
	5	Maximum value per cycle (Ring counter upper limit value)*3	○	*2 • Initial value: 0.0	Real number	Defines for each operation profile data format. Specify "0" for the data format that does not require it.	0x0103
	6	Time per cycle	○	0 or more*1	Real number	Specifies the time per cycle. Specify "0" for the data format that does not require it.	0x0103

*1 The maximum value differs depending on the data format.
*2 Differs depending on the data format.
*3 It is the item name for the digital cam switch.

■(N-1)th line: Stroke amount

○: Omission possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
N-1	1	Stroke amount	○	*1	Real number	Specifies the stroke amount. Specify "0" for the data format that does not require it.	0x0103
	2	Unit setting	○	■Rules F: An arbitrary unit • Initial value: 0x0F	Unsigned integer	Specifies the unit of stroke amount.	0x0103
	3	Unit character string	○	31 characters maximum • Initial value: "" ☞ Page 490 Units	String	Specifies an arbitrary character string when "an arbitrary unit" is set to the unit setting.	0x0103

*1 Differs depending on the data format.

■(N)th line: Common footer (EOF)

○: Omission possible, ×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
N	1	Last line tag	×	EOF: 3 characters	String	Fixed string	0x0103
N+1	1	File CRC	○	Arbitrary	Unsigned integer	Indicates the file CRC. To create a csv file externally, omit this line.	0x0103

Interpolation method specification (Interpolate): "0: Linear interpolation"

The following shows a case for specifying setting values below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	99: Cam data format
	3	Interpolation method specification (Interpolate)	0: Linear interpolation

■6th line: Number of sections

Specify 0.

■7th line or later: I/O data

×: Omission impossible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Input value (0th point)	×	☞ Page 496 Positioning Range	Real number	☞ Page 824 Operation Profile Data	0x0103
8	1	Output value (0th point)	×		Real number		0x0103
9	1	Input value (1st point)	×		Real number		0x0103
⋮							
For the number of coordinates × 2	1	Output value (nth point) (For the number of coordinates)	×	☞ Page 496 Positioning Range	Real number	☞ Page 824 Operation Profile Data	0x0103

Interpolation method specification (Interpolate): "1: Section interpolation"

The following shows a case for specifying setting values below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	99: Cam data format
	3	Interpolation method specification (Interpolate)	1: Section interpolation

■6th line: Number of sections

Specify the number of sections.

■7th line or later: Parameter

○: Omission possible, ×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Cam curve types	×	Sets the cam curve with a value. For settable curves, refer to the following. ☞ Page 824 Operation Profile Data	Integer	☞ Page 824 Operation Profile Data	0x0103
	2	End point	×	☞ Page 824 Operation Profile Data	Real number		0x0103
	3	Stroke	×		Real number		0x0103
	4	Curve applicable range (P1)	○		Real number		0x0103
	5	Curve applicable range (P2)	○		Real number		0x0103
	6	Acceleration/deceleration range compensation (Range L1)	○		Real number		0x0103
	7	Acceleration/deceleration range compensation (Range L2)	○		Real number		0x0103
	8	End point velocity	○		Real number		0x0103
	9	End point acceleration	○		Real number		0x0103
8	1-7	Same as line No.7					
⋮ (For the number of sections)							

Interpolation method specification (Interpolate): "2: Spline Interpolation"

The following shows a case for specifying setting values below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	99: Cam data format
	3	Interpolation method specification (Interpolate)	2: Spline interpolation

■6th line: Number of sections

Specify the number of sections.

■7th line or later: Parameter

×: Omission impossible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	End point	×	☞ Page 824 Operation Profile Data	Real number	☞ Page 824 Operation Profile Data	0x0103
	2	Stroke	×		Real number		0x0103
8	1-2	Same as line No.7					
⋮ (For the number of sections)							

Cam data format for rotary cutter (Specifying a double-precision real number)

The following shows a case for specifying setting values below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	123: Cam data for rotary cutter (Specifying a double-precision real number)

■6th line: Number of sections

Specify 0.

■7th line or later: Parameter

×: Omission impossible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Auto-generation options	×	☞ Page 824 Operation Profile Data	Unsigned integer	☞ Page 824 Operation Profile Data	0x0103
	2	Synchronous section acceleration ratio	×		Real number		0x0103
	3	Sheet length	×		Real number		0x0103
	4	Sheet synchronization width	×		Real number		0x0103
	5	Synchronous axis length	×		Real number		0x0103
	6	Synchronous position adjustment	×		Real number		0x0103
	7	Acceleration/deceleration width	×		Real number		0x0103
	8	Number of cutters	×		Unsigned integer		0x0103

Digital cam switch data format

The following shows a case for specifying setting values below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	150: Digital cam switch data format

■6th line: Number of sections

Line No.	Column No.	Item	Omission	Setting range	Setting format	Description	Supported file version
6	1	Number of sections	×	1 to 10000	Unsigned integer	Set the total number of switches.	0x0103

■7th line: Reference velocity

○: Omission possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Reference velocity	○	0.0 or later	Real number	Specify the reference velocity. This setting is used for displaying signal on/off waveforms on the engineering tool when CamSwitchMode is set to time-based. Set "0.0" when not using the time-based setting.	0x0103
	2	Unit character string	○	☞ Page 824 Operation Profile Data Initial value: ""	String	Specify any string. When CamSwitchMode is set to time-based, waveforms cannot be displayed on the engineering tool if a string other than the strings that can be specified is stored (such as min and s).	0x0103

■8th line or later: Switch settings

○: Omission possible, ×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
8	1	FirstOnPosition of switch 1	×	☞ Page 824 Operation Profile Data	Real number	☞ Page 824 Operation Profile Data	0x0103
	2	LastOnPosition of switch 1	○		Real number		0x0103
	3	Direction of switch 1	×		Integer		0x0103
	4	CamSwitchMode of switch 1	×		Integer		0x0103
	5	Duration of switch 1	○		Real number		0x0103
9	1	Duration of switch 2	×	☞ Page 824 Operation Profile Data	Real number	☞ Page 824 Operation Profile Data	0x0103
⋮							
8 + (Number of switches)	5	Duration of switch 10000	○	☞ Page 824 Operation Profile Data	Real number	☞ Page 824 Operation Profile Data	0x0103

Multiple axes positioning data format

The following is a case for specifying setting values shown below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	1000: Multiple axes positioning data format

■6th line: Number of sections

×: Omission impossible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
6	1	Number of sections	×	0 to (total number of positioning data)	Unsigned integer	Specify the number of positioning data settings. ☞ Page 849 Multiple axes positioning data	0x0103

■7th line: Parameter

×: Omission impossible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Total number of positioning data	×	1 to 5000	Unsigned integer	☞ Page 849 Multiple axes positioning data	0x0103

■8th line: Condition signal

○: Omission possible

Line No.	Column No.	Item		Omission	Setting range (Initial value)	Setting format	Description	Supported file version
8*1	1	Condition signal 1 (ConditionSignal1)	I/O number (StartIO)	○*2	—*3	Unsigned integer	☞ Page 849 Multiple axes positioning data	0x0103
	2		Target (Target)	○*2	—*3 63 characters maximum	String		0x0103
	3		Signal detection method (Detection)	○*2	—*3	Integer		0x0103
	4		Compensation time (CompensationTime)	○*2	—*3	Real number		0x0103
	5		Filter time (FilterTime)	○*2	—*3	Real number		0x0103
	6 ⋮ 10	Condition signal 2 (ConditionSignal2)	Same as column No.1 to 5					
	11 ⋮ 15	Condition signal 3 (ConditionSignal3)	Same as column No.1 to 5					
	16 ⋮ 20	Condition signal 4 (ConditionSignal4)	Same as column No.1 to 5					
	21 ⋮ 25	Condition signal 5 (ConditionSignal5)	Same as column No.1 to 5					
	26 ⋮ 30	Condition signal 6 (ConditionSignal6)	Same as column No.1 to 5					
	31 ⋮ 35	Condition signal 7 (ConditionSignal7)	Same as column No.1 to 5					
	36 ⋮ 40	Condition signal 8 (ConditionSignal8)	Same as column No.1 to 5					
	41 ⋮ 45	Condition signal 9 (ConditionSignal9)	Same as column No.1 to 5					
	46 ⋮ 50	Condition signal 10 (ConditionSignal10)	Same as column No.1 to 5					

*1 Where there is no need to set all columns, use the line "" (string of length 0).

*2 This item cannot be omitted when setting a back column. Where there is no need to set the column itself, use "" (string of length 0).

*3 Any value can be set. When expanding the operation profile data, no error occurs due to the setting value.
However, there is a setting range depending on the operation profile data control FB used. For details, refer to the following.
☞ Page 691 Condition signal setting

■9th line: Skip signal

○: Omission possible

Line No.	Column No.	Item		Omission	Setting range (Initial value)	Setting format	Description	Supported file version
9*1	1	Skip signal 1 (SkipSignal1)	I/O number (StartIO)	○*2	—*3	Unsigned integer	☞ Page 849 Multiple axes positioning data	0x0103
	2		Target (Target)	○*2	—*3 63 characters maximum	String		0x0103
	3		Signal detection method (Detection)	○*2	—*3	Integer		0x0103
	4		Compensation time (CompensationTime)	○*2	—*3	Real number		0x0103
	5		Filter time (FilterTime)	○*2	—*3	Real number		0x0103
	6 ⋮ 10	Skip signal 2 (SkipSignal2)	Same as column No.1 to 5					
	11 ⋮ 15	Skip signal 3 (SkipSignal3)	Same as column No.1 to 5					
	16 ⋮ 20	Skip signal 4 (SkipSignal4)	Same as column No.1 to 5					
	21 ⋮ 25	Skip signal 5 (SkipSignal5)	Same as column No.1 to 5					
	26 ⋮ 30	Skip signal 6 (SkipSignal6)	Same as column No.1 to 5					
	31 ⋮ 35	Skip signal 7 (SkipSignal7)	Same as column No.1 to 5					
	36 ⋮ 40	Skip signal 8 (SkipSignal8)	Same as column No.1 to 5					
	41 ⋮ 45	Skip signal 9 (SkipSignal9)	Same as column No.1 to 5					
	46 ⋮ 50	Skip signal 10 (SkipSignal10)	Same as column No.1 to 5					

*1 Where there is no need to set all columns, use the line "" (string of length 0).

*2 This item cannot be omitted when setting a back column. Where there is no need to set the column itself, use "" (string of length 0).

*3 Any value can be set. When expanding the operation profile data, no error occurs due to the setting value.
However, there is a setting range depending on the operation profile data control FB used. For details, refer to the following.
☞ Page 692 Skip signal setting

■10th line onwards: Positioning data

○: Omission possible, ×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
10	1	Positioning data No. (DataNo)	×	1 to (total number of positioning data)	Unsigned integer	☞ Page 849 Multiple axes positioning data	0x0103
	2	Operation pattern (OperationPattern)	○*1	—*2	Integer		0x0103
	3	Control method (ControlMethod)	×	—*2	Integer		0x0103
	4	Interpolation axis 1 (InterpolationAxis1)	○*1	—*2	Integer		0x0103
	5	Interpolation axis 2 (InterpolationAxis2)	○*1	—*2	Integer		0x0103
	6	Interpolation axis 3 (InterpolationAxis3)	○*1	—*2	Integer		0x0103
	7	Interpolation axis 4 (InterpolationAxis4)	○*1	—*2	Integer		0x0103
	8	Circular interpolation mode (CircMode)	○*1	—*2	Integer		0x0103
	9	Path selection (CircPathChoice)	○*1	—*2	Integer		0x0103
	10	Target position/Movement amount/End point 1 (Position1)	○*1	—*2	Real number		0x0103
	11	Target position/Movement amount/End point 2 (Position2)	○*1	—*2	Real number		0x0103
	12	Target position/Movement amount/End point 3 (Position3)	○*1	—*2	Real number		0x0103
	13	Target position/Movement amount/End point 4 (Position4)	○*1	—*2	Real number		0x0103
	14	Direction selection 1 (Direction1)	○*1	—*2	Integer		0x0103
	15	Direction selection 2 (Direction2)	○*1	—*2	Integer		0x0103
	16	Direction selection 3 (Direction3)	○*1	—*2	Integer		0x0103
	17	Direction selection 4 (Direction4)	○*1	—*2	Integer		0x0103
	18	Sub point 1 (CircAuxPoint1)	○*1	—*2	Real number		0x0103
	19	Sub point 2 (CircAuxPoint2)	○*1	—*2	Real number		0x0103
	20	Sub point 3 (CircAuxPoint3)	○*1	—*2	Real number		0x0103
	21	Sub point 4 (CircAuxPoint4)	○*1	—*2	Real number		0x0103
	22	Velocity mode (VelocityMode)	○*1	—*2	Integer		0x0103
	23	Velocity (Velocity)	○*1	—*2	Real number		0x0103
	24	Acceleration (Acceleration)	○*1	—*2	Real number		0x0103
	25	Deceleration (Deceleration)	○*1	—*2	Real number		0x0103
	26	Jerk (Jerk)	○*1	—*2	Real number		0x0103

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
10	27	Circular interpolation error tolerance (CircErrorTolerance)	○*1	—*2	Real number	☞ Page 849 Multiple axes positioning data	0x0103
	28	Positioning data options (DataOptions)	○*1	—*2	Unsigned integer		0x0103
	29	Dwell time (DwellTime)	○*1	—*2	Real number		0x0103
	30	M code (Mcode)	○*1	—*2	Unsigned integer		0x0103
	31	M code output timing override (McodeOutput_Overridev	○*1	—*2	Integer		0x0103
	32	Jump destination positioning data No. (JumpDestinationDataNo)	○*1	—*2	Unsigned integer		0x0103
	33	Condition signal No. (ConditionSignalNo)	○*1	—*2	Unsigned integer		0x0103
	34	Number of LOOP to LEND repetitions (LoopCount)	○*1	—*2	Unsigned integer		0x0103
	35	Skip signal No. (SkipSignalNo)	○*1	—*2	Unsigned integer		0x0103
	36	Pitch (Pitch)	○*1	0	Unsigned integer	Not used. *: Omit or specify "0".	0x0103
11	1-36	Same as line No.10					
⋮ (For the number of sections)							

*1 This item cannot be omitted when setting a back column. Where there is no need to set the column itself, use "" (string of length 0).

*2 Any value can be set. When expanding the operation profile data, no error occurs due to the setting value.
However, there is a setting range depending on the operation profile data control FB used. For details, refer to the following.
☞ Page 668 Positioning data to be set

An example of a CSV file for setting positioning data is shown below.

Ex.

For two-axis absolute value circular interpolation control

• Positioning data

Line No.	Column No.	Item	Setting value
10	1	Positioning data No. (DataNo)	1
	2	Operation pattern (OperationPattern)	1: Continuous positioning (ContinuousPositioning)
	3	Control method (ControlMethod)	0103h: Absolute value circular interpolation (CircularAbsolute)
	4	Interpolation axis 1 (InterpolationAxis1)	Configuration axis 2
	5	Interpolation axis 2 (InterpolationAxis2)	Configuration axis 3
	8	Circular interpolation mode (CircMode)	1: Center point specification (mcCenter)
	9	Path selection (CircPathChoice)	0: CW (mcCW)
	10	Target position/Movement amount/End point 1 (Position1)	Configuration axis 2: 100.0
	11	Target position/Movement amount/End point 2 (Position2)	Configuration axis 3: 100.0
	18	Sub point 1 (CircAuxPoint1)	Configuration axis 2: 50.0
	19	Sub point 2 (CircAuxPoint2)	Configuration axis 3: 50.0
	23	Velocity (Velocity)	10.0
	24	Acceleration (Acceleration)	1.0
	25	Deceleration (Deceleration)	1.0
	26	Jerk (Jerk)	2.0
	27	Circular interpolation error tolerance (CircErrorTolerance)	100.0
	28	Positioning data options (DataOptions)	0
	29	Dwell time (DwellTime)	100.0

• CSV file (delimiter: comma (,))

Description
1,1,0x0103,2,3,,,1,0,100.0,100.0,,,,,,,50.0,50.0,,,,10.0,1.0,1.0,2.0,100.0,0,100.0

Ex.

When data No.10 is set to NOP

• CSV file (delimiter: comma (,))

Description
10,,0x0080

Notation for each setting format

Notation for each setting format is shown below.

Type		Notation	Example
Integer	Decimal	Directly enter a signed or unsigned decimal number.	123, +123, -123
	Hexadecimal	Add "0x" or "0X" before a hexadecimal number.	0xFF, 0XEAD
Real number	Decimal notation	Directly enter a signed or unsigned real decimal number with a decimal point.	2.34, +2.34, -2.34
	Exponential notation	Add "e" or "E" and a signed or unsigned exponent (decimal) at the end of the real number.	1.0e6, 1.0E-6
String		Directly enter a string.	ABC

33 ADVANCED SYNCHRONOUS CONTROL

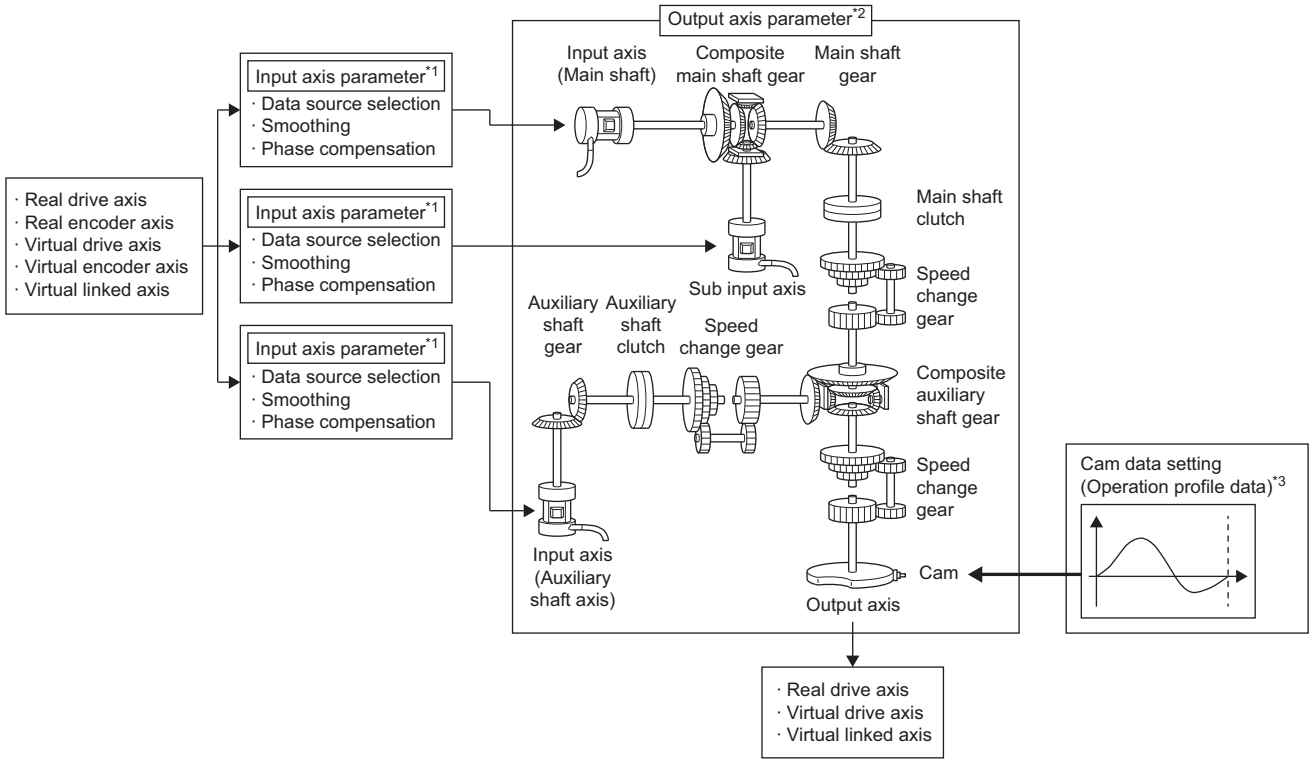
33.1 Overview of Advanced Synchronous Control

Advanced synchronous control can be achieved using software instead of controlling mechanically with gears, clutches, speed change gears, cams, or others.

Advanced synchronous control synchronizes control with the input axis by setting parameters for advanced synchronous control and operation profile data and by starting MCv_AdvancedSync (Advanced Synchronous Control) on each output axis.

Set the input axes for advanced synchronous control and the filter settings using the input axis parameters.

Set the output axis for advanced synchronous control using the output axis parameters. The setting of the auxiliary axes and sub input axes, as well as the settings for gears, clutches, speed change gears, and cams are included under the output axis parameters.



*1 For details on input axes, refer to the following.
☞ Page 911 Input Axis Function

*2 For details on output axes, refer to the following.
☞ Page 920 Output Axis Function

*3 For details on cams, refer to the following.
☞ Page 964 Output axis module

Operation of this function at each status of system

○: Available, ×: Not available

System status	Input axis operation	Output axis operation
STOP	○*1	×
RUN	○	○
Moderate error	×	×
Major error	×	×

*1 The status of input axes can be monitored even when MCv_AdvancedSync (Advanced Synchronous Control) has not been started.

Relevant variables

Input axis (AdvInputName.)

Variable name	Name	Reference
LabelID	Axis label ID	Page 914 Input axis (AdvInputName.)
Axis	Axis information	
PrConst.	Input axis parameter constant	Page 890 Input axis parameter constant (AdvInputName.PrConst.)
Pr.	Input axis parameter	Page 890 Input axis parameters (AdvInputName.Pr.)
Md.	Input axis monitor data	Page 890 Input axis monitor data (AdvInputName.Md.)

■Input axis parameter constant (AdvInputName.PrConst.)

Variable name	Name	Reference
SourceValue	Data source selection	Page 914 Input axis parameter constant (AdvInputName.PrConst.)
SmoothingTimeConstant	Smoothing time constant	
PhaseCompensationTimeConstant	Phase compensation time constant	
DirectionRestriction	Moving direction restriction	

■Input axis parameters (AdvInputName.Pr.)

Variable name	Name	Reference
PhaseCompensationAdvanceTime	Phase compensation advance time	Page 917 Input axis parameter (AdvInputName.Pr.)

■Input axis monitor data (AdvInputName.Md.)

Variable name	Name	Reference
ActiveStatus	Active status	Page 917 Input axis monitor data (AdvInputName.Md.)
CumulativePosition	Cumulative current position	
SetVelocity	Set velocity	
PhaseCompensationAmount	Phase Compensation Amount	
DirectionRestrictionAmount	Moving direction restriction amount	

Output axis (AdvOutputName.)

Variable name	Name	Reference
LabelID	Axis label ID	Page 922 Output axis (AdvOutputName.)
Axis	Axis information	
PrConst.	Output axis parameter constant	Page 890 Output axis parameter constant (AdvOutputName.PrConst.)
Pr.	Output axis parameter	Page 891 Output axis parameter (AdvOutputName.Pr.)
Md.	Output axis monitor data	Page 893 Output axis monitor data (AdvOutputName.Md.)
Cd.	Output axis control data	Page 894 Output axis control data (AdvOutputName.Cd.)

■Output axis parameter constant (AdvOutputName.PrConst.)

Variable name	Name	Reference
SmoothingTimeConstant	Output axis smoothing time constant	Page 922 Output axis parameter constant (AdvOutputName.PrConst.)
MasterClutchSmoothingTimeConstant	Main shaft clutch smoothing time constant	Page 926 Output axis parameter constant (AdvOutputName.PrConst.)
AuxClutchSmoothingTimeConstant	Auxiliary shaft clutch smoothing time constant	Page 937 Output axis parameter constant (AdvOutputName.PrConst.)
MasterSpeedChangeGearSmoothingTimeConstant	Main shaft speed change gear smoothing time constant	Page 962 Output axis parameter constant (AdvOutputName.PrConst.)
AuxSpeedChangeGearSmoothingTimeConstant	Auxiliary shaft speed change gear smoothing time constant	
OutSpeedChangeGearSmoothingTimeConstant	Output axis speed change gear smoothing time constant	

■Output axis parameter (AdvOutputName.Pr.)

Variable name	Name	Reference
SubAxis	Sub input axis object	Page 923 Output axis parameter (AdvOutputName.Pr.)
AuxAxis	Auxiliary shaft object	
MasterOnClutchSignal	Main shaft clutch ON signal setting	Page 926 Output axis parameter (AdvOutputName.Pr.)
MasterOffClutchSignal	Main shaft clutch OFF signal setting	
AuxOnClutchSignal	Auxiliary shaft clutch ON signal setting	Page 937 Output axis parameter (AdvOutputName.Pr.)
AuxOffClutchSignal	Auxiliary shaft clutch OFF signal setting	
Gear.	Gear parameter	*1
Clutch.	Clutch parameter	*2
SpeedChangeGear.	Speed change gear parameter	*3
Cam.	Cam parameter	*4
Restore.	Synchronous control initial position parameter	*5

*1 Gear parameter (AdvOutputName.Pr.Gear.)

Variable name	Name	Reference
MasterCompositeGear	Composite main shaft gear	Page 925 Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)
MasterNumerator	Main shaft gear: Numerator	
MasterDenominator	Main shaft gear: Denominator	
AuxCompositeGear	Composite auxiliary shaft gear	Page 936 Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)
AuxNumerator	Auxiliary shaft gear: Numerator	
AuxDenominator	Auxiliary shaft gear: Denominator	

*2 Clutch parameter (AdvOutputName.Pr.Clutch.)

Variable name	Name	Reference
MasterOnControl	Main shaft clutch ON control setting	Page 928 Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)
MasterOffControl	Main shaft clutch OFF control setting	
MasterReference	Main shaft clutch reference address setting	
MasterOnAddress	Main shaft clutch ON address	
MasterMovementAmountBeforeOn	Movement amount before main shaft clutch ON	
MasterOffAddress	Main shaft clutch OFF address	
MasterMovementAmountBeforeOff	Movement amount before main shaft clutch OFF	
MasterSmoothingMethod	Main shaft clutch smoothing method	
MasterOnSlippageAmount	Slippage amount at main shaft clutch ON	
MasterOffSlippageAmount	Slippage amount at main shaft clutch OFF	
AuxOnControl	Auxiliary shaft clutch ON control setting	Page 939 Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)
AuxOffControl	Auxiliary shaft clutch OFF control setting	
AuxReference	Auxiliary shaft clutch reference address setting	
AuxOnAddress	Auxiliary shaft clutch ON address	
AuxMovementAmountBeforeOn	Movement amount before auxiliary shaft clutch ON	
AuxOffAddress	Auxiliary shaft clutch OFF address	
AuxMovementAmountBeforeOff	Movement amount before auxiliary shaft clutch OFF	
AuxSmoothingMethod	Auxiliary shaft clutch smoothing method	
AuxOnSlippageAmount	Slippage amount at auxiliary shaft clutch ON	
AuxOffSlippageAmount	Slippage amount at auxiliary shaft clutch OFF	

*3 Speed change gear parameter (AdvOutputName.Pr.SpeedChangeGear.)

Variable name	Name	Reference
MasterGearIn	Main shaft speed change gear valid setting	Page 961 Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)
MasterRatioNumerator	Main shaft speed change ratio: Numerator	
MasterRatioDenominator	Main shaft speed change ratio: Denominator	
AuxGearIn	Auxiliary shaft speed change gear valid setting	
AuxRatioNumerator	Auxiliary shaft speed change ratio: Numerator	
AuxRatioDenominator	Auxiliary shaft speed change ratio: Denominator	
OutGearIn	Output axis speed change gear valid setting	
OutRatioNumerator	Output axis speed change ratio: Numerator	
OutRatioDenominator	Output axis speed change ratio: Denominator	

*4 Cam parameter (AdvOutputName.Pr.Cam.)

Variable name	Name	Reference
LengthPerCycle	Length per cycle	Page 965 Cam parameter of output axis parameters (AdvOutputName.Pr.Cam.)
StrokeAmount	Cam stroke amount	
CamNo.	Cam No.	
StartingPoint	Cam starting point	
LengthPerCycleChange	Length per cycle change setting	
PhaseCompensationAdvancedTime	Phase compensation advance time	
PhaseCompensationTimeConstant	Phase compensation time constant	

*5 Synchronous control initial position parameter (AdvOutputName.Pr.Restore.)

Variable name	Name	Reference
MasterGearPositionPerCycleMethod	Setting method of current position per cycle after main shaft gear	Page 1005 Synchronous control initial position parameter (AdvOutputName.Pr.Restore.)
MasterGearInitialPositionPerCycle	Current position per cycle after main shaft gear (initial setting)	
AuxGearPositionPerCycleMethod	Setting method of current position per cycle after auxiliary shaft gear	
AuxGearInitialPositionPerCycle	Current position per cycle after auxiliary shaft gear (initial setting)	
PositionRestorationObject	Cam axis position restoration object	
ReferenceSetPositionMethod	Setting method of cam reference position	
PositionPerCycleMethod	Setting method of current position per cycle	
InitialReferenceSetPosition	Cam reference position (initial setting)	
InitialPositionPerCycle	Current position per cycle (initial setting)	
RestorationAllowablePosition	Cam set position restoration: Allowable movement amount setting	

■Output axis monitor data (AdvOutputName.Md.)

Variable name	Name	Reference
SyncStatus	Synchronization status	Page 923 Output axis monitor data (AdvOutputName.Md.)
MasterAxisNo	Main shaft	
SubAxisNo	Sub input axis	
AuxAxisNo	Auxiliary shaft	
Clutch.	Clutch monitor	*1
Cam.	Cam monitor	*2

*1 Clutch monitor (AdvOutputName.Md.Clutch.)

Variable name	Name	Reference
MasterOnOffStatus	Main shaft clutch ON/OFF status	Page 933 Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)
MasterSmoothingStatus	Main shaft clutch smoothing status	
MasterCumulativeSlippage	Main shaft clutch slippage (accumulative)	
AuxOnOffStatus	Auxiliary shaft clutch ON/OFF status	Page 944 Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)
AuxSmoothingStatus	Auxiliary shaft clutch smoothing status	
AuxCumulativeSlippage	Auxiliary shaft clutch slippage (accumulative)	

*2 Cam monitor (AdvOutputName.Md.Cam.)

Variable name	Name	Reference
MasterCompositeGearSetPosition	Current position after composite main shaft gear	Page 969 Cam monitor of output axis monitor data (AdvOutputName.Md.Cam.)
MasterGearPositionPerCycle	Current position per cycle after main shaft gear	
AuxGearPositionPerCycle	Current position per cycle after auxiliary shaft gear	
PhaseCompensationAmount	Phase compensation amount	
PositionPerCycle	Current position per cycle	
ReferenceSetPosition	Cam reference position	
SetPosition	Cam set position	
CamNo	Execution profile No.	
StrokeAmount	Execution cam stroke amount	
LengthPerCycle	Execution length per cycle	
StartingPoint	Execution cam starting point	
SyncControlChangeStatus	Synchronous control change status	Page 985 Cam monitor of output axis monitor data (AdvOutputName.Md.Cam.)

■Output axis control data (AdvOutputName.Cd.)

Variable name	Name	Reference
Clutch.	Clutch control data	*1
SpeedChangeGear.	Speed change gear control data	*2
Cam.	Cam control data	*3

*1 Clutch control data (AdvOutputName.Cd.Clutch.)

Variable name	Name	Reference
MasterCommand	Main shaft clutch command	Page 933 Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)
MasterInvalidCommand	Main shaft clutch control invalid command	
MasterForcedOff	Main shaft clutch forced OFF command	
MasterClutchSmoothingTimeConstant	Main shaft clutch smoothing time constant change value	
AuxCommand	Auxiliary shaft clutch command	Page 945 Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)
AuxInvalidCommand	Auxiliary shaft clutch control invalid command	
AuxForcedOff	Auxiliary shaft clutch forced OFF command	
AuxClutchSmoothingTimeConstant	Auxiliary shaft clutch smoothing time constant change value	

*2 Speed change gear control data (AdvOutputName.Cd.SpeedChangeGear.)

Variable name	Name	Reference
MasterSmoothingTimeConstant	Main shaft speed change gear smoothing time constant change value	Page 963 Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)
AuxSmoothingTimeConstant	Auxiliary shaft speed change gear smoothing time constant change value	
OutSmoothingTimeConstant	Output axis speed change gear smoothing time constant change value	

*3 Cam control data (AdvOutputName.Cd.Cam.)

Variable name	Name	Reference
OutSmoothingTimeConstant	Output axis smoothing time constant change value	Page 971 Cam control data of output axis parameters (AdvOutputName.Cd.Cam.)
SyncControlChangeRequest	Synchronous control change request	Page 986 Cam control data of output axis control data (AdvOutputName.Cd.Cam.)
SyncControlChangeCommand	Synchronous control change command	
SyncControlChange	Synchronous control change value	
SyncControlReflectionTime	Synchronous control change value reflection time	

Relevant FBs

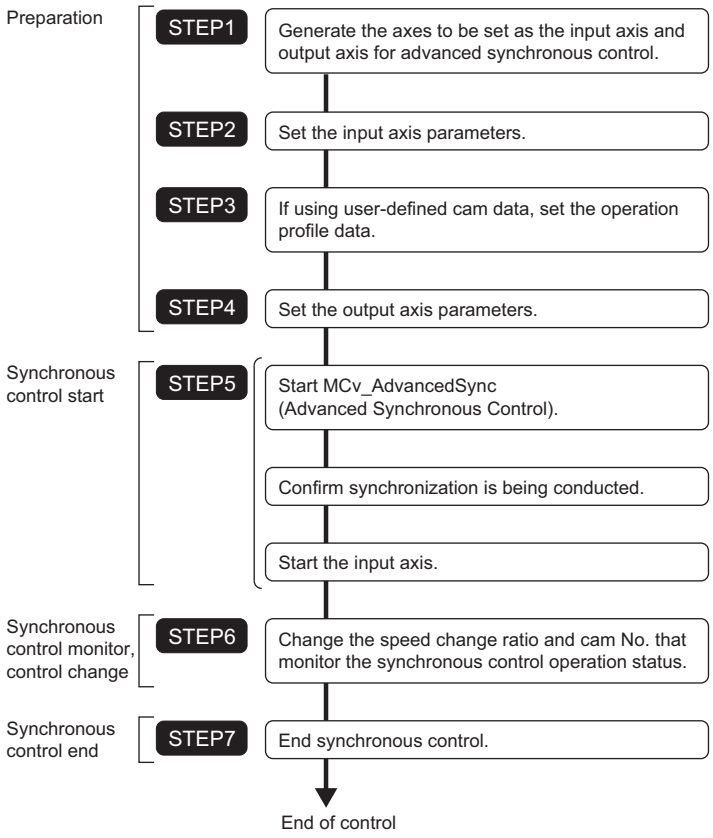
For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Motion control FB	Name
MCv_AdvancedSync	Advanced synchronous control	Starts synchronization control according to the set advanced synchronous control setting.
MCv_AdvPositionPerCycleCalc	Advanced synchronous control current position per cycle calculation	Calculates the current position per cycle based on the set cam data.
MCv_AdvCamSetPositionCalc	Advanced synchronous control cam set position calculation	Calculates the cam set position based on the set cam data.

33.2 Control Details for Advanced Synchronous Control

This section describes the procedure for conducting advanced synchronous control.



Procedure for executing advanced synchronous control

This section describes the details of the procedure for conducting advanced synchronous control.

1. Generate the axes to be set as the input axis and output axis for advanced synchronous control.

In order to use advanced synchronous control, the axes to be set as the input axis and output axis must be generated.

Axes that can be set as an input axis and output axis are shown in the following table. For the specifications of each axis type, refer to the following.

☞ Page 443 Axis

☞ Page 466 Axis Assignment

○: Can be set, ×: Cannot be set

Axis type		Input axis	Output axis	Remarks
Real axis	Real drive axis	○	○	When control for multiple FBs (motion) is required, execute each FB with a virtual linked axis, and configure the axes to transmit the results (command) to the real drive axis.
	Real encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), Necessary Object Data Unset (error code: 1AF7H) occurs and it does not start.
Virtual axis	Virtual drive axis	○	○	Commands can be mainly created by positioning control or others.
	Virtual linked axis	○	○	Use as an intermediary axis to transmit a command to the real drive axis. When using multiple FBs (motion), assign them to virtual linked axes.
	Virtual encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), Necessary Object Data Unset (error code: 1AF7H) occurs and it does not start.

Generating the advanced synchronous control input axis and output axis will consume memory per each setting. Adjust the maximum RAM size (MotionControl_AdvancedSync_System.PrConst.AddonMemory.RamSizeMax) supported to match the system structure.

For memory usage, refer to the following.

☞ Page 910 System memory usage

Also, if the axes set as an input axis or output axis are using an absolute position system, backup RAM will be consumed. For backup RAM usage for each setting, refer to the following.

☞ Page 991 Backup data management for advanced synchronous control

2. Set the input axis parameters.

Generate an input axis from "Input Setting" (1) under "Advanced Synchronous Control" in GX Works3.

When an input axis is generated, ADV_INPUT type labels are generated in global label "Adv+Global" (2).*1

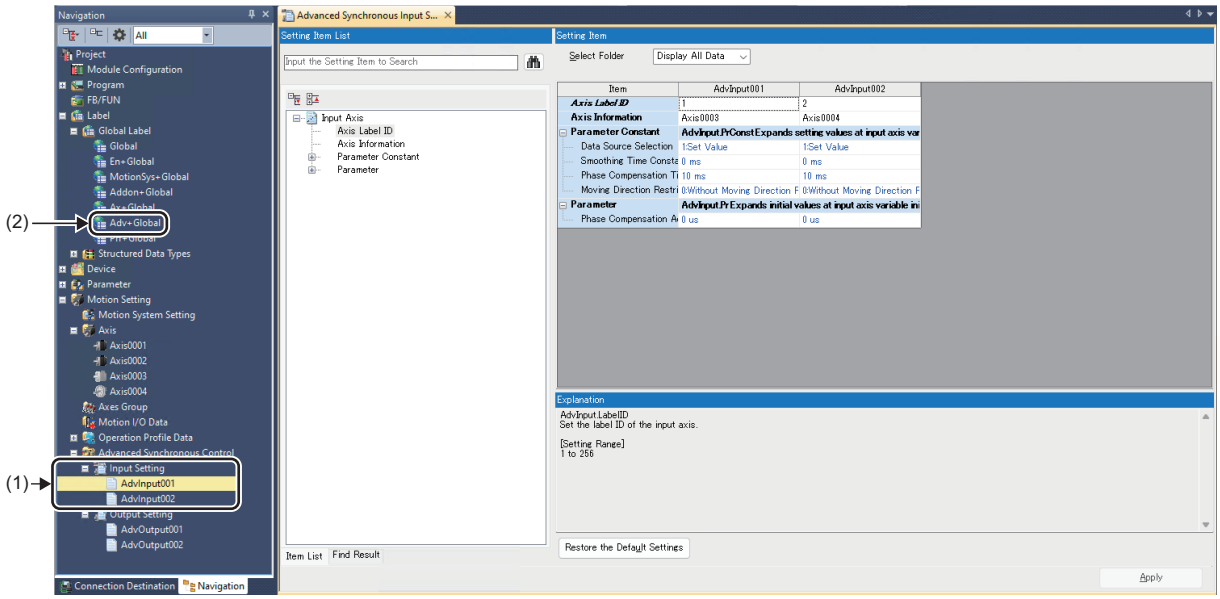
Set the axis to be used as an input axis in the Axis information (AdvInputName.Axis) of the input axis under input settings. It is not possible to set the same axis to the axis information of different input axes. For details on settable axis types, refer to step 1.

For details on input settings, refer to the following.

☞ Page 911 Input Axis Function

*1 ADV_INPUT type labels defined in local label cannot be used in advanced synchronous control.

Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Input Setting]



3. Set cam data.

Set the cam data from the operation profile data.

Set this when using a cam whose slave axis synchronizes its position with the master axis according to the cam data and output settings.

Before using the cam function, the cam table must be transmitted to the open area and made controllable. For details on transmitting a cam table to the open area and data types that can be controlled by the cam operation, refer to the following.

☞ Page 964 Output axis module

☞ Page 972 Cam function

☞ Page 824 OPERATION PROFILE DATA FUNCTION

Set the set operation profile data to "Cam No." (AdvOutputName.Pr.Cam.CamNo) of the "Output Setting". When using a "Cam No." other than "0", it is required to install the add-on "ProfileControl" in advance. If MCv_AdvancedSync (Advanced Synchronous Control), MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation), or MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation) is started without "ProfileControl" installed, the following errors occur.

Motion control FB	Error code
MCv_AdvancedSync (Advanced Synchronous Control)	Add-on Acquisition Failure (error code: 1AF6H)
MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation)	Add-on Acquisition Failure (error code: 1BCBH)
MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)	

4. Perform the output settings.

Generate an output axis from "Output Setting" (3) under "Advanced Synchronous Control" in GX Works3.

When an output axis is generated, ADV_OUTPUT type labels are generated in global label "Adv+Global" (2). *1

Set the axis to be used as an output axis in the Axis information (AdvOutputName.Axis) of the output axis under "Output Setting". It is not possible to set the same axis to the axis information of different output axes.

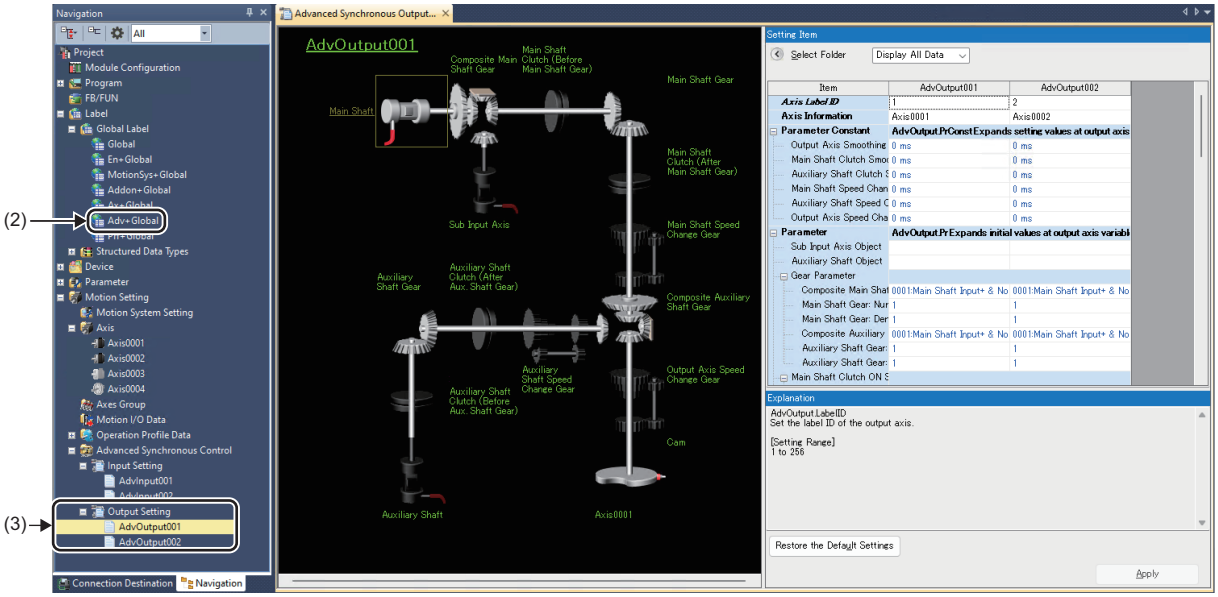
By setting the input axis set in step 1 to "Auxiliary axis" (AdvOutputName.Pr.AuxAxis) and "Sub input axis" (AdvOutputName.Pr.SubAxis), the auxiliary axis and sub input axis inputs can be combined to the master axis.

For details on output settings, refer to the following.

☞ Page 920 Output Axis Function

*1 ADV_OUTPUT type labels defined in local label cannot be used in advanced synchronous control.

Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Output Setting]



5. Start synchronous control.

Set the input axis and output axis set in steps 1 to 3 to the MCv_AdvancedSync (Advanced Synchronous Control) input/output variables.

- Input axis: Master axis (Master)
- Output axis: Slave axis (Slave)

If using analysis mode, set the following input variables.

- Synchronous control analysis mode setting (Options (Options): Bit 16)

Start synchronous control by starting MCv_AdvancedSync (Advanced Synchronous Control). For details on starting and confirmation during synchronization, refer to the following.

☞ Page 900 Starting/stopping for advanced synchronous control

6. Change the synchronous control monitor and control.

Monitors such as the current position per cycle for advanced synchronous control can be checked in the Output axis monitor data (AdvOutputName.Md.).

The advanced synchronous control gear, clutch, speed change gear, and synchronous control change function can be used in the output axis control data (AdvOutputName.Cd) and the output axis parameters (AdvOutputName.Pr) of the output axis while MCv_AdvancedSync (Advanced Synchronous Control) is running.

For details on output axis functions, refer to the following.

☞ Page 920 Output Axis Function

7. Stop synchronous control.

To stop the operation, use the following method.

- Change MCv_AdvancedSync (Advanced Synchronous Control) Enable (Enable) from TRUE to FALSE.
- Start MC_Stop (Forced Stop).

Advanced synchronous control can be ended even while the input axis is in operation. However, as the output axis under stop operation is not in synchronization, stop the operation of the input axis before ending.

For details on stopping advanced synchronous control, refer to the following.

☞ Page 900 Starting/stopping for advanced synchronous control

Starting/stopping for advanced synchronous control

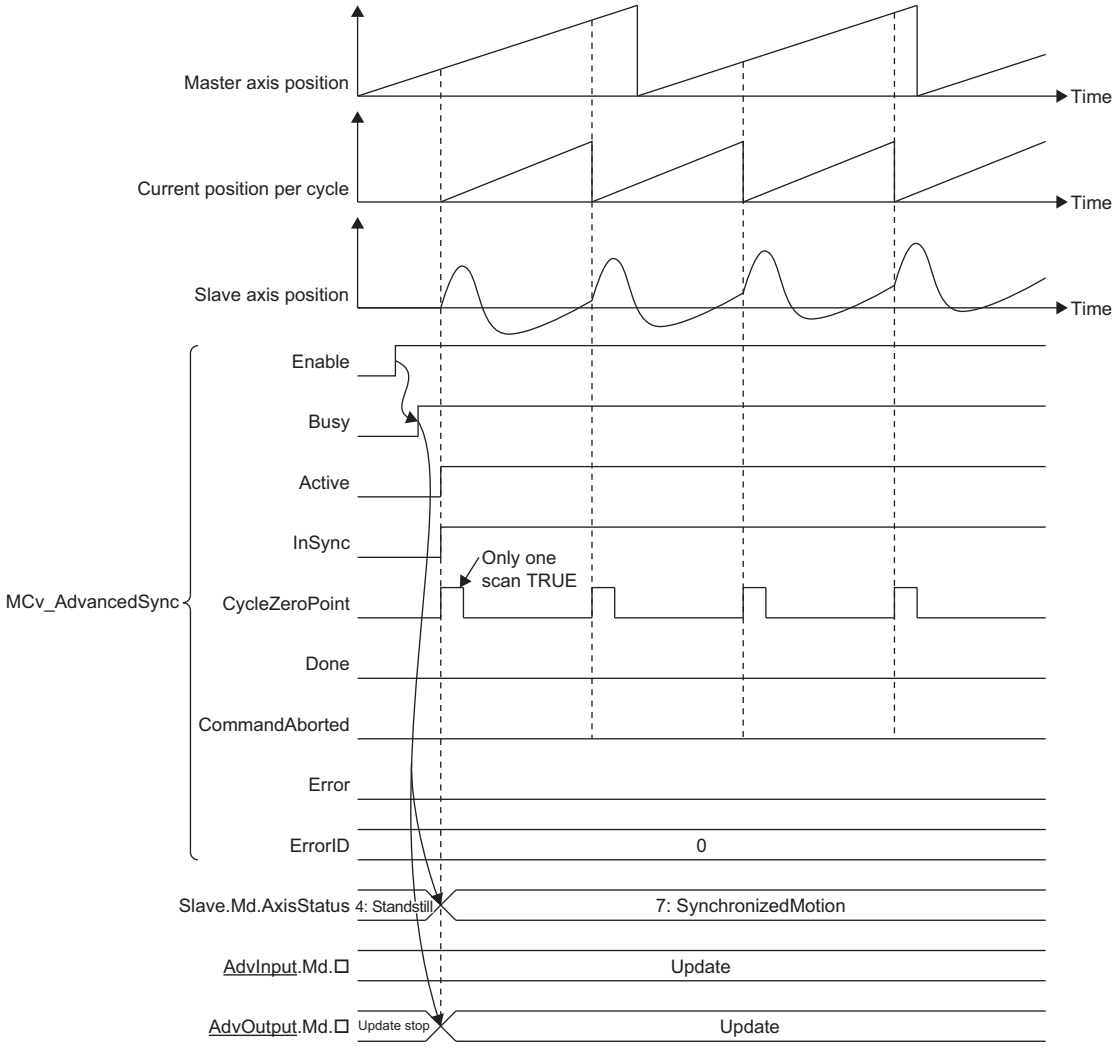
This section describes how to start and stop the operation for advanced synchronous control.

Operation when starting

To start advanced synchronous control, set MCv_AdvancedSync (Advanced Synchronous Control) Enable (Enable) to TRUE. Synchronous control can only be started when the slave axis Axis status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)". Upon starting advanced synchronous control, the slave axis Axis status (AxisName.Md.AxisStatus) changes to "7: During synchronous operation (SynchronizedMotion)". When synchronous control is started, if the status is not "4: Standby (Standstill)", the slave axis Axis status (AxisName.Md.AxisStatus) will change to "1: Stopping on error (ErrorStop)" and Start not possible (error code: 1AFCH) will occur.

The Input axis monitor data (AdvInputName.Md.☐) will continuously be updated regardless of whether synchronous control has started.

The Output axis monitor data (AdvOutputName.Md.☐) will be updated after the slave axis Axis status (AxisName.Md.AxisStatus) changes to "7: During synchronous operation (SynchronizedMotion)".



Stop operation

When MCv_AdvancedSync (Advanced Synchronous Control) Enable (Enable) is set to FALSE, or if a stop cause occurs on the axis set in axis information of the output axis, the Slave axis (Slave) immediately stops or decelerates to a stop according to the stop cause and stopping process.

The following shows stop causes during axis operation and the process when each cause occurs.

Stop cause*1	Stopped axis	Axis status (AxisName.Md.AxisStatus)		Stop process*2
		During deceleration stop	After stopping	
Enable (Enable) is set to FALSE during synchronous control by MCv_AdvancedSync (Advanced Synchronous Control)	Each axis	7: During synchronous operation (SynchronizedMotion)	4: Standby (Standstill)	Deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General))

*1 For other stop causes, refer to the following.
☞ Page 584 Stop causes during axis operation

*2 For each operation of stopping processes, refer to the following.
☞ Page 586 Stop processes for single axis

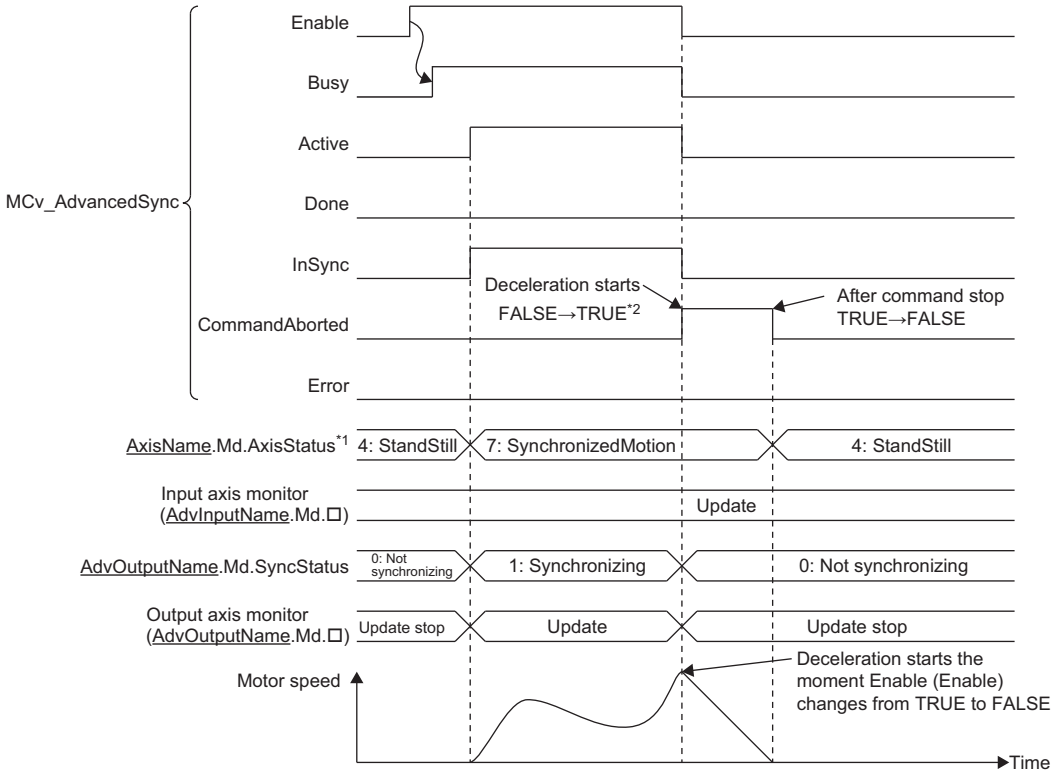
After the stop cause occurs, an Input axis monitor data (AdvInputName.Md.☐) update will not stop, but an Output axis monitor data (AdvOutputName.Md.☐) update will stop and the values at the moment when the stop cause occurred will be retained. The Output axis monitor data (AdvOutputName.Md.☐) will be updated the next time MCv_AdvancedSync (Advanced Synchronous Control) is executed.

Point

To stop using the deceleration set in Deceleration (Deceleration) under MCv_AdvancedSync (Advanced Synchronous Control), set the Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) to "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)".

Timing charts showing what happens when a stop cause occurs are shown below.

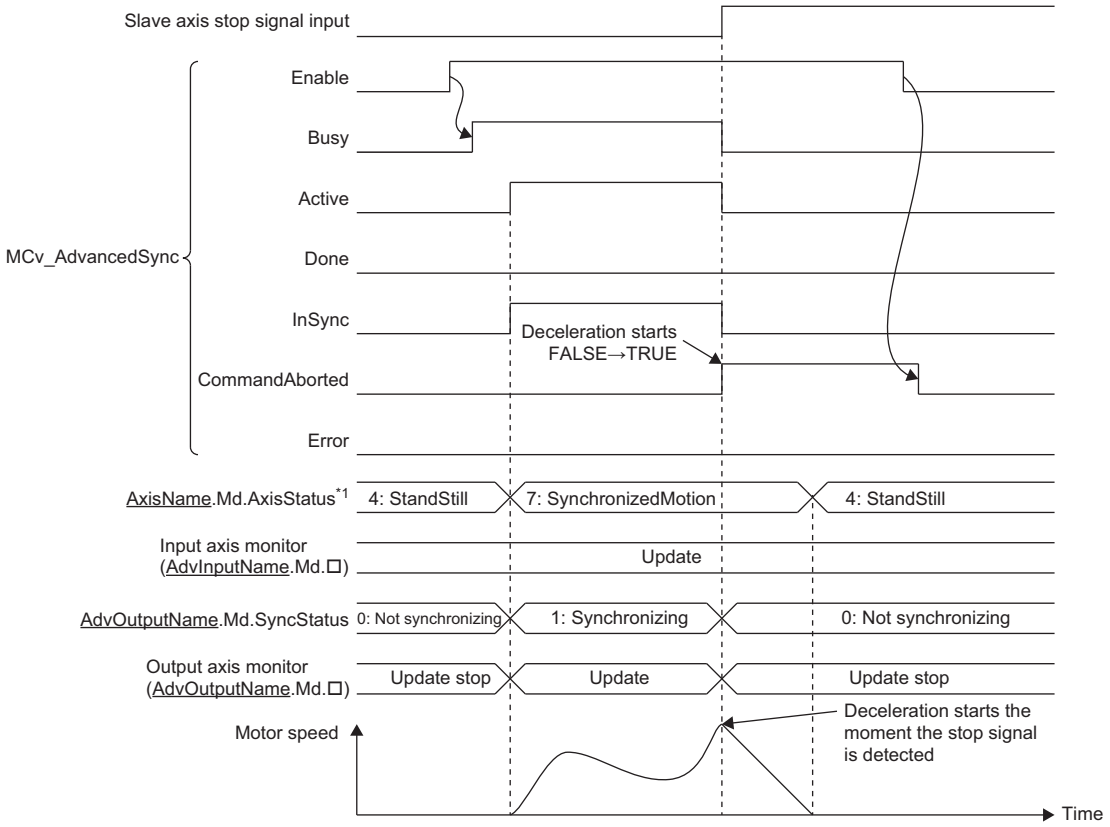
■When MCv_AdvancedSync (Advanced Synchronous Control) Enable (Enable) is set to FALSE during advanced synchronous control



*1 This is the state of Slave axis (Slave).

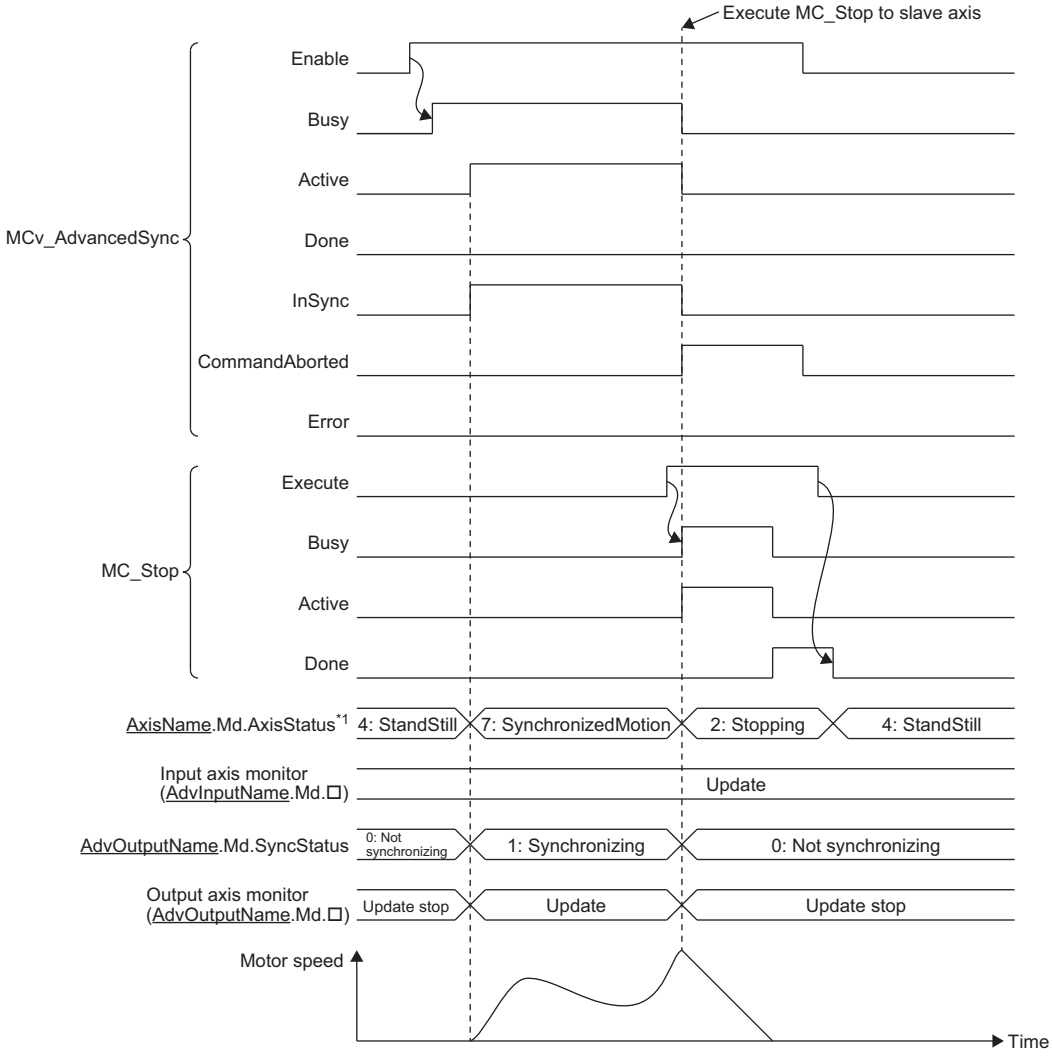
*2 If Immediate stop is selected, only one scan will be TRUE.

■When a slave axis stop signal is detected during advanced synchronous control



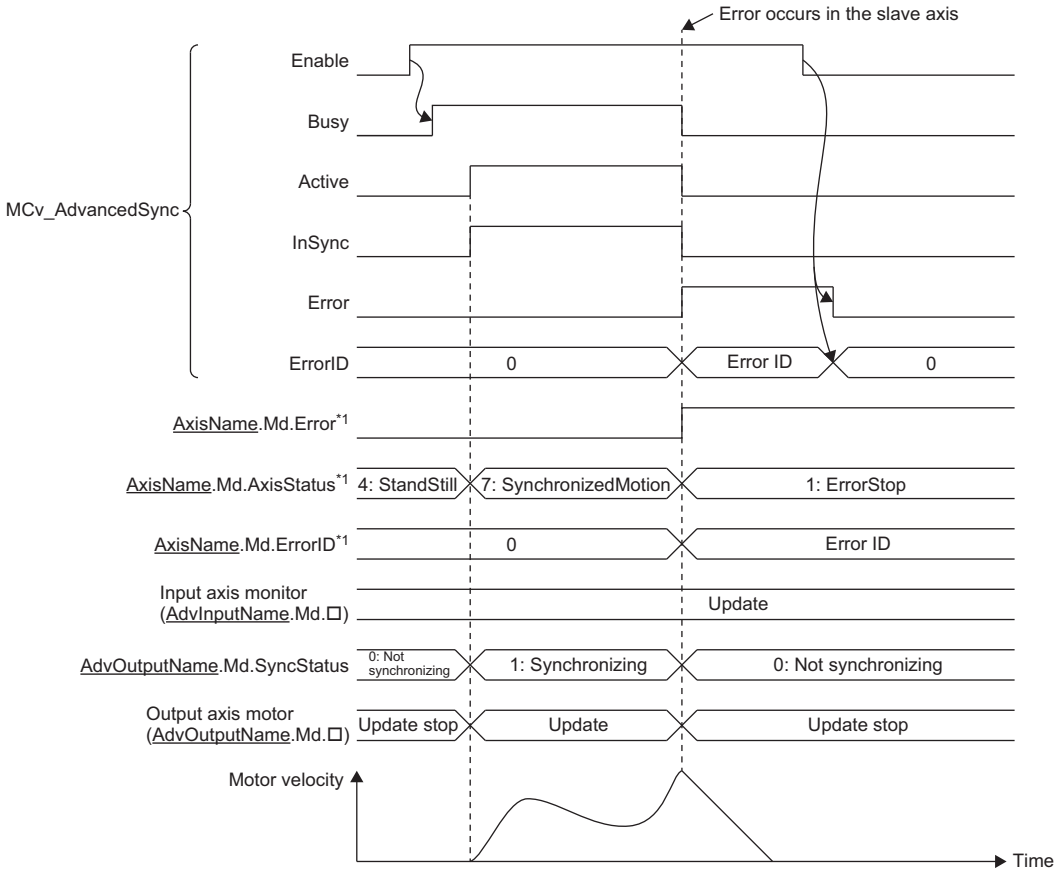
*1 This is the state of Slave axis (Slave).

■When stop cause (MC_Stop (Forced Stop) execution/stop signal detection) occurs during advanced synchronous control



*1 This is the state of Slave axis (Slave).

■When a stop cause (Slave axis error, Forced stop) occurs during advanced synchronous control



*1 This is the state of Slave axis (Slave).

Precautions

- During execution of MCv_AdvancedSync (Advanced Synchronous Control), if a stop cause occurs on the axis set in the input axis information of the Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), or Sub input axis (AdvOutputName.Pr.SubAxis), the Slave axis (Slave) will continue control using commands transmitted from the input axis. The Slave axis (Slave) axis status will not change. Also, if a stop cause occurs in the axis set in the output axis Axis information (AdvOutputName.Axis), it will not affect the axis set in the input axis Axis information (AdvInputName.Axis).
- When MCv_AdvancedSync is started, Master axis and slave axis cyclic reference (error code: 1AADH) occurs when the following conditions are satisfied.

Conditions
When linking multiple axes with MCv_AdvancedSync (Advanced Synchronous Control), and setting the Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), and Sub input axis (AdvOutputName.Pr.SubAxis) to the Slave axis (Slave) of single axis synchronous control FB of the back part.
When linking 257 or more single axis synchronous control FBs

- When the Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), and Sub input axis (AdvOutputName.Pr.SubAxis) change to servo OFF due to a servo alarm or a forced stop, an unexpected operation of the Slave axis (Slave) may occur. Therefore, stop MCv_AdvancedSync (Advanced Synchronous Control) using MC_Stop (Forced Stop).
- If an input axis is operated during the analyzing of MCv_AdvancedSync (Advanced Synchronous Control) startup (until the Slave axis (Slave) axis status (AxisName.Md.AxisStatus) becomes "7: During synchronous operation (SynchronizedMotion)"), the change amount based on current value change and the movement amount of the input axis during analyzing is reflected immediately after synchronous control starts. As the output axis may suddenly accelerate depending on the change amount and movement amount of the input axis, start the operation of the input axis after checking synchronous control is in operation.
- If the member variable setting value of ADV_INPUT or ADV_OUTPUT that imports setting values during synchronous control is changed to a value out of range while MCv_AdvancedSync (Advanced Synchronous Control) is being executed, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs, and control will continue using the setting values before the change. If the member variable setting value of ADV_INPUT or ADV_OUTPUT is out of range when MCv_AdvancedSync is started, Out of Parameter Range (Advanced Synchronous Control Input Axis) (error code: 1A65H) or Out of Parameter Range (Advanced Synchronous Control Output Axis) (error code: 1A66H) occurs, and advanced synchronous control will not start.
- Operation cycle mismatch (error code: 1B29H) occurs when the following conditions are satisfied when MCv_AdvancedSync is started. Even if MCv_SyncOperationCycles (Synchronize Control Operation Cycle) is enabled, Operation cycle mismatch (error code: 1B29H) will occur at startup of MCv_AdvancedSync if the following conditions are satisfied.

Conditions
When the control operation cycle is different between the Master axis (Master), Auxiliary axis (AdvOutputName.Pr.AuxAxis), Sub input axis (AdvOutputName.Pr.SubAxis), and Slave axis (Slave)
When the control operation cycle of the output axis and the refresh cycle of the clutch signal are different

Advanced synchronous control precautions

This section describes precautions when using advanced synchronous control.

Decimal points

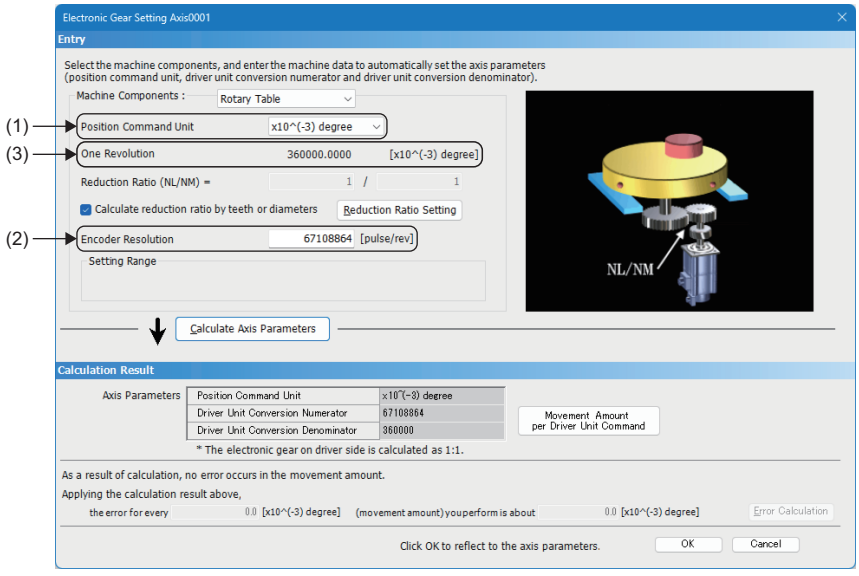
- The decimal point range guaranteed for the input axis and output axis together is up to 5 decimal places. When setting the units, set the appropriate unit for the system to the Position command unit (AxisName.Pr.Unit_Position).
  When control is performed in units of degrees, to accurately control values equal to or less than the decimal "0.00001" using control, set the position command unit to "$\times 10^{-3}$ degree" or "$\times 10^{-6}$ degree" instead of "degree". As a result, the value of "0.00001" can be handled as "10.0" in terms of control, meaning it can be controlled accurately.

Ex.

Setting in units of degrees

Accuracy required by the system	Value to set for axis parameters*1			Monitor display
	(1) Position Command Unit (AxisName.Pr.Unit_Position)	(2) Driver Command Unit Numerator (AxisName.Pr.Drive_Unit ConvRatioNum)	(3) Driver Command Unit Denominator (AxisName.Pr.Drive_Unit ConvRatioDen)	
360000000360.00000 [degree]	H00410000 degree $\times 10^{-0}$	67108864 (Servo motor resolution)	360	360.00000... [degree]
360.00000000 [degree]	HFD410000 degree $\times 10^{-3}$		360000	360000.00000... [10^(-3) degree]
360.00000000000 [degree]	HFA410000 degree $\times 10^{-6}$		360.00000360000000	360000000.00000... [10^(-6) degree]

*1 Set axis parameters in the "Electronic Gear Setting" window. The window can be displayed as follows: Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Target axis ⇨ [Basic Parameter] ⇨ Click the [...] button in [Position Command Unit].



- If the position command unit of the axis specified as an output axis has been set to "$\times 10^{-6}$degree", in addition to operating the slave axis by synchronous control restoration, it is possible to exceed the velocity limit value with the axis set as the output axis. If the velocity limit value is exceeded, move the set position of the axis set as the output axis in advance to a position close to the restoration position, or change the position command unit to a large unit such as "$\times 10^{-3}$degree".
- As the guaranteed range for decimals is up to 5 decimal places, the numbers of the current position of the axis set as the input axis are truncated after the 5th decimal place. In addition, if a value with more than 5 decimal places is set for a parameter or control data variable with a double-precision real number data type, the values after the 5th decimal place are ignored.
- If double-precision real numbers are monitored with the engineering tool, any values after the 5th decimal place may differ from the actual values.

Ex.

If the current position per cycle is in "180.00000" position

The monitor may display this as "179.999999...".

Smoothing

■Import timing

The smoothing time constant becomes enabled when the system is started. To reflect any changed values, a system restart is required.

■Smoothing time constant setting value and operation cycle setting

When the smoothing time constant is set to the maximum value (5000 [ms]), in addition to the operation cycle being less than or equal to 125 [μs], there will be restriction on the movement amount that can be processed per operation cycle. The relationship between the operation cycle and movement amount is shown in the following table.

Operation cycle [μs]	Movement amount per operation cycle when the smoothing time constant is 5000 [ms]
125	-1073741824.0 to 1073741823.0
250 or more	-2147483648.0 to 2147483647.0

If a value larger than the movement amount corresponding to the operation cycles in the above table is input into one operation cycle, Advanced Synchronization Control Operation Overflow Warning (event code: 00D3EH) occurs on the input axis and Advanced Synchronization Control Operation Overflow (error code: 1B23H) occurs on the output axis.
The filter level can be calculated by the following formula. Any decimal values rounded to the nearest integer. However, if the result is rounded to "0", the filter level will operate using level 1.
Filter level = (smoothing time [ms]) ÷ operation cycle [ms]

■Smoothing function memory usage

- When using the smoothing function, the longer the total of the smoothing time constant used by advanced synchronous control, the more system memory the add-on MotionControl_AdvancedSync consumes. The overall smoothing time is calculated using the following formula.
  Total smoothing time = Total smoothing time constant (AdvInputName.PrConst.SmoothingTimeConstant) + Total Master axis clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant) + Total Auxiliary axis clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant) + Total Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant) + Total Master axis speed change gear smoothing time constant (AdvOutputName.PrConst.MasterSpeedChangeGearSmoothingTimeConstant) + Total Auxiliary axis speed change gear smoothing time constant (AdvOutputName.PrConst.AuxSpeedChangeGearSmoothingTimeConstant) + Total Output axis speed change gear smoothing time constant (AdvOutputName.PrConst.OutSpeedChangeGearSmoothingTimeConstant)
- The smoothing function secures memory used by the smoothing process at power ON. Memory usage can be calculated using the following formula.
  Memory usage = Filter level × 8 bytes
- Operation when smoothing memory is insufficient
  Depending on the smoothing time constant setting, Advanced Synchronous Control Smoothing Memory Shortage (error code: 1A0DH) or Advanced Synchronous Control Add-on Memory Shortage (error code: 1A0CH) will occur at startup. If an error occurs, reduce the smoothing time constant used by advanced synchronous control, or set the add-on MotionControl_AdvancedSync parameter (AddonSystem.PrConst.AddonMemory) to satisfy the required memory capacity.

Writing to the controller

Deleting an axis or axes group variable by writing to the controller (including online program change) causes an Invalid write to the controller (error code: 3408H). Then, the motor will immediately stop due to the setting. Note that immediate stop may damage the machine.

Combination with other functions

■External signal selection

The current position per cycle under advanced synchronous control can be referred to by specifying [AXIS] for data type of the TARGET_REF structure target (Target). Set "@AdvSyncPosPerCyc" for "Target modification (string starting with @)".
The following shows data to be referred to by using the MC_SOURCE type enumerator set in Data name.
○: Can be set, ×: Cannot be set

MC_SOURCE type enumerator	Description	Modification
		@AdvSyncPosPerCyc
1: Set Value (mcSetValue)	Current position per cycle in the previous operation cycle of the output axis	○
2: Actual Value (mcActualValue)	External Signal Selection Incorrect (error code: 1BD6H) (detail code: H0002) occurs.	×
101: Latest Set Value (mcLatestSetValue)	Current position per cycle in this operation cycle of the output axis	○
102: Latest Actual Value (mcLatestActualValue)	External Signal Selection Incorrect (error code: 1BD6H) (detail code: H0002) occurs.	×

The data is updated as a ring counter. The range of the ring counter is 0.0 to (length per cycle - 0.00001).

Precautions

Do not change the length per cycle with Length per cycle change setting (AdvOutputName.Pr.Cam.LengthPerCycleChange) for the output axis for which the current position per cycle is referred to with the touch probe or digital cam switch during synchronous control. If the length per cycle is changed, correct data may not be referred to.

■Touch probe

When latching the Input axis variables (AdvInputName.☐) and Output axis variables (AdvOutputName.☐) using MC_TouchProbe (Touch Probe), latch is possible by specifying the data type to [VAR]. However, the latch data stores a value delayed by one operation cycle.
In addition, latch data estimations do not take into account any values exceeding the permissible value.

■Digital cam switch

When referring to the Input axis variables (AdvInputName.☐) and Output axis variables (AdvOutputName.☐) using the data source of MC_DigitalCamSwitch (digital cam switch), the reference is possible by specifying the data type to [VAR]. However, a value delayed by one operation cycle is stored as the value referred to by the data source.
In addition, data source estimations do not take into account any values exceeding the permissible value.

■Synchronous control function

The following motion control FB cannot be combined with advanced synchronous control.
To change the cam reference position, the current position per cycle, and current position per cycle after main shaft/auxiliary shaft gear during synchronous control, use the synchronous control change function.

- MCv_ChangeCycle (Current Position Change Per Cycle)

Required object data

Refer to the required object data for the output axis function.

☞ Page 989 Required object data

Relevant add-ons

The following add-ons are required to use this function.

Item	Add-on
Required	• baseSystem • Axis • MotionEngine • MotionControl_General • MotionControl_AdvancedSync • MotionControl_Sync
When using synchronous control initial position function	AbsSystem
When using operation profile data	ProfileControl
When using an external input signal with a clutch	SignalIO

System memory usage

■RAM usage

- When there are no input settings, output settings, and motion control FBs, 270 KB of memory will be used. The memory usage for input settings, output settings, and each motion control FB is shown below. Change the add-on MotionControl_AdvancedSync parameter (AddonSystem.PrConst.AddonMemory) where necessary.

Axis type	RAM usage
Input axis	2.7KB
Output axis	8.2KB
MCv_AdvancedSync (Advanced Synchronous Control)	1.0KB

- For memory usage when using smoothing, refer to the following.

  ☞ Page 908 Smoothing function memory usage

■When the add-on memory capacity is insufficient

When the memory used for add-ons is insufficient, Add-on memory insufficient (error code: 340CH) occurs. If an error occurs, set the add-on MotionControl_AdvancedSync parameter (AddonSystem.PrConst.AddonMemory) to satisfy the required memory capacity.

The add-on memory free space and filter function usage can be checked with System Memory Usage (AddonSystem.Md.AddonMemory).

■Backup RAM usage

For backup RAM usage, refer to the following.

☞ Page 991 Backup data management for advanced synchronous control

Buffer mode

For the buffer modes that can be specified with MCv_AdvancedSync (Advanced Synchronous Control), refer to the following.

☞ Page 555 Buffer mode that can be set

33.3 Input Axis Function

In GX Works3, configure the input settings for advanced synchronous control and generate and initialize the input axes necessary for advanced synchronous control. Any set axes will be assigned to the global label data as an input axis variable. Input axes are defined as an axis variable consisting of monitor information such as parameter information and current positions.

As the input axis settings are enabled after power ON, the status of input axes can be monitored even when MCv_AdvancedSync (Advanced Synchronous Control) has not been started.

When a warning or error occurs in the input axis, the warning or error is stored in the axis set in the input axis Axis information (AdvInputName.Axis).

The input axis functions are shown below.

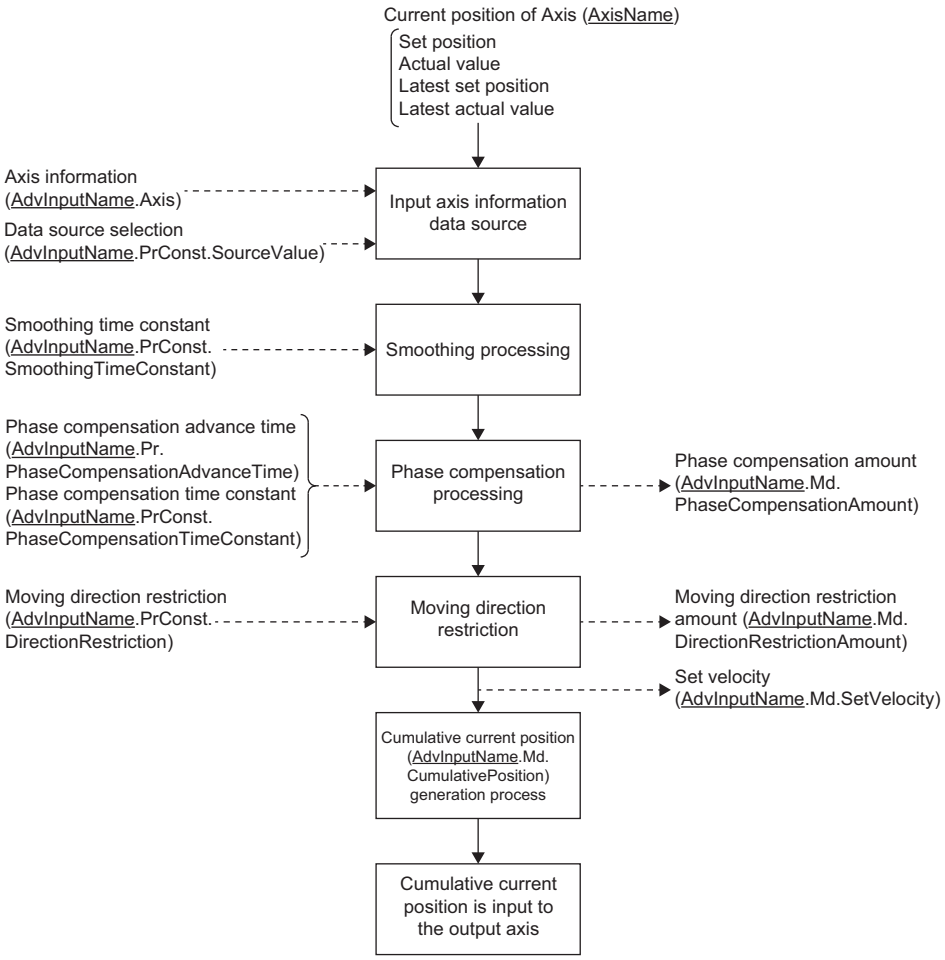
Function	Description	Application
Type setting	Sets the axis and data source used for the input axis.	Set the axis to transmit to the advanced synchronous control output axis and its input values.
Smoothing	Smoothing processing will be conducted for the input value of the axis set in type setting.	It is possible to suppress the velocity change by smoothing processing when "Actual Value" or "Latest Actual Value" is set as the input value in the data source. However, the input response is delayed by the set time due to the smoothing process.
Phase compensation	Phase compensation processing will be conducted for the input values of the axis set in type setting.	When a real drive axis or real encoder axis is set to the input axis, a phase delay occurs between the input axis and output axis motor shaft end. The phase compensation function is used to prevent phase deviation. For phase compensation of the input axis delay time, set the delay time peculiar to the system to the input axis Phase compensation advance time (AdvInputName.Pr.PhaseCompensationAdvanceTime).*1
Moving direction restriction	Moving direction restriction will be applied to the input values of the axis set in type setting.	When "Actual Value" or "Latest Actual Value" is set as the input value in the data source, it is possible to prevent reverse operation due to mechanical vibration or other factors.
Monitor	Monitors the input axis. Input axis monitor values are stored in the following monitor data. • Active status (AdvInputName.Md.ActiveStatus) • Cumulative current position (AdvInputName.Md.CumulativePosition) • Set velocity (AdvInputName.Md.SetVelocity) • Phase compensation amount (AdvInputName.Md.PhaseCompensationAmount) • Moving direction restriction amount (AdvInputName.Md.DirectionRestrictionAmount)	When the status of the input axis is monitored, this is described on the program.

*1 For the delay time peculiar to the system, refer to the following.

☞ Page 1016 Phase compensation function

After the input axis is generated, specify the input axis Axis information (AdvInputName.Axis) to the Master axis (Master) of the MCv_AdvancedSync (Advanced Synchronous Control). If using an auxiliary shaft and a sub input axis, specify the input axis Axis information (AdvInputName.Axis) to the Auxiliary shaft object (AdvOutputName.Pr.AuxAxis) and the Sub input axis object (AdvOutputName.Pr.SubAxis).

The relationship between the axis current position set in the input axis Axis information (AdvInputName.Axis) and each input axis function is shown below.



Input axis initialization timing

The input axis variables are initialized at the following timing.

Timing	Process
Power ON CPU module reset	Refers to the global label data, and initializes all set input axis variables.
At PLC READY OFF → ON	■Uninitialized axes Refers to the global label data and initializes all axis variables. ■Initialized axes When the parameter error occurs at loading, the axis is not deleted. In this case, the READY does not turn on. For the label initialization processing when the PLC READY turns off to on, refer to "Label initialization function" in the following manual. MELSEC MX Controller MX-R Model Programming Manual

Input axis position command unit

The input axis position command unit is the Position command unit (AxisName.Pr.Unit_Position) and the Position command unit string (AxisName.Pr.Unit_PositionString) of the axis set in the input axis Axis information (AdvInputName.Axis).
In addition, the position command unit of the input axis and output axis during synchronous control will not affect control. The result of the calculation performed for the position information of the input axis which has no unit information is used as the command of the output axis.
Refer to the explanation of each monitor data for details on input axis monitor display units.

Input axis positioning range

Regardless of the Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) or Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue) of the axis positioning range set in the input axis Axis information (AdvInputName.Axis), the input axis Cumulative current position (AdvInputName.Md.CumulativePosition) will be within the following range.

Positioning range
-10000000000.0 ≤ Positioning range < 10000000000.0

Input axis relevant variables

Input axis (AdvInputName.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
LabelID	Axis label ID	At system start	WORD (UINT)	1 to 256	0
Axis	Axis information		AXIS_REF	—	—

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Axis label ID(AdvInputName.LabelID)

Sets the label ID of the input axis.

Stores the variable ID of the input axis for advanced synchronous control.

The range is 1 to 256.

■Axis information (AdvInputName.Axis)

- Sets the Axis information (AxisName.AxisRef) of the axis that will be the input axis for advanced synchronous control. Up to 256 input axes can be generated.
  It is not possible to set the same axis to the axis information of different input axes. If it is set, Advanced Synchronous Control Input Axis Incorrect (error code: 1A0EH) will occur.
- Do not set the Axis information (AxisName.AxisRef) of an axis defined in local labels. If it is set, input axes will not be generated.

Input axis parameter constant (AdvInputName.PrConst.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
SourceValue	Data source selection	At system start	INT (MC_SOURCE)	• 1: Set Value (mcSetValue) • 2: Actual Value (mcActualValue) • 101: Latest Set Value (mcLatestSetValue) • 102: Latest Actual Value (mcLatestActualValue)	1: Set Value (mcSetValue)
SmoothingTimeConstant	Smoothing time constant		WORD (UINT)	0 to 5000 [ms]	0 [ms]
PhaseCompensationTimeConstant	Phase compensation time constant		WORD (UINT)	0 to 65535 [ms]	10 [ms]
DirectionRestriction	Moving direction restriction		INT (MC_INPUT_DIRECTION)	• 0: Without movement direction restriction (NoDirectionRestriction) • 1: Enable only for current position increase direction (mcPositiveDirection) • 2: Enable only for current position decrease direction (mcNegativeDirection)	0: Without moving direction restriction (NoDirectionRestriction)

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Data source selection (AdvInputName.PrConst.SourceValue)

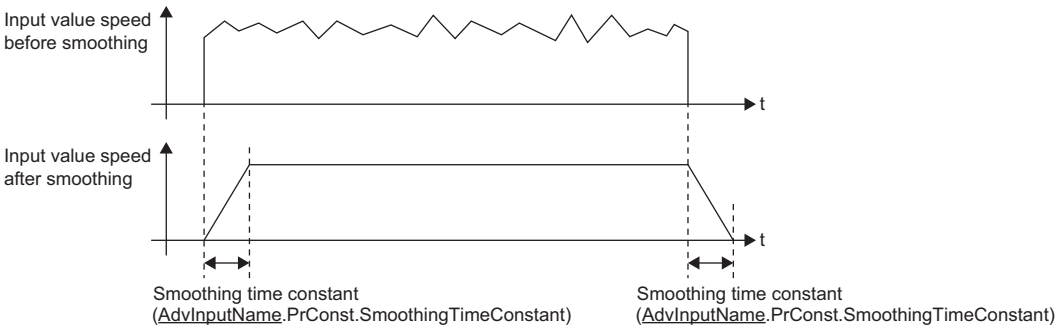
Set the input axis data source to be referenced in advanced synchronous control.

Setting value	Description
1: Set Value (mcSetValue)	Uses the set position of the axis specified to the input axis in the previous operation cycle.
2: Actual Value (mcActualValue)	Uses the actual position of the axis specified to the input axis in the previous operation cycle.
101: Latest Set Value (mcLatestSetValue)	Uses the set position of the axis specified to the input axis in the current operation cycle.
102: Latest Actual Value (mcLatestActualValue)	Uses the actual position of the axis specified to the input axis in the current operation cycle.

- If using "101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)", the commands of multiple motion control FBs can be transmitted in the same operation cycle. In this case, make the first calling order and the linking order of linked motion control FBs the same.
- When Data source selection (AdvInputName.PrConst.SourceValue) is set to "1: Set Value (mcSetValue)" or "101: Latest Set Value (mcLatestSetValue)" and the master axis is disconnected or changes to servo OFF due to a servo alarm or forced stop, the change in values may become large. This can be prevented by setting Data source selection (AdvInputName.PrConst.SourceValue) to "2: Actual Value (mcActualValue)" or "102: Latest Actual Value (mcLatestActualValue)".
- When actual value is specified for an axis (virtual drive axis, virtual linked axis, virtual encoder axis) that does not have an Actual Position (AxisName.Md.ActualPosition), the axis operates by the value that is the same as Set Position (AxisName.Md.SetPosition).
- For real encoder axes, since the set position is calculated from the actual position, operation will be the same regardless of the set value.

■Smoothing time constant (AdvInputName.PrConst.SmoothingTimeConstant)

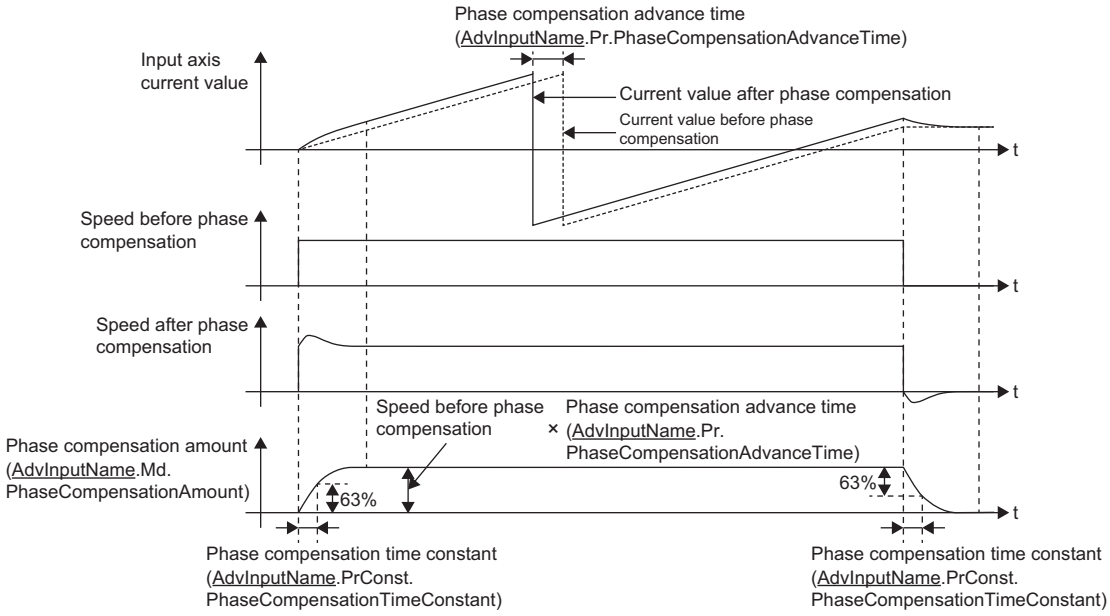
Set the averaged time for the smoothing process of the input movement amount from the input axis. The smoothing process can moderate velocity change when "Actual Value" or "Latest Actual Value" is set to the input value. However, the input response is delayed by the set time due to the smoothing process.



■Phase compensation time constant (AdvInputName.PrConst.PhaseCompensationTimeConstant)

Set the time constant for reflecting the phase compensation amount for the first order delay.

63% of the phase compensation amount is reflected in the specified time constant.



■Moving direction restriction (AdvInputName.PrConst.DirectionRestriction)

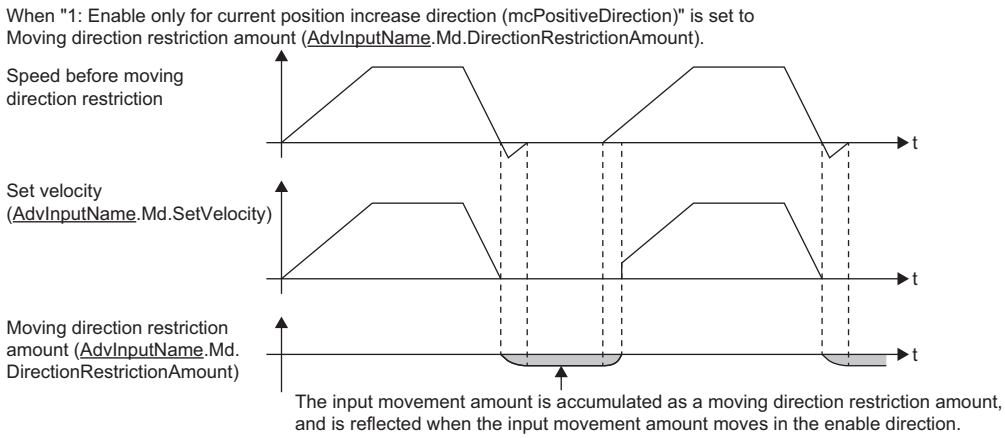
Set this parameter to restrict the input movement amount from the input axis to one direction.

Setting value	Description
0: Without movement direction restriction (NoDirectionRestriction)	Moving direction restriction is not executed.
1: Enable only for current position increase direction (mcPositiveDirection)	Enable only the input movement amount in a positive direction of the input axis cumulative current position.
2: Enable only for current position decrease direction (mcNegativeDirection)	Enable only the input movement amount in a negative direction of the input axis cumulative current position.

The input movement amounts of the enable direction and opposite direction are accumulated as a moving direction restriction amount, which will be reflected when the input movement amount is in the enable direction. As such, even when reverse operations are repeated, there will be no deviation in the input axis cumulative current position.

When the following operations are conducted for the input axis, the movement amount will be cleared to 0.

- When a servo amplifier is connected
- When a servo amplifier is disconnected
- When homing is executed
- When the current position is changed



Input axis parameter (AdvInputName.Pr.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
PhaseCompensationAdvanceTime	Phase compensation advance time	Operation cycle	DINT	-100000000 to 100000000 [μs]	0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Phase compensation advance time (AdvInputName.Pr.PhaseCompensationAdvanceTime)

Sets the time to advance or delay the phase (input response) of the input axis.

Setting value	Description
1 to 100000000 [μs]	Advance the phase (input response) according to the setting time.
0 [μs]	Do not execute phase compensation.
-100000000 to 1 [μs]	Delay the phase (input response) according to the setting time.

If the setting time is too long, the system experiences overshoot or undershoot at acceleration/deceleration of the input speed. In this case, set longer time to reflect the phase compensation amount in Phase compensation time constant (AdvInputName.PrConst.PhaseCompensationTimeConstant).

Input axis monitor data (AdvInputName.Md.)

Variable name	Name	Import*1	Data type*1	Stored value
ActiveStatus	Active status	Immediate	INT	• -1: Disabled • 0: Not connected • 1: Input axis enabled
CumulativePosition	Cumulative current position	Operation cycle	LREAL	-10000000000.0 ≤ Input axis cumulative current position < 10000000000.0 [Position command unit of the axis set as the input axis]
SetVelocity	Set velocity		LREAL	-2500000000.0 to 2500000000.0 [Position command unit of the axis set as the input axis]
PhaseCompensationAmount	Phase compensation amount		LREAL	-2147483648.0 to 2147483647.0 [Position command unit of the axis set as the input axis]
DirectionRestrictionAmount	Moving direction restriction amount		LREAL	-2147483648.0 to 2147483647.0 [Position command unit of the axis set as the input axis]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Active status (AdvInputName.Md.ActiveStatus)

Stores the status of the input axis.

Setting value	Description
-1: Disabled	Input axis generation has failed due to parameters being outside the possible range.
0: Not connected	The initial processing of the axis set as an input axis has not been completed, such as when a servo amplifier is not connected.
1: Input axis enabled	The input axis can be used for synchronous control.

■Cumulative current position (AdvInputName.Md.CumulativePosition)

The cumulative current position of the input axis is stored in the position units of the axis set in the input axis Axis information (AdvInputName.Axis) as shown below.

The current position of the input axis is the value after smoothing, phase compensation, and movement direction restriction processes.

Data source selection (AdvInputName.PrConst.SourceValue) setting value	Description
1: Set Value (mcSetValue)	• The set position of the axis set in the input axis Axis information (AdvInputName.Axis) in the previous operation cycle is stored. • When the set current position or the actual current position is changed by homing or current position change, it will be changed to the current position after change.
2: Actual Value (mcActualValue)	The value calculated using the position address returned by the device station of the axis set in the input axis Axis information (AdvInputName.Axis) in the previous operation cycle is stored.
101: Latest Set Value (mcLatestSetValue)	• The set position of the axis set in the input axis Axis information (AdvInputName.Axis) in this operation cycle is stored. • When the set current position or the actual current position is changed by homing or current position change, it will be changed to the current position after change.
102: Latest Actual Value (mcLatestActualValue)	The value calculated using the position address returned by the device station of the axis set in the input axis Axis information (AdvInputName.Axis) in this operation cycle is stored.

■Set velocity (AdvInputName.Md.SetVelocity)

The speed of the input axis is stored in speed units of the axis set in the input axis Axis information (AdvInputName.Axis).

The speed of the input axis is the value after smoothing, phase compensation, and moving direction restriction processes.

Point

Depending on the movement amount per input axis operation cycle, the range of "-2500000000.0 to 2500000000.0" may be exceeded.

■Phase compensation amount (AdvInputName.Md.PhaseCompensationAmount)

The phase compensation amount of the input axis is stored in position command units of the axis set in the input axis Axis information (AdvInputName.Axis).

The phase compensation amount of the input axis is the value after smoothing and phase compensation processes.

■Moving direction restriction amount (AdvInputName.Md.DirectionRestrictionAmount)

During moving direction restriction of the input axis, the enabled direction and the cumulative value of the opposite input movement amount are stored as shown below in position units of the axis specified as the input axis.

Moving direction restriction (AdvInputName.PrConst.DirectionRestriction) setting value	Description
1: Enable only for current position increase direction	A negative cumulative value is stored during moving direction restriction. "0.0" is stored if there is no restriction.
2: Enable only for current position decrease direction	Stores positive cumulative values during moving direction restriction. "0.0" is stored if there is no restriction.

Since the moving direction restriction is processed after the phase compensation process, if an undershoot occurs due to phase compensation during a deceleration stop, the moving direction restriction amount may remain.

Precautions

The following are precautions for using an input axis.

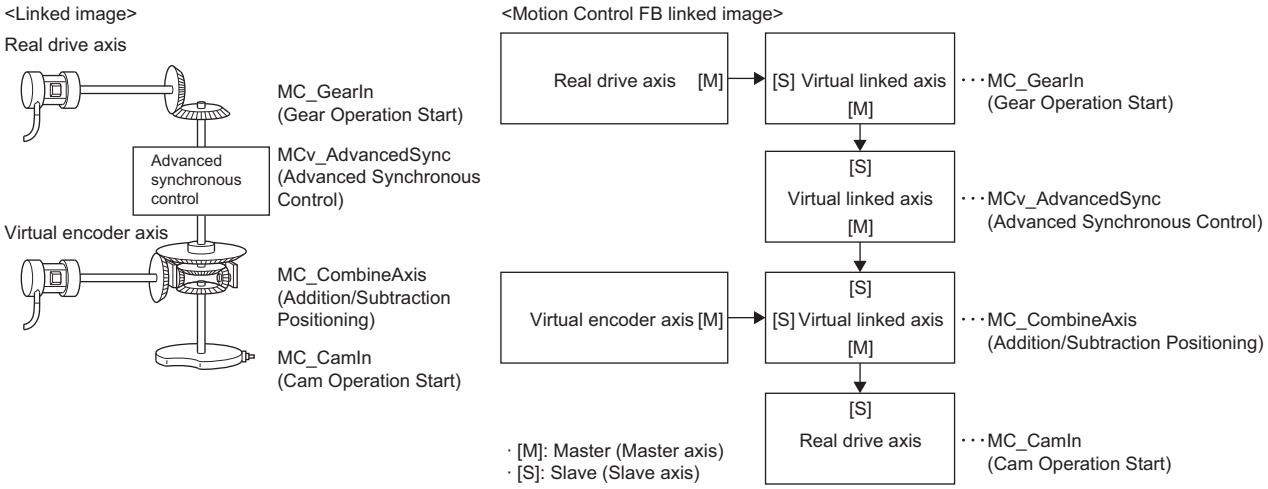
Advanced synchronous control operation overflow warning

When the driver conversion numerator/driver conversion denominator setting value of the axis set in the input axis Axis information (AdvInputName.Axis) or the input axis speed is significantly large, an overflow in the internal operation of the input axis will occur, and Advanced Synchronous Control Operation Overflow Warning (event code: 00D3EH) may occur. When a warning occurs, the synchronized position of the input axis and output axis may shift out of position. In this case, fix the setting values of the driver conversion numerator/driver conversion denominator or reduce the speed of the input axis.

Advanced synchronous control linking order

The Latest Set Value (mcLatestSetValue) and Latest Actual Value (mcLatestActualValue) of the Data Source Selection (AdvInputName.PrConst.SourceValue) use a position of the master axis in the same operation cycle, and the others use a position of the master axis in the previous operation cycle.
Using the Latest Set Value (mcLatestSetValue) and Latest Actual Value (mcLatestActualValue) can transmit multiple motion control FB commands in the same operation cycle. In this case, make the first calling order and the linking order of linked motion control FBs the same.

Ex.
When transmitting movement of the real drive axis, the virtual encoder axis, and advanced synchronous control to MC_CamIn (Cam Operation Start) control in the same operation cycle



When using the above combination of MCv_AdvancedSync (Advanced Synchronous Control) and single axis synchronous control FB (linked order), set the first call order as follows.

- First call order

1. Motion control FB which moves the real drive axis set as a Master axis (Master) of MC_GearIn (Gear Operation Start)
2. MC_GearIn (Gear Operation Start)
3. MCv_AdvancedSync (Advanced Synchronous Control)
4. MC_CombineAxes (Addition/Subtraction Positioning)
5. MC_CamIn (Cam Operation Start)

- Set Master axis data source selection (MasterValueSource) of each single axis synchronous control FB and advanced synchronous control data source selection (AdvInputName.PConst.PosSource) to "101: Latest Set Value (mcLatestSetValue)".

33.4 Output Axis Function

In GX Works3, configure output settings and generate and initialize the output axes necessary for advanced synchronous control.

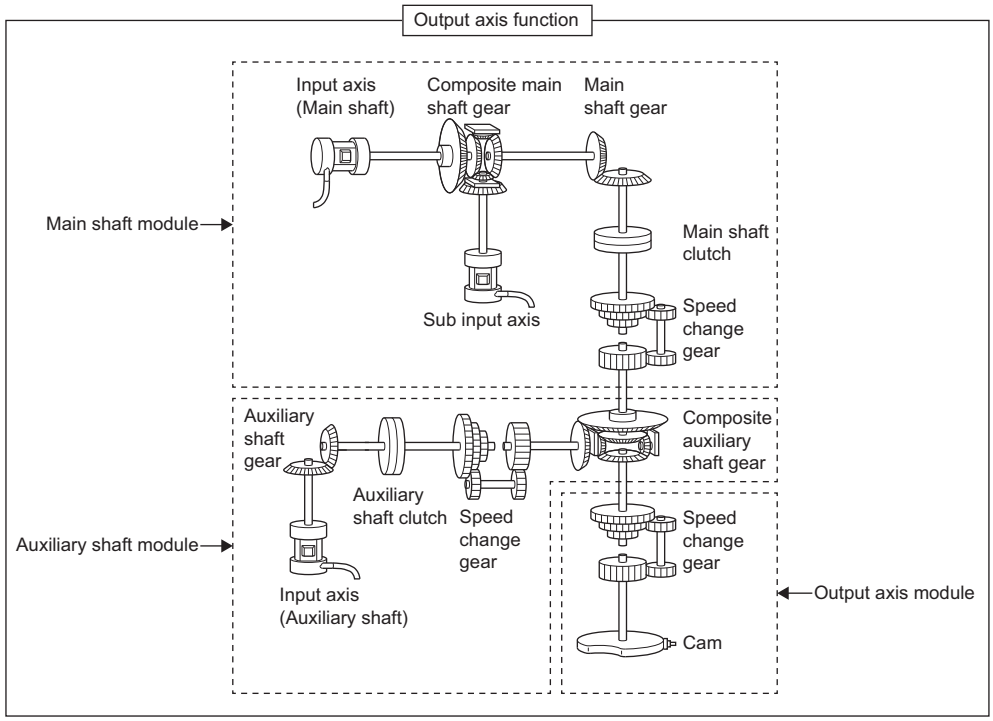
Output axes are defined as the output axis variables consisting of parameter information, control data, and monitor information such as current positions.

Any generated output axes are specified in the output axis Axis information (AdvOutputName.Axis) of the Slave Axis (Slave) of MCv_AdvancedSync (Advanced Synchronous Control).

When a warning or error occurs on the output axis, the warning or error is stored in the axis set in the output axis Axis information (AdvOutputName.Axis).

This section describes the parameters, control data, and monitor data of the "Main shaft module", "Auxiliary shaft module", and "Output axis module" of advanced synchronous control.

The "Main shaft module", "Auxiliary shaft module" and "Output axis module" are defined as shown below.



Point

The arrangement and number of modules in advanced synchronous control are fixed.

Output axis initialization timing

The output axis variables are initialized at the following timings.

Timing	Processing
• Power ON • Reset	Refers to the global label data, and initializes all set output axis variables.
At PLC READY OFF → ON	■Uninitialized axes Refers to the global label data and initializes all output axis variables. ■Initialized axes Refer to the global label data for the output axis parameter data (AdvOutputName.Pr.□) and reload again. When the parameter error occurs at loading, the axis is not deleted. In this case, the READY does not turn on. For the label initialization processing when the PLC READY turns off to on, refer to "Label initialization function" in the following manual. 📖MELSEC MX Controller MX-R Model Programming Manual

Output axis positioning range

- Set the Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue) and Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) to the values below. If any other values are set, an Out of Advanced Synchronous Control Output Axis Ring Counter Range (error code: 1B26H) error will occur at system start.

Setting range	
Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue)	**Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue)**
0.0	0.0 < Setting value ≤ 2147483647.0
-10000000000.0	10000000000.0

- Do not set digits after the decimal point in the Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue) and Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) of the positioning range of the axis set in the output axis Axis information (AdvOutputName.Axis). If set, an error will occur with the value output to the slave axis and the Set position (AxisName.Md.SetPosition) of the axis set to the output axis in synchronous control when the permissible value is exceeded.

Output axis relevant variables

Output axis (AdvOutputName.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
LabelID	Axis label ID	At system start	WORD (UINT)	1 to 256	0
Axis	Axis information		AXIS_REF	—	—

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Axis label ID (AdvOutputName.LabelID)

- Sets the label ID of the output axis.
- The range is 1 to 256.

■Axis information (AdvOutputName.Axis)

- Sets the Axis information (AxisName.AxisRef) of the axis that will be the output axis for advanced synchronous control.
- Up to 256 output axes can be generated.
- It is not possible to set the same axis to the axis information of different output axes.
- Do not set the Axis information of an axis (AxisName.AxisRef) defined in local labels. If it is set, output axes will not be generated.
- Settable axis types to the output axis are shown below.

○: Can be set, ×: Cannot be set

Axis type		Output axis setting
Real axis	Real drive axis	○
	Real encoder axis	×*1
Virtual axis	Virtual drive axis	○
	Virtual encoder axis	×*1
	Virtual linked axis	○

*1 If set, Advanced Synchronous Control Output Axis Incorrect (error code: 1A0FH) will occur.

Output axis parameter constant (AdvOutputName.PrConst.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
SmoothingTimeConstant	Output axis smoothing time constant	At system start	WORD (UINT)	0 to 5000 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant)

Set the averaging time to execute a smoothing process for the movement amount to the output axis after cam conversion.
The smoothing process can moderate rapid velocity changes on the cam of cam data (linear interpolation) or others.
However, the output response is delayed by the set time due to the smoothing process.

Output axis parameter (AdvOutputName.Pr.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
SubAxis	Sub input axis object	At start	AXIS_REF	—	—
AuxAxis	Auxiliary axis object		AXIS_REF	—	—

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Sub input axis object (AdvOutputName.Pr.SubAxis)

Set the sub input axis object axis.

This variable will be disabled when set to "0".

When an axis to which input settings have not been assigned is set, Advanced Synchronization Control Axis Unset (error code: 1B22H) will occur.

■Auxiliary shaft object (AdvOutputName.Pr.AuxAxis)

Set the auxiliary axis object axis.

This variable will be disabled when set to "0".

When an axis to which input settings have not been assigned is set, Advanced Synchronization Control Axis Unset (error code: 1B22H) will occur.

Output axis monitor data (AdvOutputName.Md.)

Variable name	Name	Import*1	Data type*1	Stored value
Synchronous status	SyncStatus	At start	INT	• -1: Disabled • 0: Not synchronizing • 1: In synchronization
Master shaft	MasterAxisNo		WORD (UINT)	0 to 10000
Sub input axis	SubAxisNo		WORD (UINT)	0 to 10000
Auxiliary axis	AuxAxisNo		WORD (UINT)	0 to 10000

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Synchronization status (AdvOutputName.Md.SyncStatus)

The synchronization status of the output axis is stored.

Setting value	Description
-1: Disabled	The output axis cannot be used in this status due to being in initial processing or because of out of range parameters.
0: Not synchronizing	The output axis is not synchronized with the input axis by MCv_AdvancedSync (Advanced Synchronous Control).
1: In synchronization	The output axis is synchronized with the input axis by MCv_AdvancedSync (Advanced Synchronous Control).

■Main shaft (AdvOutputName.Md.MasterAxisNo)

The axis number of the main shaft set in the input axis Axis information (AdvInputName.Axis) in synchronization with the output axis is stored.

"0" is stored when a main shaft is not connected.

■Sub input axis (AdvOutputName.Md.SubAxisNo)

The axis number of the sub input axis set in the input axis Axis information (AdvInputName.Axis) in synchronization with the output axis is stored.

"0" is stored when a sub input axis is not connected.

■Auxiliary shaft (AdvOutputName.Md.AuxAxisNo)

The axis number of the auxiliary shaft set in the input axis Axis information (AdvInputName.Axis) in synchronization with the output axis is stored.

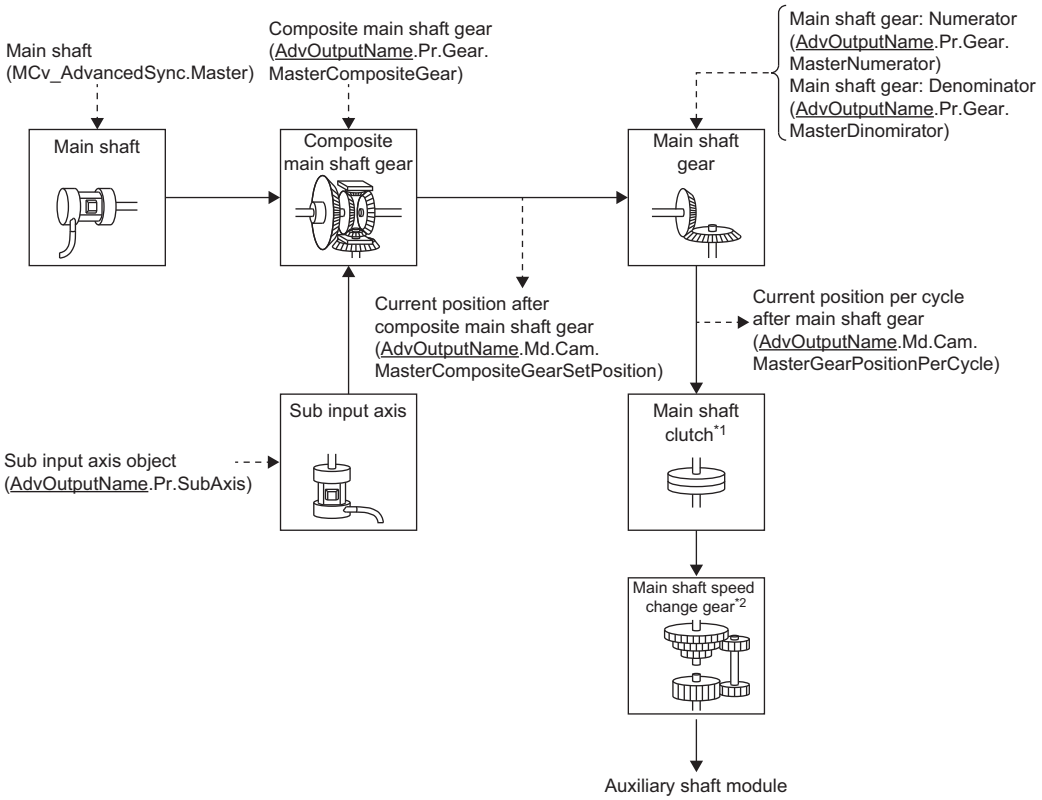
"0" is stored when an auxiliary shaft is not connected.

Main shaft module

The main shaft control modules transmit the movement amount input from an input axis to the output axis.
The main shaft module corresponds to the axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).
The functions for a main shaft control module include gears, clutches, and speed change gears. For the setting items, refer to the following.

Function	Member	Variable	Reference
Gear	Output axis parameter (AdvOutputName.Pr.)	Gear parameter (Gear.)	Page 925 Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)
Clutch	Output axis parameter constant (AdvOutputName.PrConst.)	—	Page 926 Output axis parameter constant (AdvOutputName.PrConst.)
	Output axis parameter (AdvOutputName.Pr.)	—	Page 926 Output axis parameter (AdvOutputName.Pr.)
		Clutch parameter (Clutch.)	Page 928 Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)
	Output axis monitor data (AdvOutputName.Md.)	Clutch monitor (Clutch.)	Page 933 Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)
	Output axis control data (AdvOutputName.Cd.)	Clutch control data (Clutch.)	Page 933 Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)
Speed change gear	Output axis parameter constant (AdvOutputName.PrConst.)	—	Page 962 Output axis parameter constant (AdvOutputName.PrConst.)
	Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)	Speed change gear parameter (SpeedChangeGear.)	Page 961 Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)
	Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)	Speed change gear control data (SpeedChangeGear.)	Page 963 Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)

- Main shaft module: The input value is generated as a composite value from two input axes (the main shaft and sub input axis) through the composite main shaft gear. The composite input value can be converted by the main shaft gear that provides the deceleration ratio, rotation direction, and other elements for the machine system.



*1 Clutch (☞ Page 947 Clutch)
*2 Speed change gear (☞ Page 960 Speed change gear)

Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterCompositeGear	Composite main shaft gear	Operation cycle (FB is starting)	WORD (HEX)	H□□□□ Main shaft input method 0: No input 1: Input + 2: Input - Sub input method 0: No input 1: Input + 2: Input -	0001H
MasterNumerator	Main shaft gear: Numerator	At start	DINT	-2147483647 to 2147483647	1
MasterDenominator	Main shaft gear: Denominator		DWORD (UDINT)	1 to 2147483647	1

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Composite main shaft gear (AdvOutputName.Pr.Gear.MasterCompositeGear)

Set the composite method for the current positions from the main shaft and sub input axis.

Setting value	Description
0: No input	The input value from the input axis is calculated as 0.
1: Input +	The input value from the input axis is calculated as it is.
2: Input -	The input value from the input axis is calculated with its opposite sign.

Operation assumes "0: No input" if the value is set out of the range from 0 to 2.

Point

The composite method for the composite main shaft gear can be changed during synchronous control. It can also be used as a clutch to switch input values of the main shaft and auxiliary shafts.

■Main shaft gear: Numerator (AdvOutputName.Pr.Gear.MasterNumerator)

Set the numerator for the main shaft gear input value conversion.

The input value is converted as follows.

$$\text{Input value after conversion} = \text{Input value before conversion} \times \frac{\text{Main shaft gear: Numerator}}{\text{Main shaft gear: Denominator}}$$

The input value direction can be reversed by setting a negative value in the setting value of the gear numerator.

Point

Set a reduced fraction for "Main shaft gear: Numerator/Main shaft gear: Denominator".

■Main shaft gear: Denominator (AdvOutputName.Pr.Gear.MasterDenominator)

Set the denominator for the main shaft gear input value conversion.

Set together with Main shaft gear: Numerator.

Output axis parameter constant (AdvOutputName.PrConst.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterClutchSmoothingTimeConstant	Main shaft clutch smoothing time constant	At system start	WORD (UINT)	0 to 5000 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant)

Set a time constant when the time constant method is set to "1: Time constant method (Exponent) (TimeConstantExponent)" or "2: Time constant method (Linear) (TimeConstantLinear)" in the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod).
The time constant setting applies for both clutch ON/OFF.

Output axis parameter (AdvOutputName.Pr.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterOnClutchSignal	Main shaft clutch ON signal setting	At system start	SIGNAL_SELECT	—	—
MasterOffClutchSignal	Main shaft clutch OFF signal setting			—	—

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft clutch ON signal setting (AdvOutputName.Pr.MasterOnClutchSignal)

Set the variable and device used as the clutch external signal in SIGNAL_SELECT structure when the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) is set to "15: I/O data specification (ClutchSignal)". For SIGNAL_SELECT structure, refer to the following.
☞ Page 1156 SIGNAL_SELECT Structure
The following shows the settings peculiar to Main shaft clutch ON signal setting (AdvOutputName.Pr.MasterOnClutchSignal).

Structure	Variable name	Type	Setting range
SIGNAL_SELECT (Signal Select)	Source (Signal)	TARGET_REF	■Type • BOOL ■Data type • [OBJ] • [VAR] • [DEV] • [LINK]
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (Rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (Falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

Point

If the following data types are set to the target (Source.Target), after communication with the device station has been established, start MCv_AdvancedSync (Advanced Synchronous Control). If the communication has not been established, External Signal Selection Incorrect (error code: 1BD6H) (detail code: 0002H) occurs.
• [OBJ]
• [LINK]

■Main shaft clutch OFF signal setting (AdvOutputName.Pr.MasterOffClutchSignal)

Set the variable and device used as the clutch external signal in SIGNAL_SELECT structure when the Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl) is set to "15: I/O data specification (ClutchSignal)". For SIGNAL_SELECT structure, refer to the following.

☞ Page 1156 SIGNAL_SELECT Structure

The following shows the settings peculiar to Main shaft clutch OFF signal setting (AdvOutputName.Pr.MasterOffClutchSignal).

Structure	Variable name	Type	Setting range
SIGNAL_SELECT (Signal Select)	Source (Signal)	TARGET_REF	■Type • BOOL ■Data type • [OBJ] • [VAR] • [DEV] • [LINK]
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (Rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (Falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

Point

If the following data types are set to the target (Source.Target), after communication with the device station has been established, start MCv_AdvancedSync (Advanced Synchronous Control). If the communication has not been established, External Signal Selection Incorrect (error code: 1BD6H) (detail code: 0002H) occurs.

• [OBJ]

• [LINK]

Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterOnControl	Main shaft clutch ON control setting	Operation cycle (FB is starting)	INT (MC_CLUTCH_METHOD)	• 0: Invalid (NoClutch) (Direct coupled operation) • 1: Clutch command (ClutchCommand) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)	0: Invalid (NoClutch)
MasterOffControl	Main shaft clutch OFF control setting		INT (MC_CLUTCH_METHOD)	• 0: Invalid (NoClutch) (OFF control invalid) • 1: Clutch command (ClutchCommand) (One-shot operation) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)	0: Invalid (NoClutch)
MasterReference	Main shaft clutch reference address setting	At start	INT (MC_CLUTCH_REFERENCE)	• 0: Current position before gear (GearFrontPosition) • 1: Current position per cycle after gear (GearPositionPerCycle)	0: Current position before gear (GearFrontPosition)
MasterOnAddress	Main shaft clutch ON address	Operation cycle (FB is starting)	LREAL	-10000000000.0 to 10000000000.0	0.0
MasterMovementAmountBeforeOn	Movement amount before main shaft clutch ON	At completing clutch ON condition	LREAL	-2147483648.0 to 2147483647.0	0.0
MasterOffAddress	Main shaft clutch OFF address	Operation cycle (FB is starting)	LREAL	-10000000000.0 to 10000000000.0	0.0
MasterMovementAmountBeforeOff	Movement amount before main shaft clutch OFF	At completing clutch OFF condition	LREAL	-2147483648.0 to 2147483647.0	0.0
MasterSmoothingMethod	Main shaft clutch smoothing method	At start	INT (MC_CLUTCH_SMOOTHING_METHOD)	• 0: Direct (ClutchSmoothingDisabled) • 1: Time constant method (Exponent) (TimeConstantExponent) • 2: Time constant method (Linear) (TimeConstantLinear) • 3: Slippage method (Exponent) (SlippageExponent) • 4: Slippage method (Linear) (SlippageLinear) • 5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)	0: Direct (ClutchSmoothingDisabled)
MasterOnSlippageAmount	Slippage amount at main shaft clutch ON	At turning clutch on	LREAL	0.0 to 2147483647.0	0.0
MasterOffSlippageAmount	Slippage amount at main shaft clutch OFF	At turning clutch off	LREAL	0.0 to 2147483647.0	0.0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl)

Set the control method for main shaft clutch ON. The Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) can be changed during synchronous control. However, changes from settings other than "0: Invalid (NoClutch)" to "0: Invalid (NoClutch)" are not possible.

Setting value	Description
0: Invalid (NoClutch) (Direct coupled operation)	Execute direct coupled operation without clutch control.
1: Clutch command (ClutchCommand)	The clutch is turned on/off by the operations of the Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand) TRUE/FALSE. (In the clutch command ON/OFF mode, the setting in the Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl) is not referred to.)
2: Clutch command leading edge (ClutchLeadingEdge)	The clutch is turned on when the Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand) passes the leading edge (from FALSE to TRUE).
3: Clutch command trailing edge (ClutchTrailingEdge)	The clutch is turned on when the Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand) passes the trailing edge (from TRUE to FALSE).
4: Address mode (ClutchAddress)	The clutch is turned on when the reference address (the current position after composite main shaft gear or the current position per cycle after main shaft gear) reaches the Main shaft clutch ON address (AdvOutputName.Pr.Clutch.MasterOnAddress). When the reference address passes through the ON address, the movement amount after the ON address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.
15: I/O data specification (ClutchSignal)	The clutch is turned on when the external input signal set in the Main shaft clutch ON signal setting (AdvOutputName.Pr.MasterOnClutchSignal) is detected.

Point

- Other clutch parameter settings are not referred to because direct coupled operation is performed by setting the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) to "0: Invalid (NoClutch)". The Main shaft clutch forced OFF command (AdvOutputName.Cd.Clutch.MasterForcedOff) and the change of the clutch control setting are ignored during direct coupled operation.
- Changes from settings other than "0: Invalid (NoClutch)" to "0: Invalid (NoClutch)" are not possible during synchronous control. If the setting is changed in that manner, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs.

■Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl)

Set the control method for main shaft clutch OFF.

Setting value	Description
0: Invalid (NoClutch) (OFF control invalid)	Clutch OFF control is not used. Set it only for execution with clutch ON control.
1: Clutch command (ClutchCommand) (One-shot operation)	After Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus) is turned on, it moves the distance set in Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff), then the clutch turns off. (One-shot operation) If the Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff) is "0.0", the Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus) does not turn to "TRUE (Clutch ON status)" in order to turn back off immediately.
2: Clutch command leading edge (ClutchLeadingEdge)	The clutch is turned off when the Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand) passes the leading edge (from FALSE to TRUE).
3: Clutch command trailing edge (ClutchTrailingEdge)	The clutch is turned off when the Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand) passes the trailing edge (from TRUE to FALSE).
4: Address mode (ClutchAddress)	The clutch is turned off when the reference address (the current position after composite main shaft gear or the current position per cycle after main shaft gear) reaches the Main shaft clutch OFF address (AdvOutputName.Pr.Clutch.MasterOffAddress). When the reference address passes through the OFF address, the movement amount after the OFF address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.
15: I/O data specification (ClutchSignal)	The clutch is turned off when the external input signal set in the Main shaft clutch OFF signal setting (AdvOutputName.Pr.MasterOffClutchSignal) is detected.

■Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference)

Set the address to be referred to at clutch control.

Note that the processing order of gears and clutches varies by the reference address.

Setting value	Description
0: Current position before gear (GearFrontPosition)	The clutch is controlled by using the current position after composite main shaft gear, which is before the main shaft gear conversion. The movement amount after the clutch control is converted then output through the main shaft gear. * The clutch processing is performed for the current position after composite main shaft gear. The current position after composite main shaft gear is used as the reference address when the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) is set to "4: Address mode (ClutchAddress)".
1: Current position per cycle after gear (GearPositionPerCycle)	The clutch is controlled by using the current position per cycle after main shaft gear. The movement amount after the main shaft clutch control is output as it is. * The clutch processing is performed for the current position per cycle after main shaft gear. The current position per cycle after main shaft gear is used as the reference address when the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) is set to "4: Address mode (ClutchAddress)".

The unit settings of the following parameters are in position command units of the main shaft.

- Main shaft clutch ON address (AdvOutputName.Pr.Clutch.MasterOnAddress)
- Main shaft clutch OFF address (AdvOutputName.Pr.Clutch.MasterOffAddress)
- Movement amount before main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOn)
- Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff)
- Slippage amount at main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterOnSlippageAmount)
- Slippage amount at main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterOffSlippageAmount)

■Main shaft clutch ON address (AdvOutputName.Pr.Clutch.MasterOnAddress)

Set the clutch ON address when "4: Address mode (ClutchAddress)" is set in the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl).

When "1: Current position per cycle after gear (GearPositionPerCycle)" is set in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference), the setting address is converted for control within the range from "0.0 to (length per cycle - 0.00001)".

Setting value
-10000000000.0 ≤ Main shaft clutch ON address (AdvOutputName.Pr.Clutch.MasterOnAddress) < 10000000000.0

Ex.

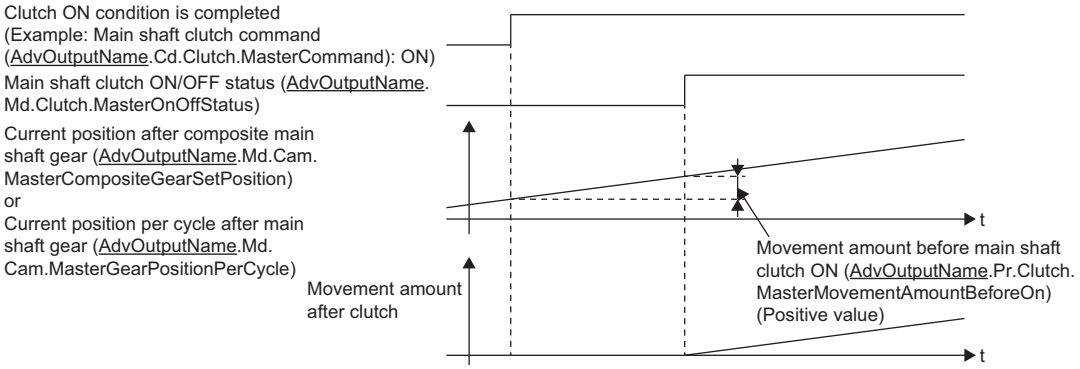
Length per cycle: 20000.0

The ON address is controlled as "19000.0" when the setting value is "-1000.0".

■Movement amount before main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOn)

Set the movement amount for the reference address with a signed number regarding from when the main shaft clutch ON condition is met until when the clutch turns on.

Setting value	Description
0.00001 to 2147483647.0 (Positive value)	Used when the reference address is increasing in direction.
0.0	No movement (The clutch turns on at the same time as when the ON condition is met.)
-2147483648.0 to -0.00001 (Negative value)	Used when the reference address is decreasing in direction.



■Main shaft clutch OFF address (AdvOutputName.Pr.Clutch.MasterOffAddress)

Set the clutch OFF address when "4: Address mode (ClutchAddress)" is set in the Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl).

When "1: Current position per cycle after gear (GearPositionPerCycle)" is set in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference), the setting address is converted for control within the range from "0.0 to (length per cycle - 0.00001)".

Setting value
-10000000000.0 ≤ Main shaft clutch OFF address (AdvOutputName.Pr.Clutch.MasterOffAddress) < 10000000000.0

Ex.

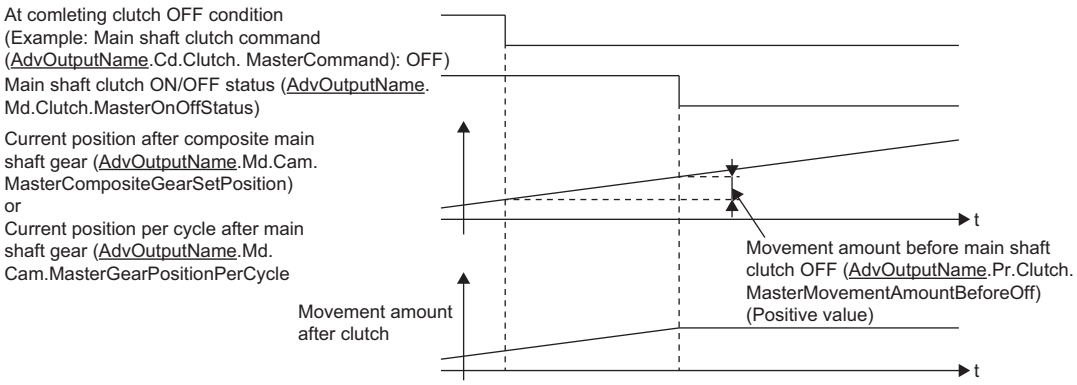
Length per cycle: 20000.0

The OFF address is controlled as "60.0" when the setting value is "40060.0".

■Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff)

Set the movement amount for the reference address with a signed number regarding from when the main shaft clutch OFF condition is met until when the clutch turns off.

Setting value	Description
0.00001 to 2147483647.0 (Positive value)	Used when the reference address is increasing in direction.
0.0	No movement (The clutch turns off at the same time as when the OFF condition is met.)
-2147483648.0 to -0.00001 (Negative value)	Used when the reference address is decreasing in direction.



■Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod)

Set the smoothing method for clutch ON/OFF.

Setting value	Description
0: Direct (ClutchSmoothingDisabled)	No smoothing for the main shaft clutch.
1: Time constant method (Exponent) (TimeConstantExponent)	Smoothing with an exponential curve based on the time constant setting.
2: Time constant method (Linear) (TimeConstantLinear)	Smoothing with linear acceleration/deceleration based on the time constant setting.
3: Slippage method (Exponent) (SlippageExponent)	Smoothing with an exponential curve based on the slippage amount setting.
4: Slippage method (Linear) (SlippageLinear)	Smoothing with linear acceleration/deceleration based on the slippage amount setting.
5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)	Smoothing with linear acceleration/deceleration (input value follow up) based on the slippage amount setting.

■Slippage amount at main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterOnSlippageAmount)

Set the slippage amount at clutch ON when any of the following is set in the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod). "3: Slippage method (Exponent) (SlippageExponent)", "4: Slippage method (Linear) (SlippageLinear)", or "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)".
The slippage amount is set in units based on the setting in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference).
If the set amount is negative, slippage amount at clutch ON is controlled as 0 (direct).

Point

Do not set digits after the decimal point when "3: Slippage method (Exponent) (SlippageExponent)" is set in the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod). If set, smoothing is performed with the digits after the decimal point ignored.

■Slippage amount at main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterOffSlippageAmount)

Set the slippage amount at clutch OFF when any of the following is set in the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod). "3: Slippage method (Exponent) (SlippageExponent)", "4: Slippage method (Linear) (SlippageLinear)", or "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)".
The slippage amount is set in units based on the setting in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference).
If the set amount is negative, slippage amount at clutch OFF is controlled as 0 (direct).

Point

Do not set digits after the decimal point when "3: Slippage method (Exponent) (SlippageExponent)" is set in the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod). If set, smoothing is performed with the digits after the decimal point ignored.

Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)

Variable name	Name	Import*1	Data type*1	Monitor value
MasterOnOffStatus	Main shaft clutch ON/OFF status	Operation cycle (FB is starting)	BOOL	• FALSE: Clutch OFF status • TRUE: Clutch ON status
MasterSmoothingStatus	Main shaft clutch smoothing status		BOOL	• FALSE: Not on clutch smoothing • TRUE: On clutch smoothing
MasterCumulativeSlippage	Main shaft clutch slippage (accumulative)		LREAL	-2147483648.0 to 2147483647.0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)

The main shaft clutch ON/OFF status is stored.

■Main shaft clutch smoothing status (AdvOutputName.Md.Clutch.MasterSmoothingStatus)

The smoothing status of the main shaft clutch is stored.

The status is updated by the Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod).

Method	Description
Time constant method	The status is always "TRUE: On clutch smoothing" during the clutch ON status. The status will be "FALSE: Not on clutch smoothing" when the clutch is turned off and smoothing is completed.
Slippage method	The status is "TRUE: On clutch smoothing" until the clutch accumulative slippage amount reaches the slippage at clutch ON when the clutch is turned on. The status will change to "FALSE: Not on clutch smoothing" when the clutch accumulative slippage amount reaches the slippage at clutch ON. The status is "TRUE: On clutch smoothing" until the clutch accumulative slippage amount reaches 0 when the clutch is turned off. The status will change to "FALSE: Not on clutch smoothing" when the clutch accumulative slippage amount reaches 0.

■Main shaft clutch slippage (accumulative) (AdvOutputName.Md.Clutch.MasterCumulativeSlippage)

The accumulative slippage amount with the slippage method during clutch smoothing is stored as a signed value.

The absolute value of the accumulative slippage increases to reach the slippage at clutch ON during clutch ON.

The absolute value of the accumulative slippage decreases to reach "0.0" during clutch OFF.

Monitoring of the accumulative slippage is used to check the smoothing progress with the slippage method.

Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterCommand	Main shaft clutch command	Operation cycle (FB is starting)	BOOL	• FALSE: Clutch command OFF • TRUE: Clutch command ON	FALSE
MasterInvalidCommand	Main shaft clutch control invalid command		BOOL	• FALSE: Clutch control valid • TRUE: Clutch control invalid	FALSE
MasterForcedOff	Main shaft clutch forced OFF command		BOOL	• FALSE: Clutch normal control • TRUE: Clutch forced OFF	FALSE
MasterClutchSmoothingTimeConstant	Main shaft clutch smoothing time constant change value	At start	INT	0 to 5000 [ms]	0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand)

Sets ON/OFF for the main shaft clutch command.

This command is used when any of the following is set in the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl).

- 1: Clutch command (ClutchCommand)
- 2: Clutch command leading edge (ClutchLeadingEdge)
- 3: Clutch command trailing edge (ClutchTrailingEdge)

The status just before synchronous control starts is considered as clutch command OFF. If synchronous control is started while the clutch command is on, the condition is established just after starting synchronous control, by setting "2: Clutch command leading edge (ClutchLeadingEdge)". The condition is not established just after starting synchronous control, by setting "3: Clutch command trailing edge (ClutchTrailingEdge)".

■Main shaft clutch control invalid command (AdvOutputName.Cd.Clutch.MasterInvalidCommand)

The main shaft clutch control is invalid if "TRUE: Clutch control invalid" is set. The clutch ON/OFF status maintained is the one before clutch control becomes invalid.

Clutch control will not become invalid during movement before clutch ON and during movement before clutch OFF. Instead, clutch control will become invalid after movement is completed.

■Main shaft clutch forced OFF command (AdvOutputName.Cd.Clutch.MasterForcedOff)

Set "TRUE: Clutch forced OFF" to force the clutch OFF.

The output value from the clutch becomes "0" immediately, even during clutch smoothing. The slippage (accumulative) amount is set to 0 if smoothing with a slippage method.

Reset to "FALSE: Clutch normal control" to restart the clutch control from the clutch OFF status after using the clutch forced OFF command.

■Main shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.MasterClutchSmoothingTimeConstant)

The smoothing time constant of the main shaft clutch is changed. The setting is imported when MCv_AdvancedSync(Advanced Synchronous Control) is started.

Setting value	Description
When a negative value is set	No smoothing.
When 0 is set	Smoothing based on the setting value of the Main shaft clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant).
When a positive value is set	Smoothing based on the setting value of the Main shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.MasterClutchSmoothingTimeConstant).

Set within the following setting range.

If the set value exceeds the range below, "Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH)" occurs, and smoothing is executed based on the setting value of the Main shaft clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant).

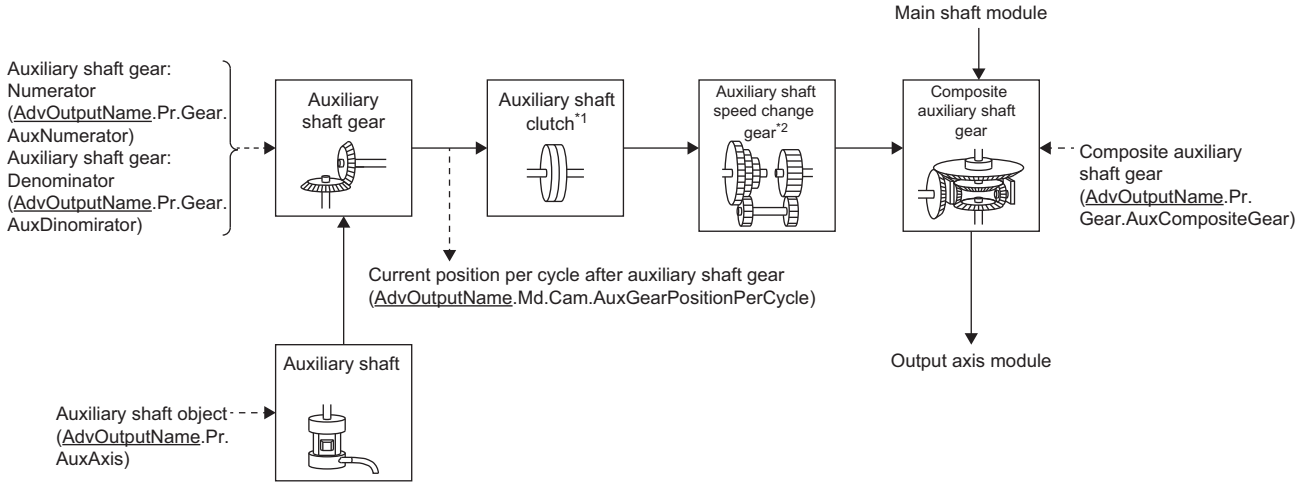
Setting range
Main shaft clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant) > Main shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.MasterClutchSmoothingTimeConstant)

Auxiliary shaft module

The auxiliary shaft modules transmit the movement amount input from an input axis to the output axis.
The auxiliary shaft module corresponds to the axis set in Auxiliary shaft object (AdvOutputName.Pr.AuxAxis).
The functions for an auxiliary shaft module include gears, clutches, and speed change gears. For the setting items, refer to the following.

Function	Member	Variable	Reference
Gear	Output axis parameter (AdvOutputName.Pr.)	Gear parameter (Gear.)	Page 936 Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)
Clutch	Output axis parameter constant (AdvOutputName.PrConst.)	—	Page 937 Output axis parameter constant (AdvOutputName.PrConst.)
	Output axis parameter (AdvOutputName.Pr.)	—	Page 937 Output axis parameter (AdvOutputName.Pr.)
		Clutch parameter (Clutch.)	Page 939 Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)
	Output axis monitor data (AdvOutputName.Md.)	Clutch monitor (Clutch.)	Page 944 Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)
	Output axis control data (AdvOutputName.Cd.)	Clutch control data (Clutch.)	Page 945 Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)
Speed change gear	Output axis parameter constant (AdvOutputName.PrConst.)	—	Page 962 Output axis parameter constant (AdvOutputName.PrConst.)
	Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)	Speed change gear parameter (SpeedChangeGear.)	Page 961 Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)
	Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)	Speed change gear control data (SpeedChangeGear.)	Page 963 Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)

- Auxiliary shaft module The input value is generated from the auxiliary shaft. The input value can be converted by the auxiliary shaft gear that provides the deceleration ratio, rotation direction, and other elements for the machine system.



*1 Clutch (☞ Page 947 Clutch)
*2 Speed change gear (☞ Page 960 Speed change gear)

Gear parameter of output axis parameters (AdvOutputName.Pr.Gear.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
AuxCompositeGear	Composite auxiliary shaft gear	Operation cycle (FB is starting)	WORD (HEX)	H□□□□ Main shaft input method 0: No input 1: Input + 2: Input - Auxiliary shaft input method 0: No input 1: Input + 2: Input -	0001H
AuxNumerator	Auxiliary shaft gear: Numerator	At start	DINT	-2147483647 to 2147483647	1
AuxDenominator	Auxiliary shaft gear: Denominator		DWORD (UDINT)	1 to 2147483647	1

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Composite auxiliary shaft gear (AdvOutputName.Pr.Gear.MasterCompositeGear)

Set the composite method for the current position after the main shaft and sub input axis composition and the current position of the auxiliary shaft.

Setting value	Description
0: No input	The input value from the input axis is calculated as 0.
1: Input +	The input value from the input axis is calculated as it is.
2: Input -	The input value from the input axis is calculated with its opposite sign.

Operation assumes "0: No input" if the value is set out of the range from 0 to 2.

Point

The composite method for the composite auxiliary shaft gear can be changed during synchronous control. It can also be used as a clutch to switch input values of the main shaft and auxiliary shafts.

■Auxiliary shaft gear: Numerator (AdvOutputName.Pr.Gear.AuxNumerator)

Set the numerator for the auxiliary gear input value conversion.

The input value is converted as follows.

$$\text{Input value after conversion} = \text{Input value before conversion} \times \frac{\text{Auxiliary shaft gear: Numerator}}{\text{Auxiliary shaft gear: Denominator}}$$

The input value direction can be reversed by setting a negative value in the setting value of the gear numerator.

Point

Set a reduced fraction for "Auxiliary shaft gear: Numerator/Auxiliary shaft gear: Denominator".

■Auxiliary shaft gear: Denominator (AdvOutputName.Pr.Gear.AuxDenominator)

Set the denominator for the auxiliary gear input value conversion.

Set together with Auxiliary gear: Numerator.

Output axis parameter constant (AdvOutputName.PrConst.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
AuxClutchSmoothingTimeConstant	Auxiliary shaft clutch smoothing time constant	At system start	WORD (UINT)	0 to 5000 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Auxiliary shaft clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant)

Set a time constant when the time constant method is set to "1: Time constant method (Exponent) (TimeConstantExponent)" or "2: Time constant method (Linear) (TimeConstantLinear)" in the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod).
The time constant setting applies for both clutch ON/ OFF.

Output axis parameter (AdvOutputName.Pr.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
AuxOnClutchSignal	Auxiliary shaft clutch ON signal setting	At system start	SIGNAL_SELECT	—	—
AuxOffClutchSignal	Auxiliary shaft clutch OFF signal setting			—	—

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Auxiliary shaft clutch ON signal setting (AdvOutputName.Pr.AuxOnClutchSignal)

Set the variable and device used as the clutch external signal in SIGNAL_SELECT structure when the Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl) is set to "15: I/O data specification (ClutchSignal)". For SIGNAL_SELECT structure, refer to the following.
Page 1156 SIGNAL_SELECT Structure
The following shows the settings peculiar to Auxiliary shaft clutch ON signal setting (AdvOutputName.Pr.AuxOnClutchSignal).

Structure	Variable name	Type	Setting range
SIGNAL_SELECT (Signal Select)	Source (Signal)	TARGET_REF	■Type • BOOL ■Data type • [OBJ] • [VAR] • [DEV] • [LINK]
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

Point

When setting [OBJ] for Target (Source.Target), start MCv_AdvancedSync (Advanced Synchronous Control) after the communication with device stations is established. If the communication is not established, External Signal Selection Incorrect (error code: 0032H) occurs.

■Auxiliary shaft clutch OFF signal setting (AdvOutputName.Pr.AuxOffClutchSignal)

Set the variable and device used as the clutch external signal in SIGNAL_SELECT structure when the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) is set to "15: I/O data specification (ClutchSignal)". For SIGNAL_SELECT structure, refer to the following.

☞ Page 1156 SIGNAL_SELECT Structure

The following shows the settings peculiar to Auxiliary shaft clutch OFF signal setting (AdvOutputName.Pr.AuxOffClutchSignal).

Structure	Variable name	Type	Setting range
SIGNAL_SELECT (Signal Select)	Source (Signal)	TARGET_REF	■Type • BOOL ■Data type • [OBJ] • [VAR] • [DEV] • [LINK]
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

Point

When setting [OBJ] for Target (Source.Target), start MCv_AdvancedSync (Advanced Synchronous Control) after the communication with device stations is established. If the communication is not established, External Signal Selection Incorrect (error code: 0032H) occurs.

Clutch parameter of output axis parameters (AdvOutputName.Pr.Clutch.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
AuxOnControl	Auxiliary shaft clutch ON control setting	Operation cycle (FB is starting)	INT (MC_CLUTCH_METHOD)	• 0: Invalid (NoClutch) (Direct coupled operation) • 1: Clutch command (ClutchCommand) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)	0: Invalid (NoClutch)
AuxOffControl	Auxiliary shaft clutch OFF control setting		INT (MC_CLUTCH_METHOD)	• 0: Invalid (NoClutch) (OFF control invalid) • 1: Clutch command (ClutchCommand) (One-shot operation) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)	0: Invalid (NoClutch)
AuxReference	Auxiliary shaft clutch reference address setting	At start	INT (MC_CLUTCH_REFERENCE)	• 0: Current position before gear (GearFrontPosition) • 1: Current position per cycle after gear (GearPositionPerCycle)	0: Current position before gear (GearFrontPosition)
AuxOnAddress	Auxiliary shaft clutch ON address	Operation cycle (FB is starting)	LREAL	-10000000000.0 to 10000000000.0	0.0
AuxMovementAmountBeforeOn	Movement amount before auxiliary shaft clutch ON	At completing clutch ON condition	LREAL	-2147483648.0 to 2147483647.0	0.0
AuxOffAddress	Auxiliary shaft clutch OFF address	Operation cycle (FB is starting)	LREAL	-10000000000.0 to 10000000000.0	0.0
AuxMovementAmountBeforeOff	Movement amount before auxiliary shaft clutch OFF	At completing clutch OFF condition	LREAL	-2147483648.0 to 2147483647.0	0.0
AuxSmoothingMethod	Auxiliary shaft clutch smoothing method	At start	INT (MC_CLUTCH_SMOOTHING_METHOD)	• 0: Direct (ClutchSmoothingDisabled) • 1: Time constant method (Exponent) (TimeConstantExponent) • 2: Time constant method (Linear) (TimeConstantLinear) • 3: Slippage method (Exponent) (SlippageExponent) • 4: Slippage method (Linear) (SlippageLinear) • 5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)	0: Direct (ClutchSmoothingDisabled)
AuxOnSlippageAmount	Slippage amount at auxiliary shaft clutch ON	At turning clutch on	LREAL	0.0 to 2147483647.0	0.0
AuxOffSlippageAmount	Slippage amount at auxiliary shaft clutch OFF	At turning clutch off	LREAL	0.0 to 2147483647.0	0.0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl)

Set the control method for auxiliary shaft clutch ON. The Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl) can be changed during synchronous control. However, changes from settings other than "0: Invalid (NoClutch)" to "0: Invalid (NoClutch)" are not possible.

Setting value	Description
0: Invalid (NoClutch) (Direct coupled operation)	Execute direct coupled operation without clutch control.
1: Clutch command (ClutchCommand)	The clutch is turned on/off by the operations of the Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand) TRUE/FALSE. (In the clutch command ON/OFF mode, the setting in the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) is not referred to.)
2: Clutch command leading edge (ClutchLeadingEdge)	The clutch is turned on when the Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand) passes the leading edge (from FALSE to TRUE).
3: Clutch command trailing edge (ClutchTrailingEdge)	The clutch is turned on when the Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand) passes the trailing edge (from TRUE to FALSE).
4: Address mode (ClutchAddress)	The clutch is turned on when the reference address (the cumulative current position of the auxiliary shaft or the current position per cycle after auxiliary shaft gear) reaches the Auxiliary shaft clutch ON address (AdvOutputName.Pr.Clutch.AuxOnAddress). When the reference address passes through the ON address, the movement amount after the ON address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.
15: I/O data specification (ClutchSignal)	The clutch is turned on when the external input signal set in the Auxiliary shaft clutch ON signal setting (AdvOutputName.Pr.AuxOnClutchSignal) is detected.

Point

- Other clutch parameter settings are not referred to because direct coupled operation is used by setting the Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl) to "0: Invalid (NoClutch)". The Auxiliary shaft clutch forced OFF command (AdvOutputName.Cd.Clutch.AuxForcedOff) and the change of the clutch control setting are ignored during direct coupled operation.
- Changes from settings other than "0: Invalid (NoClutch)" to "0: Invalid (NoClutch)" are not possible during synchronous control. If the setting is changed in that manner, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs.

■Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl)

Set the control method for auxiliary shaft clutch OFF.

Setting value	Description
0: Invalid (NoClutch) (OFF control invalid)	Clutch OFF control is not used. Set it only for execution with clutch ON control.
1: Clutch command (ClutchCommand) (One-shot operation)	After Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus) is turned on, it moves the distance set in Movement amount before auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOff), then the clutch turns off. (One-shot operation) If the Movement amount before auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOff) is "0.0", the Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus) does not turn to "TRUE (Clutch ON status)" in order to turn back off immediately.
2: Clutch command leading edge (ClutchLeadingEdge)	The clutch is turned on when the Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand) passes the leading edge (from FALSE to TRUE).
3: Clutch command trailing edge (ClutchTrailingEdge)	The clutch is turned on when the Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand) passes the trailing edge (from TRUE to FALSE).
4: Address mode (ClutchAddress)	The clutch is turned off when the reference address (the cumulative current position of the auxiliary shaft or the current position per cycle after auxiliary shaft gear) reaches the Auxiliary shaft clutch OFF address (AdvOutputName.Pr.Clutch.AuxOffAddress). When the reference address passes through the OFF address, the movement amount after the OFF address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.
15: I/O data specification (ClutchSignal)	The clutch is turned off when the external input signal set in the Auxiliary shaft clutch OFF signal setting (AdvOutputName.Pr.AuxOffClutchSignal) is detected.

■Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference)

Set the address to be referred to at clutch control.

Note that the processing order of gears and clutches varies by the reference address.

Setting value	Description
0: Current position before gear (GearFrontPosition)	The clutch is controlled by using the input axis cumulative current position set in auxiliary shaft, which is before the auxiliary shaft gear conversion. The movement amount after the clutch control is converted then output through the auxiliary shaft gear. * The clutch processing is performed for the current position of the auxiliary shaft. The current position of auxiliary shaft is used as the reference address when the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) is set to "4: Address mode (ClutchAddress)".
1: Current position per cycle after gear (GearPositionPerCycle)	The clutch is controlled by using the current position per cycle after auxiliary shaft gear. The movement amount after the clutch control is output as it is. * The clutch processing is performed for the current position per cycle after auxiliary shaft gear. The current position per cycle after auxiliary shaft gear is used as the reference address when the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) is set to "4: Address mode (ClutchAddress)".

The unit settings of the following parameters are in position command units of the auxiliary shaft.

- Auxiliary shaft clutch ON address (AdvOutputName.Pr.Clutch.AuxOnAddress)
- Auxiliary shaft clutch OFF address (AdvOutputName.Pr.Clutch.AuxOffAddress)
- Movement amount before auxiliary shaft clutch ON (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOn)
- Movement amount before auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOff)
- Slippage amount at auxiliary shaft clutch ON (AdvOutputName.Pr.Clutch.AuxOnSlippageAmount)
- Slippage amount at auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxOffSlippageAmount)

■Auxiliary shaft clutch ON address (AdvOutputName.Pr.Clutch.AuxOnAddress)

Set the clutch ON address when "4: Address mode (ClutchAddress)" is set in the Auxiliary shaft clutch Main shaft ON clutch control setting (AdvOutputName.Pr.Clutch.AuxOnControl). When "1: Current position per cycle after gear (GearPositionPerCycle)" is set in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference), the setting address is converted for control within the range from 0.0 to (length per cycle - 0.00001).

Setting value
-10000000000.0 ≤ Auxiliary shaft clutch ON address (AdvOutputName.Pr.Clutch.AuxOnAddress) < 10000000000.0

Ex.

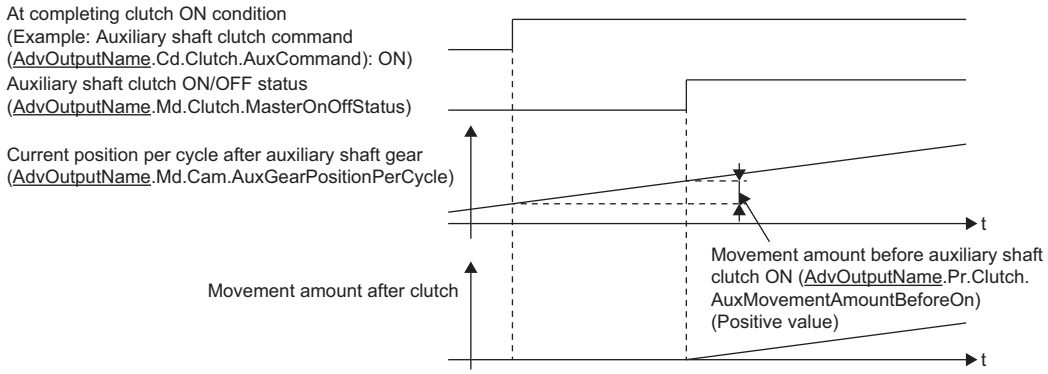
Length per cycle: 20000.0

The ON address is controlled as "19000.0" when the setting value is "-1000.0".

■Movement amount before auxiliary shaft clutch ON (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOn)

Set the movement amount for the reference address with a signed number regarding from when the clutch ON condition is met until when the clutch turns on.

Setting value	Description
0.00001 to 2147483647.0 (Positive value)	Used when the reference address is increasing in direction.
0.0	No movement (The clutch turns on at the same time as when the ON condition is met.)
-2147483648.0 to -0.00001 (Negative value)	Used when the reference address is decreasing in direction.



■Auxiliary shaft clutch OFF address (AdvOutputName.Pr.Clutch.AuxOffAddress)

Set the clutch OFF address when "4: Address mode (ClutchAddress)" is set in the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl). When "1: Current position per cycle after gear (GearPositionPerCycle)" is set in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference), the setting address is converted for control within the range from 0.0 to (length per cycle - 0.00001).

Setting value
-10000000000.0 ≤ Auxiliary shaft clutch OFF address (AdvOutputName.Pr.Clutch.AuxOffAddress) < 10000000000.0

Ex.

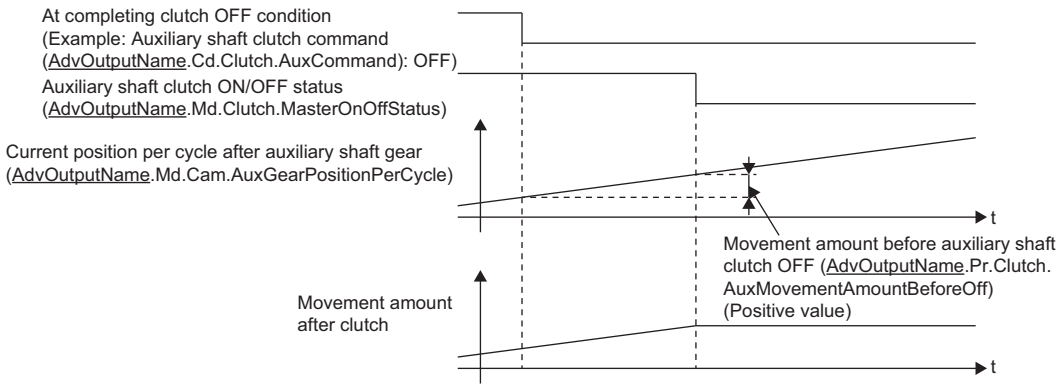
Length per cycle: 20000.0

The OFF address is controlled as "60.0" when the setting value is "40060.0".

■Movement amount before auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOff)

Set the movement amount for the reference address with a signed number regarding from when the auxiliary shaft clutch OFF condition is met until when the clutch turns off.

Setting value	Description
0.00001 to 2147483647.0 (Positive value)	Used when the reference address is increasing in direction.
0.0	No movement (The clutch turns off at the same time as when the OFF condition is met.)
-2147483648.0 to -0.00001 (Negative value)	Used when the reference address is decreasing in direction.



■Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod)

Set the smoothing method for clutch ON/OFF.

Setting value	Description
0: Direct (ClutchSmoothingDisabled)	No smoothing for the auxiliary shaft clutch.
1: Time constant method (Exponent) (TimeConstantExponent)	Smoothing with an exponential curve based on the time constant setting.
2: Time constant method (Linear) (TimeConstantLinear)	Smoothing with linear acceleration/deceleration based on the time constant setting.
3: Slippage method (Exponent) (SlippageExponent)	Smoothing with an exponential curve based on the slippage amount setting.
4: Slippage method (Linear) (SlippageLinear)	Smoothing with linear acceleration/deceleration based on the slippage amount setting.
5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)	Smoothing with linear acceleration/deceleration (input value follow up) based on the slippage amount setting.

■Slippage amount at auxiliary shaft clutch ON (AdvOutputName.Pr.Clutch.AuxOnSlippageAmount)

Set the slippage amount at clutch ON when any of the following is set in the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod). "3: Slippage method (Exponent) (SlippageExponent)", "4: Slippage method (Linear) (SlippageLinear)", or "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)".
Set the slippage amount in units based on the setting in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference).
If the set amount is negative, slippage amount at clutch ON is controlled as 0 (direct).

Point

Do not set digits after the decimal point when "3: Slippage method (Exponent) (SlippageExponent)" is set in the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod). If set, smoothing is performed with the digits after the decimal point ignored.

■Slippage amount at auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxOffSlippageAmount)

Set the slippage amount at clutch OFF when any of the following is set in the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod). "3: Slippage method (Exponent) (SlippageExponent)", "4: Slippage method (Linear) (SlippageLinear)", or "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)".
Set the slippage amount in units based on the setting in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference).
If the set amount is negative, slippage amount at clutch OFF is controlled as 0 (direct).

Point

Do not set digits after the decimal point when "3: Slippage method (Exponent) (SlippageExponent)" is set in the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod). If set, smoothing is performed with the digits after the decimal point ignored.

Clutch monitor of output axis monitor data (AdvOutputName.Md.Clutch.)

Variable name	Name	Import*1	Data type*1	Monitor value
AuxOnOffStatus	Auxiliary shaft clutch ON/OFF status	Operation cycle (FB is starting)	BOOL	• FALSE: Clutch OFF status • TRUE: Clutch ON status
AuxSmoothingStatus	Auxiliary shaft clutch smoothing status		BOOL	• FALSE: Not on clutch smoothing • TRUE: On clutch smoothing
AuxCumulativeSlippage	Auxiliary shaft clutch slippage (accumulative)		LREAL	-2147483648.0 to 2147483647.0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)

The auxiliary shaft clutch ON/OFF status is stored.

■Auxiliary shaft clutch smoothing status (AdvOutputName.Md.Clutch.AuxSmoothingStatus)

The smoothing status of the auxiliary shaft clutch is stored.

The status is updated by the Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod).

Method	Description
Time constant method	The status is always "TRUE: On clutch smoothing" during the clutch ON status. The status will be "FALSE: Not on clutch smoothing" when the clutch is turned off and smoothing is completed.
Slippage method	The status is "TRUE: On clutch smoothing" until the clutch accumulative slippage amount reaches the slippage at clutch ON when the clutch is turned on. The status will change to "FALSE: Not on clutch smoothing" when the clutch accumulative slippage amount reaches the slippage at clutch ON. The status is "TRUE: On clutch smoothing" until the clutch accumulative slippage amount reaches 0 when the clutch is turned off. The status will change to "FALSE: Not on clutch smoothing" when the clutch accumulative slippage amount reaches 0.

■Auxiliary shaft clutch slippage (accumulative) (AdvOutputName.Md.Clutch.AuxCumulativeSlippage)

The accumulative slippage amount with the slippage method during clutch smoothing is stored as a signed value.

The absolute value of the accumulative slippage increases to reach the slippage at clutch ON during clutch ON.

The absolute value of the accumulative slippage decreases to reach "0.0" during clutch OFF.

Monitoring of the accumulative slippage is used to check the smoothing progress with the slippage method.

Clutch control data of output axis control data (AdvOutputName.Cd.Clutch.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
AuxCommand	Auxiliary shaft clutch command	Operation cycle (FB is starting)	BOOL	• FALSE: Clutch command OFF • TRUE: Clutch command ON	FALSE
AuxInvalidCommand	Auxiliary shaft clutch control invalid command		BOOL	• FALSE: Clutch control valid • TRUE: Clutch control invalid	FALSE
AuxForcedOff	Auxiliary shaft clutch forced OFF command		BOOL	• FALSE: Clutch normal control • TRUE: Clutch forced OFF	FALSE
AuxClutchSmoothingTimeConstant	Auxiliary shaft clutch smoothing time constant change value	At start	INT	0 to 5000 [ms]	0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand)

Sets ON/OFF for the auxiliary shaft clutch command.

This command is used when any of the following is set in the Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl).

- 1: Clutch command (ClutchCommand)
- 2: Clutch command leading edge (ClutchLeadingEdge)
- 3: Clutch command trailing edge (ClutchTrailingEdge)

The status just before synchronous control starts is considered as clutch command OFF. If synchronous control is started while the clutch command is on, the condition is established just after starting synchronous control, by setting "2: Clutch command leading edge (ClutchLeadingEdge)". The condition is not established just after starting synchronous control, by setting "3: Clutch command trailing edge (ClutchTrailingEdge)".

■Auxiliary shaft clutch control invalid command (AdvOutputName.Cd.Clutch.AuxInvalidCommand)

The auxiliary shaft clutch control is invalid if "TRUE: Clutch control invalid" is set. The clutch ON/OFF status maintained is the one before clutch control becomes invalid.

Clutch control will not become invalid during movement before clutch ON and during movement before clutch OFF. Instead, clutch control will become invalid after movement is completed.

■Auxiliary shaft clutch forced OFF command (AdvOutputName.Cd.Clutch.AuxForcedOff)

Set "TRUE: Clutch forced OFF" to force the clutch OFF. The output value from the clutch becomes "0" immediately, even during clutch smoothing. The slippage (accumulative) amount is set to 0 if smoothing with a slippage method.

Reset to "FALSE: Clutch normal control" to restart the clutch control from the clutch OFF status after using the clutch forced OFF command.

■Auxiliary shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.AuxClutchSmoothingTimeConstant)

The smoothing time constant of the auxiliary shaft clutch is changed. The setting is imported when MCv_AdvancedSync (Advanced Synchronous Control) is started.

Setting value	Description
When a negative value is set	No smoothing.
When 0 is set	Smoothing based on the setting value of the Auxiliary shaft clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant).
When a positive value is set	Smoothing based on the setting value of the Auxiliary shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.AuxClutchSmoothingTimeConstant).

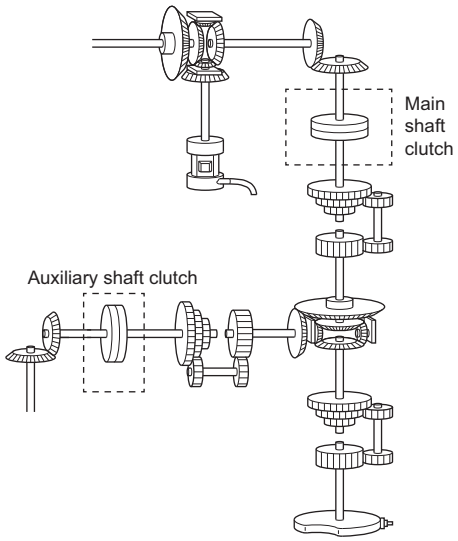
Set within the following setting range.

If the set value exceeds the range below, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs, and smoothing is executed based on the setting value of the Auxiliary shaft clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant).

Setting range
Auxiliary shaft clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant) > Auxiliary shaft clutch smoothing time constant change value (AdvOutputName.Cd.Clutch.AuxClutchSmoothingTimeConstant)

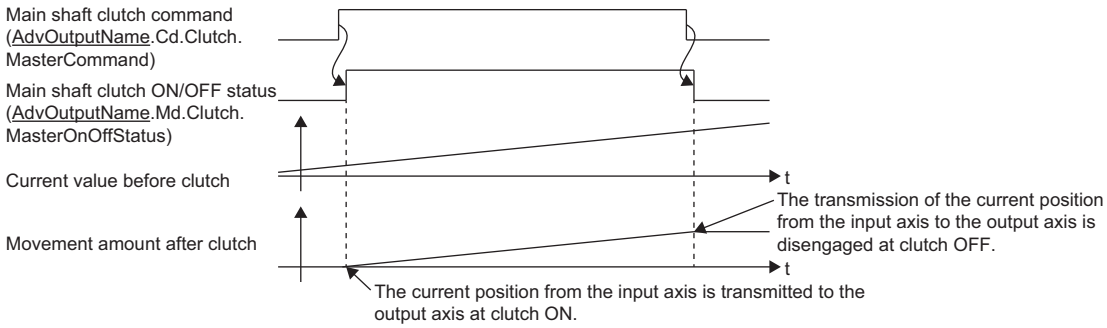
Clutch

The clutch is used to transmit/disengage command pulses from the main/auxiliary shaft input through turning the clutch on/off, which controls the operation/stop of the output axis.
A clutch can be configured for the main and auxiliary shaft modules.



When the conditions set in Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) and Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl) are satisfied, the clutch status changes from FALSE to TRUE. When the conditions set in Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl) and Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) are satisfied, the clutch status changes from TRUE to FALSE.
The current position of the input axis is transmitted to the output axis at the timing of the clutch ON/OFF status changing to TRUE.
The input and output axes are disengaged at the timing of the clutch ON/OFF status turning to FALSE.
The following explains the operations of clutch ON/OFF.

Ex.
When the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) is set to "1: Clutch command (ClutchCommand)"



The movement amount of the output axis before clutch ON and OFF can be adjusted with parameters of the movement amount before clutch ON or the movement amount before clutch OFF.
The smoothing time constant can be set to smooth the operation of the output axis before and after clutch ON/OFF.

Clutch control setting

Set the clutch ON and OFF control methods separately. Set the ON control methods in Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) and Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl), and the OFF control methods in Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl) and Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl).

The clutch control setting can be changed during synchronous control. However, changes from settings other than "0: Invalid (NoClutch) (Direct coupled operation)" to "0: Invalid (NoClutch) (Direct coupled operation)" are not possible in the ON control mode.

Item	Setting item		Setting value
	Main shaft clutch	Auxiliary shaft clutch	
Clutch ON control setting	Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl)	Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl)	• 0: Invalid (NoClutch) (Direct coupled operation) • 1: Clutch command (ClutchCommand) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)
Clutch OFF control setting	Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl)	Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl)	• 0: Invalid (NoClutch) (OFF control invalid) • 1: Clutch command (ClutchCommand) (One-shot operation) • 2: Clutch command leading edge (ClutchLeadingEdge) • 3: Clutch command trailing edge (ClutchTrailingEdge) • 4: Address mode (ClutchAddress) • 15: I/O data specification (ClutchSignal)

When the clutch ON condition and the clutch OFF condition are completed simultaneously within one operation cycle, both clutch ON and OFF processing are executed within one operation cycle. Therefore, the clutch changes from off to on and again to off at the clutch OFF status, and changes from on to off and again to on at the clutch ON status.

The clutch ON/OFF operations for clutch ON and OFF control settings are shown below.

■Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl)/Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl)

- Invalid (Direct coupled operation): Execute direct coupled operation without clutch control.

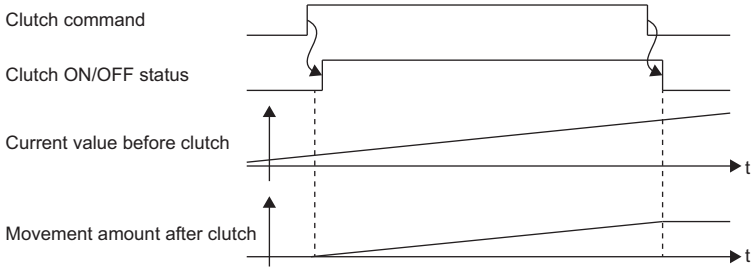
Point

- Other clutch parameter settings are not referred to because direct coupled operation is used by setting the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) and the Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl) to "0: Invalid (NoClutch) (Direct coupled operation)". The "clutch forced OFF command" and the change of the clutch control setting are ignored during direct coupled operation.
- Changes from settings other than "0: Invalid (NoClutch) (Direct coupled operation)" to "0: Invalid (NoClutch) (Direct coupled operation)" are not possible during synchronous control. If the setting is changed in that manner, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs.

• Clutch command

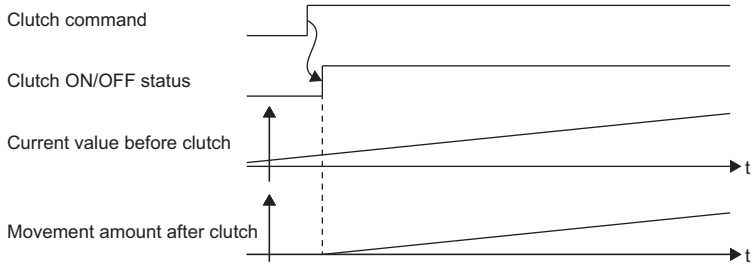
The clutch is turned on/off by the TRUE/FALSE operation of "clutch command".

When "1: Clutch command (ClutchCommand)" is set in the Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl) and the Auxiliary shaft clutch ON control setting (AdvOutputName.Pr.Clutch.AuxOnControl), the settings of the Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl) and the Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl) are not referred to.

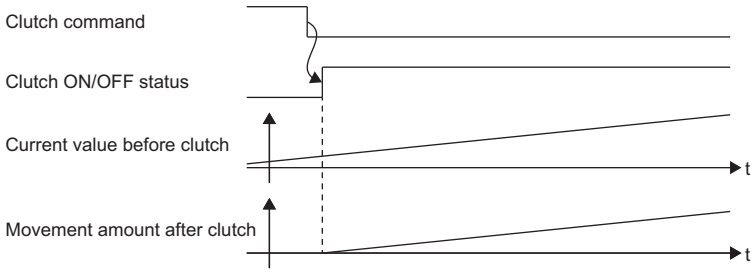


Item	Main shaft clutch	Auxiliary shaft clutch
Clutch command	Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand)	Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand)
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)

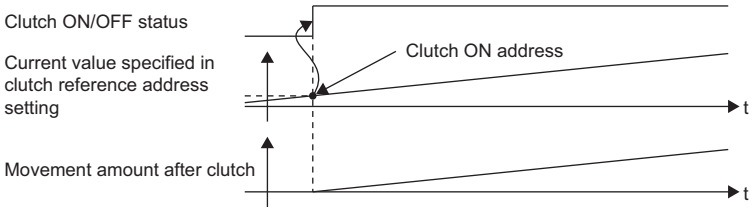
• Clutch command leading edge: The clutch is turned on when the "clutch command" passes the leading edge (from FALSE to TRUE).



• Clutch command trailing edge: The clutch is turned on when the "clutch command" passes the trailing edge (from TRUE to FALSE).



• Address mode: The clutch is turned on when the "reference address" reaches "Clutch ON address". When the reference address passes through the ON address, the movement amount after the ON address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.



Item	Main shaft clutch	Auxiliary shaft clutch
Reference address	The current position specified in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference) • 0: Current position before gear (GearFrontPosition)*1 • 1: Current position per cycle after gear (GearPositionPerCycle)*2	The current position specified in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference) • 0: Current position before gear (GearFrontPosition)*3 • 1: Current position per cycle after gear (GearPositionPerCycle)*4
Clutch ON address	Main shaft clutch ON address (AdvOutputName.Pr.Clutch.MasterOnAddress)	Auxiliary shaft clutch ON address (AdvOutputName.Pr.Clutch.AuxOnAddress)
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)

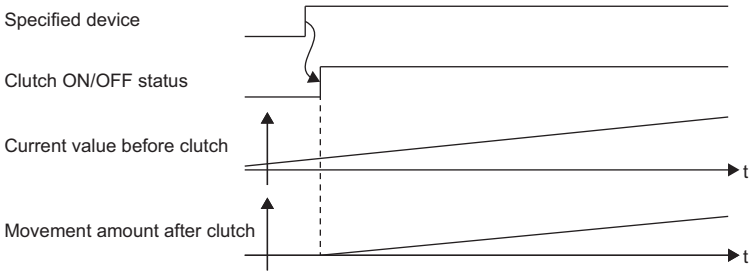
*1 As a monitor, the Current position after composite main shaft gear (AdvOutputName.Md.Cam.MasterCompositeGearSetPosition) is referred to.

*2 As a monitor, the Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) is referred to.

*3 As a monitor, the cumulative current position of the auxiliary shaft (the Cumulative current position (AdvInputName.Md.CumulativePosition) of the input axis set in the auxiliary shaft) is referred to.

*4 As a monitor, the Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) is referred to.

• I/O data specification: The clutch is turned on at an input signal detection.



When using an external signal, set the following clutch ON signal settings.

Item	Main shaft	Auxiliary shaft
Clutch ON signal setting	Main shaft clutch ON signal setting (AdvOutputName.Pr.MasterOnClutchSignal)	Auxiliary shaft clutch ON signal setting (AdvOutputName.Pr.AuxOnClutchSignal)

The type for the clutch ON signal setting is SIGNAL_SELECT (Signal Select). The setting range of the clutch ON signal setting is as follows.

Structure	Variable name	Type	Setting range*1
SIGNAL_SELECT (Signal Select)	Source (Signal). Target (Target)	TARGET_REF	■ Type • BOOL ■Data type • [OBJ]*2*3 • [VAR] • [DEV] • [LINK]*4
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)*5	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

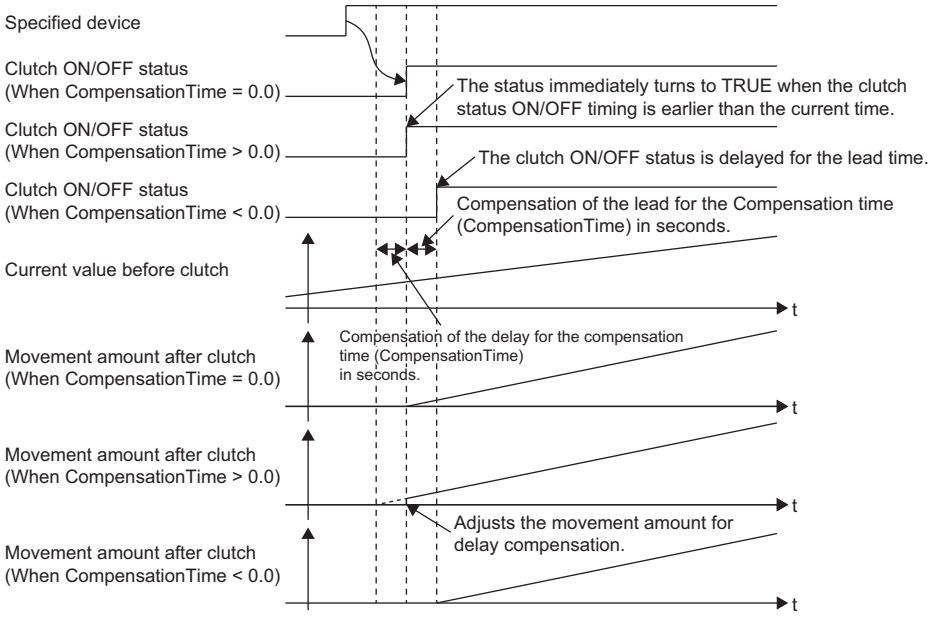
*1 In the following cases, Out of Parameter Range (Advanced Synchronous Control Output Axis) (error code: 1A66H) occurs.
· The target modification is omitted when [OBJ] is specified as data type
· Detection (Signal detection method) of data type [LINK] is set to "4: Detection at rising edge/falling edge (BothEdges)"
· Source.Target is omitted or the target does not exist
· The set value in the Signal detection method (Detection), the Compensation time (CompensationTime), or the Filter time (FilterTime) is out of range

*2 If the Axis Emulate function is enabled and a station address is set for the referred station, the emulating object will be referred to.

*3 External signal high-accuracy input can be used. When using the external signal high-accuracy input, set the Detection (Signal detection method) to "4: Detection at rising edge/falling edge (BothEdges)". For details, refer to the following.
☞ Page 1164 External Signal High-Accuracy Input
For the high-accuracy settings, refer to the following.
☞ Page 2152 Connection to Servo Amplifier That Supports CC-Link IE TSN

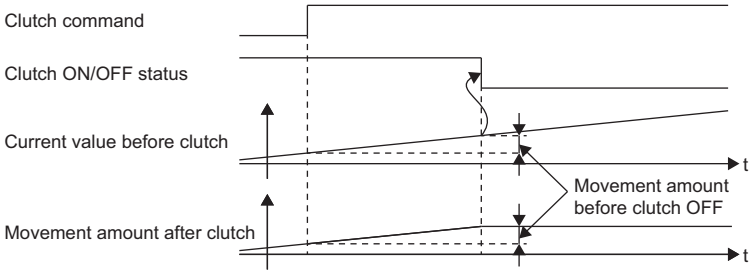
*4 Use the external signal high-accuracy input for data type [LINK] For details, refer to the following.
☞ Page 1164 External Signal High-Accuracy Input

*5 The detection time of an input signal can be compensated by setting the Compensation time (CompensationTime). Set a positive value to compensate the delay of the input signal, and set a negative value to compensate the lead. As shown below, the clutch ON/OFF status varies depending on the compensation time setting.
When delay is compensated with the Compensation time (CompensationTime), the movement amount after clutch may change rapidly. Adjust so that the movement amount changes gradually with the smoothing function of the clutch and output axis.



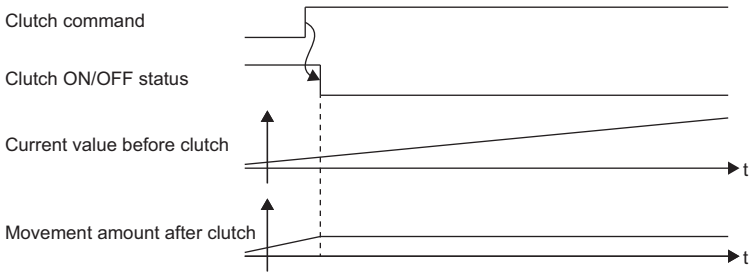
■Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl)/Auxiliary shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.AuxOffControl)

- Invalid (OFF control invalid): Clutch OFF control is not used. Set it only for execution with clutch ON control.
- Clutch command (One-shot operation): The clutch is turned off after moving the distance "Movement amount before clutch OFF" after the "clutch ON/OFF status" changes from FALSE to TRUE.
  If the "Movement amount before clutch OFF" is "0.0", the "Clutch ON/OFF status" does not turn on in order to turn back off immediately.

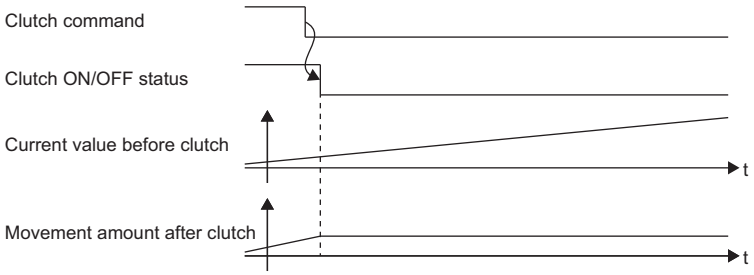


Item	Main shaft clutch	Auxiliary shaft clutch
Clutch command	Main shaft clutch command (AdvOutputName.Cd.Clutch.MasterCommand)	Auxiliary shaft clutch command (AdvOutputName.Cd.Clutch.AuxCommand)
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)
Movement amount before clutch OFF	Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff)	Movement amount before auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxMovementAmountBeforeOff)

- Clutch command leading edge: The clutch is turned off when the "clutch command" passes the leading edge (from FALSE to TRUE).

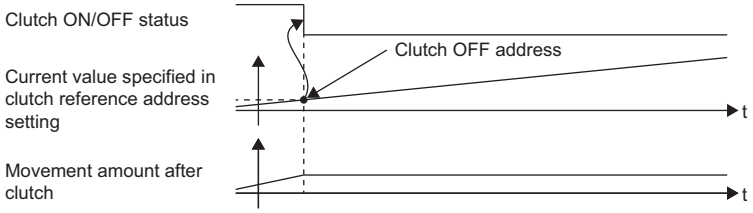


- Clutch command trailing edge: The clutch is turned off when the "clutch command" passes the trailing edge (from TRUE to FALSE).



• Address mode: The clutch is turned off when the "reference address" reaches "Clutch OFF address".

When the reference address passes through the OFF address, the movement amount before the OFF address is passed is output as the output movement amount of the clutch. Therefore, the clutch is controlled with the accurate movement amount.



Item	Main shaft clutch	Auxiliary shaft clutch
Reference address	The current position specified in the Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference) • 0: Current position before gear (GearFrontPosition)*1 • 1: Current position per cycle after gear (GearPositionPerCycle)*2	The current position specified in the Auxiliary shaft clutch reference address setting (AdvOutputName.Pr.Clutch.AuxReference) • 0: Current position before gear (GearFrontPosition)*3 • 1: Current position per cycle after gear (GearPositionPerCycle)*4
Clutch OFF address	Main shaft clutch OFF address (AdvOutputName.Pr.Clutch.MasterOffAddress)	Auxiliary shaft clutch OFF address (AdvOutputName.Pr.Clutch.AuxOffAddress)
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)

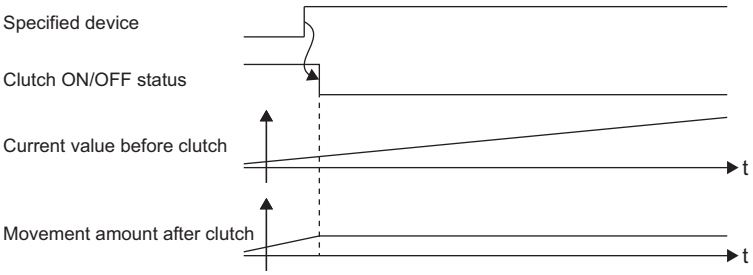
*1 As a monitor, the Current position after composite main shaft gear (AdvOutputName.Md.Cam.MasterCompositeGearSetPosition) is referred to.

*2 As a monitor, the Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) is referred to.

*3 As a monitor, the cumulative current position of the auxiliary shaft (the Cumulative current position (AdvInputName.Md.CumulativePosition) of the input axis set in the auxiliary shaft) is referred to.

*4 As a monitor, the Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) is referred to.

• I/O data specification: The clutch is turned off at an input signal detection.



When using an external signal for I/O data specification, set the following clutch OFF signal settings

Item	Main shaft	Auxiliary shaft
Clutch OFF signal setting	Main shaft clutch OFF signal setting (AdvOutputName.Pr.MasterOffClutchSignal)	Auxiliary shaft clutch OFF signal setting (AdvOutputName.Pr.AuxOffClutchSignal)

The type for the OFF clutch signal setting is SIGNAL_SELECT (Signal select). The setting range of the clutch OFF signal setting is as follows.

Structure	Variable name	Type	Setting range*1
SIGNAL_SELECT (Signal Select)	Source (Signal). Target (Target)	TARGET_REF	■ Type • BOOL ■Data type • [OBJ]*2*3 • [VAR] • [DEV] • [LINK]*4
	Detection (Signal detection method)	INT (MC_SIGNAL_LOGIC)	• 2: Detection at FALSE → TRUE (rising edge) (RisingEdge) • 3: Detection at TRUE → FALSE (falling edge) (FallingEdge) • 4: Detection at rising edge/falling edge (BothEdges)
	CompensationTime (Compensation time)*5	LREAL	-5.0 to 5.0 [s]
	FilterTime (Filter time)	LREAL	0.0 [s]

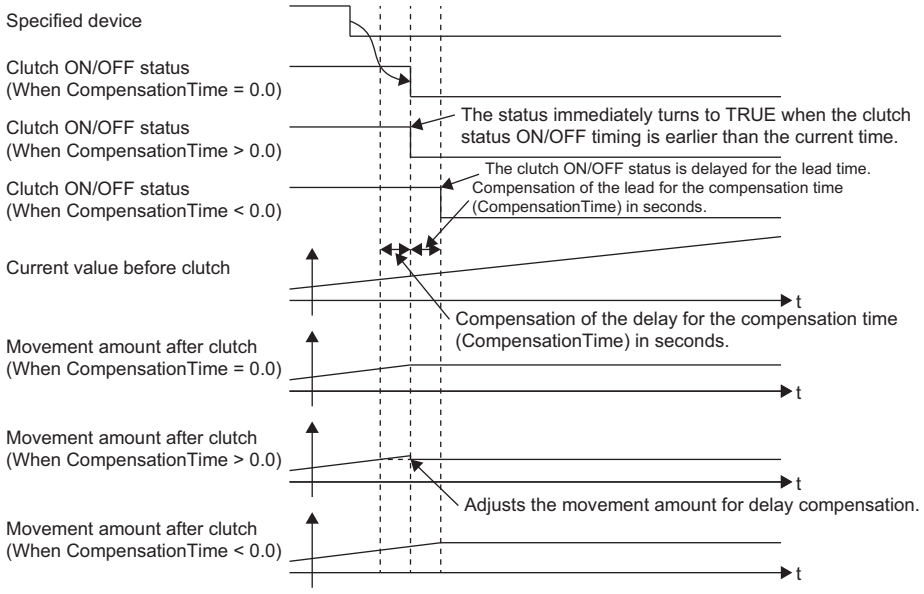
*1 In the following cases, Out of Parameter Range (Advanced Synchronous Control Output Axis) (error code: 1A66H) occurs.
· The target modification is omitted when [OBJ] is specified as data type
· Detection (Signal detection method) of data type [LINK] is set to "4: Detection at rising edge/falling edge (BothEdges)"
· Source.Target is omitted or the target does not exist
· The set value in the Signal detection method (Detection), the Compensation time (CompensationTime), or the Filter time (FilterTime) is out of range

*2 If the Axis Emulate function is enabled and a station address is set for the referred station, the emulating object will be referred to.

*3 The external signal high-accuracy input is available. When using the external signal high-accuracy input, set the Detection (Signal detection method) to "4: Detection at rising edge/falling edge (BothEdges)". For details, refer to the following.
☞ Page 1164 External Signal High-Accuracy Input
For the high-accuracy settings, refer to the following.
☞ Page 2152 Connection to Servo Amplifier That Supports CC-Link IE TSN

*4 Use the external signal high-accuracy input for data type [LINK] Set Detection (Signal Detection Method) to "2: Detection at FALSE → TRUE (rising edge) (Rising Edge)" or "3: Detection at TRUE → FALSE (falling edge) (FallingEdge)". For details, refer to the following.
☞ Page 1164 External Signal High-Accuracy Input

*5 The detection time of an input signal can be compensated by setting the Compensation time (CompensationTime). Set a positive value to compensate the delay of the input signal, and set a negative value to compensate the lead. As shown below, the clutch ON/OFF status varies depending on the compensation time setting.
When delay is compensated with the Compensation time (CompensationTime), the movement amount after clutch may change rapidly. Adjust so that the movement amount changes gradually with the smoothing function of the clutch and output axis.



Smoothing method for clutch

Set the clutch smoothing method in Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod) and "Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod)".

The following methods are available for clutch smoothing.

- Time constant method smoothing
- Slippage method smoothing

When not using clutch smoothing, set "0: Direct" in the clutch smoothing method.

Item	Setting item		Setting value
	Main shaft clutch	Auxiliary shaft clutch	
Clutch smoothing method	Main shaft clutch smoothing method (AdvOutputName.Pr.Clutch.MasterSmoothingMethod)	Auxiliary shaft clutch smoothing method (AdvOutputName.Pr.Clutch.AuxSmoothingMethod)	• 0: Direct (ClutchSmoothingDisabled) • 1: Time constant method (Exponent) (TimeConstantExponent) • 2: Time constant method (Linear) (TimeConstantLinear) • 3: Slippage method (Exponent) (SlippageExponent) • 4: Slippage method (Linear) (SlippageLinear) • 5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)

The operation of each smoothing method is shown below.

■Time constant method smoothing

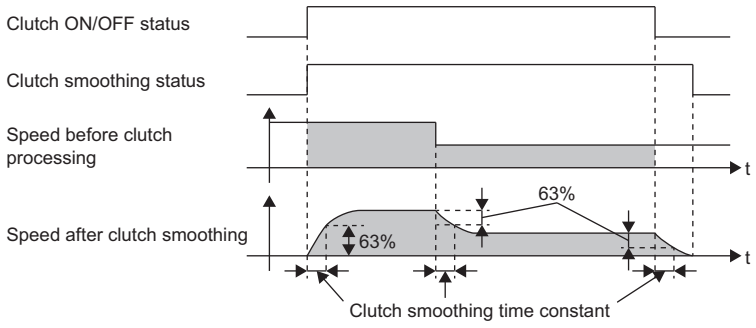
Smoothing is executed with the time constant set in "smoothing time constant" at clutch ON/OFF. After clutch ON smoothing is complete, smoothing is executed with the time constant when the speed of the input value changes.

As shown below, the movement amount while the clutch changes from on to off does not change after clutch smoothing.

Movement amount after clutch smoothing = Movement amount before clutch smoothing

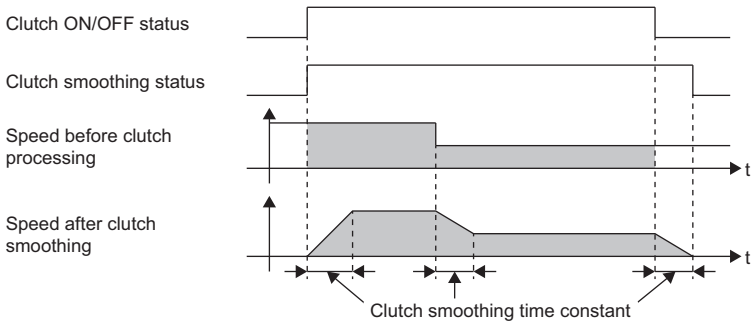
Item	Setting item		Setting value
	Main shaft clutch	Auxiliary shaft clutch	
Clutch smoothing time constant	Main shaft clutch smoothing time constant (AdvOutputName.PrConst.MasterClutchSmoothingTimeConstant)	Auxiliary shaft clutch smoothing time constant (AdvOutputName.PrConst.AuxClutchSmoothingTimeConstant)	0 to 5000 [ms]

- Time constant method exponential curve smoothing: Set "1: Time constant method (Exponential) (TimeConstantExponent)" in the "clutch smoothing method".



Item	Main shaft clutch	Auxiliary shaft clutch
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)
Clutch smoothing status	Main shaft clutch smoothing status (AdvOutputName.Md.Clutch.MasterSmoothingStatus)	Auxiliary shaft clutch smoothing status (AdvOutputName.Md.Clutch.AuxSmoothingStatus)

• Time constant method linear acceleration/deceleration smoothing: Set "2: Time constant method (Linear) (TimeConstantLinear)" in the "clutch smoothing method".



■Slippage method smoothing

Smoothing is executed with the value in "slippage at clutch ON" when the clutch turns on, and with "slippage at clutch OFF" when the clutch turns off.

Because smoothing is still executed with the set slippage amount when the input speed to the clutch changes, the position of clutch ON/OFF can be controlled without being affected by speed changes.

A direct operation follows after completing clutch ON smoothing.

The movement amount while the clutch changes from on to off is as follows after clutch smoothing.

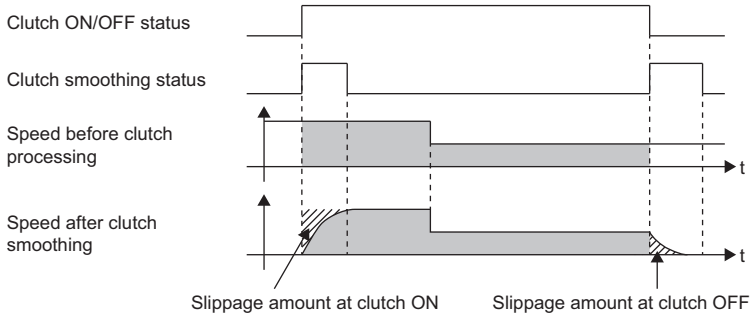
Movement amount after clutch smoothing = Movement amount before clutch smoothing + (Slippage amount at OFF - Slippage amount at ON)

Item	Setting item		Setting value
	Main shaft clutch	Auxiliary shaft clutch	
Slippage amount at clutch ON	Slippage amount at main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterOnSlippageAmount)	Slippage amount at auxiliary shaft clutch ON (AdvOutputName.Pr.Clutch.AuxOnSlippageAmount)	0 to 2147483647 [Main shaft position command units*1/ auxiliary shaft position command units*2]
Slippage amount at clutch OFF	Slippage amount at main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterOffSlippageAmount)	Slippage amount at auxiliary shaft clutch OFF (AdvOutputName.Pr.Clutch.AuxOffSlippageAmount)	

*1 The position command unit of the axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

*2 The position command unit of the axis set as the Auxiliary axis (AdvOutputName.Pr.AuxAxis).

• Slippage method exponential curve smoothing: Set "3: Slippage method (Exponential) (SlippageExponent)" in the "clutch smoothing method".



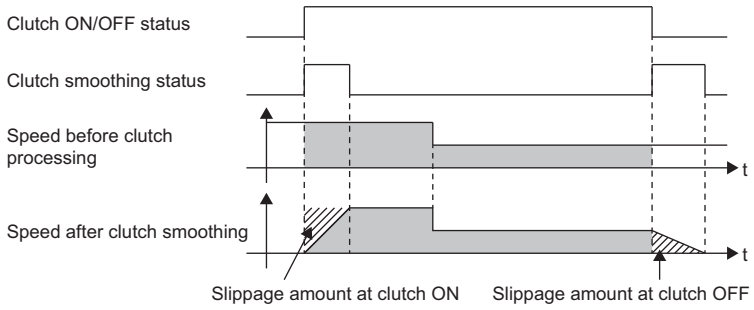
Item	Main shaft clutch	Auxiliary shaft clutch
Clutch ON/OFF status	Main shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.MasterOnOffStatus)	Auxiliary shaft clutch ON/OFF status (AdvOutputName.Md.Clutch.AuxOnOffStatus)
Clutch smoothing status	Main shaft clutch smoothing status (AdvOutputName.Md.Clutch.MasterSmoothingStatus)	Auxiliary shaft clutch smoothing status (AdvOutputName.Md.Clutch.AuxSmoothingStatus)

- Slippage method linear acceleration/deceleration smoothing: Set "4: Slippage method (Linear) (SlippageLinear)" or "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)" in the "clutch smoothing method".

Input speed during smoothing	Smoothing method	
	4: Slippage method (Linear) (SlippageLinear)	5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)
When input speed is fixed	No difference	
When there is a continuous small fluctuation in the input speed	The smoothing sections change.	The smoothing section is fixed.
When input speed has a large fluctuation	The change in the output speed is small. (The average speed may rise higher than before the start of smoothing)	The output speed changes with the input speed. (When re-accelerating after the input speed drops, a sudden acceleration may occur)

■When input speed is fixed

The operation for "4: Slippage method (Linear) (SlippageLinear)" and "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)" is the same.

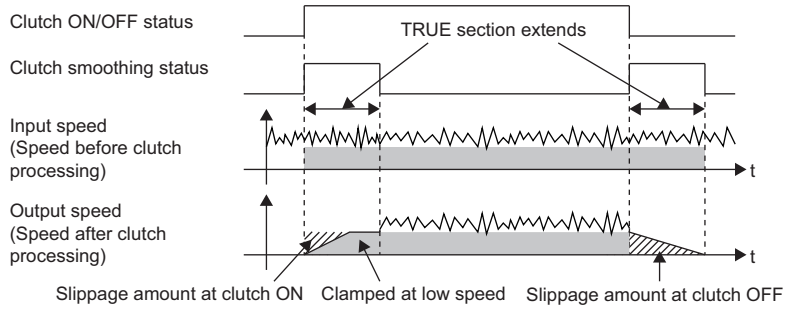


■When there is a continuous small fluctuation in the input speed

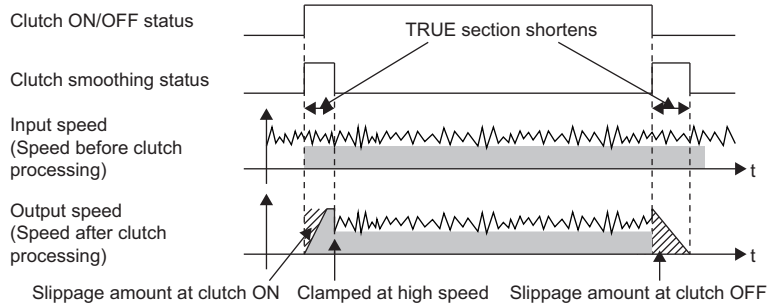
- When "4: Slippage method (Linear) (SlippageLinear)" is set

The clutch smoothing status TRUE section changes with the fluctuation of the input speed.

- When the clutch smoothing status TRUE section is extended

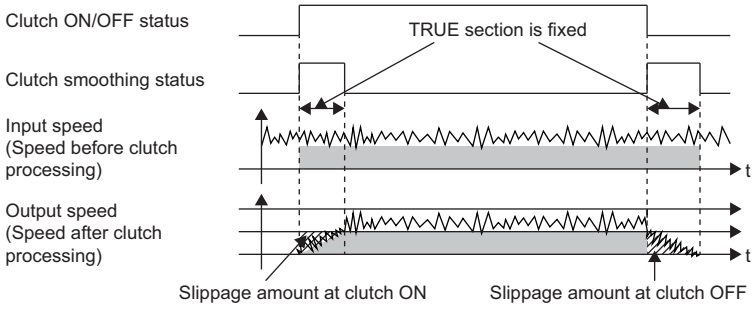


- When the clutch smoothing status TRUE section is shortened



• When "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)" is set

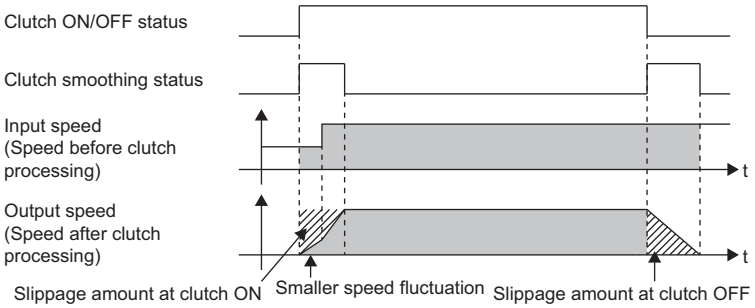
The clutch smoothing status TRUE section is fixed.



■When input speed has a large fluctuation

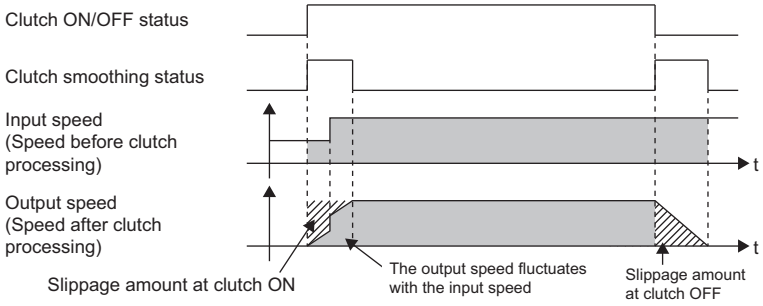
• When "4: Slippage method (Linear) (SlippageLinear)" is set

The fluctuation in the output speed is smaller compared to the fluctuation in the input speed. (The average speed may rise higher than before the start of smoothing)



• When "5: Slippage method (Linear: Input value follow up) (SlippageLinearFollow)" is set

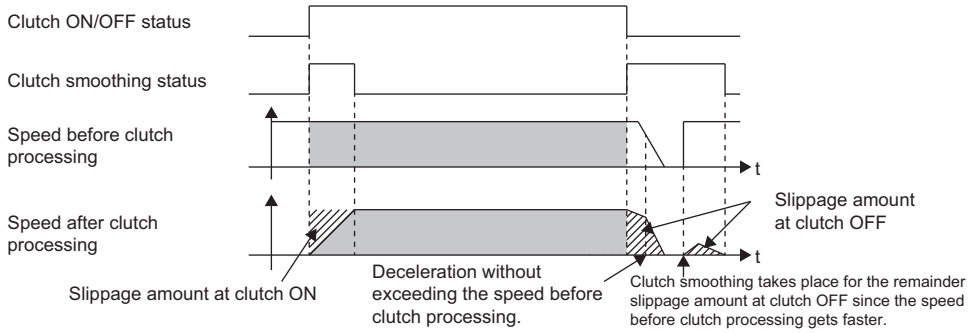
The output speed fluctuates with the input speed. (When re-accelerating after the input speed drops, a sudden acceleration may occur)



■Operation at input speed deceleration during slippage method smoothing

When the speed before clutch processing decreases, the speed after clutch smoothing is controlled to keep it from exceeding the speed before clutch processing.

If slippage amount remains when the speed before clutch processing becomes "0.0", the smoothing process will continue. When the speed before clutch processing gets faster than the speed after clutch smoothing again, clutch smoothing will be executed for the remainder slippage amount.



Example of clutch use

For an example of clutch use, refer to the following.

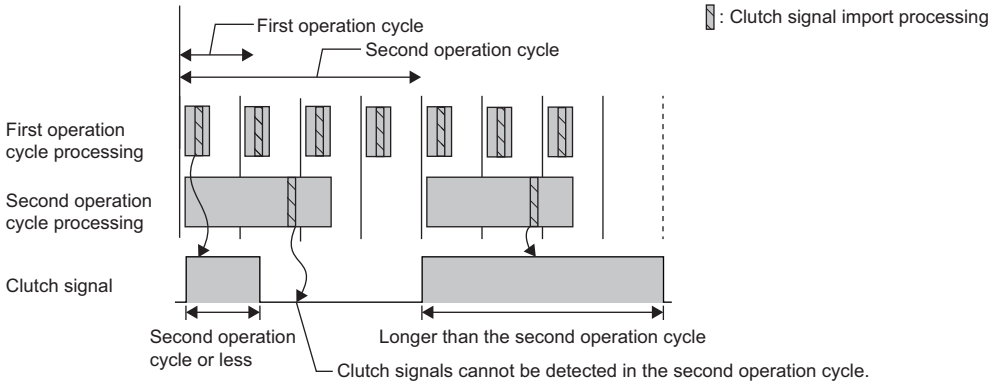
☞ Page 1019 Flying shear

Precautions for the clutch

- When "15: I/O data specification (ClutchSignal)" is specified in the clutch control settings and clutch control is performed using an external signal, be sure to secure at least the following times for TRUE and FALSE of clutch signals. If the times are shorter than the following, signals cannot be detected correctly.

■When external signal high-accuracy input is used
- Device station: Filter time of the device station
- Input module: Input response time of the input module

■When not using external signal high-accuracy input
- Refresh cycle of the clutch signal



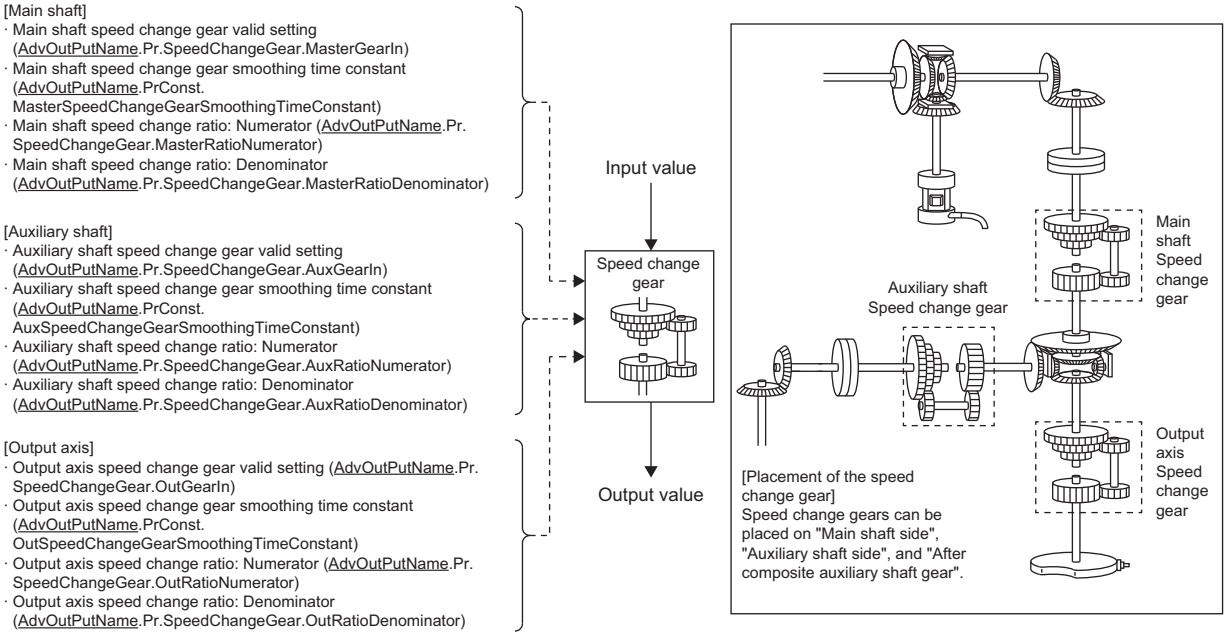
- When the following data types are specified in the clutch signal settings, match the control operation cycle of the output axis with the operation cycle (network communication cycle) of the referenced module.
  - [OBJ]
  - [VAR] (When a network label is specified)
  - [LINK]

Speed change gear

A speed change gear is used to change the input speed from the main shaft, auxiliary shaft, and composite auxiliary shaft gear during operation. One speed change gear can be set to a main shaft module, an auxiliary shaft module, and an output axis module respectively.

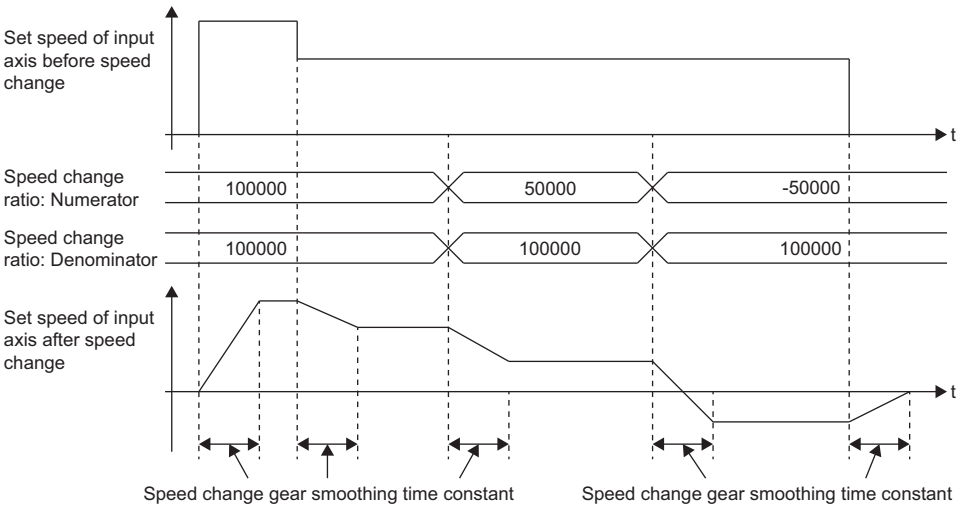
When not using a speed change gear, set "FALSE (Without speed change gear)".

Speed changes from a speed change gear are executed as linear acceleration/deceleration using the time set for the speed change gear smoothing time constant.



Input values for speed change are processed as follows.

$$\text{Input value after conversion} = \text{Input value before conversion} \times \frac{\text{Speed change ratio: Numerator}}{\text{Speed change ratio: Denominator}}$$



Speed change gear parameter of output axis (AdvOutputName.Pr.SpeedChangeGear.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterGearIn	Main shaft speed change gear valid setting	At start	BOOL	• FALSE: Without speed change gear • TRUE: With speed change gear	FALSE
MasterRatioNumerator	Main shaft speed change ratio: Numerator	Operation cycle (FB is starting)	DINT	-2147483648 to 2147483647	1
MasterRatioDenominator	Main shaft speed change ratio: Denominator		DWORD (UDINT)	1 to 2147483647	1
AuxGearIn	Auxiliary shaft speed change gear valid setting	At start	BOOL	• FALSE: Without speed change gear • TRUE: With speed change gear	FALSE
AuxRatioNumerator	Auxiliary shaft speed change ratio: Numerator	Operation cycle (FB is starting)	DINT	-2147483648 to 2147483647	1
AuxRatioDenominator	Auxiliary shaft speed change ratio: Denominator		DWORD (UDINT)	1 to 2147483647	1
OutGearIn	Output axis speed change gear valid setting	At start	BOOL	• FALSE: Without speed change gear • TRUE: With speed change gear	FALSE
OutRatioNumerator	Output axis speed change ratio: Numerator	Operation cycle (FB is starting)	DINT	-2147483648 to 2147483647	1
OutRatioDenominator	Output axis speed change ratio: Denominator		DWORD (UDINT)	1 to 2147483647	1

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft speed change gear valid setting (AdvOutputName.Pr.SpeedChangeGear.MasterGearIn)/Auxiliary shaft speed change gear valid setting (AdvOutputName.Pr.SpeedChangeGear.AuxGearIn)/Output axis speed change gear valid setting (AdvOutputName.Pr.SpeedChangeGear.OutGearIn)

Set whether to use or not to use a speed change gear for each axis.

Setting value	Description
FALSE (Without speed change gear)	Speed change is not processed, and the input value is transmitted without conversion.
TRUE (With speed change gear)	Speed change is processed for the input value based on the speed change ratio settings.

■Main shaft speed change ratio: Numerator (AdvOutputName.Pr.SpeedChangeGear.MasterRatioNumerator)/Auxiliary shaft speed change ratio: Numerator (AdvOutputName.Pr.SpeedChangeGear.AuxRatioNumerator)/Output axis speed change ratio: Numerator (AdvOutputName.Pr.SpeedChangeGear.OutRatioNumerator)

Set the numerator for the speed change ratio for each axis.

Speed change ratio: Numerator can be changed anytime during synchronous control.

Input values for speed change are processed as follows.

$$\text{Input value after conversion} = \text{Input value before conversion} \times \frac{\text{Speed change ratio: Numerator}}{\text{Speed change ratio: Denominator}}$$

The input speed direction can be reversed by setting a negative value in Speed change ratio: Numerator.

Point

Set a reduced fraction for "Main shaft speed change ratio: Numerator/Main shaft Speed change ratio: Denominator", "Auxiliary shaft speed change ratio: Numerator/Auxiliary shaft Speed change ratio: Denominator", and "Output axis speed change ratio: Numerator/Output axis speed change ratio: Denominator".

■Main shaft speed change ratio: Denominator (AdvOutputName.Pr.SpeedChangeGear.MasterRatioDenominator)/Auxiliary shaft speed change ratio: Denominator (AdvOutputName.Pr.SpeedChangeGear.AuxRatioDenominator)/ Output axis speed change ratio: Denominator (AdvOutputName.Pr.SpeedChangeGear.OutRatioDenominator)

Set the denominator for the speed change ratio for each axis.

Speed change ratio: Denominator can be changed anytime during synchronous control.

Set together with Speed change ratio: Numerator.

Speed change ratio: Denominator is set within the range from "1 to 2147483647".

Output axis parameter constant (AdvOutputName.PrConst.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterSpeedChangeGearSmoothingTimeConstant	Main shaft speed change gear smoothing time constant	At system start	WORD (UINT)	0 to 5000 [ms]	0 [ms]
AuxSpeedChangeGearSmoothingTimeConstant	Auxiliary shaft speed change gear smoothing time constant		WORD (UINT)	0 to 5000 [ms]	0 [ms]
OutSpeedChangeGearSmoothingTimeConstant	Output axis speed change gear smoothing time constant		WORD (UINT)	0 to 5000 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft speed change gear smoothing time constant (AdvOutputName.PrConst.MasterSpeedChangeGearSmoothingTimeConstant)/Auxiliary shaft speed change gear smoothing time constant (AdvOutputName.PrConst.AuxSpeedChangeGearSmoothingTimeConstant)/Output axis speed change gear smoothing time constant (AdvOutputName.PrConst.OutSpeedChangeGearSmoothingTimeConstant)

Set the averaging time to execute a smoothing process for the speed change when speed change is processed.

The input value transmission is delayed by the set time due to the smoothing process.

Speed is changed directly when "0" is set.

Speed change gear control data of output axis (AdvOutputName.Cd.SpeedChangeGear.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterSmoothingTimeConstant	Main shaft speed change gear smoothing time constant change value	At start	INT	0 to 5000 [ms]	0 [ms]
AuxSmoothingTimeConstant	Auxiliary shaft speed change gear smoothing time constant change value		INT	0 to 5000 [ms]	0 [ms]
OutSmoothingTimeConstant	Output axis speed change gear smoothing time constant change value		INT	0 to 5000 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Main shaft speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.MasterSmoothingTimeConstant)/Auxiliary shaft speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.AuxSmoothingTimeConstant)/Output axis speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.OutSmoothingTimeConstant)

The speed change gear smoothing time constant of each axis is changed.

The setting is imported when MCv_AdvancedSync (Advanced Synchronous Control) is started.

Set as follows.

Setting value	Description
When a negative value is set	No smoothing.
When 0 is set	Smoothing is executed based on the setting value of the speed change gear smoothing time constant*1.
When a positive value is set	Smoothing is executed based on the setting value of the speed change gear smoothing time constant change value*2. Set within the following setting range. Speed change gear smoothing time constant*1 > Speed change gear smoothing time constant change value*2 * If the set value exceeds the range above, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs, and smoothing is executed based on the setting value of the speed change gear smoothing time constant*1.

*1 The speed change gear smoothing time constant is as follows.

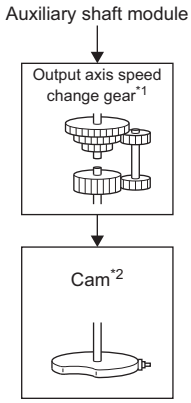
Axis	Variable
Main shaft	Main shaft speed change gear smoothing time constant (AdvOutputName.PrConst.MasterSpeedChangeGearSmoothingTimeConstant)
Auxiliary shaft	Auxiliary shaft speed change gear smoothing time constant (AdvOutputName.PrConst.AuxSpeedChangeGearSmoothingTimeConstant)
Output axis	Output axis speed change gear smoothing time constant (AdvOutputName.PrConst.OutSpeedChangeGearSmoothingTimeConstant)

*2 The speed change gear smoothing time constant change value is as follows.

Axis	Variable
Main shaft	Main shaft speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.MasterSmoothingTimeConstant)
Auxiliary shaft	Auxiliary shaft speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.AuxSmoothingTimeConstant)
Output axis	Output axis speed change gear smoothing time constant change value (AdvOutputName.Cd.SpeedChangeGear.OutSmoothingTimeConstant)

Output axis module

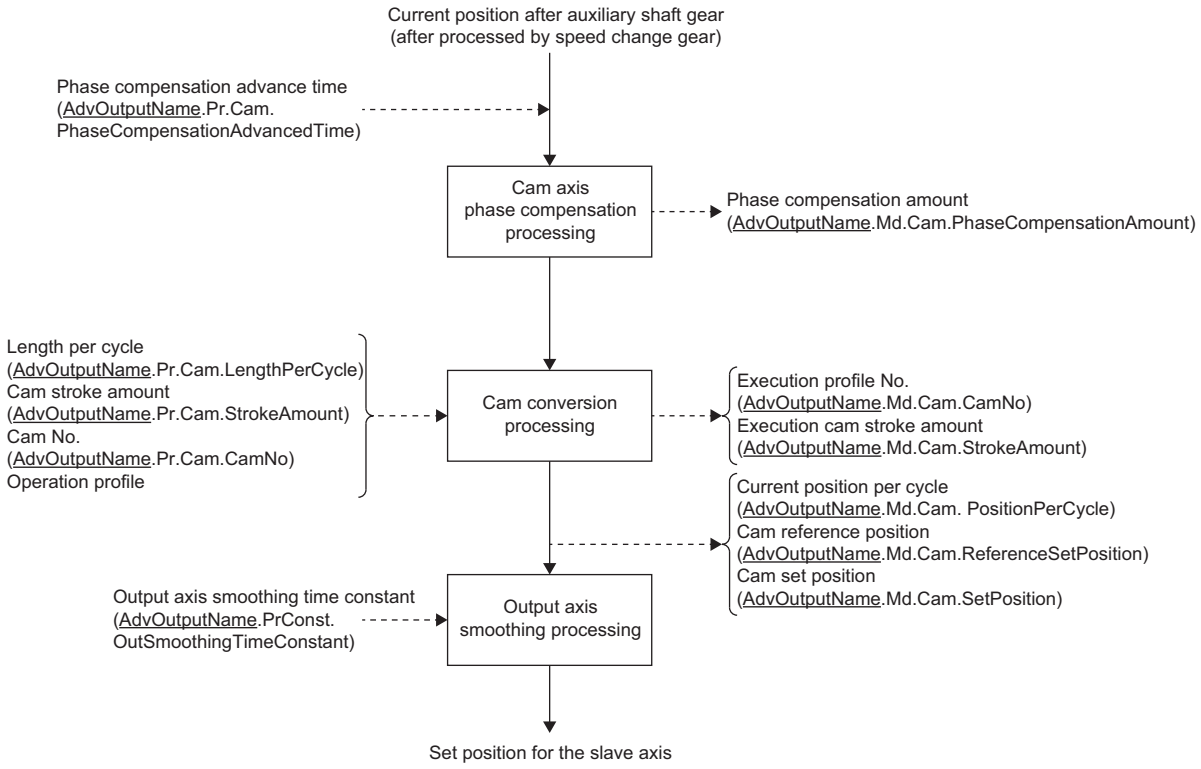
For the output axis module, the current position per cycle is calculated based on the input value (the cam set position based on the current position after auxiliary shaft gear after speed change gear processing), which is then converted based on the cam data settings and output to the slave axes as the set position.
In addition, smoothing and phase compensation can be set for the output command.



*1 Speed change gear (☞ Page 960 Speed change gear)

*2 Cam function processing

The parameters and monitor data related to the cam function processing are shown below.



Cam parameter of output axis parameters (AdvOutputName.Pr.Cam.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
LengthPerCycle	Length per cycle	At start/At passing through the 0th point of cam data	LREAL	1.0 to 2147483647.0	1000000.0
StrokeAmount	Cam stroke amount		LREAL	-2147483648.0 to 2147483647.0	1000000.0
CamNo	Cam No.		WORD (UINT)	0 to 60000	0
StartingPoint	Cam starting point		DWORD (UDINT)	0 to 65535	0
LengthPerCycleChange	Length per cycle change setting	At start	INT (MC_LENGTH_PER_CYCLE_CHANGE)	• 0: Invalid (LengthChangeInvalid) • 1: Valid (LengthChangeValid)	0: Invalid (LengthChangeInvalid)
PhaseCompensationAdvancedTime	Phase compensation advance time	At start/Operation cycle (FB is starting)	DINT	-100000000 to 100000000 [μs]	0 [μs]
PhaseCompensationTimeConstant	Phase compensation time constant	At start	WORD (UINT)	0 to 65535 [ms]	10 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle)

Set the length per cycle of the cam axis to generate the current position per cycle.

The unit settings are in units of the input axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

Set a value within the range from "1.0 to 2147483647.0".

The length per cycle can be changed during synchronous control by setting Length per cycle change setting (AdvOutputName.Pr.Cam.LengthPerCycleChange) to "1: Valid (LengthChangeValid)". When the current position per cycle passes through the 0th point of cam data, or is at the 0th point of cam data, the value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) is imported.

When cam data is set, the waveform after the length per cycle is changed varies by the cam data format.

- For cam data (section interpolation)/cam data (spline interpolation): The waveform is shortened/extended so that the one cycle set in the operation profile data is equal to the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). The maximum value of the stroke amount does not vary with the change of the length per cycle. An example of using cam data (section interpolation) and changing the length per cycle during synchronous control is shown below.

Ex.

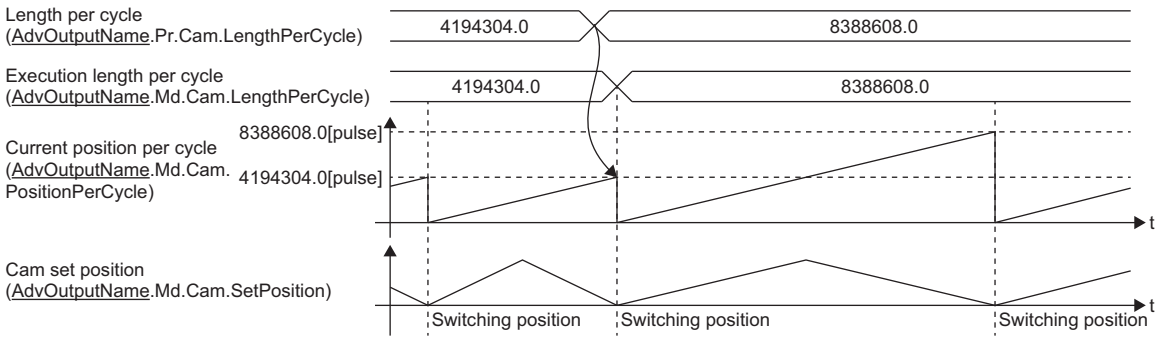
A setting example of cam data (section interpolation)

· Length per cycle: 4194304.0

· Cam stroke amount: ±4194304.0

· Stroke ratio data

Section No.	Start point [pulse]	End point [pulse]	Stroke [%]
1	0.0	2097152.0	100.0
2	297152.0	4194304.0	0.0



- For cam data (linear interpolation): When the input value of the final coordinates is less than the length per cycle, it is controlled using a line segment calculated from the two coordinates nearest to the final coordinates. An example of using cam data (linear interpolation) and changing the length per cycle to a value that exceeds the input value of cam data final coordinates during synchronous control is shown below.

Ex.

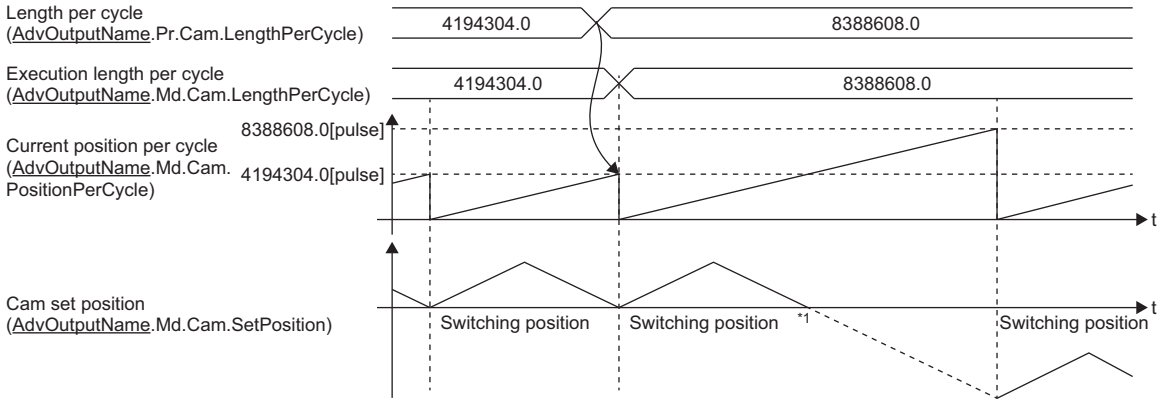
A setting example of cam data (linear interpolation)

· Length per cycle: 4194304.0

· Cam stroke amount: ±4194304.0

· Coordinate data

Point	Input value	Cam set position
1	0.0	0.0
2	2097152.0	4194304.0
3	4194304.0	0.0



*1 Because the coordinates where "input value = length per cycle" do not exist, control is performed using a line segment calculated from the two coordinates nearest to the final coordinates.

Point

- Do not set digits after the decimal point. If set, the errors will be accumulated every time the current position per cycle permissible value is exceeded.
- When cam data change and length per cycle change are executed simultaneously, the length per cycle will not be changed if cam data change fails.

■Cam stroke amount (AdvOutputName.Pr.Cam.StrokeAmount)

When the Interpolation method specification (Interpolate) of the operation profile data is set to "1: Section interpolation" or "2: Spline interpolation", or the data format is set to "Rotary cutter", set the cam stroke amount corresponding to a 100% stroke ratio in the position command unit of the axis set in the output axis Axis information (AdvOutputName.Axis).

The cam stroke amount can be changed during synchronous control.

The value of Cam stroke amount (AdvOutputName.Pr.Cam.StrokeAmount) is imported when the current position per cycle passes through the 0th point of cam data, or is at the 0th point.

Point

Do not set digits after the decimal point. If set, the errors will be accumulated every time the current position per cycle permissible value is exceeded.

■Cam No. (AdvOutputName.Pr.Cam.CamNo)

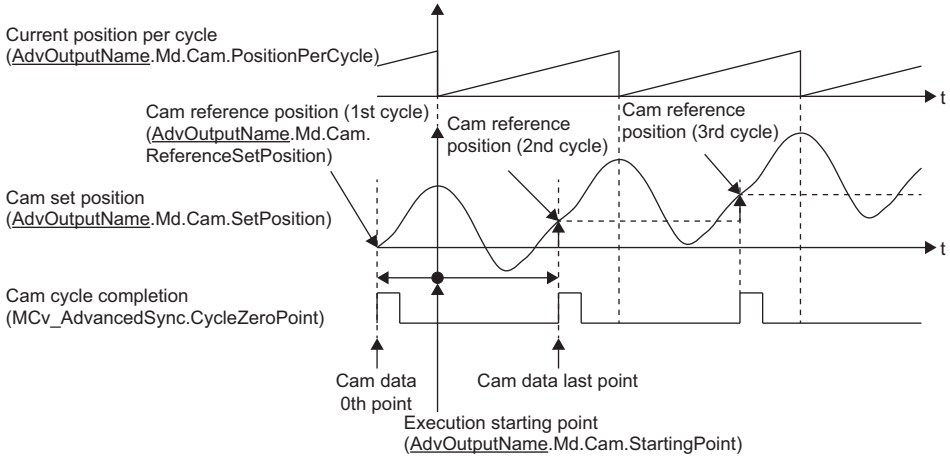
Set the cam No. used for cam control.

■Cam starting point (AdvOutputName.Pr.Cam.StartingPoint)

Set the starting point of cam data in resolutions.

This setting is valid only when the Interpolation method specification (Interpolate) of the operation profile data is set to "1: Section interpolation" or "2: Spline interpolation", or the data format is set to "Rotary cutter".

The initial value of the Cam starting point (AdvOutputName.Pr.Cam.StartingPoint) is "0". (The cam axis is controlled with cam data starting from the 0th point (stroke ratio 0%).) When a value other than "0" is set, cam control is started from a stroke ratio other than 0%.



Point

- The cam reference position is the cam set position at the 0th point of cam data.
- The Cam starting point (AdvOutputName.Pr.Cam.StartingPoint) is imported when cam data switches. When a value exceeding the cam data resolution is set in the Cam starting point (AdvOutputName.Pr.Cam.StartingPoint), control is performed using the cam data and cam starting point before the change.

■Length per cycle change setting (AdvOutputName.Pr.Cam.LengthPerCycleChange)

Set this when changing the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) during synchronous control.

This can change the length per cycle in cam No.0 (linear cam), cam data (linear interpolation), or cam data (section interpolation). However, this cannot change the length per cycle in cam data (section interpolation) that uses cam data with starting point other than 0.

Setting value	Description
0: Invalid (LengthChangeInvalid)	Cannot change the length per cycle during synchronous control.
1: Valid (LengthChangeValid)	Imports the value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) when the current position per cycle passes through the 0th point of cam data, or is at the 0th point.

■Phase compensation advance time (AdvOutputName.Pr.Cam.PhaseCompensationAdvancedTime)

Set the time to advance or delay the phase of the current position per cycle in the cam control.

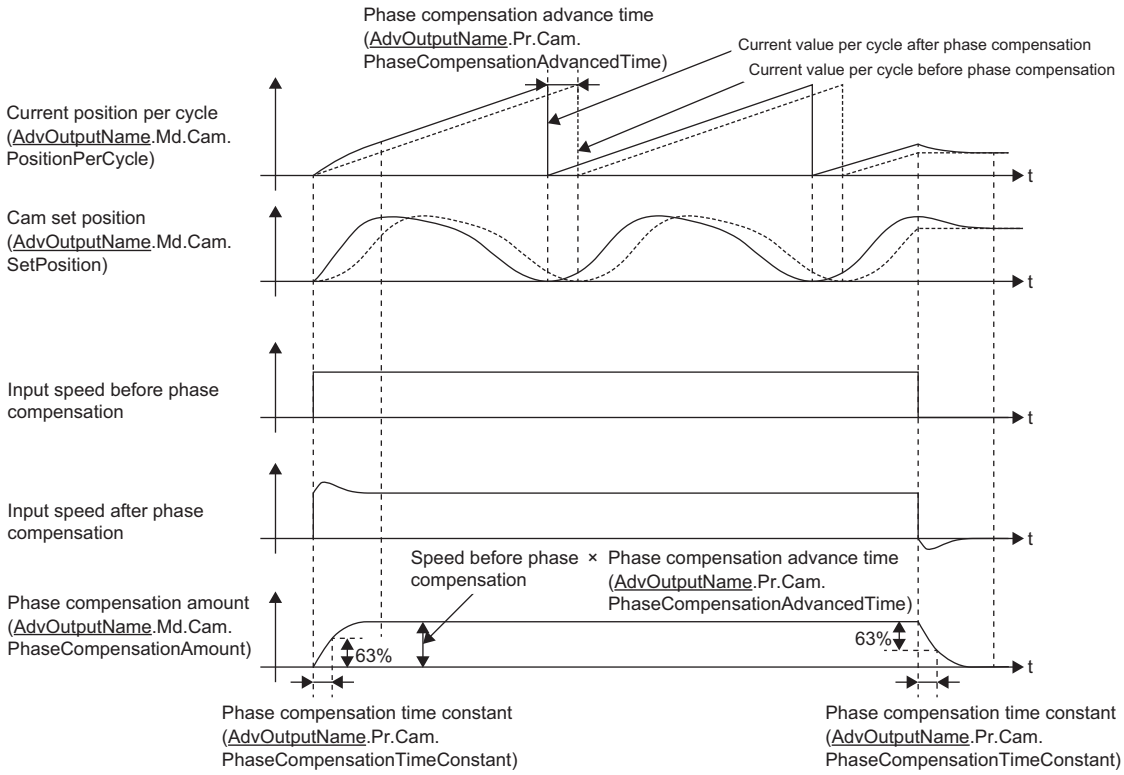
Setting value	Description
1 to 100000000 [μs]	Advance the phase according to the setting time.
0 [μs]	Do not execute phase compensation.
-100000000 to 1 [μs]	Delay the phase according to the setting time.

If the setting time is too long, the system experiences overshoot or undershoot at acceleration/deceleration of the input movement amount to the output axis. In this case, set a longer time to reflect the phase compensation amount in the Phase compensation time constant (AdvOutputName.Pr.Cam.PhaseCompensationTimeConstant).

■Phase compensation time constant (AdvOutputName.Pr.Cam.PhaseCompensationTimeConstant)

Set the time constant for reflecting the phase compensation amount for the first order delay.

63% of the phase compensation amount is reflected in the specified time constant.



Cam monitor of output axis monitor data (AdvOutputName.Md.Cam.)

Variable name	Name	Import*1	Data type*1	Monitor value
MasterCompositeGearSetPosition	Current position after composite main shaft gear	Operation cycle (FB is starting)	LREAL	-10000000000.0 to 10000000000.0
MasterGearPositionPerCycle	Current position per cycle after main shaft gear		LREAL	0.0 to (length per cycle - 0.00001)
AuxGearPositionPerCycle	Current position per cycle after auxiliary shaft gear		LREAL	0.0 to (length per cycle - 0.00001)
PhaseCompensationAmount	Phase compensation amount		LREAL	-2147483648.0 to 2147483647.0
PositionPerCycle	Current position per cycle		LREAL	0.0 to (length per cycle - 0.00001)
ReferenceSetPosition	Cam reference position		LREAL	-10000000000.0 to 10000000000.0
SetPosition	Cam set position		LREAL	-10000000000.0 to 10000000000.0
CamNo	Execution profile No.		WORD (UINT)	0 to 60000
StrokeAmount	Execution cam stroke amount		LREAL	-2147483648.0 to 2147483647.0
LengthPerCycle	Execution length per cycle		LREAL	1.0 to 2147483647.0
StartingPoint	Execution cam starting point		DWORD (UDINT)	0 to 65535

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Current position after composite main shaft gear (AdvOutputName.Md.Cam.MasterCompositeGearSetPosition)

The current position after the composite main shaft gear combines the values from the main shaft and the sub input axis is stored as an accumulative value.

The unit settings are in units of the input axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

The Current position after composite main shaft gear (AdvOutputName.Md.Cam.MasterCompositeGearSetPosition) is backed up. For details, refer to the following.

☞ Page 990 Synchronous Control Initial Position

■Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle)

The input movement amount after the main shaft gear is stored within the range from "0.0 to (length per cycle - 0.00001)".

The unit settings are in units of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

The Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) is backed up. For details, refer to the following.

☞ Page 990 Synchronous Control Initial Position

■Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle)

The input movement amount after the auxiliary shaft gear is stored within the range from "0.0 to (length per cycle - 0.00001)".

The unit settings are in units of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

The Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) is backed up. For details, refer to the following.

☞ Page 990 Synchronous Control Initial Position

■Phase compensation amount (AdvOutputName.Md.Cam.PhaseCompensationAmount)

The phase compensation amount after smoothing processing with the Phase compensation time constant (AdvOutputName.Pr.Cam.PhaseCompensationTimeConstant) is stored.

The unit settings of phase compensation amount are in units of the input axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).

■Current position per cycle (AdvOutputName.Md.Cam.PositionPerCycle)

The current position per cycle is stored within the range from "0.0 to (length per cycle - 0.00001)".
The current position after phase compensation processing can be monitored. The unit settings are in units of the input axis set as the Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).
The Current position per cycle (AdvOutputName.Md.Cam.PositionPerCycle) is backed up. For details, refer to the following.
☞ Page 990 Synchronous Control Initial Position

■Cam reference position (AdvOutputName.Md.Cam.ReferenceSetPosition)

The set position is stored as the cam reference position of the cam operation. The unit settings are in position command units of the axis set in the output axis Axis information (AdvOutputName.Axis).
The cam reference position range is the positioning range of the axis assigned as the output axis.
The Cam reference position (AdvOutputName.Md.Cam.ReferenceSetPosition) is backed up. For details, refer to the following.
☞ Page 990 Synchronous Control Initial Position

■Cam set position (AdvOutputName.Md.Cam.SetPosition)

- The set position of the cam axis is stored. The unit settings are in position command units of the axis set in the output axis Axis information (AdvOutputName.Axis).
- When the Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant) is "0" during the execution of synchronous control, the value of the Set position (AxisName.Md.SetPosition) of the axis set in the output axis Axis information (AdvOutputName.Axis) is equal to the value of the Cam set position (AdvOutputName.Md.Cam.SetPosition).
- When the Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant) is other than "0" during the execution of synchronous control, the value of the Set position (AxisName.Md.SetPosition) of the axis set in the output axis Axis information (AdvOutputName.Axis) is equal to the value of the Cam set position (AdvOutputName.Md.Cam.SetPosition) after the smoothing is completed.
- The Cam set position (AdvOutputName.Md.Cam.SetPosition) is backed up. For details, refer to the following.
  ☞ Page 990 Synchronous Control Initial Position

■Execution profile No. (AdvOutputName.Md.Cam.CamNo)

The executing cam No. is stored.
When the Cam No. (AdvOutputName.Pr.Cam.CamNo) is changed during synchronous control, this is updated when the controlling cam No. switches.
The same value of the Execution profile No. (AdvOutputName.Md.Cam.CamNo) is stored to the Execution profile ID (AxisName.Md.ProfileID).

■Execution cam stroke amount (AdvOutputName.Md.Cam.StrokeAmount)

The executing cam stroke amount is stored.
When the Cam stroke amount (AdvOutputName.Pr.Cam.StrokeAmount) is changed during synchronous control, this is updated when the controlling cam stroke amount switches.

■Execution length per cycle (AdvOutputName.Md.Cam.LengthPerCycle)

The executing cam length per cycle is stored.
When the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) is changed during synchronous control, this is updated when the controlling length per cycle switches.

■Execution cam starting point (AdvOutputName.Md.Cam.StartingPoint)

The executing cam starting point is stored. When the Cam starting point (AdvOutputName.Pr.Cam.StartingPoint) is changed during synchronous control, this is updated when the cam switches.

Cam control data of output axis parameters (AdvOutputName.Cd.Cam.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
OutSmoothingTimeConstant	Output axis smoothing time constant change value	At start	INT	0 to 5000 [ms]	0

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Output axis smoothing time constant change value (AdvOutputName.Cd.Cam.OutSmoothingTimeConstant)

The output axis smoothing time constant is changed. The setting is imported when MCv_AdvancedSync (Advanced Synchronous Control) is started.

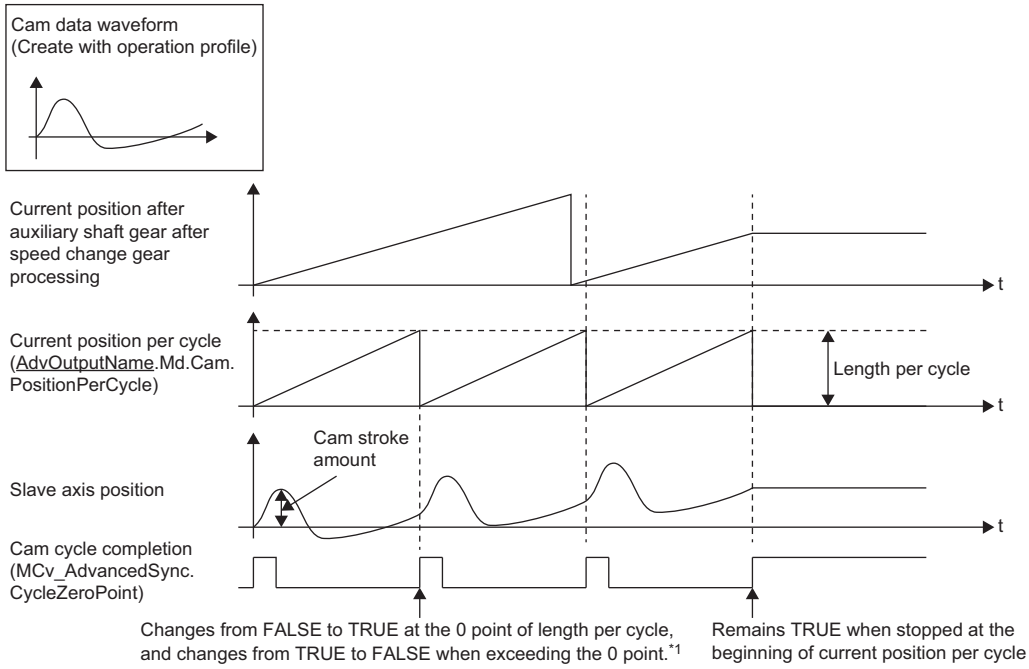
Setting value	Description
When a negative value is set	No smoothing.
When 0 is set	Smoothing is executed based on the setting value of the Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant).
When a positive value is set	Smoothing is executed based on the setting value of the Output axis smoothing time constant change value (AdvOutputName.Cd.Cam.OutSmoothingTimeConstant). Set within the following setting range. Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant) > Output axis smoothing time constant change value (AdvOutputName.Cd.Cam.OutSmoothingTimeConstant) * If the set value exceeds the range above, Out of Advanced Synchronous Control Variable Range Warning (error code: 0D3FH) occurs, and smoothing is executed based on the setting value of the Output axis smoothing time constant (AdvOutputName.PrConst.SmoothingTimeConstant).

Cam function

Cam data sets the cam ID to Cam No. (AdvOutputName.Pr.Cam.CamNo).

To use the operation profile data, set auto expand in the expand setting beforehand, or use MC_CamTableSelect (Cam Table Selection) to open the data in the open area.

Timing chart during cam operation



*1 When a value other than 0 is set to the cam data starting point, it becomes TRUE at the set cam data starting point.

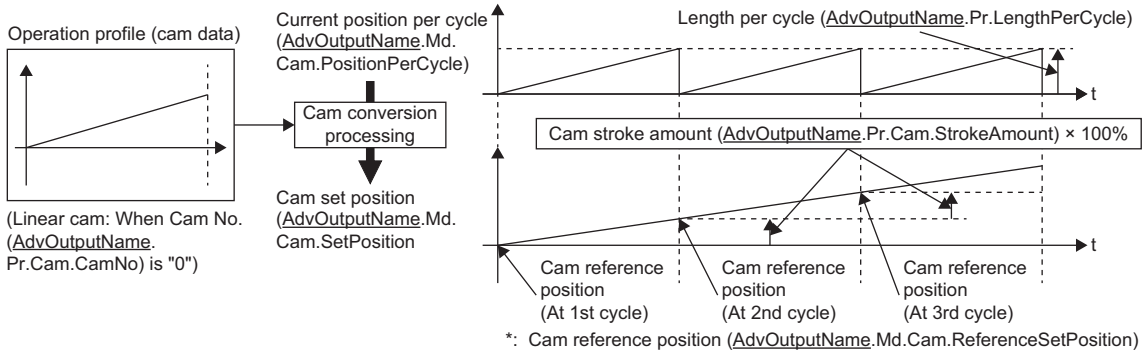
Cam data operation

Cam data for advanced synchronous control performs the following operations.

■Linear cam

A linear operation with one cycle as a 100% stroke ratio.

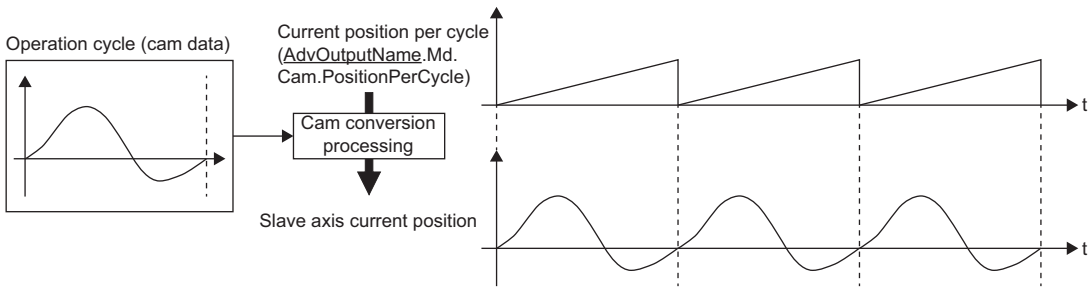
A linear cam operation occurs when Cam No. (AdvOutputName.Pr.Cam.CamNo) is set to "0".



■Two-way cam

A reciprocating cam operation with a constant cam stroke range.

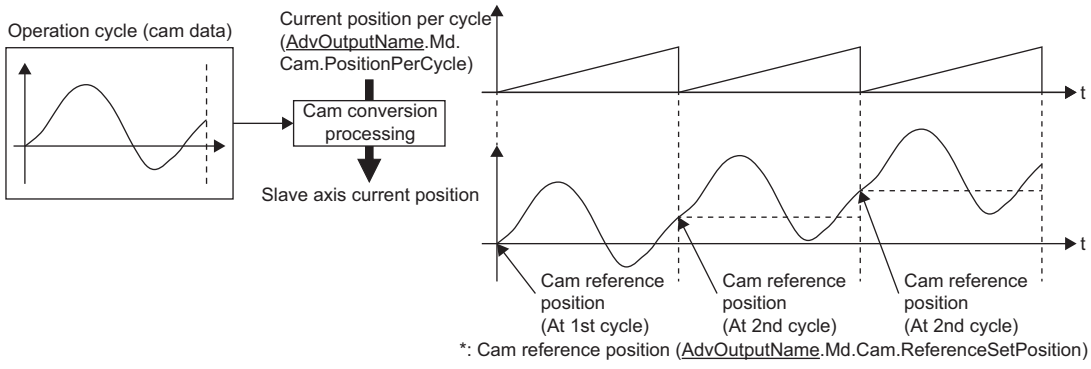
A two-way cam operation occurs when "start point = end point" for the cam data created with the operation profile data.



■Feed cam

A cam operation where the cam reference position is updated every cycle.

A feed cam operation occurs when "start point ≠ end point" for the cam data created with the operation profile data.



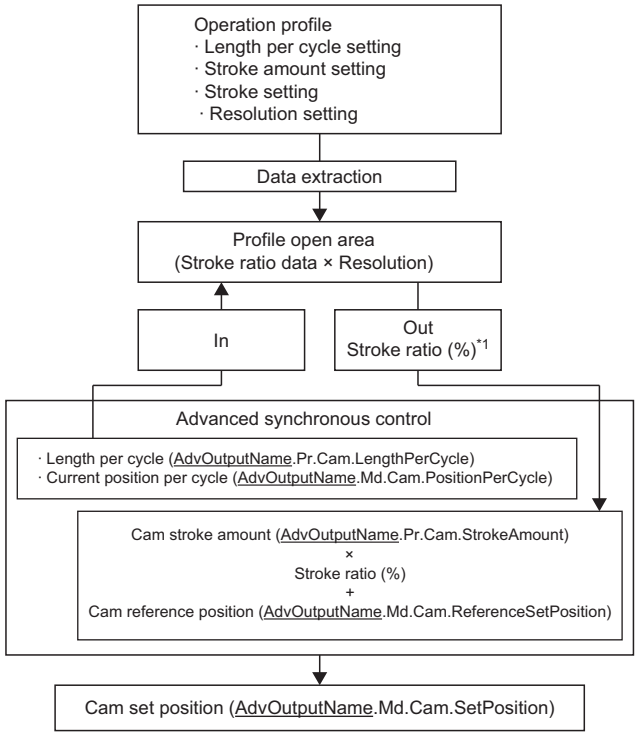
Cam control by operation profile data

When using cam control in advanced synchronous control, the data transmitted to the open area varies depending on the interpolation method specification of the operation profile data and the data format.

■When the Interpolation method specification (Interpolate) of the operation profile data is "1: Section interpolation" or "2: Spline interpolation", or the data format is set to "Rotary cutter"

The cam data is defined in equal divisions for one cam cycle based on the cam resolution, and configured with stroke ratio data from points within the cam resolution.

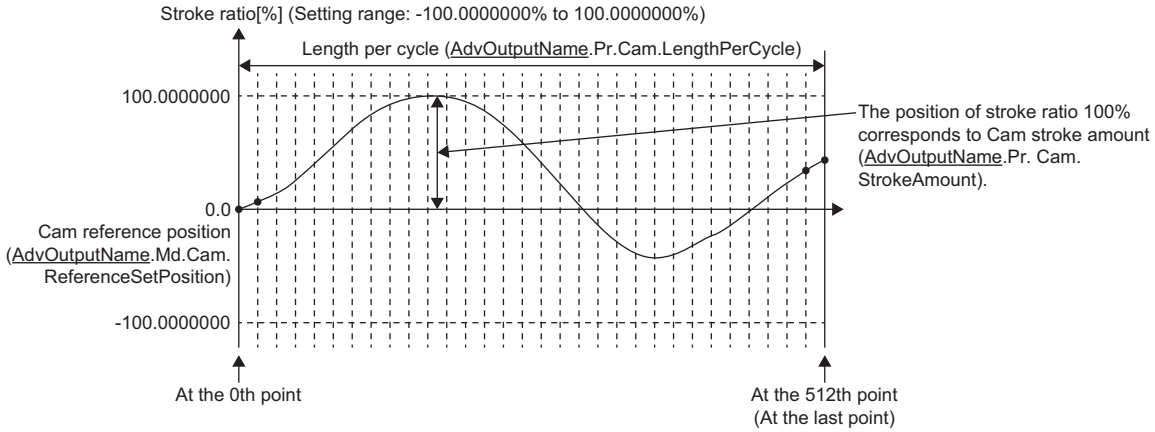
When this setting is configured, the relationship between the operation profile data and advanced synchronous control is as follows.



*1 The stroke ratio is calculated according to Current position per cycle (AdvOutputName.Md.Cam.PositionPerCycle) using the stroke ratio and resolution of the open area and Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle).

Ex.

When the cam resolution is 512



• Timing for reflecting cam control data

If the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) or the Cam No. (AdvOutputName.Pr.Cam.CamNo), or the Cam stroke amount (AdvOutputName.Pr.Cam.StrokeAmount) is changed, the new value is imported and reflected when the Current position per cycle (AdvOutputName.Pr.Cam.PositionPerCycle) passes through the 0th point of cam data, or is at the 0th point.

For "Cam starting point = 0", the cam reference position is updated when the current position per cycle exceeds the permissible value.

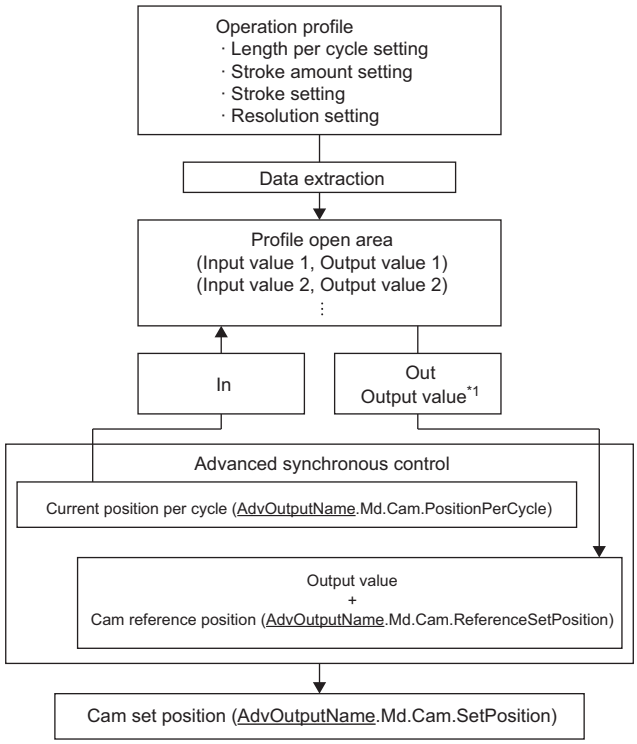
For "Cam starting point ≠ 0", the cam reference position is updated when the current position per cycle passes through the 0th point of cam data.

■When the Interpolation method specification (Interpolate) of the operation profile data is set to "0: Linear interpolation"

The cam data defines a cam curve in two or more points of coordinate data for one cycle. The coordinate data is expressed as "(input value, output value)", with "input value = axis current position per cycle", and "output value = stroke amount from cam reference position".

The Cam stroke amount (AdvOutputName.Pr.Cam.StrokeAmount) of output axis parameter is ignored, and the output value of the coordinate data becomes cam stroke amount.

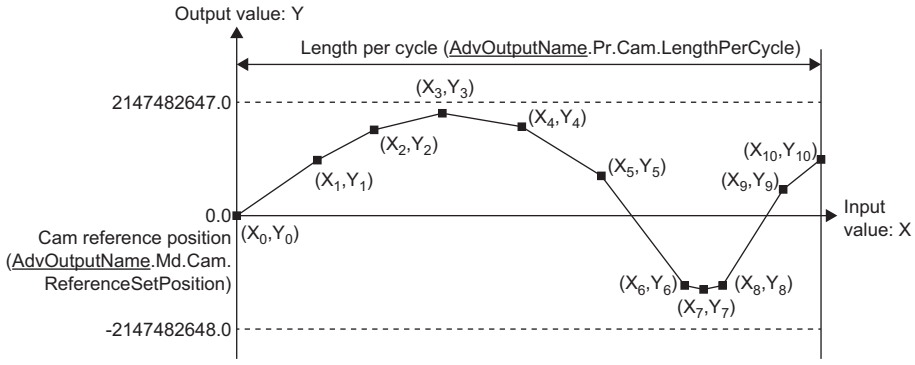
When this setting is configured, the relationship between the operation profile data and advanced synchronous control is as follows.



*1 The output value corresponding to the Current position per cycle (AdvOutputName.Md.Cam.PositionPerCycle) is calculated based on the input value and output value of the open area. In addition, the result of the calculation is truncated after the 5th decimal place.

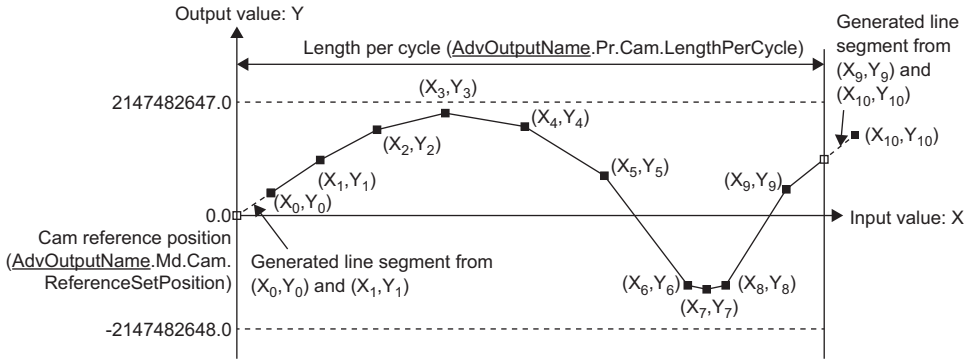
Ex.

When the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) is equivalent to the setting value of the length per cycle setting in the operation profile data



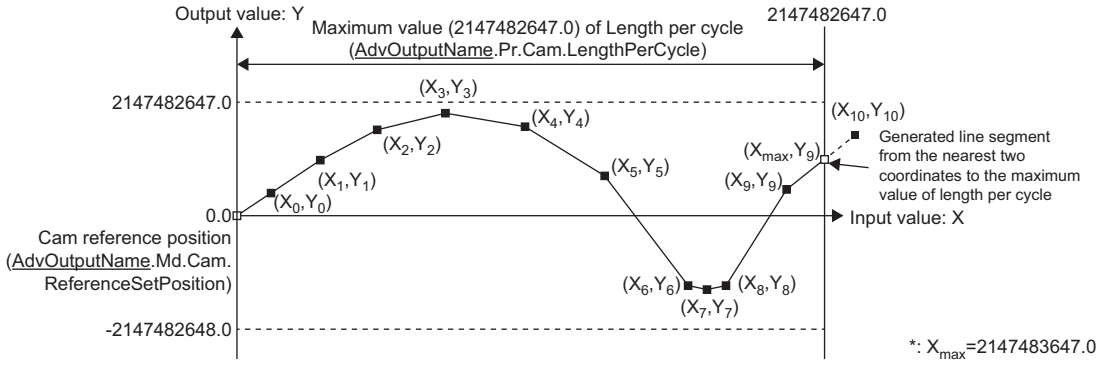
Ex.

When "input value = 0" and "input value = length per cycle" coordinates do not exist in the coordinate data, control is performed using a line segment calculated from the nearest two coordinates.



Ex.

If the input value exceeds the maximum value (2147483647.0) of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle), the control is performed using a line segment calculated from the two coordinates nearest to the maximum value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). In this case, the input value X at the last point of the coordinates is equivalent to the maximum value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle).



- Timing for reflecting cam control data

If the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) or the Cam No. (AdvOutputName.Pr.Cam.CamNo) is changed during synchronous control, the new value is imported and reflected when the Current position per cycle (AdvOutputName.Pr.Cam.PositionPerCycle) passes through "0.0", or is at the position of "0.0".

The cam reference position is updated when the current position per cycle passes through "0.0".

■Setting list for using the operation profile data in advanced synchronous control

The settings for using the operation profile data in advanced synchronous control are shown below.

When specifying setting values, set the specified value, or a value within the range. When a specified value or a value within the range is not set, an error or an unintended operation may occur.

Setting item[*1]		Interpolation method specification (Interpolate)	
		1: Section Interpolation/2: Spline Interpolation	0: Linear Interpolation
Periodic (Options (Options): Bit 0)		Set to "1: Periodic". When set to other than "1: Periodic", Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur at FB start.	
Master axis (input) absolute coordinate (Options (Options): Bit 1)		Set to "0: Relative coordinate". When set to other than "0: Relative coordinate", Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur at FB start.	
Slave axis (output) absolute coordinate (Options (Options): Bit 2)		Set to "0: Relative coordinate". When set to other than "0: Relative coordinate", Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur at FB start.	
Profile ID		Set to any value within the range of 1 to 60000.	
Interpolation method specification (Interpolate)		Set to "1: Section Interpolation" or "2: Spline Interpolation".	Set to "0: Linear Interpolation".
Resolution/coordinate number (Resolution)		Set the number of divisions for a cam curve for one cycle.	Set the number of coordinate points in a cam curve for one cycle. The 0th point is included in the number of coordinate points.
Input unit character string (InputUnitString)		Set the unit of the axis to be set as the main shaft.	
Output unit character string (OutputUnitString)		Set the unit of the stroke amount.	Set the unit of the axis to be set as the output axis.
Start point (StartPoint)		Set to "0.0". When set to other than "0.0", Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur at FB start. When setting the cam data starting point in advanced synchronous control, set the Cam starting point (AdvOutputName.Pr.Cam.StartingPoint) of the output axis parameters.	
Initial stroke amount (StartStroke)		Set to "0.0". When set to other than "0.0", Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur at FB start.	
Initial velocity (StartVelocity)		Set this item when "1: Section Interpolation" is used. Set the velocity at the start point/end point. Use when the Cam curve type (CurveType) is set to "12: 5th curve (Adj.) (FifthCurve_SpeedDesignation)".	It is not used in the coordinate data format.
Initial acceleration (StartAcceleration)		Set this item when "1: Section Interpolation" is used. Set the acceleration at the start point/end point. Use when the Cam curve type (CurveType) is set to "12: 5th curve (Adj.) (FifthCurve_SpeedDesignation)".	
I/O data	Input value	Do not set this item when "1: Section Interpolation" or "2: Spline Interpolation" is used.	• Set the input value at each point No. • Set the input value within the range of "0.0 to 2147483647.0". When an input value exceeding "2147483647.0" is set, the control is performed using a line segment calculated from the two coordinates nearest to the maximum value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle).
	Output value		• Set the output value corresponding with the input value at each point No. • Set the output value within the range of "-2147483648.0 to 2147483647.0". If a value outside the range is set, Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur.

Setting item*1		Interpolation method specification (Interpolate)	
		1: Section Interpolation/2: Spline Interpolation	0: Linear Interpolation
Parameter	Cam curve type (CurveType)	Set to any type to match the cam data to be created.	It is not used in the coordinate data format.
	End point (EndPoint)	Set the end point of each section.	
	Stroke (Stroke)	Set the stroke of each section.	
	Curve applicable range (RangeP1/RangeP2)	Set the curve applicable range (start point: P1, end point: P2) for the cam curve. (0.0 to 1.0) Set within the range of "P1 < P2". However, for "P1 = P2 = 0", "P1 = 0" and "P2 = 1" are applied. For curve applicable range, the setting can be omitted.	
	Acceleration/deceleration range compensation (RangeL1)	Set the acceleration/deceleration range (L1, L2) of the cam curve. (0.0001 < L1, L2 < 1.0000) The range that can be set differs depending on the cam curve. For "L1 = L2 = 0.0000", the default value for each cam curve is applied. On the curve that does not use L1 or L2, the setting value is ignored.	
	End point velocity (EndVelocity)	Set the end point velocity of the cam curve.	
	End point acceleration (EndAcceleration)	Set the end point acceleration of the cam curve.	
Length per cycle (CycleLength)		Although the setting is ignored in advanced synchronous control, set the same value to the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). The setting value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle) is used for actual control.	
Minimum value per cycle (CycleMin)		Do not set this item when "1: Section Interpolation" or "2: Spline Interpolation" is used.	Set to "0.0". Set this item when the Interpolation method specification (Interpolate) is set to "0: Linear Interpolation".
Maximum value per cycle (CycleMax)			Set the setting value of Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). Set this item when the Interpolation method specification (Interpolate) is set to "0: Linear Interpolation".
Time per cycle (CycleTime)		Set the time that is required for one cycle. Use when the cam curve type (CurveType) is set to "12: 5th curve (Adj.) (FifthCurve_SpeedDesignation)".	Not used in "0: Linear Interpolation".
Stroke amount (Stroke)		When the unit is "%", the setting is ignored. When the unit is other than "%", set to 100 % stroke amount. ■Example: If the stroke amount is set to "200.0" when the unit is "mm", the cam data will have "200.0" as the 100% stroke ratio.	Set to a value equal to or more than the maximum value of the output value in the I/O data.
Number of sections (NumberOfSections)		Set to a value within the following ranges depending on the interpolation method specification (Interpolate). ■"1: Section Interpolation" 1 to 360 ■"2: Spline Interpolation" 3 to 360	It is not used in the coordinate data format.

*1 The variable inside the ( ) is the member name of the PROFILE_CAM_DATA data type, or the PROFILE_CAM_ELEMENT data type.

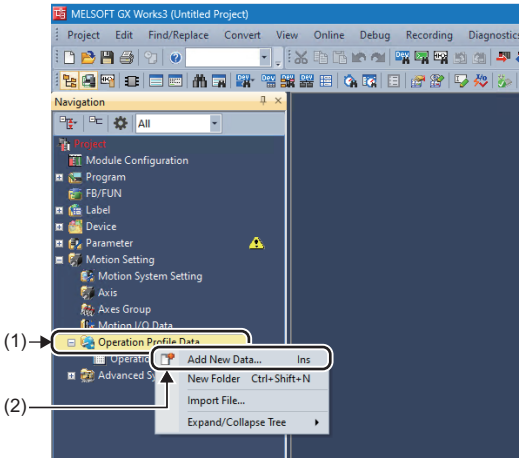
When the data format is "rotary cutter", refer to the following.

☞ Page 837 Rotary cutter

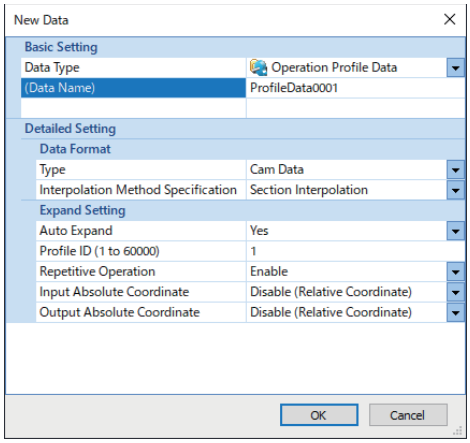
Setting method of operation profile data

This section describes the setting method for using operation profile data in advanced synchronous control.

1. In the Navigation window, right-click [Motion Setting], then [Operation Profile Data] (1), and select [Add New Data] (2).



2. In the "New Data" window, configure the basic settings and detailed settings, and click the [OK] button.

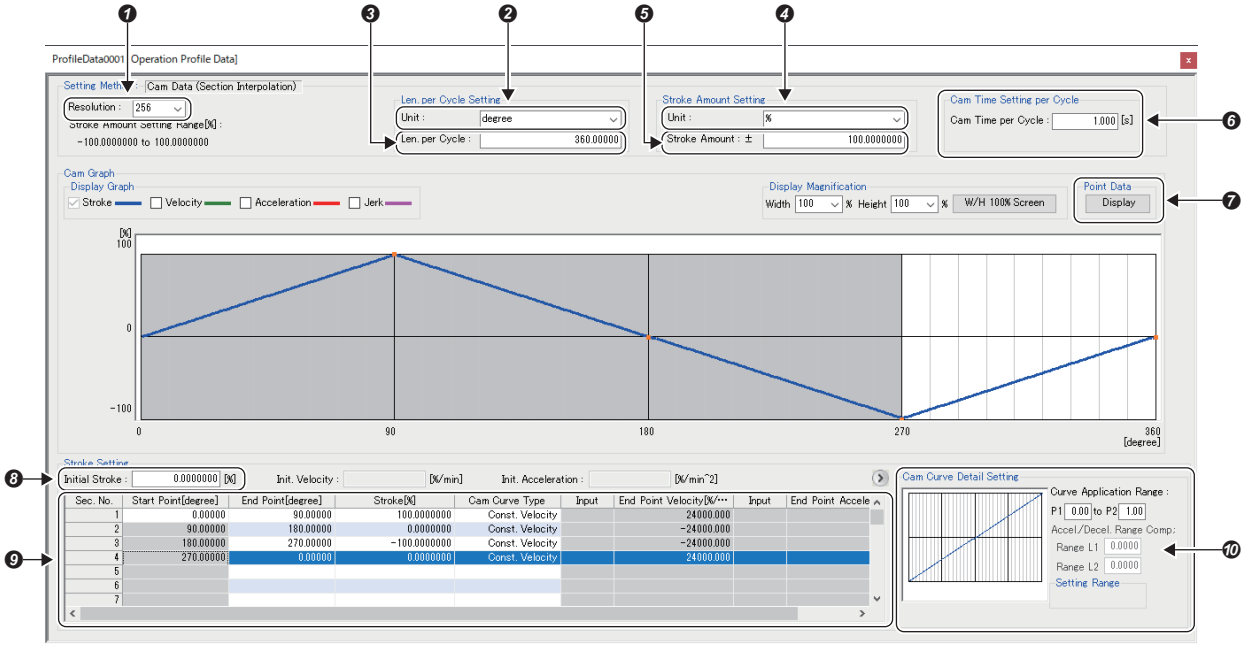


Setting item			Setting
Basic setting	Data type		Set "Operation Profile Data".
	Data name		Set any data name.
Detailed setting	Data format	Type	Set the type of data to be created. • Cam data • Rotary cutter
		Interpolation method specification	Set the interpolation method to match the cam to be created. • Linear interpolation • Section interpolation • Spline interpolation
	Expand setting	Auto expand	To expand the operation profile data automatically, set to "Yes". When set to "No", operation profile data must be stored in the open area by MC_CamTableSelect (Cam Table Selection) to use the operation profile data in the control.
		Profile ID	Set to any value within the range of 1 to 60000.
		Repetitive operation	Set to "Enable".
		Input absolute coordinate	Set to "Disable (Relative Coordinate)".
		Output absolute coordinate	Set to "Disable (Relative Coordinate)".

3. Set the operation profile data. Set as follows according to the set type and interpolation method specification.

- Cam data

■Section interpolation

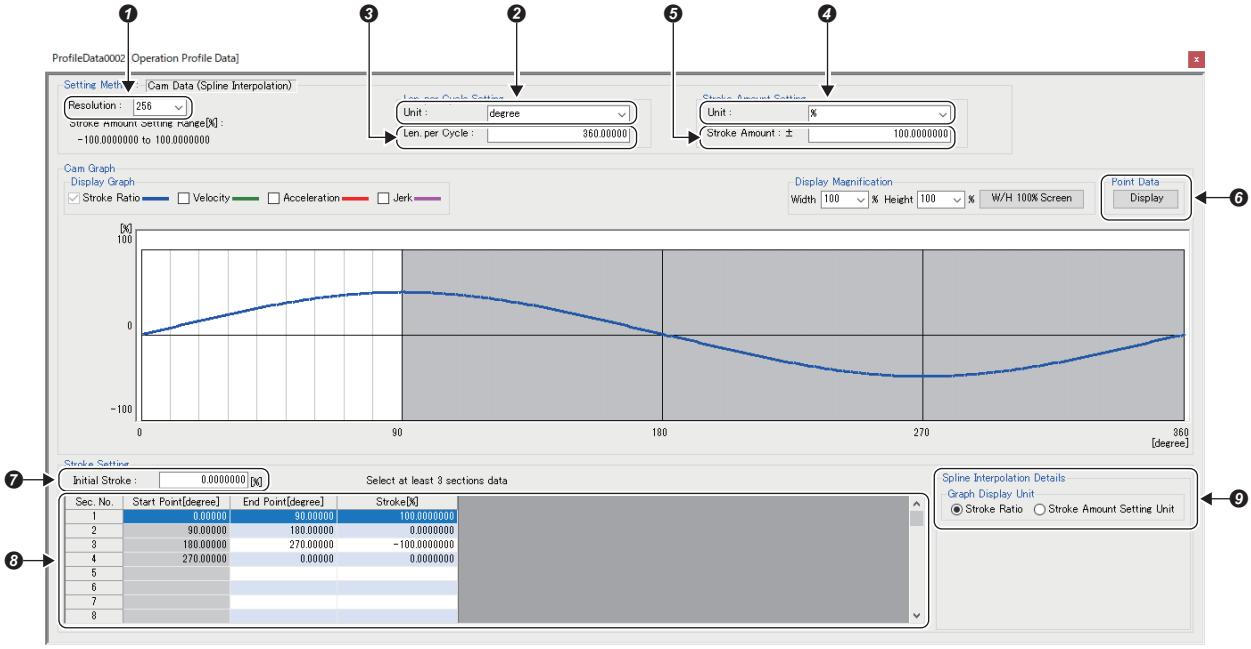


❶ Set the resolution to match the cam data to be created.
❷ Set to the same unit as that of the main shaft. *1
❸ Set to the same value as that set in the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). *1
❹ Set to any unit.
❺ When the unit is other than "%", set to 100 % stroke amount.
❻ Use when cam curve type is set to "5th Curve (Adj.)".
❼ Click the [Display] button of the point data to check the stroke data of the open area.
❽ Set to "0.0".
❾ Set the input value and the output value to match the cam data to be created. *2
❿ Set the detailed settings to match the cam data to be created. *2

*1 Although the setting is ignored in advanced synchronous control, set this item in order to match the setting window and the actual cam operation.

*2 For details, refer to the following.
☞ Page 827 Cam data

■Spline interpolation

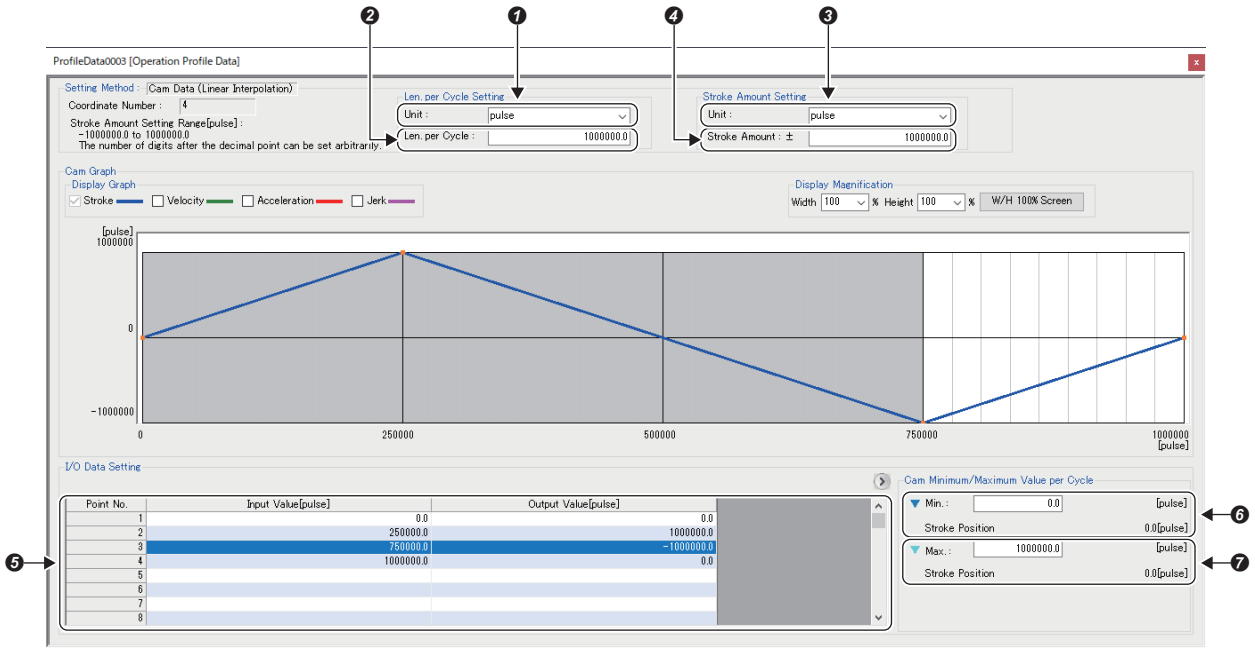


❶ Set the resolution to match the cam data to be created.
❷ Set to the same unit as that of the main shaft. *1
❸ Set to the same value as that set in the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle). *1
❹ Set to any unit.
❺ When the unit is other than "%", set to 100 % stroke amount.
❻ Click the [Display] button of the point data to check the stroke data of the open area.
❼ Set to "0.0".
❽ Set the input value and the output value to match the cam data to be created. *2
❾ Set the detailed settings to match the cam data to be created.

*1 Although the setting is ignored in advanced synchronous control, set this item in order to match the setting window and the actual cam operation.

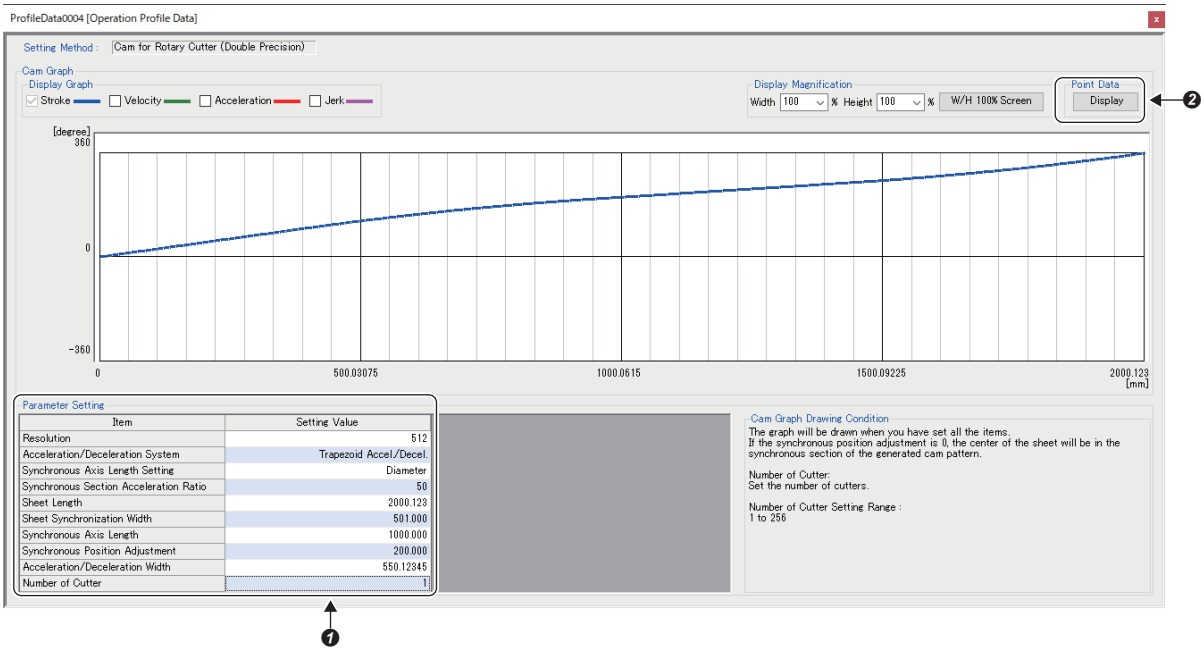
*2 For details, refer to the following.
☞ Page 827 Cam data

■Linear interpolation



❶ Set the unit of the axis to be set as the main shaft.
❷ Set to the same value as that set in the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle).
❸ Set the unit of the axis to be set as the output axis.
❹ Set to a value equal to or more than the maximum value of the output value in the I/O data.
❺ Set the input value and the output value to match the cam data to be created.
❻ Set to "0.0".
❼ Set to the setting value of the Length per cycle (AdvOutputName.Pr.Cam.LengthPerCycle).

• Rotary cutter



❶ Set it to match the cam data to be created.
❷ Click the [Display] button of the point data to check the stroke data of the open area.

Precautions

- When rewriting the open area during control by using the Profile Write (MCv_WriteProfileData), depending on the waveform pattern, the stroke value may change rapidly, causing an impact to be applied to the machine. Create operation profile data so that the waveform before and after the change does not become discontinued.
- For operation profile data format that can be used in the advanced synchronous control, refer to the following. If an unavailable operation profile data format is used in the advanced synchronous control, Operation Profile Data Settings Incorrect Under Advanced Synchronous Control (error code: 1B2AH) will occur.

☞ Page 826 Operation profile data types

- If the Cam No. (AdvOutputName.Pr.Cam.CamNo) is changed during advanced synchronous control in the following cases, a warning occurs, and control continues with the cam data before the change.

Description	Event code
A value out of range for Cam No. (AdvOutputName.Pr.Cam.CamNo) was set.	Out of Advanced Synchronous Control Variable Range Warning (event code: 0D3FH)
The cam table does not exist.	No Cam Table Warning (event code: 0D44H)
A value that cannot be used in advanced synchronous control was set in the operation profile data.	Operation Profile Data Settings Incorrect Under Advanced Synchronous Control Warning (event code: 0D46H)
A value which exceeds the resolution was set to the cam starting point.	Operation Profile Data Settings Incorrect Under Advanced Synchronous Control Warning (event code: 0D46H)
Failed to acquire the add-on ProfileControl.	Add-on Acquisition Failure Warning (event code: 0D47H)

Synchronous control change function

While MCv_AdvancedSync (Advanced Synchronous Control) is activated, this function can be used to change the cam reference position, the current position per cycle, and the current position per cycle after main shaft/auxiliary shaft gear during synchronous control.

The following methods exist for the synchronous control change function. (☞ Page 987 Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand))

Synchronous control change command	Application	Output axis operation
Cam reference position movement	Adjust the cam reference position by the movement amount.	Operated
Change current position per cycle	Change the current position per cycle.	None
Change current position per cycle after main shaft gear	Change the current position per cycle after main shaft gear.	None
Change current position per cycle after auxiliary shaft gear	Change the current position per cycle after auxiliary shaft gear.	None
Current position per cycle movement	Adjust the phase of the cam set position by the movement amount.	Operated

Cam monitor of output axis monitor data (AdvOutputName.Md.Cam.)

Variable name	Name	Import*1	Data type*1	Monitor value
SyncControlChangeStatus	Synchronous control change status	Operation cycle (FB is starting)	INT	• -1: Synchronous control change failure • 0: Synchronous control change not requested • 1: Synchronous control change in progress • 2: Synchronous control change complete

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Synchronous control change status (AdvOutputName.Md.Cam.SyncControlChangeStatus)

- When Synchronous control change request (AdvOutputName.Cd.Cam.SyncControlChangeRequest) is set to "TRUE (Synchronous control change requested)", "1: Synchronous control change in progress" is stored to Synchronous control change status (AdvOutputName.Md.Cam.SyncControlChangeStatus) during synchronous control change processing, and "2: Synchronous control change complete" is stored after processing.
- Synchronous control change status (AdvOutputName.Md.Cam.SyncControlChangeStatus) is "0: Synchronous control change not requested" according to the following conditions.
  - Synchronous control change request (AdvOutputName.Cd.Cam.SyncControlChangeRequest) is set to "FALSE (Synchronous control change not requested".
  - Advanced synchronous control is stopped.
- When Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand) and Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange) are set out of range, and Synchronous control change request (AdvOutputName.Cd.Cam.SyncControlChangeRequest) is set to "TRUE (Synchronous control change requested)", "-1: Synchronous control change failure" is stored.

Cam control data of output axis control data (AdvOutputName.Cd.Cam.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
SyncControlChangeRequest	Synchronous control change request	Operation cycle (FB is starting)	BOOL	• FALSE: Synchronous control change not requested • TRUE: Synchronous control change requested	FALSE
SyncControlChangeCommand	Synchronous control change command		INT (MC_SYNC_CHANGE_COMMAND)	• 0: Cam reference position movement (ReferenceSetPositionMovement) • 1: Change current position per cycle (ChangeCurrentPositionPerCycle) • 2: Change current position per cycle after main shaft gear (ChangeMasterGearPositionPerCycle) • 3: Change current position per cycle after auxiliary shaft gear (ChangeAuxGearPositionPerCycle) • 4: Current position per cycle movement (PositionPerCycleMovement)	0: Cam reference position movement (ReferenceSetPositionMovement)
SyncControlChange	Synchronous control change value		LREAL	-2147483648.0 to 2147483647.0	0.0
SyncControlReflectionTime	Synchronous control change value reflection time		WORD (UINT)	0 to 65535 [ms]	0 [ms]

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

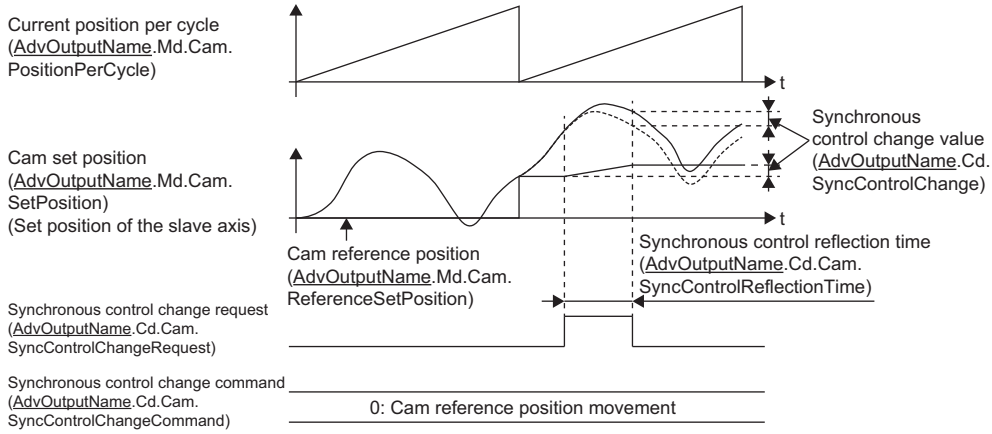
■Synchronous control change request (AdvOutputName.Cd.Cam.SyncControlChangeRequest)

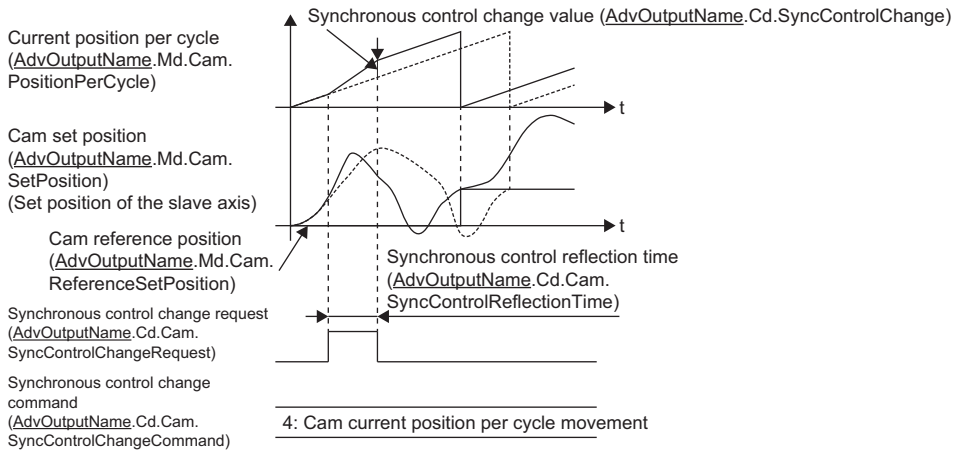
The synchronous control change is requested.

When set to "TRUE (Synchronous control change requested)", Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand) is executed.

■Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand)

Set the synchronous control change command.

Synchronous control change command	Description
0: Cam reference position movement (ReferenceSetPositionMovement)	This command is executed to move the cam reference position through adding the setting movement amount of Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange). The movement amount is added after being averaged in Synchronous control change reflection time (AdvOutputName.Cd.Cam.SyncControlReflectionTime). Set a long reflection time when a large movement amount is used since the cam set position moves with the movement amount.  • When Synchronous control change request (AdvOutputName.Cd.Cam.SyncControlChangeRequest) is reset to "FALSE (Synchronous control change not requested)" while executing the cam reference position movement, operation is stopped midway. Even if the cam reference position movement command is executed again, the remaining movement amount is not reflected, and the control is performed with a new Synchronous control change value (AdvOutputName.Cd.SyncControlChange) imported. • If synchronous control is ended while the cam reference position movement is being executed, operation stops midway. Even if synchronous control is restarted, the remaining movement amount of the cam reference position is not reflected.
1: Change current position per cycle (ChangeCurrentPositionPerCycle)	The current position per cycle is changed to Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange). The cam reference position will be also changed to correspond to the changed current position per cycle. This operation is completed in one operation cycle.
2: Change current position per cycle after main shaft gear (ChangeMasterGearPositionPerCycle)	The current position per cycle after main shaft gear is changed to the value set in Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange). This operation is completed in one operation cycle. Clutch control is not executed if the current position per cycle after main shaft gear (the position before being changed and after being changed) has already passed through the ON/OFF address in address mode.
3: Change current position per cycle after auxiliary shaft gear (ChangeAuxGearPositionPerCycle)	The current position per cycle after auxiliary shaft gear is changed to the value set in Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange). This operation is completed in one operation cycle. Clutch control is not executed if the current position per cycle after auxiliary shaft gear (the position before being changed and after being changed) has already passed through the ON/OFF address in address mode.

Synchronous control change command	Description
4: Current position per cycle movement (PositionPerCycleMovement)	This command is executed to move the current position per cycle through adding the setting movement amount of Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange). The movement amount is added after being averaged in Synchronous control change reflection time (AdvOutputName.Cd.Cam.SyncControlReflectionTime). Set a long reflection time when a large movement amount is used since the cam set position moves with the movement amount. 

■Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange)

Set the change value for synchronous control change processing.

Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand)	Synchronous control change value (AdvOutputName.Cd.Cam.SyncControlChange)		
	Setting range	Unit	Setting details
0: Cam reference position movement (ReferenceSetPositionMovement)	-2147483648.0 to 2147483647.0	Position units of the axis set in the output axis	• Set the movement amount of the cam reference position. • It moves within the range from -2147483648.0 to 2147483647.0.
1: Change current position per cycle (ChangeCurrentPositionPerCycle)			• Set the change current position per cycle. • The setting value is converted within the range from "0.0 to (length per cycle - 0.00001)".
2: Change current position per cycle after main shaft gear (ChangeMasterGearPositionPerCycle)			
3: Change current position per cycle after auxiliary shaft gear (ChangeAuxGearPositionPerCycle)			
4: Current position per cycle movement (PositionPerCycleMovement)			• Set the movement amount of the current position per cycle. • It moves within the range from -2147483648 to 2147483647.

■Synchronous control change value reflection time (AdvOutputName.Cd.Cam.SyncControlReflectionTime)

Set the reflection time for synchronous control change processing.

Synchronous control change command (AdvOutputName.Cd.Cam.SyncControlChangeCommand)	Setting details for Synchronous control change reflection time (AdvOutputName.Cd.Cam.SyncControlReflectionTime)
0: Cam reference position movement (ReferenceSetPositionMovement)	Set the time to reflect the movement amount to the cam reference position.
1: Change current position per cycle (ChangeCurrentPositionPerCycle)	Setting not required.
2: Change current position per cycle after main shaft gear (ChangeMasterGearPositionPerCycle)	
3: Change current position per cycle after auxiliary shaft gear (ChangeAuxGearPositionPerCycle)	
4: Current position per cycle movement (PositionPerCycleMovement)	The time to reflect the movement amount to the current position per cycle.

Precautions

The following are precautions when operating an output axis.

- Do not set digits after the decimal point in the Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue) and Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) of the positioning range of the axis set in the output axis Axis information (AdvOutputName.Axis). If set, an error will occur with the value output to the slave axis and the Set position (AxisName.Md.SetPosition) of the axis set to the output axis in synchronous control when the permissible value is exceeded.
- When the intermediate result of the movement amount calculated by each module exceeds the range of "-2147483648.0 to 2147483647.0", Advanced Synchronization Control Operation Overflow (error code: 1B23H) occurs. Check the function of the module in which the overflow occurred with the detail code. The detail codes of Advanced Synchronous Control Operation Overflow (error code: 1B23H) are shown below.

Function of the module in which the overflow occurred	Detail code	Action
Composite main shaft gear	0001H	Reduce the speed of the main shaft main input axis and the main shaft sub input axis.
Main shaft gear	0002H	Reduce the gear ratio (gear numerator/gear denominator).
Main shaft clutch	0003H	Reduce the speed of the input axis when a clutch is used.
Main shaft module speed change gear	0004H	Reduce the speed change ratio (speed change ratio numerator/speed change ratio denominator).
Auxiliary shaft	0005H	Reduce the set velocity of the axis set as the auxiliary shaft.
Auxiliary shaft gear	0006H	Reduce the gear ratio (gear numerator/gear denominator).
Auxiliary shaft clutch	0007H	Reduce the speed of the input axis when a clutch is used.
Auxiliary shaft module speed change gear	0008H	Reduce the speed change ratio (speed change ratio numerator/speed change ratio denominator).
Composite auxiliary shaft gear	0009H	Reduce the input value of the main shaft and the auxiliary shaft.
Output axis speed change gear	000AH	Reduce the speed change ratio (speed change ratio numerator/speed change ratio denominator).
Output axis phase compensation	000BH	Reduce the value of phase compensation advance time or increase the phase compensation time constant.
Output axis smoothing	000CH	Review the setting value of the time constant so that the number of smoothing steps reduces or increase the setting value of the operation cycle.
Output axis synchronous control change	000DH	Reduce the synchronous control change value or increase the synchronous control change reflection time.
Output axis cam calculation	000EH	Review the cam waveform so that the stroke does not vary rapidly.

Required object data

The following shows the starting availability condition with or without PDO mapping when using it as the Output axis (AdvOutputName.Axis) of MCv_AdvancedSync (Advanced Synchronous Control).

PDO mapping necessary/not necessary	
Target position	**Position actual Value**
Necessary	Not required
Not necessary	Necessary
Not necessary	Not necessary

33.5 Synchronous Control Initial Position

The synchronous control monitor data can be aligned to a set position when starting MCv_AdvancedSync (Advanced Synchronous Control), as the initial position for synchronous control. Restoration is executed when MCv_AdvancedSync (Advanced Synchronous Control) is started.

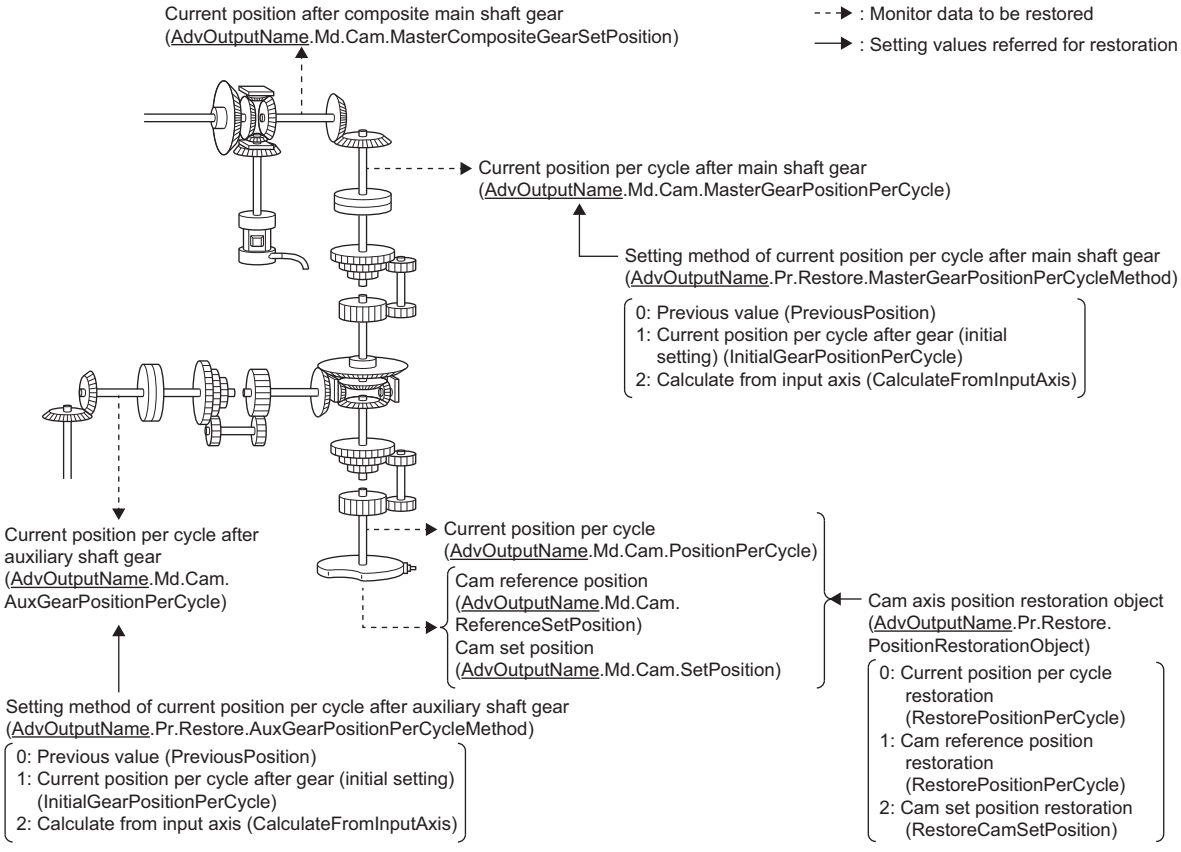
The alignment to a synchronous control initial position is useful for restoring a system based on the last control status along with restarting synchronous control after cancelling midway.

The following monitor data are restored to a synchronous control initial position. To restore the data, the axes set in the axis information of the input axis and output axis must be set to an absolute position detection system.

Synchronous control monitor data		The position when starting synchronous control
Name	**Variable name**	
Current position after composite main shaft gear	AdvOutputName.Md.Cam.MasterCompositeGearSetPosition	Restored to a position based on the current position of the input axis of the main shaft.
Current position per cycle after main shaft gear	AdvOutputName.Md.Cam.MasterGearPositionPerCycle	Restored according to the Setting method of current position per cycle after main shaft gear (AdvOutputName.Pr.Restore.MasterGearPositionPerCycleMethod).
Current position per cycle after auxiliary shaft gear	AdvOutputName.Md.Cam.AuxGearPositionPerCycle	Restored according to the Setting method of current position per cycle after auxiliary shaft gear (AdvOutputName.Pr.Restore.AuxGearPositionPerCycleMethod).
Current position per cycle	AdvOutputName.Md.Cam.PositionPerCycle	Restored according to the Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject).
Cam reference position	AdvOutputName.Md.Cam.ReferenceSetPosition	
Cam set position*1	AdvOutputName.Md.Cam.SetPosition	

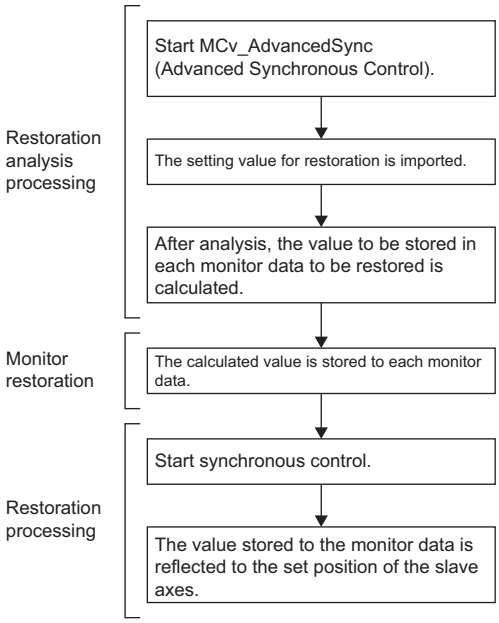
*1 The Set position (AxisName.Md.SetPosition) of the axis set as the output axis of the advanced synchronous control is calculated based on the cam set position.

The relationship between each module, the monitor data to be restored, and the setting values referred to for restoration is shown below.



Restoration processing method

The restoration processing method is shown below. Restoration is executed in the following order: restoration analysis, monitor restoration, and restoration processing.



Backup data management for advanced synchronous control

For advanced synchronous control, the initial value of synchronous control monitor data and the data used to calculate and restore the synchronous control initial position are periodically saved to the latch drive as "abs_advsync.bin" file.
In order to back up data, the add-on AbsSystem must be valid.
When the axes set in the axis information of the input axis and output axis are not set to an absolute position detection system, backup data is not generated.
An "abs_advsync.bin" file of size up to the size specified in the Maximum backup RAM size (AddonSystem.PrConst.AddonMemory.BackupRamSizeMax) can be saved. If the total size of the backup data exceeds the limit for backup data when adding the input axis and output axis, the variable that exceeds the limit will not be added.
When the total size of the backup data exceeds the limit, Advanced Synchronous Control Backup Memory Insufficient Warning (event code: 00F18H) occurs.
The backup data size for an input axis and an output axis is shown below.

Axis type	Backup data size (k byte)
Input axis	0.1
Output axis	0.1

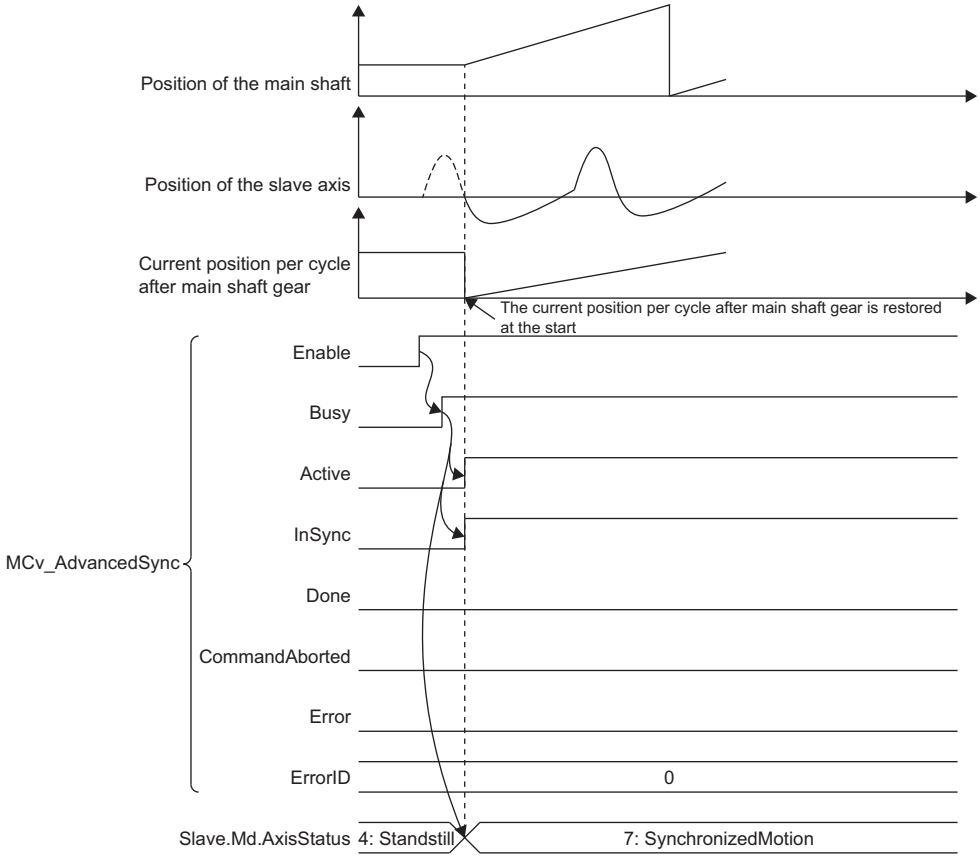
When turning the system power on again after setting a smaller value set in the Maximum backup RAM size (AddonSystem.PrConst.AddonMemory.BackupRamSizeMax) than the last time the system was powered on, the "abs_advsync.bin" file will be regenerated, and all backup data will be cleared. As the backup data is linked to the label IDs of the input axis and output axis, when the target axis No. specified in the input axis labels and output axis labels is changed before/after the system is powered on again, restoration cannot be performed correctly because the links are broken. If restoration cannot be performed correctly, Advanced Synchronous Control Restoration Incorrect Warning (event code: 0D40H) occurs.

Restoration method for current position after composite main shaft gear, current position per cycle after main shaft gear, and current position per cycle after auxiliary shaft gear at start of synchronous control

The initial position alignment and restoration of the current position after composite main shaft gear, the current position per cycle after main shaft gear, and the current position per cycle after auxiliary shaft gear are executed when MCv_AdvancedSync (Advanced Synchronous Control) is started.

Ex.

When the current position per cycle after main shaft gear is restored



Restoration method

The current position after composite main shaft gear, the current position per cycle after main shaft gear, and the current position per cycle after auxiliary shaft gear are restored as follows according to the operations executed on the axes assigned to the main shaft or auxiliary shaft before starting MCv_AdvancedSync (Advanced Synchronous Control).

Operation of the axes assigned to the main shaft and auxiliary shaft (before starting MCv_AdvancedSync (Advanced Synchronous Control))	Absolute position management setting (AxisName.PrConst.PosRestoration_AbsPosEnable) of the axes set in the input axis Axis information	
	Absolute position detection system valid	Absolute position detection system invalid
Execution of MC_Home (Home Position Return)	Restoration method (1)	
Execution of MC_SetPosition (Current Position Change)	Restoration method (1)	
Transition of the Active status (AdvInputName.Md.ActiveStatus) of input axis from"0: Not connected" to "1: Input axis enabled".	Restoration method (2)	Restoration method (1)
Others	Restoration method (2)	

Precautions

- The input axis value is rounded to a value within the positioning range, and the difference between this value and the current position of the input axis when synchronous control was last conducted is used as the change amount in "Restoration method (2)".
- When the input axis movement since synchronous control was last conducted exceeds "±10000000000.0 [input axis unit]" before synchronous control starts, the change amount cannot be calculated correctly.

■Restoration method (1)

Setting item	Restoration method	Calculation formula
Current position after composite main shaft gear	The new current position after composite main shaft gear is calculated based on the input axis cumulative current position of the main shaft.	Input direction of composite main shaft gear*1 × Cumulative current position of the input axis (main shaft)
Current position per cycle after main shaft gear	The new current position per cycle after main shaft gear is calculated based on the current position after composite main shaft gear.	Main shaft gear ratio*2 × Current position after composite main shaft gear
Current position per cycle after auxiliary shaft gear	The new current position per cycle after auxiliary shaft gear is calculated based on the input axis cumulative current position of the auxiliary shaft.	Auxiliary shaft gear ratio*2 × Cumulative current position of the input axis (auxiliary shaft)

*1 The "Input direction of composite main shaft gear" value in the formula is as follows according to the Composite main shaft gear (AdvOutputName.Pr.Gear.MasterCompositeGear).

Composite main shaft gear (AdvOutputName.Pr.Gear.MasterCompositeGear)	Setting value for "Input direction of composite main shaft gear"
No input (H□□□0)	0
Input+ (H□□□1)	1
Input- (H□□□2)	-1

*2 The gear ratio of the main and auxiliary shafts is calculated by the following formula.

Item	Calculation formula
Main shaft gear ratio	$\frac{\text{Main shaft gear: Numerator (AdvOutputName.Pr.Gear.MasterNumerator)}}{\text{Main shaft gear: Denominator (AdvOutputName.Pr.Gear.MasterDenominator)}}$
Auxiliary shaft gear ratio	$\frac{\text{Auxiliary shaft gear: Numerator (AdvOutputName.Pr.Gear.AuxNumerator)}}{\text{Auxiliary shaft gear: Denominator (AdvOutputName.Pr.Gear.AuxDenominator)}}$

■Restoration method (2)

The movement amount of the main shaft, sub input axis, or auxiliary shaft from the last synchronous control session is reflected to the current position after composite main shaft gear, the current position per cycle after main shaft gear, and the current position per cycle after auxiliary shaft gear.

Setting item	Restoration method	Calculation formula
Current position after composite main shaft gear	The movement amount of the main shaft from the last synchronous control session is reflected to the current position after composite main shaft gear.	Current position after composite main shaft gear at the last synchronous control session + Input direction of composite main shaft gear × Amount of change in the cumulative current position of input axis (main shaft) from the last synchronous control session
Current position per cycle after main shaft gear	The movement amount from the last synchronous control session is reflected to the current position per cycle after main shaft gear. The movement amount of the main shaft from the last synchronous control session is reflected to the current position after composite main shaft gear and the current position per cycle after main shaft gear.	Current position per cycle after main shaft gear at the last synchronous control session + Main shaft gear ratio × Amount of change in the current position after composite main shaft gear from the last synchronous control session
Current position per cycle after auxiliary shaft gear	The movement amount from the last synchronous control session is reflected to the current position per cycle after auxiliary shaft gear. The movement amount of the auxiliary shaft from the last synchronous control session is reflected to the current position per cycle after auxiliary shaft gear.	Current position per cycle after auxiliary shaft gear at the last synchronous control session + Auxiliary shaft gear ratio × Amount of change in the cumulative current position of input axis (auxiliary shaft) from the last synchronous control session

Point

As shown below, the expression "at the last synchronous control session" refers to the state immediately before MCv_AdvancedSync (Advanced Synchronous Control) is interrupted and Synchronization status (AdvOutputName.Md.SyncStatus) changes to "0: Not synchronizing".

- Immediately before MCv_AdvancedSync (Advanced Synchronous Control) is stopped by a stop command or error.
- Immediately before the power supply of the motion system is turned off

Cam axis position at synchronous control start

The cam axis position is composed of the relationship of the three positions "Current position per cycle", "Cam reference position", and "Cam set position". The remaining position can be restored by determining two positions when starting MCv_AdvancedSync (Advanced Synchronous Control). Determine which position to restore by selecting one of the following shown below in the Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject).

- 0: Current position per cycle restoration (RestorePositionPerCycle)
- 1: Cam reference position restoration (RestoreReferenceSetPosition)
- 2: Cam set position restoration (RestoreCamSetPosition)

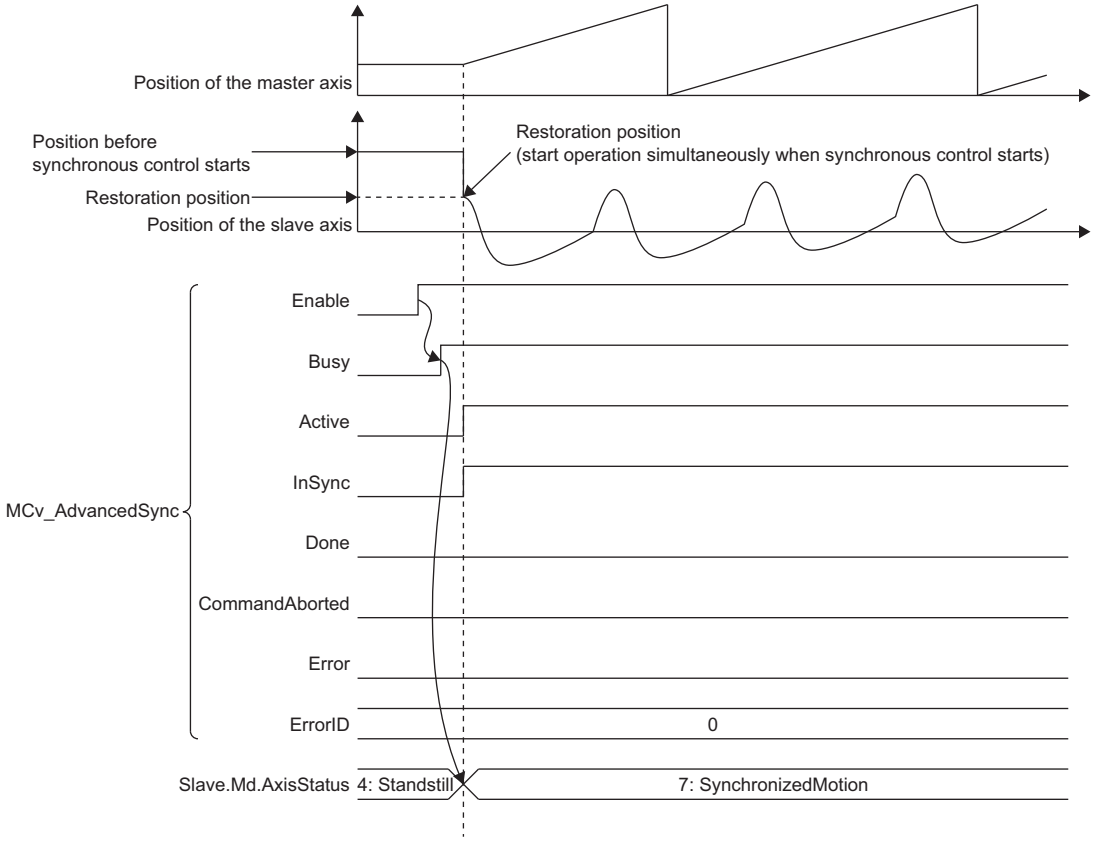
The parameters that need to be set for the cam axis position restoration are shown below. (For details on the settings, refer to synchronous control initial position parameter.) (☞ Page 1005 Variables related to synchronous control initial position)

○: Required, △: Required when using initial setting value, —: Not required

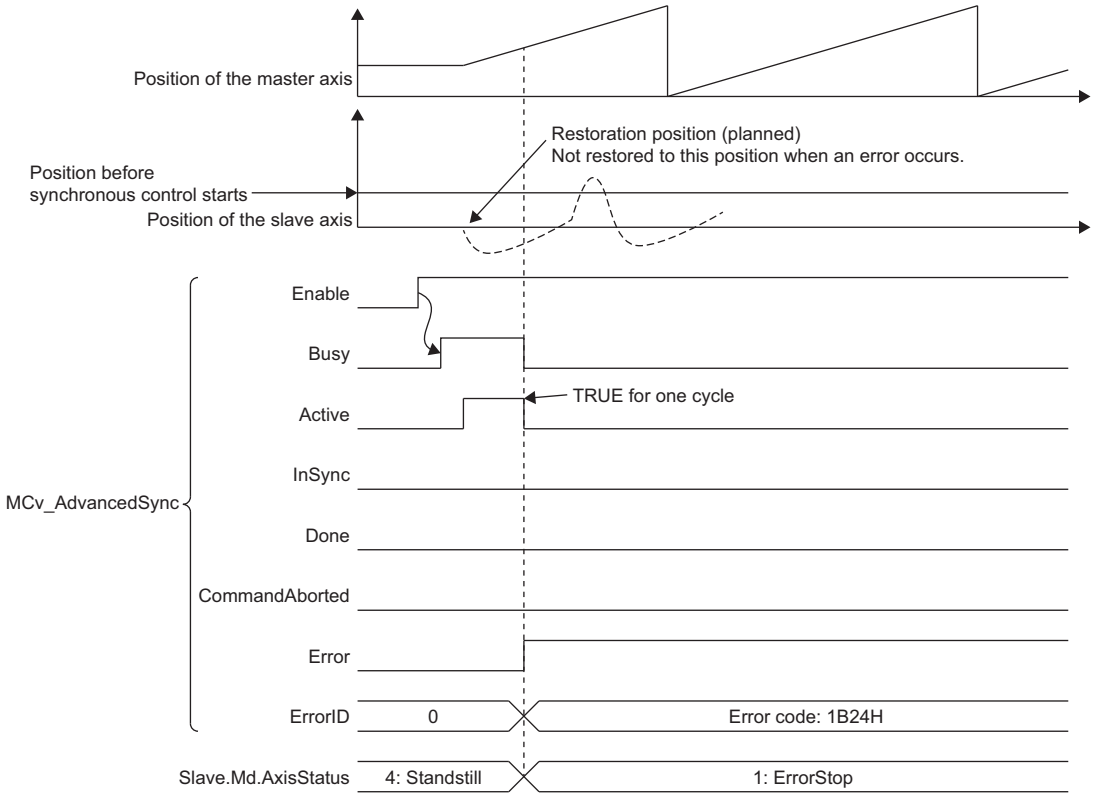
Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject)	Setting method of cam reference position (AdvOutputName.Pr.Restore.ReferenceSetPositionMethod)	Cam reference position (initial setting) (AdvOutputName.Pr.Restore.InitialReferenceSetPosition)	Setting method of current position per cycle (AdvOutputName.Pr.Restore.PositionPerCycleMethod)	Current position per cycle (initial setting) (AdvOutputName.Pr.Restore.InitialPositionPerCycle)	Restoration processing details
0: Current position per cycle restoration (RestorePositionPerCycle)	○	△	—	○ (Used as search starting position)	Restores "current position per cycle" based on "cam reference position" and "cam set position".
1: Cam reference position restoration (RestoreReferenceSetPosition)	—	—	○	△	Restores "cam reference position" based on "current position per cycle" and "cam set position".
2: Cam set position (RestoreCamSetPosition)	○	△	○	△	Restores "cam set position" based on "current position per cycle" and "cam reference position".

The initial position alignment and restoration of the cam axis position are executed when MCv_AdvancedSync (Advanced Synchronous Control) is started.

- A timing chart when cam restoration is normally executed



- A timing chart when an error occurs in cam output axis restoration

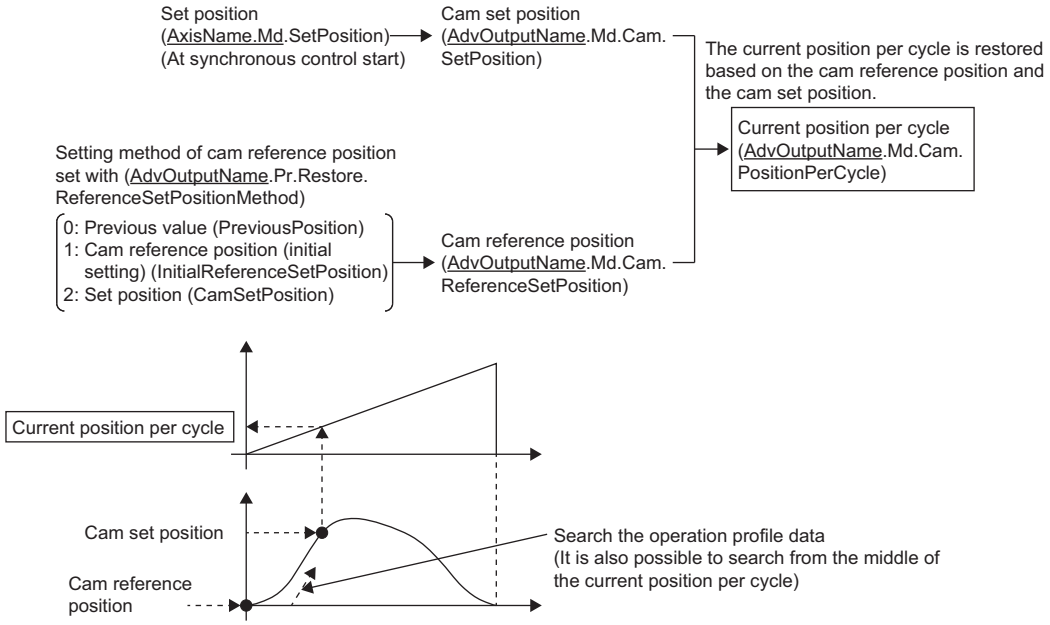


Current position per cycle restoration

If synchronous control is attempted with Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject) set to "0: Current position per cycle restoration (RestorePositionPerCycle)", the current position per cycle will be restored based on the cam reference position and the cam set position, and MCv_AdvancedSync (Advanced Synchronous Control) will start.

Set the cam reference position to be used for restoration with a parameter. The cam set position uses the set position of the output axis set to the slave axis when MCv_AdvancedSync (Advanced Synchronous Control) starts.

The current position per cycle restoration is calculated by searching from the beginning to the end of the cam pattern for the corresponding current position per cycle. The starting position for searching the cam pattern is set with the Current position per cycle (initial setting) (AdvOutputName.Pr.Restore.InitialPositionPerCycle). (It can be searched from the return path in a two-way operation cam pattern.)



*1 The current position per cycle indicated by [ ] is restored.

- With a two-way operation cam pattern, if the corresponding current position per cycle is not found, Advanced Synchronous Control Restoration Disabled (error code: 1B24H) occurs, and MCv_AdvancedSync (Advanced Synchronous Control) cannot start.
- With a feed operation cam pattern, if the corresponding current position per cycle is not found in the first cycle, the cam reference position is changed automatically and the position is searched again.
- If the cam resolution is large, search processing may take a long time when starting synchronous control. For an approximate guide of the searching time, refer to the following.

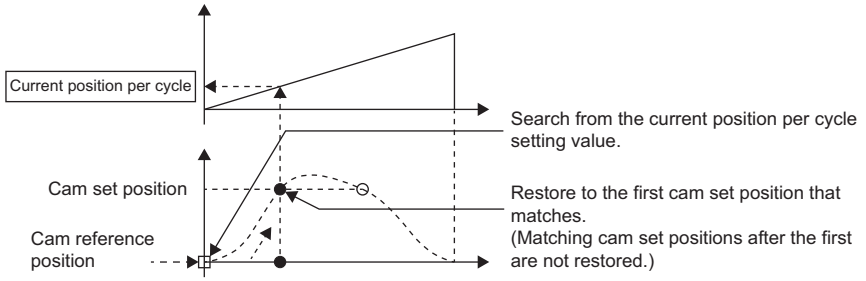
☞ Page 1008 Restoration time of the current position per cycle

- When the Ring counter lower limit value (AxisName.PrConst.RingCount_LowerValue) of the output axis positioning range is "0.0", the current position is not restored in a cam stroke range that crosses over "0.0", and Advanced Synchronous Control Restoration Disabled (error code: 1B24H) occurs. Execute the current position per cycle restoration within a cam stroke range between 0 and the Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) of the positioning range.
- When the difference between the cam reference position and the cam set position exceeds "10000000000.0" at restoration, the current position per cycle cannot be restored correctly. Adjust the values so that the difference between the cam reference position and the cam set position is smaller than "10000000000.0" for restoration.

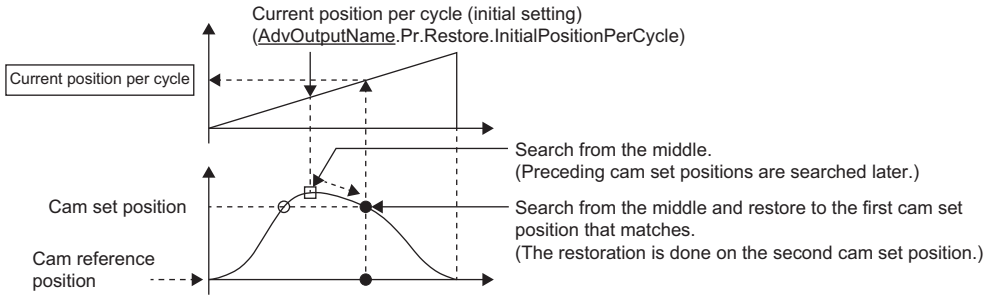
The following shows details of the current position per cycle restoration operation.

■Current position per cycle restoration operation with a "two-way operation cam pattern"

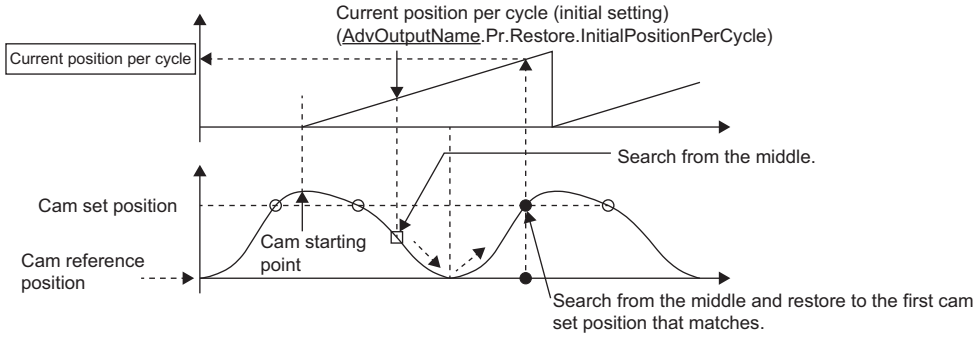
- Search from "Current position per cycle = 0" (Cam starting point = 0)



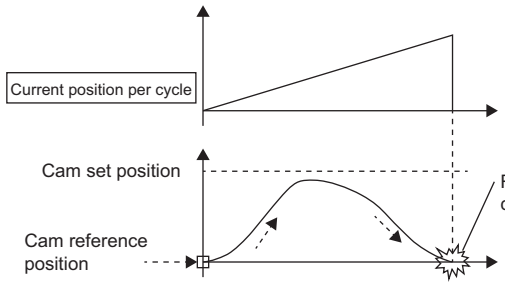
- Search from the middle of the current position per cycle (Cam starting point = 0)



- Search from the middle of the current position per cycle (Cam starting point ≠ 0)

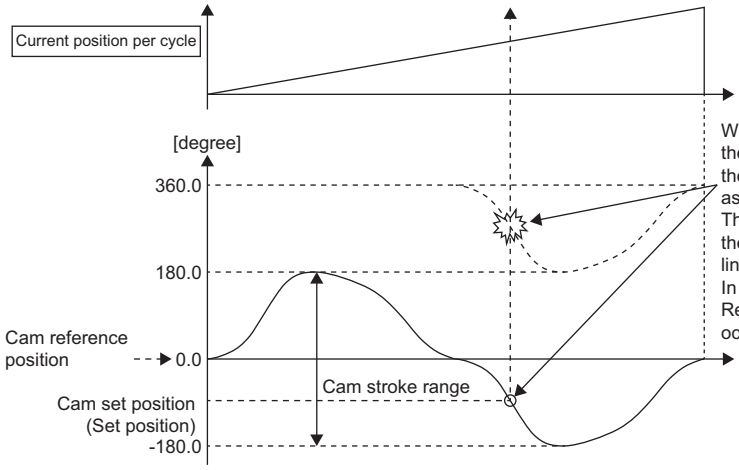


- The search fails
  - When a matching cam set position is not found



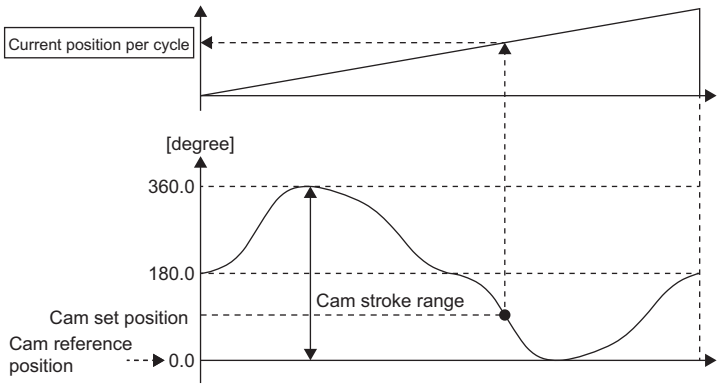
Restoration fails if there is no match found for the cam set position within one cycle.

  - When the current position restoration is executed in a cam stroke range that crosses over "0.0" (the positioning range is "0.0 to 360.0 degrees")



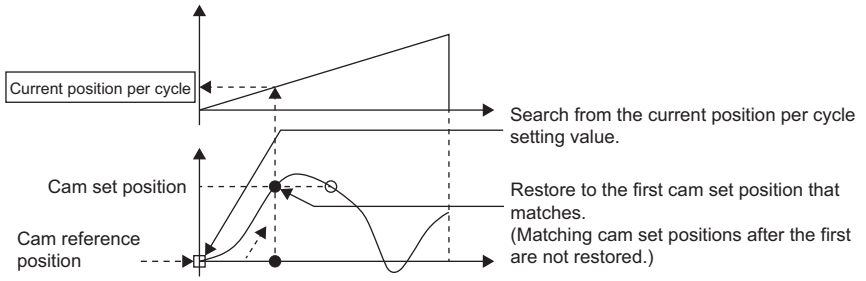
When the cam stroke amount is "180.0" and the positioning range is "0.0 to 359.99999", the cam stroke range is "-180.0 to 179.99999" as shown by the solid line in the graph.
The current position per cycle is restored to the cam set position as shown by the dotted line in the graph.
In this case, "Advanced Synchronous Control Restoration Disabled (error code: 1B24H)" occurs, and the search fails.

  - In the case above, execute current position restoration within a cam stroke range of the positioning range (0.0 to 360.0 degrees).

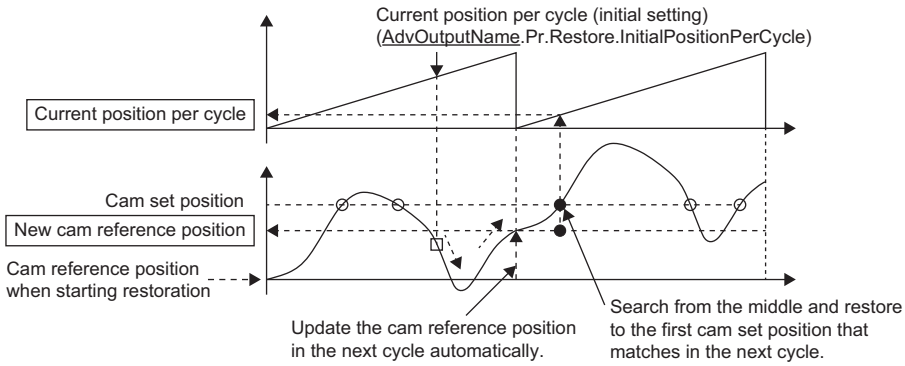


■Current position per cycle restoration operation with a "feed operation cam pattern"

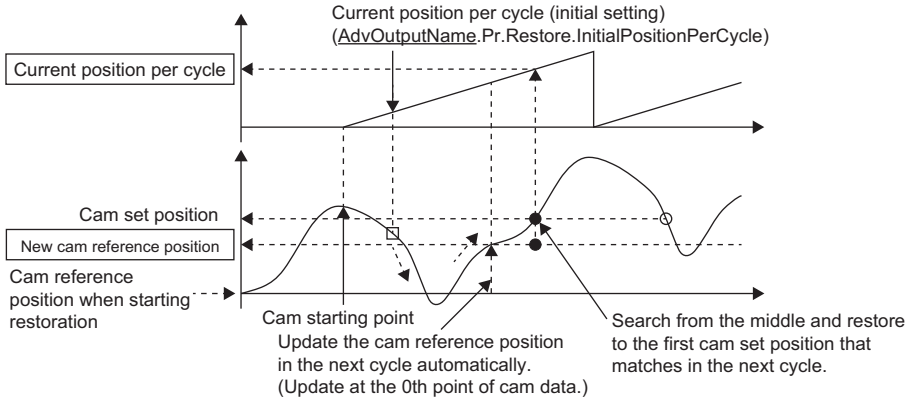
- Search from "Current position per cycle = 0" (Cam starting point = 0)



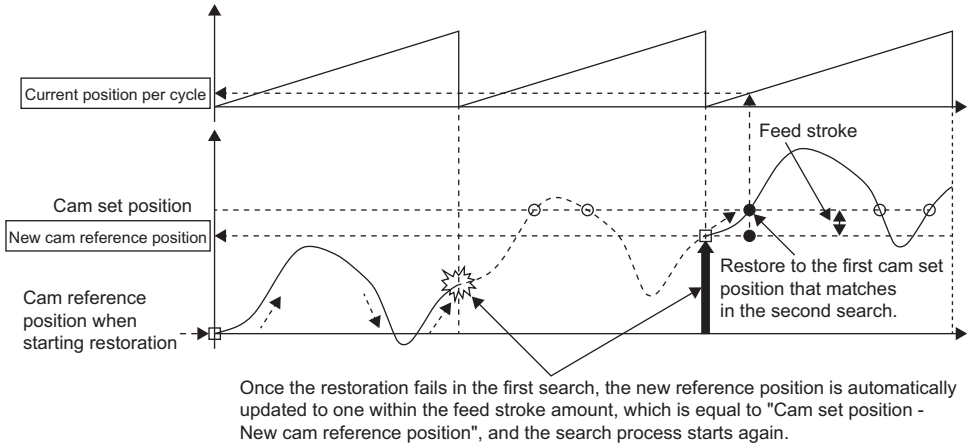
- Search from the middle of the current position per cycle (Cam starting point = 0)



- Search from the middle of the current position per cycle (Cam starting point ≠ 0)



- The first search fails and a search begins for the second time



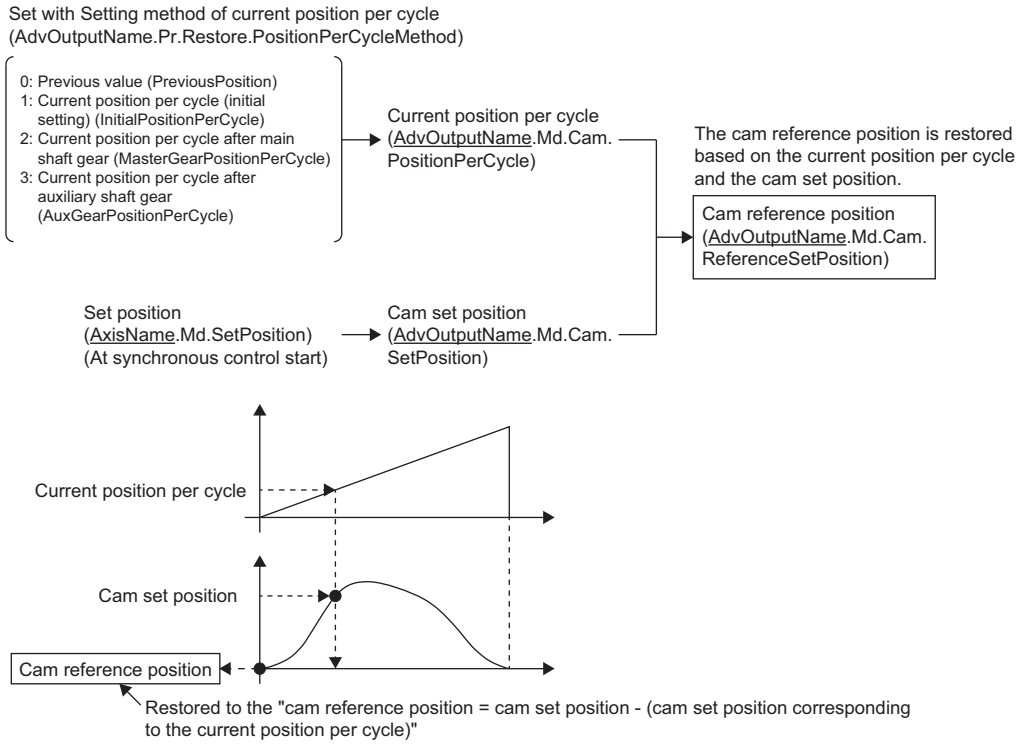
Once the restoration fails in the first search, the new reference position is automatically updated to one within the feed stroke amount, which is equal to "Cam set position - New cam reference position", and the search process starts again.

Point

If the first search fails, a second search may not be processed on the next cycle for a cam pattern with a feed stroke that is smaller than 100% of the stroke as above.
The intended current position per cycle can be found in the first search, by setting or positioning the cam reference position in advance.

Cam reference position restoration

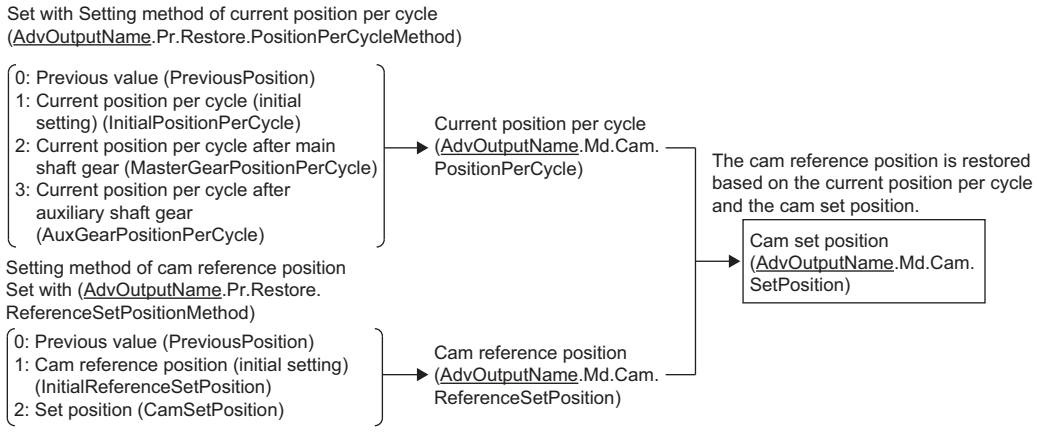
If synchronous control is attempted with Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject) set to "1: Cam reference position restoration (RestorePositionPerCycle)", the cam reference position will be restored based on the current position per cycle and the cam set position, and synchronous control will start. Set the current position per cycle to be used for restoration with the parameter.

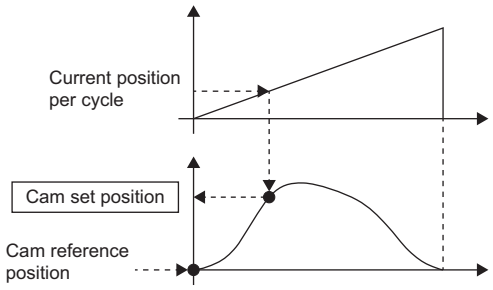


*1 The cam reference position indicated by [ ] is restored.

Cam set position restoration

If synchronous control is attempted with Cam axis position restoration object (AdvOutputName.Pr.Restore. PositionRestorationObject) set to "2: Cam set position restoration (RestoreCamSetPosition)", the cam set position will be restored based on the current position per cycle and the cam reference position, and synchronous control will start. Set the current position per cycle and cam reference position to be used for restoration with the parameter.





*1 The cam set position indicated by ☐ is restored.

Point

The cam moves to its restored cam set position immediately after starting synchronous control when the restored cam set position is different from the set position at synchronous control start.

■Cam set position restoration allowable movement setting value

When MCv_AdvancedSync (Advanced Synchronous Control) is started, if the difference between the restored cam set position and the set position of the slave axis is larger than the cam set position restoration allowable movement setting value, Advanced Synchronous Control Restoration Disabled (error code: 1B24H) occurs, and synchronous control cannot start. When using cam set position restoration, before starting MCv_AdvancedSync (Advanced Synchronous Control), calculate the corresponding cam set position with MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation), MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation), or synchronous control analysis mode. Start synchronous control after positioning to the correct cam set position.

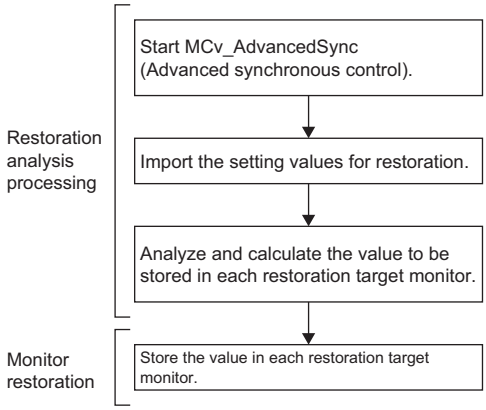
Synchronous control analysis mode

When MCv_AdvancedSync (Advanced Synchronous Control) is started, the synchronous control analysis mode only performs an analysis on synchronous control restoration. This mode is used to check the synchronous position of the output axis for the synchronous position alignment before starting MCv_AdvancedSync (Advanced Synchronous Control). After starting MCv_AdvancedSync (Advanced Synchronous Control), when synchronous control analysis mode setting (Options (Options): Bit 16) of MCv_AdvancedSync (Advanced Synchronous Control) is "TRUE (Enabled)", operation is performed in synchronous control analysis mode.
When analysis is completed, Execution completion (Done) of MCv_AdvancedSync (Advanced Synchronous Control) turns to "TRUE", and the Output axis monitor data (AdvOutputName.Md.☐) that are not in Synchronization status (AdvOutputName.Md.SyncStatus) are all updated. The following Output axis monitor data (AdvOutputName.Md.☐) are also updated to the restored values. In this case, synchronous control analysis mode setting (Options (Options): Bit 16) of MCv_AdvancedSync (Advanced Synchronous Control) will not turn to "FALSE (Disabled)". When starting synchronous control without using the synchronous control analysis mode, turn synchronous control analysis mode setting (Options (Options): Bit 16) of MCv_AdvancedSync (Advanced Synchronous Control) to "FALSE (Disabled)".

Output axis monitor data (AdvOutputName.Md.☐)
• Current position after composite main shaft gear (AdvOutputName.Md.Cam.MasterCompositeGearSetPosition) • Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) • Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) • Current position per cycle (AdvOutputName.Md.Cam.PositionPerCycle) • Cam reference position (AdvOutputName.Md.ReferenceSetPosition) • Cam set position (AdvOutputName.Md.Cam.SetPosition)

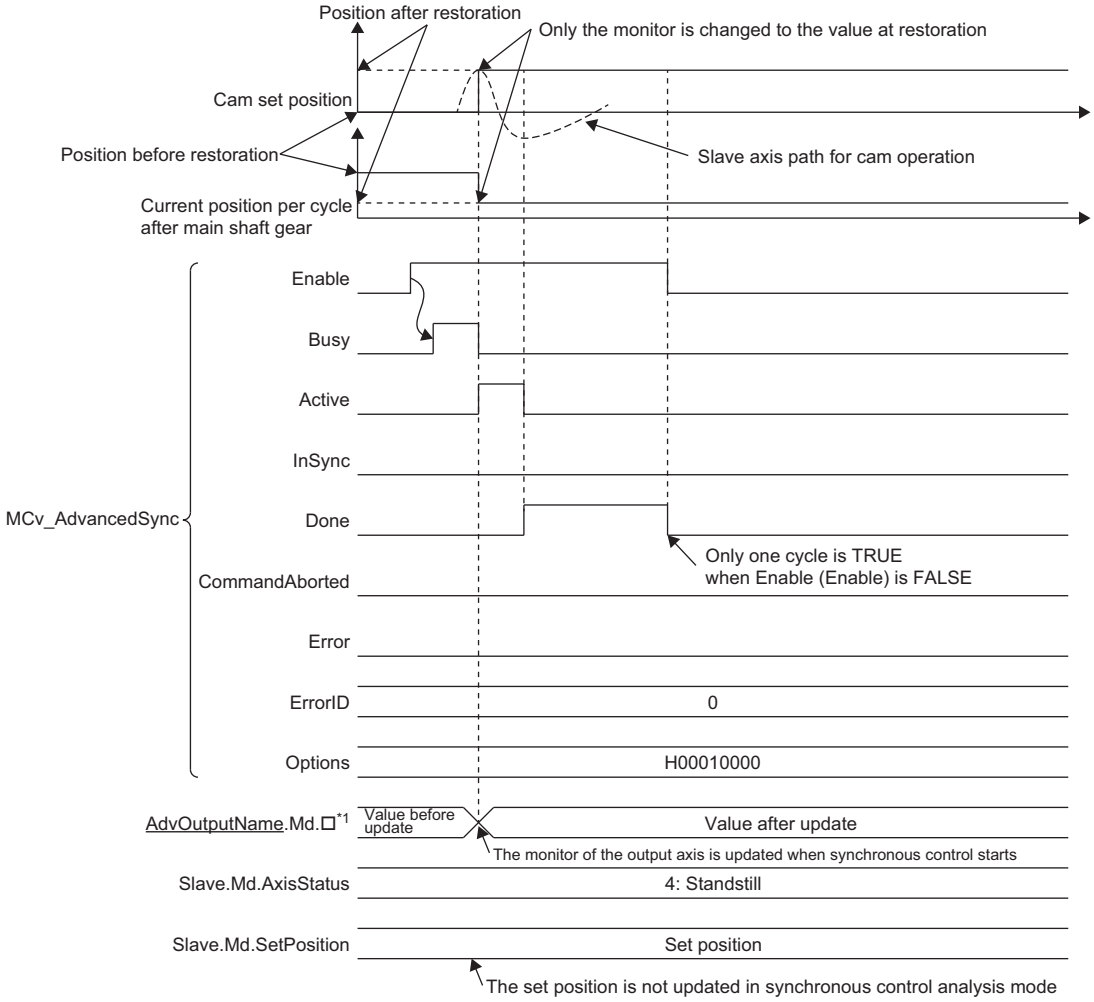
Processing in synchronous control analysis mode

In synchronous control analysis mode, unlike normal restoration, processing is executed until monitor restoration.



Synchronous control analysis mode will not operate if the Axis status (AxisName.Md.AxisStatus) of the Slave axis (Slave) of MCv_AdvancedSync (Advanced synchronous control) is other than "4: Standby (Standstill)".
When MCv_AdvancedSync (Advanced synchronous control) is started in synchronous control analysis mode, if the cam current position per cycle cannot be restored, Advanced Synchronous Control Restoration Disabled (error code: 1B24H) occurs.

Timing chart of synchronous control analysis mode



*1 Synchronization status (AdvOutputName.Md.SyncStatus) of the Output axis monitor data remains "0: Not synchronizing" and is not updated.

Variables related to synchronous control initial position

Synchronous control initial position parameter (AdvOutputName.Pr.Restore.)

Variable name	Name	Import*1	Data type*1	Setting value	Initial value
MasterGearPositionPerCycleMethod	Setting method of current position per cycle after main shaft gear	At start	INT (MC_GEAR_RESTORE_METHOD)	• 0: Previous value (PreviousPosition) • 1: Current position per cycle after main shaft gear (initial setting) (InitialGearPositionPerCycle) • 2: Calculate from input axis (CalculateFromInputAxis)	0: Previous value (PreviousPosition)
AuxGearPositionPerCycleMethod	Setting method of current position per cycle after auxiliary shaft gear		INT (MC_GEAR_RESTORE_METHOD)	• 0: Previous value (PreviousPosition) • 1: Current position per cycle after auxiliary shaft gear (initial setting) (InitialGearPositionPerCycle) • 2: Calculate from input axis (CalculateFromInputAxis)	0: Previous value (PreviousPosition)
PositionRestorationObject	Cam axis position restoration object		INT (MC_CAM_RESTORE_METHOD)	• 0: Current position per cycle restoration (RestorePositionPerCycle) • 1: Cam reference position restoration (RestoreReferenceSetPosition) • 2: Cam set position restoration (RestoreCamSetPosition)	0: Current position per cycle restoration (RestorePositionPerCycle)
ReferenceSetPositionMethod	Setting method of cam reference position		INT (MC_CAM_REFERENCE_METHOD)	• 0: Previous value (PreviousPosition) • 1: Cam reference position (initial setting) (InitialReferenceSetPosition) • 2: Cam set position (CamSetPosition)	0: Previous value (PreviousPosition)
PositionPerCycleMethod	Setting method of current position per cycle		INT (MC_CAM_CYCLE_METHOD)	• 0: Previous value (PreviousPosition) • 1: Current position per cycle (initial setting) (InitialPositionPerCycle) • 2: Current position per cycle after main shaft gear (MasterGearPositionPerCycle) • 3: Current position per cycle after auxiliary shaft gear (AuxGearPositionPerCycle)	0: Previous value (PreviousPosition)
MasterGearInitialPositionPerCycle	Current position per cycle after main shaft gear (initial setting)		LREAL	0.0 to 2147483647.0	0.0
AuxGearInitialPositionPerCycle	Current position per cycle after auxiliary shaft gear (initial setting)		LREAL	0.0 to 2147483647.0	0.0
InitialReferenceSetPosition	Cam reference position (initial setting)		LREAL	-10000000000.0 to 10000000000.0	0.0
InitialPositionPerCycle	Current position per cycle (initial setting)		LREAL	0.0 to 2147483646.0	0.0
RestorationAllowablePosition	Cam set position restoration: Allowable movement amount setting		DWORD (UDINT)	0 to 2147483647 [pulses]	25600

*1 For details on importing and data types, refer to "List of Variables" in the following manual.
MELSEC MX Controller MX-R Model Programming Manual

■Setting method of current position per cycle after main shaft gear (AdvOutputName.Pr.Restore.MasterGearPositionPerCycleMethod)

Select the setting method for current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) when starting MCv_AdvancedSync (Advanced Synchronous Control).

Setting value	Description
0: Previous value (PreviousPosition)	The current position per cycle after main shaft gear from the previous synchronous control is stored.
1: Current position per cycle after main shaft gear (initial setting) (InitialGearPositionPerCycle)	The value set in Current position per cycle after main shaft gear (initial setting) (AdvOutputName.Pr.Restore.MasterGearInitialPositionPerCycle) is stored.
2: Calculate from input axis (CalculateFromInputAxis)	The value calculated based on the current position after composite main shaft gear is stored.

■Setting method of current position per cycle after auxiliary shaft gear (AdvOutputName.Pr.Restore.AuxGearPositionPerCycleMethod)

Select the setting method for current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) when starting MCv_AdvancedSync (Advanced Synchronous Control).

Setting value	Description
0: Previous value (PreviousPosition)	The current position per cycle after auxiliary shaft gear from the previous synchronous control is stored.
1: Current position per cycle after auxiliary shaft gear (initial setting) (InitialGearPositionPerCycle)	The value set in Current position per cycle after auxiliary shaft gear (initial setting) (AdvOutputName.Pr.Restore.AuxGearInitialPositionPerCycle) is stored.
2: Calculate from input axis (CalculateFromInputAxis)	The value calculated based on the current position of the auxiliary shaft is stored.

■Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject)

Select "Current position per cycle", "Cam reference position", or "Cam set position" to be restored when synchronous control is started.

Setting value	Description
0: Current position per cycle restoration (RestorePositionPerCycle)	The current position per cycle is restored from "Cam reference position" and "Cam set position".
1: Cam reference position restoration (RestoreReferenceSetPosition)	The cam reference position is restored from "Current position per cycle" and "Cam set position".
2: Cam set position restoration (RestoreCamSetPosition)	The cam set position is restored from "Current position per cycle" and "Cam reference position".

■Setting method of cam reference position (AdvOutputName.Pr.Restore.ReferenceSetPositionMethod)

Set the setting method for the cam reference position to be used for restoration when Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "0: Current position per cycle restoration (RestorePositionPerCycle)" or "2: Cam set position restoration (RestoreCamSetPosition)".

Setting value	Description
0: Previous value (PreviousPosition)	The cam reference position from the previous synchronous control is stored. The set position is stored when the cam reference position from the previous synchronous control is not saved.
1: Cam reference position (initial setting) (InitialReferenceSetPosition)	The value set in Cam reference position (initial setting) (AdvOutputName.Pr.Restore.InitialReferenceSetPosition) is stored.
2: Cam set position (CamSetPosition)	The value set in Set position (AxisName.Md.SetPosition) of the slave axis is stored.

■Setting method of current position per cycle (AdvOutputName.Pr.Restore.PositionPerCycleMethod)

Set the setting method for the current position per cycle to be used for restoration when Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "1: Cam reference position restoration (RestorePositionPerCycle)" or "2: Cam set position restoration (RestoreCamSetPosition)".

Setting value	Description
0: Previous value (PreviousPosition)	The current position per cycle from the previous synchronous control is stored as is.
1: Current position per cycle (initial setting) (InitialPositionPerCycle)	The value set in Current position per cycle (initial setting) (AdvOutputName.Pr.Restore.InitialPositionPerCycle) is stored.
2: Current position per cycle after main shaft gear (MasterGearPositionPerCycle)	Current position per cycle after main shaft gear (AdvOutputName.Md.Cam.MasterGearPositionPerCycle) is stored.
3: Current position per cycle after auxiliary shaft gear (AuxGearPositionPerCycle)	Current position per cycle after auxiliary shaft gear (AdvOutputName.Md.Cam.AuxGearPositionPerCycle) is stored.

■Current position per cycle after main shaft gear (initial setting) (AdvOutputName.Pr.Restore.MasterGearInitialPositionPerCycle)

Set the initial setting value of the current position per cycle after main shaft gear when Setting method of current position per cycle after main shaft gear (AdvOutputName.Pr.Restore.MasterGearPositionPerCycleMethod) is set to "1: Current position per cycle after main shaft gear (initial setting) (InitialGearPositionPerCycle)". The unit settings are in units of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).
Set within the range from "0.0 to (Length per cycle - 0.00001)".

■Current position per cycle after auxiliary shaft gear (initial setting) (AdvOutputName.Pr.Restore.AuxGearInitialPositionPerCycle)

Set the initial setting value of the current position per cycle after auxiliary shaft gear when Setting method of current position per cycle after auxiliary shaft gear (AdvOutputName.Pr.Restore.AuxGearPositionPerCycleMethod) is set to "1: Current position per cycle after auxiliary shaft gear (initial setting) (InitialGearPositionPerCycle)".
The unit settings are in units of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).
Set within the range from "0.0 to (Length per cycle - 0.00001)".

■Cam reference position (initial setting) (AdvOutputName.Pr.Restore.InitialReferenceSetPosition)

When Setting method of cam reference position (AdvOutputName.Pr.Restore.ReferenceSetPositionMethod) is set to "1: Cam reference position (initial setting) (InitialReferenceSetPosition)", set the initial setting value of the cam reference position in the units of the axis set to the output axis Axis information (AdvOutputName.Axis).

■Current position per cycle (initial setting) (AdvOutputName.Pr.Restore.InitialPositionPerCycle)

Set a value according to the setting for Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject).
The unit settings are in units of the input axis set to Master axis (Master) of MCv_AdvancedSync (Advanced Synchronous Control).
Set within the range from "0.0 to (Length per cycle - 0.00001)".

Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject)	Description
0: Current position per cycle restoration (RestorePositionPerCycle)	Set the starting point for search processing to restore the current position per cycle. Set to restore the position on the return path of a two-way operation cam pattern. For details on search processing, refer to the following. ☞ Page 997 Current position per cycle restoration
1: Cam reference position restoration (RestoreReferenceSetPosition)	Set the initial setting value for the current position per cycle when Setting method of current position per cycle (AdvOutputName.Pr.Restore.PositionPerCycleMethod) is set to "1: Current position per cycle (initial setting) (InitialPositionPerCycle)".
2: Cam set position restoration (RestoreCamSetPosition)	

■Cam set position restoration: Allowable movement amount setting (AdvOutputName.Pr.Restore.RestorationAllowablePosition)

Set the allowable value of the difference between the restored cam set position and the set position in units of the servo command value of the output axis when Cam axis position restoration object (AdvOutputName.Pr.Restore.PositionRestorationObject) is set to "2: Cam set position restoration (RestoreCamSetPosition). If the setting value is large, a rapid operation may occur when starting synchronous control.

Point

The MR-J5(W)-G servo parameter "In-position range (PA10)" initial value (25600) is set as the initial value.

Precautions

Accuracy at restoration

Since accuracy of the advanced synchronous control output axis is guaranteed for up to 5 decimal places, the calculations during restoration are also performed with this accuracy.
Therefore, depending on the position of the output axis, the fourth decimal place of the current position of the output axis may move slightly, but this does not result in position displacement. Depending on parameter settings and programs, the axis may move significantly at restoration. For safety reasons, check the movement amount by restoration in synchronous control analysis mode before starting synchronous control.

Current position per cycle restoration for coordinate data

- When the last point of cam data is larger than the length per cycle, the entire range of cam data is searched regardless of the set value of the length per cycle, which may result in restoration to a position different from the path of synchronous control.
- When the last point of cam data is smaller than the length per cycle, the current position per cycle may become larger than the length per cycle depending on the relationship between the cam set position and the cam reference position. When using the coordinate data, match the last point of cam data with the length per cycle.

Restoration time of the current position per cycle

The current position per cycle restoration completion time varies depending on the resolution, coordinate number, and the restoration settings.
An approximate guide of the restoration time is shown below.

■Cam data (section interpolation/spline interpolation)/rotary cutter

Resolution/Coordinate number	256			65535		
Operation cycle [ms]	**0.25**	**0.5**	**1.0**	**0.25**	**0.5**	**1.0**
Restoration time [ms]	0.4	0.3	0.4	5.2	4.7	4.5

■Cam data (linear interpolation)

Resolution/Coordinate number	256			65535		
Operation cycle [ms]	**0.25**	**0.5**	**1.0**	**0.25**	**0.5**	**1.0**
Restoration time [ms]	0.4	0.3	0.4	5.8	5.2	4.9

33.6 Cam Position Calculation Function

The cam position calculation function calculates the current position per cycle and the cam set position with the following motion control FBs.

- MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation)
- MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation)

This function is used to calculate the synchronous position of the output axis for the synchronous position alignment before starting advanced synchronous control.

With the synchronous control analysis mode, the output axis whose position is to be calculated must be in the standby status (Axis status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)"). However, with the cam position calculation function, the calculation can be executed regardless of the output axis status, thus it is used to calculate the synchronous position of the next control in advance while the output axis is operating.

Control details

Setting the ring counter

Set the Ring counter upper limit value (AxisName.PrConst.RingCount_UpperValue) of the output axis to the Ring counter upper limit (RingCountUpperValue) of MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation) or MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation).

When a value other than "0.0" is set to MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation) or MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation), the ring counter lower limit is calculated as "0.0".

Setting the cam starting point

- Set the cam position calculation Cam starting point (StartingPoint) of MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Cam Set Position Calculation) or MCv_AdvPositionPerCycleCalc (Advanced Synchronous Control Current Position Per Cycle Calculation) when taking into account the cam starting point for calculations.
- The cam position calculation Cam starting point (StartingPoint) sets the position to start cam data in resolution. This is valid only in the following cases.
  · When the Interpolation method specification (Interpolate) of the operation profile data is "1: Section interpolation" or "2: Spline interpolation"
  · When the data type is set to "Rotary cutter"

Current position per cycle calculation (MCv_AdvPositionPerCycleCalc)

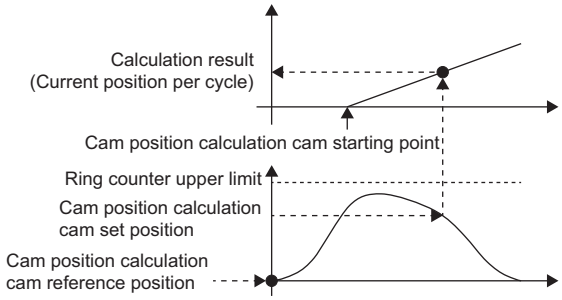
When Execution command (Execute) is changed from FALSE to TRUE, the current position per cycle is calculated based on the cam position calculation Cam reference position (ReferenceSetPosition) and the cam position calculation Cam set position (SetPosition) from the cam data. The calculation result is output to the Calculation result (CalculationResult).

■When the ring counter upper limit is set

The cam position calculation cam reference position and the cam position calculation cam set position are rounded to the ring counter upper limit before calculation when the cam position calculation Ring counter upper limit (RingCountUpperValue) is set.

■When the cam starting point is set

The cam starting point is taken into account for the current position per cycle calculation when the cam position calculation Cam starting point (StartingPoint) is set.



■Searching the current position per cycle

When calculating the current position per cycle from the cam data, the position corresponding to the cam position calculation cam set position is searched from the cam data based on the position set in the cam position calculation Current position per cycle (PositionPerCycle).

The cam position calculation cam set position is searched with the following procedure.

- Cam data (when the Interpolation method specification (Interpolate) of the operation profile data is "1: Section interpolation" or "2: Spline interpolation", or when the data type is set to "Rotary cutter")

■When "nth point of cam data ≤ Cam position calculation Current position per cycle (PositionPerCycle) < Cam data n + First point"

• The position corresponding to the cam position calculation Cam set position (SetPosition) is searched from the nth point of cam data.

■When the cam position calculation current position per cycle (PositionPerCycle) is in the middle of cam data and there is no corresponding position until the last point of cam data

• The search returns to the 0th point of cam data and searches to the position where the search started.

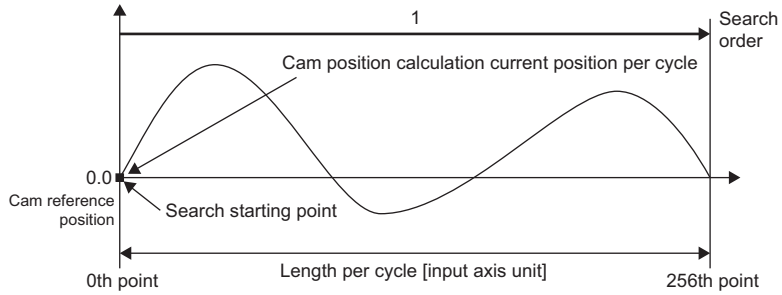
■When there is no corresponding position after searching the entire range of cam data

• For a two-way cam, Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs.

• For a feed cam, the cam position calculation Cam set position (SetPosition) is calculated from the stroke difference, and the entire range is re-searched from the 0th point. When there is no corresponding position even after re-searching, Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs.

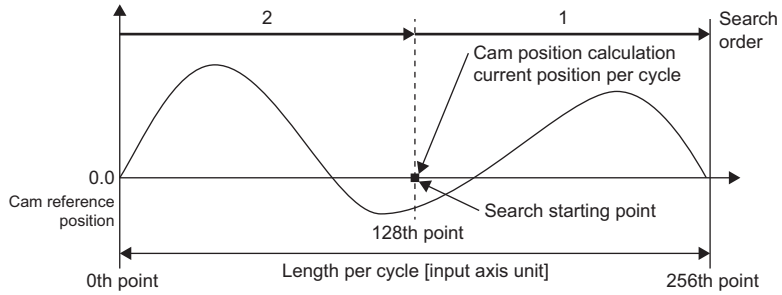
(Example 1)

When the cam position calculation Current position per cycle (PositionPerCycle) corresponds to the 0th point of cam data



(Example 2)

When the cam position calculation Current position per cycle (PositionPerCycle) corresponds to the 128th point of cam data



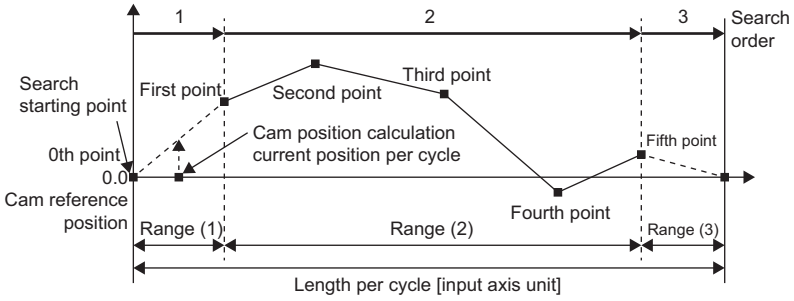
- Cam data (when the Interpolation method specification (Interpolate) of the operation profile data is "0: Linear interpolation")

■Range before the first point of cam data

- When the first point of cam data is larger than 0 and "Cam position calculation Current position per cycle (PositionPerCycle) < First point of cam data" is satisfied, the position corresponding to the cam position calculation Cam set position (SetPosition) is searched from the range before the first point of cam data.
- When there is no corresponding position in range (1), range (2) is searched. When there is also no corresponding position in range (2), range (3) is searched.
- When there is no corresponding position after searching ranges (1) to (3), Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs for a two-way cam. For a feed cam, the cam position calculation Cam set position (SetPosition) is calculated from the stroke difference, and the entire range is re-searched from the 0th point. When there is no corresponding position even after re-searching, Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs.

(Example)

When the cam position calculation current position per cycle is before the first point of cam data



* Search from range (1).

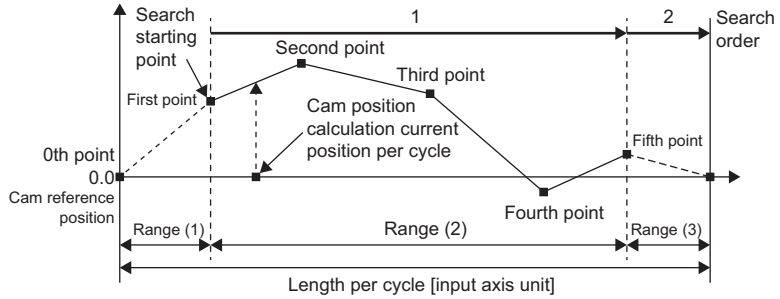
* When there is no corresponding position in range (1), search in order from the first point of cam data in range (2).

■Within the cam data range

- When "Cam position calculation Current position per cycle (PositionPerCycle) < Last point of cam data" is satisfied, the position corresponding to the cam position calculation Cam set position (SetPosition) is searched from within the cam data range.
- When "nth point of cam data ≤ Cam position calculation Current position per cycle < Cam data n + First point" is satisfied, the position corresponding to the cam position calculation Cam set position is searched from the nth point of cam data.
- When the cam position calculation current position per cycle is in the middle of cam data and there is no corresponding position until the last point of cam data, the search returns to the first point of cam data and searches to the position where the search started.
- When there is no corresponding position in range (1), range (2) is searched. When there is also no corresponding position in range (2), range (3) is searched.
- When there is no corresponding position after searching ranges (2) and (3), Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs for a two-way cam.
- For a feed cam, the cam position calculation Cam set position is calculated from the stroke difference, and the entire range is re-searched from the 0th point. When there is no corresponding position even after re-searching, Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs.

(Example 1)

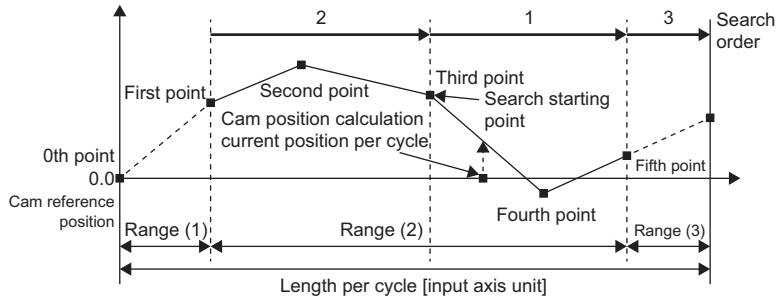
When the cam position calculation current position per cycle corresponds to the first point of cam data



❶ Search in order from cam data first point to second point, second point to third point, and up to fourth point to fifth point (last point).
❷ If there is no corresponding position until the last point of cam data, search from range (3).

(Example 2)

When the cam position calculation current position per cycle corresponds to the third point of cam data



❶ Search in order from cam data third point to fourth point, fourth point to fifth point (last point).
❷ If there is no corresponding position until the last point of cam data, search from the first point of cam data.
❸ If there is no corresponding position in the cam data first point to second point and second point to third point, search from range (3).

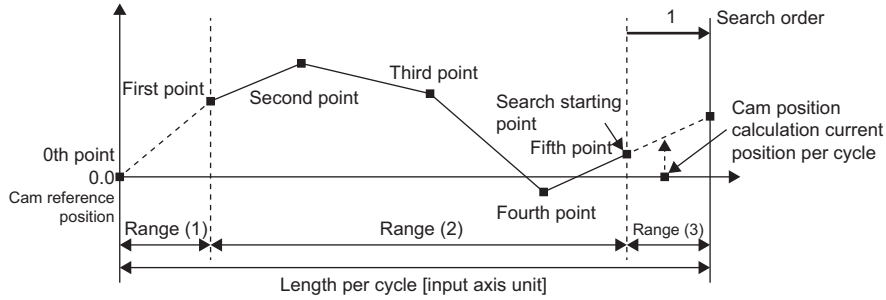
■Range from the cam data last point to the length per cycle

When "Last point of cam data ≤ Cam position calculation Current position per cycle (PositionPerCycle) < Length per cycle" is satisfied, the position corresponding to the cam position calculation Cam set position (MCv_AdvPositionPerCycleCalc.SetPosition) is searched from the last point of cam data. When there is no corresponding position after searching range (3), Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs for a two-way cam.

For a feed cam, the cam position calculation Cam set position is calculated from the stroke difference, and the entire range is re-searched from the 0th point. When there is no corresponding position even after re-searching, Unable to Calculate Cam Position Under Advanced Synchronous Control (error code: 1BCEH) occurs.

(Example)

When the cam position calculation current position per cycle corresponds to the last point of cam data



❶ Search from range (3).

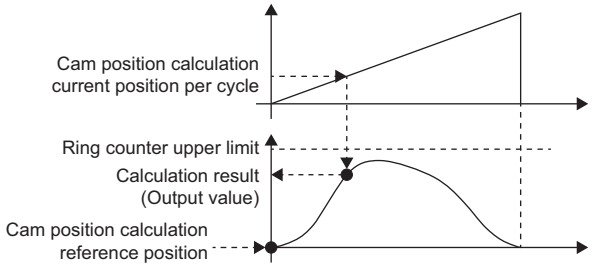
Cam set position calculation (MCv_AdvCamSetPositionCalc)

When Execution command (Execute) is changed from FALSE to TRUE, the cam set position is calculated based on the cam position calculation Current position per cycle (PositionPerCycle) and the cam position calculation Cam reference position (ReferenceSetPosition). The calculation result is output to the Calculation result (CalculationResult).

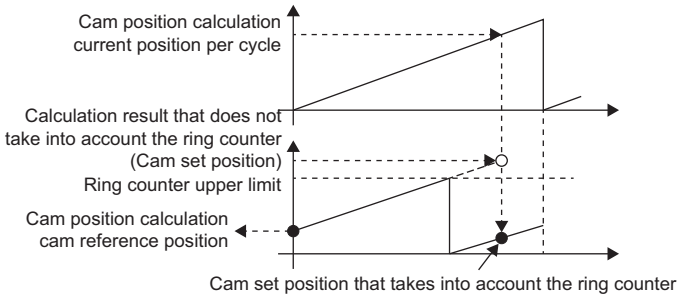
■When the ring counter upper limit is set

The calculation result is rounded to a value that takes into account the ring counter when the cam position calculation Ring counter upper limit (RingCountUpperValue) is set.

- When the calculation result does not exceed the ring counter upper limit

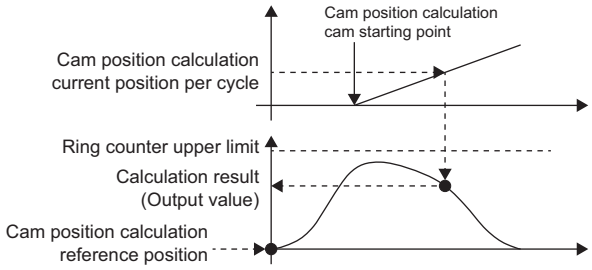


- When the calculation result exceeds the ring counter upper limit



■When the cam starting point is set

The cam set position is calculated with the current position per cycle that takes into account the cam starting point when the cam position calculation Cam starting point (StartingPoint) is set.



Precautions

- Set the cam data to expand automatically in the expand setting in advance, or send it to the open area with MC_CamTableSelect (Cam Table Selection) for use.
- Apply the calculation results of the Current position per cycle calculation (MCv_AdvPositionPerCycleCalc) and the Cam set position calculation (MCv_AdvCamSetPositionCalc) only to MCv_AdvancedSync (Advanced Synchronous Control). If they are applied to synchronous control FBs (such as MC_CamIn) other than MCv_AdvancedSync (Advanced Synchronous Control), the calculation result and the actual operation will not match.
- The current position per cycle calculation of the coordinate data may result as follows depending on the length per cycle of the last point of cam data.

Last point of cam data	Description
Larger than the length per cycle	The entire range of cam data is searched regardless of the set value of the length per cycle, which may result in a different calculation result from the path of synchronous control.
Smaller than the length per cycle	The current value per cycle may become larger than the length per cycle depending on the relationship between the cam set position and the cam reference position. When using the coordinate data, it is recommended to match the last point of cam data with the length per cycle.

33.7 Application Function

Phase compensation function

In synchronous control, a slight phase delay occurs between the input axis (real drive axis, real encoder axis, virtual encoder axis) and the output axis motor shaft end. The phase compensation function compensates in this case so that the phase does not deviate.

Phase compensation can be set for the input and output axes. It is possible to compensate the delay time peculiar to the system based on the axis type on the input axis side. It is also possible to compensate the delay time equivalent to the position deviation for each drive unit on the output axis side.

Phase compensation on delay time of the input axis

Set delay time peculiar to the system in the phase compensation advance time of the input axis (AdvInputName.Pr.PhaseCompensationAdvanceTime). For reference, the delay time peculiar to a system with the MR-J5(W)-G connected to the drive unit is shown.

As the delay time will change depending on the actual equipment configuration, make adjustments from the reference values below.

■Delay time peculiar to the system for a real drive axis (MR-J5(W)-G)*1

The delay time depends on the setting of Data source selection (AdvInputName.PrConst.SourceValue) as follows.

- When set to "1: Set Value (mcSetValue)" or "101: Latest Set Value (mcLatestSetValue)"
  · Delay time: 0 [μs]
- When set to "2: Actual Value (mcActualValue)" or "102: Latest Actual Value (mcLatestActualValue)"
  The delay time is calculated using the following formula.

0: Response preferred method (EmphasisResponse)
Operation cycle × 5 + 750 [μs]

*1 The delay time of "1: Set Value (mcSetValue)" and "2: Actual Value (mcActualValue)" is the delay time of "101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" + one operation cycle.
When compensating a delay, set the value obtained by adding one operation cycle to the delay time peculiar to the system as the compensation time.

■Delay time peculiar to the system for a real encoder axis*1

The delay time is calculated using the following formula regardless of the setting of Data source selection (AdvInputName.PrConst.SourceValue).

0: Response preferred method (EmphasisResponse)
Operation cycle × 5 + 750 [μs]

*1 The delay time of "1: Set Value (mcSetValue)" and "2: Actual Value (mcActualValue)" is the delay time of "101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" + one operation cycle.
When compensating a delay, set the value obtained by adding one operation cycle to the delay time peculiar to the system as the compensation time.

■Delay time peculiar to the system for a virtual encoder axis

The delay time is calculated using the following formula.

• Delay time peculiar to the input target + Virtual encoder input value refresh time [μs]

Ex.

In the following cases

Example	Description
1	■When setting the MR-J5(W)-G object data_PosActualValue (AxisName.Md.Io_PosActualValue) to the virtual encoder axis object data (AxisName.PrConst.SlaveObject.PosActualValue) settings • Delay time peculiar to the system for a real drive axis*1 + Refresh cycle of AxisName.Md.Io_PosActualValue (one operation cycle)
2	■When updating the virtual encoder axis encoder input value (AxisName.Cd.Encoder_InputValue) with a counter value of another unit in an ST program • Delay time peculiar to the counter + ST program scan time

*1 "102: Latest Actual Value (mcLatestActualValue)" of Data source selection (AdvInputName.PrConst.SourceValue)

■Delay time peculiar to the system for a virtual drive axis/virtual linked axis

The delay time is "0 [μs]" regardless of the setting of Data source selection (AdvInputName.PrConst.SourceValue).

Phase compensation of delay time of the output axis

Set the delay time equivalent to the position deviation of the drive unit in the output axis phase compensation advance time (AdvOutputName.Pr.Cam.PhaseCompensationAdvancedTime). The delay time equivalent to position deviation of the drive unit is calculated using the following formula.

When the MR-J5(W)-G is used: Delay time [μs] = 1000000 ÷ Servo parameter "Model loop gain (PB07)"

When the servo parameter "Feed forward gain (PB04)" is set, the delay time is set to a smaller value than the value shown above.

The model loop gain will change when "Gain adjustment mode selection (PA08.0)" is set to "1: Auto tuning mode 1" or "2: Auto tuning mode 2". For axes executing phase compensation, set "3: Manual mode" or "0: 2 gain adjustment mode 1 (interpolation mode)" to prevent model loop gain from changing.

Setting example

When the output axis is synchronized with a real encoder axis, set the phase compensation advance time as follows.

- When model loop gain of the output axis is 80

Setting item		Setting value
Input axis	Phase compensation advance time (AdvInputName.Pr.PhaseCompensationAdvanceTime)	Set the delay time peculiar to the system for a real encoder axis. Refer to the following for delay time peculiar to the system for a real encoder axis. ☞ Page 1016 Delay time peculiar to the system for a real encoder axis*1
Output axis	Phase compensation advance time (AdvOutputName.Pr.Cam.PhaseCompensationAdvancedTime)	1000000 ÷ 80 = 12500 [μs]

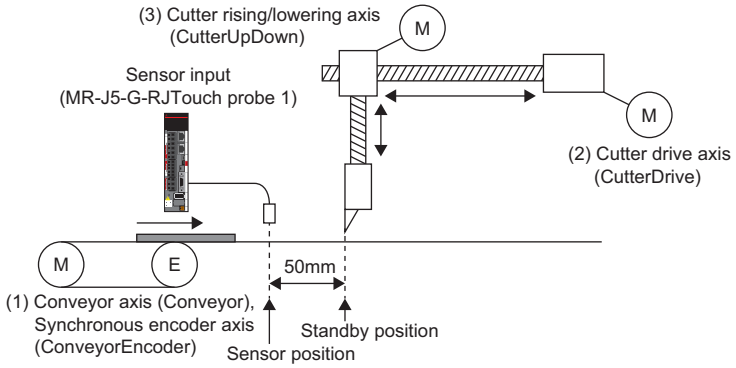
When the slave axis set velocity overshoots or undershoots during acceleration/deceleration, increase the phase compensation time constant.

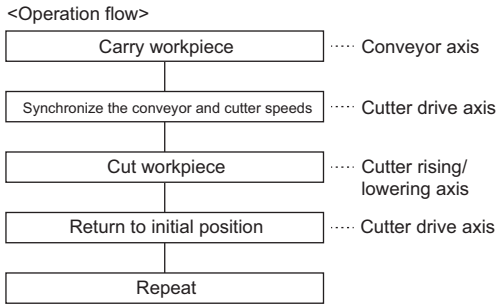
33.8 Example Programs

Example programs for advanced synchronous control are shown below.

Flying shear

This section describes the example programs and how to use clutch operation that uses an advanced synchronous control FB sensor input based on a flying shear system.

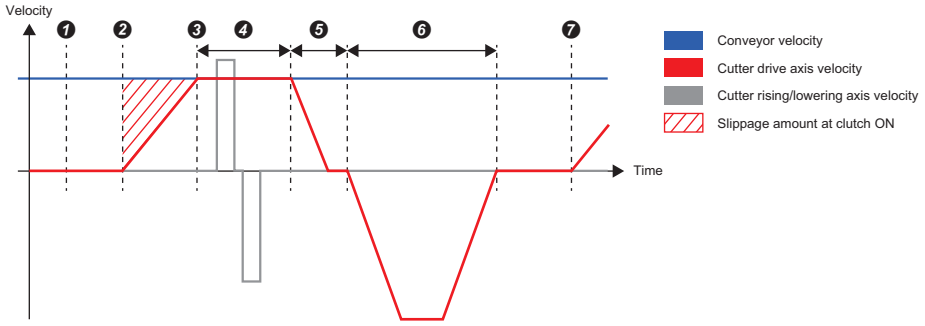


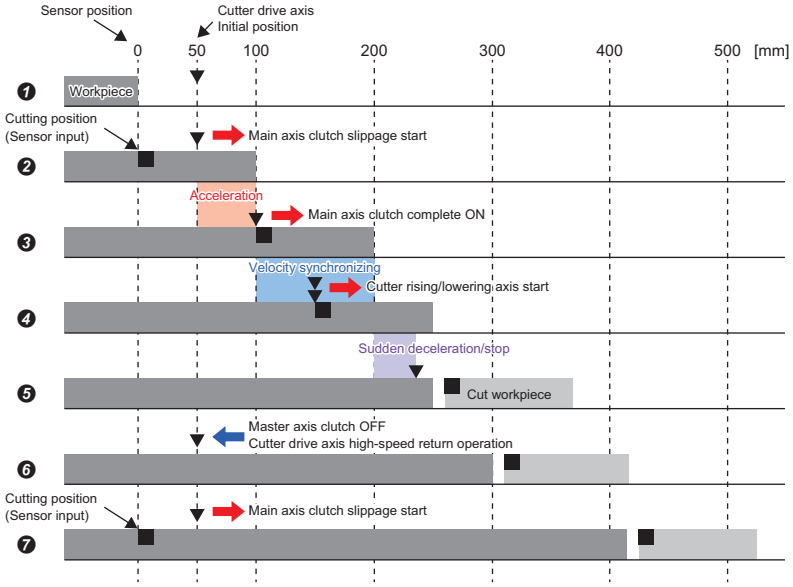


Setting item	(1) Conveyor axis	(1) Synchronous encoder axis	(2) Cutter drive axis	(3) Vertical cutter axis	Virtual drive axis for cutter drive axis high-speed return operation
Axis name	Conveyor	ConveyorEncoder	CutterDrive	CutterUpDown	CutterDriveBack
Axis type	Real drive axis	Real encoder axis	Real drive axis	Real drive axis	Virtual drive axis
Real encoder axis type setting	—	Via drive unit	—	—	—
Station address	192.168.3.1	192.168.3.1	192.168.3.2	192.168.3.3	—
Position command unit	μm	μm	μm	μm	μm
Velocity command unit	U/min	U/min	U/min	U/min	U/min

Operation overview

1. Advanced synchronous control FB starts with the conveyor axis as the "input axis" and the cutter drive axis as the "output axis".
2. The sensor input starts the clutch ON operation of the main shaft clutch.
3. After smoothing is complete with main shaft clutch ON, the speed of the conveyor axis and the cutter drive axis is the same.
4. The vertical cutter axis is started by positioning control when the speed of the conveyor axis and the cutter drive axis becomes the same, and it cuts the workpiece.
5. After completing the cutting of the workpiece (completion of positioning control of the vertical cutter axis), the main shaft clutch turns off and the cutter drive axis is stopped.
6. After stopping the cutter drive axis, positioning of the virtual drive axis that is set as the auxiliary shaft returns the cutter drive axis to its initial position.
7. Steps 2 to 6 are repeated.





Parameter settings

■Setting of the real encoder axis (conveyor axis) to be used as the input axis of advanced synchronous control

In the "CC-Link IE TSN Configuration" window under Network Configuration Settings in GX Works3, add the required objects for the real encoder axis in the "PDO Mapping Setting" of the MR-J5(W)-G(-RJ) that uses a synchronous encoder in [PDO Mapping Setting] ⇨ "PDO Mapping Setting" window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]

- RPDO mapping: None
- TPDO mapping

Index	Sub-index	Entry name	Data type
2d36	00	Scale cycle counter	UNSIGNED32
2d37	00	Scale ABS counter	INTEGER32
2d3c	00	Scale measurement encoder recept	UNSIGNED32

Also, when using a synchronous encoder, the scale measurement function must be enabled in MR-J5(W)-G(-RJ). Set the following servo parameter.

No.	Symbol	Name	Setting value
PA22.3	**PCS	Scale measurement function selection	Set 1 or 2. • 1: Use with absolute position detection system • 2: Use with incremental system

For the settings of the real encoder axis, refer to the following.

☞ Page 455 Real encoder axis

■Setting of the sensor input (MR-J5(W)-G(-RJ) touch probe function)

In the "CC-Link IE TSN Configuration" window under Network Configuration Settings in GX Works3, add the required objects for the touch probe function in the "PDO Mapping Setting" of the MR-J5(W)-G(-RJ) that uses a touch probe in [PDO Mapping Setting] ⇨ "PDO Mapping Setting" window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]

- RPDO mapping

Index	Sub-index	Entry name	Data type
60b8	00	Touch probe function	UNSIGNED16

- TPDO mapping

Index	Sub-index	Entry name	Data type
60b9	00	Touch probe status	UNSIGNED16
60d1	00	Touch probe time stamp 1 positiv	UNSIGNED32
60d2	00	Touch probe time stamp 1 negativ	UNSIGNED32

In the network label settings in GX Works3, make the Touch probe function set in the RPDO mapping and TPDO mapping into a label.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Network Label Setting]

For touch probe function settings, refer to the following.

☞ Page 1164 External Signal High-Accuracy Input

For how to create network labels, refer to the following.

☞ Page 108 Network labels

■Advanced synchronous control parameter settings

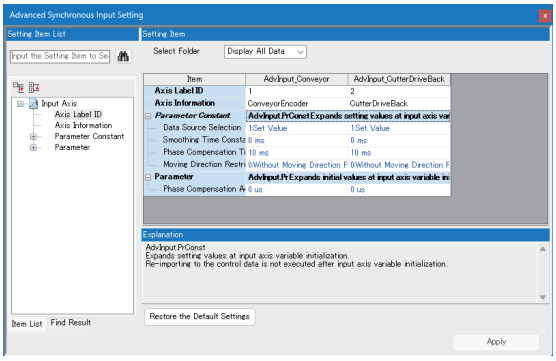
Set the parameters of the axes to be used as the input/output of the advanced synchronous control FB.

Parameter	Axis used
Input axis parameter	• Conveyor axis • Virtual drive axis for cutter drive axis high-speed return operation
Output axis parameter	• Cutter drive axis

- Input axis parameter settings: In the "Advanced Synchronous Input Setting" window, configure the input axis settings of the main shaft and auxiliary shaft used by the advanced synchronous control FB.

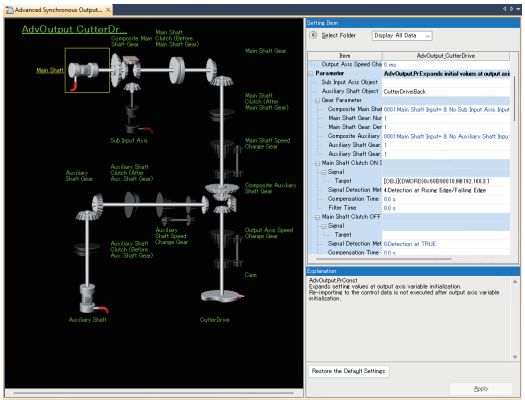
Data name	Setting details
AdvInput_Conveyor	Real encoder axis (ConveyorEncoder) of the conveyor axis
AdvInput_CutterDriveBack	Virtual drive axis (CutterDriveBack) used for cutter drive axis high-speed return operation

Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Input Setting]



- Output axis parameter settings: In the "Advanced Synchronous Output Setting" window, configure the output axis settings of the output axes used by the advanced synchronous control FB.

Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Output Setting]



■Settings of axes used by output axis and auxiliary shaft

Setting item	Setting value
Axis information (AdvOutputName.Axis)	CutterDrive (the axis used as the cutter drive axis)
Auxiliary shaft object (AdvOutputName.Pr.AuxAxis)	CutterDriveBack (the axis used for the cutter drive axis high-speed return operation)

■Main shaft clutch setting

Setting item	Setting value
Main shaft clutch ON control setting (AdvOutputName.Pr.Clutch.MasterOnControl)	15: I/O data specification (ClutchSignal)
Main shaft clutch OFF control setting (AdvOutputName.Pr.Clutch.MasterOffControl)	1: Clutch command (ClutchCommand)
Main shaft clutch ON signal setting (Signal target) (AdvOutputName.Pr.MasterOnClutchSignal.Source.Target)	[OBJ]0x60B90010.6@192.168.3.1 (Toggle status for latch completion at the rising edge of touch probe 1)
Main shaft clutch ON signal setting (Signal detection method) (AdvOutputName.Pr.MasterOnClutchSignal.Detection)	4: Detection at rising edge/falling edge (BothEdges)
Main shaft clutch ON signal setting (Compensation time) (AdvOutputName.Pr.MasterOnClutchSignal.CompensationTime)	0.0 [s]
Main shaft clutch ON signal setting (Filter time) (AdvOutputName.Pr.MasterOnClutchSignal.FilterTime)	0.0 [s]
Main shaft clutch reference address setting (AdvOutputName.Pr.Clutch.MasterReference)	0: Current position before gear (GearFrontPosition)
Movement amount before main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOn)	0.0 [mm]
Movement amount before main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterMovementAmountBeforeOff)	330.0 [mm]
Main shaft clutch smoothing method (AdvOutputName.Pr.ClutchMasterSmoothingMethod)	4: Slippage method (linear) (SlippageLinear)
Slippage amount at main shaft clutch ON (AdvOutputName.Pr.Clutch.MasterOnSlippageAmount)	50.0 [mm] (Distance between the sensor position and the cutter drive axis initial position)
Slippage amount at main shaft clutch OFF (AdvOutputName.Pr.Clutch.MasterOffSlippageAmount)	20.0 [mm]

■Gear parameters

Setting item	Setting value
Composite main shaft gear (AdvOutputName.Pr.Gear.MasterCompositeGear)	0001: Main shaft input+ · No input of the sub input axis
Main shaft gear: Numerator (AdvOutputName.Pr.Gear.MasterNumerator)	1
Main shaft gear: Denominator (AdvOutputName.Pr.Gear.MasterDenominator)	1
Composite auxiliary shaft gear (AdvOutputName.Pr.Gear.AuxCompositeGear)	0011: Main shaft input+ · Auxiliary shaft input+
Auxiliary shaft gear: Numerator (AdvOutputName.Pr.Gear.AuxNumerator)	1
Auxiliary shaft gear: Denominator (AdvOutputName.Pr.Gear.AuxDenominator)	1

Program creation

■Enabling the touch probe function of MR-J5(W)-G(-RJ)

Use the label created in "Setting of the sensor input (MR-J5(W)-G(-RJ) touch probe function)" to enable the touch probe function.

• Example program

ST program

```
// TouchProbe Enable
MR_J5_G_RJ_001_TouchProbeFunction:=UINT#16#0013;
```

• Labels used: None

■Starting advanced synchronous control

Check that the input axis is enabled (AdvInput_Conveyor.Md.ActiveStatus is "1: Input axis enabled") and the output axis is on standby (CutterDrive.Md.AxisStatus is "4: Standby (Standstill)") before starting the advanced synchronous control FB.

• Example program

ST program

```
IF gb_SystemStart THEN
    // AdvSync Start
    IF  AdvInput_Conveyor.Md.ActiveStatus=1 AND
        CutterDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill THEN
        gb_AdvSync_Drive_Enable:=TRUE;
        END_IF;
END_IF;

MCv_AdvancedSync_Drive(
    Master:= AdvInput_Conveyor.Axis,
    Slave:=  AdvOutput_CutterDrive.Axis,
    Enable:= gb_AdvSync_Drive_Enable,
    InSync=> gb_AdvSync_Drive_InSync);
```

• Labels used

Label name	Data type	Comment
gb_SystemStart	Bit	System start command
MCv_AdvancedSync_Drive	MCv_AdvancedSync	Advanced synchronous control FB (cutter drive axis)
gb_AdvSync_Drive_Enable	Bit	Advanced synchronous control FB start command
gb_AdvSync_Drive_InSync	Bit	Advanced synchronous control FB synchronizing

■Starting the conveyor axis (JOG operation)

Check that the output axis is synchronized (AdvOutput_CutterDrive.Md.SyncStatus is "1: In synchronization") and start JOG operation on the conveyor axis.

• Example program

ST program

```
IF gb_SystemStart THEN
    // ConveyorAxis Move
    IF AdvOutput_CutterDrive.Md.SyncStatus=1 THEN
        gl_SetSpeedComveyor:=40000000.0;
        gb_MoveConveyorReq:=TRUE;
        END_IF;
    END_IF;

MCv_Jog_Conveyor(
    Axis:= Conveyor.AxisRef,
    JogForward:= gb_MoveConveyorReq,
    Velocity:= gl_SetSpeedComveyor,
    Acceleration:= 0.5,
    Deceleration:= 0.5,
    Options:= H0001);
```

• Labels used

Label name	Data type	Comment
gb_SystemStart	Bit	System start command
MCv_Jog_Conveyor	MCv_Jog	JOG operation FB (conveyor axis)
gb_MoveConveyorReq	Bit	Positive direction JOG operation command
gl_SetSpeedComveyor	Double-precision real number	Command velocity of JOG operation

■Positioning control of the vertical cutter axis

Check that smoothing is complete with output axis main shaft clutch ON (Main shaft clutch ON/OFF status (AdvOutput_CutterDrive.Md.Clutch.MasterOnOffStatus) is TRUE and Main shaft clutch smoothing status (AdvOutput_CutterDrive.Md.Clutch.MasterSmoothingStatus) is FALSE) before starting positioning control of the vertical cutter axis. (An example of a two-way operation conducted by multiple start with Buffered.)

• Example program

ST program

```
IF AdvOutput_CutterDrive.Md.Clutch.MasterOnOffStatus AND
   NOT(AdvOutput_CutterDrive.Md.Clutch.MasterSmoothingStatus) AND
   NOT(lb_CutterMoveComp) THEN

   MC_MoveAbsolute_1.Execute:=TRUE;
   IF MC_MoveAbsolute_1.Busy THEN
      MC_MoveAbsolute_2.Execute:=TRUE;
   END_IF;
END_IF;

IF MC_MoveAbsolute_1.Done AND
   MC_MoveAbsolute_2.Done THEN
   MC_MoveAbsolute_1.Execute:=FALSE;
   MC_MoveAbsolute_2.Execute:=FALSE;
   lb_CutterMoveComp:=TRUE;
END_IF;

MC_MoveAbsolute_1(
   Axis:= CutterUpDown.AxisRef,
   Position:= 30000.0 ,//30.0[mm]
   Velocity:= 3000000.0 ,//3000000.0[mm/min]
   Acceleration:= 0.1,
   Deceleration:= 0.1,
   Direction:= MC_DIRECTION__mcShortestWay,
   Options:= H0001);

MC_MoveAbsolute_2(
   Axis:= CutterUpDown.AxisRef,
   Position:= 0.0,
   Velocity:= 3000000.0 ,
   Acceleration:= 0.1,
   Deceleration:= 0.1,
   Direction:= MC_DIRECTION__mcShortestWay ,
   BufferMode:= MC_BUFFER_MODE__mcBuffered,
   Options:= H0001);
```

• Labels used

Label name	Data type	Comment
MC_MoveAbsolute_1	MC_MoveAbsolute	Absolute positioning (cutting operation)
MC_MoveAbsolute_2	MC_MoveAbsolute	Absolute positioning (retracting operation)
lb_CutterMoveComp	Bit	Cutter operation complete flag

■Cutter drive axis high-speed return operation (positioning control of the virtual drive axis set to auxiliary shaft)

Check that smoothing is complete with output axis main shaft clutch OFF (Main shaft clutch ON/OFF status (AdvOutput_CutterDrive.Md.Clutch.MasterOnOffStatus) is FALSE and Main shaft clutch smoothing status (AdvOutput_CutterDrive.Md.Clutch.MasterSmoothingStatus) is FALSE), and positioning control of the vertical cutter axis is complete before starting positioning control of the virtual drive axis (CutterDriveBack) set to the auxiliary shaft.

• Example program

ST program

```
IF NOT(AdvOutput_CutterDrive.Md.Clutch.MasterOnOffStatus) AND
   NOT(AdvOutput_CutterDrive.Md.Clutch.MasterSmoothingStatus) AND
   lb_CutterMoveComp THEN
   MC_MoveRelative_1.Execute:=TRUE;
END_IF;

IF MC_MoveRelative_1.Done THEN
   MC_MoveRelative_1.Execute:=FALSE;
   lb_CutterMoveComp:=FALSE;
END_IF;

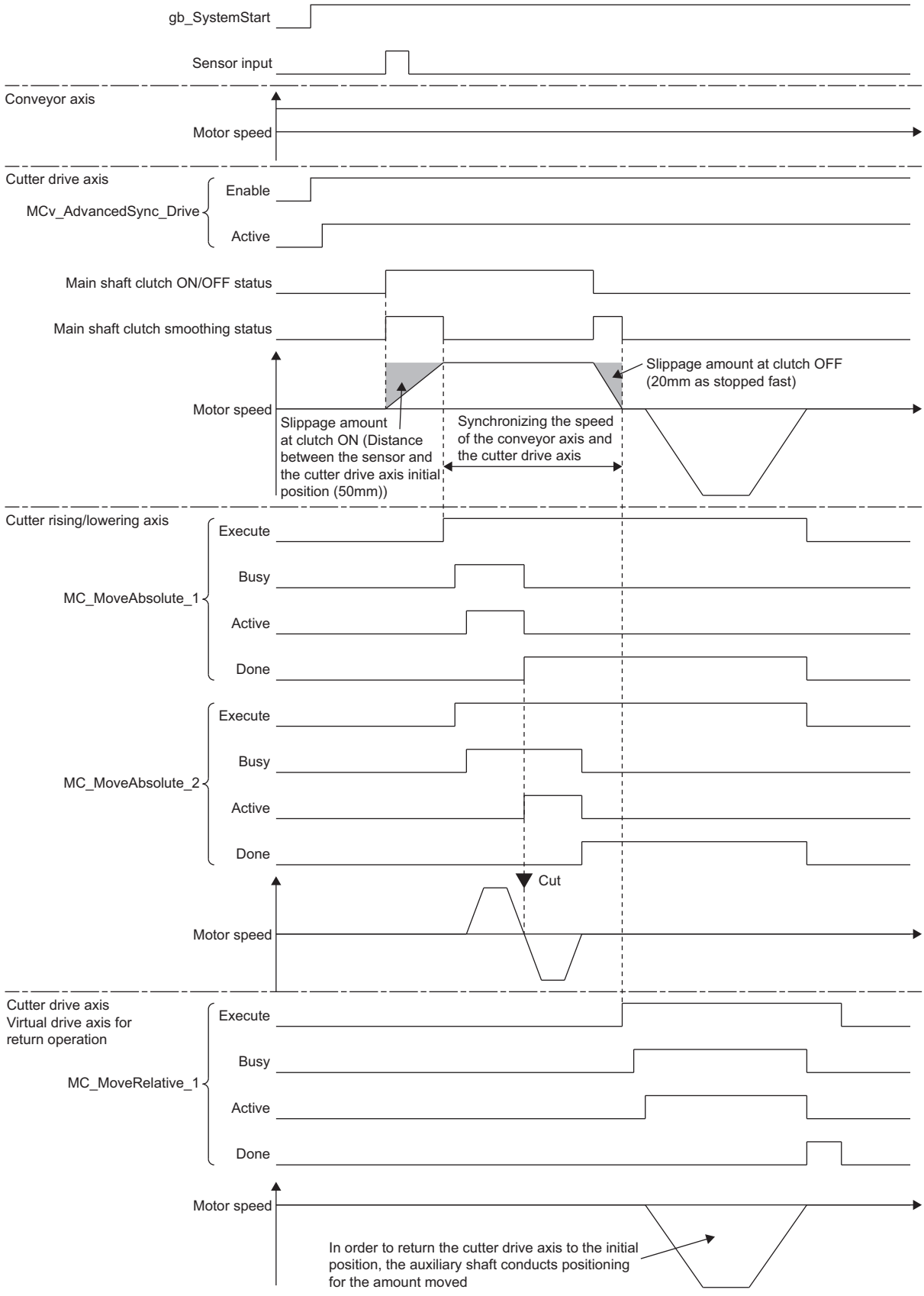
MC_MoveRelative_1(
   Axis:= CutterDriveBack.AxisRef,
   Distance:= -250000.0,
   Velocity:= 3000000.0,
   Acceleration:= 0.5,
   Deceleration:= 0.5,
   Options:= H0001);
```

• Labels used

Label name	Data type	Comment
MC_MoveRelative_1	MC_MoveRelative	Relative positioning (cutter drive axis return operation)
lb_CutterMoveComp	Bit	Cutter operation complete flag

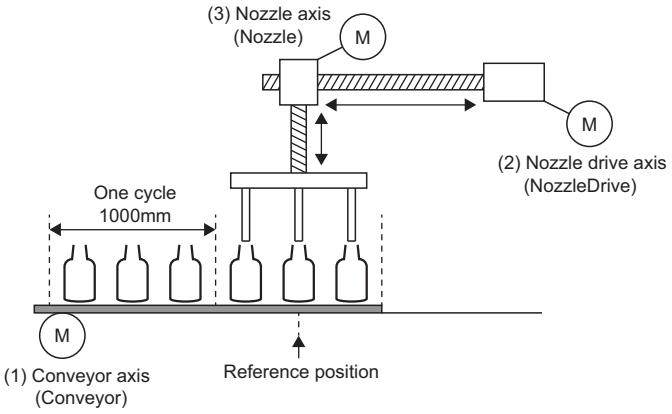
Timing chart

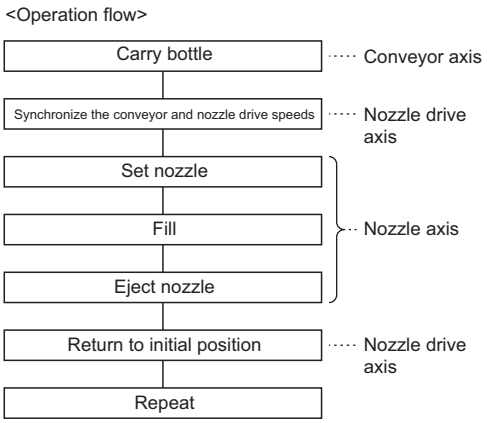
The timing chart for the operation that uses the program example is shown below.



Filling machine

This section describes the example program and how to use synchronous control of multiple axes that use advanced synchronous control FB operation profile data (cam data), and how to restart synchronous control based on a filling machine system.

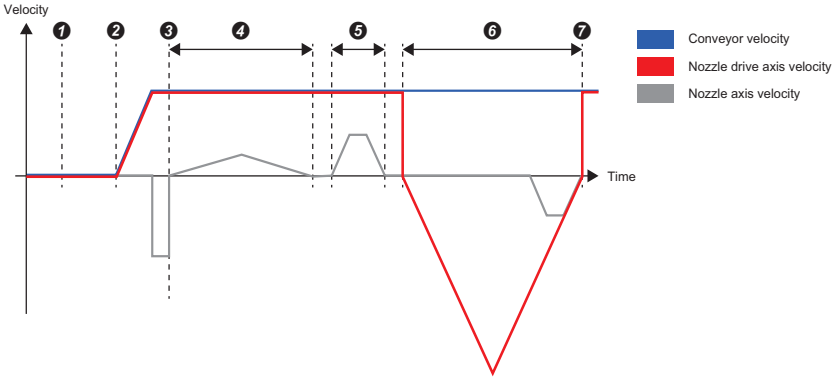


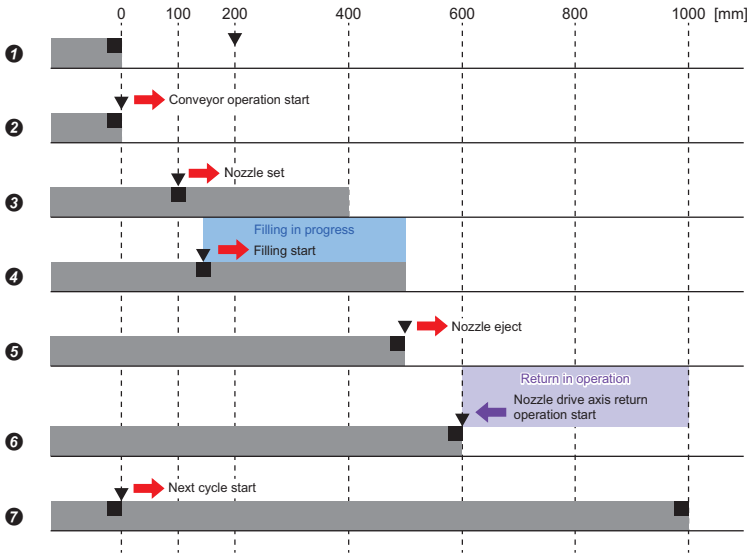


Setting item	(1) Conveyor axis	(2) Nozzle drive axis	(3) Nozzle axis
Axis name	Conveyor	NozzleDrive	Nozzle
Axis type	Real drive axis	Real drive axis	Real drive axis
Station address	192.168.3.1	192.168.3.2	192.168.3.3
Position command unit	μm	μm	μm
Velocity command unit	U/min	U/min	U/min

Operation overview

1. An advanced synchronous control FB starts with the conveyor axis as the input axis and the nozzle drive axis as the output axis. Additionally, an advanced synchronous control FB starts with the conveyor axis as the input axis and the nozzle axis as the output axis.
2. The conveyor axis starts. The nozzle drive axis and the nozzle axis synchronize with the conveyor axis according to the set length per cycle and operation profile data (cam data) and execute the operations in steps 3 to 6.
3. The nozzle is set on the nozzle axis.
4. The bottle is filled.
5. The nozzle on the nozzle axis is ejected.
6. The nozzle drive axis and nozzle axis return to the reference position.
7. Steps 3 to 6 are repeated.





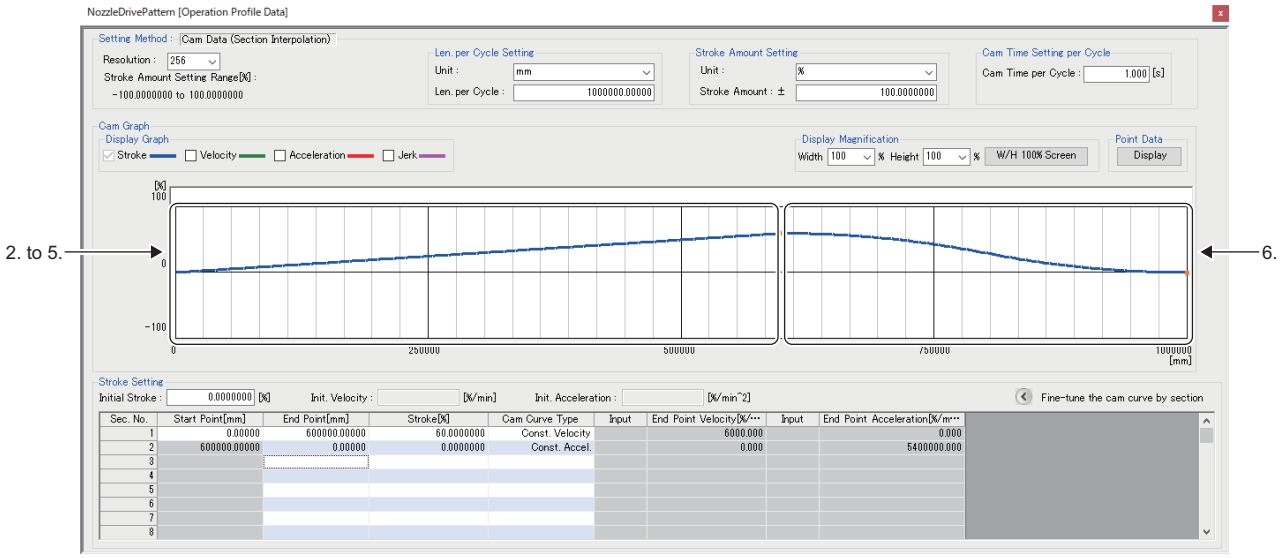
Creating operation profile data (cam data)

The following describes how to create the operation profile data (cam data) used by the nozzle drive axis and nozzle axis (output axes).

■Creating the nozzle drive axis operation profile data (cam data)

Create the "NozzleDrivePattern" cam data below with "Profile ID: 1" as the operation profile data (cam data).

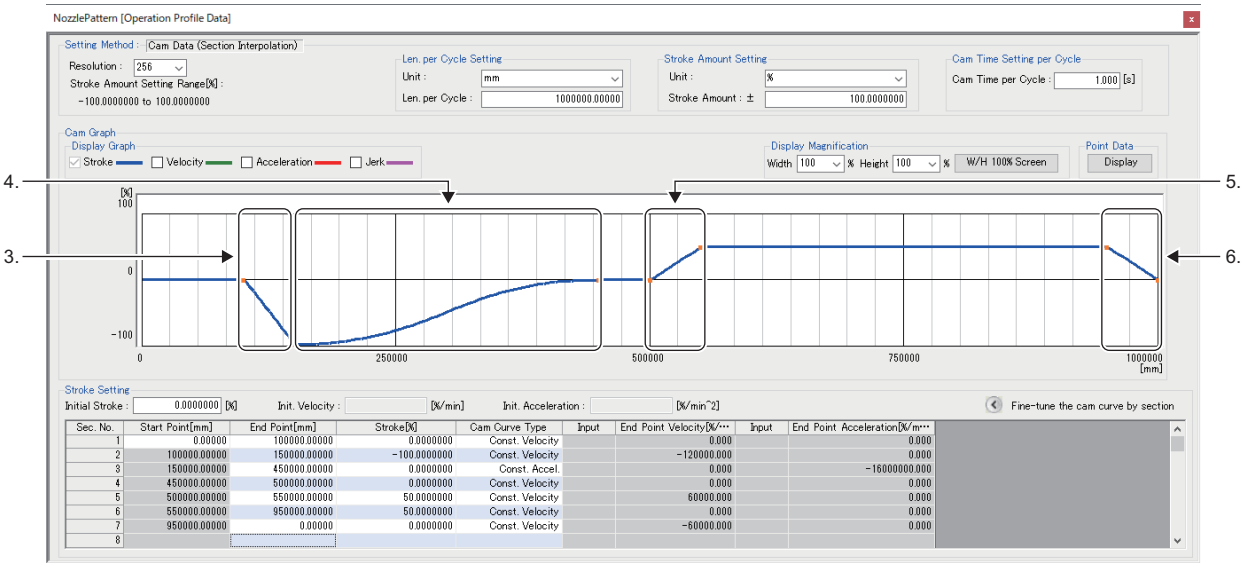
Step	Cam pattern details of each step	Setting details
2. to 5.	Cam pattern that synchronizes the speed with the conveyor axis	• Current position per cycle: 0.0 [mm] → 600000.0 [mm] • Stroke amount: 0.0 [%] → 60.0 [%]
6.	Cam pattern that returns the nozzle drive axis to the reference position	• Current position per cycle: 600000.0 [mm] → 1000000.0 [mm] (0.0 [mm]) • Stroke amount: 60.0 [%] → 0.0 [%]



■Creating the nozzle axis operation profile data (cam data)

Create the "NozzlePattern" cam data below with "Profile ID: 2" as the operation profile data (cam data).

Step	Cam pattern details of each step	Setting details
3.	Cam pattern for the nozzle setting operation	• Current position per cycle: 100000.0 [mm] → 150000.0 [mm] • Stroke amount: 0.0 [%] → -100.0 [%]
4.	Cam pattern while filling (operation that gradually raises the nozzle)	• Current position per cycle: 150000.0 [mm] → 450000.0 [mm] • Stroke amount: -100.0 [%] → 0.0 [%]
5.	Cam pattern for the nozzle eject operation	• Current position per cycle: 500000.0 [mm] → 550000.0 [mm] • Stroke amount: 0.0 [%] → 50.0 [%]
6.	Cam pattern that returns the nozzle to the reference position	• Current position per cycle: 950000.0 [mm] → 1000000 [mm] (0.0 [mm]) • Stroke amount: 50.0 [%] → 0.0 [%]



Parameter settings

Set the input axis parameters for the axis (conveyor axis) to be used as the input for the advanced synchronous control FB and the output axis parameters for the axes (nozzle drive axis and nozzle axis) to be used as the output for the advanced synchronous control FB.

Set the parameters for the axes used as the input/output for the advanced synchronous control FB.

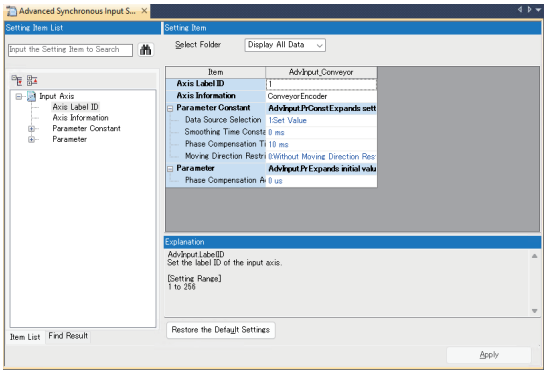
Parameter	Axis used
Input axis parameter	Conveyor axis
Output axis parameter	• Nozzle drive axis • Nozzle axis

■Advanced synchronous control input axis parameter settings

In the "Advanced Synchronous Input Setting" window, configure the input axis settings of the main shaft and auxiliary shaft used by the advanced synchronous control FB.

Data name	Setting details
AdvInput_Conveyor	Real drive axis (Conveyor) of the conveyor axis

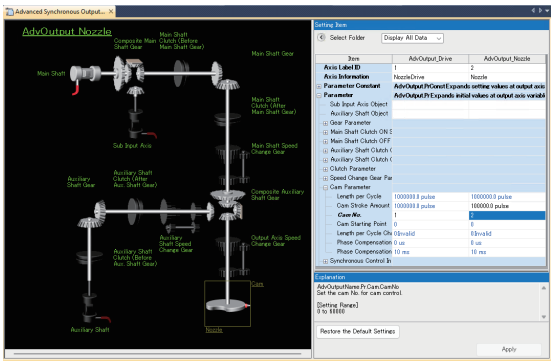
Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Input Setting]



■Advanced synchronous control FB output axis parameter settings

In the "Advanced Synchronous Output Setting" window, configure the output axis settings of the output axes used by the advanced synchronous control FB.

Navigation window ⇨ [Motion Setting] ⇨ [Advanced Synchronous Control] ⇨ [Output Setting]



- Settings of axes used by output axis and auxiliary shaft

Setting item	Setting value	
	Nozzle drive axis	Nozzle axis
Axis information (AdvOutputName.Axis)	NozzleDrive	Nozzle

- Cam parameter setting

Setting item	Setting value	
	Nozzle drive axis	Nozzle axis
Length per cycle	1000000.0 (Match with the length per cycle set in the operation profile data)	1000000.0 (Match with the length per cycle set in the operation profile data)
Cam stroke amount	1000000.0 (Same as the length per cycle)	100000.0 (Set the stroke amount of the output axis when the stroke amount [%] set in the operation profile data is 100 [%].)
Cam No.	1 (The profile ID set in the operation profile data (NozzleDrivePattern))	2 (The profile ID set in the operation profile data (NozzlePattern))

Program creation

■Starting advanced synchronous control (initial start)

After setting the positions of the input axis and output axes by homing or other methods, check that the input axis is enabled (AdvInput_Conveyor.Md.ActiveStatus is "1: Input axis enabled") and the output axes are on standby (NozzleDrive.Md.AxisStatus is "4: Standby (Standstill)" and Nozzle.Md.AxisStatus is "4: Standby (Standstill)") before starting the advanced synchronous control FB. This section also describes the procedures for restarting synchronous control using cam set position restoration (restoring the input axis position as reference).

For restarting synchronous control using cam set position restoration (restoring the input axis position as reference), refer to the following.

☞ Page 1039 Starting advanced synchronous control (restart)

Set the positions of the input axis (Conveyor) and the output axes (NozzleDrive and Nozzle), set the synchronous control initial position parameters as shown below, and start the advanced synchronous control FB.

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	0: Current position per cycle restoration (RestorePositionPerCycle)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	2: Cam set position (CamSetPosition)
Current position per cycle (initial setting) • AdvOutput_NozzleDrive.Pr.Restore.InitialPositionPerCycle • AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle	0.0

• Example program

■Nozzle drive axis

ST program

```
IF NOT(gb_SystemStart) THEN
   gb_PositionAdjustComp_Drive:=FALSE;
   END_IF;

//----------For initial start (from here)----------
IF gb_SystemStart AND NOT(gb_SyncRestart) THEN
   // AdvSync Start(NozzleDrive)
   // Set Restore Parameter
   AdvOutput_Drive.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
   AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
   AdvOutput_Drive.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__CamSetPosition;
   AdvOutput_Drive.Pr.Restore.InitialPositionPerCycle:=0.0;

   IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
      NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill THEN
      gdw_AdvSync_Drive_Options:=H00000000;
      gb_AdvSync_Drive_Enable:=TRUE;
   END_IF;
END_IF;
//----------For initial start (until here)----------

//----------For restart (from here)----------
IF gb_SystemStart AND gb_SyncRestart THEN
   // AdvSync Restart(NozzleDrive)

   // Select For Restore Target
   CASE gw_SelectRestoreMode OF
   RESTORE_POSITION_PER_CYCLE_FOR_PREPROMODE :
<Omission>*1
   RESTORE_POSITION_PER_CYCLE_FOR_CAMCALCFUNC :
<Omission>*1
   RESTORE_SETPOSITION_FOR_PREPROMODE :
<Omission>*1
   RESTORE_SETPOSITION_FOR_CAMCALCFUNC :
<Omission>*1

   ELSE
      ;
   END_CASE;
END_IF;
//----------For restart (until here)----------

MC_MoveAbsolute_Drive(
   Axis:= NozzleDrive.AxisRef,
   Execute:= gb_MoveAbsolute_Drive_Execute,
   Position:= gl_MoveAbsolute_Drive_Position,
   Velocity:= 10000000.0,
   Acceleration:= 0.5,
   Deceleration:= 0.5,
   Direction:= MC_DIRECTION__mcShortestWay,
   Options:= H0001);

MCv_AdvancedSync_Drive(
   Master:= AdvInput_Conveyor.Axis,
   Slave:=  AdvOutput_Drive.Axis,
   Options:= gdw_AdvSync_Drive_Options,
   Enable:= gb_AdvSync_Drive_Enable,
   InSync=> gb_AdvSync_Drive_InSync);

MCv_AdvCamSetPositionCalc_Drive(
   Execute:= gb_AdvCamSetPositionCalc_Drive_Execute,
   CamTableID:= g_CamTableID_Drive,
   LengthPercycle:= gl_AdvCamSetPositionCalc_Drive_LengthPercycle,
   StrokeAmount:= gl_AdvCamSetPositionCalc_Drive_StrokeAmount,
   ReferenceSetPosition:= gl_AdvCamSetPositionCalc_Drive_ReferenceSetPosition,
   PositionPerCycle:= gl_AdvCamSetPositionCalc_Drive_PositionPerCycle);
```

*1 For an example program when restarting advanced synchronous control, refer to the following.

☞ Page 1039 Starting advanced synchronous control (restart)

■Nozzle axis

ST program

```
IF NOT(gb_SystemStart) THEN
  gb_PositionAdjustComp_Nozzle:=FALSE;
END_IF;

//----------For initial start (from here)----------
IF gb_SystemStart AND NOT(gb_SyncRestart) THEN
  // AdvSync Start(Nozzle)
  // Set Restore Parameter
  AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
  AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
  AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__CamSetPosition;
  AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle:=0.0;

  IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
    Nozzle.Md.AxisStatus=MC_AXIS_STATUS__Standstill THEN
    gdw_AdvSync_Nozzle_Options:=H00000000;
    gb_AdvSync_Nozzle_Enable:=TRUE;
  END_IF;
END_IF;
//----------For initial start (until here)----------

//----------For restart (from here)----------
IF gb_SystemStart AND gb_SyncRestart THEN
  // AdvSync Restart(Nozzle)

  // Select For Restore Target
  CASE gw_SelectRestoreMode OF
  RESTORE_POSITION_PER_CYCLE_FOR_PREPROMODE :
<Omission>*1
  RESTORE_POSITION_PER_CYCLE_FOR_CAMCALCFUNC :
<Omission>*1
  RESTORE_SETPOSITION_FOR_PREPROMODE :
<Omission>*1
  RESTORE_SETPOSITION_FOR_CAMCALCFUNC :
<Omission>*1

  ELSE
    ;
  END_CASE;
END_IF;
//----------For restart (until here)----------

MC_MoveAbsolute_Nozzle(
  Axis:= Nozzle.AxisRef,
  Execute:= gb_MoveAbsolute_Nozzle_Execute,
  Position:= gl_MoveAbsolute_Nozzle_Position,
  Velocity:= 10000000.0,
  Acceleration:= 0.5,
  Deceleration:= 0.5,
  Direction:= MC_DIRECTION__mcShortestWay,
  Options:= H0001);

MCv_AdvancedSync_Nozzle(
  Master:= AdvInput_Conveyor.Axis,
  Slave:=  AdvOutput_Nozzle.Axis,
  Options:= gdw_AdvSync_Nozzle_Options,
  Enable:= gb_AdvSync_Nozzle_Enable,
  Deceleration:= 2000000.0,
  InSync=> gb_AdvSync_Nozzle_InSync);

MCv_AdvCamSetPositionCalc_Nozzle(
  Execute:= gb_AdvCamSetPositionCalc_Nozzle_Execute,
  CamTableID:= g_CamTableID_Nozzle,
  LengthPercycle:= gl_AdvCamSetPositionCalc_Nozzle_LengthPercycle,
  StrokeAmount:= gl_AdvCamSetPositionCalc_Nozzle_StrokeAmount,
  ReferenceSetPosition:= gl_AdvCamSetPositionCalc_Nozzle_ReferenceSetPosition,
  PositionPerCycle:= gl_AdvCamSetPositionCalc_Nozzle_PositionPerCycle);

//-----Continued on next page-----
```

ST program

```
//-----Continued from previous page-----

MCv_AdvPositionPerCycleCalc_Nozzle(
  Execute:= gb_AdvPositionPerCycleCalc_Nozzle_Execute,
  CamTableID:= g_CamTableID_Nozzle,
  LengthPercycle:= gl_AdvPositionPerCycleCalc_Nozzle_LengthPercycle,
  StrokeAmount:= gl_AdvPositionPerCycleCalc_Nozzle_StrokeAmount,
  ReferenceSetPosition:= gl_AdvPositionPerCycleCalc_Nozzle_ReferenceSetPosition,
  SetPosition:= gl_AdvPositionPerCycleCalc_Nozzle_SetPosition,
  PositionPerCycle:= gl_AdvPositionPerCycleCalc_Nozzle_PositionPerCycle);
```

*1 For an example program when restarting advanced synchronous control, refer to the following.
☞ Page 1039 Starting advanced synchronous control (restart)

• Labels used

Label name	Data type	Comment
gb_SystemStart	Bit	System start command
gb_SyncRestart	Bit	System restart command
MC_MoveAbsolute_Drive	MC_MoveAbsolute	Absolute value positioning FB (Nozzle drive axis positioning)
gb_MoveAbsolute_Drive_Execute	Bit	Absolute value positioning FB start command (nozzle drive axis)
gl_MoveAbsolute_Drive_Position	Double-precision real number	Absolute value positioning FB target position (nozzle drive axis)
gb_PositionAdjustComp_Drive	Bit	Nozzle drive axis positioning complete flag
MCv_AdvancedSync_Drive	MCv_AdvancedSync	Advanced synchronous control FB (nozzle drive axis)
gb_AdvSync_Drive_Enable	Bit	Advanced synchronous control FB start command (nozzle drive axis)
gdw_AdvSync_Drive_Options	Double word [unsigned]/bit string [32-bit]	Advanced synchronous control FB option (nozzle drive axis)
gb_AdvSync_Drive_InSync	Bit	Advanced synchronous control FB synchronizing (nozzle drive axis)
MC_MoveAbsolute_Nozzle	MC_MoveAbsolute	Absolute value positioning FB (nozzle axis positioning)
gb_MoveAbsolute_Nozzle_Execute	Bit	Absolute value positioning FB start command (nozzle axis)
gl_MoveAbsolute_Nozzle_Position	Double-precision real number	Absolute value positioning FB target position (nozzle axis)
gb_PositionAdjustComp_Nozzle	Bit	Nozzle axis positioning complete flag
MCv_AdvancedSync_Nozzle	MCv_AdvancedSync	Advanced synchronous control FB (nozzle axis)
gb_AdvSync_Nozzle_Enable	Bit	Advanced synchronous control FB start command (nozzle axis)
gdw_AdvSync_Nozzle_Options	Double word [unsigned]/bit string [32-bit]	Advanced synchronous control FB option (nozzle axis)
gb_AdvSync_Nozzle_InSync	Bit	Advanced synchronous control FB synchronizing (nozzle axis)
gw_SelectRestoreMode	Word [signed]	Restoration mode selection at system restart
g_CamTableID_Drive	MC_CAM_ID	Cam ID (nozzle axis)
g_CamTableID_Nozzle	MC_CAM_ID	Cam ID (nozzle drive axis)
MCv_AdvCamSetPositionCalc_Nozzle	MCv_AdvCamSetPositionCalc	Advanced synchronous control cam set position calculation FB (nozzle axis)
gb_AdvCamSetPositionCalc_Nozzle_Execute	Bit	Advanced synchronous control cam set position calculation FB execution command (nozzle axis)
gl_AdvCamSetPositionCalc_Nozzle_PositionPerCycle	Double-precision real number	Advanced synchronous control cam set position calculation FB current position per cycle (nozzle axis)
gl_AdvCamSetPositionCalc_Nozzle_LengthPercycle	Double-precision real number	Advanced synchronous control cam set position calculation FB length per cycle (nozzle axis)
gl_AdvCamSetPositionCalc_Nozzle_StrokeAmount	Double-precision real number	Advanced synchronous control cam set position calculation FB stroke amount (nozzle axis)
gl_AdvCamSetPositionCalc_Nozzle_ReferenceSetPosition	Double-precision real number	Advanced synchronous control cam set position calculation FB cam reference position (nozzle axis)
MCv_AdvCamSetPositionCalc_Drive	MCv_AdvCamSetPositionCalc	Advanced synchronous control cam set position calculation FB (nozzle drive axis)
gb_AdvCamSetPositionCalc_Drive_Execute	Bit	Advanced synchronous control cam set position calculation FB execution command (nozzle drive axis)
gl_AdvCamSetPositionCalc_Drive_PositionPerCycle	Double-precision real number	Advanced synchronous control cam set position calculation FB current position per cycle (nozzle drive axis)
gl_AdvCamSetPositionCalc_Drive_LengthPercycle	Double-precision real number	Advanced synchronous control cam set position calculation FB length per cycle (nozzle drive axis)
gl_AdvCamSetPositionCalc_Drive_StrokeAmount	Double-precision real number	Advanced synchronous control cam set position calculation FB stroke amount (nozzle drive axis)

Label name	Data type	Comment
gl_AdvCamSetPositionCalc_Drive_ReferenceSetPosition	Double-precision real number	Advanced synchronous control cam set position calculation FB cam reference position (nozzle drive axis)
MCv_AdvPositionPerCycleCalc_Nozzle	MCv_AdvPositionPerCycleCalc	Advanced synchronous control current position per cycle calculation FB (nozzle axis)
gb_AdvPositionPerCycleCalc_Nozzle_Execute	Bit	Advanced synchronous control current position per cycle calculation FB execution command (nozzle axis)
gl_AdvPositionPerCycleCalc_Nozzle_PositionPerCycle	Double-precision real number	Advanced synchronous control current position per cycle calculation FB current position per cycle (nozzle axis)
gl_AdvPositionPerCycleCalc_Nozzle_LengthPercycle	Double-precision real number	Advanced synchronous control current position per cycle calculation FB length per cycle (nozzle axis)
gl_AdvPositionPerCycleCalc_Nozzle_StrokeAmount	Double-precision real number	Advanced synchronous control current position per cycle calculation FB stroke amount (nozzle axis)
gl_AdvPositionPerCycleCalc_Nozzle_ReferenceSetPosition	Double-precision real number	Advanced synchronous control current position per cycle calculation FB cam reference position (nozzle axis)
gl_AdvPositionPerCycleCalc_Nozzle_SetPosition	Double-precision real number	Advanced synchronous control current position per cycle calculation FB cam set position (nozzle axis)
gdw_AdvInput_Conveyor_CumulativePosition	Double word [signed]	Cumulative current position (conveyor axis) A temporary variable for rounding the cumulative current position to the current position per cycle range
gdw_AdvOutput_Nozzle_LengthPerCycle	Double word [signed]	Current position per cycle (nozzle axis) A temporary variable for rounding the cumulative current position to the current position per cycle range
gdw_AdvOutput_Drive_LengthPerCycle	Double word [signed]	Current position per cycle (nozzle drive axis) A temporary variable for rounding the cumulative current position to the current position per cycle range
RESTORE_POSITION_PER_CYCLE_FOR_PREPROMODE	Word [signed]	Restoration mode selection at system restart: Current position per cycle restoration (analysis mode) (constant = 1)
RESTORE_POSITION_PER_CYCLE_FOR_CAMCALCFUNC	Word [signed]	Restoration mode selection at system restart: Current position per cycle restoration (cam position calculation function) (constant = 2)
RESTORE_SETPOSITION_FOR_PREPROMODE	Word [signed]	Restoration mode selection at system restart: Cam set position restoration (analysis mode) (constant = 3)
RESTORE_SETPOSITION_FOR_CAMCALCFUNC	Word [signed]	Restoration mode selection at system restart: Cam set position restoration (cam position calculation function) (constant = 4)

■Starting advanced synchronous control (restart)

When restarting advanced synchronous control, select a restoration method suitable for the configuration and application of the equipment and start the advanced synchronous control FB. Additionally, use "synchronous control analysis mode" or "cam position calculation function" when recalculating to synchronize the input axis and output axis in order to restart advanced synchronous control.

An example of restoration procedures when using "synchronous control analysis mode" or "cam position calculation function" is shown below.

No.	Restoration method	Using method	Application
1	Current position per cycle restoration	Synchronous control analysis mode	Restart synchronization after moving the nozzle axis to the retract point.
2		Cam position calculation function (MCv_AdvCamSetPositionCalc (Advanced synchronous control current position per cycle calculation))	
3	Cam set position restoration	Synchronous control analysis mode	Restart with the phases of input axis cumulative current position and the output axis current position per cycle matched. (When the workpiece has not been set)
4		Cam position calculation function (MCv_AdvPositionPerCycleCalc (Advanced synchronous control cam set position calculation))	

Point

For restoration after turning on the motion system power again, the input axis and output axis must be set to an absolute position detection system.

Operating procedure

■No.1 "Restart synchronization after moving the nozzle axis to the retract point" (when using synchronous control analysis mode)

1. Position the output axis (Nozzle) to the retract point (position of stroke amount "50%").
2. Set the synchronous control initial position parameters of the output axis (Nozzle) as follows, and execute the advanced synchronous control FB with the synchronous control analysis mode setting (Options (Options): Bit 16) set to "1: Enabled".

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	0: Current position per cycle restoration (RestorePositionPerCycle)
Setting method of cam reference position • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Current position per cycle (initial setting) • AdvOutput_NozzleDrive.Pr.Restore.InitialPositionPerCycle	0.0

3. To calculate the Cam set position (AdvOutput_Drive.Md.Cam.SetPosition) at the start of advanced synchronous control of the output axis (NozzleDrive) based on the current position per cycle calculated in step 2, set the synchronous control initial position parameters of the output axis (NozzleDrive) as follows, and execute the advanced synchronous control FB with the synchronous control analysis mode setting (Options (Options): Bit 16) set to "1: Enabled".

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject	2: Cam set position restoration (RestoreCamSetPosition)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Setting method of current position per cycle • AdvOutput_NozzleDrive.Pr.Restore.PositionPerCycleMethod	1: Current position per cycle (initial setting) (InitialPositionPerCycle)
Current position per cycle (initial setting) • AdvOutput_NozzleDrive.Pr.Restore.InitialPositionPerCycle	Current position per cycle calculated in step 2 • AdvOutput_Nozzle.Md.Cam.PositionPerCycle

4. After synchronous control analysis mode execution completion (MCv_AdvancedSync.Done is TRUE), position the nozzle drive axis (NozzleDrive) to the position of the updated Cam set position (AdvOutput_Drive.Md.Cam.SetPosition).
5. Set the synchronous control initial position parameters of the output axes (NozzleDrive and Nozzle) as follows, and start (change Execute from FALSE to TRUE) the advanced synchronous control FB.

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	0: Current position per cycle restoration (RestorePositionPerCycle)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Current position per cycle (initial setting) • AdvOutput_NozzleDrive.Pr.Restore.InitialPositionPerCycle • AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle	Current position per cycle calculated in step 2 • AdvOutput_Nozzle.Md.Cam.PositionPerCycle

• Example program

■Nozzle drive axis

ST program*1

```
// Select For Restore Target
CASE gw_SelectRestoreMode OF
RESTORE_POSITION_PER_CYCLE_FOR_PREPROMODE :
  // Set Restore Parameter
  AdvOutput_Drive.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
  AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestoreCamSetPosition;
  AdvOutput_Drive.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
  AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__InitialPositionPerCycle;
  AdvOutput_Drive.Pr.Restore.InitialPositionPerCycle:=gl_Restored_Nozzle_PositionPerCycle;

  // Positionadjustment
  IF gb_PositionAdjustComp_Nozzle THEN
    IF NOT(gb_PositionAdjustComp_Drive) THEN
      IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
        gdw_AdvSync_Drive_Options:=H00010000;
        gb_AdvSync_Drive_Enable:=TRUE;

        IF MCv_AdvancedSync_Drive.Done THEN
          gl_MoveAbsolute_Drive_Position:=AdvOutput_Drive.Md.Cam.SetPosition;
          gb_MoveAbsolute_Drive_Execute:=TRUE;
        END_IF;

        IF MC_MoveAbsolute_Drive.Done THEN
          gb_AdvSync_Drive_Enable:=FALSE;
          gb_MoveAbsolute_Drive_Execute:=FALSE;
          gb_PositionAdjustComp_Drive:=TRUE;
        END_IF;
      END_IF;
      ELSE
      IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
        NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
        NOT(MCv_AdvancedSync_Drive.Done) THEN
        // Set Restore Parameter
        AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
        AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__InitialPositionPerCycle;
        AdvOutput_Drive.Pr.Restore.InitialPositionPerCycle:=gl_Restored_Nozzle_PositionPerCycle;
        gdw_AdvSync_Drive_Options:=H00000000;
        gb_AdvSync_Drive_Enable:=TRUE;
      END_IF;
    END_IF;
  ND_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■Nozzle axis

ST program*1

```
// Select For Restore Target
CASE gw_SelectRestoreMode OF
RESTORE_POSITION_PER_CYCLE_FOR_PREPROMODE :
  // AdvSync Restart(Nozzle)
  AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
  AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
  AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
  AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle:=0.0;
  // Positionadjustment
  IF NOT(gb_PositionAdjustComp_Nozzle) THEN
    IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
        gl_MoveAbsolute_Nozzle_Position:=AdvOutput_Nozzle.Pr.Cam.StrokeAmount * 0.5;
        gb_MoveAbsolute_Nozzle_Execute:=TRUE;
      IF MC_MoveAbsolute_Nozzle.Done THEN
        gdw_AdvSync_Nozzle_Options:=H00010000;
        gb_AdvSync_Nozzle_Enable:=TRUE;
      END_IF;

      IF MCv_AdvancedSync_Nozzle.Done THEN
        gl_Restored_Nozzle_PositionPerCycle:=AdvOutput_Nozzle.Md.Cam.PositionPerCycle;
        gb_AdvSync_Nozzle_Enable:=FALSE;
        gb_PositionAdjustComp_Nozzle:=TRUE;
      END_IF;
    END_IF;
    ELSE
    IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
      NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
      NOT(MCv_AdvancedSync_Nozzle.Done) THEN
      AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__InitialPositionPerCycle;
      AdvOutput_Drive.Pr.Restore.InitialPositionPerCycle:=gl_Restored_Nozzle_PositionPerCycle;
      gdw_AdvSync_Nozzle_Options:=H00000000;
      gb_AdvSync_Nozzle_Enable:=TRUE;
    END_IF;
  END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

- Labels used: For the labels used in the program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■No.2 "Restart synchronization after moving the nozzle axis to the retract point" (when using cam position calculation function (MCv_AdvCamSetPositionCalc (Advanced Synchronous Control Current Position Per Cycle Calculation)))

1. Position the output axis (Nozzle) to the retract point (position of stroke amount "50%").
2. Calculate the current position per cycle based on the set position of the output axis (output axis (Nozzle) in this case) which keeps the set position.

Setting item	Setting value
Cam table ID • MCv_AdvPositionPerCycleCalc_Nozzle.CamTableID	Cam No. of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.CamNo
Cam position length per cycle • MCv_AdvPositionPerCycleCalc_Nozzle.LengthPerCycle	Length per cycle of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.LengthPerCycle
Cam position calculation stroke amount • MCv_AdvPositionPerCycleCalc_Nozzle.StrokeAmount	Stroke amount of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.StrokeAmount
Cam position calculation cam set position • MCv_AdvPositionPerCycleCalc_Nozzle.CamSetPosition	Set position of output axis (Nozzle) • AdvOutput_Nozzle.Md.SetPosition
Cam position calculation cam reference position • MCv_AdvPositionPerCycleCalc_Nozzle.ReferenceSetPosition	Cam reference position of output axis (Nozzle) • AdvOutput_Nozzle.Md.Cam.ReferenceSetPosition
Cam position calculation current position per cycle • MCv_AdvPositionPerCycleCalc_Nozzle.PositionPerCycle	Current position per cycle of output axis (Nozzle) • AdvOutput_Nozzle.Md.Cam.PositionPerCycle

3. Calculate the cam set position of the output axis (NozzleDrive) based on the current position per cycle calculated in step 2.

Setting item	Setting value
Cam table ID • MCv_AdvCamSetPositionCalc_Drive.CamTableID	Cam No. of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.CamNo
Cam position length per cycle • MCv_AdvCamSetPositionCalc_Drive.LengthPerCycle	Length per cycle of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.LengthPerCycle
Cam position calculation stroke amount • MCv_AdvCamSetPositionCalc_Drive.StrokeAmount	Stroke amount of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.StrokeAmount
Cam position calculation cam reference position • MCv_AdvCamSetPositionCalc_Drive.ReferenceSetPosition	Cam reference position of output axis (NozzleDrive) • AdvOutput_Drive.Md.Cam.ReferenceSetPosition
Cam position calculation current position per cycle • MCv_AdvCamSetPositionCalc_Drive.PositionPerCycle	Current position per cycle calculated in step 2 • MCv_AdvPositionPerCycleCalc.CalculationResult

4. Position the output axis (NozzleDrive) to the cam set position calculated in step 3, and match the current position per cycle of the output axis (Nozzle) and output axis (NozzleDrive).
5. Set the synchronous control initial position parameters of the output axes (NozzleDrive and Nozzle) as shown below, and start (change Enable from FALSE to TRUE) the advanced synchronous control FB.

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	0: Current position per cycle restoration (RestorePositionPerCycle)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Setting method of current position per cycle • AdvOutput_NozzleDrive.Pr.Restore.PositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod	1: Current position per cycle (initial setting) (InitialPositionPerCycle)
Current position per cycle (initial setting) • AdvOutput_NozzleDrive.Pr.Restore.InitialPositionPerCycle • AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle	Current position per cycle calculated in step 2 • MCv_AdvPositionPerCycleCalc.CalculationResult

• Example program

■Nozzle drive axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
  // AdvSync Restart(NozzleDrive)

  // Select For Restore Target
  CASE gw_SelectRestoreMode OF
<Omission>
  RESTORE_POSITION_PER_CYCLE_FOR_CAMCALCFUNC :
    // Set Restore Parameter
    AdvOutput_Drive.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
    AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
    AdvOutput_Drive.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
    AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__InitialPositionPerCycle;
    AdvOutput_Drive.Pr.Restore.InitialPositionPerCycle:=gl_Restored_Nozzle_PositionPerCycle;

    // Positionadjustment
    IF gb_PositionAdjustComp_Nozzle THEN
      IF NOT(gb_PositionAdjustComp_Drive) THEN
        IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
          g_CamTableID_Drive.ProfileID.Number := AdvOutput_Drive.Pr.Cam.CamNo;
          gl_AdvCamSetPositionCalc_Drive_LengthPercycle := AdvOutput_Drive.Pr.Cam.LengthPerCycle;
          gl_AdvCamSetPositionCalc_Drive_StrokeAmount := AdvOutput_Drive.Pr.Cam.StrokeAmount;
          gl_AdvCamSetPositionCalc_Drive_ReferenceSetPosition := AdvOutput_Drive.Md.Cam.ReferenceSetPosition;
          gl_AdvCamSetPositionCalc_Drive_PositionPerCycle := gl_Restored_Nozzle_PositionPerCycle;
          gb_AdvCamSetPositionCalc_Drive_Execute := TRUE;

          IF MCv_AdvCamSetPositionCalc_Drive.Done THEN
            gl_MoveAbsolute_Drive_Position:=MCv_AdvCamSetPositionCalc_Drive.CalculationResult;
            gb_MoveAbsolute_Drive_Execute:=TRUE;
          END_IF;

          IF MC_MoveAbsolute_Drive.Done THEN
            gb_AdvSync_Drive_Enable:=FALSE;
            gb_MoveAbsolute_Drive_Execute:=FALSE;
            gb_PositionAdjustComp_Drive:=TRUE;
          END_IF;
        END_IF;
      ELSE
        IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
          NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
          NOT(MCv_AdvancedSync_Drive.Done) THEN
          gdw_AdvSync_Drive_Options:=H00000000;
          gb_AdvSync_Drive_Enable:=TRUE;
        END_IF;
      END_IF;
    END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■Nozzle axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
  // AdvSync Restart(Nozzle)

  // Select For Restore Target
  CASE gw_SelectRestoreMode OF
<Omission>
  RESTORE_POSITION_PER_CYCLE_FOR_CAMCALCFUNC :
    // Set Restore Parameter
    AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
    AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestorePositionPerCycle;
    AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
    AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__InitialPositionPerCycle;
    AdvOutput_Nozzle.Pr.Restore.InitialPositionPerCycle:=gl_Restored_Nozzle_PositionPerCycle;

    // Positionadjustment
    IF NOT(gb_PositionAdjustComp_Nozzle) THEN
      IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
        gl_MoveAbsolute_Nozzle_Position:=AdvOutput_Nozzle.Pr.Cam.StrokeAmount * 0.5;
        gb_MoveAbsolute_Nozzle_Execute:=TRUE;
        IF MC_MoveAbsolute_Nozzle.Done THEN
          g_CamTableID_Nozzle.ProfileID.Number := AdvOutput_Nozzle.Pr.Cam.CamNo;
          gl_AdvPositionPerCycleCalc_Nozzle_LengthPercycle := AdvOutput_Nozzle.Pr.Cam.LengthPerCycle;
          gl_AdvPositionPerCycleCalc_Nozzle_StrokeAmount := AdvOutput_Nozzle.Pr.Cam.StrokeAmount;
          gl_AdvPositionPerCycleCalc_Nozzle_ReferenceSetPosition := AdvOutput_Nozzle.Md.Cam.ReferenceSetPosition;
          gl_AdvPositionPerCycleCalc_Nozzle_SetPosition := Nozzle.Md.SetPosition;
          gl_AdvPositionPerCycleCalc_Nozzle_PositionPerCycle := 0.0;
          gb_AdvPositionPerCycleCalc_Nozzle_Execute := TRUE;
        END_IF;
        IF MCv_AdvPositionPerCycleCalc_Nozzle.Done THEN
          gl_Restored_Nozzle_PositionPerCycle := MCv_AdvPositionPerCycleCalc_Nozzle.CalculationResult;
          gb_AdvSync_Nozzle_Enable:=FALSE;
          gb_PositionAdjustComp_Nozzle:=TRUE;
        END_IF;
      END_IF;
    ELSE
      IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
        NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
        NOT(MCv_AdvancedSync_Nozzle.Done) THEN
        gdw_AdvSync_Nozzle_Options:=H00000000;
        gb_AdvSync_Nozzle_Enable:=TRUE;
      END_IF;
    END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

• Labels used: For the labels used in the program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■No.3 "Restart with the phases of input axis cumulative current position and the output axis current position per cycle matched" (when using synchronous control analysis mode)

1. Set the synchronous control initial position parameters of the output axes (NozzleDrive and Nozzle) as follows, and execute the advanced synchronous control FB with the synchronous control analysis mode setting (Options (Options): Bit 16) set to "1: Enabled".
2. After synchronous control analysis mode execution completion (MCv_AdvancedSync.Done is TRUE), use the updated Cam set position (AdvOutput_Drive.Md.Cam.SetPosition, AdvOutput_Nozzle.Md.Cam.SetPosition) to position the nozzle drive axis (NozzleDrive) and nozzle axis (Nozzle) to the position of the updated cam set position.
3. Set the synchronous control analysis mode setting (Options (Options): Bit 16) to "0: Disabled" and start (change Enable from FALSE to TRUE) the advanced synchronous control FB again.

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	2: Cam set position restoration (RestoreCamSetPosition)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Setting method of current position per cycle • AdvOutput_NozzleDrive.Pr.Restore.PositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod	2: Current position per cycle after main shaft gear (MasterGearPositionPerCycle)

• Example program

■Nozzle drive axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
  // AdvSync Restart(NozzleDrive)

  // Select For Restore Target
  CASE gw_SelectRestoreMode OF
<Omission>
  RESTORE_SETPOSITION_FOR_PREPROMODE :
    // Set Restore Parameter
    AdvOutput_Drive.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
    AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestoreCamSetPosition;
    AdvOutput_Drive.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
    AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__MasterGearPositionPerCycle;

    // Positionadjustment
    IF NOT(gb_PositionAdjustComp_Drive) THEN
      IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
        gdw_AdvSync_Drive_Options:=H00010000;
        gb_AdvSync_Drive_Enable:=TRUE;

        IF MCv_AdvancedSync_Drive.Done THEN
          gl_MoveAbsolute_Drive_Position:=AdvOutput_Drive.Md.Cam.SetPosition;
          gb_MoveAbsolute_Drive_Execute:=TRUE;
        END_IF;

        IF MC_MoveAbsolute_Drive.Done THEN
          gb_AdvSync_Drive_Enable:=FALSE;
          gb_MoveAbsolute_Drive_Execute:=FALSE;
          gb_PositionAdjustComp_Drive:=TRUE;
        END_IF;
      END_IF;
      ELSE
      IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
        NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
        NOT(MCv_AdvancedSync_Drive.Done) THEN
        gdw_AdvSync_Drive_Options:=H00000000;
        gb_AdvSync_Drive_Enable:=TRUE;
      END_IF;
    END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■Nozzle axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
   // AdvSync Restart(Nozzle)

   // Select For Restore Target
   CASE gw_SelectRestoreMode OF
<Omission>
   RESTORE_SETPOSITION_FOR_PREPROMODE :
      // Set Restore Parameter
      AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
      AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestoreCamSetPosition;
      AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
      AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__MasterGearPositionPerCycle;

      // Positionadjustment
      IF NOT(gb_PositionAdjustComp_Nozzle) THEN
         IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
            gdw_AdvSync_Nozzle_Options:=H00010000;
            gb_AdvSync_Nozzle_Enable:=TRUE;

            IF MCv_AdvancedSync_Nozzle.Done THEN
               gl_MoveAbsolute_Nozzle_Position:=AdvOutput_Nozzle.Md.Cam.SetPosition;
               gb_MoveAbsolute_Nozzle_Execute:=TRUE;
            END_IF;

            IF MC_MoveAbsolute_Nozzle.Done THEN
               gb_AdvSync_Nozzle_Enable:=FALSE;
               gb_MoveAbsolute_Nozzle_Execute:=FALSE;
               gb_PositionAdjustComp_Nozzle:=TRUE;
            END_IF;
         END_IF;
         ELSE
         IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
            Nozzle.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
            NOT(MCv_AdvancedSync_Nozzle.Done) THEN
            gdw_AdvSync_Nozzle_Options:=H00000000;
            gb_AdvSync_Nozzle_Enable:=TRUE;
         END_IF;
      END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

• Labels used: For the labels used in the program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■No.4 "Restart with the phases of input axis cumulative current position and the output axis current position per cycle matched" (when using the cam position calculation function (MCv_AdvPositionPerCyclecalc (Advanced Synchronous Control Cam Set Position Calculation)))

1. Use the cumulative current position of the input axis (Conveyor) to calculate the cam set position with the following settings, and calculate the cam set position of the output axes (NozzleDrive and Nozzle).

Setting item	Setting value	
	Output axis (NozzleDrive)	Output axis (Nozzle)
Cam table ID • MCv_AdvCamSetPositionCalc_Drive.CamTableID • MCv_AdvCamSetPositionCalc_Nozzle.CamTableID	Cam No. of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.CamNo	Cam No. of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.CamNo
Cam position length per cycle • MCv_AdvCamSetPositionCalc_Drive.LengthPerCycle • MCv_AdvCamSetPositionCalc_Nozzle.LengthPerCycle	Length per cycle of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.LengthPerCycle	Length per cycle of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.LengthPerCycle
Cam position calculation stroke amount • MCv_AdvCamSetPositionCalc_Drive.StrokeAmount • MCv_AdvCamSetPositionCalc_Nozzle.StrokeAmount	Stroke amount of output axis (NozzleDrive) • AdvOutput_Drive.Pr.Cam.StrokeAmount	Stroke amount of output axis (Nozzle) • AdvOutput_Nozzle.Pr.Cam.StrokeAmount
Cam position calculation cam reference position • MCv_AdvCamSetPositionCalc_Drive.ReferenceSetPosition • MCv_AdvCamSetPositionCalc_Nozzle.ReferenceSetPosition	Cam reference position of output axis (NozzleDrive) • AdvOutput_Drive.Md.Cam.ReferenceSetPosition	Cam reference position of output axis (Nozzle) • AdvOutput_Nozzle.Md.Cam.ReferenceSetPosition
Cam position calculation current position per cycle • MCv_AdvCamSetPositionCalc_Drive.PositionPerCycle • MCv_AdvCamSetPositionCalc_Nozzle.PositionPerCycle	The value of the input axis (Conveyor) cumulative current position rounded within the cam position length per cycle*1	The value of the input axis (Conveyor) cumulative current position rounded within the cam position length per cycle*1

*1 When main shaft/auxiliary shaft gear or main shaft/auxiliary shaft speed change gear are set, the gear ratio and speed change ratio for the movement amount from synchronization stop until restart need to be taken into account of in the calculation. When setting gears and speed change gears, using synchronous control analysis mode is recommended.

2. Position to the position of the cam set position (MCv_AdvCamSetPositionCalc.CalculationResult) calculated with the nozzle drive axis (NozzleDrive) and nozzle axis (Nozzle) in step 1.

3. Set the synchronous control initial position parameters of the output axes (NozzleDrive and Nozzle) as shown below, and start (change Enable from FALSE to TRUE) the advanced synchronous control FB.

Setting item	Setting value
Setting method of current position per cycle after main shaft gear • AdvOutput_NozzleDrive.Pr.Restore.MasterGearPositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod	2: Calculate from input axis (CalculateFromInputAxis)
Cam axis position restoration object • AdvOutput_NozzleDrive.Pr.Restore.PositionRestorationObject • AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject	2: Cam set position restoration (RestoreCamSetPosition)
Setting method of cam reference position • AdvOutput_NozzleDrive.Pr.Restore.ReferenceSetPositionMethod • AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod	0: Previous value (PreviousPosition)
Setting method of current position per cycle • AdvOutput_NozzleDrive.Pr.Restore.PositionPerCycleMethod • AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod	2: Current position per cycle after main shaft gear (MasterGearPositionPerCycle)

• Example program

■Nozzle drive axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
  // AdvSync Restart(NozzleDrive)

  // Select For Restore Target
  CASE gw_SelectRestoreMode OF
<Omission>
  RESTORE_SETPOSITION_FOR_CAMCALCFUNC :
    // Set Restore Parameter
    AdvOutput_Drive.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
    AdvOutput_Drive.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestoreCamSetPosition;
    AdvOutput_Drive.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
    AdvOutput_Drive.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__MasterGearPositionPerCycle;

    // Positionadjustment
    IF NOT(gb_PositionAdjustComp_Drive) THEN
      IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
        g_CamTableID_Drive.ProfileID.Number := AdvOutput_Drive.Pr.Cam.CamNo;
        gl_AdvCamSetPositionCalc_Drive_LengthPercycle := AdvOutput_Drive.Pr.Cam.LengthPerCycle;
        gl_AdvCamSetPositionCalc_Drive_StrokeAmount := AdvOutput_Drive.Pr.Cam.StrokeAmount;
        gl_AdvCamSetPositionCalc_Drive_ReferenceSetPosition := AdvOutput_Drive.Md.Cam.ReferenceSetPosition;

        //Rounding PositionPerCycle
        gdw_AdvInput_Conveyor_CumulativePosition := LREAL_TO_DINT(AdvInput_Conveyor.Md.CumulativePosition);
        gdw_AdvOutput_Drive_LengthPerCycle := LREAL_TO_DINT(AdvOutput_Drive.Pr.Cam.LengthPerCycle);
        IF AdvInput_Conveyor.Md.CumulativePosition < 0.0 THEN
          gl_AdvCamSetPositionCalc_Drive_PositionPerCycle := AdvInput_Conveyor.Md.CumulativePosition -
                                                             (DINT_TO_LREAL(DIV((gdw_AdvInput_Conveyor_CumulativePosition + 1) ,
                                                             gdw_AdvOutput_Drive_LengthPerCycle) - 1) *
                                                             AdvOutput_Drive.Pr.Cam.LengthPerCycle);
        ELSE
          gl_AdvCamSetPositionCalc_Drive_PositionPerCycle := AdvInput_Conveyor.Md.CumulativePosition -
                                                             (DINT_TO_LREAL(DIV(gdw_AdvInput_Conveyor_CumulativePosition ,
                                                             gdw_AdvOutput_Drive_LengthPerCycle)) *
                                                             AdvOutput_Drive.Pr.Cam.LengthPerCycle);
        END_IF;
        gb_AdvCamSetPositionCalc_Drive_Execute := TRUE;

        IF MCv_AdvCamSetPositionCalc_Drive.Done THEN
          gl_MoveAbsolute_Drive_Position:=MCv_AdvCamSetPositionCalc_Drive.CalculationResult;
          gb_MoveAbsolute_Drive_Execute:=TRUE;
        END_IF;

        IF MC_MoveAbsolute_Drive.Done THEN
          gb_AdvSync_Drive_Enable:=FALSE;
          gb_MoveAbsolute_Drive_Execute:=FALSE;
          gb_PositionAdjustComp_Drive:=TRUE;
        END_IF;
      END_IF;
      ELSE
      IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
        NozzleDrive.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
        NOT(MCv_AdvancedSync_Drive.Done) THEN
        gdw_AdvSync_Drive_Options:=H00000000;
        gb_AdvSync_Drive_Enable:=TRUE;
      END_IF;
    END_IF;

  ELSE
    ;
  END_CASE;
END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■Nozzle axis

ST program*1

```
IF gb_SystemStart AND gb_SyncRestart THEN
   // AdvSync Restart(Nozzle)

   // Select For Restore Target
   CASE gw_SelectRestoreMode OF
<Omission>
   RESTORE_SETPOSITION_FOR_CAMCALCFUNC :
      // Set Restore Parameter
      AdvOutput_Nozzle.Pr.Restore.MasterGearPositionPerCycleMethod:=MC_GEAR_RESTORE_METHOD__CalculateFromInputAxis;
      AdvOutput_Nozzle.Pr.Restore.PositionRestorationObject:=MC_CAM_RESTORE_METHOD__RestoreCamSetPosition;
      AdvOutput_Nozzle.Pr.Restore.ReferenceSetPositionMethod:=MC_CAM_REFERENCE_METHOD__PreviousPosition;
      AdvOutput_Nozzle.Pr.Restore.PositionPerCycleMethod:=MC_CAM_CYCLE_METHOD__MasterGearPositionPerCycle;

      // Positionadjustment
      IF NOT(gb_PositionAdjustComp_Nozzle) THEN
         IF AdvInput_Conveyor.Md.ActiveStatus=1 THEN
            g_CamTableID_Nozzle.ProfileID.Number := AdvOutput_Nozzle.Pr.Cam.CamNo;
            gb_AdvCamSetPositionCalc_Nozzle_Execute := TRUE;
            gl_AdvCamSetPositionCalc_Nozzle_LengthPercycle := AdvOutput_Nozzle.Pr.Cam.LengthPerCycle;
            gl_AdvCamSetPositionCalc_Nozzle_StrokeAmount := AdvOutput_Nozzle.Pr.Cam.StrokeAmount;
            gl_AdvCamSetPositionCalc_Nozzle_ReferenceSetPosition := AdvOutput_Nozzle.Md.Cam.ReferenceSetPosition;

            //rounding
            gdw_AdvInput_Conveyor_CumulativePosition := LREAL_TO_DINT(AdvInput_Conveyor.Md.CumulativePosition);
            gdw_AdvOutput_Nozzle_LengthPerCycle := LREAL_TO_DINT(AdvOutput_Nozzle.Pr.Cam.LengthPerCycle);
            IF AdvInput_Conveyor.Md.CumulativePosition < 0.0 THEN
               gl_AdvCamSetPositionCalc_Nozzle_PositionPerCycle := AdvInput_Conveyor.Md.CumulativePosition -
                                                                   (DINT_TO_LREAL(DIV((gdw_AdvInput_Conveyor_CumulativePosition + 1) ,
                                                                   gdw_AdvOutput_Nozzle_LengthPerCycle) - 1) *
                                                                   AdvOutput_Nozzle.Pr.Cam.LengthPerCycle);
               ELSE
               gl_AdvCamSetPositionCalc_Nozzle_PositionPerCycle := AdvInput_Conveyor.Md.CumulativePosition -
                                                                   (DINT_TO_LREAL(DIV(gdw_AdvInput_Conveyor_CumulativePosition ,
                                                                    gdw_AdvOutput_Nozzle_LengthPerCycle)) *
                                                                   AdvOutput_Nozzle.Pr.Cam.LengthPerCycle);
            END_IF;
            IF MCv_AdvCamSetPositionCalc_Nozzle.Done THEN
               gl_MoveAbsolute_Nozzle_Position:=MCv_AdvCamSetPositionCalc_Nozzle.CalculationResult;
               gb_MoveAbsolute_Nozzle_Execute:=TRUE;
            END_IF;

            IF MC_MoveAbsolute_Nozzle.Done THEN
               gb_AdvSync_Nozzle_Enable:=FALSE;
               gb_MoveAbsolute_Nozzle_Execute:=FALSE;
               gb_PositionAdjustComp_Nozzle:=TRUE;
            END_IF;
         END_IF;
         ELSE
         IF AdvInput_Conveyor.Md.ActiveStatus=1 AND
            Nozzle.Md.AxisStatus=MC_AXIS_STATUS__Standstill AND
            NOT(MCv_AdvancedSync_Nozzle.Done) THEN
            gdw_AdvSync_Nozzle_Options:=H00000000;
            gb_AdvSync_Nozzle_Enable:=TRUE;
         END_IF;
      END_IF;

   ELSE      ;
   END_CASE;
END_IF;
```

*1 For the entire program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

• Labels used: For the labels used in the program, refer to the following.

☞ Page 1035 Starting advanced synchronous control (initial start)

■Starting the conveyor axis (JOG operation)

Check that the output axes are synchronized (AdvOutput_Drive.Md.SyncStatus is "1: In synchronization" and AdvOutput_Nozzle.Md.SyncStatus is "1: In synchronization") and start the conveyor axis (Conveyor).

• Example program

ST program

```
IF gb_SystemStart THEN
    // Conveyor Move
    IF AdvOutput_Drive.Md.SyncStatus=1 AND AdvOutput_Nozzle.Md.SyncStatus=1 THEN
        gl_SetSpeedComveyor:=10000000.0;
        gb_MoveConveyorReq:=TRUE;
    END_IF;
END_IF;

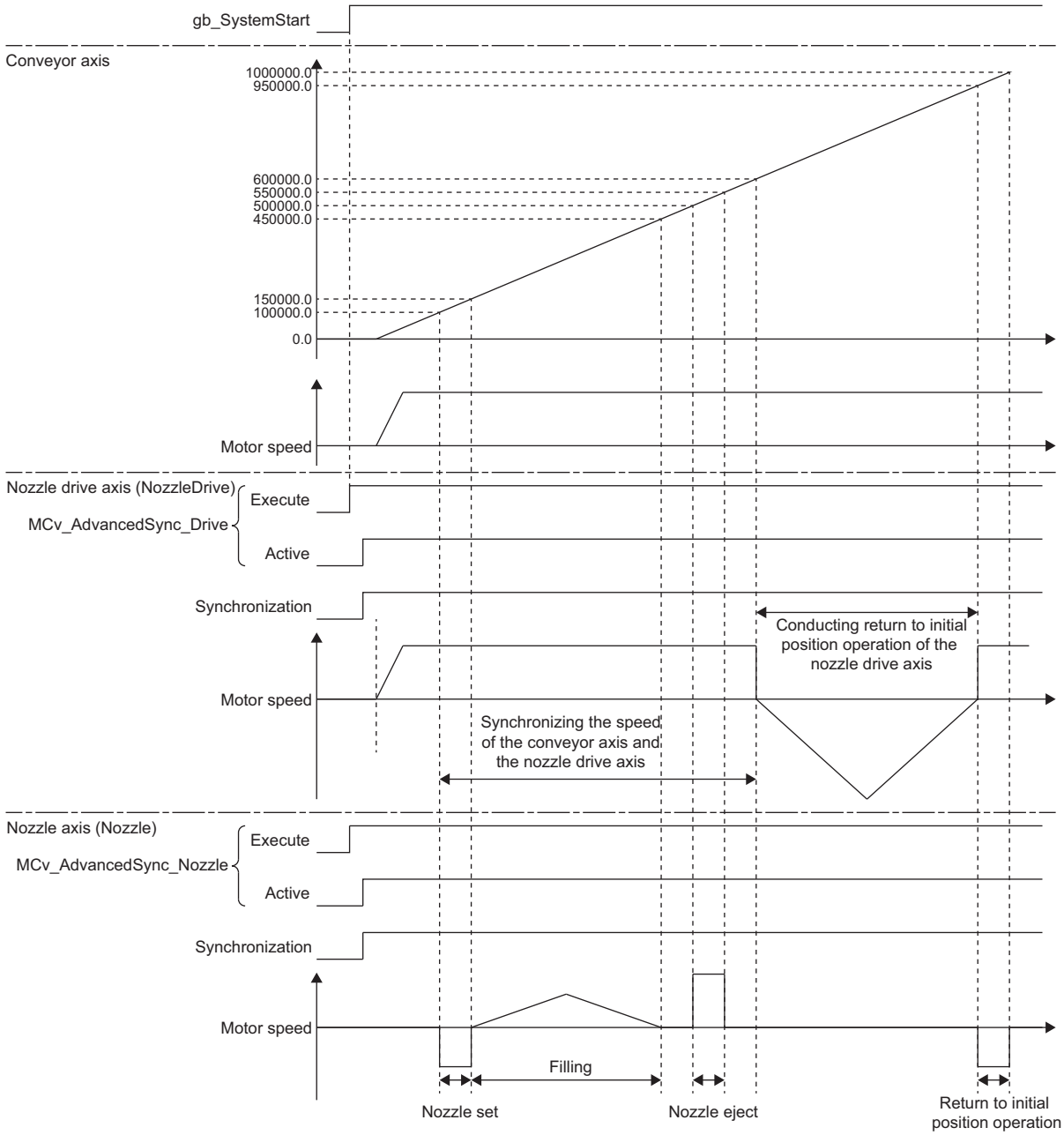
MCv_Jog_Conveyor(
    Axis:= Conveyor.AxisRef,
    JogForward:= gb_MoveConveyorReq,
    Velocity:= gl_SetSpeedComveyor,
    Acceleration:= 0.5,
    Deceleration:= 0.5,
    Options:= H0001);
```

• Labels used

Label name	Data type	Comment
gb_SystemStart	Bit	System start command
MCv_Jog_Conveyor	MCv_Jog	JOG operation FB (conveyor axis)
gb_MoveConveyorReq	Bit	Positive direction JOG operation command
gl_SetSpeedComveyor	Double-precision real number	Command velocity of JOG operation

Timing chart

The timing chart for the operation that uses the program example is shown below.



34 FUNCTIONS RELATED TO POSITION

The functions related to position have the following items.

Item	Description	Reference
Current position change function	Changes the set position and cumulative current position to any address.	Page 1054 Current Position Change Function
Command in-position	Checks the remaining distance to the target position, and turns the command in-position flag to TRUE. The command in-position flag is used as a front-loading signal indicating beforehand the completion of the control.	Page 1059 Command In-position
Software stroke limit	Sets an address as the movable range. Even if a movement command to the address outside the setting range is issued, the command will not be executed. By not executing the command outside the movable area, even if an incorrect command or unexpected operation occurs, the system will not operate out of the movable area and damage to the machine can be prevented.	Page 1061 Software Stroke Limit
Hardware stroke limit	Sets a limit switch at the upper/lower limit of the physical movable range, and stops the control by the input of a signal from the limit switch. Damage to the machine can be prevented by stopping the control before the upper/lower limit of the physical movable range is reached.	Page 1069 Hardware Stroke Limit

34.1 Current Position Change Function

This function changes the set position and cumulative current position to any address.

- The current position change method includes a method of changing the set position at control execution (MC_SetPosition (Current Position Change)). (The machine feed value is not changed.)
- The "absolute position set" and the "relative position set" can be specified in the address to change.
- This function can be executed only while Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
- A current position change to outside the ring counter range and outside the software stroke limit range cannot be executed.
- For operation when executing a current position change to the synchronous control master axis, refer to the following.

☞ Page 780 SYNCHRONOUS CONTROL

Point

When a current position change is completed, that "the current position change is executed" is recorded in the event history.

Targets to be changed and corresponding FBs

Target to be changed			Corresponding FB
Position	Current value		MC_SetPosition (Current Position Change)
	Limit value (Software stroke limit)		—*1
	Limit value (Software stroke limit)	Maximum value of the limit value	—*2

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, they cannot be changed during control.

*2 The maximum value of the limit value cannot be changed.

Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_SetPosition	Current position change	Changes the current position of the specified axis (set position, actual position).

Current position change

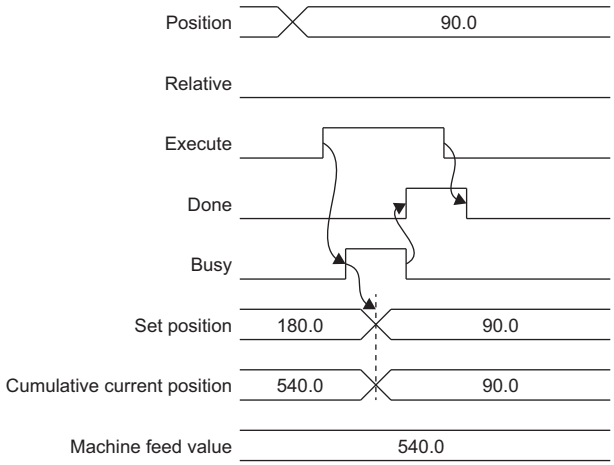
The control details of current position change are shown below.

Execution when the axis stops

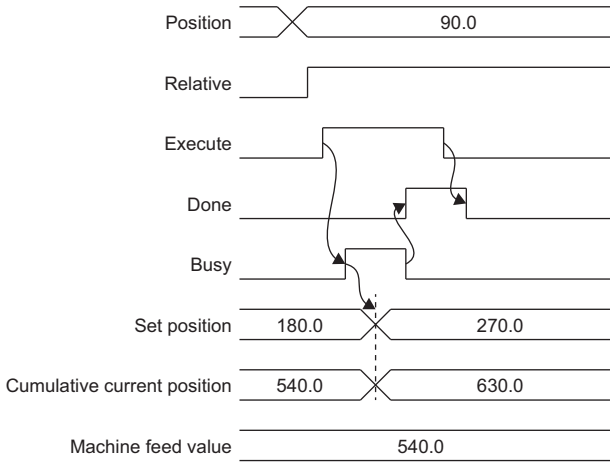
The current position change operation starts at rising edge detection of Execution command (Execute) of MC_SetPosition (Current Position Change).
In the current position change, the set position and the cumulative current position are changed to the position specified in Target position (Position).
Target position (Position) is "Relative position set" when Relative position selection (Relative) is TRUE, and it is "Absolute position set" when Relative position selection (Relative) is FALSE.

Ex.
When executing the current position change to 90.0 while the axis stops with the ring counter lower limit value of 0.0, the ring counter upper limit value of 360.0, and the set position of 180.0 (the cumulative current position of 540.0).

<When Relative position selection (Relative) is FALSE (Absolute position set)>



<When Relative position selection (Relative) is TRUE (Relative position set)>



Execution during axis operation

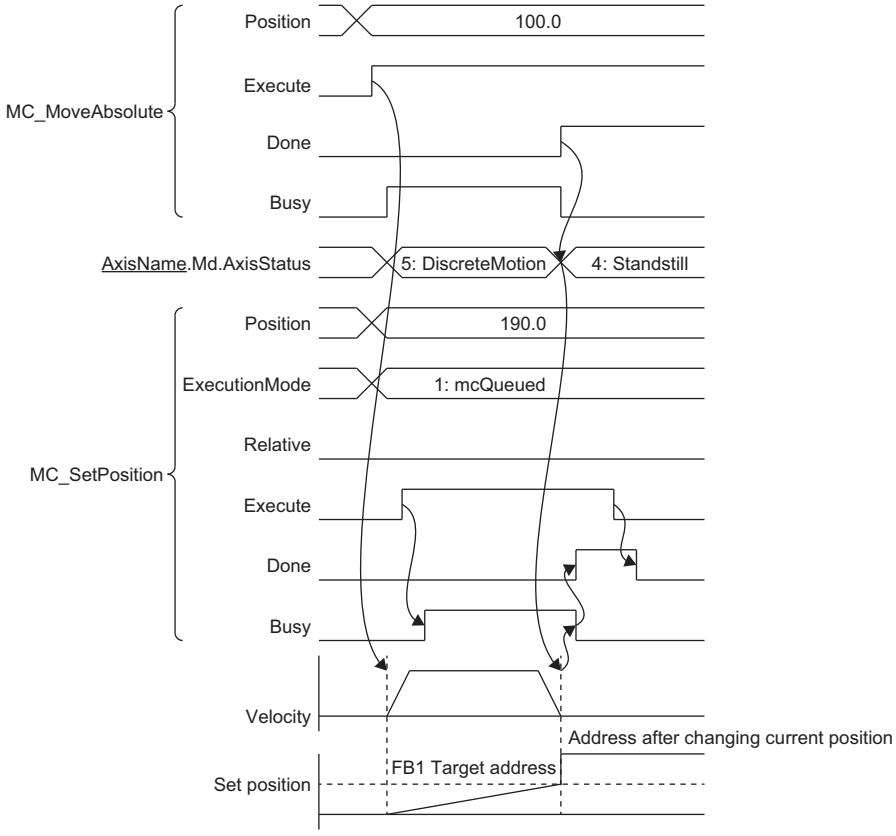
■Execute at Completion of Previous One

When "1: Execute at Completion of Previous One (mcQueued)" is set in Execution mode (ExecutionMode), this FB is executed after the on-going FB is completed.

At rising edge detection of Execution command (Execute), Executing (Busy) becomes TRUE and remains TRUE until Axis Status (AxisName.Md.AxisStatus) changes to "4: Standby (Standstill)".

As soon as Axis Status (AxisName.Md.AxisStatus) turns "4: Standby (Standstill)", the current position change operation will start.

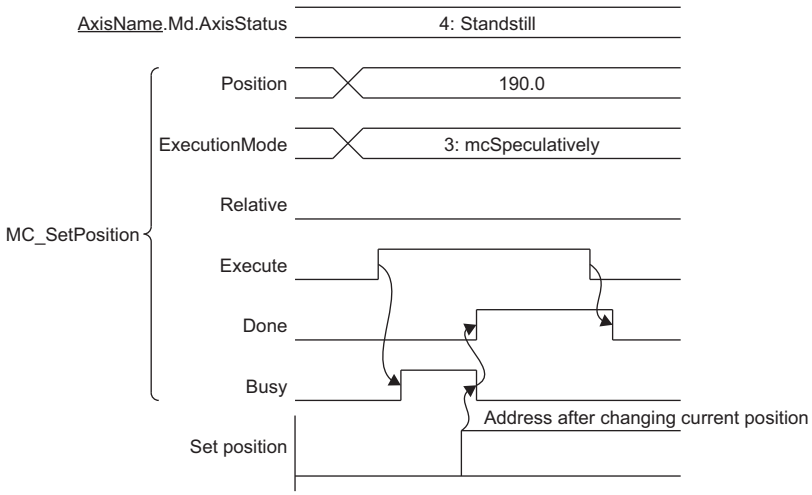
Ex.



■Speculative execution

When "3: Execute Speculatively (mcSpeculatively)" is specified to Execution mode (ExecutionMode), the current position change can be performed only when Axis Status (AxisName.Md.AxisStatus) of the relevant axis is "4: Standby (Standstill)" at the rising edge detection of Execution command (Execute). If Axis Status (AxisName.Md.AxisStatus) of the relevant axis is not "4: Standby (Standstill)", or FB instruction is being executed, MC_SetPosition instruction error (error code: 1B9CH) occurs, and the current position change is not performed.

Ex.



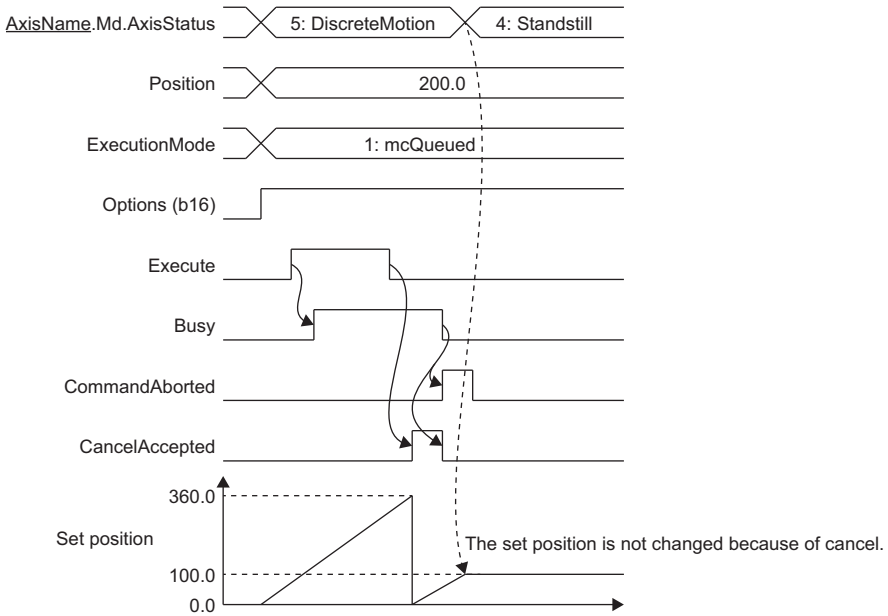
Cancel

Current position change that is in the standby status can be canceled after FB execution.

- To enable cancel, execute the FB with the status of Cancel accepted after FB start (Options (Options): bit 16) set to "1: Allow".
- Cancel is started at falling edge detection of Execution command (Execute).
- Cancel is accepted only when Executing (Busy) of the output pin is TRUE.
- When FB accepts cancel, Cancel acceptance (CancelAccepted) of the output pin becomes TRUE.
- When cancel is completed, Abortion of execution (CommandAborted) of the output pin becomes TRUE.
- When cancel was carried out, the set position is not changed.

Ex.

When canceling while Axis Status (AxisName.Md.AxisStatus) is waiting for switching to "4: Standby (Standstill)" after starting MC_SetPosition (Current Position Change) with Execution mode (ExecutionMode) set to "1: Execute at Completion of Previous One (mcQueued)"



34.2 Command In-position

This function checks the remaining distance to the target position, and turns the command in-position flag to TRUE.
The command in-position flag is used as a front-loading signal indicating beforehand the completion of the control.
The command in-position function is valid for all controls that require target address specification.
It changes Command In-position (AxisName.Md.CmdInPos) to TRUE when the remaining distance to the target position becomes Command In-position Width (AxisName.Md.CmdInPos_Width) or less.
It changes Command In-position (AxisName.Md.CmdInPos) to FALSE when the axis starts and when the FB is switched by multiple start.

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
CmdInPos_Width	Command In-position Width	Sets the command in-position width. • 0.0: Function disabled • 0.000000001 to 10000000000.0: Function enabled*1

*1 When a positive number less than 0.000000001 is set, the value is imported as "0.0".

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
CmdInPos_Width	Command In-position Width	Displays the command in-position width. • The value is the one into which the setting value of Command In-position Width (AxisName.Pr.CmdInPos_Width) is imported. • When Command In-position Width (AxisName.Md.CmdInPos_Width) is "0.0", the command in-position function of the axis is disabled.
CmdInPos	Command In-position	Displays whether the remaining distance to the target position is Command In-position Width (AxisName.Md.CmdInPos_Width) or less. • FALSE: Command in-position width or more • TRUE: Command in-position width or less

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
CmdInPos_Width	Command In-position Width	Sets the command in-position width on the composite axis of the axes group. • 0.0: Function disabled • 0.000000001 to 10000000000.0: Function enabled*1

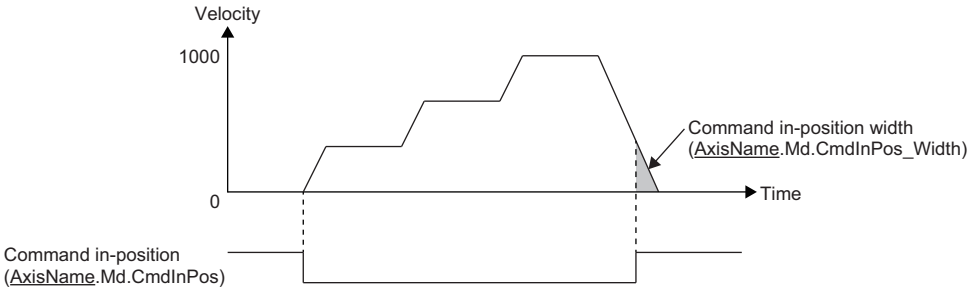
*1 When a positive number less than 0.000000001 is set, the value is imported as "0.0".

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
CmdInPos_Width	Command In-position Width	Displays the command in-position width on the composite axis of the axes group. • The value is the one into which the setting value of Command In-position Width (AxesGroupName.Pr.CmdInPos_Width) is imported. • When Command In-position Width (AxesGroupName.Md.CmdInPos_Width) is "0.0", the command in-position function of the axes group is disabled.
CmdInPos	Command In-position	Displays whether the remaining distance to the target position on the composite axis is Command In-position Width (AxesGroupName.Pr.CmdInPos_Width) or less. • FALSE: Command in-position width or more • TRUE: Command in-position width or less

Command in-position range check

A command in-position range check is carried out every operation cycle.
However, while the axis stops, Command In-position (AxisName.Md.CmdInPos) is not refreshed.
When Command In-position Width (AxisName.Md.CmdInPos_Width) is "0.0", a command in-position range check is not carried out.
For an axes group, the remaining distance on the composite axis (line/arc) is checked based on Command In-position Width (AxesGroupName.Md.CmdInPos_Width). When the long axis velocity specification and the reference axis velocity specification are used for linear interpolation control, the remaining distance on the long axis and the reference axis is checked.
The flag is stored in Command In-position (AxesGroupName.Md.CmdInPos).
During axes group operation, the command in-position function of the configuration axes is disabled. Command In-position (AxisName.Md.CmdInPos) of the configuration axes is not changed to TRUE during axes group operation. (It is changed to FALSE when the axes group is started.)



- (Remaining distance) ≤ (Command in-position width (AxisName.Md.CmdInPos_Width))

34.3 Software Stroke Limit

This function sets an address as the movable range. Even if a movement command to the address outside the setting range is issued, the command will not be executed.
By not executing the command outside the movable area, even if an incorrect command or unexpected operation occurs, the system will not operate out of the movable area and damage to the machine can be prevented.
In the motion system, the set position and machine feed value are used as the addresses indicating the current value. However, in the software stroke limit function, which address is used to perform the limit check is specified in Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target).

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	Sets the software stroke limit upper value. • -10000000000.0 to 10000000000.0
SwStrokeLimit_Lower	Software Stroke Limit Lower Value	Sets the software stroke limit lower value. • -10000000000.0 to 10000000000.0
SwStrokeLimit_Target	Software Stroke Limit Target	Sets the software stroke limit target. • -1: Invalid (Invalid) • 1: Set position (SetPosition) • 3: Machine feed value (FeedMachinePosition)

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	Displays the software stroke limit upper value.
SwStrokeLimit_Lower	Software Stroke Limit Lower Value	Displays the software stroke limit lower value.
SwStrokeLimit_Target	Software Stroke Limit Target	Displays the software stroke limit check method target.
SwStrokeLimit_Override	Software Stroke Limit Override	Displays the software stroke limit valid/invalid status. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)

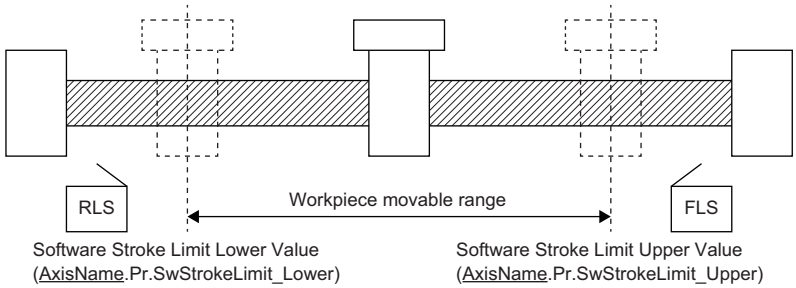
Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
SwStrokeLimit_Override	Software Stroke Limit Override	Temporarily switches whether to enable/disable the software stroke limit check. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)

Definition of movable range

Movable range differences by selection of set position and machine feed value

The following drawing shows the movable range of the workpiece when the software stroke limit function is used.

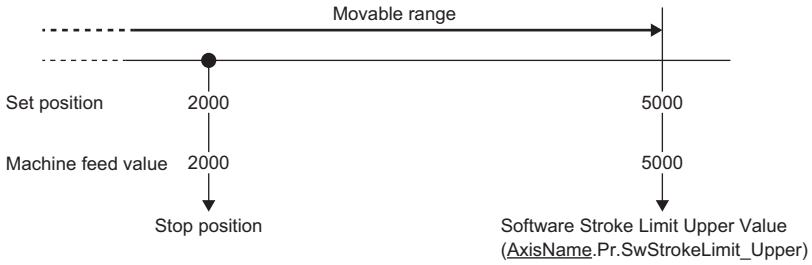


The set position or the machine feed value can be specified in the software stroke limit. (The cumulative current position cannot be specified.)

The following drawing shows the differences in the operation when the set position is used or when the machine feed value is used in the movable range limit check.

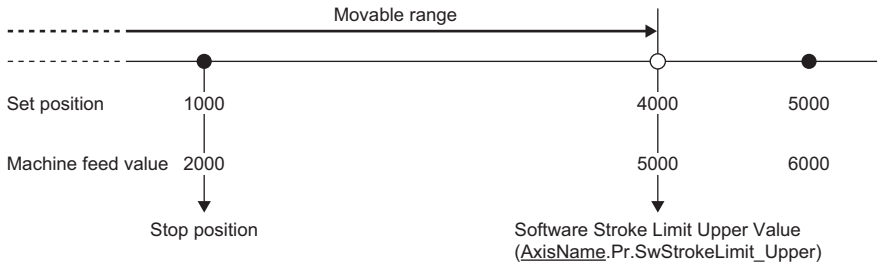
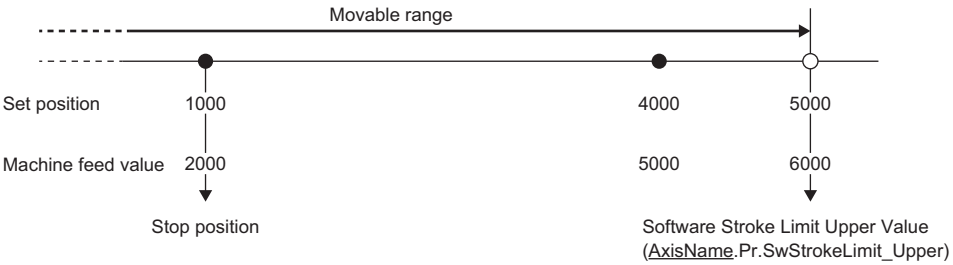
Ex.

When assuming that the current value is "2000", and Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) is set to "5000".



- Current value changing

  When the current value is changed by a new current value command from 2000 to 1000, the set position will change to 1000, but the machine feed value will stay the same at 2000.

Setting	Description
When the machine feed value is set at the limit	The set position of "4000 (machine feed value: 5000)" becomes the upper stroke limit. 
When the set position is set at the limit	The set position of "5000 (machine feed value: 6000)" becomes the upper stroke limit. 

Point

When "3: Machine feed value (FeedMachinePosition)" is set in Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target), the movable range becomes an absolute range with respect to the home position.
When "1: Set Position (SetPosition)" is set, the movable range becomes the relative range from the set position.

■When selecting the set position when the ring counter is valid

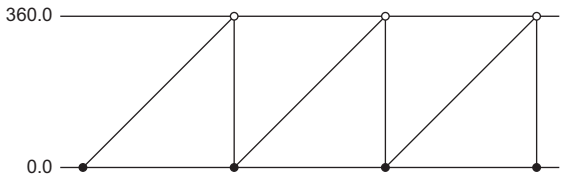
- Set position

  The storing range of the set position is shown below.

Monitor data	Range
Set Position (AxisName.Md.SetPosition)	Ring counter lower limit value ≤ Set position < Ring counter upper limit value

Ex.

When the ring counter lower limit value is "0.0" and the ring counter upper limit value is "360.0"
The set position address becomes the ring address of "0.0 to 359.999...".



- Setting the software stroke limit

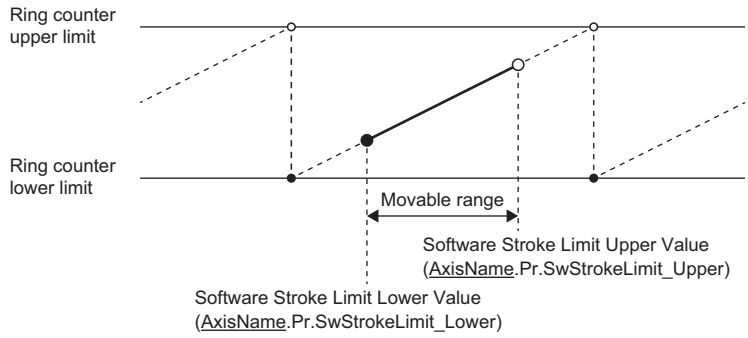
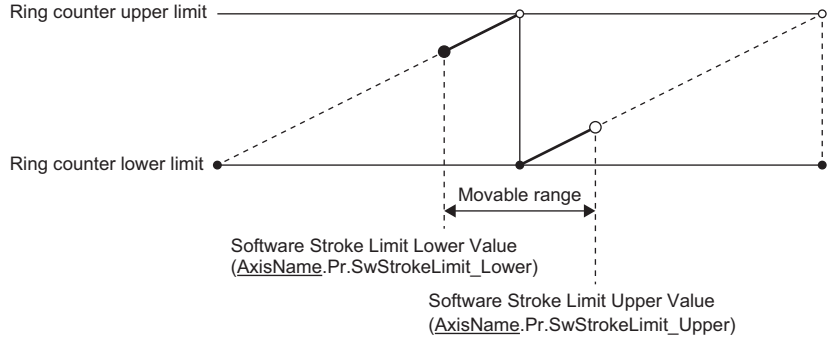
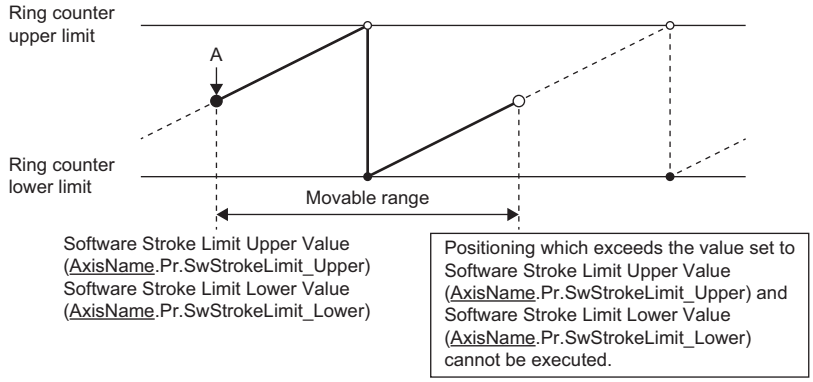
  The setting range of the software stroke limit upper/lower value is shown below.

Parameter	Setting range
Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)	Ring counter lower limit value < Set value ≤ Ring counter upper limit value
Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)	Ring counter lower limit value ≤ Set value < Ring counter upper limit value

Movable range: Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) ≤ Set position < Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)

• Details of the movable range

The movable range varies as shown below depending on the relationship between Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).

Movable range	Description
Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) > Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)	
Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) < Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)	
Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) = Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)	 • When the setting is "Set position = Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) = Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)", the set position is determined to be positioned at Software Stroke Limit Lower Value (position A in the above figure), and operation is possible within the "movable range" in the above figure.

■When selecting the set position or the machine feed value when the ring counter is invalid

- Machine feed value

  The storing range of the machine feed value is shown below.

Monitor data	Storing range
Machine Feed Value (AxisName.Md.FeedMachinePosition)	-10000000000.0 ≤ Machine Feed Value < 10000000000.0

- Setting the software stroke limit

  The setting range of the software stroke limit upper/lower value is shown below.

Parameter	Setting range
Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)	Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) < Setting value ≤ 10000000000.0
Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)	-10000000000.0 ≤ Setting value < Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)

Movable range: Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) ≤ Set position < Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)

Invalidating the software stroke limit

To invalidate the software stroke limit, set "-1: Invalid (Invalid)" in Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target). By setting "-1: Invalid (Invalid)", the software stroke limit check is not executed in all controls regardless of the setting values of Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).

Returning from outside the software stroke limit range

The axis cannot start outside the software stroke limit range while the software stroke limit is valid.
After setting "ONLY_INSIDE (Check disabled only for movement returning to the range)" or "DISABLE (Check disabled)" in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), execute the axis operation to return to the movable range.
Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) is case-sensitive.

Point

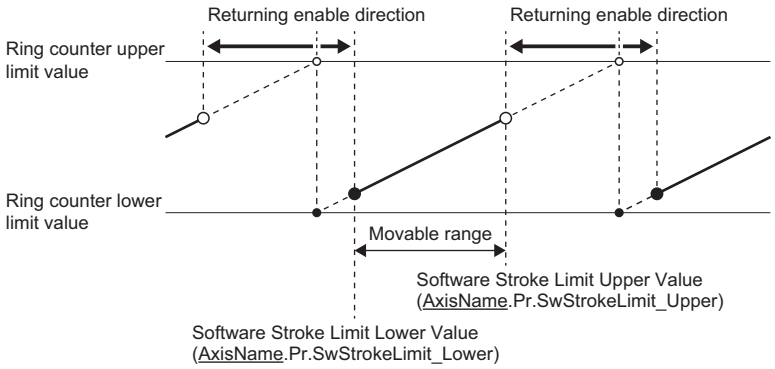
- In Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), the software stroke limit can be temporarily disabled without changing the settings of Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).
- In Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), only the check in the returning enable direction can be disabled from outside the software stroke limit range. By disabling it only in the direction returning to the movable range, motions in unexpected directions can be prevented.
- If start or multiple start is performed while the software stroke limit is disabled by Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), "start while the software stroke limit is disabled" is recorded in the event history.

■Returning enable direction to the movable range

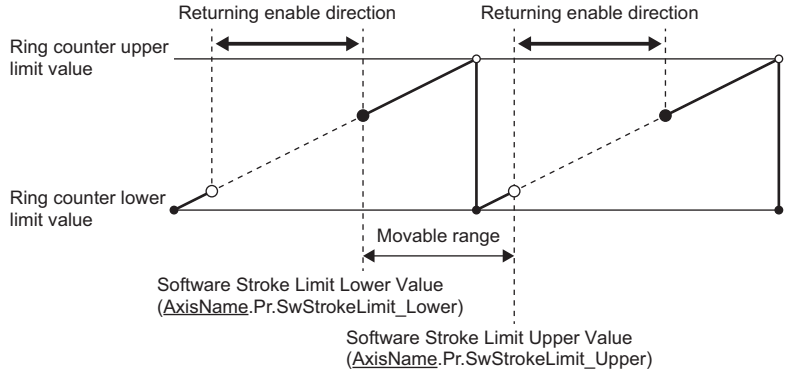
- When "ONLY_INSIDE (Check disabled only for movement returning to the range)" is set in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), movement is allowed from outside the software stroke limit range to the movable range in the returning enable direction.
- The returning enable direction from outside the software stroke limit range means the direction in which the axis can return to the movable range without exceeding the ring counter value.
- If the axis operates in the direction so as to exceed the ring counter value from outside the software stroke limit range, Software stroke limit over (start position) (error code: 1A81H) or Software stroke limit over (target position) (error code: 1A80H) will be detected, and the axis will not start.
- Also, even if it is the returning enable direction, when a position which is outside the software stroke limit range exceeding the movable range is specified as the target position, Software stroke limit over (target position) (error code: 1A80H) will be detected, and the axis will not start.
- To return to the movable range ignoring the returning enable direction, set DISABLE (Check disabled) in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and perform a move to the movable range.

■Returning enable direction when setting "ONLY_INSIDE (Check disabled only for movement returning to the range)" in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override)

- When Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) > Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)



- When Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) < Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)



Checking the software stroke limit enabled/disabled

- In the Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override), the software stroke limit check enabled/disabled status can be checked.
- Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override) imports setting values of Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) when the status of PLC READY (MotionSystem.Cd.SequenceReady) is turned on, at start, or at multiple start, and updates as shown below.

Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target)	Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override)	Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override)
-1: Invalid (Invalid)	—	DISABLE: Check disabled
1: Set position (SetPosition) 3: Machine feed value (FeedMachinePosition)	Other than the following: No disabling request	Display is blank: No disabling request
	DISABLE: Check disabled	DISABLE: Check disabled
	ONLY_INSIDE: Check disabled only for movement returning to the range	ONLY_INSIDE: Check disabled only for movement returning to the range

Specifications of the software stroke limit check

The software stroke limit check is carried out at executing the motion FB and during control.

The following table shows the check details of the software stroke limit.

Check details	Check timing	Processing when an error occurs
An error shall occur if the target position is outside the software stroke limit range.	When executing the motion FB which has the "target position"	Software stroke limit over (target position) (error code: 1A80H) is output and the axis does not start.
An error shall occur if the start position is outside the software stroke limit range.	When executing the motion FB	Software stroke limit over (start position) (error code: 1A81H) is output and the axis does not start.
An error shall occur if the current value is outside the software stroke limit range during control.	During control	Software stroke limit over (forward direction) (error code: 1A83H) or Software stroke limit over (reverse direction) (error code: 1A84H) is output and the stop processing is executed.*1

*1 The error occurs when a command to a position outside the software stroke limit range is detected, and the stop processing is executed. To stop within the software stroke limit range, set to immediately stop.

The checking details of the following functions are different from the above.

- Homing control
- Multiple axes positioning data operation

For details, refer to the following.

☞ Page 617 HOMING

☞ Page 665 Multiple Axes Positioning Data Operation

Precautions

- Execute homing beforehand for the software stroke limit function to function properly.
- If Software stroke limit upper value (AxisName.Pr.SwStrokeLimit_Upper) or Software stroke limit lower value (AxisName.Pr.SwStrokeLimit_Lower) is outside the setting range, Out of parameter range (axis) (error code: 1A60H) will be detected.
- During interpolation control, the software stroke limit check is executed for all the current values of the interpolation control axes. When an error occurs in any axis, all axes will not start.
- When "3: Machine feed value (FeedMachinePosition)" is set as the setting value of Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target) to the axis type which does not have Machine Feed Value (AxisName.Md.FeedMachinePosition), Out of parameter range (axis) (error code: 1A60H) will be detected.

34.4 Hardware Stroke Limit

This function sets a limit switch at the upper/lower limit of the physical movable range, and stops the control by the input of a signal from the limit switch.
Damage to the machine can be prevented by stopping the control before the upper/lower limit of the physical movable range is reached.

⚠WARNING

- The negative logic (normally closed contact) is recommended for wiring the hardware stroke limit. If the positive logic (normally open contact) is used, a serious accident may occur when disconnection or sensor failure occurs.
- To use the hardware stroke limit function, the add-on ExternalSignal must be valid. When the add-on is not installed or invalid, the axis does not stop and an error is not output even if the signal is input.

For details on the signals that can be used in the hardware stroke limit, refer to the following.
☞ Page 1154 EXTERNAL SIGNAL SELECTION

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○*1
Major error	○*1

*1 FLS/RLS signals may not be sent depending on the error.
When a moderate or major error occurs, the motion system notifies the device station that an error has been detected in the CPU operating status.
For operation of the device station when an error is detected, refer to the manual for each device station.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
HwStrokeLimit_FlsSignal	Upper Limit Signal	Sets a signal that uses the upper limit signal (FLS). Upper limit signal (HwStrokeLimit_FlsSignal) is the structure of SIGNAL_SELECT type. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following. ☞ Page 1154 EXTERNAL SIGNAL SELECTION The specific setting and the operation of this signal are shown below. ■I/O Number (StartIO) Ignores the input value. ■Target (Target) When the specification is not set, signal disabled is determined and the signal not detecting status is always set. Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) is not imported. Only [VAR], [DEV], and [CONST] can be specified for data type. * If an unavailable value is set, Out of parameter range (axis) (error code: 1A60H) occurs. The error cause can be checked with the following detail codes. • An incorrect string was set (detail code: 0001H) • An unavailable data type was set (detail code: 0002H) • An unavailable type was specified (detail code: 0003H) • A type other than the numerical value type was specified at label specification (detail code: 0004H) • A signal that does not exist was set (detail code: 0005H) • A global label where access from an external device is disabled was set (detail code: 0005H) • The number of characters exceeded the upper limit (detail code: 0007H). • "Asynchronous" was set in the network synchronous communication setting of the device station being referred to (detail code: 8002H) • An unsupported device was set (detail code: 8002H) • A device number out of range was set (detail code: 8002H) ■Signal Detection Method (Detection) The specification is allowed at the following level detection only. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel) * When a value outside the range is set, Out of parameter range (axis) (error code: 1A60H) (detail code: 8003H) occurs. ■Compensation Time (CompensationTime) Ignores the input value. ■Filter Time (FilterTime) The setting range is from 0.0 to +5.0 [s]. * When a value outside the range is set, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.

Variable/structure name	Name	Details
HwStrokeLimit_RlsSignal	Lower Limit Signal	Sets a signal that uses the lower limit signal (RLS). Lower limit signal (HwStrokeLimit_RlsSignal) is the structure of SIGNAL_SELECT type. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following. ☞ Page 1156 SIGNAL_SELECT Structure It may be regarded as signal detection depending on the variable used as an external signal and the status of devices controlled by the controller. For details, refer to the following. ☞ Page 1154 EXTERNAL SIGNAL SELECTION The specific setting and the operation of this signal are shown below. ■I/O Number (StartIO) Ignores the input value. ■Target (Target) When the specification is not set, signal disabled is determined and the signal not detecting status is always set. Control data is not imported. Only [VAR], [DEV], and [CONST] can be specified for data type. * If an unavailable value is set, Out of parameter range (axis) (error code: 1A60H) occurs. The error cause can be checked with the following detail codes. • An incorrect string was set (detail code: 0001H) • An unavailable data type was set (detail code: 0002H) • An unavailable type was specified (detail code: 0003H) • A type other than the numerical value type was specified at label specification (detail code: 0004H) • A signal that does not exist was set (detail code: 0005H) • A global label where access from an external device is disabled was set (detail code: 0005H) • The number of characters exceeded the upper limit (detail code: 0007H). • "Asynchronous" was set in the network synchronous communication setting of the device station being referred to (detail code: 8002H) • An unsupported device was set (detail code: 8002H) • A device number out of range was set (detail code: 8002H) ■Signal Detection Method (Detection) The specification is allowed at the following level detection only. • 0: Detection at TRUE (HighLevel) • 1: Detection at FALSE (LowLevel) * When a value outside the range is set, Out of parameter range (axis) (error code: 1A60H) (detail code: 8003H) occurs. ■Compensation Time (CompensationTime) Ignores the input value. ■Filter Time (FilterTime) The setting range is from 0.0 to +5.0 [s]. * When a value outside the range is set, Out of Filter Time Setting Range of Each Axis Signal Warning (event code: 00D24H) occurs, and the axis operates with 0.0 of the filter time.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
HwStrokeLimit_FlsStatus	Upper Limit Signal Status	Displays the detection status of the upper limit signal (FLS). • FALSE: Not detecting the upper limit signal (FLS) • TRUE: Detecting the upper limit signal (FLS) * Displays the detection state in which the signal detection method and the filter time are reflected but not the signal input state.
HwStrokeLimit_RlsStatus	Lower Limit Signal Status	Displays the detection status of the lower limit signal (RLS). • FALSE: Not detecting the lower limit signal (RLS) • TRUE: Detecting the lower limit signal (RLS) * Displays the detection state in which the signal detection method and the filter time are reflected but not the signal input state.
HwStrokeLimit_Override	Hardware Stroke Limit Override	Displays the acceptance status of the command to switch enable/disable of the hardware stroke limit check. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
HwStrokeLimit_Override	Hardware Stroke Limit Override	Switches enable/disable of the hardware stroke limit check. • DISABLE: Check disabled • ONLY_INSIDE: Check disabled only for movement returning to the range • Other than the above: Check enabled (no disabling request)

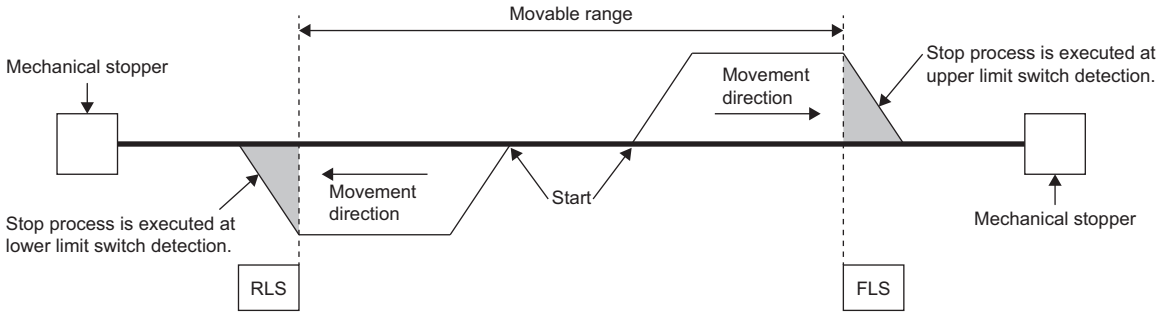
Hardware stroke limit check details

The check of hardware stroke limit range is carried out during executing and controlling the motion FB.

The following table shows the check details of the hardware stroke limit.

Check details	Check timing	Processing when an error occurs
Signal input from the upper limit signal (FLS) is detected at start.	At start	FLS signal detection (at start) (error code: 1A9EH) occurs and the axis does not start.
Signal input from the lower limit signal (RLS) is detected at start.	At start	RLS signal detection (at start) (error code: 1A9FH) occurs and the axis does not start.
Signal input from the upper limit signal (FLS) is detected during control.	During control	FLS signal detection (controlling) (error code: 1AA0H) occurs and the axis stops.*1
Signal input from the lower limit signal (RLS) is detected during control	During control	RLS signal detection (controlling) (error code: 1AA1H) occurs and the axis stops.*1

*1 The axis stops according to the stop processing.



Point

While the limit switch is detected, the operation cannot be performed regardless of the detection direction/ movement direction.

Returning from outside the hardware stroke limit range

While the limit switch is detected, the operation cannot be started regardless of the detection direction.
After setting "ONLY_INSIDE (Check disabled only for movement returning to the range)" or "DISABLE (Check disabled)" in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), execute the axis operation to return to the controllable range.

Point

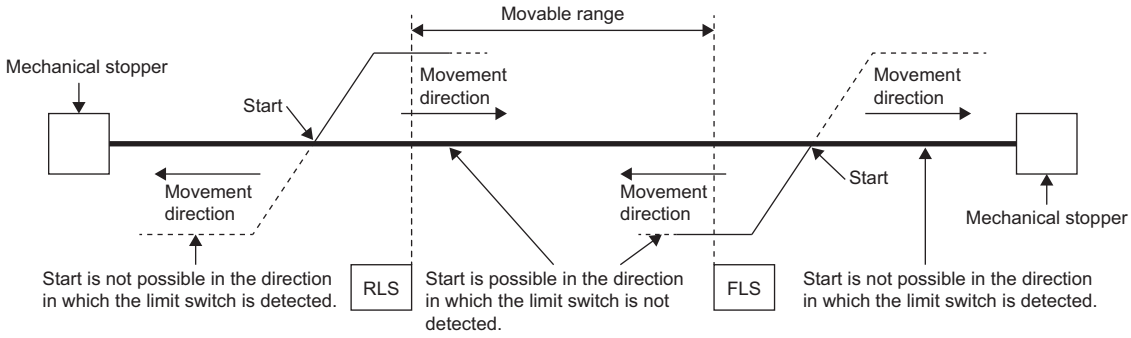
- When an item other than "ONLY_INSIDE (Check disabled only for movement returning to the range)" and "DISABLE (Check disabled)" is set in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), the axis operates with "No disabling request".
  Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is case-sensitive.
- If start or multiple start is performed while the hardware stroke limit is disabled by Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), "start while hardware stroke limit is disabled" is recorded in the event history.

Precautions

Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is valid only in the hardware stroke limit processing on the controller side. The stroke limit processing on the drive unit side is not affected by Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override).

When setting ONLY_INSIDE (Check disabled only for movement returning to the range)

The axis can start in the direction in which the limit switch has not been detected.



When setting DISABLE (Check disabled)

The axis can start regardless of the limit switch detection status.

Checking whether the hardware stroke limit is enabled/disabled

- In the Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override), the hardware stroke limit check enabled/disabled status can be checked.
- Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) imports the setting value of Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) at start or at multiple start, and updates as shown below.

Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override)	Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override)
DISABLE (Check disabled)	DISABLE (Disabling hardware stroke limit check)
ONLY_INSIDE (Check disabled only for movement returning to the range)	ONLY_INSIDE (Disabling hardware stroke limit check only for movement returning to the range)
Other than the above	No display (No disabling request. Hardware stroke limit check is enabled.)

Precautions

- Install the upper limit signal (FLS) in the direction in which the set position increases, and install the lower limit signal (RLS) in the direction in which the set position decreases. If inverting the install positions of the upper limit signal (FLS)/lower limit signal (RLS), hardware stroke limit function cannot be operated properly.
- The upper limit signal (FLS) and lower limit signal (RLS) detected on the controller can be sent to the servo amplifier. For details on the setting method at connecting the MR-J5(W)-G, refer to the following.
  ☞ Page 2155 How to use

Point

- The controller sends the signals as "FALSE: Detecting the signal", "TRUE: Not detecting the signal" to the servo amplifier. Therefore, the servo amplifier side must be set by using "the negative logic (normally closed contact)" to receive the signal.
- When labeling the data sent from the controller, the sent data is overwritten with the label value and the detection state cannot be sent to the servo amplifier. To send the data to the servo amplifier, do not label the data.

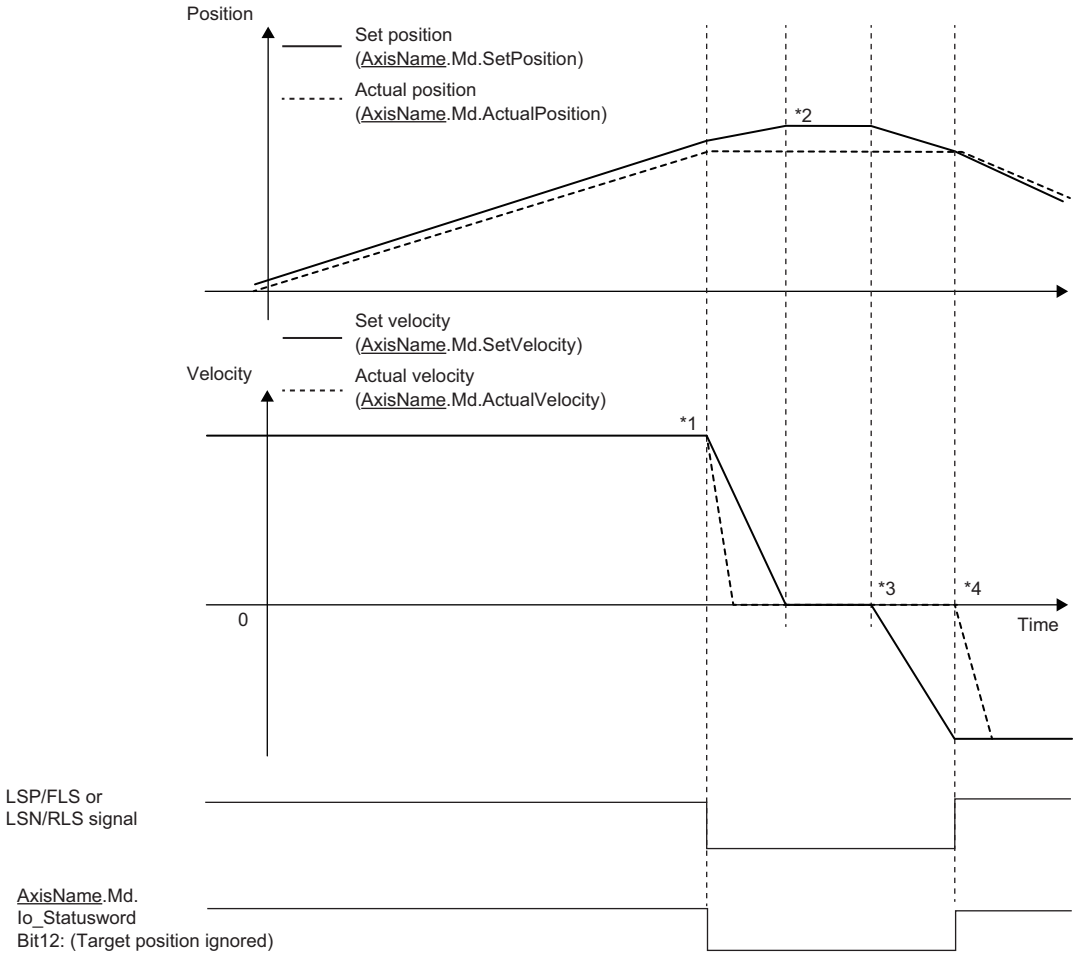
- The LSP/LSN signal input to the servo amplifier when connecting to the MR-J5(W)-G can be set as the hardware stroke limit signal. For details on the setting method, refer to the following.
  ☞ Page 2155 How to use
- When the MR-J5(W)-G is connected, the operation differs at LSP/FLS or LSN/RLS signal detection depending on the setting of "Limit switch enabled status selection (PD41.2)" of the servo parameter "Function selection D-4 (PD41)".

Setting	Operation
When "0: Limit switch always enabled"	The drive unit side executes the stop processing, and then turns to servo-lock status (Statusword Bit12: off) and the drive unit will ignore the motion system command. The motion system can stop the command by enabling Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored).
When "1: Enabled only for homing mode" or the drive unit is in Homing mode	The drive unit side will execute the stop processing. When the drive unit is in a mode other than Homing mode, the signal will be ignored. Therefore, set it to stop by the motion system using the hardware stroke limit function.

- When "Limit switch enabled status selection (PD41.2)" of servo parameter "Function selection D-4 (PD41)" is "0: Limit switch always enabled", the stop will be executed ignoring the command from the motion system at limit switch detection. Therefore, when using the MR-J5(W)-G, it is recommended to set "1: Enabled only for homing mode", and "Sensor input method selection (PD41.3)" to "1: Input from controller".
  When setting "0: Limit switch always enabled", the command on the controller side needs to be stopped. Be sure to enable Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored).
  The example of operation is shown below.

Ex.

When detecting a limit signal at the drive unit side



*1 When the LSP/FLS or LSN/RLS signal is detected, the stop process is executed by the drive unit. When Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored) is enabled, the motion system will detect Driver command discard detection (error code: 1B18H) and execute the command stop. For details on the setting, refer to the following.
☞ Page 578 Stop

*2 After completion of the stop process on the motion system side, it stops with the status where Actual Position (AxisName.Md.ActualPosition) deviates from Set Position (AxisName.Md.SetPosition). (The position command from the motion system to the outside of the stroke limit is ignored in the drive unit.)

*3 After the stop, when axis control is performed in the direction toward the inside of the stroke limit, the position command (the set position and machine feed value) and command velocity of the motion system are updated. However, the servo motor does not operate.

*4 When the position command from the motion system becomes "the command position where the LSP/FLS or LSN/RLS signal is detected", the servo motor starts the operation to the inside of the stroke limit.

Point

- To stop while holding the relation between the master axis and the slave axis of the axes group and the synchronous control when detecting the stroke limit of the drive unit, set "Limit switch enabled status selection (PD41.2)" of the servo parameter "Function selection D-4 (PD41)" to "1: Enabled only for homing mode".
- When the signal is turned on (limit signal OFF) in the status where the actual position deviates from the position command with the stop by the stroke limit detection of the drive unit, the motor makes rapid movement to the position command of the motion system. Restore the deviation between the actual position and the position command by axis control to the inside of the stroke limit. (Set the servo OFF status, so that restoring the position command to the actual position by follow up is possible. After the restoration, set the servo ON again and move the motor to the inside of the stroke limit with the axis control.)
- When the position command of the motion system stops on the stroke limit side closer than the actual position by the stroke limit detection of the drive unit and the axis control is performed toward the inside of the stroke limit, the actual position follows the set position from the motion system.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine

35 FUNCTIONS RELATED TO VELOCITY

The functions related to velocity have the following items.

Item	Description	Reference
Acceleration/Deceleration Processing Function	Adjusts the acceleration/deceleration of each motion control to the acceleration/deceleration curve suitable for device.	Page 1078 Acceleration/Deceleration Processing Function
Velocity limit	Limits the command velocity to a value within the speed limit value setting range when the command velocity during control exceeds the speed limit value. By limiting the command velocity within the preset velocity limit value range, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.	Page 1112 Velocity Limit
Override function	Changes the target velocity and the target acceleration/deceleration during the execution of the control by setting the override coefficient.	Page 1116 Override Function

35.1 Acceleration/Deceleration Processing Function

This function adjusts the acceleration/deceleration of each motion control to the acceleration/deceleration curve suitable for device.

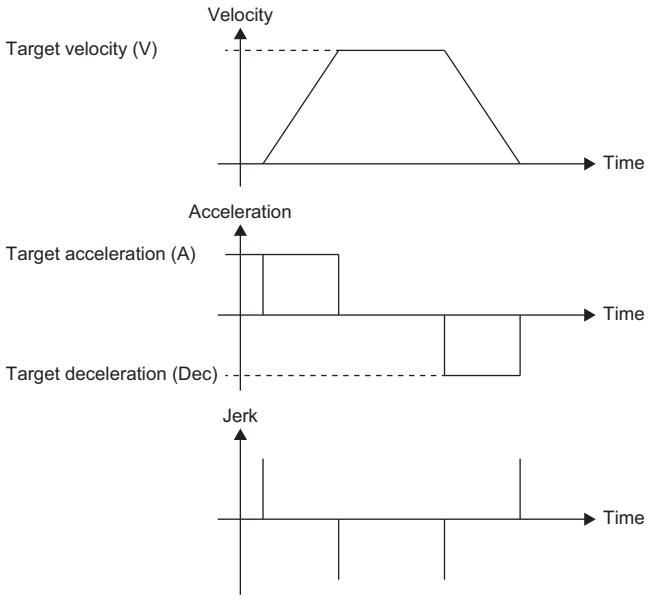
Acceleration/deceleration method

The following methods can be selected for the acceleration/deceleration method. When a value outside the range is set in the acceleration/deceleration method, Out of acceleration/deceleration method range (error code: 1AF8H) will occur and the axis will not start.

Acceleration/deceleration method	Description
Acceleration/deceleration specification method (Default)	An acceleration/deceleration method using Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) specified in the FB.
Acceleration/deceleration time-fixed method	An acceleration/deceleration method using the acceleration/deceleration time specified in the FB regardless of the velocity.

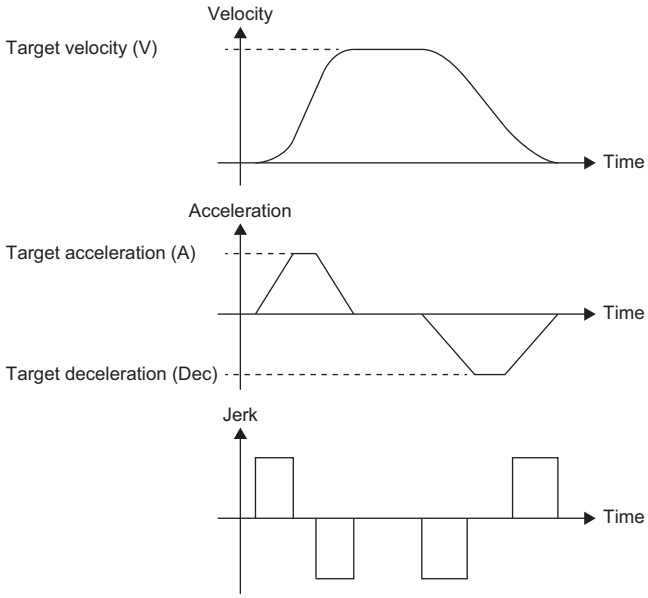
■Trapezoidal acceleration/deceleration

When "0.0" is set in the jerk, the curve is called the trapezoidal acceleration/deceleration. The velocity shows a trapezoidal waveform.



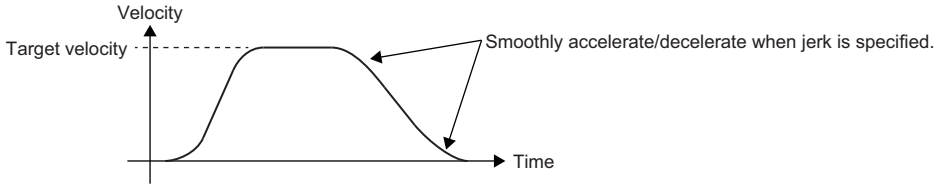
■Jerk acceleration/deceleration

When a value other than "0.0" is set in the jerk, the curve is called the jerk acceleration/deceleration. The velocity shows an S-shaped waveform.



Jerk

Jerk is the temporal change ratio of the acceleration or deceleration. The unit is "command unit (U)/s^3". When the jerk is set, since the velocity waveform shows a S-shape and the axis can smoothly accelerate and decelerate at the start and the end of acceleration and deceleration, it can reduce the burden on the motor and impact on the machine.

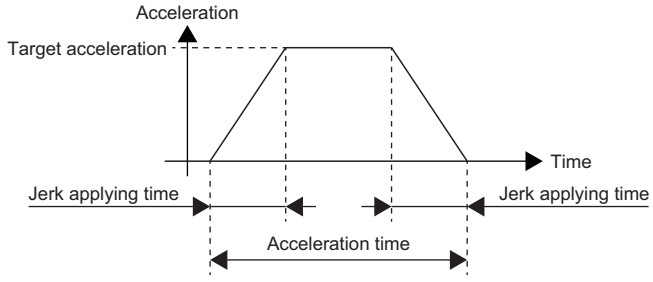


■Jerk applying time/Jerk applying ratio

The sum of the time required to reach the target acceleration after startup and the time from the target acceleration to the acceleration 0 at the end of acceleration is called the jerk applying time. The ratio of jerk applying time to acceleration (deceleration) time is called the jerk applying ratio.

The jerk applying time and the jerk applying ratio can be calculated with the following formula.

Item	Expression
Jerk applying time	2 × Target Acceleration ÷ Jerk
Jerk applying ratio	(Jerk applying time ÷ Acceleration time) × 100 [%]



Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Sets the positive direction velocity limit value. For details, refer to the following. ☞ Page 1112 Velocity Limit
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Sets the negative direction velocity limit value. For details, refer to the following. ☞ Page 1112 Velocity Limit
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Sets the operation when the velocity limit value is exceeded. For details, refer to the following. ☞ Page 1112 Velocity Limit
AccelerationLimit	Acceleration Limit Value	Sets the acceleration limit value. • 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2]*1 * When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it does not limit the acceleration. * When "0.0000" is set, it does not limit the acceleration.
DecelerationLimit	Deceleration Limit Value	Sets the deceleration limit value. • 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2]*1 * When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it does not limit the deceleration. * When "0.0000" is set, it does not limit the deceleration.
JerkLimit	Jerk Limit Value	Sets the jerk limit value. Range: 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^3]*1 • When "0.0000" is set, the value is not limited. * When "0.0000" is set, it does not limit the jerk.
AccelerationZeroBehavior	Operation Selection at Start Acceleration/ Deceleration 0	Selects the operation when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start. • -1: Error (Not Started) (ACCError) • 1: Maximum Acceleration/Deceleration (MaximumAcceleration)
OverrunOperation	Operation Setting at Overrun	Sets the operation performed when the target position is exceeded during positioning operation. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)
VelocityBias	Velocity bias value	Sets the velocity bias value for each axis. Range: 0, ±0.0001 to ±2500000000.0 • 0: Velocity bias disabled

*1 When a positive number less than 0.0001 is set, the value is imported as "0.0000".

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
VelocityLimit	Velocity Limit Value	Sets the velocity limit value. For details, refer to the following. ☞ Page 1112 Velocity Limit
AccelerationLimit	Acceleration Limit Value	Sets the acceleration limit value. • 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2]*1 * When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it limits the acceleration calculated from the specified acceleration/deceleration time. * When "0.0000" is set, it does not limit the acceleration.
DecelerationLimit	Deceleration Limit Value	Sets the deceleration limit value. • 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^2]*1 * When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it limits the deceleration calculated from the specified acceleration/deceleration time. * When "0.0000" is set, it does not limit the acceleration.
JerkLimit	Jerk Limit Value	Sets the jerk limit value. • 0.0000, a positive number from 0.0001 to 2147483647.0 [U/s^3]*1 • When "0.0000" is set, it does not limit the jerk.
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Selects the operation when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start. • -1: Error (Not Started) (ACCError) • 1: Maximum Acceleration/Deceleration (MaximumAcceleration)
OverrunOperation	Operation Setting at Overrun	Sets the operation performed when the target position is exceeded during operation. • 1: Immediate Stop (ImmediateStop)
VelocityBias	Velocity bias value	Sets the velocity bias value for each axes group. Range: 0, ±0.0001 to ±2500000000.0 • 0: Velocity bias disabled

*1 When a positive number less than 0.0001 is set, the value is imported as "0.0000".

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
CommandedAcceleration	Commanded Acceleration	Stores the acceleration specified by users. (Unit: U/s^2) When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it stores the specified acceleration/deceleration time. (Unit: s) During axes group operation, it stores "0.0" in Commanded Acceleration (AxisName.Md.CommandedAcceleration) of the configuration axis.
CommandedDeceleration	Commanded Deceleration	Stores the deceleration specified by users. (Unit: U/s^2) When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it is an illegal value. During axes group operation, it stores "0.0" in Commanded Deceleration (AxisName.Md.CommandedDeceleration) of the configuration axis.
TargetAcceleration	Target Acceleration	Stores the acceleration that is maximum during acceleration. (Unit: U/s^2) During axes group operation, it stores "0.0" in Target Acceleration (AxisName.Md.TargetAcceleration) of the configuration axis.
TargetDeceleration	Target Deceleration	Stores the deceleration that is maximum during deceleration. (Unit: U/s^2) During axes group operation, it stores "0.0" in Target Deceleration (AxisName.Md.TargetDeceleration) of the configuration axis.
SetAcceleration	Set Acceleration	Stores the command output acceleration. It is the acceleration/deceleration calculated from the difference of set velocity. (Unit: U/s^2)*1 Depending on the direction of movement and the value of Set Acceleration (AxisName.Md.SetAcceleration), the acceleration and deceleration status varies. ■The movement direction is the positive direction (address increasing direction) • 0.0: During stop or fixed-speed • Positive value: During acceleration • Negative value: During deceleration ■The movement direction is the negative direction (address decreasing direction) • 0.0: During stop or fixed-speed • Positive value: During deceleration • Negative value: During acceleration "0.0" is stored when the target velocity is reached. During axes group operation, it stores the set acceleration of the configuration axis.
CommandedJerk	Commanded Jerk	Stores the jerk specified by users. (Unit: U/s^3) During axes group operation, it stores "0.0" in Commanded Jerk (AxisName.Md.CommandedJerk) of the configuration axis.
InVelocity	Target Velocity Reached	Displays whether the set velocity has reached the target velocity or not. During axes group operation, it stores FALSE in Target Velocity Reached (AxisName.Md.InVelocity) of the configuration axis. • FALSE: Not reached • TRUE: Reached
AutoDeceleration	Automatically Decelerating	Displays the status of auto deceleration processing. TRUE is stored while the auto deceleration processing is being executed. When the multiple start is executed, TRUE is set while the auto deceleration processing is executed during the last positioning point execution. FALSE is set when the control change is performed. During axes group operation, it stores FALSE in Automatically Decelerating (AxisName.Md.AutoDeceleration) of the configuration axis. • FALSE: Not during auto deceleration • TRUE: During auto deceleration
VelocityBias	Velocity bias value	The setting value of the velocity bias value (AxisName.Pr.VelocityBias) imported at ready ON is stored.

*1 The stored value includes an error because a floating-point error occurs.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
CommandedAcceleration	Commanded Acceleration	Stores the acceleration specified by users. (Unit: U/s^2) When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it stores the specified acceleration/deceleration time. (Unit: s)
CommandedDeceleration	Commanded Deceleration	Stores the deceleration specified by users. (Unit: U/s^2) When the acceleration/deceleration method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)", it is an illegal value.
TargetAcceleration	Target Acceleration	Stores the acceleration that is maximum during acceleration. (Unit: U/s^2)
TargetDeceleration	Target Deceleration	Stores the deceleration that is maximum during deceleration. (Unit: U/s^2)
SetAcceleration	Set Acceleration	Stores the command output acceleration. It is the acceleration/deceleration calculated from the difference of set velocity. (Unit: U/s^2)*1 The value is positive when the acceleration changes in the positive direction (address increasing direction), and the value is negative when the acceleration changes in the negative direction (address decreasing direction).
CommandedJerk	Commanded Jerk	Stores the jerk specified by users. (Unit: U/s^3)
InVelocity	Target Velocity Reached	Displays whether the set velocity has reached the target velocity or not. • FALSE: Not reached • TRUE: Reached
AutoDeceleration	Automatically Decelerating	Displays the status of auto deceleration processing. TRUE is stored while the auto deceleration processing is being executed. When the multiple start is executed, TRUE is set while the auto deceleration processing is executed during the last positioning point execution. FALSE is set when the control change is performed. • FALSE: Not during auto deceleration • TRUE: During auto deceleration
VelocityBias	Velocity bias value	The setting value of the velocity bias value (AxesGroupName.Pr.VelocityBias) imported at ready ON is stored.

*1 The stored value includes an error because a floating-point error occurs.

Settings of motion FB

The acceleration/deceleration method can be selected in "bits 0 to 2" of Options (Options) of the motion FB.

The details of the bits are shown below.

Bit	Function description
0 to 2	Acceleration/deceleration method setting • 0: Acceleration/deceleration specification method (mcAccDec) • 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ☞ Page 1078 Acceleration/deceleration method

Whether a method can be selected or not differs depending on the FB. For details, refer to the following.

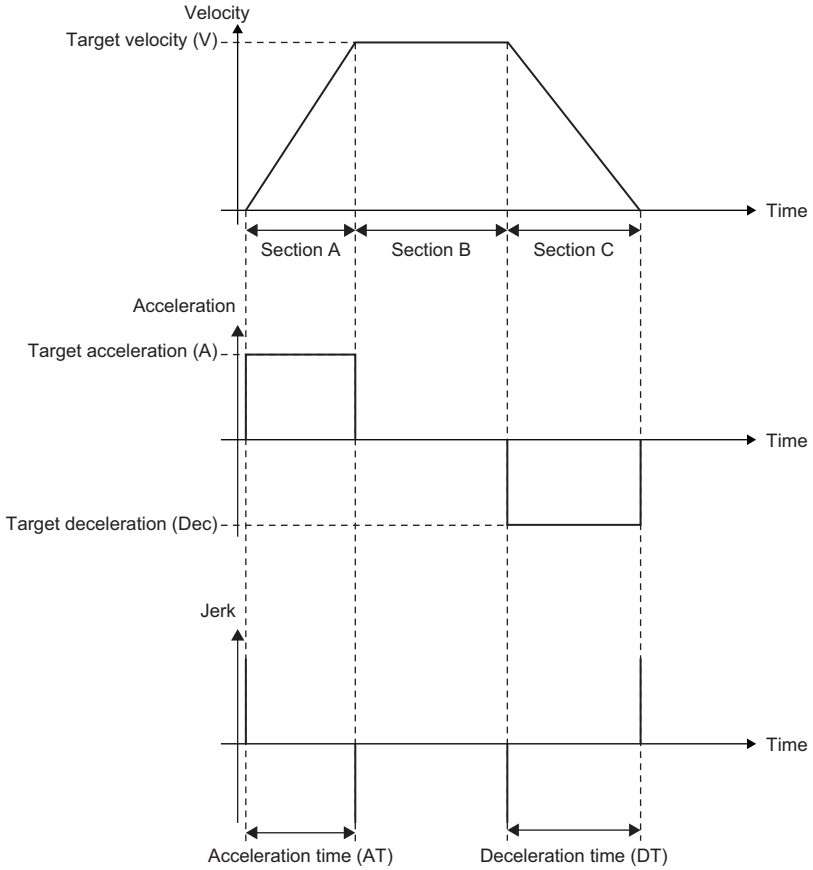
MELSEC MX Controller MX-R Model Programming Manual

Acceleration/deceleration method

Acceleration/deceleration specification method

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in the Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, set the acceleration, deceleration, and jerk.

■Trapezoidal acceleration/deceleration



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section	Acceleration is performed at the target acceleration.	○	×
B	Fixed speed section	Control is performed at the target velocity. (Acceleration = 0.0)	×	×
C	Deceleration section	Deceleration is performed at the target deceleration.	×	○

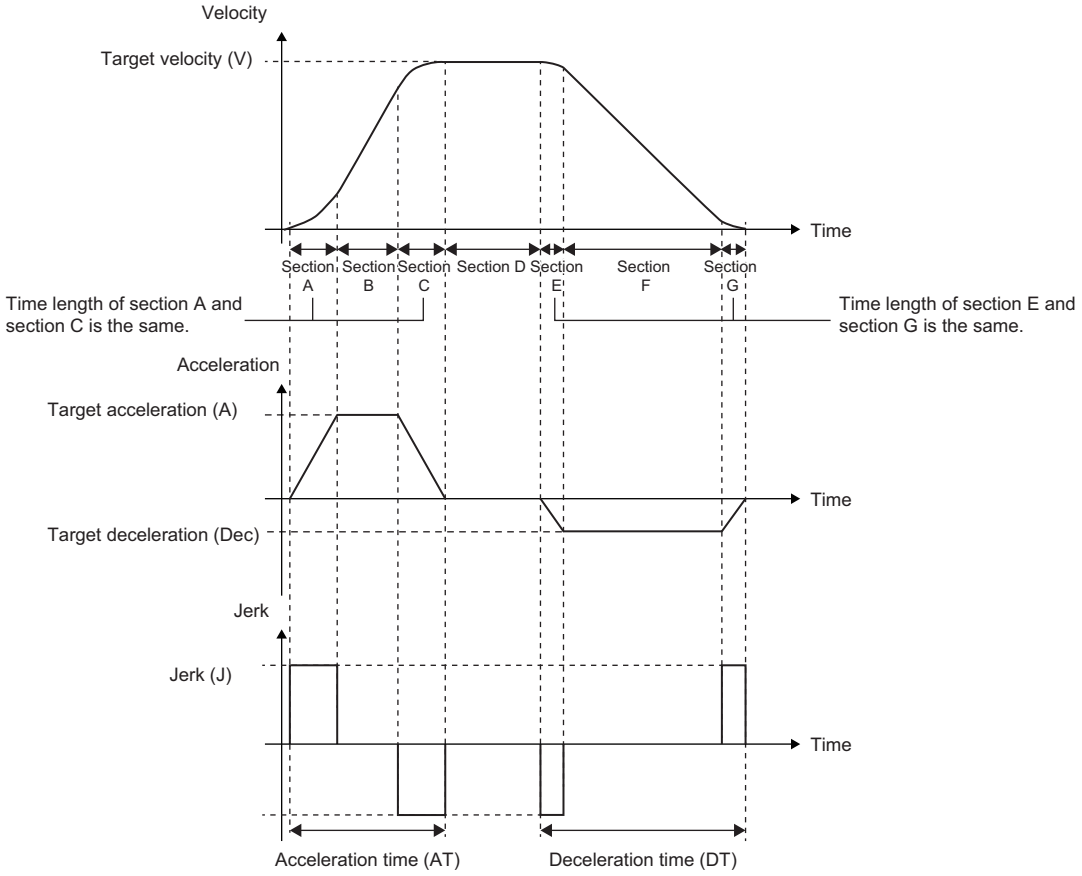
• Acceleration/deceleration time parameter calculation

○: Operation possible, ×: Operation not possible

Type	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Target acceleration	A	—	—	○	×
	Target deceleration	Dec	—	—	×	○
Calculation value	Acceleration section time	AT	Time from the velocity 0.0 to the target velocity	V ÷ A*1	○	×
	Deceleration section time	DT	Time to decelerate from the target velocity to the velocity 0.0	V ÷ Dec*1	×	○

*1 This is the calculation formula when the unit of V is [U/s]. When other than [U/s], calculate by converting into [U/s].

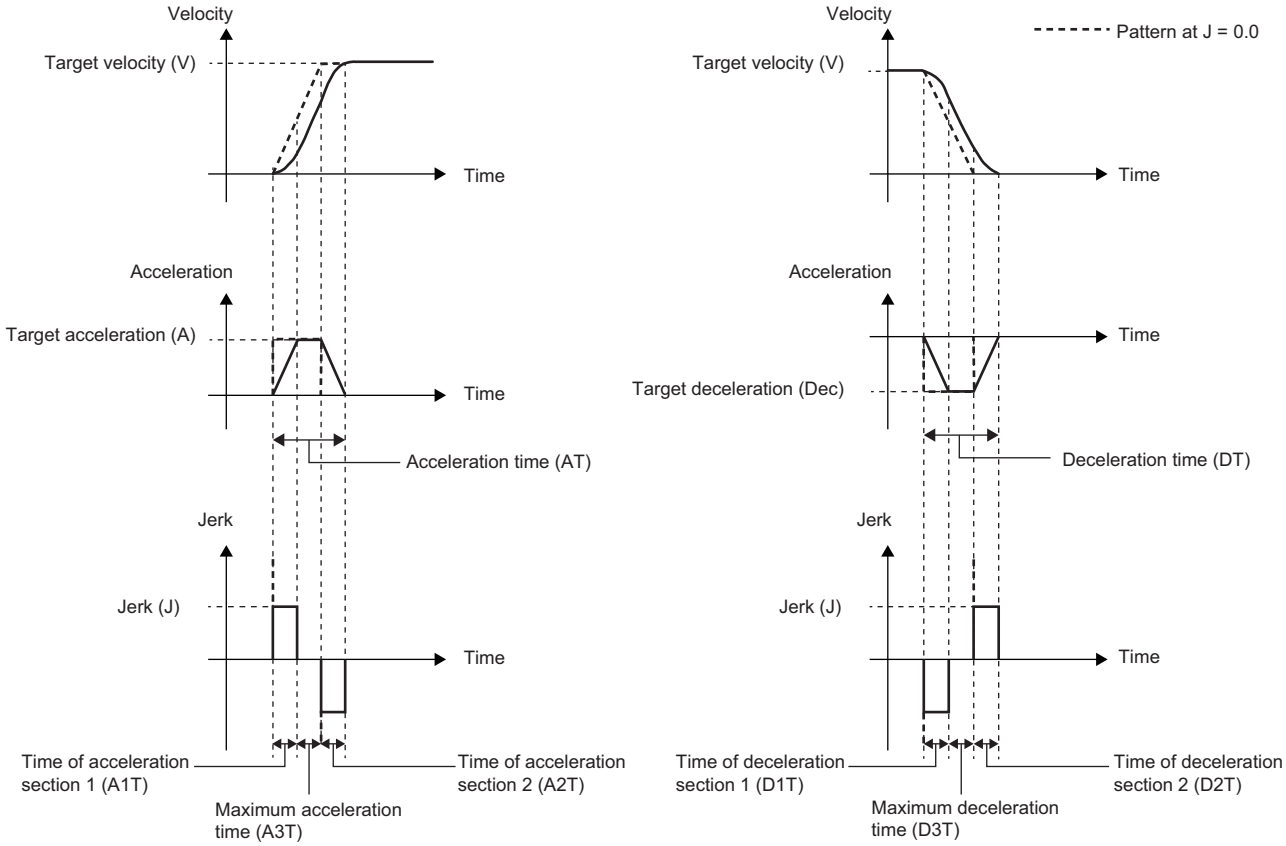
■Jerk acceleration/deceleration



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section 1	Acceleration is performed by changing (increasing) the acceleration with the specified jerk from the acceleration start to the target acceleration.	○	×
B	Maximum acceleration section	Accelerates at the target acceleration.	○	×
C	Acceleration section 2	At the end of acceleration, acceleration is performed by changing (decreasing) the acceleration with the specified jerk from the target acceleration to acceleration 0.	○	×
D	Fixed speed section	Control is performed at the target velocity. (Acceleration = 0.0)	×	×
E	Deceleration section 1	Deceleration is performed by changing (increasing) the deceleration with the specified jerk from the deceleration start to the target deceleration.	×	○
F	Maximum deceleration section	Deceleration is performed at the target deceleration.	×	○
G	Deceleration section 2	At the end of deceleration, deceleration is performed by changing (decreasing) the deceleration with the specified jerk from the target deceleration to deceleration 0.	×	○

• Acceleration/deceleration time parameter calculation



○: Operation possible, ×: Operation not possible

Type	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Target acceleration*1	A	—	—	○	×
	Target deceleration*1	Dec	—	—	×	○
	Jerk	J	—	—	○	○
Calculation value	Acceleration section 1 time	A1T	Time obtained by dividing the jerk applying time of the acceleration section by 2	A ÷ J	○	×
	Acceleration section 2 time	A2T	Time obtained by dividing the jerk applying time of the acceleration section by 2	A ÷ J	○	×
	Maximum acceleration section time	A3T	Time of the maximum acceleration section.	(V ÷ A) - (A ÷ J)*3	○	×
	Acceleration time*2	AT	Time from the velocity 0.0 to the target velocity	A1T + A2T + A3T = (V ÷ A) + (A ÷ J)*3	○	×
	Deceleration section 1 time	D1T	Time obtained by dividing the jerk applying time of the deceleration section by 2	Dec ÷ J	×	○
	Deceleration section 2 time	D2T	Time obtained by dividing the jerk applying time of the deceleration section by 2	Dec ÷ J	×	○
	Maximum deceleration section time	D3T	Time of the maximum deceleration section.	(V ÷ Dec) - (Dec ÷ J)*3	×	○
	Deceleration time*2	DT	Time to decelerate from the target velocity to the velocity 0.0	D1T + D2T + D3T = (V ÷ Dec) + (Dec ÷ J)*3	×	○

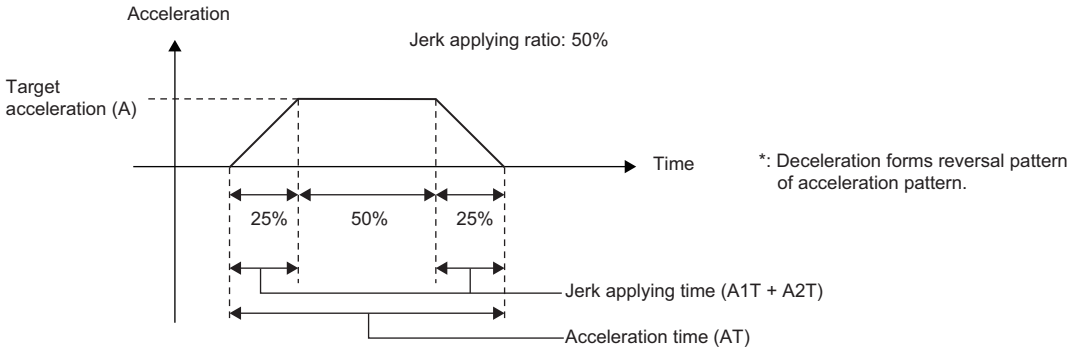
*1 Target acceleration/target deceleration may be adjusted by acceleration/deceleration waveform adjustment. For details, refer to the following.
☞ Page 1092 Acceleration/deceleration waveform adjustment when specifying jerk
*2 Acceleration time and deceleration time may be limited. For details, refer to the following.
☞ Page 1098 Limit of acceleration time/deceleration time
*3 This is the calculation formula when the unit of V is [/s]. When other than [U/s], calculate by converting into [U/s].

- Jerk calculation

When the velocity and the acceleration of operation are fixed, the jerk can be calculated with the following formula by specifying the jerk applying ratio.

$$\text{Jerk (J)} = \frac{(2 - \text{Jerk applying ratio}) \times (\text{Square of acceleration (A)})}{\text{Jerk applying ratio} \times \text{Speed (V)}}$$

The acceleration section jerk applying ratio is the ratio of the jerk applying time to the acceleration time. The jerk applying time is the sum of the acceleration section 1 time and the acceleration section 2 time.



Ex.

When calculating the jerk with the following values set.

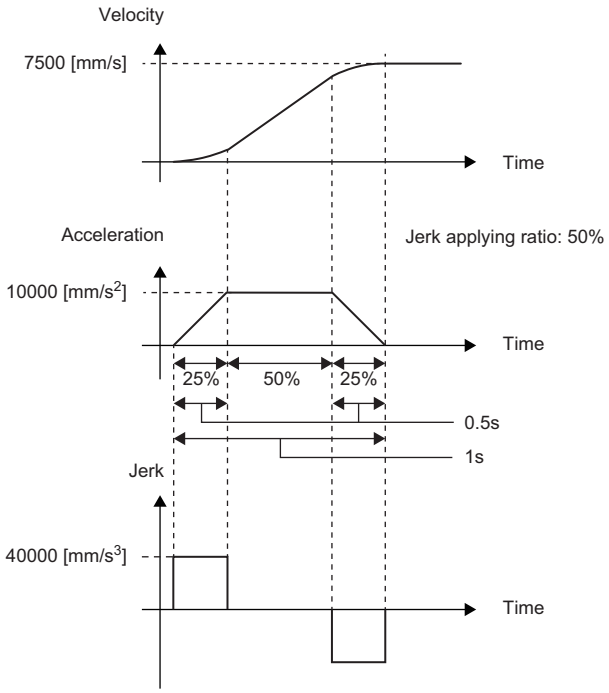
Item	Setting value
Velocity	7500 [mm/s]
Acceleration	10000 [mm/s^2]
Jerk applying ratio	0.5 (50%)

$$\text{Jerk (J)} = \frac{(2 - 0.5) \times 10000^2}{0.5 \times 7500} = 40000 \text{ [mm/s}^3\text{]}$$

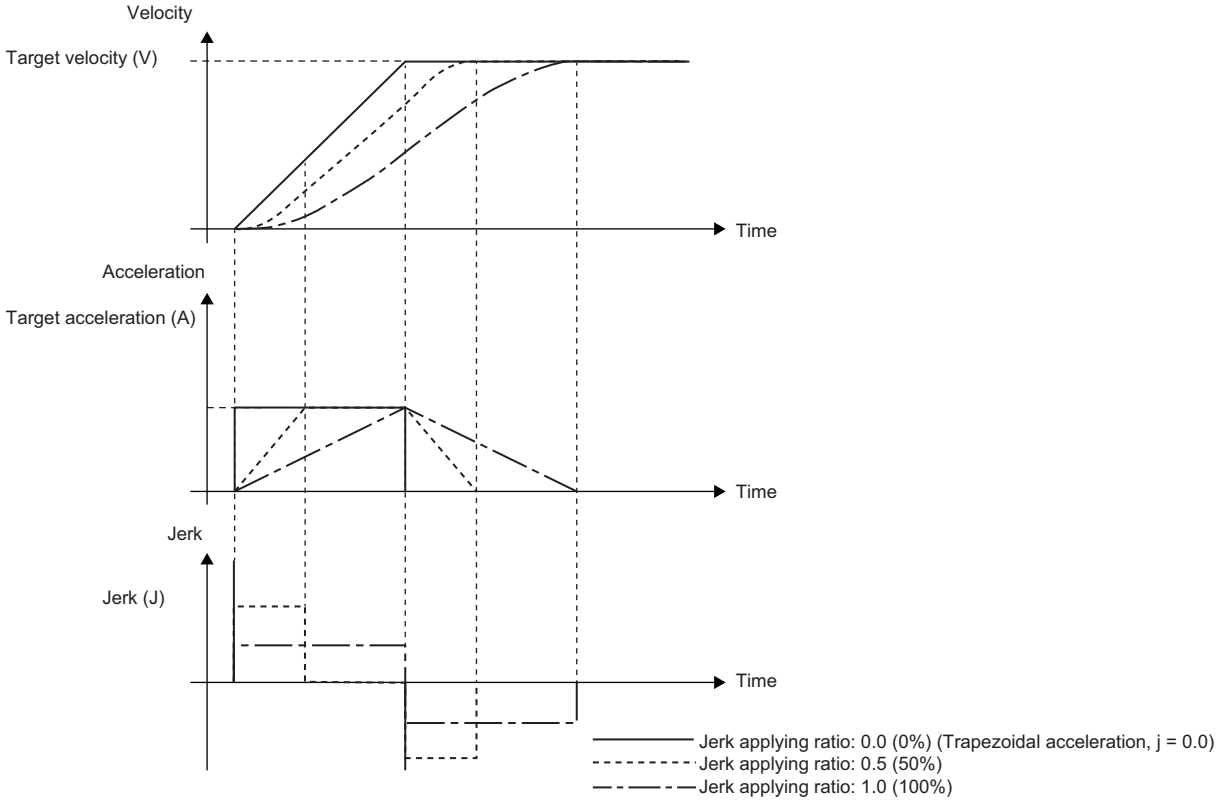
The acceleration time can be calculated when the velocity, the acceleration, and the jerk are fixed. For details, refer to the following.

☞ Page 1085 Jerk acceleration/deceleration

$$\text{Acceleration time (AT)} = \frac{\text{Speed (V)}}{\text{Acceleration (A)}} + \frac{\text{Acceleration (A)}}{\text{Jerk (J)}} = \frac{7500}{10000} + \frac{10000}{40000} = 1\ [\text{s}]$$



When the jerk applying ratio is big or the jerk is small, the acceleration time (deceleration time) becomes longer than that of the trapezoidal acceleration/deceleration. When the jerk applying ratio is 100%, the acceleration time (deceleration time) becomes doubled compared with the trapezoidal acceleration/deceleration. When setting the jerk, pay attention to the acceleration time (deceleration time).



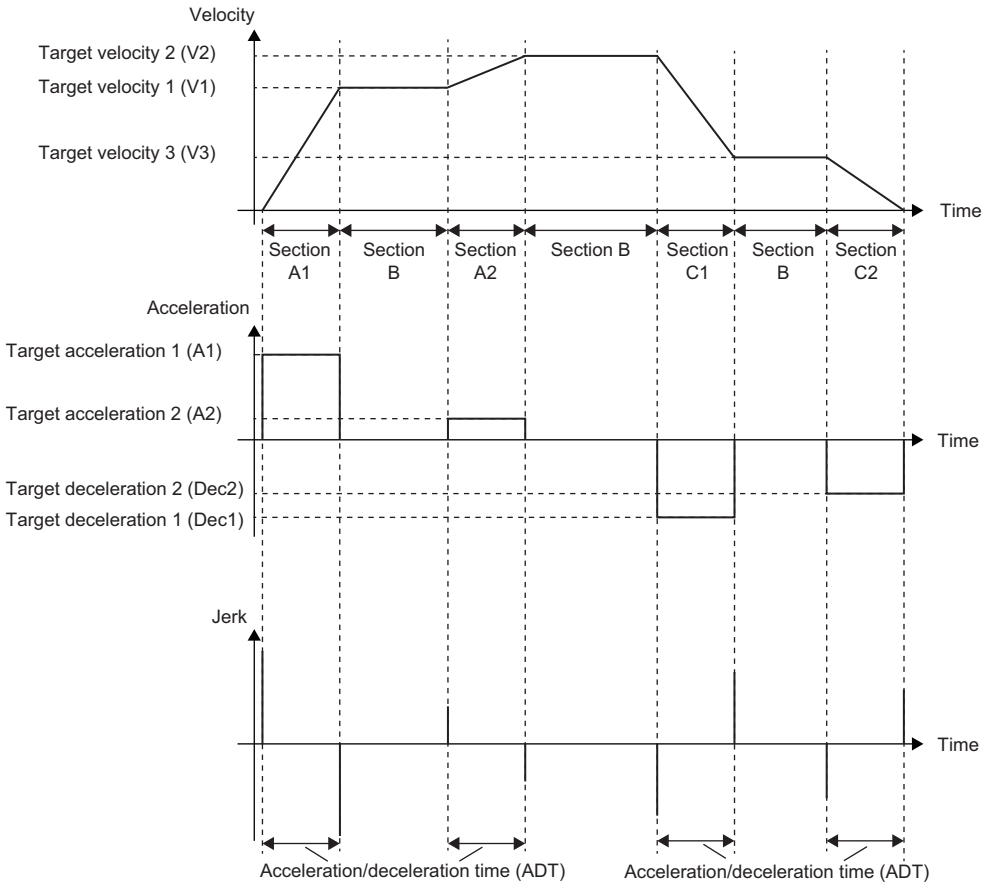
Point

Since the velocity calculation is based on a given jerk, when the acceleration (deceleration) and the target velocity at FB execution are different from the acceleration (deceleration) used at calculating the jerk, the final acceleration time/deceleration time of control are calculated according to the calculation formula of the acceleration/deceleration time parameter.
If the jerk applying ratio exceeds 100% due to the acceleration (deceleration) or the target velocity at FB execution, the target velocity may be reached before the target acceleration is reached.
For details, refer to the following.
☞ Page 1092 Acceleration/deceleration waveform adjustment when specifying jerk

Acceleration/deceleration time-fixed method

When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in the Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, set the acceleration/deceleration time in Acceleration (Acceleration). Deceleration (Deceleration) and Jerk (Jerk) are not used.

Calculates acceleration and deceleration from the acceleration/deceleration time at acceleration/deceleration. When a value smaller than one operation cycle other than 0.0000 is set as the acceleration/deceleration time, the target velocity is reached in one operation cycle.



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section	Acceleration is performed so that the acceleration time from the set velocity to the target velocity is the acceleration/deceleration time.	○	×
B	Fixed speed section	Control is performed at the target velocity. (Acceleration = 0.0)	×	×
C	Deceleration section	Deceleration is performed so that the deceleration time from the set velocity to the target velocity is the acceleration/deceleration time.	×	○

• Acceleration/deceleration parameter calculation

○: Operation possible, ×: Operation not possible

Type	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Acceleration/ deceleration time*1	ADT	—	—	○	○
Calculation value	Current velocity	Vnow	The set velocity at target acceleration and target deceleration calculation	—	○	○
	Target acceleration*2	A	Acceleration from the current velocity to the target velocity*3	(V - Vnow) ÷ ADT*4	○	×
	Target deceleration*2	Dec	Deceleration to decelerate from the current velocity to the target velocity*3	(V - Vnow) ÷ ADT*4	×	○

*1 The deceleration time at automatic deceleration may be longer than the specified acceleration/deceleration time (ADT) due to the compensation of the remaining distance.

*2 It may exceed the acceleration limit value or the deceleration limit value. For details, refer to the following. If it exceeds the acceleration/deceleration range, it will be the upper limit value of the acceleration/deceleration.

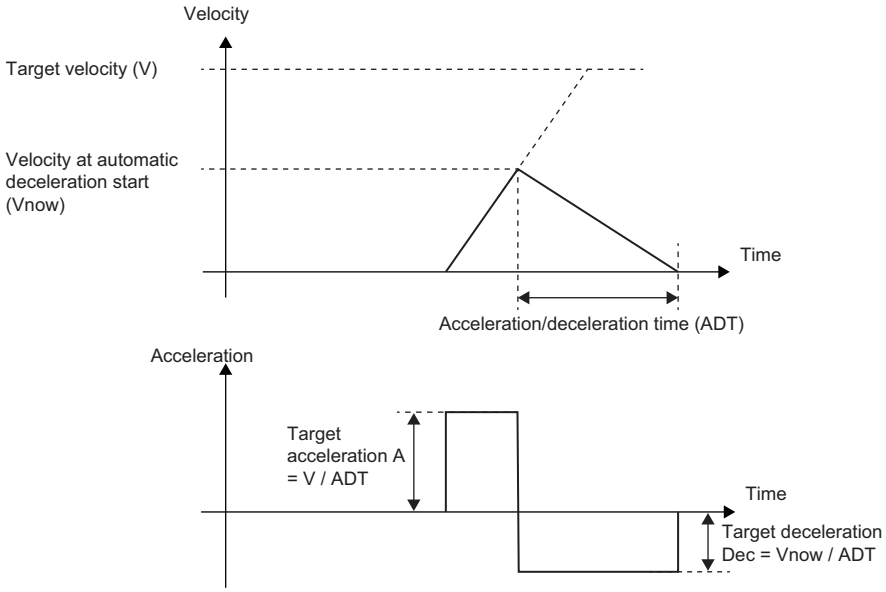
☞ Page 1096 Acceleration limit value/deceleration limit value

*3 The target velocity will be 0 at stop.

*4 This is the calculation formula when the unit of V is [/s]. When other than [U/s], calculate by converting into [U/s].

When the movement amount which does not allow acceleration up to the target velocity is specified at positioning operation, automatic deceleration will start to decelerate and stop at the target position while accelerating. In this case, deceleration is recalculated with the velocity at automatic deceleration start.

Set acceleration/deceleration specification method to set time-fixed acceleration/deceleration at acceleration/deceleration.



Acceleration/deceleration waveform adjustment when specifying jerk

When the jerk acceleration/deceleration (J ≠ 0.0) is specified, the acceleration waveform and the deceleration waveform are adjusted whether the values of the target velocity (V), the target acceleration (A), the target deceleration (Dec), and the jerk (J) satisfy the following condition or not.

Acceleration/deceleration	Condition
For acceleration	$V \geq \frac{A^2}{J}$
For deceleration	$V \geq \frac{Dec^2}{J}$

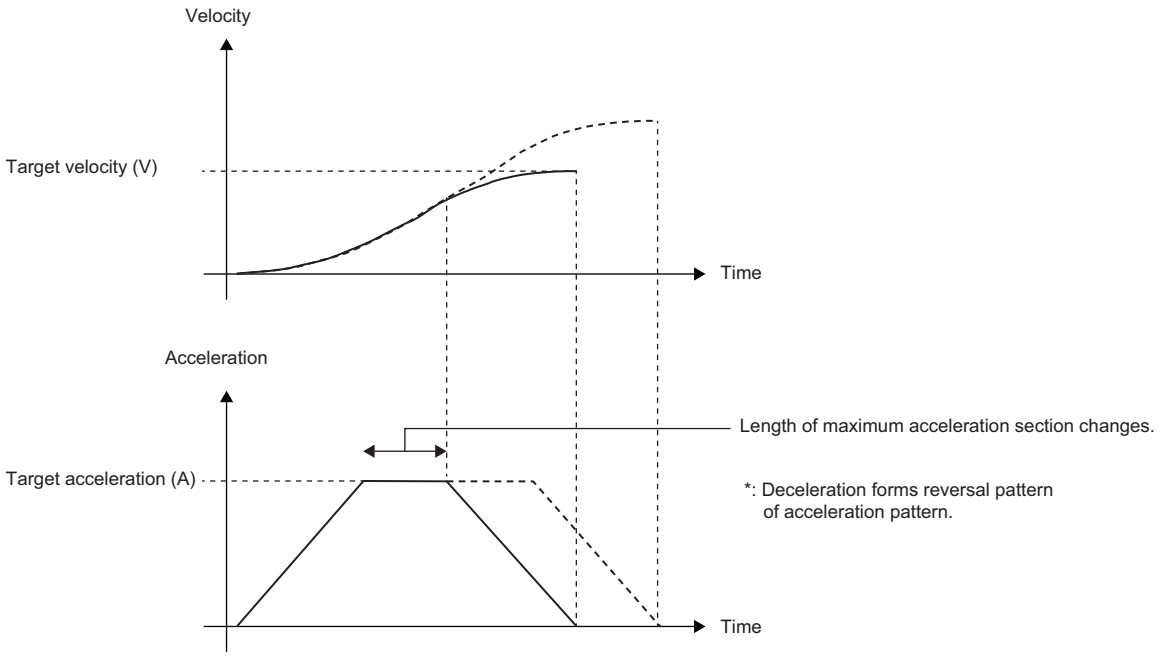
When the condition is satisfied

The target acceleration (deceleration) can be reached.

The maximum acceleration section time and the maximum deceleration section time are adjusted by the velocity, the acceleration, the deceleration, and the jerk, and the waveform changes to reach the target velocity at the end of acceleration.

For the acceleration time and the deceleration time, refer to the following.

☞ Page 1084 Acceleration/deceleration method

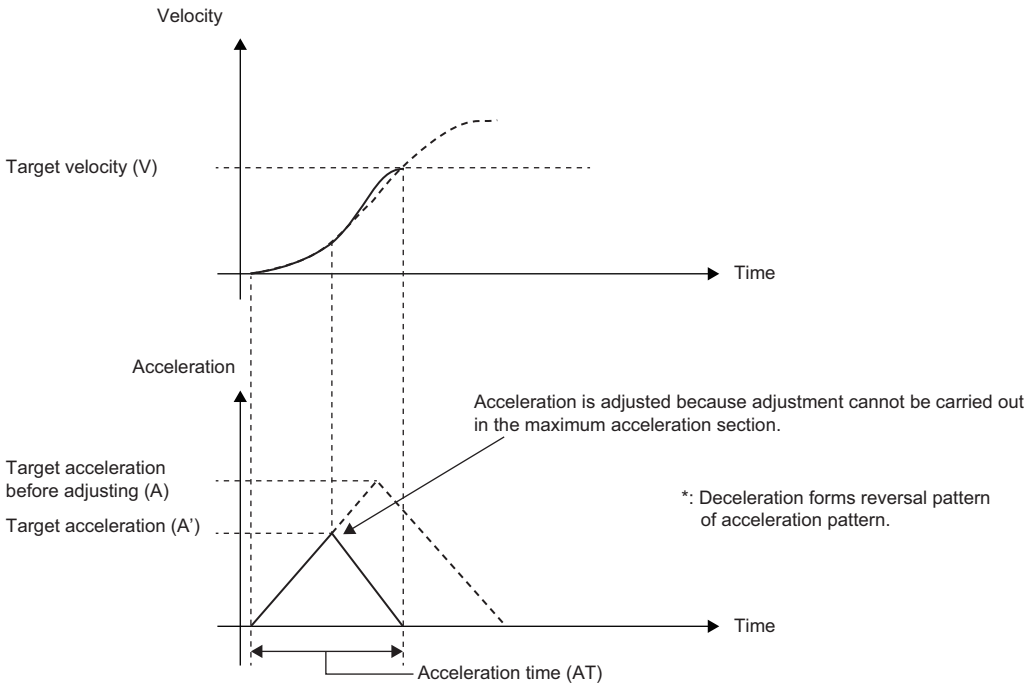


When the condition is not satisfied

When accelerating to the target acceleration, the velocity exceeds the target velocity during acceleration. Therefore, the acceleration is adjusted to reach the target velocity at the end of acceleration. (The velocity does not reach the specified target acceleration (deceleration).)

When the acceleration is adjusted, there is no maximum acceleration section, and the acceleration waveform becomes a triangle. Also, the same adjustment is applied to the deceleration.

Term	Abbreviation	Description
Target acceleration before adjustment	A	Target acceleration before acceleration adjustment
Target acceleration	A'	Target acceleration after acceleration adjustment
Target deceleration before adjustment	Dec	Target deceleration before deceleration adjustment
Target deceleration	Dec'	Target deceleration after deceleration adjustment



The target acceleration (A') and the target deceleration (Dec') can be calculated with the following formula.

$A' = \sqrt{V \times J}$

$Dec' = \sqrt{V \times J}$

The target acceleration (A') and the target deceleration (Dec') after adjustment become smaller than the target acceleration (A) and the target deceleration (Dec) before adjustment.

The acceleration time and the deceleration time can be calculated with the following formula.

Acceleration time (AT) = (V ÷ A') + (A' ÷ J)

Deceleration time (DT) = (V ÷ Dec') + (Dec' ÷ J)

Operation when specifying acceleration/deceleration 0

When "0.0" is specified for the acceleration/deceleration, the operation differs at startup and the rest.
When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, the operation is the one performed when "0.0" is specified for the acceleration/deceleration time. The operation is the same as specifying "0.0" for acceleration/deceleration.

Specifying "0.0" at start

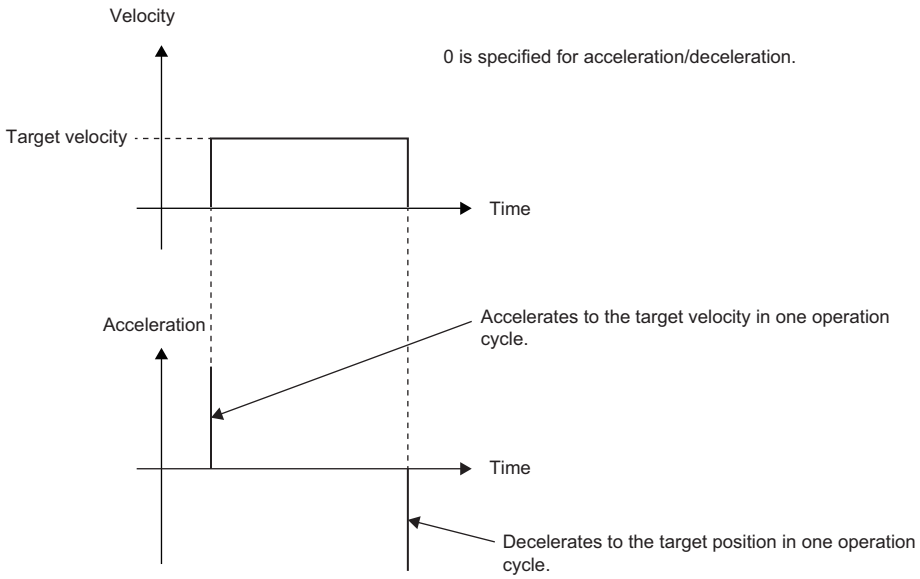
Select the operation when "0.0" is specified for the acceleration and the deceleration in Operation Selection at Start Acceleration/Deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). To operate by the vector velocity at interpolation control, follow Operation Selection at Start Acceleration/Deceleration 0 (AxesGroupName.Pr.AccelerationZeroBehavior).

■When selecting "-1: Error (Not Started) (ACCError)"

Acceleration/Deceleration 0 specified operation error at start (error code: 1A88H) occurs, and the axis does not start.

■When selecting "1: Maximum Acceleration/Deceleration (MaximumAcceleration)"

If "0.0" is specified for the acceleration or the deceleration, an error will not occur. For acceleration, even if the jerk is set, trapezoidal acceleration/deceleration is operated and the acceleration/deceleration is performed in one operation cycle. In these cases, acceleration/deceleration is performed exceeding the acceleration limit value and deceleration limit value.



Precautions

Pay full attention when setting "1: Maximum Acceleration/Deceleration (MaximumAcceleration)" because operation is rapid motion.

Point

Operation when specifying acceleration/deceleration 0 is applied to acceleration/deceleration after override.

Specifying "0.0" other than at start

■At the acceleration change/At the deceleration change

If "0.0" is specified at the acceleration change or deceleration change, Out of acceleration range warning (event code: 00D17H) or Out of deceleration range warning (event code: 00D18H) will occur, causing the change not to be accepted. Operation continues with the previous target acceleration and deceleration.

■At multiple start

When "0.0" is specified for the acceleration or the deceleration in the multiple started FB, the target acceleration or the target deceleration of the previous FB is taken over.

Specifying "0.0" at stop processing

In MC_Stop (Forced Stop)/MC_GroupStop (Group Forced Stop) and the deceleration at stop setting, when "0.0" is specified for the deceleration, the axis immediately stops without an acceleration/deceleration.

Acceleration limit value/deceleration limit value

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, acceleration/deceleration is limited by the acceleration/deceleration limit value.
When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in Options of the FB, it is not limited. When "0.0" is specified for the acceleration/deceleration limit value, it is not limited as well.
Specify an acceleration limit value and deceleration limit value in Acceleration Limit Value (AxisName.Pr.AccelerationLimit) and Deceleration Limit Value (AxisName.Pr.DecelerationLimit). To operate by the vector velocity at interpolation control, follow Acceleration Limit Value (AxesGroupName.Pr.AccelerationLimit) and Deceleration Limit Value (AxesGroupName.Pr.DecelerationLimit).

Operation

This operation is for the FB which has Acceleration (Acceleration) and Deceleration (Deceleration) of input variables.
Acceleration/deceleration is limited at the following timing.

■At start

If exceeding the acceleration limit value or the deceleration limit value, Acceleration limit value over (error code: 1AA6H) or Deceleration limit value over (error code: 1AA7H) will occur, and the axis will not start.

■At acceleration change/At deceleration change

If exceeding the acceleration limit value or the deceleration limit value by changing the acceleration or the deceleration, Acceleration Limit Value Over Warning (event code: 00D06H) or Deceleration Limit Value Over Warning (event code: 00D07H) will occur, and the change will not be accepted. The acceleration/deceleration operation before change will be continued.

■At multiple start

If the acceleration or deceleration of the multiple started FB has exceeded the acceleration limit value or the deceleration limit value, Acceleration limit value over (error code: 1AA6H) or Deceleration limit value over (error code: 1AA7H) will occur, causing the under-control FB to be interrupted and the operation to be stopped. For details, refer to the following.
☞ Page 576 Precautions

■At stop processing

- When decelerating stop by MC_Stop (Forced Stop)/MC_GroupStop (Group Forced Stop)
  When exceeding the deceleration limit value, Deceleration Limit Value Over (error code: 1AA7H) occurs and the axis stops according to Stop Selection at Stop Cause Occurrence (AxisName(AxesGroupName).Pr.StopMode_General).
- When decelerating to stop by a cause other than MC_Stop (Forced Stop)/MC_GroupStop (Group Forced Stop)
  When exceeding the deceleration limit value, Deceleration Limit Value Over Warning (event code: 00D07H) occurs and the target deceleration becomes the deceleration limit value.

Jerk limit value

When the jerk acceleration/deceleration is (J ≠ 0.0), Jerk is limited by a value specified in Jerk Limit Value (JerkLimit). When "0.0" is specified for the jerk limit value, the jerk is not limited.
Specify the jerk limit value in Jerk Limit Value (AxisName.Pr.JerkLimit). To operate by the vector velocity at interpolation control, follow Jerk Limit Value (AxesGroupName.Pr.JerkLimit).

Operation

This operation is for the FB which has Jerk (Jerk) of input variables.
Jerk is limited at the following timing.

■At start

If the specified jerk at start exceeds the jerk limit value, Jerk limit value over (error code: 1AA8H) will occur, and the axis will not start.

■At multiple start

If the specified jerk in the multiple started FB has exceeded the jerk limit value, Jerk limit value over (error code: 1AA8H) will occur, causing the under-control FB to be interrupted and the operation to be stopped. For details, refer to the following.
☞ Page 576 Precautions

Limit of acceleration time/deceleration time

The acceleration time and the deceleration time are limited by 8400.0 [s].
When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, the acceleration time and the deceleration time calculated from the acceleration and the deceleration are limited. For a method of calculating the acceleration time and the deceleration time, refer to the following.
☞ Page 1084 Acceleration/deceleration specification method

Operation

■At start

Depending on Acceleration/deceleration method setting (Options (Options) bits 0 to 2), the operation is as follows.

- When "0: Acceleration/deceleration specification method (mcAccDec)"
  If the acceleration time or the deceleration time exceeds 8400.0 [s], Acceleration Time Over at Start (error code: 1A8BH) or Deceleration Time Over at Start (error code: 1A8CH) will occur, and the axis will not start.
- When "1: Acceleration/deceleration time-fixed method (mcFixedTime)"
  When acceleration time and deceleration time exceeding 8400.0 [s] are specified, Out of Acceleration/Deceleration Time Range (error code: 1A89H) occurs, and the axis will not start.

■At control change

Limits time from the issuance of the control change instruction until acceleration or deceleration finishes. Depending on Acceleration/deceleration method setting (Options (Options) bits 0 to 2), the operation is as follows.

- When "0: Acceleration/deceleration specification method (mcAccDec)"
  Performing a velocity change, an acceleration change, or a deceleration change may exceed 8400.0 [s]. In this case, Acceleration Time Limit Over Warning (event code: 00D04H) or Deceleration Time Limit Over Warning (event code: 00D05H) occurs, and operation is performed as shown below.

Warning	Operation
Acceleration Time Limit Over Warning (event code: 00D04H)	Changes to the velocity and acceleration are not accepted. It keeps operating with the previous velocity and acceleration.
Deceleration Time Limit Over Warning (event code: 00D05H)	Changes to the velocity and deceleration are not accepted. It keeps operating with the previous velocity and deceleration.

- When "1: Acceleration/deceleration time-fixed method (mcFixedTime)"
  When the acceleration/deceleration time change exceeding 8400.0 [s] is performed, Out of Acceleration/Deceleration Time Range Warning (event code: 00D19H) occurs, and the axis will not accept the acceleration/deceleration time change. When the velocity change is performed at the same time, the axis operates with previous acceleration time and deceleration time. If the velocity change is not performed at the same time, the axis keeps the current acceleration/deceleration operation during accelerating/decelerating.

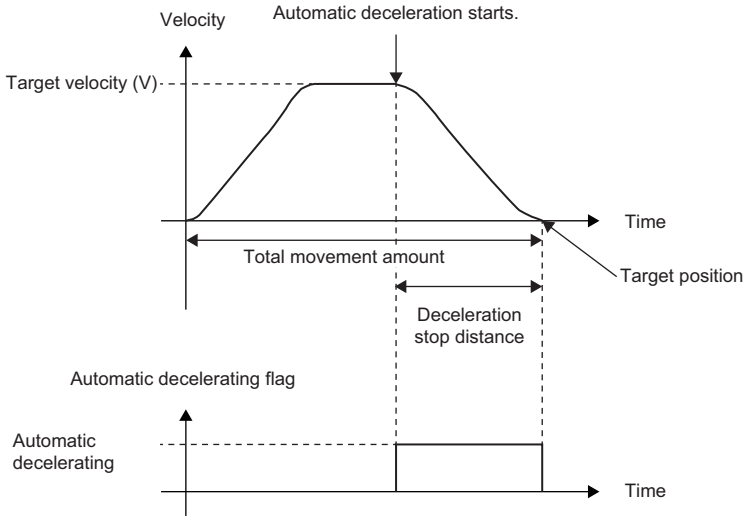
■When the acceleration time/deceleration time is within one operation cycle

When the acceleration time or the deceleration time is less than one operation cycle due to the specified velocity, acceleration, deceleration, and jerk, the velocity reaches the target velocity in one operation cycle regardless of the jerk.

Automatic deceleration

Decelerating to a velocity of "0.0" to stop at the specified target position is called automatic deceleration.
During automatic deceleration, Automatically Decelerating (AxisName.Md.AutoDeceleration) is TRUE.
When automatic deceleration is performed, the deceleration may go ahead or behind the target deceleration. Therefore, Set Acceleration (AxisName.Md.SetAcceleration) may exceed Target Deceleration (AxisName.Md.TargetDeceleration).
Besides, the current velocity may continue due to the compensation of the remaining distance during automatic deceleration for the trapezoidal acceleration/deceleration and acceleration/deceleration time-fixed method. In this case, Set Acceleration (AxisName.Md.SetAcceleration) will be "0".

Item	Description
Deceleration stop distance	Distance required for deceleration to stop at the target position
Total movement amount	Movement amount from start of the FB to reaching the target position
Cumulative movement amount	Movement amount from start of the FB to the current position
Next Δ movement amount	Movement amount in the next operation cycle



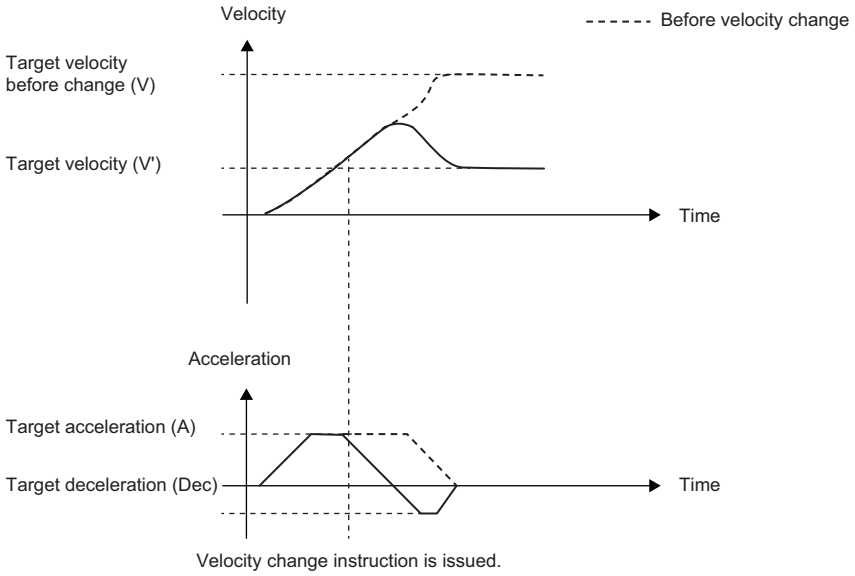
Automatic deceleration starts when the following condition is satisfied.
Deceleration stop distance > Total movement amount - Cumulative movement amount - Next Δ movement amount

- When a multiple start is in execution, automatic deceleration processing is performed when decelerating to the target position during execution of the final positioning point.
- The automatic deceleration flag turns off at the deceleration caused by the stop command or the stop cause occurrence.

Changing control of jerk acceleration/deceleration

Acceleration/deceleration operation at changing control immediately changes the acceleration and the deceleration for the trapezoidal acceleration/deceleration (J = 0.0).

For the jerk acceleration/deceleration (J ≠ 0.0), when a control change is carried out during acceleration or deceleration, acceleration/deceleration will be performed taking over the previous acceleration (deceleration). Therefore, if a control change that causes the deceleration operation is executed during acceleration, the operation will continue to accelerate until the acceleration becomes 0 without decelerating immediately.



Item	Description
Velocity change	Indicates the following operations. • For retrigger/continuous update of velocity input variables • For execution of velocity override factor change
Acceleration change	Indicates the following operations. • For retrigger/continuous update of acceleration input variables • For execution of acceleration override factor change
Deceleration change	Indicates the following operations. • For retrigger/continuous update of deceleration input variables • For execution of acceleration override factor change

The following shows the specific operation of the jerk acceleration/deceleration during control change.

Target position change

The specific acceleration/deceleration operation of jerk acceleration/deceleration is shown below. For the basic control description, refer to the following.

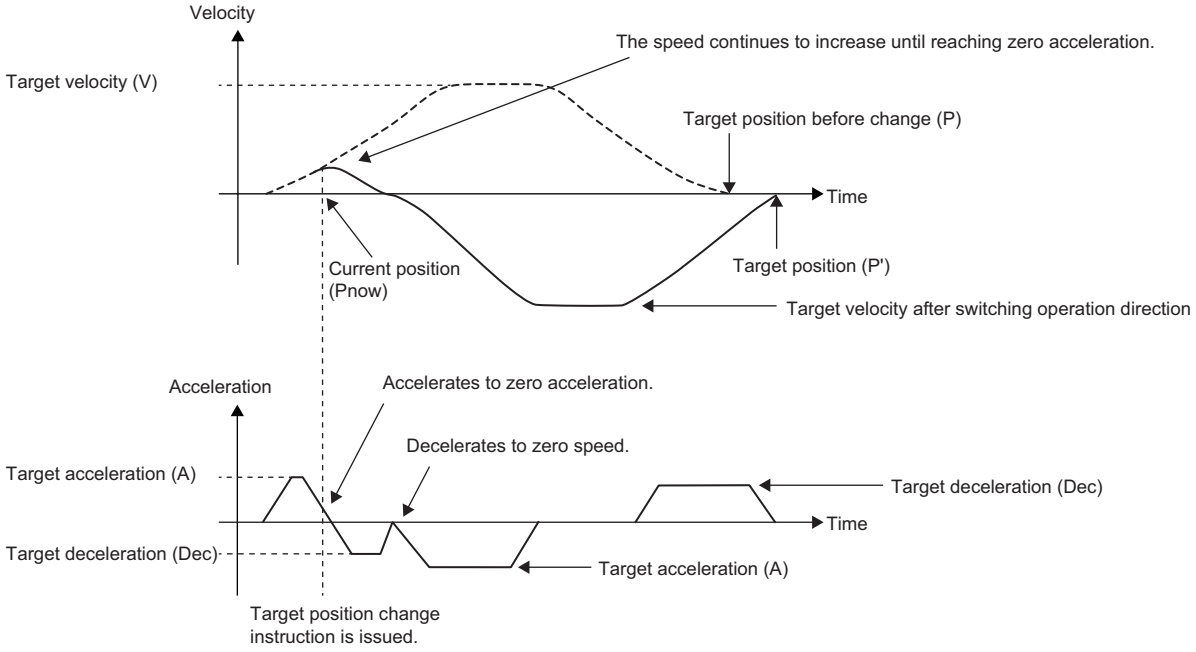
☞ Page 1147 Target Position/Movement Distance Change

Item	Abbreviation	Description
Current position	Pnow	The position when a target position change instruction is issued
Target position before change	P	The target position before the target position is changed
Target position	P'	The target position after the target position was changed

■When the operation direction is reversed

When the target position after change is specified in the front of the current position, the operation direction is reversed. The axis accelerates to the acceleration of 0, then decelerates to the velocity 0. When the velocity reaches 0, the operation direction is reversed and acceleration/deceleration is performed to the target position.

■For the acceleration/deceleration specification method



Velocity change

The specific acceleration/deceleration operation of jerk acceleration/deceleration is shown below. For the basic control description, refer to the following.

☞ Page 1151 Command Velocity Change

Item	Abbreviation	Description
Current velocity	Vnow	The velocity when changing the velocity
Target velocity	V	The target velocity before the velocity is changed
Target velocity after change	V'	The target velocity after the velocity was changed

In jerk acceleration/deceleration, to smooth acceleration at velocity change, velocity change is performed taking over the current acceleration before change.

■When not reaching the target acceleration

If the target velocity decreases due to velocity change, the target acceleration may not be reached. Adjust the target acceleration not to exceed the target velocity. For details, refer to the following.

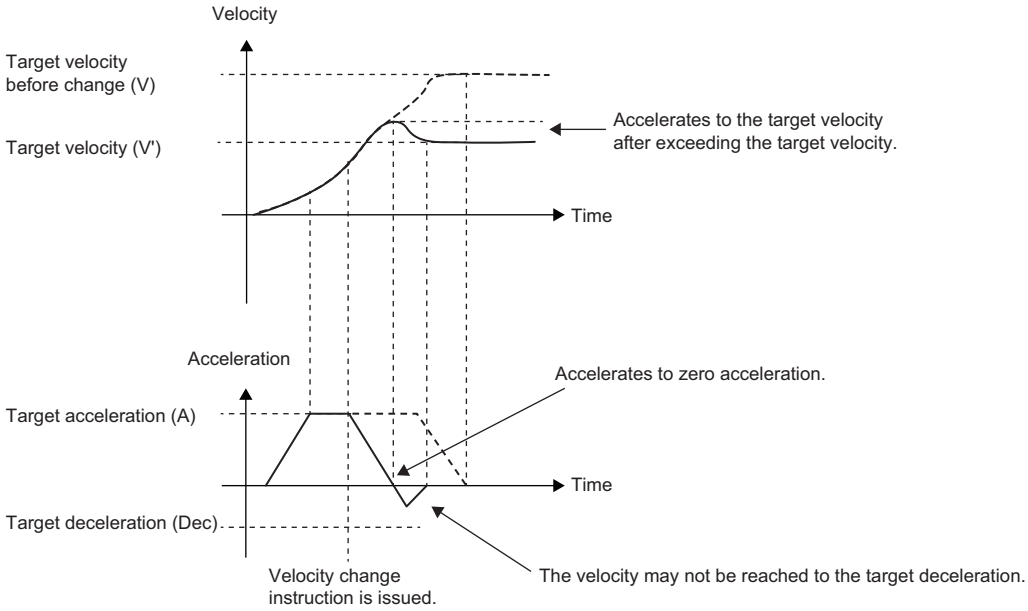
☞ Page 1092 Acceleration/deceleration waveform adjustment when specifying jerk

■When exceeding the target velocity

If velocity is changed to a value smaller than the target velocity before change during acceleration, the target velocity may be exceeded. The axis accelerates to acceleration 0 after the velocity change instruction is issued, but exceeds the target velocity. After reaching the acceleration 0, it accelerates to the target velocity.

■Acceleration/deceleration specification method

After reaching the acceleration 0 due to velocity change during acceleration, the target deceleration may not be reached when decelerating to the target velocity.



■When a target velocity change is performed during automatic deceleration

The velocity change is accepted, however operation in execution is not changed. The target velocity after change is used when re-acceleration is performed by target position change.

Acceleration change

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, acceleration change is performed.

Item	Abbreviation	Description
Current acceleration	Anow	The acceleration when changing the acceleration
Target acceleration before change	A	Target acceleration before acceleration is changed
Target acceleration	A'	Target acceleration after acceleration was changed

■When not reaching the target acceleration

When the target acceleration increases by acceleration change and the target velocity is exceeded at the specified acceleration, the target acceleration will not be reached because the target velocity is given priority. For details, refer to the following.

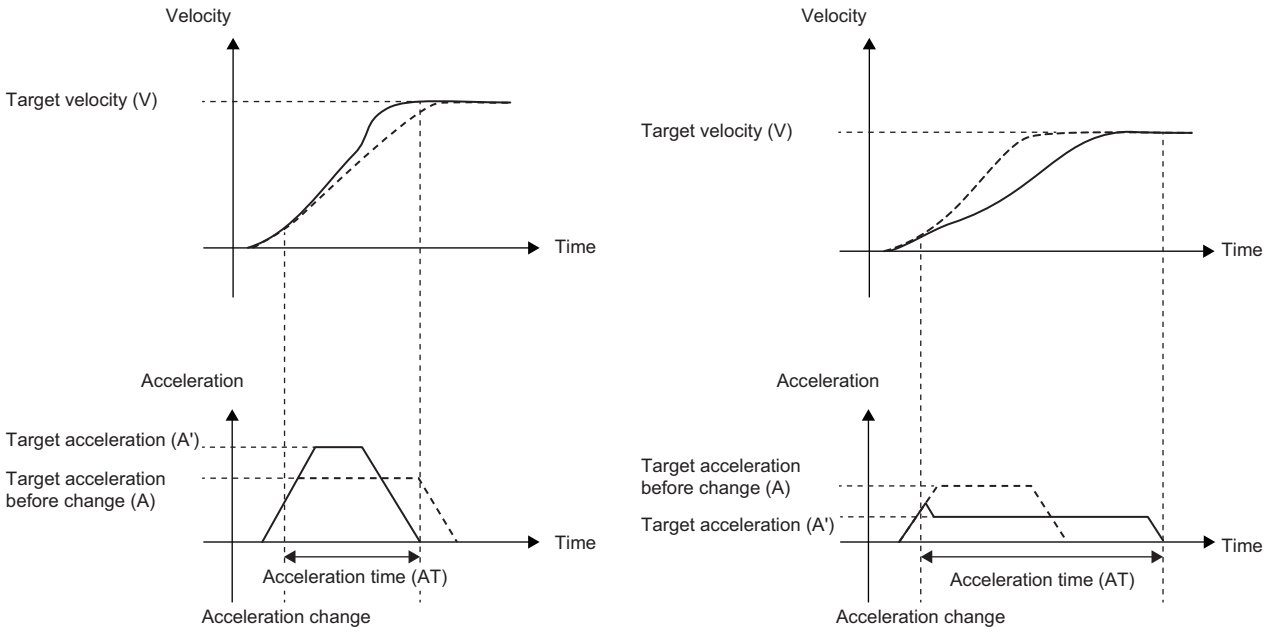
☞ Page 1092 Acceleration/deceleration waveform adjustment when specifying jerk

Also, when velocity change and acceleration change are simultaneously performed, the target acceleration may not be reached because the target velocity is given priority.

■Acceleration change

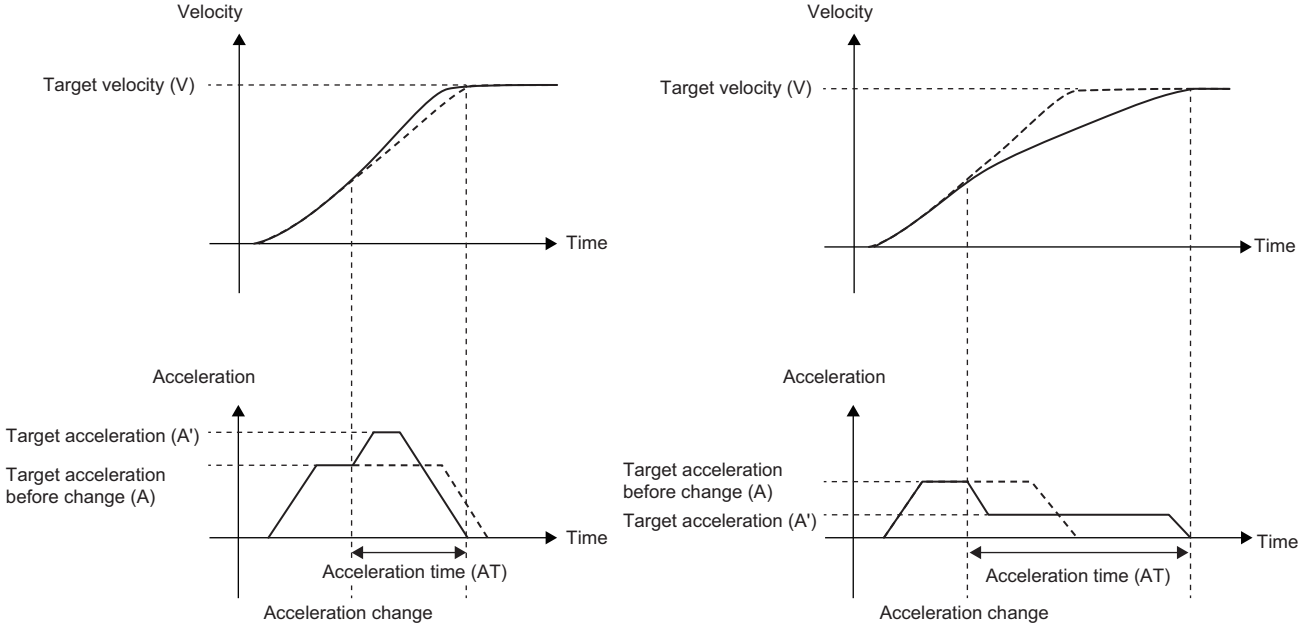
The acceleration change pattern can be classified as below based on the operation status when acceleration change is performed.

- When executing acceleration change in the acceleration section 1
  Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the velocity and the acceleration immediately before the acceleration change.



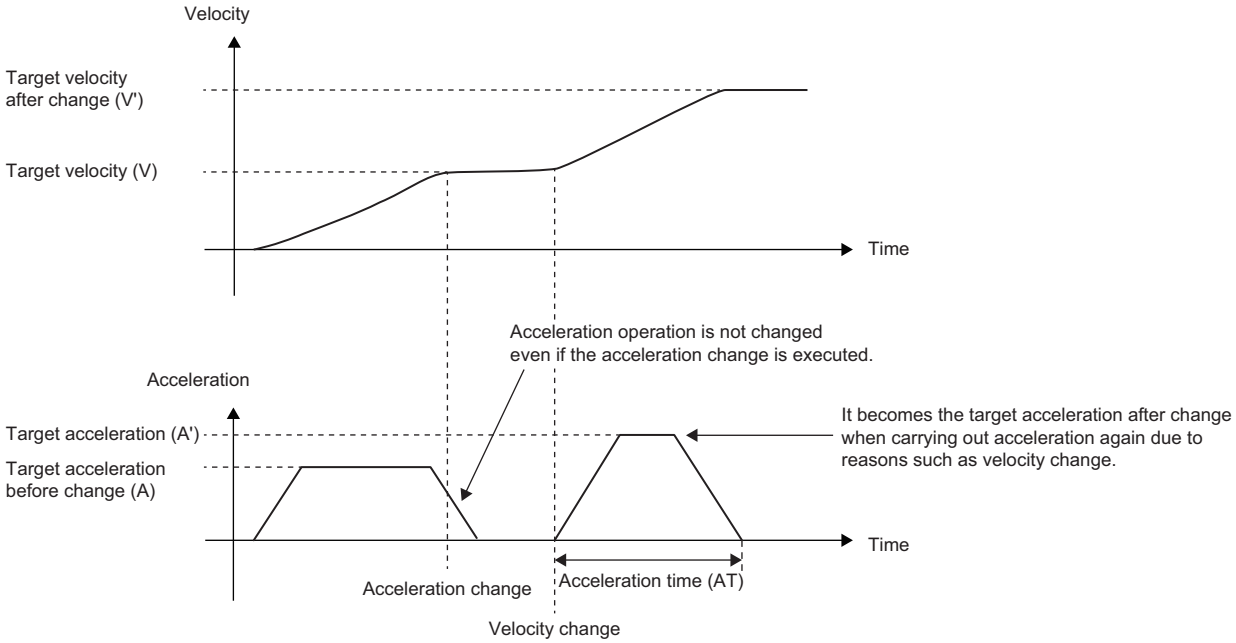
• When executing acceleration change in the maximum acceleration section

Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the velocity and the acceleration immediately before the acceleration change.



• When executing acceleration change in the acceleration section 2 or during fixed-speed, deceleration, or automatic deceleration

The acceleration change is accepted; however acceleration operation during execution does not change. When re-acceleration is performed by velocity change or others, the axis accelerates with the acceleration after change.



Deceleration change

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bits 0 to 2) of the FB, deceleration change can be performed.

Item	Abbreviation	Description
Current deceleration	DecNow	The deceleration when changing the deceleration
Target deceleration before change	Dec	Target deceleration before deceleration is changed
Target deceleration after change	Dec'	Target deceleration after deceleration was changed

When deceleration change is performed during operation, the target position may be overrun by decreasing the deceleration. In this case, the axis is controlled based on Operation Setting at Overrun (AxisName(AxesGroupName).Pr.OverrunOperation).

- When executing deceleration change in the acceleration section or fixed-speed section
  The deceleration change is accepted; however the operation during execution does not change. When deceleration is performed, the axis decelerates with the deceleration after change.
- When executing deceleration change in deceleration other than the automatic deceleration
  The basic operation is the same as the acceleration change. For details, refer to the following.
  ☞ Page 1103 Acceleration change
- When executing deceleration change in the automatic deceleration
  The deceleration change is accepted; however the operation during execution does not change. When re-deceleration is performed after re-acceleration by changing the target position, the axis decelerates with the deceleration after change.

Acceleration/deceleration method and multiple start

This section describes the acceleration/deceleration operation specific to the acceleration/deceleration method. For the basic operation of the buffer mode, refer to the following.

☞ Page 547 Multiple Start (Buffer Mode)

Item	Description
Switching point	The point where FBs are switched
Under-control FB	FB that is during control on the axis and the axes group (FB whose Active is TRUE)
Next FB	FB that multiple starts during operation of the axis and the axes group

Acceleration/deceleration operation

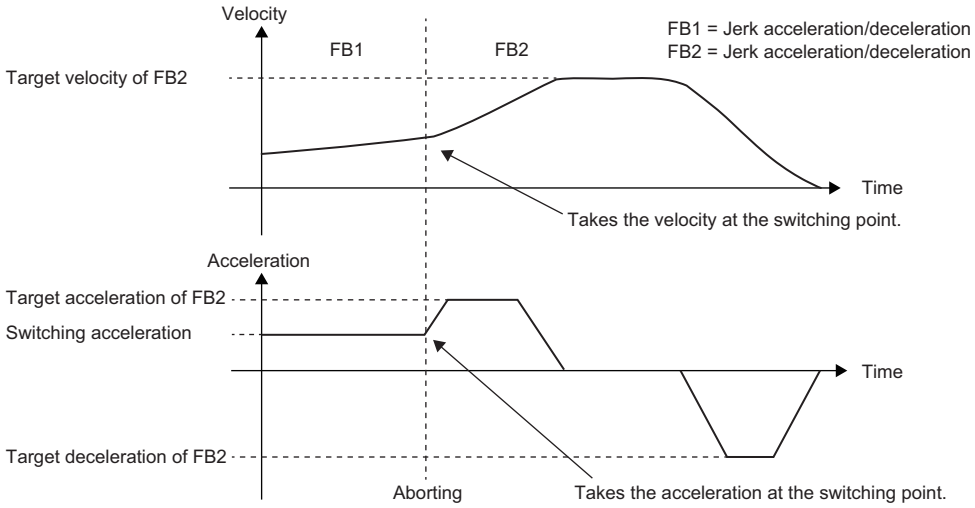
■When the acceleration/deceleration methods are different between the under-control FB and the next FB

Acceleration/Deceleration method mismatched (error code: 1A8AH) occurs and the axis stops. Specify the same acceleration/deceleration method in the FBs.

■When the acceleration/deceleration methods are the same between the under-control FB and the next FB

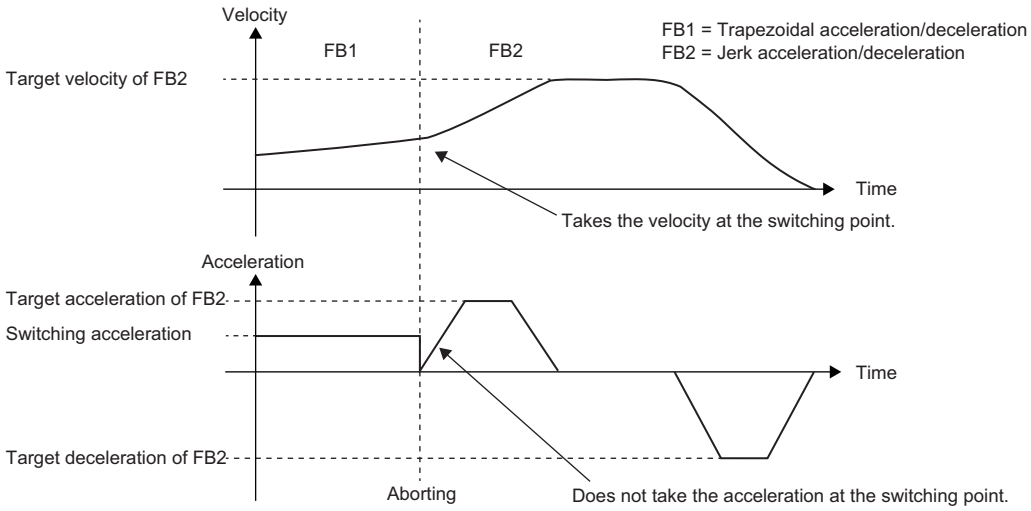
- When switching is "from jerk acceleration/deceleration to another jerk acceleration/deceleration"

  The axis accelerates/decelerates taking over the velocity and the acceleration (deceleration) at the switching point. However, when the jerk setting values are different between the under-control FB and the next FB, the jerk of the next FB will be the same as the jerk of the under-control FB. Also, after reaching the switching point during acceleration (deceleration), the on-going velocity waveform continues in case all settings of the target velocity, the acceleration, the deceleration, and the jerk are the same between the under-control FB and the next FB. If there is a different setting in any of those, the velocity change is performed to the target velocity of the next FB.



- When switching is other than "from jerk acceleration/deceleration to another jerk acceleration/deceleration"

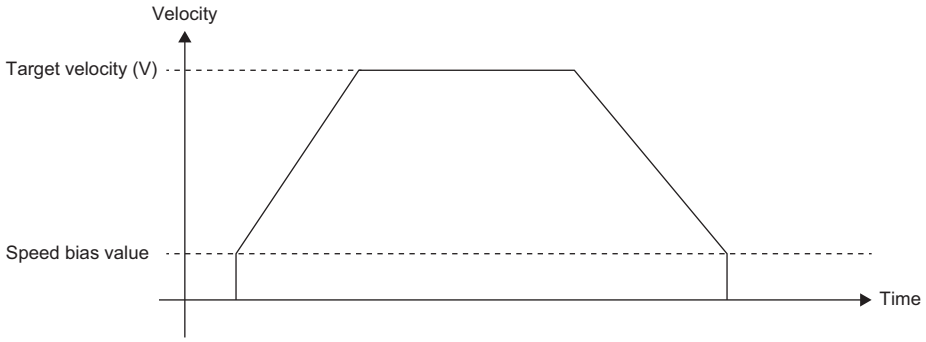
  In the following case, the acceleration (deceleration) is not taken over at the switching point.
  - Switching from jerk acceleration/deceleration to trapezoidal acceleration/deceleration
  - Switching from trapezoidal acceleration/deceleration to another trapezoidal acceleration/deceleration
  - Switching from trapezoidal acceleration/deceleration to jerk acceleration/deceleration



Velocity bias

Velocity bias is a function that optionally sets the command velocity when starting and stopping the axis.
When a stepping motor is used, the motor can be smoothly started and stopped by setting the starting velocity suitable for the motor to the velocity bias value.
Velocity bias is enabled in the following operations when the acceleration/deceleration method is set to the acceleration/deceleration specification method or the acceleration/deceleration time-fixed method.

- Single axis positioning control
- Single axis speed control
- Single axis manual control
- Multiple axes positioning control
- Multiple axes positioning data operation
- Direct control (position follow-up, speed control)



Setting method

Set velocity bias value (AxisName (AxesGroupName).Pr.VelocityBias) for each axis.

Setting item	Name	Details
VelocityBias	Velocity bias value	Sets the velocity bias value for each axis and axes group. Range: 0, ±0.0001 to ±2500000000.0 • 0: Velocity bias disabled

- When velocity bias is used in linear interpolation control, the velocity bias value to be used varies depending on the velocity mode setting. If the long axis velocity or reference axis velocity is specified in the velocity mode, the velocity bias value of the axis parameter is used. If the vector velocity is specified in the velocity mode, the velocity bias value of the axes group parameter is used.
- When velocity bias is used in circular interpolation control, the velocity bias value of the axes group parameter is used.
- Set "0" to this parameter when not using the velocity bias.
- Set the velocity bias value to Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive), Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), and Velocity Limit Value (AxesGroupName.Pr.VelocityLimit) or less. If a value larger than the velocity limit value is set, Velocity bias value velocity limit value over (error code: 1B39H) will occur at PLC READY ON, and ready is not turned on.
- Set the velocity and velocity override factor so that the target velocity is equal to or larger than velocity bias value. If the target velocity is set to a value other than 0 and less than the velocity bias value at axis start, Less than velocity bias value error (error code: 1B3AH) will occur and the axis will not start.
- If the target velocity is a value other than 0 and less than the velocity bias value due to multiple start, velocity change, or velocity override factor change, Less than velocity bias value warning (error code: 0D4BH) will occur. In this case, the changed target velocity operates with the velocity bias value.
- Velocity bias is enabled only for trapezoidal acceleration/deceleration. If an operation with a jerk value other than 0 is started for an axis with a velocity bias value other than 0, Velocity bias function combination unsupported warning (error code: 0D4AH) will occur. In this case, velocity bias starts as disabled.
- When acceleration/deceleration is performed by acceleration/deceleration time-fixed method, the time required from the velocity bias value to the completion of the acceleration is regarded as the acceleration time, and the time required to decelerate to the velocity bias value is regarded as the deceleration time.

Velocity bias precautions

- When using a motor other than stepping motor, set the velocity bias value to 0. If the value is set to other than 0, vibration or impact will occur.
- When multiple axes positioning operation is performed by specifying an axis or axes group with enabled velocity bias, the axis other than that specified in velocity mode may suddenly accelerate or decelerate at start and stop.
- Set the velocity bias value according to the stepping motor driver specifications. Failure to do so may cause an error or step-out due to the sudden velocity change and overload.
- If the operation with the velocity bias enabled is being performed, the target velocity cannot be changed to less than the velocity bias value. To stop temporarily, change the velocity override factor and command velocity so that the target velocity is 0.
- If a value equal to the velocity bias value or less is specified for the target velocity by acceleration/deceleration time-fixed method, the acceleration/deceleration is 0. In this case, if "-1: error (Not Started) (ACCError)" is set to Operation Selection at Start Acceleration/Deceleration 0 (AxisName (AxesGroupName).Pr.AccelerationZeroBehavior), Acceleration/Deceleration 0 specified operation error at start (error code: 1A88H) will occur and the axis will not start.
- Velocity bias does not support homing. For details on the operation and setting during driver homing, refer to the manual for the drive unit.

Precautions

Precautions when the range is exceeded

Precautions for when the acceleration/deceleration calculated from the acceleration/deceleration and the acceleration time/deceleration time after acceleration override exceeds the range are shown below.

■When the acceleration calculated from the acceleration time or the acceleration after acceleration override exceeds the range of "0 or 0.0001 to 2147483647.0 [U/s^2]"

Out of Acceleration Range Clamping Warning (event code: 00D35H) occurs, and the acceleration will be as follows.

- When "Acceleration after acceleration override > 2147483647.0 [U/s^2]"
  The acceleration will be "2147483647.0 [U/s^2]".
- When "0 < Acceleration after acceleration override < 0.0001"
  The acceleration will be "0". For operation, refer to the following.
  ☞ Page 1094 Operation when specifying acceleration/deceleration 0

■When the deceleration calculated from the deceleration time or the deceleration after acceleration override exceeds the range of "0 or 0.0001 to 2147483647.0 [U/s2]"

Out of Deceleration Range Clamping Warning (event code: 00D36H) occurs, and the deceleration will be as follows.

- When "Deceleration after acceleration override > 2147483647.0 [U/s^2]"
  The deceleration clamps at "2147483647.0 [U/s^2]".
- When "0 < Deceleration after acceleration override < 0.0001"
  The deceleration will be "0". For operation, refer to the following.
  ☞ Page 1094 Operation when specifying acceleration/deceleration 0

■When the acceleration time (deceleration time) after acceleration override exceeds 8400.0 [s]

Out of Acceleration/Deceleration Time Range Clamping Warning (event code: 00D37H) occurs and the acceleration time (deceleration time) will be "8400.0 [s]".

Restrictions on commanded acceleration, deceleration, and jerk lower limit values

To perform floating-point operation, the lower limit value of commanded acceleration, commanded deceleration, and commanded jerk are limited by the following restrictions.

■Lower limit restrictions of acceleration/deceleration

The set velocity may not change as information error occurs if the values of calculation cycle converted velocity and acceleration differ greatly. Therefore, set the values of velocity and acceleration so that they stay within the effective digits (approximately 15 digits) of a floating-point number (64 bits).
When the calculation cycle converted acceleration is smaller than the set velocity, Out of Operation Cycle Converted Acceleration Range Warning (event code: 00D38H) occurs. Similarly, Out of Operation Cycle Converted Deceleration Range Warning (event code: 00D39H) occurs for deceleration. Check the set velocity. If it is not changed, either increase the acceleration and deceleration or extend the operation cycle.

Ex.

When control change is performed with the following settings during fixed-speed while Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) is "HFD000300 [/ms]", operation cycle is "0.125 [ms]", and velocity is "2499999999.9"

- Velocity (Velocity): 2500000000.0
- Acceleration (Acceleration): 62.0

* Acceleration/deceleration specification method (Trapezoidal acceleration/deceleration)

Calculation cycle converted velocity upper limit value = 2500000000.0 [pulses/ms] × 0.125 [ms] = 312500000.0 [pulses]
Calculation cycle converted acceleration = 62.0 [pulses/s^2] × (0.125 [ms] ÷ 1000)^2 = 9.6875E-07 [pulses]
In above case, Out of Operation Cycle Converted Acceleration Range Warning (event code: 00D38H) occurs because the calculation cycle converted acceleration lower limit value is "1E-06 [pulses]".

■Lower limit restriction of jerk

The set velocity or set acceleration may not change as information error occurs if the value of jerk to the values of calculation cycle converted velocity and acceleration differs greatly. Therefore, set the value of jerk so that it stays within the effective digits (approximately 15 digits) of a floating-point number (64 bits).
When the calculation cycle converted jerk is smaller than the velocity and the acceleration, Out of Operation Cycle Converted Jerk Range Warning (event code: 00D3AH) occurs. Check the set velocity and set acceleration. If they are not changed, either increase the jerk or extend the operation cycle.

Ex.
When started with the following settings while Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) is "HFD000300 [/ms]" and operation cycle is "0.125 [ms]"

- Velocity (Velocity): 100000.0
- Acceleration (Acceleration): 30000.0
- Deceleration (Deceleration): 30000.0
- Jerk (Jerk): 20.0

* Acceleration/deceleration specification method (Jerk acceleration/deceleration)
Calculation cycle converted velocity upper limit value = 100000.0 [pulses/ms] × 0.125 [ms] = 12500.0 [pulses]
Calculation cycle converted acceleration = 30000.0 [pulses/s^2] × (0.125 [ms] ÷ 1000)^2 = 0.00046875 [pulses]
Calculation cycle converted jerk = 20.0 [pulses/s^3] × (0.125 [ms] ÷ 1000)^3 = 3.90625E-11 [pulses]
In above case, the calculation cycle converted acceleration lower limit value will be "4.0E-11 [pulses]". Also, Out of Operation Cycle Converted Jerk Range Warning (event code: 00D3AH) occurs because the calculation cycle converted jerk lower limit value will be the same value "4.0E-11 [pulses]".
When the calculation cycle converted jerk is too small, Jerk Acceleration/Deceleration Disabled Warning (event code: 00D3BH) occurs and operation is performed as trapezoidal acceleration/deceleration.

Ex.
When started with the following settings while Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) is "H00000300 [/s]" and operation cycle is "31.25 [μs]"

- Velocity (Velocity): 0.4
- Acceleration (Acceleration): 0.005
- Deceleration (Deceleration): 0.005
- Jerk (Jerk): 0.0001

In above case, Jerk Acceleration/Deceleration Disabled Warning (event code: 00D3BH) occurs because the calculation cycle converted jerk is "3.05176E-18".

35.2 Velocity Limit

Limits the command velocity to a value within the speed limit value setting range when the command velocity during control exceeds the speed limit value.
By limiting the command velocity within the preset velocity limit value range, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.

Relevant variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Sets the address increasing direction velocity limit value for each axis.
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Sets the address decreasing direction velocity limit value for each axis.
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Sets the operation when the velocity limit value during control is exceeded. • 0: Ignore (Ignore) • 3: Immediate Stop (ImmediateStop)

Axes group parameter (AxesGroupName.Pr.)

Variable/structure name	Name	Details
VelocityLimit	Velocity Limit Value	Sets the velocity limit value of the axes group.

How to set the velocity limit function

Velocity limit value for each axis

Set Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), for each axis.

Setting item	Setting range	Setting details
Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive)	0.0001 ≤ Setting value ≤ 2500000000.0	Sets the velocity limit value (the maximum velocity during control) for operation in the address increasing direction.
Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative)		Sets the velocity limit value (the maximum velocity during control) for operation in the address decreasing direction.

Velocity limit value for each axes group

Set Velocity Limit Value (AxesGroupName.Pr.VelocityLimit), for each axes group.

Setting item	Setting range	Setting details
Velocity Limit Value (AxesGroupName.Pr.VelocityLimit)	0.0001 ≤ Setting value ≤ 2500000000.0	Sets the velocity limit value (the maximum velocity during control) of the axes group.

Operation when the velocity limit value is exceeded

The operation when specifying the velocity exceeding the velocity limit value differs depending on single axis control, single axis synchronous control and interpolation control.

For single axis control

The velocity limit is executed to the actual target velocity which the override and other factors are considered for the commanded velocity.

■At start

If the target velocity at start exceeds the velocity limit value (Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) for the positive direction and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) for the negative direction) of each axis, Velocity limit value over (error code: 1A87H) will occur, and the axis will not start.

■During control

The velocity limit is not executed.

■During control (At velocity change)

If a velocity exceeding the velocity limit value of each axis is specified by the override function and input label change in execution, Velocity Limit Value Over Warning (event code: 00D03H) will occur, and the control continues at the velocity before change.

For details on the override function and input label change in execution, refer to the following.

☞ Page 1116 Override Function

☞ Page 1146 INPUT VARIABLE CHANGE IN EXECUTION

For single axis synchronous control

Executes the velocity limit to the set velocity of the slave axis.

■At start

The velocity limit is not executed.

■During control

If the set velocity exceeds the velocity limit value (Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) for the positive direction and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) for the negative direction) of each axis, follow Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation).

If the absolute value of the set velocity exceeds the maximum velocity, Velocity range over during controlling (error code: 1B1AH) will occur and the operation will stop.

For interpolation control

For the velocity limit at the interpolation control, Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive), Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), and Velocity Limit Value (AxesGroupName.Pr.VelocityLimit) are used.

The operation when the target velocity exceeds the velocity limit value is as follows.

■At start

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative)*1	Velocity is not restricted.	Long axis velocity is restricted by velocity limit value of long axis.*2	Reference axis velocity is restricted by velocity limit value of reference axis.*2	Velocity is not restricted.
Velocity Limit Value (AxesGroupName.Pr.VelocityLimit)	Velocity is restricted for vector velocity.*2	Velocity is not restricted.	Velocity is not restricted.	Velocity is restricted for vector velocity.*2

*1 Whether either Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) is used is determined by the movement direction at the limit value check.

*2 When the velocity limit value is exceeded, it will not start. Velocity limit value over (error code: 1A87H) occurs.

■During control

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative)*1	Velocity is restricted for command velocity of each configuration axis. When the velocity limit value is exceeded, the operation follows Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation).			
Velocity Limit Value (AxesGroupName.Pr.VelocityLimit)	Velocity is not restricted.			

*1 Whether either Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) is used is determined by the movement direction at the limit value check.

■During control (At velocity change)

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative)*1	Velocity is not restricted.	Long axis velocity is restricted by velocity limit value of long axis.*2	Reference axis velocity is restricted by velocity limit value of reference axis.*2	Velocity is not restricted.
Velocity Limit Value (AxesGroupName.Pr.VelocityLimit)	Velocity is restricted for vector velocity.*2	Velocity is not restricted.	Velocity is not restricted.	Velocity is restricted for vector velocity.*2

*1 Whether either Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) is used is determined by the movement direction at the limit value check.

*2 When the velocity limit value is exceeded, the velocity change will not be accepted. Velocity Limit Value Over Warning (event code: 00D03H) is output.

Operation Setting at Velocity Limit Value Exceeded

The operation when the velocity of any axis exceeds the velocity limit value during control can be specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation).

The following two types can be selected for the operation when the velocity exceeds the velocity limit value.

- 0: Ignore (Ignore)
- 3: Immediate Stop (ImmediateStop)

When the multiple axes exceed the limit value, the priority is "3: Immediate Stop (ImmediateStop)" > "0: Ignore (Ignore)".

Control continuation

When "0: Ignore (Ignore)" is specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation), Velocity Limit Value Over Warning (event code: 00D03H) occurs at the time of detecting the command velocity exceeding the velocity limit value, and the command exceeding the velocity limit value is output as it is.

Control stop

When "3: Immediate Stop (ImmediateStop)" is specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation), Velocity limit value over during controlling (error code: 1AA4H) occurs at the time of detecting the command velocity exceeding the velocity limit value, and the positioning control in execution stops.

35.3 Override Function

By setting the override coefficient, this function changes the target velocity and the target acceleration/deceleration during the execution of the control.

- This function sets the factor for the velocity and performs the control to change the target velocity.
- This function sets the factor for the acceleration/deceleration and performs the control to change the target acceleration/target deceleration. (The ratio to the acceleration/deceleration time cannot be set.)
- This function is invalid when using the control without the target velocity and the target acceleration. (Example: Cam operation of the positioning control)
- When the velocity and the acceleration/deceleration are changed by retrigger or continuous update, the override factor will be added to changed velocity and the acceleration/deceleration.
- The override factor can be changed by using a dedicated FB or changing control data.

Change method	Description
Change using a dedicated FB	MC_SetOverride (Override Value Setting), MC_GroupSetOverride (Axes Group Override Value Setting)
Change using control data	Data such as Velocity Override Factor (AxisName.Cd.VelocityOverride) and Velocity Override Factor (AxesGroupName.Cd.VelocityOverride)

- The override factor can be set in the axis control data and the axes group control data. Only the override factor set in the axis control data is valid for single axis control, and only the override factor set in the axes group control data is valid for axes group control.
- The override factor is not reflected immediately during deceleration stop after stop cause occurrence. It is reflected at the timing when another stop cause occurs.

Targets to be changed and corresponding FBs, control data

Target to be changed			Corresponding FB	Corresponding control data
Velocity	Current value		Motion control FB that holds Velocity (Velocity) as an input variable MC_SetOverride (Override Value Setting) MC_GroupSetOverride (Axes Group Override Value Setting)	Velocity Override Factor (AxisName.Cd.VelocityOverride) Velocity Override Factor (AxesGroupName.Cd.VelocityOverride)
	Limit value		—*1	—*1
	Limit value	Maximum value of the limit value	—*2	—*2

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, they cannot be changed during control.

*2 The maximum value of the limit value cannot be changed.

Relevant variables

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
VelocityOverride	Velocity Override Factor	Sets the velocity override factor.
AccelerationOverride	Acceleration Override Factor	Sets the acceleration override factor.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
VelocityOverride	Velocity Override Factor	Displays the velocity override factor.
AccelerationOverride	Acceleration Override Factor	Displays the acceleration override factor.

Axes group control data (AxesGroupName.Cd.)

Variable/structure name	Name	Details
VelocityOverride	Velocity Override Factor	Sets the velocity override factor.
AccelerationOverride	Acceleration Override Factor	Sets the acceleration override factor.

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
VelocityOverride	Velocity Override Factor	Displays the velocity override factor.
AccelerationOverride	Acceleration Override Factor	Displays the acceleration override factor.

Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MC_SetOverride	Override Value Setting	Changes the target velocity, the target acceleration and the target deceleration of the specified axis.
MC_GroupSetOverride	Axes Group Override Value Setting	Changes the target velocity, the target acceleration and the target deceleration of the specified axes group.

How to change control data

Override factor setting range

The following shows each override factor setting range.

■Axis control data

Control data	Setting range
Velocity Override Factor (AxisName.Cd.VelocityOverride)*1	0.0 (0%) ≤ Setting value ≤ 10.0 (1000%)
Acceleration Override Factor (AxisName.Cd.AccelerationOverride)*2	0.01 (1%) ≤ Setting value ≤ 10.0 (1000%)

*1 When "0" is set to velocity override, "velocity override "0"" is registered in the event history.

*2 Even for the acceleration/deceleration method specifying the acceleration/deceleration time, the override factor will be used for the acceleration/deceleration.

■Axes group control data

Control data	Setting range
Velocity Override Factor (AxesGroupName.Cd.VelocityOverride)*1	0.0 (0%) ≤ Setting value ≤ 10.0 (1000%)
Acceleration Override Factor (AxesGroupName.Cd.AccelerationOverride)*2	0.01 (1%) ≤ Setting value ≤ 10.0 (1000%)

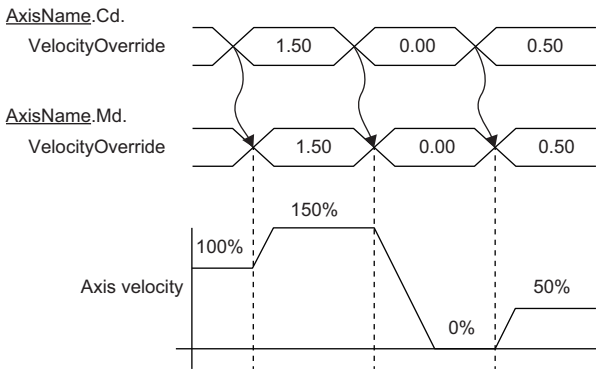
*1 When "0" is set to velocity override, "velocity override "0"" is registered in the event history.

*2 Even for the acceleration/deceleration method specifying the acceleration/deceleration time, the override factor will be used for the acceleration/deceleration.

Operation when the velocity override factor is changed

Change the velocity by changing Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride).

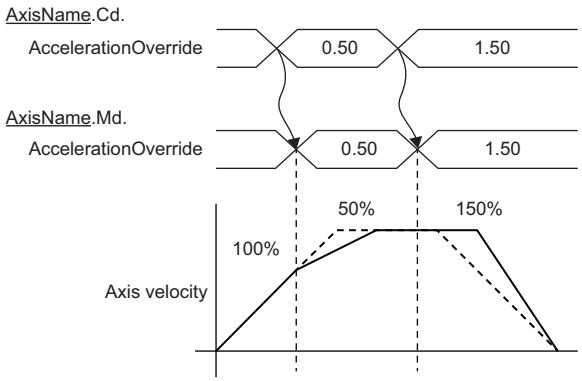
When "0.00" is set in Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride), the axis is stopped without moving to the "4: Standby (Standstill)" status.



Operation when the acceleration override factor is changed

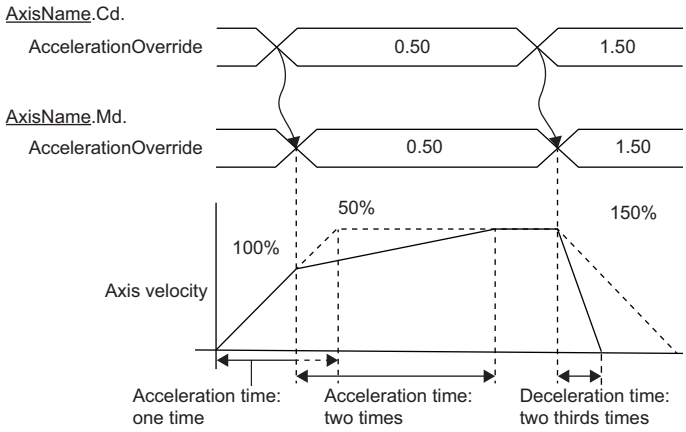
Change the acceleration/deceleration by changing Acceleration Override Factor (AxisName(AxesGroupName).Cd.AccelerationOverride).

■Acceleration/deceleration method specifying acceleration/deceleration



■Acceleration/deceleration method specifying acceleration/deceleration time

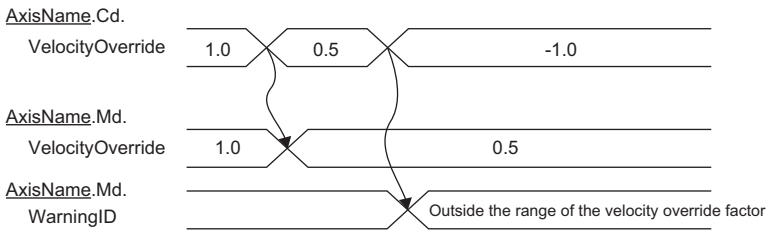
Even for the acceleration/deceleration method specifying the acceleration/deceleration time, the override factor will be used for the acceleration/deceleration.



Operation when a value outside the override factor setting range is set

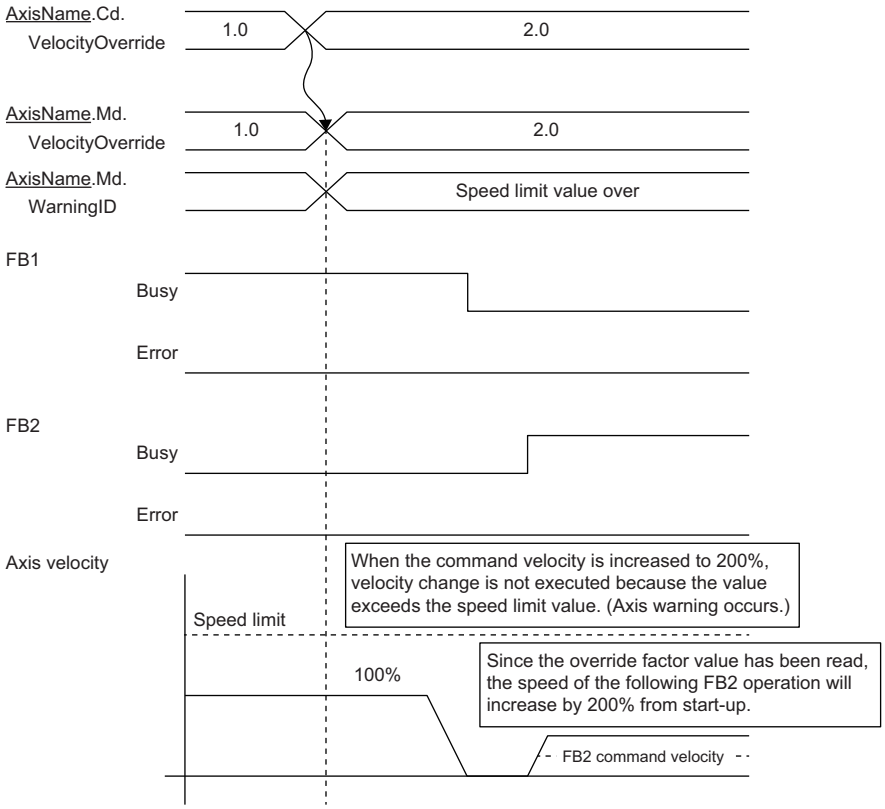
If a value outside the setting range is set in each override factor, the following warnings occur, and the override factor will remain unchanged from the previous value.

- Out of Velocity Override Factor Range Warning (event code: 00D0BH)
- Out of Acceleration Override Factor Range Warning (event code: 00D0CH)

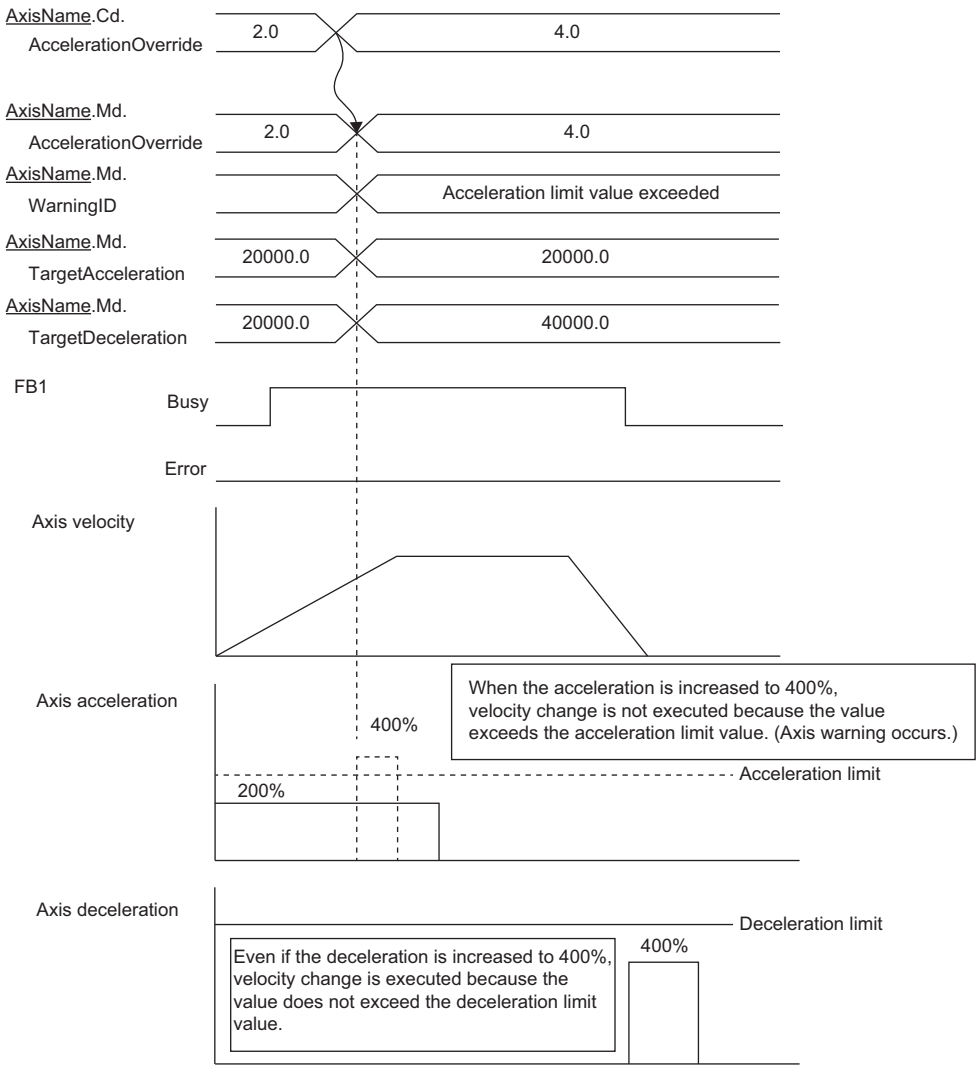


Operation at velocity/acceleration/deceleration limit value over by override

- When velocity limit value over occurs by velocity override, velocity over will occur during control execution and the velocity will not change.

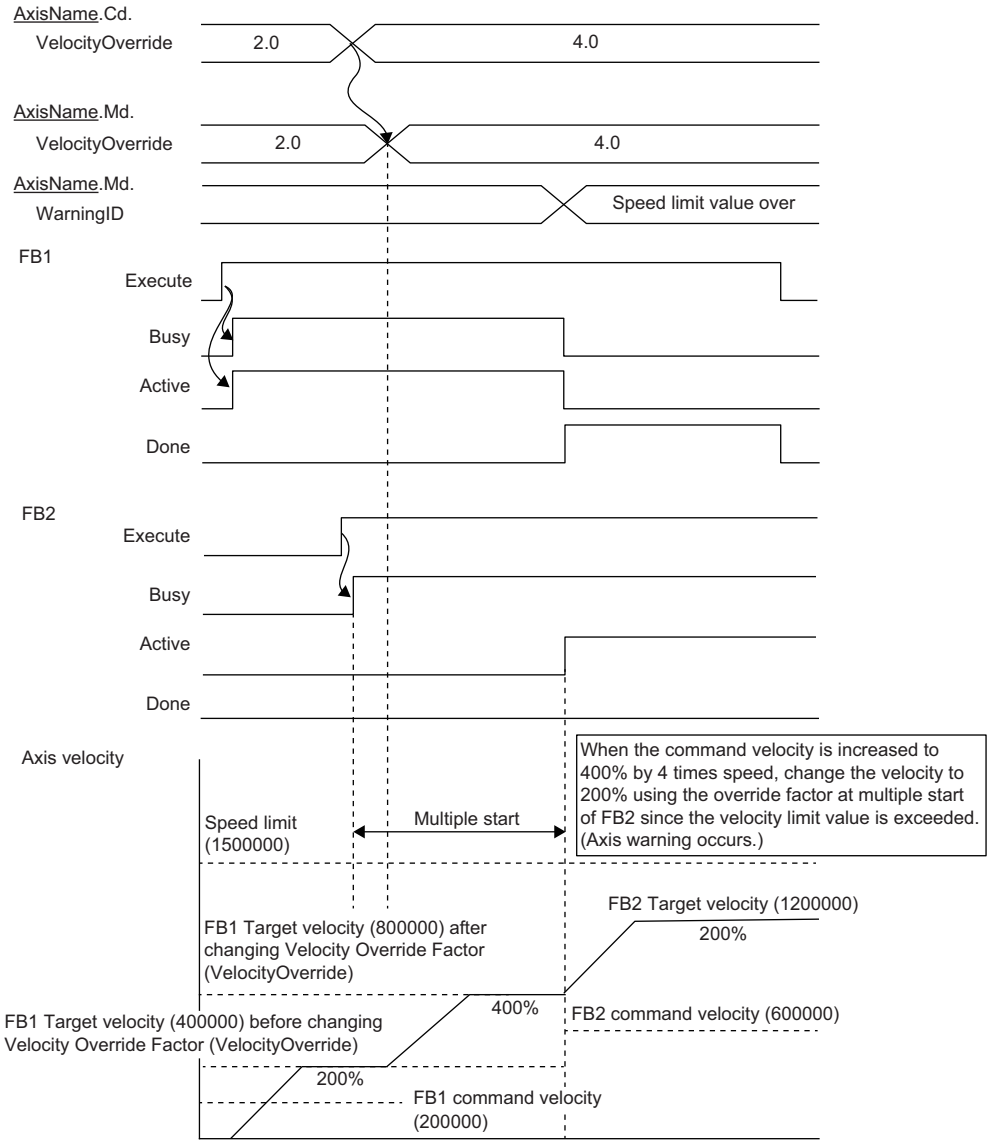


- When acceleration override factor is changed, the acceleration and deceleration will change. In this case, when acceleration limit value over occurs, the acceleration over will occur and the acceleration will not change. When deceleration limit value over occurs, the deceleration over will occur and the deceleration will not change as well. (An error does not occur by a control data change, and the override factor is changed.)



■When velocity/acceleration/deceleration limit value over occurs at switching of FB by buffer mode

- The control change of buffering FB is executed at switching of FB.
- When the control is changed at switching of FB, velocity/acceleration/deceleration limit value over may occur. When velocity/acceleration/deceleration limit value over occurs, velocity/acceleration/deceleration, and override factor at multiple starts are used for control.
- Also when velocity/acceleration/deceleration limit value over occurs at switching of FB, the import of override factor is executed. If the limit value is not exceeded at the following control change, operation will be performed with the override factor after change.



Override change operation by motion control FB

The override factor can be changed by using the MC_SetOverride (Override Value Setting)/MC_GroupSetOverride (Axes Group Override Value Setting) of the motion control FB.

For details on motion control FB operations, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Precautions

- Do not arrange two or more MC_SetOverride (Override Value Setting) and MC_GroupSetOverride (Axes Group Override Value Setting) in the same axis or the same axes group. Operation is not guaranteed when two or more of the FBs are arranged.
- In the single axis control, only the override factor set with the axis control data has an influence. In the axes group control, only the override factor set with the axes group control data has an influence.
- Do not operate Velocity Override Factor (AxisName.Cd.VelocityOverride) or Acceleration Override Factor (AxisName.Cd.AccelerationOverride) directly during performing MC_SetOverride (Override Value Setting).
- Do not operate Velocity Override Factor (AxesGroupName.Cd.VelocityOverride) or Acceleration Override Factor (AxesGroupName.Cd.AccelerationOverride) directly during performing MC_GroupSetOverride (Axes Group Override Value Setting).
- When the velocity after the velocity override is out of the range, refer to the following.
  ☞ Page 499 Velocity Range
- When the acceleration, deceleration, acceleration time, and deceleration time after the acceleration override are out of the range, refer to the following.
  ☞ Page 1078 Acceleration/Deceleration Processing Function

36 FUNCTIONS RELATED TO TORQUE

The functions related to torque have the following items.

Item	Description	Reference
Torque limit	Limits the generated torque to a value within the torque limit value range when the torque generated in the servo motor exceeds the torque limit value. It controls the operation so that unnecessary force is not applied to the load and machine by limiting the generated torque.	Page 1124 Torque Limit
Torque limit value change function	Changes the torque limit value during control.	Page 1127 Torque Limit Value Change Function

36.1 Torque Limit

This function limits the generated torque to a value within the torque limit value range when the torque generated in the servo motor exceeds the torque limit value.

It controls the operation so that unnecessary force is not applied to the load and machine by limiting the generated torque.

- Set the positive direction (address increasing direction) torque limit value and the negative direction (address decreasing direction) torque limit value for each axis.
- The torque limit value is used in the "setting of the torque limit value used in the drive unit" and the "control to suppress the command torque in MC_TorqueControl (Torque Control) or others".
- The torque limit value can be changed by changing the values of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative). When changing the torque limit value, specify a value less than or equal to Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max) setting value. (☞ Page 1127 Torque Limit Value Change Function)
- The torque limit value that is currently valid can be checked with Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative).
- For the torque limit value when connecting a drive unit, Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are set.

Relevant variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
TorqueLimit_Max	Torque Limit Maximum Value	Sets the maximum value that can be specified as the torque limit value. (Common in the positive direction and the negative direction)
TorqueLimit_PositiveInitial	Positive Direction Torque Limit Initial Value	Sets the initial value of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive).
TorqueLimit_NegativeInitial	Negative Direction Torque Limit Initial Value	Sets the initial value of Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative).

Axis control data (AxisName.Cd.)

Variable/structure name	Name	Details
TorqueLimit_Positive	Positive Direction Torque Limit Value	Sets the positive direction torque limit value.
TorqueLimit_Negative	Negative Direction Torque Limit Value	Sets the negative direction torque limit value.

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
TorqueLimit_Positive	Positive Direction Torque Limit Value	Displays the positive direction torque limit value that is currently valid.
TorqueLimit_Negative	Negative Direction Torque Limit Value	Displays the negative direction torque limit value that is currently valid.

Object data settings

When using the torque limit function in the "setting of the torque limit value used in the drive unit", assign the following objects in the object data settings. For details, refer to the following.

☞ Page 466 Axis Assignment

SDO

○: Recommended

Required object data	Object required or not	Operation with no objects in device station
Positive torque limit value (60E0H)	○	If the objects have not been assigned in the object data settings, the torque limit value is imported by the same unit as the command torque, because it is used only in the "control to suppress the command torque in MC_TorqueControl (Torque Control) or others". Since the torque limit value will not be sent to the drive unit, refer to each drive unit manual for the torque limit value used by the drive unit. For MR-J5(W)-G: 🕮 MR-J5 User's Manual (Function)
Negative torque limit value (60E1H)	○	

Point

The number of significant digits after the decimal point differs depending on the ID assigned in the object data settings. Values less than the number of significant digits are truncated.

Torque limit value setting range

Configure the settings of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) for each axis.

The setting values are used in the "setting of the torque limit value used in the drive unit" and the "control to suppress the command torque in MC_TorqueControl (Torque Control) or others".

The torque limit value can be changed by changing the setting values. For details, refer to the following.

☞ Page 1127 Torque Limit Value Change Function

When the power supply of the controller turns on, the setting values of Positive Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_PositiveInitial) and Negative Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_NegativeInitial) are stored. In this case, if Positive Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_PositiveInitial) and Negative Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_NegativeInitial) are set to a larger value than Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max), Out of forward direction torque limit initial value specification range (error code: 1ADFH) or Out of reverse direction torque limit initial value specification range (error code: 1AE0H) will occur.

If a value outside the range is set during control execution, Out of Forward Direction Torque Limit Value Specification Range Warning (event code: 00D09H) or Out of Reverse Direction Torque Limit Value Specification Range Warning (event code: 00D0AH) will occur.

Control data	Setting range
Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive)	0.0 (0%) ≤ Setting value ≤ Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max)
Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative)	

Torque limit maximum value setting range

Configure the settings of Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max) for each axis.
The torque limit maximum value is used as the upper limit value of the torque limit.
Even if a large value is input erroneously when the torque limit value is changed, the change will not be accepted, preventing erroneous input. If a value outside the range is set, Out of parameter range (axis) (error code: 1A60H) occurs.

Parameter	Setting range
Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max)	0.0 (0%) ≤ Setting value ≤ 1000.0 (1000%)

Point

Set the upper limit value of the torque limit specified in the drive unit as the torque limit maximum value.
Both the positive direction torque limit value and the negative direction torque limit value are limited by Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max).

Precautions

When the axis control is stopped by torque limiting, the droop pulse will remain in the deviation counter. If the load torque is eliminated, operation for the amount of droop pulses will be performed. Note that the movement may start suddenly as soon as the load torque is eliminated.

36.2 Torque Limit Value Change Function

This function changes the torque limit value during control.

- The torque limit value can be changed by using a dedicated FB or changing control data.

Change method	Description
Change using a dedicated FB	MCv_SetTorqueLimit (Torque Limit Value)
Change using control data	Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative)

- The number of significant digits after the decimal point differs depending on the ID assigned in the object data settings.
- In a torque limit value change, a value cannot be changed to a torque limit value that exceeds Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max).

Targets to be changed and corresponding FBs, control data

Target to be changed			Corresponding FB	Corresponding control data
Torque	Current value		Motion control FB that holds Target torque (Torque) as an input variable	—
	Limit value		MCv_SetTorqueLimit (Torque Limit Value)	Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative)
	Limit value	Maximum value of the limit value	—*1	—

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, they cannot be changed during control.

Relevant variables

For variables used in a method of changing control data, refer to the following.

☞ Page 1124 Relevant variables

Relevant FB

For details on motion control FBs, refer to the following.

📖MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_SetTorqueLimit	Torque limit value	Executes a torque limit value change.

How to change control data

Positive/Negative direction torque limit value setting range

The setting range of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) is as the following table.

Control data	Setting range
Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive)	0.0 (0%) ≤ Setting value ≤ Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max)
Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative)	

Torque limit value change timing

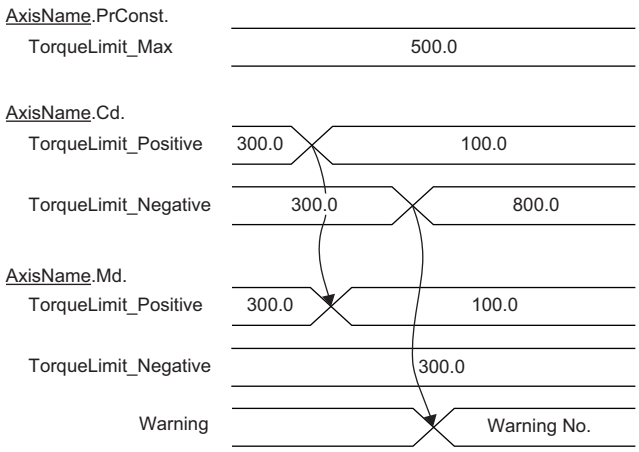
A torque limit value can be changed by changing Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative).

If a value outside the setting range is set, Out of Forward Direction Torque Limit Value Specification Range Warning (event code: 00D09H) or Out of Reverse Direction Torque Limit Value Specification Range Warning (event code: 00D0AH) will occur, and the torque limit value will remain unchanged from the previous value.

When the real drive axis is not connected, Warning Changing Torque Limit Value to Axis not yet Connected (event code: 00D23H) will occur. At this time, the torque limit value changed when connecting the real drive axis will be enabled because Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed.

Ex.

When a warning occurs after Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) changes from 300.0 to 800.0 in the status where Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max) = 500.0 is set



Torque limit value change by motion control FB

When changing the limit values of positive direction torque/negative direction torque at the same time, use the "MCv_SetTorqueLimit (Torque Limit Value)" motion control FB.

For details on motion control FB operations, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

37 COMPENSATION FUNCTION

Compensation function includes the driver unit conversion function, which can be executed by the parameter settings.

37.1 Relevant Variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
Drive_UnitConvRatioNum	Driver Unit Conversion Numerator	Sets the numerator to convert from the command unit of the motion system to the command unit of the driver. • 1 to 2147483647
Drive_UnitConvRatioDen	Driver Unit Conversion Denominator	Sets the denominator to convert from the command unit of the motion system to the command unit of the driver. • 1 to 2147483647

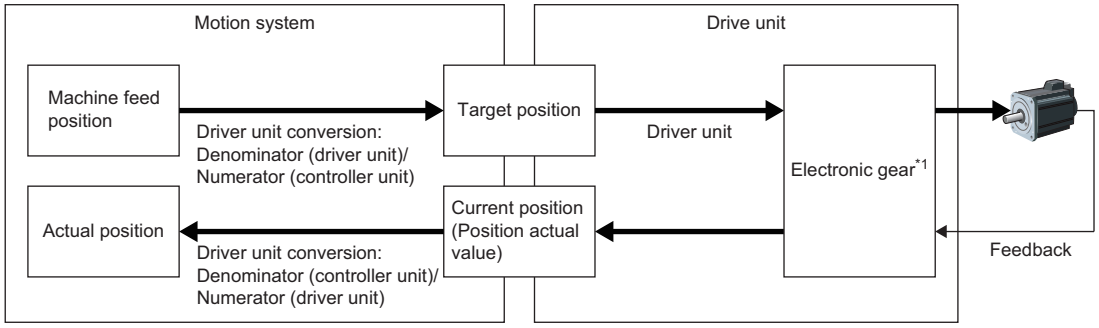
37.2 Driver Unit Conversion Function

Real drive axis

This function converts the machine feed value to the driver command value and passes it to the target position (Target position). Also, it converts the current position (Position actual value) of the drive unit and calculates the actual position.
The conversion formulas are shown below.
Target position = Machine feed value (Motion system command value) × Driver unit conversion numerator / Denominator
Actual position = Current position × Driver unit conversion denominator / Numerator

Point

When the drive unit has the electronic gear, it is recommended to set the ratio to 1:1.



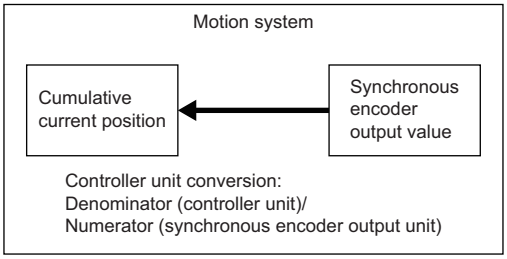
*1 If resolution adjustments are required on the drive unit side for the system, the settings can also be configured using the electronic gears on that side.

When the real drive axis is used with the following function, the driver unit conversion is performed separately from the above.

Function	Driver unit conversion	Reference
Direct control (pressure control)	The machine coordinate value of the forward-side position is converted to the driver unit and sent to object data "Forward-side stop function (2E56H)".	☞ Page 742 Pressure Control

Real encoder axis/Virtual encoder axis

Executes the driver unit conversion to the synchronous encoder output value and calculate the cumulative current position.



Control details

Set Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum) and Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen) to output the command value to the drive unit according to the specified movement amount.
Setting examples are shown below.

For a ball screw

Ex.
For the following settings

Setting item	Setting value
Ball screw pitch	20 [mm]
Controller command unit	[mm]
Drive unit command unit	[pulse]
Motor encoder resolution	67108864 [pulse/rev]

Set the number of pulses required to rotate a motor once (the encoder resolution) in Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum), and set the transfer distance of the machine per motor rotation in Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen).

- Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum) = 67108864 [pulses]
- Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen) = 20 [mm]

In this example, the movement amount per pulse is "0.000000298 [mm]".
For instance, when the movement amount of "22 [mm]" is set, the command will be "73819750.4 [pulses]" and a fraction of 0.4 [pulses] will appear. In this case, the movement amount of "67108864 [pulses]" is output to the drive unit, and the fraction is memorized inside the motion system, and positioning is performed by adding this fraction to the movement amount at the next positioning.

For linear servo

Ex.
When the controller command unit is [μm] and the drive unit command unit is [pulse]
The number of pulses of the linear encoder is calculated with the driver unit conversion numerator and the movement amount is calculated with the driver unit conversion denominator.

$$\text{Linear encoder resolution} = \frac{\text{Number of pulses (driver unit conversion numerator)}}{\text{Movement amount (driver unit conversion denominator)}}$$

Linear encoder resolution: 0.05 [μm]

$$\frac{\text{Number of pulses [pulse]}}{\text{Movement amount [μm]}} = \frac{1}{0.05} = \frac{20}{1.0}$$

- Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum) = 20 [pulses]
- Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen) = 1 [μm]

Point

• Set the driver unit conversion multiplying factor within the following range.

|The range upper limit of the controller command value × (Driver unit conversion numerator / denominator)| < 8000000000000000000

For the range upper limit of the controller command value, refer to the following.

☞ Page 496 Positioning Range

If a value outside the range is set, Driver unit conversion magnification upper over (error code: 1AF4H) will occur.

• A change of the driver unit conversion parameter is also imported when PLC READY (MotionSystem.Cd.SequenceReady) is turned on. Turn on PLC READY (MotionSystem.Cd.SequenceReady) in the following status. Otherwise, Driver unit conversion numerator/denominator change timing incorrect (error code: 1AF5H) will occur, and the system will be operated with the set value before turning on PLC READY (MotionSystem.Cd.SequenceReady).

(1): Axis Status (AxisName.Md.AxisStatus) is "0: Axis disabled (Disabled)"

(2): Follow-up Disabled (AxisName.Md.FollowupDisable) is FALSE

Precautions

- Values less than one which could not be output during machine movement are managed in the motion system, and the cumulated values will be output when the value reaches one or more.
- When machine homing is completed, the function clears the cumulative values of less than one which could not be output to "0".
- When the driver unit conversion numerator/denominator is changed, the homing request flag becomes TRUE.
- Double-precision floating-point type variables are used for calculation of the cumulative current value and the target position that is sent to the drive unit. Therefore, values that cannot be expressed within the effective digits of the double precision floating point format (the range of the mantissa part 53 bits) include errors due to rounding processing.
- The target position is calculated by a formula, "cumulative machine position from home position × driver unit conversion numerator / driver unit conversion denominator". Set so that the integral part of the calculation result does not exceed the effective digits range.
  Regarding the target position, the sent value is the one with the fractional part of the operation result truncated. Therefore, if the error due to rounding processing is at the decimal level, it is truncated, but if the integer part becomes larger than the effective digit, the command value actually output will also contain rounding error.
- When the cumulative current value per pulse after the driver unit conversion ("1 × driver unit conversion denominator / driver unit conversion numerator") is a small value less than effective digits to the present cumulative current value, the correct command cannot be sent in units of 1 [pulse].
- When the error size is a problem, reduce the multiplying factor of "driver unit conversion numerator / driver unit conversion denominator".
  For example, when setting 20 [mm] for the machine movement amount per motor rotation, set "20000" in Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen), and set [μm] in Position Command Unit (AxisName.Pr.Unit_Position). (20.0 [mm] → 20000.0 [μm])

38 COMMAND FILTER

Command filter can perform specified filter processing to inputs of the master axis, and output the result to the slave axis. For example, when setting a virtual drive axis to the master axis and a real drive axis to the slave axis, the result of filter processing to inputs of the virtual drive axis can be output to the real drive axis.

The types of command filters are shown below.

Item	Overview	Reference
Smoothing filter	Used to suppress load-side vibration, such as work-side vibration and base shake. Frequencies higher than the set frequency can be removed.	Page 1134 Smoothing Filter
Moving direction restriction filter	Restricts the movement of the slave axis to one direction relative to the movement of the master axis. This filter helps to avoid reverse operation caused by machine vibration or other factors.	Page 1137 Moving Direction Restriction Filter
Speed limit filter	Controls the speed of an axis. The speed input by the master axis can be limited to the specific speed and can be output to the slave axis.	Page 1138 Speed Limit Filter
Backlash compensation filter	Compensates amount of mechanical backlash (play). Each time the movement direction changes, this filter outputs the extra commands equivalent to the set backlash compensation amount.	Page 1139 Backlash Compensation Filter

The command filter control FB is a synchronous control FB of Enable (Enable) type and has Filter disable (FilterDisable) and Filter cumulated value (FilterPool).

Operation of this function for each system status

○: Available, ×: Not available

System status	Function operation
STOP	×
RUN	○
Moderate error	×
Major error	×

38.1 Relevant FBs

For details on motion control FBs, refer to the following.

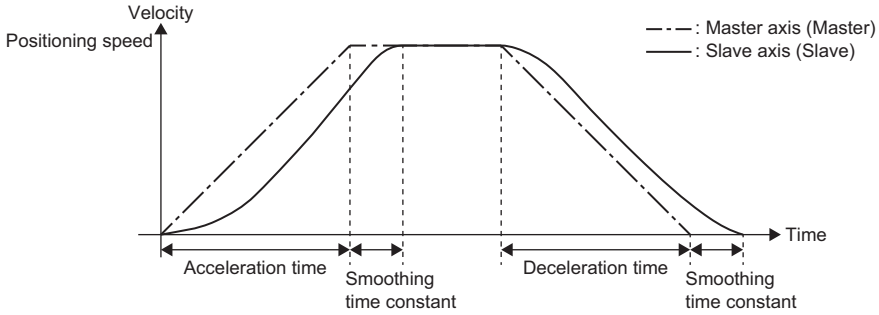
MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_SmoothingFilter	Smoothing filter	Executes filter processing based on the specified frequency.
MCv_DirectionFilter	Moving direction restriction filter	Executes filter processing to restrict movement in the set direction.
MCv_SpeedLimitFilter	Speed limit filter	Executes filter processing to restrict the speed to the set limit value.
MCv_BacklashCompensationFilter	Backlash compensation filter	Following the movement direction, this FB executes filter processing to compensate the backlash amount in the machine system.

38.2 Smoothing Filter

This function is used to suppress load-side vibration, such as work-side vibration and base shake.
Frequencies higher than the set frequency can be removed.

- Smoothing filter outputs the result of filter processing executed to the value of Master axis (Master) set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "7: During synchronous operation (SynchronizedMotion)" during smoothing filter execution.
- The time constant of smoothing is 1/Frequency (Frequency) [s], and the acceleration time and deceleration time become longer by the smoothing time constant. When Frequency (Frequency) is 10 [Hz], the smoothing time constant is 0.1 [s] = 100 [ms].

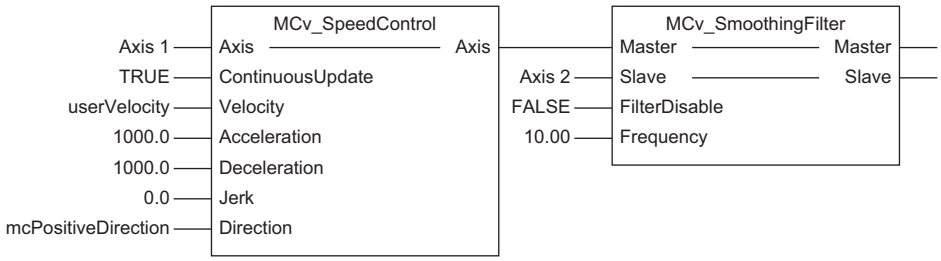


- If a smoothing filter is started while Slave axis (Slave) is in another operation instruction, the start request will be ignored, and Start not possible (error code: 1AFCH) will occur. Start the smoothing filter when Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only FB that can be multiple started during smoothing filter execution.

Program example

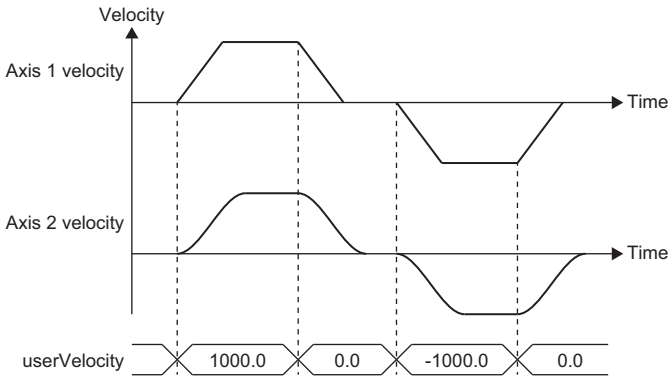
An example program to turn the trapezoidal acceleration/deceleration into smooth acceleration/deceleration waveform is shown below.

Sequence program



Operation

As Frequency (Frequency) is set to 10.0, the smoothing time constant will be 0.1 [s].



Precautions on smoothing filter

- An operation load increases in smoothing filter as the number of filter levels increases. A rough standard of operation load when the number of filter levels is 5000 is as follows.
  - MXR300-16, MXR300-32, MXR300-64: Approximately 170 [μs]
  - MXR500-128, MXR500-256: Approximately 130 [μs]
- The number of filter levels can be calculated by the following formula. Numbers after the decimal point is rounded up/down to the nearest integer. However, when the result is 0, the operation is performed as the number of filter levels is assumed to be one.

"Number of filter levels = (1 / frequency [Hz]) / operation cycle [s]"

- The smoothing filter secures the memory to use for filter processing at start. The memory usage can be calculated by the following formula. If memory is insufficient, change maximum RAM size (System.PrConst.Addon_MotionControl_AxisFilter.RamSizeMax) of Addon MotionControl_AxisFilter parameter.

"Memory usage = Number of filter levels × 8 bytes"

- The operation error may increase when the movement amount of the master axis or the slave axis is large and the following case applies. Check the unit setting of the master axis and the slave axis and decrease the movement range. If the error increases, clear the synchronization status or execute the current value change of absolute position specification.

When the total sum of the movement amount (the following formula) equivalent to the number of filter levels during control exceeds the number of significant digits which can be represented by double-precision floating-point (approximately 15 digits)

$$\sum_{i=0}^{\text{Filter level - 1}} (i \text{ The position of master axis before operation cycle - The position of master axis at starting control})$$

Required object data

For details, refer to the following.

☞ Page 783 Required Object Data

38.3 Moving Direction Restriction Filter

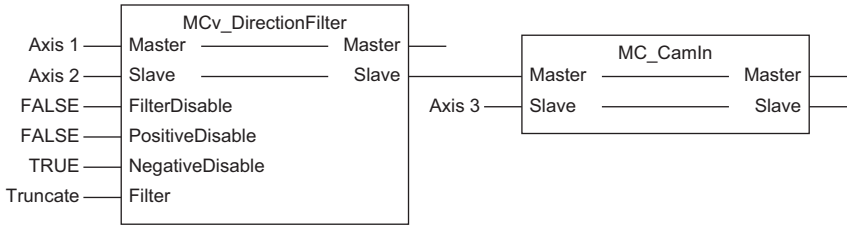
This function restricts the movement of the slave axis to one direction for the master axis movement.
This filter helps to avoid reverse operation caused by machine vibration or other factors.

- The moving direction restriction filter outputs the result of filter processing executed to the value of Master axis (Master) set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) will be "7: During synchronous operation (SynchronizedMotion)" during moving direction restriction filter execution.
- If a moving direction restriction filter is started while the slave axis is in another operation instruction, the start request will be ignored, and Start not possible (error code: 1AFCH) will occur. Start the restriction filter when Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only FB that can be multiple started during Moving Direction Restriction Filter execution.
- When turning Enable (Enable) to FALSE, execute while the slave axis is in stop status. If Enable (Enable) is turned to FALSE while the slave axis is in operation, the slave axis will stop immediately.

Program example

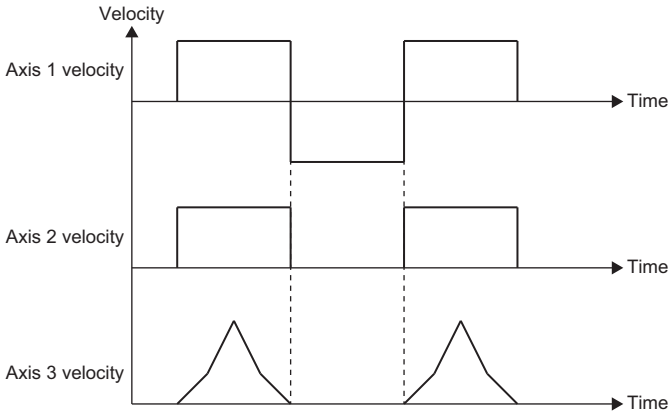
An example program for cam operation direction restriction is shown below.

Sequence program



Operation

When MCv_DirectionFilter (Moving Direction Restriction Filter) Master axis (Master) moves to the negative direction, Slave axis (Slave) does not move to the negative direction.



Required object data

For details, refer to the following.

☞ Page 783 Required Object Data

38.4 Speed Limit Filter

This function controls the speed of an axis.

The speed input by the master axis can be limited to the specific speed and can be output to the slave axis.

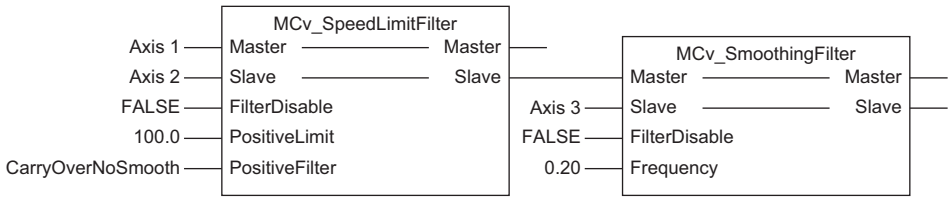
- The speed limit filter outputs the result of filter processing executed to the value of Master axis (Master) set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) will be "7: During synchronous operation (SynchronizedMotion)" during speed limit filter execution.
- If a speed limit filter is started while the slave axis is in another operation instruction, the start request will be ignored, and Start not possible (error code: 1AFCH) will occur. Start the limit filter when Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only FB that can be multiple started during speed limit filter execution.
- When turning Enable (Enable) to FALSE, execute while the slave axis is in stop status. If Enable (Enable) is turned to FALSE while the slave axis is in operation, the slave axis will stop immediately.

Program example

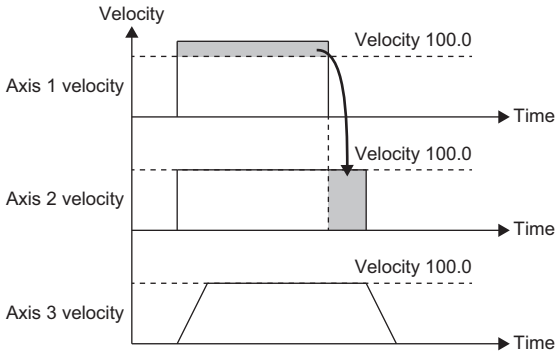
An example program for synchronous encoder speed limit is shown below.

Sequence program

The axis 1 sets the synchronous encoder.



Operation



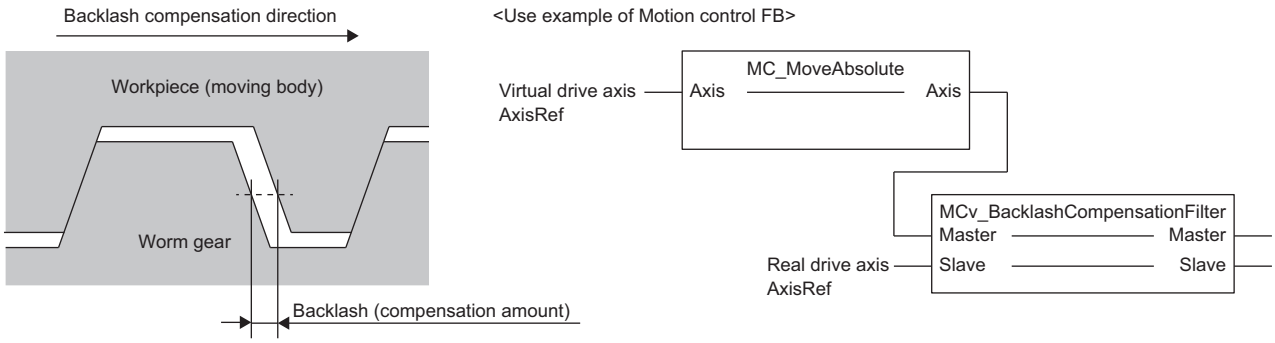
Required object data

For details, refer to the following.

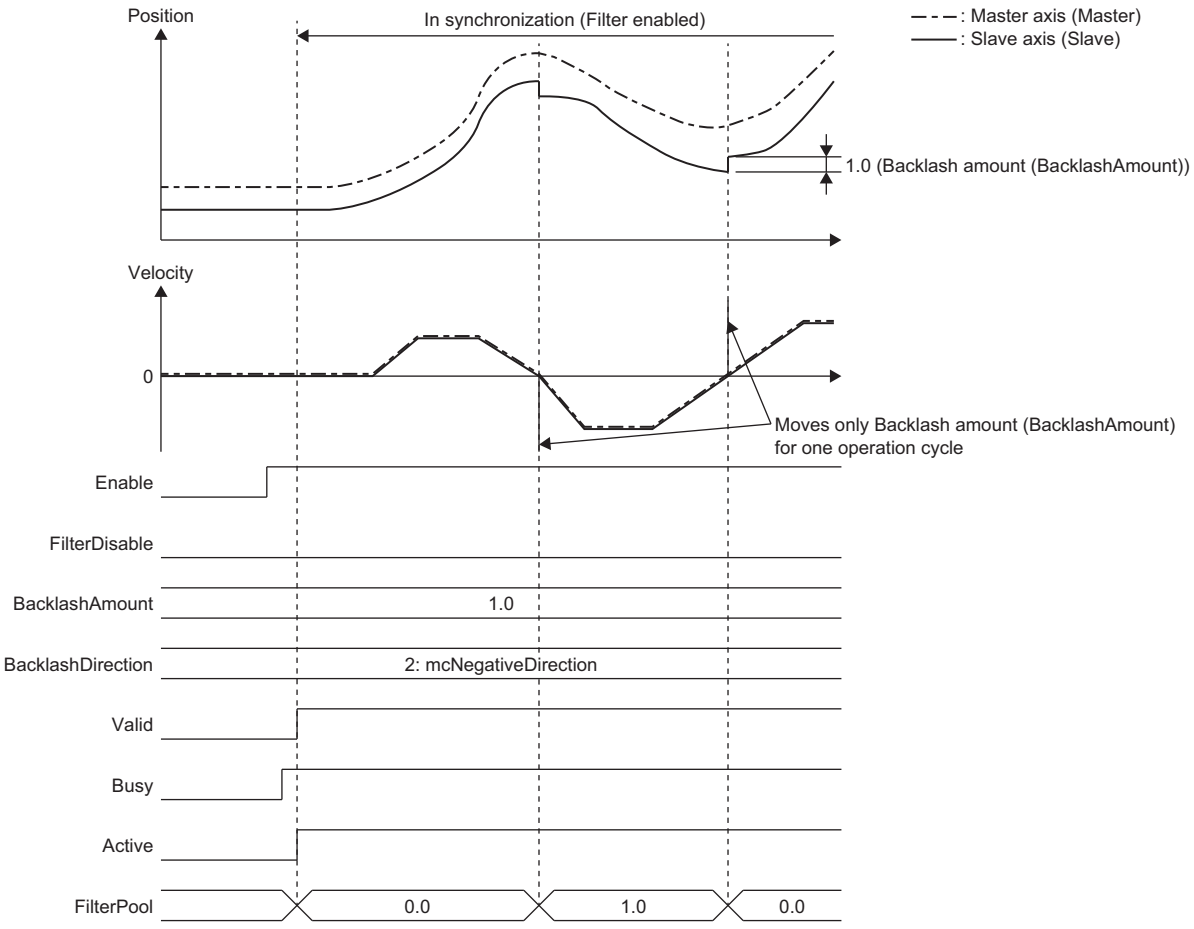
☞ Page 783 Required Object Data

38.5 Backlash Compensation Filter

This function compensates the amount of mechanical backlash (play).
Each time the movement direction changes, it outputs the extra commands equivalent to the set backlash compensation amount.



When the movement direction of Master axis (Master) is the same as Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the position equivalent to the Master axis (Master) current position shifted in the Backlash direction (BacklashDirection) by the value of Backlash amount (BacklashAmount). When the movement direction of Master axis (Master) is the reverse of Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the Master axis (Master) current position.
Whenever the Master axis (Master) movement direction changes, backlash compensation is performed with the Slave axis (Slave) extra movement amount limited to only the value of Backlash amount (BacklashAmount).

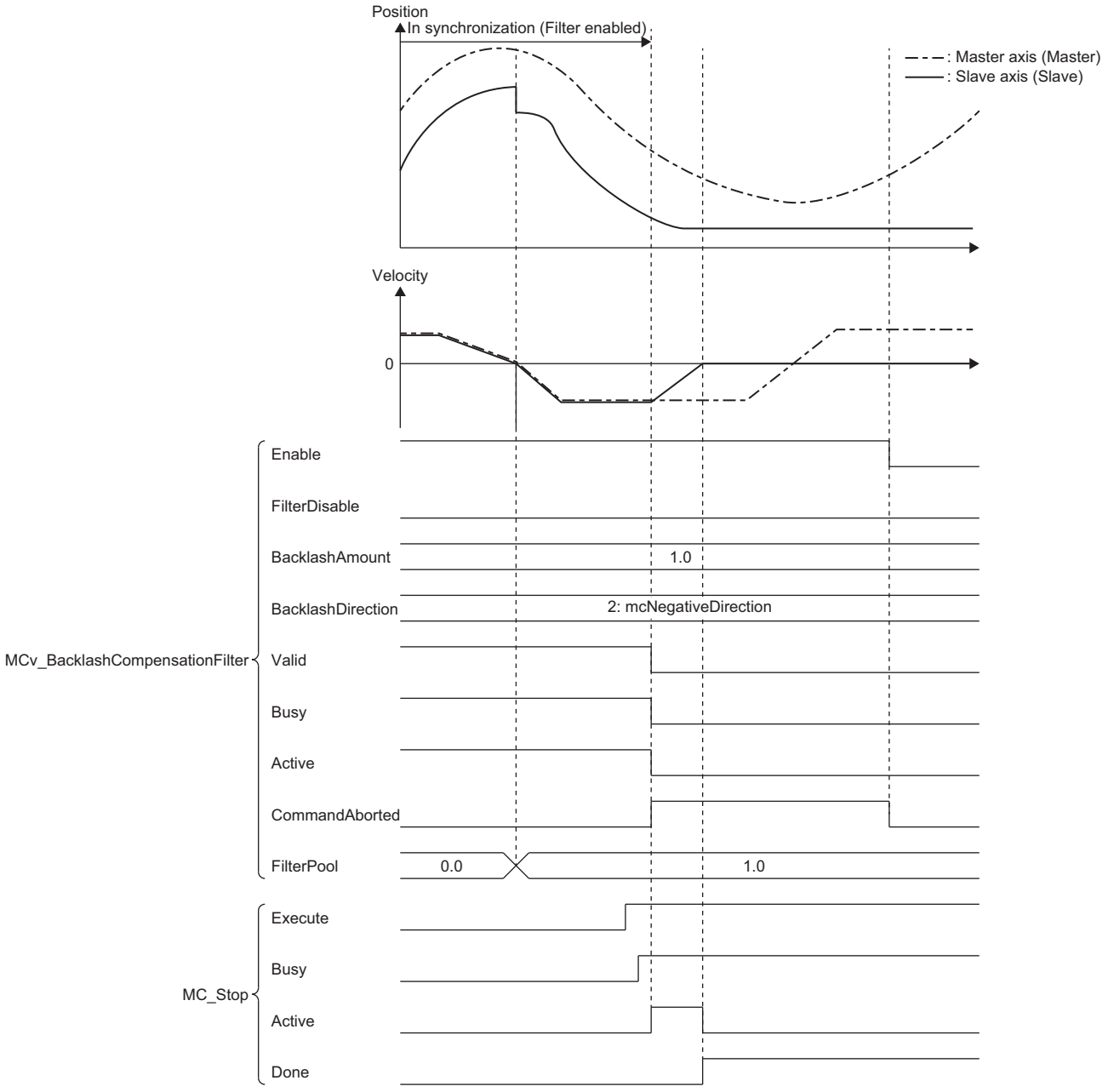


Stop operation

For details on the stop operation, refer to the following.

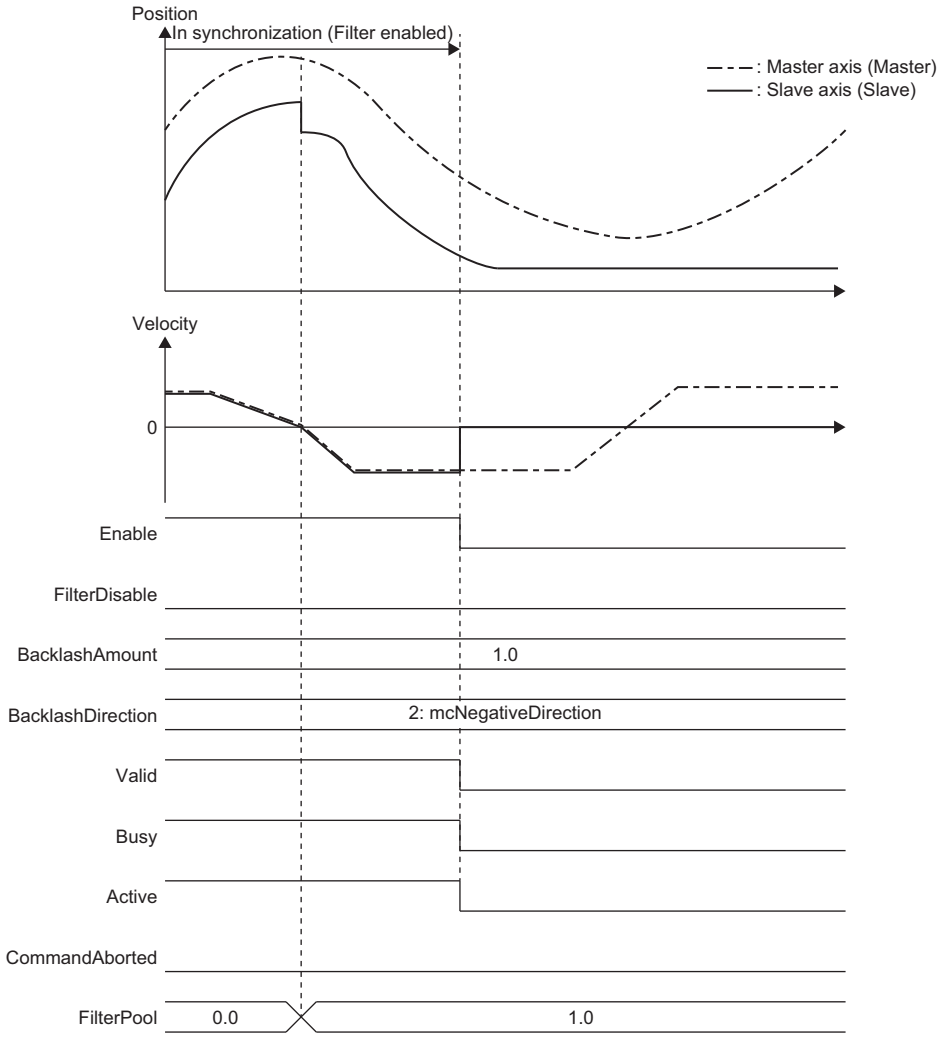
☞ Page 783 Stop Operation

This section describes the specific operation of the backlash compensation filter. When stop factor occurs to Slave axis (Slave), Slave axis (Slave) starts the stop operation from the synchronous position. The movement amount (Filter cumulated value (FilterPool)) resulting from the compensation will not be restored.



Operation at Filter disabled (At Enable (Enable) falling edge)

Slave axis (Slave) stops immediately at the synchronous position when Enable (Enable) falls. The movement amount (Filter cumulated value (FilterPool)) resulting from the compensation will not be restored.

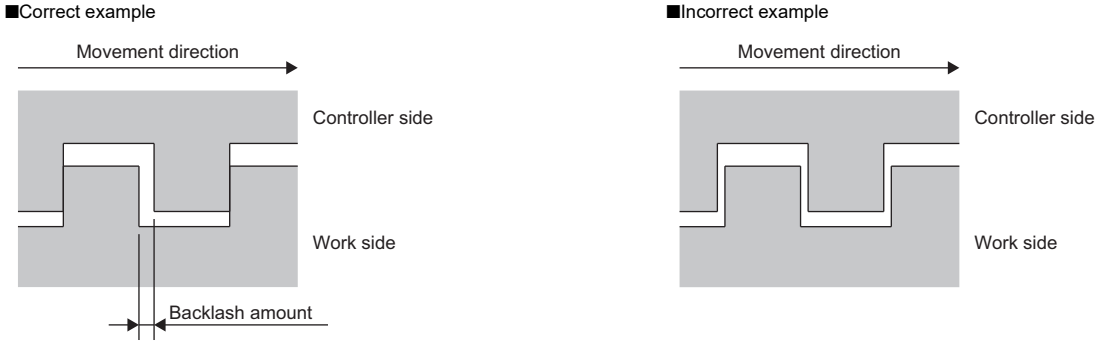


Procedure to enable the backlash compensation filter

This procedure should be performed after the machine position is established by homing, or when the backlash compensation filter is stopped and then restarted midway.

Example of usage procedure

1. Move the real drive axis by operations such as homing or JOG operation, and maintain the status so that the backlash of the machine system is generated in only one direction as shown in the correct example below.



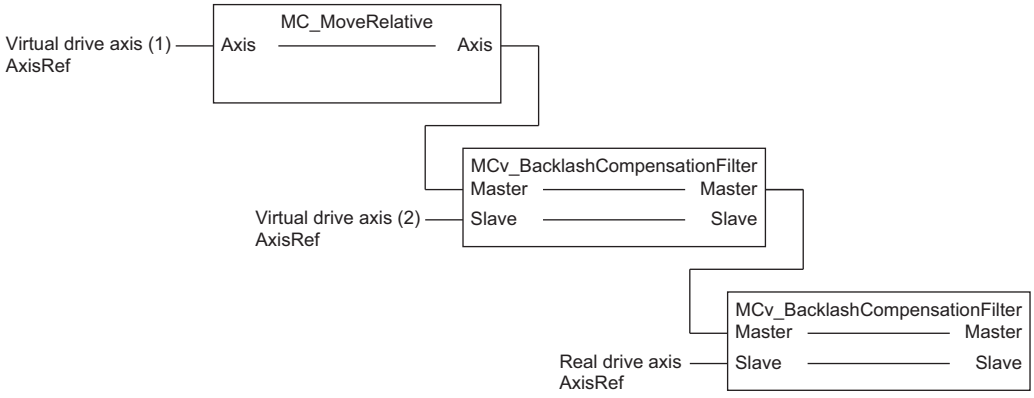
2. Match the Master axis (Master) set position with the real drive axis set position by using the current position change or others.

3. Set Backlash compensation direction (BacklashDirection) to the reverse direction of the movement of the real drive axis in Step 1, then start the backlash compensation filter. In addition, start any back part FBs that are present.

Program example

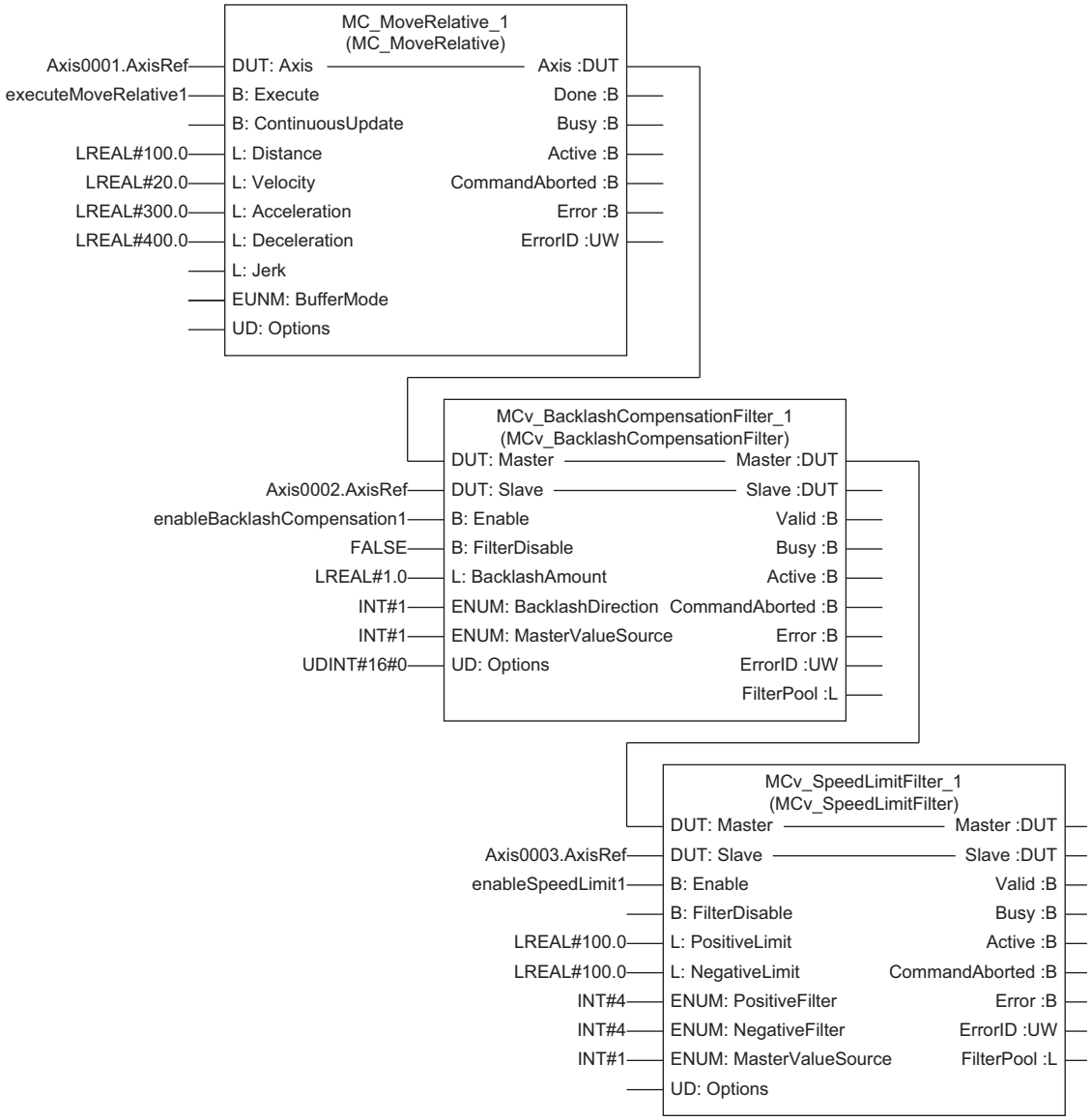
Example programs for the backlash compensation filter in the program are shown below.

The example programs are configured so that the backlash compensation filter back part is connected with the speed limit filter.



Axis	Axis name for the program example	Comment
Virtual drive axis (1)	Axis0001	• Executes the motion control such as positioning control, and generates the command to output to the drive device. • Indicates the load-side position (before speed limit).
Virtual drive axis (2)	Axis0002	• When the backlash of the machine and the motor side should be compensated by the backlash compensation filter, it will indicate the motor side position (before speed limit).
Real drive axis	Axis0003	• Indicates the motor side position (after speed limit). • Outputs the command to the drive device.

Sequence program



The following should be defined by users.

- executeMoveRelative1
- enableBacklashCompensation1
- enableSpeedLimit1

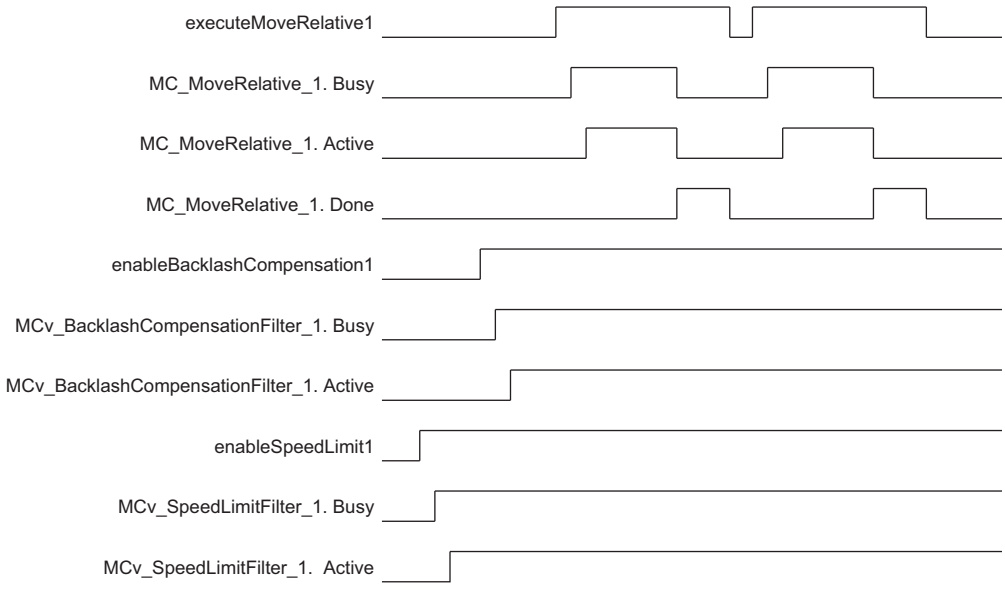
Structured text (ST language)

```
MC_MoveRelative_1.Axis := Axis0001.AxisRef;
MC_MoveRelative_1.Execute := executeMoveRelative1;
MC_MoveRelative_1.Distance := LREAL#100.0;
MC_MoveRelative_1.Velocity := LREAL#20.0;
MC_MoveRelative_1.Acceleration := LREAL#300.0;
MC_MoveRelative_1.Deceleration := LREAL#400.0;
MC_MoveRelative_1();
MCv_BacklashCompensationFilter_1.Master := MC_MoveRelative_1.Axis;
MCv_BacklashCompensationFilter_1.Slave := Axis0002.AxisRef;
MCv_BacklashCompensationFilter_1.Enable := enableBacklashCompensation1;
MCv_BacklashCompensationFilter_1.FilterDisable := FALSE;
MCv_BacklashCompensationFilter_1.BacklashAmount := LREAL#1.0;
MCv_BacklashCompensationFilter_1.BacklashDirection := INT#1;
MCv_BacklashCompensationFilter_1.MasterValueSource := INT#1;
MCv_BacklashCompensationFilter_1.Options := UDINT#0;
MCv_BacklashCompensationFilter_1();
MCv_SpeedLimitFilter_1.Master := MCv_BacklashCompensationFilter_1.Slave;
MCv_SpeedLimitFilter_1.Slave := Axis0003.AxisRef;
MCv_SpeedLimitFilter_1.Enable := enableSpeedLimit1;
MCv_SpeedLimitFilter_1.PositiveLimit := LREAL#100.0;
MCv_SpeedLimitFilter_1.NegativeLimit := LREAL#100.0;
MCv_SpeedLimitFilter_1.PositiveFilter := INT#4;
MCv_SpeedLimitFilter_1.NegativeFilter := INT#4;
MCv_SpeedLimitFilter_1();
```

The following should be defined by users.

- executeMoveRelative1
- enableBacklashCompensation1
- enableSpeedLimit1

Timing chart



Precautions on backlash compensation filter

- The backlash compensation is based on the premise that the command direction and the backlash status do not change due to external forces or other factors. The correct compensation will not be executed for the following cases:
  · A machine always weighed by external force unidirectionally such as upper and lower axis
  · A mechanism (such as rack and pinion mechanism) where the backlash amount changes depending on the machine position
- Slave axis (Slave) moves by Backlash amount (BacklashAmount) within one operation cycle at the time Master axis (Master) movement direction changes. Depending on the value, it may exceed the speed limit value or the command frequency that the drive unit can accept, connect the speed limit filter or the smoothing filter to the backlash compensation filter back part.
- Slave axis (Slave) current position (such as set position and machine feed value) will be the position that Backlash amount (BacklashAmount) compensation is added. Backlash amount (BacklashAmount) compensation will not be added to the Master axis (Master) current position.

Required object data

For details, refer to the following.
☞ Page 783 Required Object Data

38.6 Precautions on Command Filter

- Note that if Filter disable (FilterDisable) is switched during operation of the command filter, Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB due to reasons such as a stop factor being generated in Slave axis (Slave), the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.
- When the operation cycle coexistence function is used, restrictions are applied if the control operation cycle settings for the master axis and slave axis are different. Before executing the FB, synchronize input with the control operation cycle of output using Synchronize Control Operation Cycle (MCv_SyncOperationCycles). For details, refer to each function, as well as the following.

☞ Page 821 Precautions

- Use the command filter between the axes with the same control operation cycle. If synchronous control is performed between the axes with different control operation cycles, Operation cycle mismatch (error code: 1B29H) occurs.

Relevant add-ons

The following add-ons are required to use this function.

- MotionControl_AxisFilter
- MotionEngine
- MotionControl_General
- MotionControl_Sync
- Axis

39 INPUT VARIABLE CHANGE IN EXECUTION

This function changes input variables during control.
In the control whose start condition is Execute command (Execute), data such as Target position (Position) and Velocity (Velocity) can be re-imported without interrupting the operation by Execute command (Execute) retrigger.
When Continuous update (ContinuousUpdate) is TRUE at start, data such as Target position (Position) and Velocity (Velocity) are imported at each execution cycle during control.
This section describes the operation when changing the following input variables as a typical example of input variable change.

- Target position/movement distance
- Command velocity
- Acceleration/deceleration, Acceleration/deceleration time

For details on input variables that can be changed and the operation when changing input variables other than the above, refer to details on each FB.

Operation of this function for each system status

○: Available, △: Available (with restrictions), ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	△ (Available when FB is not used)
Major error	×

39.1 Relevant Variables

Axis parameter (AxisName.Pr.)

Variable/structure name	Name	Details
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. • 1: Immediate Stop (ImmediateStop) • 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Axes group parameter (AxesGroupName.Pr.)

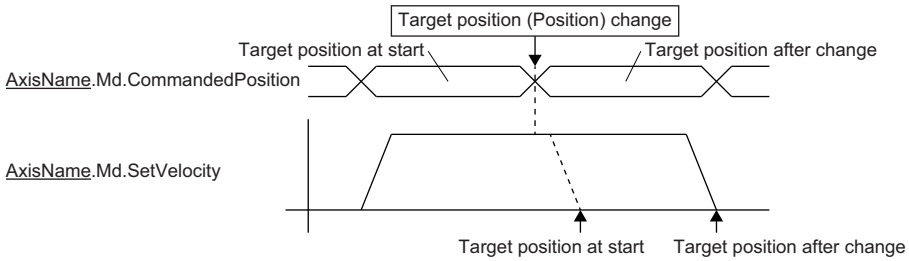
Variable/structure name	Name	Details
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. • 1: Immediate Stop (ImmediateStop)

39.2 Target Position/Movement Distance Change

This function changes the target position and the movement distance.

Target position change

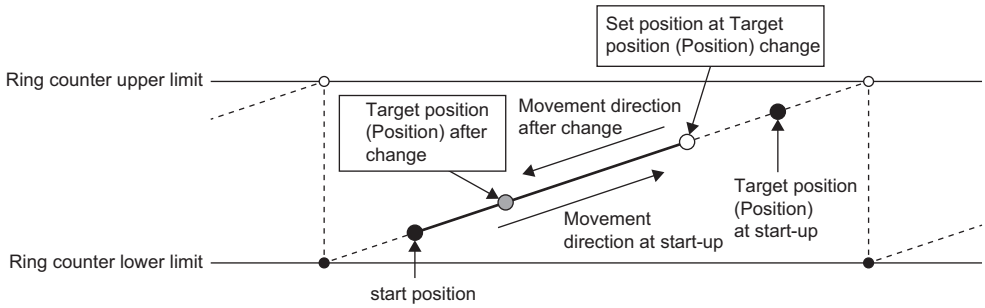
The target position is changed.



When Direction selection (Direction) can be set, the operation when changing the target position differs depending on the setting value.

For the positive direction/negative direction/current direction

When the target position is changed, the target position will be calculated not from the set position at the change but from the start position and the direction specified by Direction selection (Direction).
When the target position is changed to a position between "start position and the set position at the target position change", the operation will be reversed to the target position after change, and the control will be performed according to the selection when having reverse rotation permission selection (Options (Options) bit 5).



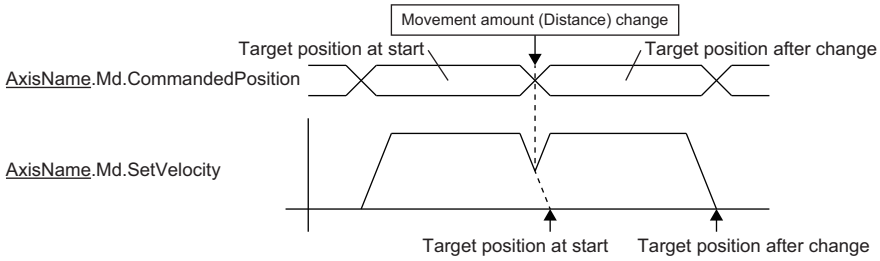
For the shortest path

When the target position is changed, the operation will be performed in the close direction from the set position at change to the target position after change.

Movement distance change

The movement distance from the start position is changed.

The movement distance after change is calculated not based on the set position at change but based on the start position.



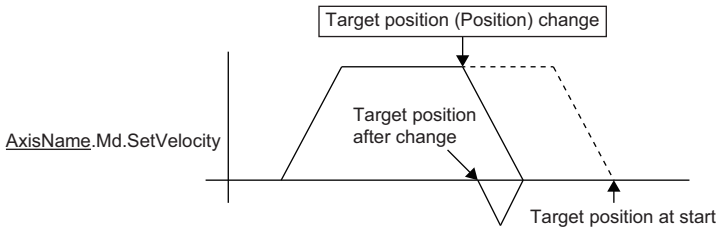
If the movement distance after change is shorter than the moved distance at movement distance change execution, the operation will be reversed, and the control will be performed according to the selection when having reverse rotation permission selection (Options (Options) bit 5).

The deceleration distance is not kept by the target position/ movement distance change

The control is performed according to the selection when having Operation Setting at Overrun (AxisName.Pr.OverrunOperation) and reverse rotation permission selection (Options (Options) bit 5).

When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options (Options) bit 5), a deceleration stop is performed once regardless of the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting. After the deceleration stop is completed, operation will start towards the changed target position.

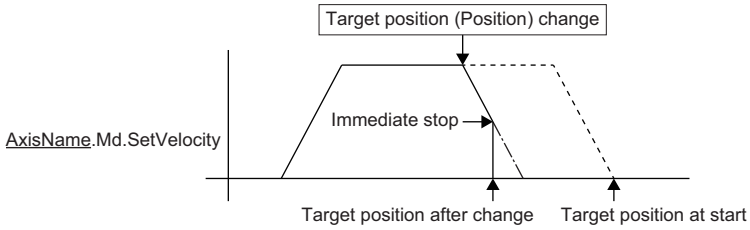


When the reverse rotation is not allowed

When "1: Do not allow" is set to the reverse rotation permission selection (Options (Options) bit 5), the axis operates according to the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting.

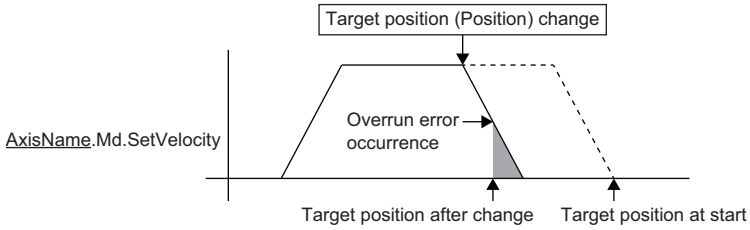
■When "1: Immediate Stop (ImmediateStop)" is set

The axis starts deceleration and it immediately stops after Overrun Warning (event code: 00D10H) occurs when it reaches the stop address.



■When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set

The axis starts deceleration, and it exceeds the stop address and stops. When the axis exceeds the stop address, Overrun error (error code: 1AE3H) occurs. However, the operation stops according to the setting of Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) when the error occurs. To stop the operation with the address which exceeds the stop address, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).



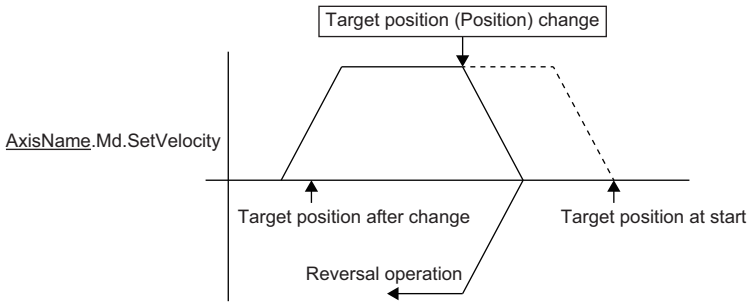
When an operation is reversed by changing the target position/ movement distance

If an operation is reversed by changing the target position/movement distance, the axis is controlled according to the selection when having reverse rotation permission selection (Options (Options) bit 5).

When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options (Options) bit 5), a deceleration stop is performed once.

After the deceleration stop is completed, operation will start towards the changed target position.

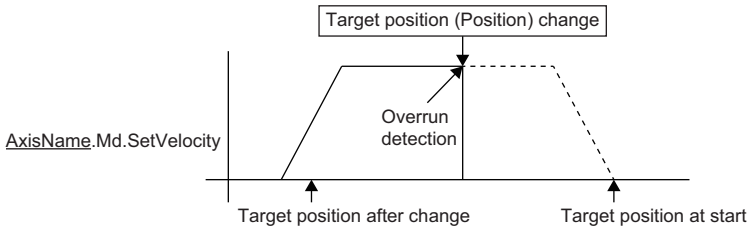


When the reverse rotation is not allowed

When "1: Do not allow" is set to the reverse rotation permission selection (Options (Options) bit 5), the axis operates according to the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting. When the target position/movement distance is changed, Overrun error (error code: 1AE3H) is detected.

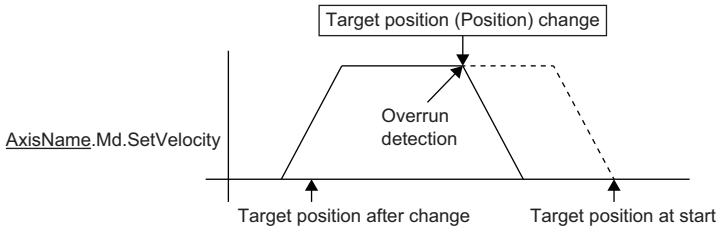
■When "1: Immediate Stop (ImmediateStop)" is set

When the target position/movement distance is changed, Overrun error (error code: 1AE3H) occurs and operation stops immediately.



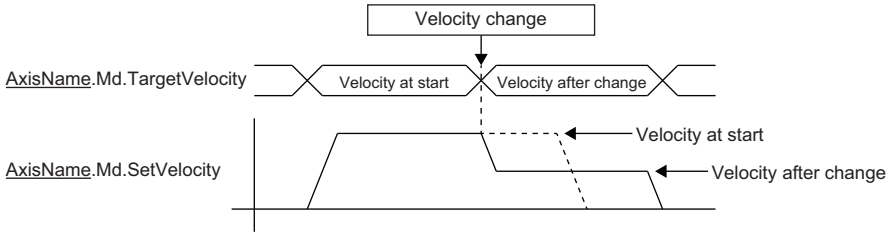
■When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set

When the target position/movement distance is changed, Overrun error (error code: 1AE3H) occurs, and operation stops following the Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) setting. To perform deceleration stop with the current deceleration, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).



39.3 Command Velocity Change

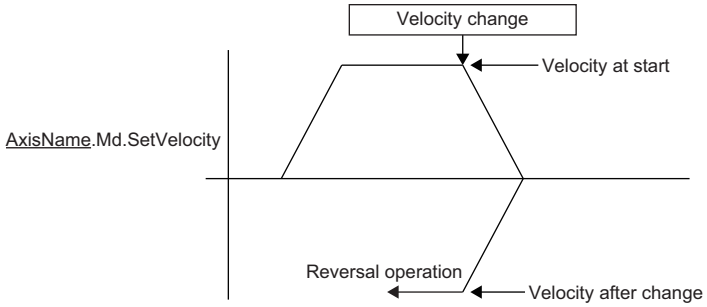
The command velocity is changed according to the acceleration/deceleration.



Command velocity sign inversion during speed control

The negative speed can be set in the speed control.

When the sign of the command velocity is reversed by changing the velocity, the reverse operation will start after the deceleration stop is completed.



During the deceleration stop to reverse the sign by changing the velocity, if a warning occurs in consequence of an attempt on a control change[*1], the control change will not be accepted. After the deceleration stop is completed, acceleration starts with the value before the control change.

Note that if the variable after the control change is any of Acceleration (Acceleration), Deceleration (Deceleration), Velocity Override Factor, and Acceleration Override Factor, a warning may occur at the acceleration after stop and the velocity value may remain 0.

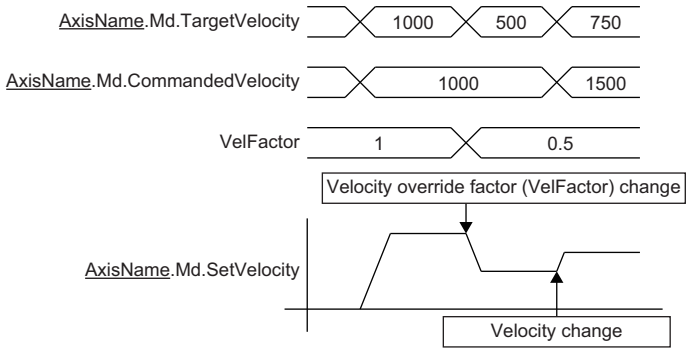
To start acceleration, remove the cause of the warning, then change the velocity (Velocity).

*1 This refers to changing any of the velocity (Velocity), acceleration (Acceleration), deceleration (Deceleration), Velocity Override Factor, and Acceleration Override Factor.

Combination with override

The velocity override factor also has an influence when the speed is changed.

The speed is changed to the speed obtained by adding the velocity override factor to the change speed.



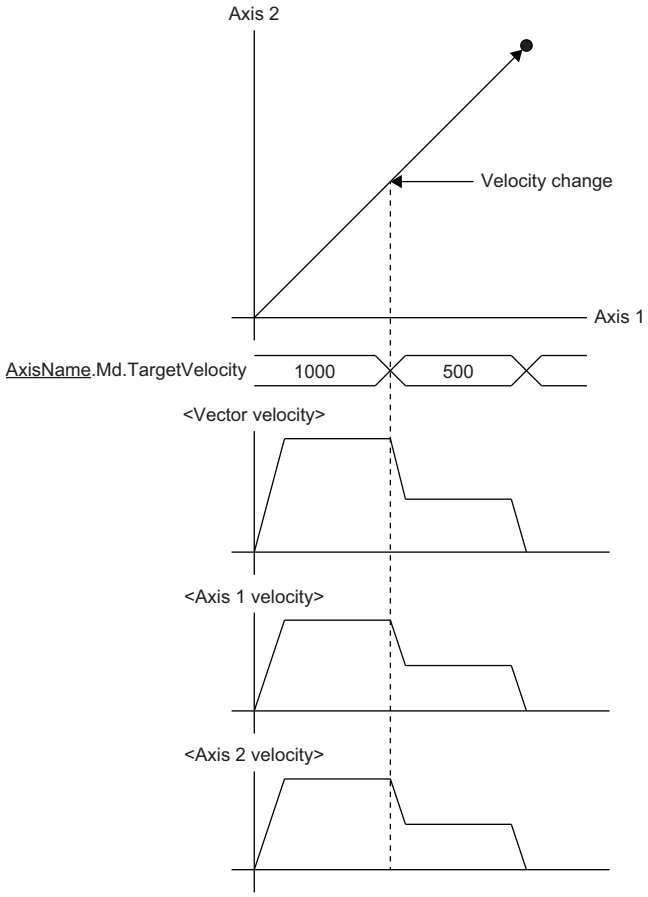
Operation during interpolation control

If the command velocity is changed during the interpolation control, the change is made according to the acceleration/deceleration method or the acceleration

Each axis speed is changed according to the velocity mode.

Ex.

When the vector velocity is set in the velocity mode



39.4 Acceleration/Deceleration and Acceleration/Deceleration Time Change

This function changes the acceleration/deceleration and the acceleration/deceleration time.
An overrun may occur by changing the acceleration/deceleration and the acceleration/deceleration time.
When an overrun is occurring, the axis is controlled according to Operation Setting at Overrun (AxisName(AxesGroupName).Pr.OverrunOperation).
For operation when changing the acceleration/deceleration and the acceleration/deceleration time, refer to the following.
☞ Page 1078 Acceleration/Deceleration Processing Function

39.5 Precautions

- Maintain the previous value for the input values that are not changed.
- Even if input variables that cannot be changed are changed, any error or warning will not occur, and the change will be ignored and the control will be continued. For input variables that can be changed, refer to details on each FB.

Relevant add-ons

The following add-ons are required to use this function.

- MotionControl_General
- MotionEngine
- Axis

40 EXTERNAL SIGNAL SELECTION

This function sets I/O signals to be used in various control.

The following functions use external signals.

☞ Page 609 Forced Stop
☞ Page 889 ADVANCED SYNCHRONOUS CONTROL
☞ Page 1069 Hardware Stroke Limit
☞ Page 1166 TOUCH PROBE
☞ Page 1190 AXIS CONTROL WAIT

Operation of this function for each system status

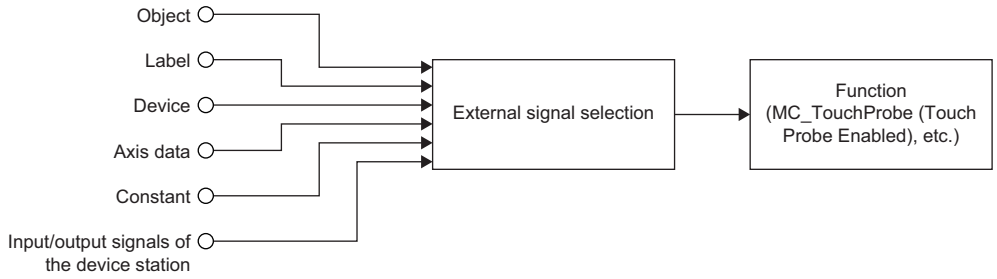
○: Available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

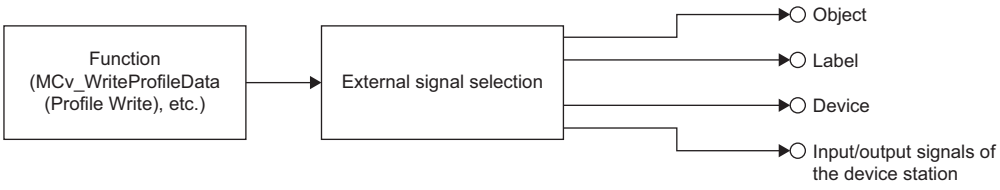
40.1 Overall Block Diagram

The relationship between an external signal selection and function is shown below.

Signal input



Signal output



40.2 Relevant Variables

Regarding external signal selection, labels in the motion system mean global labels[*1] for which "Access from External Device" is enabled. Note that local labels are not considered labels in the motion system.

*1 The following global labels are not included.
When the data type is pointer type/FB
When the class is "VAR_GLOBAL_CONSTANT"

I/O signals are expressed by the TARGET_REF structure. Another structure which has the TARGET_REF structure as a member may be defined depending on the function that uses I/O signals. For example, the MC_TRIGGER_REF structure has the SIGNAL_SELECT structure that indicates the bit I/O data as a member, and furthermore, the SIGNAL_SELECT structure includes the TARGET_REF structure.

MC_TRIGGER_REF

Variable/structure name	Name	Details
Signal	Trigger Signal	Sets the trigger signal. Trigger signal (Signal) is a SIGNAL_SELECT structure.

MC_INPUT_REF

Variable/structure name	Name	Details
Signal	Input Signal	Sets the input signal. Input signal (Signal) is a SIGNAL_SELECT structure.

MC_OUTPUT_REF

Variable/structure name	Name	Details
Signal	Output Signal	Sets the output signal. Output signal (Signal) is a SIGNAL_SELECT structure.

For the configuration of each structure, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

The SIGNAL_SELECT structure and the TARGET_REF structure, which are structures common for each function, are described below.

40.3 SIGNAL_SELECT Structure

This section describes SIGNAL_SELECT structure.

• SIGNAL_SELECT (Signal Select)

Variable/structure name	Name	Details
Source	Signal	Sets BOOL type signals used in control.
Detection	Signal detection method	Sets the signal logic.
CompensationTime	Compensation time	Sets the compensation time of the I/O signal in units of seconds.
FilterTime	Filter time	Sets the filter time for removing chattering of the input/output signals in units of seconds.

The settings of the BOOL type I/O signals which are used in control are expressed by the SIGNAL_SELECT type structure variables.

Details of the SIGNAL_SELECT type structure are described below.

Signal (Source)

• Specify BOOL type signals which are used in control with the TARGET_REF structure. The following data types can be used.

Data types
• [VAR] • [LINK] • [DEV] • [CONST] • [OBJ] (mapped to cyclic data)

• For details on the TARGET_REF structure, refer to the following.

☞ Page 1158 TARGET_REF Structure

• For operation when a signal which cannot be used is set, refer to each function.

Signal detection method (Detection)

Specify the signal logic with the MC_SIGNAL_LOGIC enumeration type.

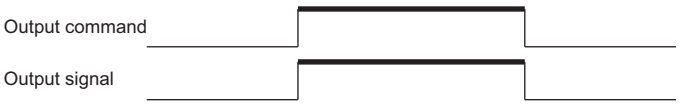
■Bit input signals

Setting	Operation
0: Detection at TRUE	When the corresponding signal is in the TRUE status, it operates as a signal input status. 
1: Detection at FALSE	When the corresponding signal is in the FALSE status, it operates as a signal input status. 
2: Detection at FALSE → TRUE (Rising Edge)	When the corresponding signal is the FALSE to TRUE rising edge, it operates as a signal input timing. 
3: Detection at TRUE → FALSE (Falling Edge)	When the corresponding signal is the TRUE to FALSE falling edge, it operates as a signal input timing. 
4: Detection at Rising Edge/Falling Edge	When the corresponding signal is the FALSE to TRUE rising edge/falling edge, it operates as a signal input timing. 

Selectable logics vary depending on the function. For details, refer to each function.

■Bit output signals

Signal logic cannot be specified. It is ignored if specified. The operation is always as follows.

Operation
When the output command is TRUE, the corresponding signal is turned to TRUE. 

Compensation time (CompensationTime)

- Specify the compensation time for the lead and delay of the I/O signal in units of seconds.
- The compensation time availability and the behavior when the value is set differ depending on the function. For details, refer to each function.

Filter time (FilterTime)

- Specify the filter time for removing chattering of the input signal in units of seconds. The input/output will only be updated if the signal status remains the same for the specified duration. The timing of input/output is delayed for the filter time.
- The availability of the filter time varies depending on the functions. For details, refer to each function.

40.4 TARGET_REF Structure

This section describes the TARGET_REF structure.

• TARGET_REF (Input Signal)

Variable/structure name	Name	Details
StartIO	I/O number	Sets the I/O number.
Target	Target	This variable sets the signal used in control with the following character string formats. * The setting is not case-sensitive. In addition, spaces are ignored. * Up to 64 characters can be stored in Target (Target). ■[Classification](Type)Data name.Bit position@Target modification • [Classification] (☞ Page 1159 [Classification] / data name) • (Type) (☞ Page 1162 (Type)) • Data name (☞ Page 1159 [Classification] / data name) • .Bit position (☞ Page 1163 .Bit position) • @Target modification (☞ Page 1163 @Target modification) ■[Classification](Type)WSTRING type label^ • [Classification] (☞ Page 1159 [Classification] / data name) • (Type) (☞ Page 1162 (Type)) • WSTRING type label^*1

*1 When specifying more than 64 characters string format, use the WSTRING type label and specify with the following method.
(1) Declare the WSTRING type global label in the motion system, and store the part of Data name.Bit position@Target modification.
(2) Specify the label name of (1) as the WSTRING type label of TARGET_REF. (To the end, add "^" that indicates reference.)

[Classification] / data name

Specify the data type in [Classification] and the target data in Data name. The specification method of the data name varies depending on the classification.

Classification	Target	Specification method of data name		Setting example
		Format	Description	
[OBJ]	CANopen object of the device station (mapped to cyclic data)	[OBJ] 0x□□□□**##	Sets the index, subindex, and size of the object. • □□□□: Index • **: Subindex • ##: Size (in bits) * Specifying the target device may be required in @Target modification. Check the specifications of the function to use. * When using an object other than the BOOL type, match the specification of (Type) with the object data type. * Some objects are available as the high-accuracy input. For details, refer to the following. ☞ Page 1164 External Signal High-Accuracy Input * An object whose size is 1 byte is not available. • Whether the device station is connected is monitored. For the operation when the device station is disconnected, check the specifications of each function. • Applicable signals are only those from device stations whose "Network Synchronous Communication" is set to "Synchronous".	[OBJ](DINT)0x607A0020 * For an MR-J5(W)-G Targetposition (Obj.607AH: 00H), 4-byte object (20H)
[VAR]	Label in the motion system*1	[VAR]Label name	Specify a label in the motion system in Label name. • The labels for timer type, retentive timer type, long timer type, long retentive timer type, counter type, and long counter type can be used only for reading by specifying the member name (S: contact, C: coil, N: current value). (Example) [VAR]label_w1.S • Digit specification of bit type array label cannot be used. • When a name of a label to which a device is assigned has been specified, devices that this function does not support cannot be used. For the devices that can be used, refer to the following. ☞ Page 1161 List of supported devices for [DEV] type • Labels to which a digit-specified bit device is assigned cannot be used. • When a network label is specified, whether the device station is connected is monitored. For the operation when the device station is disconnected, check the specifications of each function. • Applicable signals are only those from device stations whose "Network Synchronous Communication" is set to "Synchronous".	[VAR]ADunit10.OutputEnable [VAR]TestLabel[0,0]
[AXIS]	Axis data	[AXIS]MC_SOURCE	Specify an MC_SOURCE enumeration type enumerator in MC_SOURCE. Only the data type "LREAL" can be specified. • 1: Set Value (mcSetValue) • 2: Actual Value (mcActualValue) • 101: Latest Set Value (mcLatestSetValue) • 102: Latest Actual Value (mcLatestActualValue) * Specifying the target data may be required in @Target modification. Check the specifications of the function to use. * Data writing is not possible. * For the enumerators that can be specified, check the specifications of the function to use.	[AXIS]mcSetValue

Classification	Target	Specification method of data name		Setting example
		Format	Description	
[LINK]	Input/output signals of the device station	[LINK]Input/output signal name of the device station@Target modification	This data type is only available with specific functions. For details, refer to the following. ☞ Page 1164 External Signal High-Accuracy Input ☞ Page 1164 External Signal High-Accuracy Output The following signals can be specified as the input/output signal name of the device station. • Input (X): Only the external signal high-accuracy input can be used. • Output (Y): Only the external signal high-accuracy output can be used. Specify the target device station to @Target modification. Whether a module is mounted or not will be monitored. For the operation when the module is removed, refer to the specifications of each function. Applicable signals are only those from device stations whose "Network Synchronous Communication" is set to "Synchronous". Signals from an unconnected station or a non-existent station are not applicable.	[LINK]X1@192.168.3.1
[DEV]	Device in the motion system (Including buffer memory and link device of the module itself)*2	[DEV]Device name	The following devices can be set. ☞ Page 1161 List of supported devices for [DEV] type * Digit-specified bit device, index modification, and indirect specification cannot be used. * Local devices cannot be used. * @Target modification cannot be specified. (It is ignored.)	[DEV]X10 [DEV]U0\G11500000.1
[CONST]	Constant	[CONST]Constant [CONST]0xConstant	Specify Constant as floating decimal (E format is also available)/decimal integer/hexadecimal integer. The value can be changed for each cycle by specifying the @Target modification. * Data writing is not possible.	[CONST]1000 [CONST]0x100

*1 This label means global labels for which "Access from External Device" is enabled. The following global labels are not included.
When the data type is pointer type/FB
When the class is "VAR_GLOBAL_CONSTANT"

*2 For restrictions to be placed when a device is used, refer to the following.
☞ Page 1241 Direct Access to Link Devices

■List of supported devices for [DEV] type

The list of supported devices for [DEV] type is shown below.

R: Read-only, RW: Read and write, —: Not supported

Device type	Device name	Symbol	Read/Write
User device	Input	X	RW*1*2
	Direct access input	DX	—
	Output	Y	RW*1*2
	Direct access output	DY	—
	Internal relay	M	RW*2
	Latch relay	L	RW*2
	Link relay	B	RW*2
	Link special relay	SB	RW*2
	Annunciator	F	R
	Edge relay	V	—
	Timer	T	R*3
	Retentive timer	ST	R*3
	Long timer	LT	R*3
	Long retentive timer	LST	R*3
	Counter	C	R*3
	Long counter	LC	R*3
	Data register	D	RW*2
	Link register	W	RW*2
	Link special register	SW	RW*2
System device	Special relay	SM	RW
	Special register	SD	RW
	Function input	FX	—
	Function output	FY	—
	Function register	FD	—
File register	File register	R	—
		ZR	—
Index register	Index register	Z	—
	(32-bit index modification)	(ZZ)	—
	Long index register	LZ	—
Pointer	Pointer	P	—
	Interrupt pointer	I	—
Module access device	Module access device	Un\G	RW*4
CPU buffer memory access device	CPU buffer memory access device	U3En\G	RW*5
Refresh data register	Refresh data register	RD	—
Nesting	Nesting	N	—
Others	Network No. specification device	J	—
	I/O No. specification device	U	—

*1 Only unassigned devices are available.

*2 When set as a refresh target in refresh settings, whether a device station is connected is monitored. For the operation when the device station is disconnected, refer to the specifications of each function.
When set as a refresh target in "Refresh Settings", applicable signals are only those from devices whose "Network Synchronous Communication" is set to "Synchronous".

*3 Timer, retentive timer, long timer, long retentive timer, counter, and long counter have a contact (S), coil (C), and current value (N). When specifying them to the data name, specify as follows: Contact: "Device symbol S", Coil: "Device symbol C", Current value: "Device symbol N"
To specify the contact of retentive timer ST10 to the data name: [DEV]STS10
To specify the current value of long counter LC10 to the data name: [DEV]LCN10
When using timer, retentive timer, long timer, long retentive timer, counter, or long counter, specify the type in accordance with the device size.

*4 Supported only when the buffer memory of the motion function part or CC-Link IE TSN function part of the controller is specified.

*5 Supported only when the CPU function part buffer memory of the controller is specified.

(Type)

It is written when explicitly specifying the data type. For whether the type specification can be used or not, handling when the type is omitted, and type conversion rules, refer to the specifications of the function to use.
The following types can be specified.

Type	Description
(BOOL)	Bit
(INT)	Word [signed]
(DINT)	Double word [signed]
(WORD)	Word [unsigned]/bit string [16-bit]
(DWORD)	Double word [unsigned]/bit string [32-bit]
(REAL)	Single-precision real number
(LREAL)	Double-precision real number

When (BOOL) is specified for data whose type specified in [Classification] is other than BOOL type, it will be handled as if "bit position.0" is omitted, unless otherwise specified in each function description.

Ex.
For [DEV](BOOL)D0
Handled as [DEV](BOOL)D0.0.

.Bit position

When .Bit position is added to the data whose [Classification] is as follows, the data is handled as BOOL type data. From 0 to F can be used for the bit position.

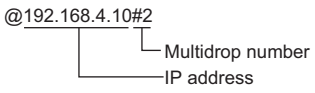
When (Type) and .Bit position are simultaneously specified, the (Type) specification is ignored and the data becomes BOOL type data.

Classification	Bit position setting range
[OBJ]	0 to F
[VAR] (Only WORD type, DWORD type, INT type, DINT type)	
[DEV]	

@Target modification

Specify auxiliary information for specifying data. The details differ depending on [Classification].

Be sure to specify it depending on the function that uses signals. If the target modification is specified for data types and functions that do not require it, the specification will be ignored.

Classification	Target modification		Setting example
	Format	Description	
[OBJ] [LINK]	@Station address	Specify the station address (IP address information to distinguish device stations). Like multi-axis drive unit, when one station includes multiple logic axes, specify the No. to distinguish logic axes.  * The multi-drop No. is set as "# + No. (decimal)". · #0: A axis · #1: B axis · #2: C axis * Multidrop No. can be omitted. When it is omitted, the device is regarded as a single axis device (for a multiple axes device, it is regarded as specifying 0 in multidrop No.).	@192.168.4.10 @192.168.4.10#2
[AXIS]	@Position @CumulativePos	Specify the target data (position, speed, and torque). Set either @Position or @CumulativePos based on the MC_SOURCE type enumerator set in Data name.*1	@Position @CumulativePos
[CONST]	@+adding value @-subtracting value	Each time referring the value, it is used to change the read value. When the data type is REAL or LREAL, this setting is invalid.	[CONST](INT)0@-10*2 [CONST](BOOL)0x00.3@+1*3

*1 The enumerators that can be specified are shown below.

○: Can be set, ×: Cannot be set

MC_SOURCE type enumerator	Description	Modification	
		@Position	@CumulativePos
1: Set Value (mcSetValue)	Set value of previous operation cycle	○	○
2: Actual Value (mcActualValue)	Actual value of previous operation cycle	○	×
101: Latest Set Value (mcLatestSetValue)	Set value of latest operation cycle	○	○
102: Latest Actual Value (mcLatestActualValue)	Actual value of latest operation cycle	○	×

*2 The referred value will be as "0, -10, -20, -30, ···".
Values from 0 to 7 can be used for bit specification for [CONST].

*3 The referred value switches between TRUE and FALSE every eight (2^3) cycles. (1 byte value +1 will be added in every cycle and the bit 3 status will be retrieved.)
Values from 0 to 7 can be used for bit specification for [CONST].

40.5 External Signal High-Accuracy Input

When signals which are compatible with the external signal high-accuracy input are used for functions which have Trigger input signal (TriggerInput) as the input, high-accuracy control using signal detection time of input devices can be performed.
Applicable signals are [OBJ] and [LINK].
For setting methods, refer to the following.
☞ Page 2152 Connection to Servo Amplifier That Supports CC-Link IE TSN

List of functions which are compatible with the external signal high-accuracy input

- Touch probe
- Advanced synchronous control

40.6 External Signal High-Accuracy Output

When signals which are compatible with the external signal high-accuracy output are used for functions which have Output (output signal) as the input/output, high-accuracy control using signal output time of output devices can be performed.
Applicable signals are [LINK] only.
For setting methods, refer to the following.
☞ Page 2152 Connection to Servo Amplifier That Supports CC-Link IE TSN

List of function which is compatible with the external signal high-accuracy output

- Digital cam switch

40.7 Precautions

When using [OBJ] and [LINK] as an output destination of a function, do not label the object and link device used as the output destination.

When [VAR] is specified in data type, if any of the following operations is performed by writing to the programmable controller (including online program change) after target data is imported, an Invalid write to the controller (error code: 3408H) will occur.

- Deleting target data
- Changing the data type of target data
- Disabling "Access from external devices" for target data

If the signal used for control cannot be used due to device disconnection or other reasons, the following functions are regarded as signal detection being forcibly performed for safety reasons.

Function	Relevant structure name	Operation when the signal is detected	Target device
Forced stop	AxisName.Pr.ForcedStop_Signal	The axis is stopped.	Device station
	MotionSystem.Pr.ForcedStop_Signal		
Hardware stroke limit	AxisName.PrConst.HwStrokeLimit_FlsSignal		
	AxisName.PrConst.HwStrokeLimit_RlsSignal		
Stop	AxisName.Pr.StopSignal		
Clutch (Advanced synchronous control)	AdvOutputName.Pr.MasterOffClutchSignal AdvOutputName.Pr.AuxOffClutchSignal	The clutch is turned off.	

The above functions apply to any of the following situations:

- The applicable device is disconnected.
- Transfer of data received from the applicable device to a device/label stops.*1
- Synchronization flag [X21] is off (only when the signal data type is set to [VAR])

*1 For details on the restart methods of network label refresh, device link refresh, watchdog counter, and transfer of received data to a device/label, refer to the following.

☞ Page 234 Refresh mode

Regarding functions that do not apply to any of the above, the refresh will stop.

Relevant add-ons

The following add-ons are required to use this function.

- SignalIO
- Axis*1
- ServoDriver_CANopen*2

*1 When using [AXIS] as the signal type

*2 When using [OBJ] as the signal type

System memory capacity

■Backup RAM usage

Backup RAM is not used.

41 TOUCH PROBE

This function records (latches) specific data at trigger input signal detection.

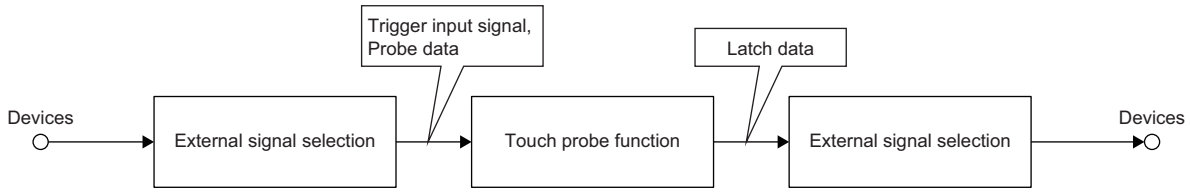
Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

41.1 Overall Block Diagram

The relationship between the touch probe function and other functions is shown below.



41.2 Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Details
MC_TouchProbe	Touch probe enabled	Specific data will be recorded due to the trigger event occurrence.
MC_AbortTrigger	Touch probe disabled	Disables the latch in execution.

41.3 Touch Probe Enabled

This function records (latches) specific data at trigger input signal detection.
It is possible to latch only the data within the range by setting the data range to latch.
When this function is used, execute MC_TouchProbe (Touch Probe Enabled). To stop this function, execute MC_AbortTrigger (Touch Probe Disabled).

Control details

The operation performed when a trigger event occurs is shown below.

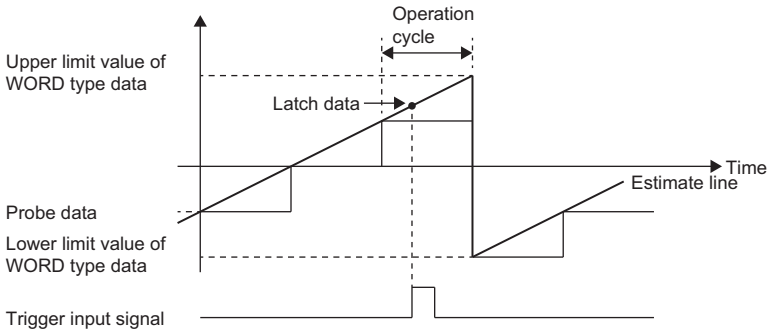
- The latch data is calculated by estimation at rising edge, falling edge, or in both directions of the signal set in Trigger input signal (TriggerInput) (hereinafter referred to as the trigger input signal).
- When Enabled window (WindowOnly) is TRUE, whether the latch data at trigger event occurrence is within the range or not is checked. Data outside the range are not latched.
- The latch data is stored to the storage location specified in Latch position (RecordedPosition) and Storage location of latch data (OutputBuffer) according to Latch mode (RecordMode), and Number of latch times (RecordedCounter) is updated.

Estimated calculation

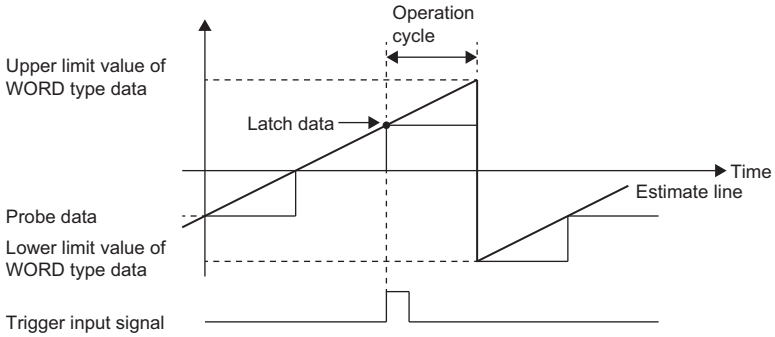
The probe data during operation cycle interval is calculated by estimation. The value calculated by estimation at the timing when Trigger input signal (TriggerInput) is input is the latch data. The value is calculated as shown below.

■When the prove data is the WORD type

■When using the external signal high-accuracy input
The trigger input timing is the time when the signals are detected at by the device station.
For setting method of high-accuracy input of the external signal selection, refer to the following.
☞ Page 2170 Setting method



■When the external signal high-accuracy input is not used
The trigger input timing is operation cycle.



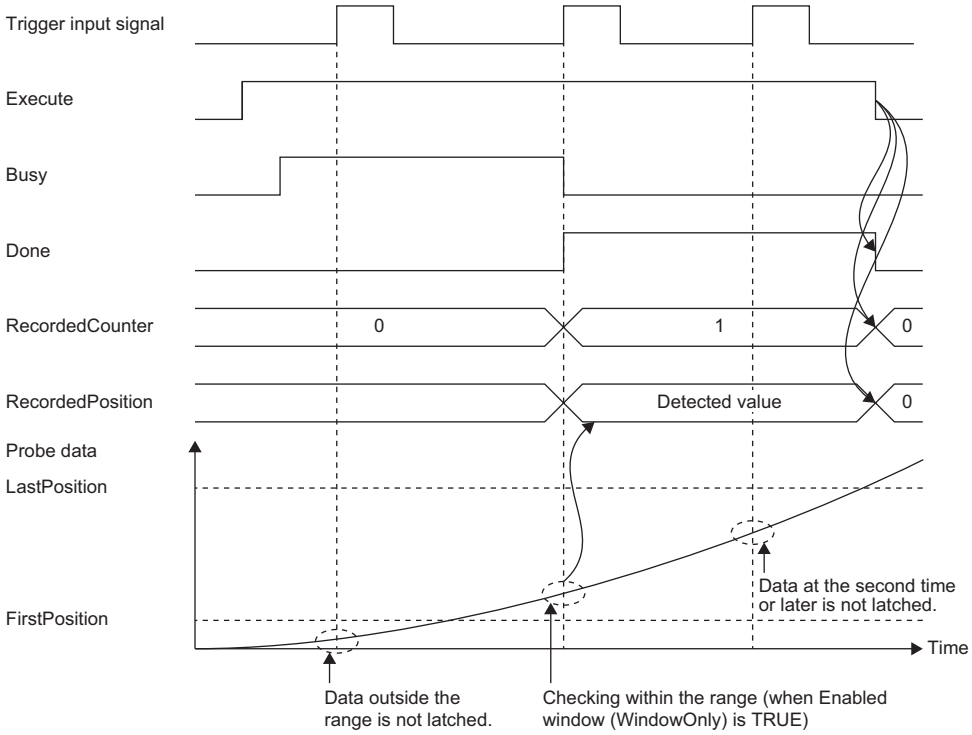
Timing chart

■When the FB is normally completed

The following shows examples of latch operation by Latch mode (RecordMode).

Ex.

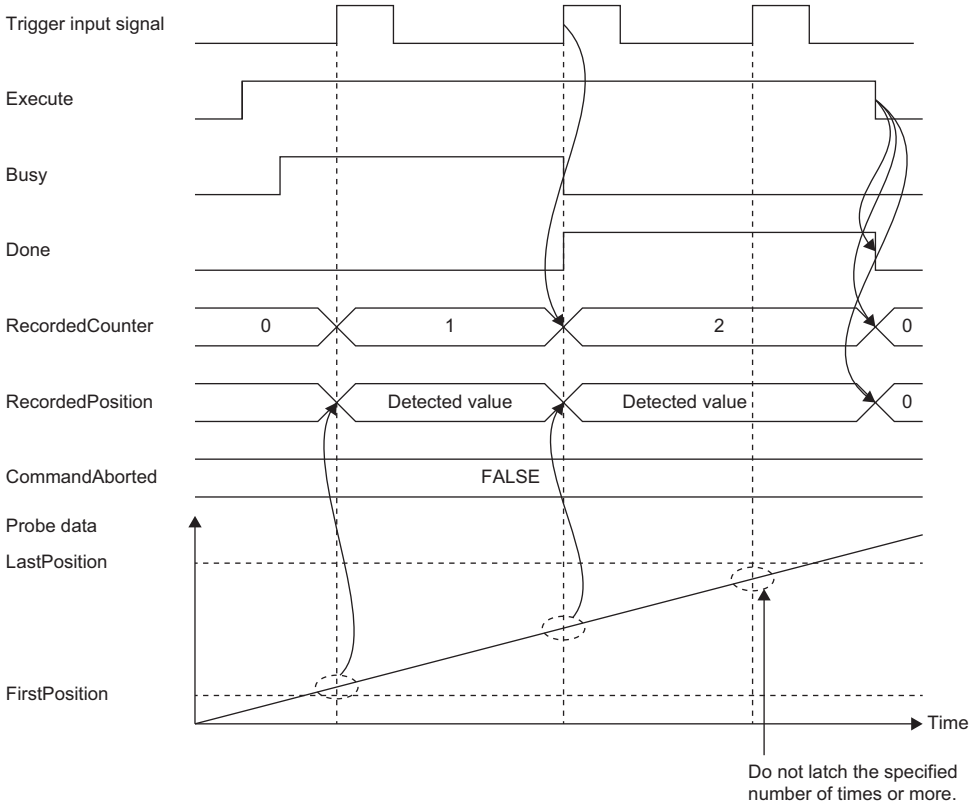
When Latch mode (RecordMode) is "0: One shot mode (OneShot)"



Ex.

When Latch mode (RecordMode) is "1: Frequency specified mode (RecordCount)"

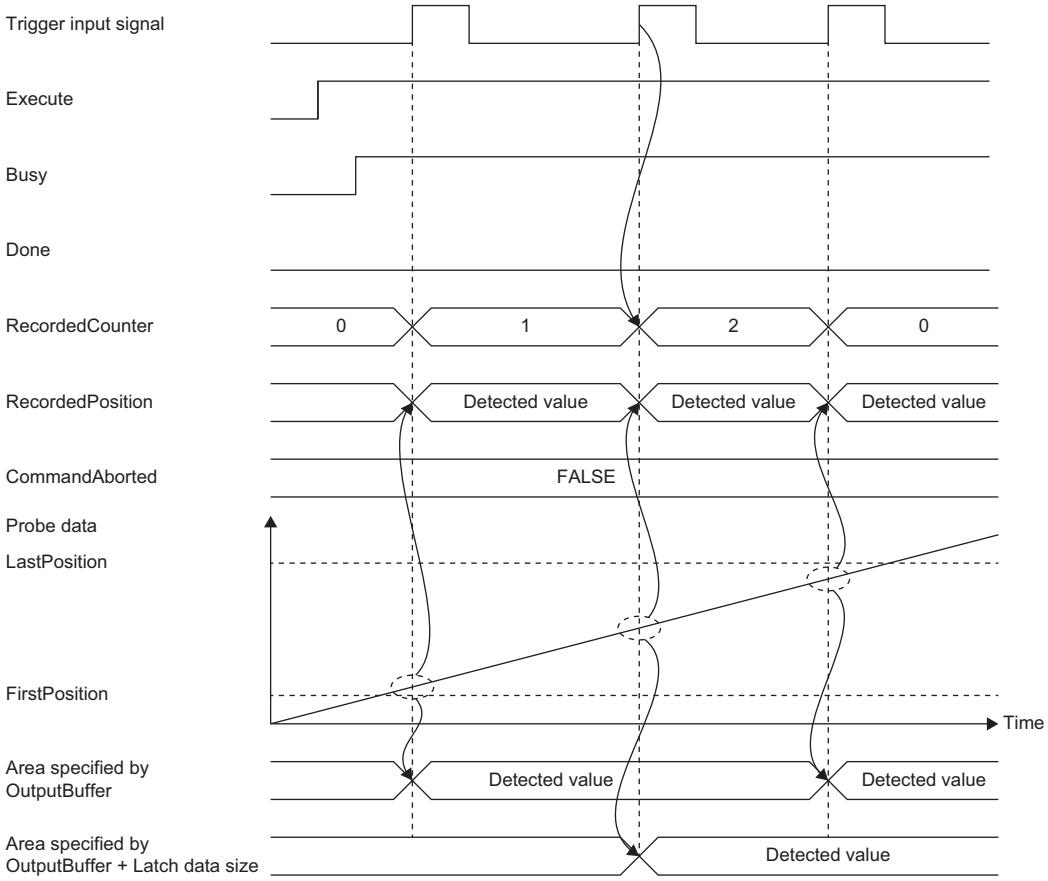
Number of latch times (RecordCount): 2



Ex.

When Latch mode (RecordMode) is "2: Ring buffer mode (RingBuffer)"

Number of latch times (RecordCount): 2



■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type Motion control FBs" in the following.

MELSEC MX Controller MX-R Model Programming Manual

Precautions

- Refresh of the motion control FB I/O argument is performed at the timing the FB is called, however, the control is executed by using operation cycle regardless of the FB call task (scan/fixed cycle/event).

The cycle to detect trigger input signals varies depending on the data type set in TriggerInput.

Type	Cycle
[VAR]	First operation cycle
[DEV]	
[CONST]	
[OBJ]	Communication cycle of the target station
[LINK]	
[VAR] (When a network label is specified)	

Latch the data set to ProbeData at the following cycle.

Type	Cycle
[VAR]	First operation cycle
[DEV]	
[OBJ]	Communication cycle of the target station Control operation cycle of the target axis
[VAR] (When a network label is specified)	
[AXIS]	

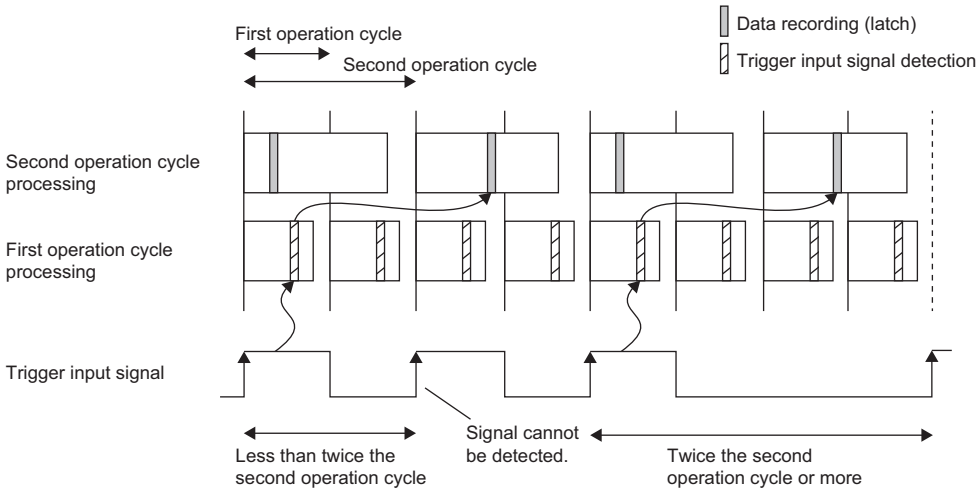
- This FB is executed even if the target axis is not connected or an error occurs.
- Be sure to secure at least the following time for TRUE and FALSE of trigger input signals. If the time is shorter than the following, signals cannot be detected correctly.

External signal high-accuracy input	TRUE and FALSE time of trigger input signals
Use	• Device: Filter time of the device • Input module: Input response time of the input module
Not use	Trigger input signal detection cycle

- The interval of trigger input signals must be at least twice as long as the longer one of the trigger input signal detection cycle or the latch cycle. If signals are input in a cycle shorter than that, signals cannot be detected correctly. When multiple trigger input signals are input before latching, the signal that is input first is used.

Ex.

When the trigger input signal detection cycle is the first operation cycle and the latch cycle is the second operation cycle



41.4 Touch Probe Disabled

The touch probe is disabled.

Control details

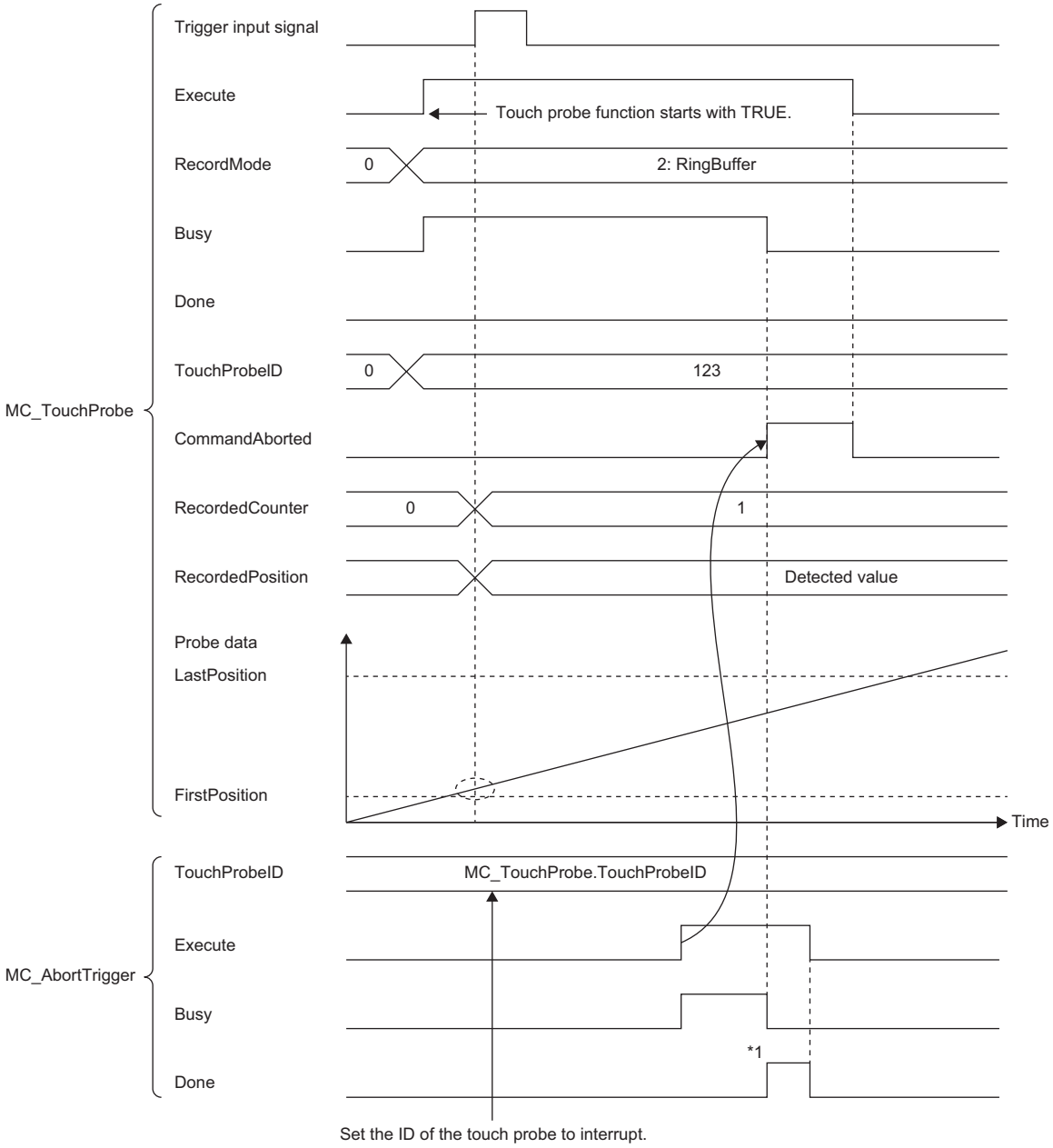
MC_TouchProbe (Touch Probe Enabled) which is specified in Touch probe ID (TouchProbeID) is disabled.
When MC_AbortTrigger (Touch Probe Disabled) is executed, if MC_TouchProbe (Touch Probe Enabled) specified in Touch probe ID (TouchProbeID) is not running, Execution completion (Done) will immediately become TRUE.
Axis information (Axis) and Trigger input signal (TriggerInput) can be omitted, because they are ignored.

Timing chart

■When the FB is normally completed

Ex.

When Latch mode (RecordMode) is "2: Ring buffer mode (RingBuffer)"



*1 Done may be turned on immediately depending on the timing to execute the program.

■When an error occurs

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type Motion control FBs" in the following.

MELSEC MX Controller MX-R Model Programming Manual

41.5 Precautions

Relevant add-ons

The following add-ons are required to use this function.

- MotionControl_General
- SignalIO
- Axis*1
- NetworkDriver_CCIETSN*2
- ServoDriver_CANopen*2

*1 For using the signal type [AXIS] of the external signals

*2 For using the signal type [OBJ] of the external signals

System memory capacity

■RAM usage

Memory capacity of MC_TouchProbe (Touch Probe Enabled) varies depending on Compensation Time (CompensationTime).

For details, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

■Backup RAM usage

Backup RAM is not used.

42 DIGITAL CAM SWITCH

Digital cam switch outputs the on/off signals according to a value of any data (data source).
Due to its higher accuracy in outputting signals compared to programs, this function can be used for the following applications.

Equipment	Application
Printing machines	Trigger of quality inspection camera
Press feeders	Adsorption/release of workpiece adsorbing air
Packaging machines	Printing expiration dates and other information
Laser processing machines	Switching on/off laser

Operation of this function for each system state

○: Available, ×: Not available

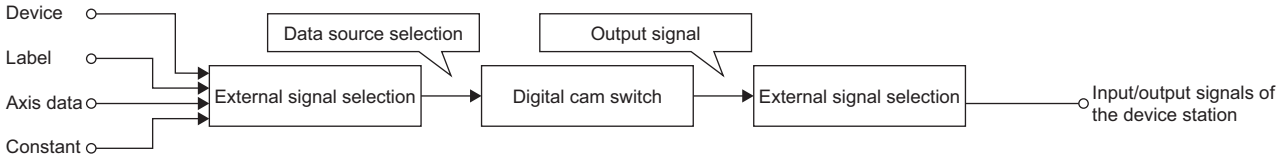
System status	Operation availability
STOP	×*1
RUN	○*2
Moderate error	×*1
Major error	×*1

*1 This function stops control over the output signal, so the signal to be output will follow the latter function of the external signal selection.
For details, refer to the following.
☞ Page 1175 Overall Block Diagram

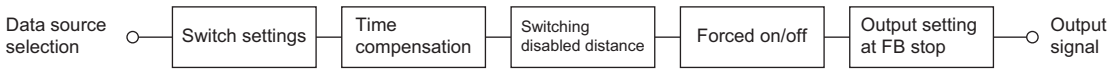
*2 For the output signal of MC_DigitalCamSwitch (Digital Cam Switch Output), refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

42.1 Overall Block Diagram

The relationship between the digital cam switch and other functions is shown below.



The following shows the relationship among the functions in the digital cam switch.



42.2 Relevant Variables

MC_CAMSWITCH_DATA_REF

Variable/structure name	Name	Description
ProfileID	Profile ID	Specifies the operation profile data ID.

MC_TRACK_REF

Variable/structure name	Name	Description
Hysteresis	Switching disabled distance	Sets the dead band to prevent chattering of the output signal.

MC_CAMSWITCH_SOURCE_REF

Variable/structure name	Name	Description
Source	Data source	Specifies the data source.
RingCount_LowerValue	Data source ring counter lower limit value	Sets the ring counter lower limit value of the data source.
RingCount_UpperValue	Data source ring counter upper limit value	Sets the ring counter upper limit value of the data source.

42.3 Relevant FB

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Motion control FB	Name
MC_DigitalCamSwitch	Digital cam switch output	Outputs on/off signals according to a value of any data.

42.4 Control Details

This function calculates the on/off timing of a switch based on the speed of the data source.
Since the accuracy will decrease if the speed of the data source is not constant, the output timing may vary greatly.
A decrease of accuracy can be suppressed by using the following methods.

- Suppress the vibration of the data source with MCv_SmoothingFilter (Smoothing filter) or other FBs.

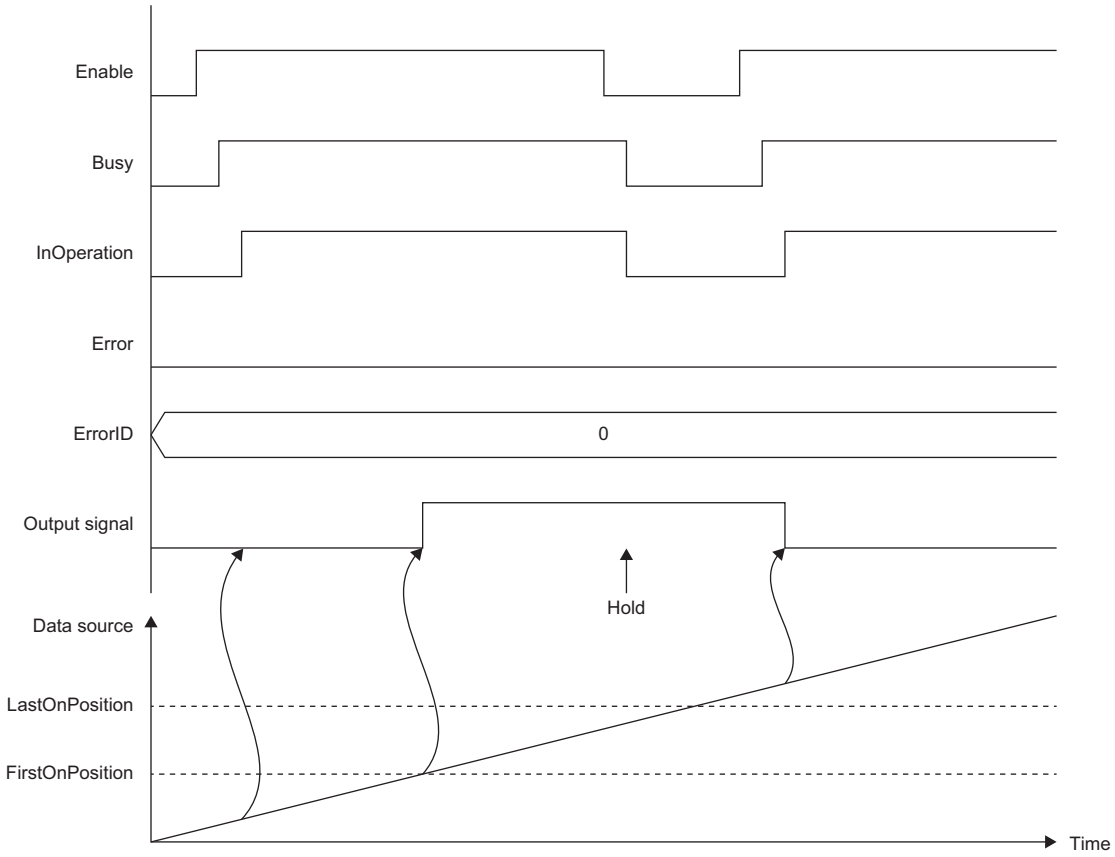
Point

Set switch settings using operation profile data. Before using this function, open the operation profile data in the open area.
For information on how to open the data in the open area and on required operation profile data for digital cam switch, refer to the following.
☞ Page 824 OPERATION PROFILE DATA FUNCTION

Timing chart

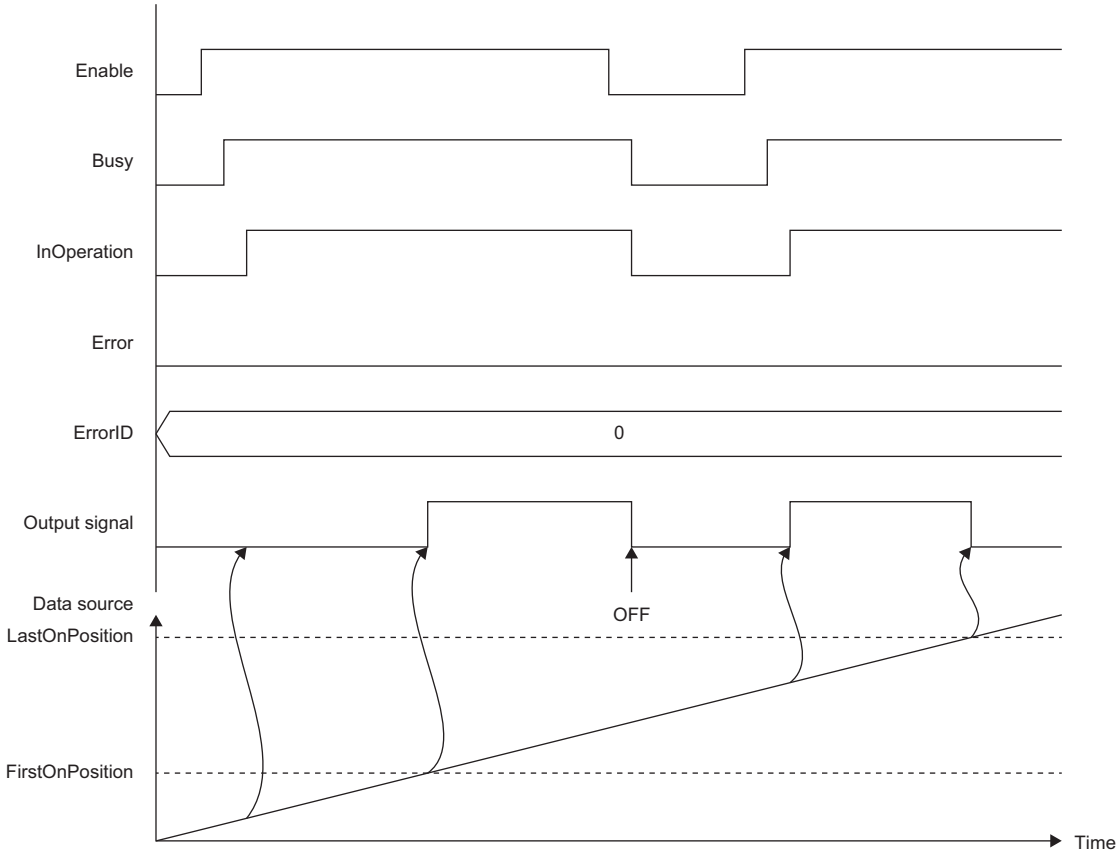
■When the operation is completed successfully

Ex.
Output setting at FB stop (Options (Options): bit16) is 0: Held



Ex.

Output setting at FB stop (Options (Options): bit16) is 1: Off



■When the operation is completed with an error

For details when an error occurs, refer to "Basic operation of Execution command (Execute) type motion control FBs" in the following.

📖MELSEC MX Controller MX-R Model Programming Manual

Switch settings

Set the on/off conditions of the output signal with the following switch settings.

- ON Start Position (FirstOnPosition)
- ON End Position (LastOnPosition)
- Switch mode selection (CamSwitchMode)
- Direction selection (Direction)

Switch mode selection (CamSwitchMode)	On condition	Off condition
0: Switch disabled	—	The output signal is always off.
1: Position-based	The output signal turns on when all the following conditions are satisfied. • While the data source is within an ON section that is set by ON Start Position (FirstOnPosition) and ON End Position (LastOnPosition)*1 • When the moving direction of the data source is equal to Direction selection (Direction) (Direction Selection (Direction): Positive direction or Negative direction)*2	The output signal turns off when either of the following conditions is satisfied. • While the data source is not within an ON section that is set by ON Start Position (FirstOnPosition) and ON End Position (LastOnPosition)*1 • When the moving direction of the data source is different from Direction selection (Direction) (Direction Selection (Direction): Positive direction or Negative direction)*2

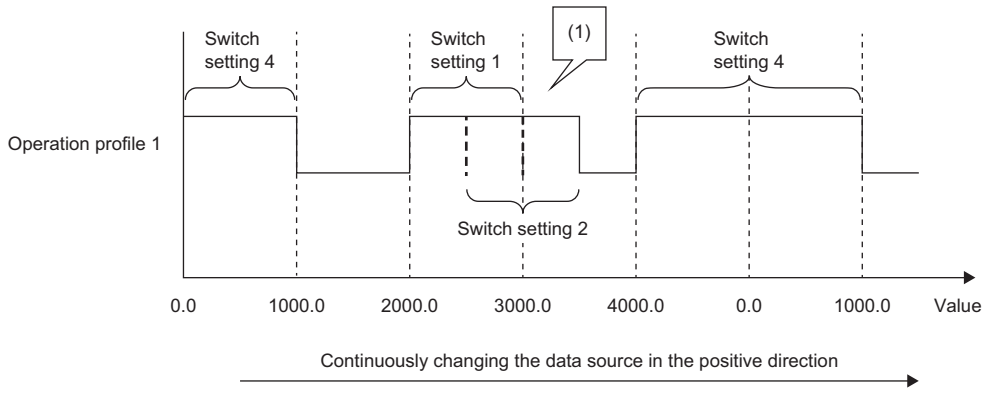
*1 Set ON Start Position (FirstOnPosition) and ON End Position (LastOnPosition) according to the range of the data source.
If ON Start Position (FirstOnPosition) and ON End Position (LastOnPosition) are set out of the range of the data source, the output signal cannot be output at the correct timing.

*2 If the data source is within an ON section when the FB starts, the output signal behaves as follows.
· If Direction selection (Direction) is either Positive direction or Negative direction, the output signal does not turn on until the data source moves.
· If Direction selection (Direction) is Both directions, the output signal turns on.

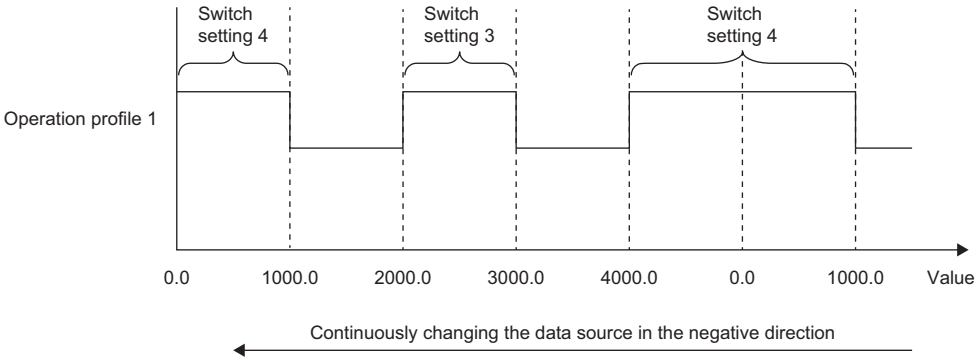
Ex.

The following is an example when the moving direction of the data source is constant (data source: ring counter data of 0.0 to 5000.0).

Operation profile data 1					
Setting item	**Switch setting 1**	**Switch setting 2**	**Switch setting 3**	**Switch setting 4**	**Switch setting 5**
ON Start Position (FirstOnPosition)	2000.0	2500.0	2000.0	4000.0	1500.0
ON End Position (LastOnPosition)	3000.0	3500.0	3000.0	1000.0	2000.0
Direction selection (Direction)	1: Positive direction	1: Positive direction	2: Negative direction	0: Both directions	0: Both directions
Switch mode selection (CamSwitchMode)	1: Position-based	1: Position-based	1: Position-based	1: Position-based	0: Switch disabled
ON time (Duration)	—	—	—	—	—

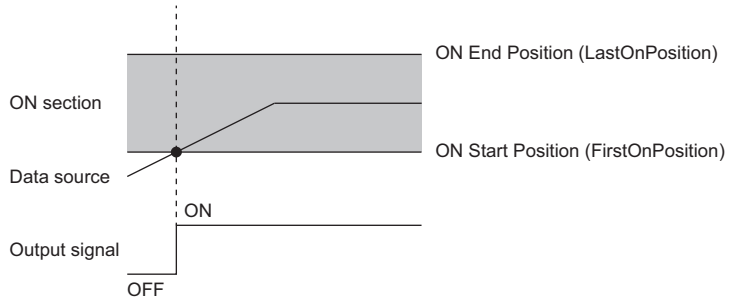


(1) If ON sections overlap, the logical sum of the output results of each switch setting is output.



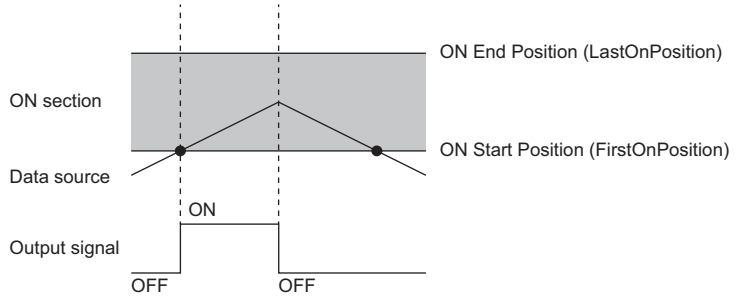
Ex.

The following is an example when the moving direction of the data source is not constant (the data source stops updating within an ON section).

Switch mode selection (CamSwitchMode)	Direction selection (Direction)	Operation
1: Position-based	1: Positive direction	Keeps the previous output signal. 

Ex.

The following is an example when the moving direction of the data source is not constant (the moving direction of the data source is reversed within an ON section).

Switch mode selection (CamSwitchMode)	Direction selection (Direction)	Operation
1: Position-based	1: Positive direction	The output signal turns off when the moving direction of the data source does not match Direction Selection (Direction). 

Time compensation

This function compensates the output timing of the output signal.

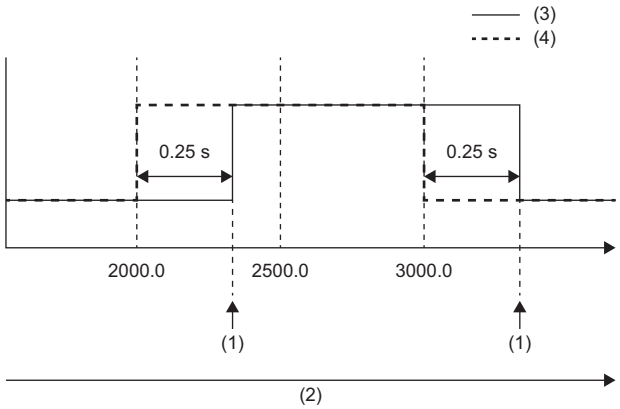
Set a positive value to delay the output timing of the output signal, and set a negative value to hasten it.

Compensation time = Outputs.Signal.CompensationTime

Ex.

When the items are set as follows:

Item	Setting value
FirstOnPosition	2000.0
LastOnPosition	3000.0
Direction	1: Positive direction
CamSwitchMode	1: Position-based
Compensation time	0.25



(1) Calculated position according to the speed of the data source
(2) The data source moves continuously in the positive direction
(3) With compensation time
(4) Without compensation time

Signal output timing

The following shows the timing of the output signal.

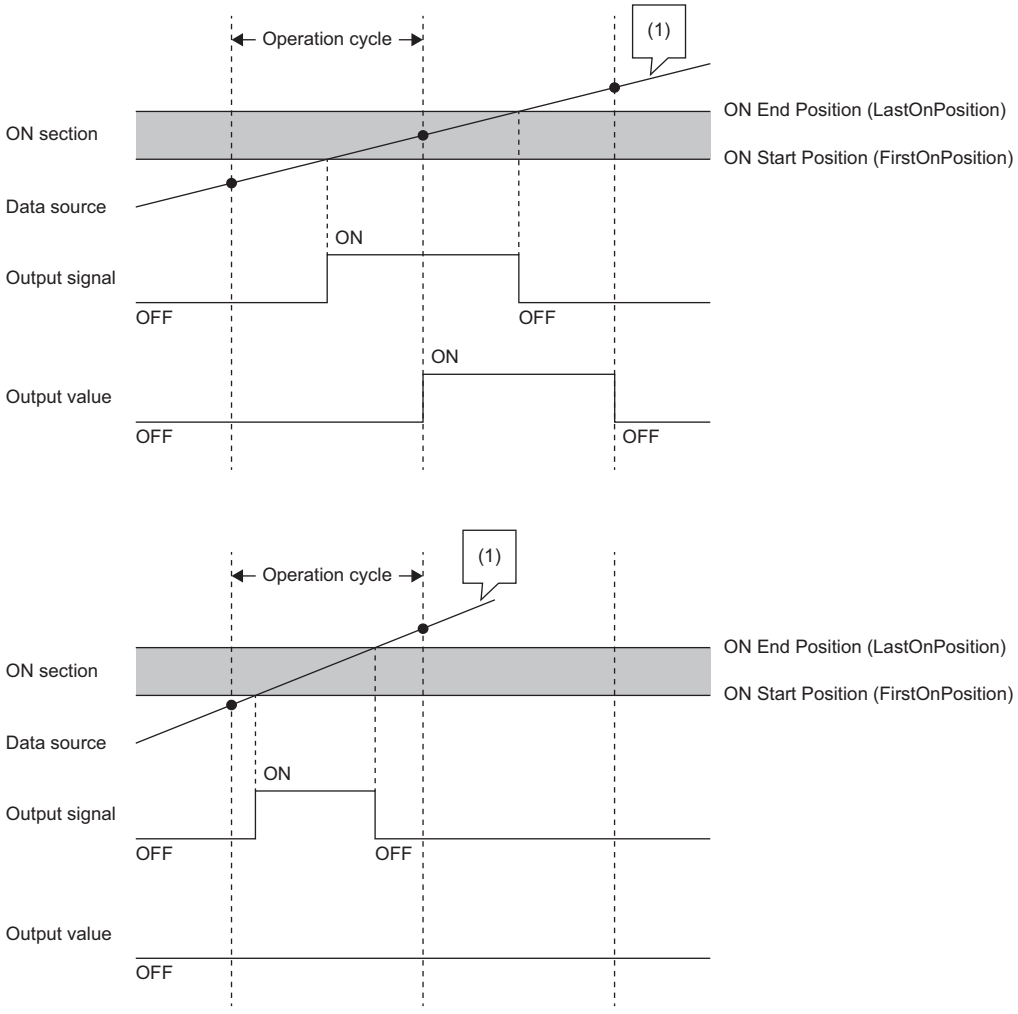
When external signal high-accuracy output is used

When external signal high-accuracy output is used, the signal is output at the accuracy of signal output time of the output device.

For the accuracy of signal output time, refer to the following.

☞ Page 1164 External Signal High-Accuracy Output

■Timing chart



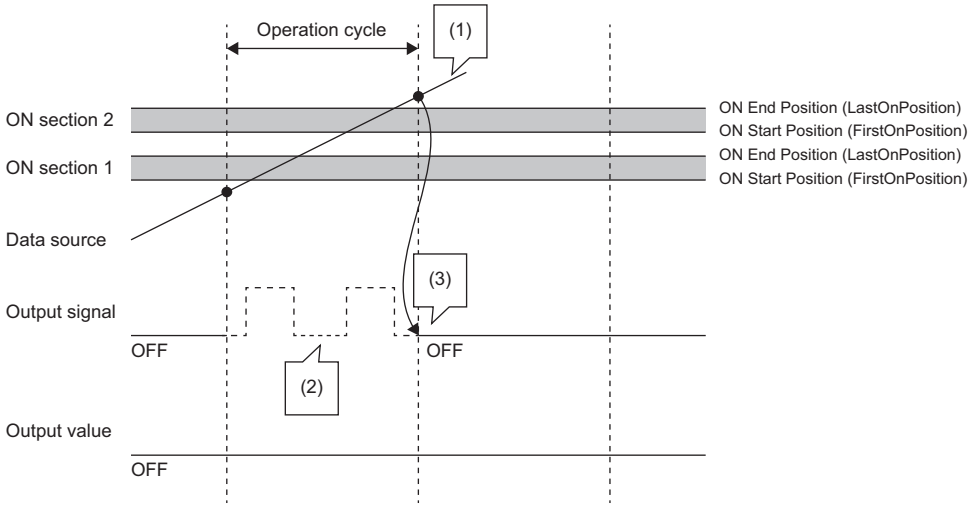
(1) Linearly interpolates the data source to be watched at operation cycle intervals.

Ensure that the data source does not pass through the ON sections of multiple switches within the same operation cycle. If the data source passes through the ON sections of multiple switches within the same operation cycle, the output signal cannot be output at the correct timing.

- The on timing and off timing (On time and Off time) within the cycle will be undefined.
- The on/off state of the output signal at the operation cycle intervals is guaranteed.

Ex.

When two ON output sections are passed through within the same operation cycle



(1) Linearly interpolates the data source to be watched at operation cycle intervals.
(2) The on/off timing within the operation cycle is undefined.
(3) The on/off state at the operation cycle intervals is guaranteed.

For the accuracy of signal output time, refer to the following.

☞ Page 1164 External Signal High-Accuracy Input

42.5 Precautions

- If Switches or TrackOptions is changed during execution, the output signal may turn on or off immediately because the change is immediately reflected to the control in the operation cycle.
- Rewriting the open area during FB execution using MCv_WriteProfileData (Profile Write) may cause an unexpected result (on/off) of the output signal. Therefore, do not rewrite the open area during FB execution. To change switch settings during FB execution, change Switches.
- When the output of MC_DigitalCamSwitch is used for other functions, at least one operation cycle may be delayed. Adjust the on/off timing of the output signal using Outputs.CompensationTime as appropriate.
- Ensure that the data source does not pass through the ON sections of multiple switches within the same operation cycle. If the data source passes through the ON sections of multiple switches within the same operation cycle, the output signal cannot be output at correct timing. For details on the output signal, refer to the following.

☞ Page 1183 Signal output timing

- Match the refresh cycle of the data source with that of the output signal. If their refresh cycles are different, an MC_DigitalCamSwitch instruction error (error code: 1BCAH) occurs.

Relevant add-ons

The following add-ons are required to use this function.

- ProfileControl
- SignalIO

43 AXIS EMULATION

This function performs axis control on the real axis without connecting any device station.
When using the emulate function, the axis can be virtually operated as if the device station is connected, even if it is not actually connected. This function enables the user to debug the user program at the start-up of the device or verify the positioning operation.
The emulate function can be used on the real drive axis.
Emulate function simulates the cyclic transmissions and transient transmissions of the device station. The operations unique to the device station can be simulated by installing emulate models corresponding to each device station as add-ons.

Point

During axis emulation, the servo amplifier is in the Pre-Operational state. The content of the network label is not reflected to the servo amplifier on the sending side and all content becomes 0 on the receiving side.
As the axis on which emulation is being performed does not update or refer to the network label, the network label cannot be used as described below.

- Change the network label values using a user program or other program and send commands to the axis on which emulation is being performed.
- Refer to the network label and check the feedback of the axis on which emulation is being performed.

When emulation is enabled on some axes of the multi-axis amplifier (MR-J5(W)-G), other axes in the same amplifier will also enter the Pre-Operational status, preventing control on the amplifier or motor. To control the amplifier and motor, configure the amplifier settings so that axes to be emulated are disabled. (Example: When emulation is only enabled on the C axis, the A and B axes will also enter the Pre-Operational status, preventing control. To control the A and B axes, configure the amplifier settings so that the C axis is disabled.)
For how to disable some axes of the multi-axis amplifier, refer to the following.
☞ Page 2156 Method for setting (LSP/LSN/DOG) input to the MR-J5(W)-G to the upper limit/lower limit and home position switch of the motion system

Emulate function can be used according to the following classification.
○: Operation possible, ×: Operation impossible

Module operation mode setting	Emulate function Switches valid/invalid	Start up as an emulate axis
Online mode*1	○	○
Offline mode	×	×

*1 For details, refer to the following.
☞ Page 151 Application Settings

Operation of this function for each system status

○: Available, ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

43.1 Relevant Variables

Axis parameter constant (AxisName.PrConst.)

Variable/structure name	Name	Details
SlaveEmulate_Enable	Axis Emulation Enabled	Sets whether the axis is used as an emulate axis. • FALSE: Disabled • TRUE: Enabled

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
SlaveEmulate_Enable	Axis Emulating	Becomes TRUE when driver emulate operation is in execution. • FALSE: Disabled • TRUE: Enabled

43.2 Setting Procedure

This section describes the procedure to configure the emulate setting of the real drive axis.

1. Set the real drive axis in the engineering tool, and start up the motion system.
2. Set the real drive axis to use it as the emulate axis in the engineering tool.

43.3 Operation During Emulate Function

The emulate function operation follows the axis parameter setting. Depending on the setting of Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable), the values of the set position and the machine feed value at connection are as shown below.

Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable)	Values of the set position and the machine feed value at connection
-1: Automatic Setting (Acquire from Connected Device) (Auto)	Both the cumulative current position and the machine feed value are "0". (The set position is according to the ring counter setting)
0: Disable Absolute Position System (ABSDisabled)	
1: Enable Absolute Position System (Enabled)	When the home position has been established, the addresses remain when the module power was disconnected most recently. When the home position has not been established, both the cumulative current position and the machine feed values are "0". (The set position is according to the ring counter setting) When a drive unit other than the MELSERVO is used, if Axis Emulation Enabled (AxisName.PrConst.SlaveEmulate_Enable) is switched, the absolute position will be erased at system start.

43.4 Specifications of the Emulated Device Station

While the emulate function is valid, the following types of the servo amplifier and servo motor are virtually connected.

Servo amplifier type	Servo motor type
MR-J5-10G	HK-KT13W

The following are the specifications of the emulated MR-J5(W)-G.

Function		Support	Description
Reception check	WDC check	×	Reception WDC (controller → device station) is not checked.
PDO-related	Emulation of feedback	○	Simulates feedback of MR-J5(W)-G. For details, refer to the following. ☞ Page 1188 Feedback data specifications
	Variable mapping	×	When the emulate function is valid, the default mapping of MR-J5(W)-G is used. For the default mapping, refer to MR-J5(W)-G manuals.
SLMP-related	Response data simulation	×	SLMP communication simulation is not supported.
Servo alarm-related	Servo alarm [AL. 035 Command frequency error] detection	○	Simulates servo alarm [AL. 035 Command frequency error] detection
	Alarm reset	○	Simulates alarm reset. (A delay to deactivate the alarm does not occur. The alarm is deactivated immediately.)
Motor type	Standard rotary type	○	Standard motor of MR-J5 (HK-KT13W) is available. A speed unit of the servo amplifier is fixed to 0.01 [r/min].
Operation mode	csp	○	Position control operation by the cyclic synchronous position mode (csp) is available.
	csv	○	Velocity control operation by the cyclic synchronous velocity mode (csv) is available.
	cst	○	Torque control operation by the cyclic synchronous torque mode (cst) is available.
	hm	○	Homing by the homing mode (hm) is available. The homing method supports the driver homing method (data set method) only.
	ct	○	Continuous operation to torque control by the continuous operation to torque control mode (ct) is available. (The operation is the same as cst.)
	cspr	×	Pressure control by cspr is not supported.
External signal-related	FLS	○	• Input via the controller is only available. (Stop operation of the device station when the FLS is off is not simulated. By FLS detection, the command from the controller stops and the servo motor stops as well.) • For input via the servo amplifier, the input value is always off.
	RLS	○	• Input via the controller is only available. (Stop operation of the device station when the RLS is off is not simulated. By RLS detection, the command from the controller stops and the servo motor stops as well.) • For input via the servo amplifier, the input value is always off.

Feedback data specifications

No.	Object name	Object detail	Support	Remarks
1	1D02h/01h: Watch dog counter UL	—	○	—
2	6061h/00h: Modes of operation display	—	○	—
3	6064h/00h: Position actual value	—	○	The value is always the same as the value of Target position.
4	606Ch/00h: Velocity actual value	—	○	—
5	60F4h/00h: Following error actual value	—	○	The value is always 0.
6	6041h/00h: Statusword	—	○	—
7	6077h/00h: Torque actual value	—	○	• The value is always 0 when set to a mode other than cst or ct. • The value is always the same as the value of Target torque.
8	2A41h/00h: Current alarm	—	○	—

43.5 Precautions

- When executing the all axes emulate switching, it takes time to complete.
- If a motor is rotated with the device station actually connected in emulation enabled state, when it is switched to emulation disabled, the position information of the axis is restored as if it moved from the position it reached during emulation enabled to the position of the connected device station during power-off.
- In the emulation being disabled, when the device station is used with the setting in which Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) is "-1: Automatic Setting (Acquire from Connected Device) (Auto)" and the connected device is used in the setting of Enable Absolute Position System, change to "1: Enable Absolute Position System (Enabled)" before switching emulation to enabled. When the emulation is enabled, "-1: Automatic Setting (Acquire from Connected Device) (Auto)" becomes "0: Disable Absolute Position System (ABSDisabled)", therefore the absolute position is erased next time the emulation is switched to disabled.
- When the add-on ServoDriver_CANopen is enabled and the add-on NetworkDriver_CCIETSN is disabled, the axis always starts in the emulation enabled state.

Relevant add-on

The following add-on is required to use this function.

- ServoDriver_CANopen

44 AXIS CONTROL WAIT

This function immediately starts the axis operation of the multiple-started motion FBs at the input timing of the execution permission signal.

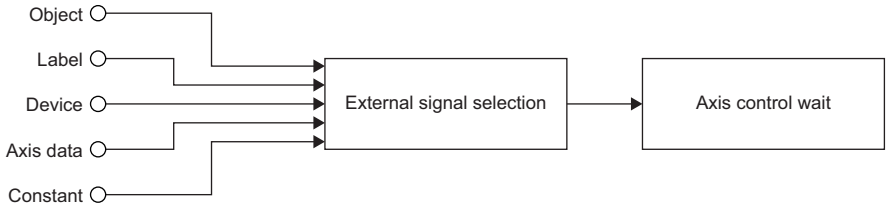
Operation of this function for each system status

○: Available, ×: Not available

System status	Function operation
STOP	×
RUN	○
Moderate error	×
Major error	×

44.1 Overall Block Diagram

The relationship between the axis control wait and other functions is shown below.



44.2 Relevant Variables

Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
AxisStatus	Axis status	Displays the current axis status. • -1: Axis variable uninitialized/Axis parameter error (Invalid) • 0: Axis disabled (Disabled) • 1: Stopping on error (ErrorStop) • 2: Decelerating to stop (Stopping) • 3: During homing (Homing) • 4: Standby (Standstill) • 5: During positioning operation (DiscreteMotion) • 6: During continuous operation (ContinuousMotion) • 7: During synchronous operation (SynchronizedMotion)

Axes group monitor data (AxesGroupName.Md.)

Variable/structure name	Name	Details
GroupStatus	Axes group status	Displays the current axes group status. • -1: Axes group variable not initialized/Axes group parameter error (Invalid) • 0: Axes group disabled (GroupDisabled) • 1: Stopping on error (GroupErrorStop) • 2: Decelerating to stop (GroupStopping) • 4: Standby (GroupStandby) • 5: Operating (GroupMoving)

44.3 Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_MoveWait	Axis control start wait	Immediately starts the axis operation of the multiple-started single-axis control FBs at the input timing of the execution permission signal.
MCv_GroupMoveWait	Axis group control start wait	Immediately starts the axis group operation of the multiple-started multi-axis control FBs at the input timing of the execution permission signal.

44.4 Axis Control Start Wait

While MCv_MoveWait (axis control start wait) is running, performing multiple starts of other motion FBs will enable the FBs to perform up to analysis, but will wait until ExecutionPermission (execution permission signal) is input.

Until ExecutionPermission (execution permission signal) is input, Axis Status (AxisName.Md.AxisStatus) is "6: During continuous operation (ContinuousMotion)".

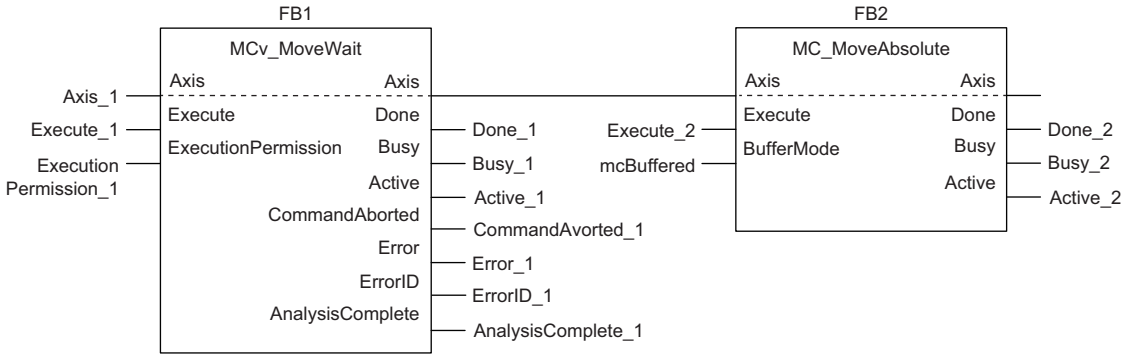
When ExecutionPermission (execution permission signal) is input, the multiple-started FBs are executed one operation cycle after the signal input is detected.

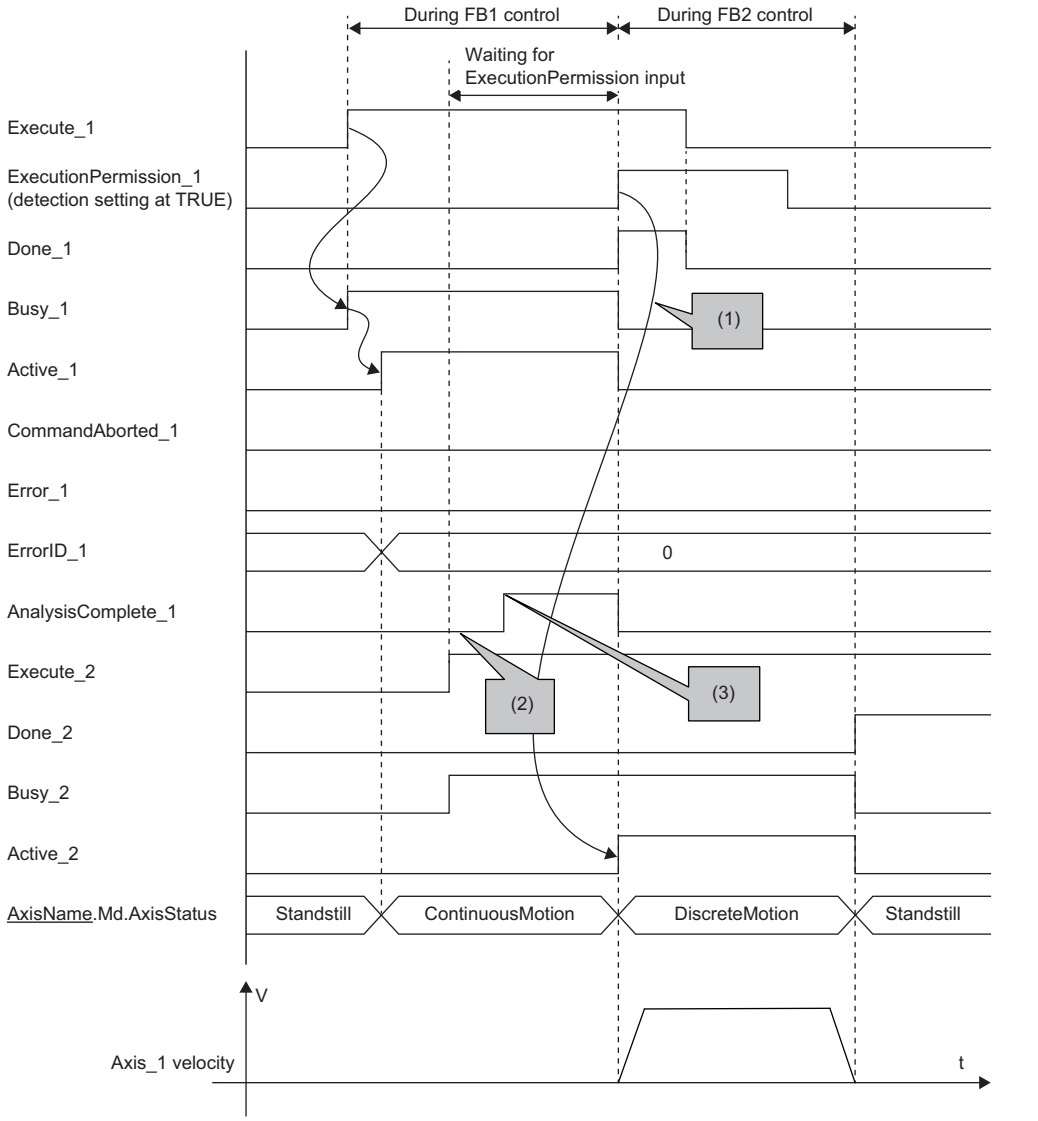
At this time, Axis Status (AxisName.Md.AxisStatus) transitions to the state corresponding to the multiple-started FBs.

After AnalysisComplete (analysis completed) becomes TRUE, input ExecutionPermission (execution permission signal).

Timing chart

When the processing is completed successfully





(1) FB2 starts one operation cycle after ExecutionPermission input is detected.
(2) Analysis of FB2 in progress
(3) Analysis of FB2 completed

When the processing is completed with an error

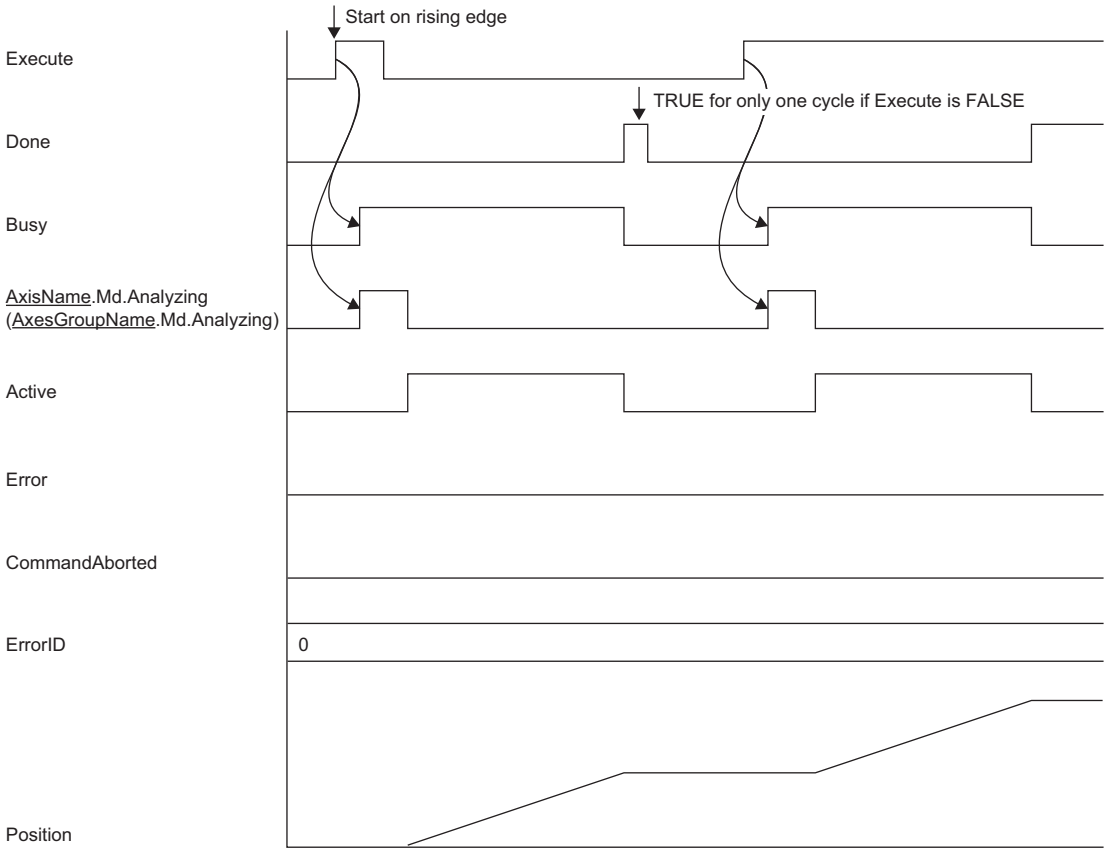
- Execution command (Execute) type FBs read the input parameters at the rising edge of the Execution command (Execute) and then start the operation. Once the operation has started, it continues until it completes even if Execute is set to FALSE.
- When the operation starts, only one output among Busy, Done, Error, and CommandAborted becomes TRUE.
- Done, Error, ErrorID, and CommandAborted are reset at the falling edge of Execute. Busy and Active are not affected.
- When the input parameters are changed during the operation, the change is reflected at restart (retrigger) of Execute or by continuous update using the ContinuousUpdate input. For details, refer to the following.

☞ Page 546 Retrigger/Continuous Update

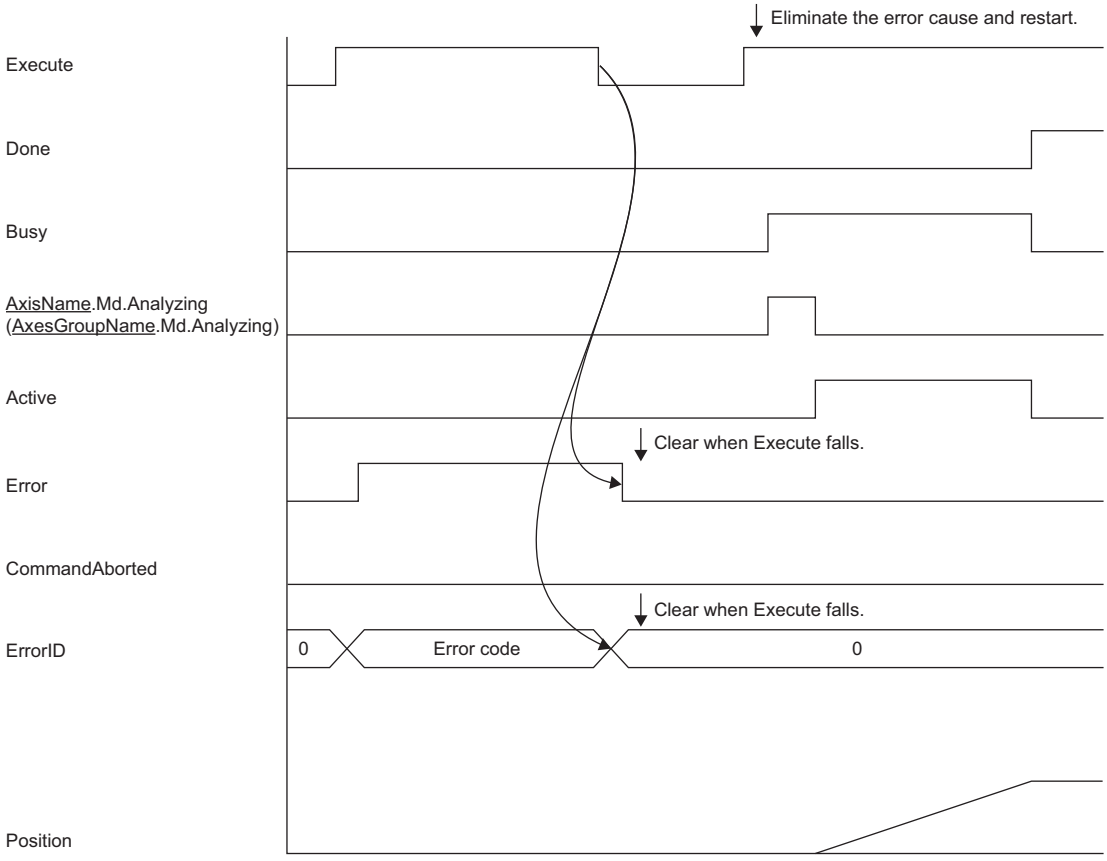
- AxisName(AxesGroupName).Md.Analyzing becomes TRUE from the rising edge of Busy, and AxisName(AxesGroupName).Md.Analyzing becomes FALSE after starting the operation.
- When Execute is used in pulse, Done becomes TRUE for one cycle only.
- Output variables not listed above are not affected by the falling edge of Execute while they continue to operate. If Execute is FALSE when the operation is completed, they will be reset upon completion. If Execute is TRUE when the operation is completed, they will be reset when Execute becomes FALSE. (In either case, the reset timing is the same as Done, Error, or CommandAborted.)

A typical operation of an Execute type FB is shown below.

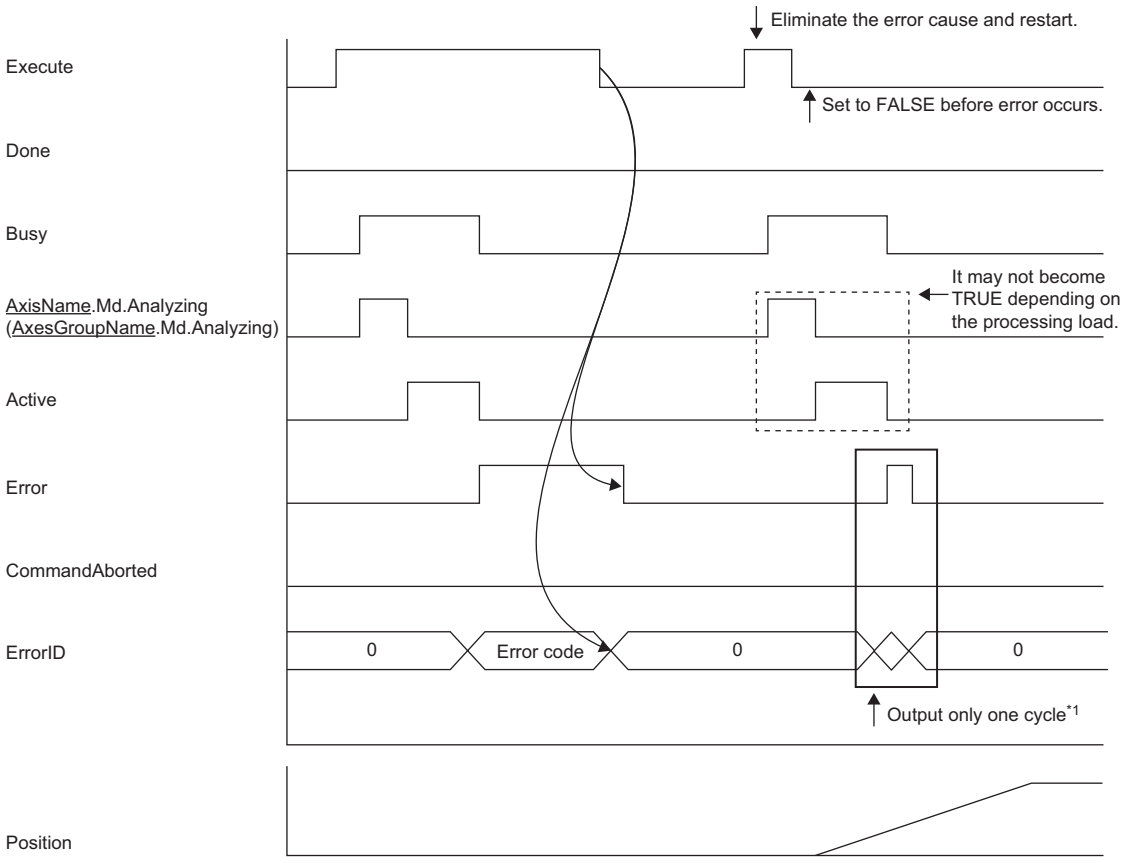
[Normal operation]



[When the I/O variables are abnormal]



[When the input variables are abnormal]



*1 The following operation is performed when the termination condition of the FB (Execute: FALSE) is met.
For FBs not related to the axis or FBs which do not stop with decelerating, Error becomes TRUE for one cycle only and ErrorID is output.
For FBs that need to perform a deceleration stop, Error becomes TRUE and ErrorID is maintained until the axis decelerates to a stop.
Error becomes FALSE and ErrorID is cleared when the axis stops.

Execution permission signal

ExecutionPermission (execution permission signal) is a signal used to cancel MCv_MoveWait (axis control start wait). Specify it using the MC_INPUT_REF structure.

The setting range of ExecutionPermission.Signal is shown below.

Item	Setting range
Source.Target*1	■Specifiable type BOOL ■Available data types • [VAR] • [DEV] • [CONST] • [OBJ]
Detection	• HighLevel • LowLevel
CompensationTime*2	-5.0 to 0.0 [s]
FilterTime	0 to 5.0 [s]

*1 External signal high-accuracy input cannot be used. When a signal for external signal high-accuracy input is specified, it operates with the same accuracy as a normal signal.

*2 If a value smaller than one operation cycle is specified for the compensation time (ExecutionPermission.Signal.CompensationTime), it will operate as 0.0 (no compensation).

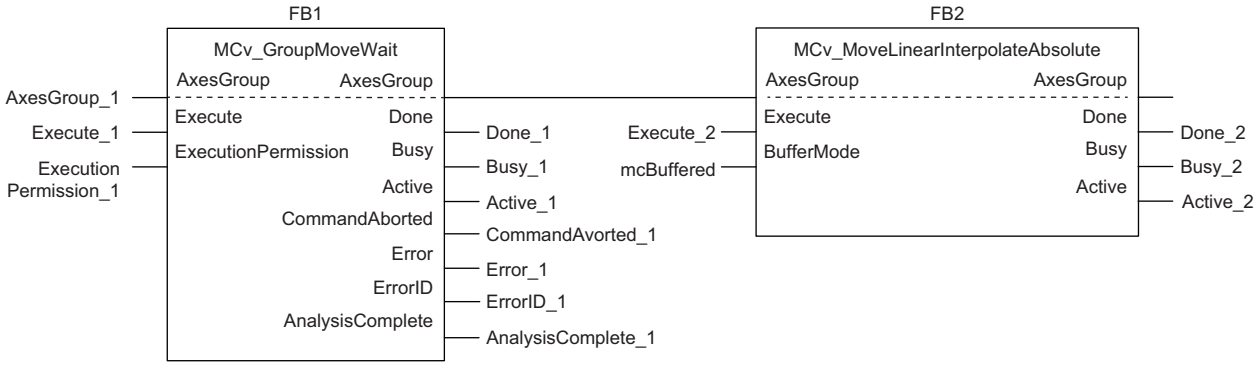
- When [OBJ] is specified, if the target modification is omitted, the object of the axis (Axis) will be referred to. However, if the axis (Axis) does not have a station address or the station address is not set, External signal selection incorrect (error code: 1B31H) will be output.
- When [OBJ] is specified, if the Axis Emulate function is enabled and a station address is set for the referred station, the emulating object will be referred to.
- When compensating the advance of ExecutionPermission (execution permission signal), to adjust the execution timing of multiple started motion FBs, set the compensation time (ExecutionPermission.Signal.CompensationTime).
- To prevent false signal detection due to chattering of ExecutionPermission (execution permission signal), set the filter time (ExecutionPermission.Signal.FilterTime).
- When a signal that is unavailable for ExecutionPermission.Signal.Source.Target is used, one of the following error codes will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H or 1B32H), or Add-on Signal IO internal error (error code: 1B33H).

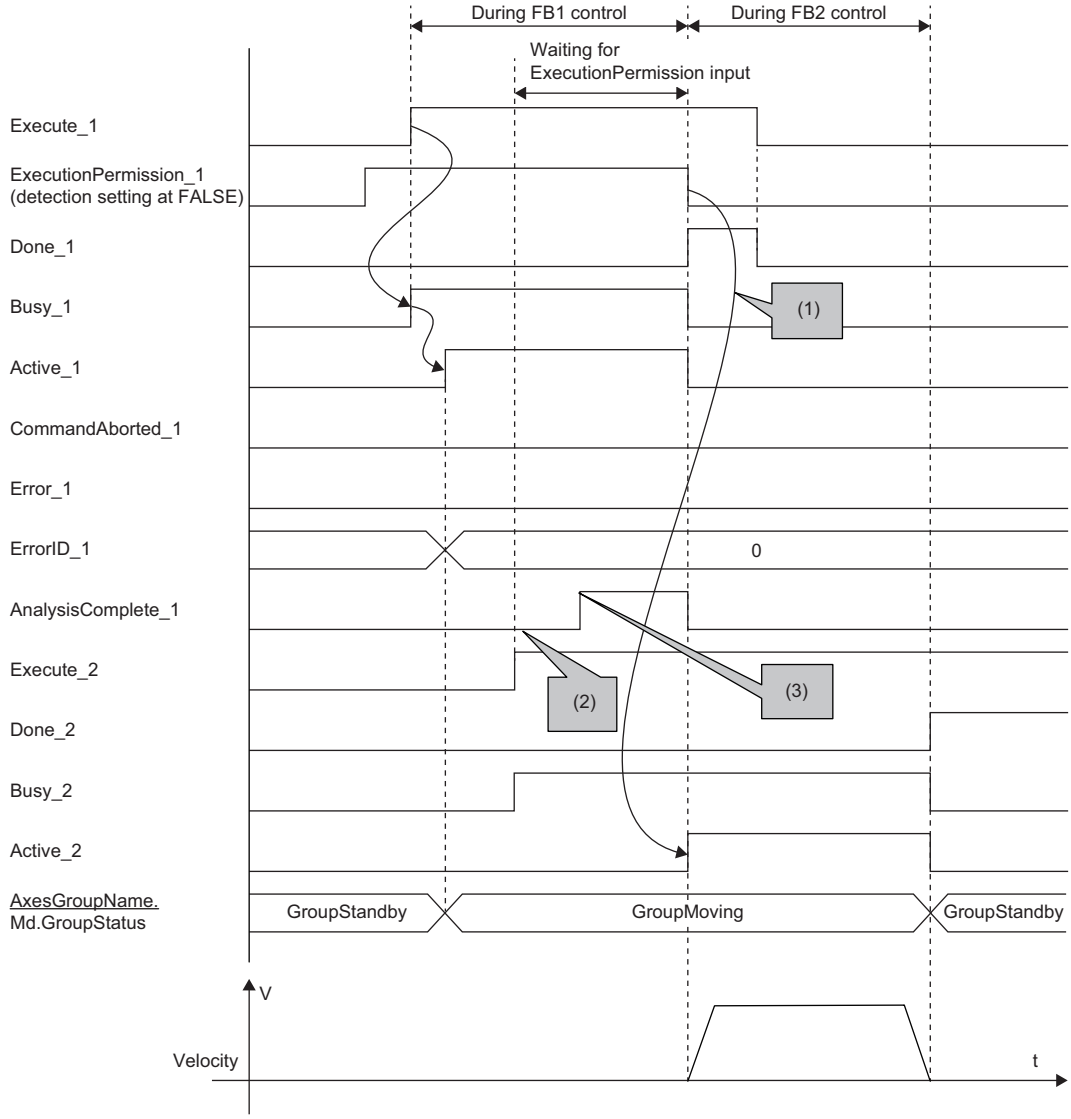
44.5 Axis Group Control Start Wait

While MCv_GroupMoveWait (axis group control start wait) is running, performing multiple starts of other motion FBs will enable the FBs to perform up to analysis, but will wait until ExecutionPermission (execution permission signal) is input.
At this time, Axes Group Status (AxesGroupName.Md.GroupStatus) becomes "5: In Operation (GroupMoving)".
When ExecutionPermission (execution permission signal) is input, the multiple-started FBs are executed one operation cycle after the signal input is detected.
After AnalysisComplete (analysis completed) becomes TRUE, input ExecutionPermission (execution permission signal).

Timing chart

When the processing is completed successfully





(1) FB2 starts after one operation cycle when ExecutionPermission input is detected.
(2) Analysis of FB2 in progress
(3) Analysis of FB2 completed

When the processing is completed with an error

Refer to the following.

☞ Page 1193 When the processing is completed with an error

Execution permission signal

ExecutionPermission (execution permission signal) is a signal used to cancel MCv_GroupMoveWait (axis group control start wait).

Specify it using the MC_INPUT_REF structure.

The setting range of ExecutionPermission.Signal is shown below.

Item	Setting range
Source.Target*1	■Specifiable type BOOL ■Available data types • [VAR] • [DEV] • [CONST] • [OBJ]
Detection	• HighLevel • LowLevel
CompensationTime*2	-5.0 to 0.0 [s]
FilterTime	0 to 5.0 [s]

*1 External signal high-accuracy input cannot be used. When a signal for external signal high-accuracy input is specified, it operates with the same accuracy as a normal signal.

*2 If a value smaller than one operation cycle is specified for the compensation time (ExecutionPermission.Signal.CompensationTime), it will operate as 0.0 (no compensation).

- When [OBJ] is specified, if the target modification is omitted, External signal selection incorrect (error code: 1B31H) will be output.
- When [OBJ] is specified, if the Axis Emulate function is enabled and a station address is set for the referred station, the emulating object will be referred to.
- When compensating the advance of ExecutionPermission (execution permission signal), to adjust the execution timing of multiple started motion FBs, set the compensation time (ExecutionPermission.Signal.CompensationTime).
- To prevent false signal detection due to chattering of ExecutionPermission (execution permission signal), set the filter time (ExecutionPermission.Signal.FilterTime).
- When a signal that is unavailable for ExecutionPermission.Signal.Source.Target is used, one of the following error codes will be output: External signal selection string incorrect (error code: 1B05H), External signal selection incorrect (error code: 1B31H or 1B32H), or Add-on Signal IO internal error (error code: 1B33H).

44.6 Program Example

Setting Execute (control start) to TRUE analyzes and puts MC_MoveRelative (Relative Value Positioning) and MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) on standby, and setting ExecutionPermission (execution permission signal) to TRUE can start the FBs in standby at the same time.

Setting

■Axis

Axis No.	Label name	Data type	Comment
1	Axis0001	AXIS_REAL	Axis 1
2	Axis0002	AXIS_REAL	Axis 2
3	Axis0003	AXIS_REAL	Axis 3

■Axes group

Axes group No.	Label name	Data type	Comment
1	AxesGroup001	AXES_GROUP	Axes group 1

Item	Setting value
Configuration Axis[1]	Axis0002
Configuration Axis[2]	Axis0003

■I/O data

Label name	Data classification	Data type	Source type	Source	Signal detection method	Compensation time	Filter time
SignalData0001	Input Signal	MC_INPUT_REF	Label	bExecutionPermission	HighLevel	0.0	0.0

■Labels used

Label name	Data type	Comment
bExecute	Bit	Control start
bExecutionPermission	Bit	Execution permission signal
MCv_MoveWait_1	MCv_MoveWait	Axis Control Start Wait FB
MC_MoveRelative_1	MC_MoveRelative	Relative Value Positioning FB
MCv_GroupMoveWait_1	MCv_GroupMoveWait	Axis Group Control Start Wait FB
MCv_MoveLinearInterpolateRelative_1	MCv_MoveLinearInterpolateRelative	Relative Value Linear Interpolation Control FB
wMoveLinearInterpolateRelativeLinearAxes	Word [signed] (0..15)	Linear interpolation axis
leMoveLinearInterpolateRelativePosition	Double-precision real number (0..15)	Target position

Program

ST programs are shown below.

```
SET( MCv_MoveWait_1.Active , bMoveRelativeExecute );
SET( MCv_GroupMoveWait_1.Active , bMoveLinearInterpolateRelativeExecute );
RST( NOT bExecute , bMoveRelativeExecute );
RST( NOT bExecute , bMoveLinearInterpolateRelativeExecute );
//-----Axis Control Start Wait-----
MCv_MoveWait_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Relative Value Positioning-----
MC_MoveRelative_1(
    Axis:= Axis0001.AxisRef ,
    Execute:= bMoveRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    Distance:= 10000.0 ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);
//----- Axis Group Control Start Wait-----
MCv_GroupMoveWait_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bExecute ,
    ExecutionPermission:= SignalData0001 ,
    Options:= H00000000
);
//-----Data setting for Relative Value Linear Interpolation Control-----
wMoveLinearInterpolateRelativeLinearAxes[0] := 1;
wMoveLinearInterpolateRelativeLinearAxes[1] := 2;
leMoveLinearInterpolateRelativeDistance[0] := 10000.0;
leMoveLinearInterpolateRelativeDistance[1] := 10000.0;
//-----Relative Value Linear Interpolation Control-----
MCv_MoveLinearInterpolateRelative_1(
    AxesGroup:= AxesGroup001.AxesGroupRef ,
    Execute:= bMoveLinearInterpolateRelativeExecute ,
    ContinuousUpdate:= FALSE ,
    LinearAxes:= wMoveLinearInterpolateRelativeLinearAxes ,
    Distance:= leMoveLinearInterpolateRelativeDistance ,
    Velocity:= 1000.0 ,
    Acceleration:= 1000.0 ,
    Deceleration:= 1000.0 ,
    Jerk:= 0.0 ,
    VelocityMode:= MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
    BufferMode:= MC_BUFFER_MODE__mcBuffered ,
    Options:= H00000000
);
```

44.7 Precautions

- After AnalysisComplete (analysis completed) becomes TRUE, input ExecutionPermission (execution permission signal). Even if the input of ExecutionPermission (execution permission signal) is detected in the state where there are no multiple started motion FBs or the analysis is not completed (AnalysisComplete is FALSE), Done (execution completed) does not become TRUE.
- After Active of MCv_MoveWait (axis control start wait) or MCv_GroupMoveWait (axis group control start wait) becomes TRUE, multiple start the motion FBs. If an error occurs during execution of MCv_MoveWait (axis control start wait) or MCv_GroupMoveWait (axis group control start wait), there is a possibility that multiple started motion FBs will be executed without waiting for the input of ExecutionPermission (execution permission signal).
- When the operation cycle coexistence function is used, set the operation cycle of the target axis for MCv_MoveWait (axis control start wait) or MCv_GroupMoveWait (axis group control start wait) to be the same as the refresh cycle for ExecutionPermission (execution permission signal). If the refresh cycles are different, the positioning start timing may vary.
- When starting axes with different operation cycles at the same time, the start timing of the axes may deviate by one operation cycle. Therefore, set the operation cycles of the axes to be the same. To start axes with different operation cycles at the same time, adjust ExecutionPermission.Signal.CompensationTime (compensation time) using multiple ExecutionPermissions (execution permission signal) with the same signal name (ExecutionPermission.Signal.Source.Target) and signal logic (ExecutionPermission.Signal.Detection).

Axis control start wait

- When executing MCv_MoveWait (axis control start wait), check that Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)". If Axis Status (AxisName.Md.AxisStatus) indicates that the axis cannot be started, Start not possible (error code: 1AFCH) will occur and control during operation will stop. If MCv_MoveWait (axis control start wait) is started while another motion FB is running, the start request will be ignored and Start during Operation Warning (event code: 00D01H) will occur.
- Set Buffered for the buffer mode (BufferMode) of the multiple started motion FBs. If Aborting is set and multiple motion FBs are started, MCv_MoveWait (axis control start wait) is interrupted and the multiple started motion FBs are immediately executed. (The input state of ExecutionPermission (execution permission signal) is ignored.) If Blending is set and multiple motion FBs are started, BufferMode specification disabled (error code: 1AE5H) will occur.

Axis group control start wait

- When executing MCv_GroupMoveWait (axes group control start wait), check that Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)". If Axis Group Status (AxesGroupName.Md.GroupStatus) indicates that the axis cannot be started, Start not possible (error code: 1AFCH) will occur and control during operation will stop. If MCv_GroupMoveWait (axes group control start wait) is started while another motion FB is running, the start request will be ignored and "Start during Operation Warning (event code: 00D01H)" will occur.
- Set Buffered for the buffer mode (BufferMode) of the multiple started motion FBs. If Aborting is set and multiple motion FBs are started, MCv_GroupMoveWait (axis group control start wait) is interrupted and the multiple started motion FBs are immediately executed. (The input state of ExecutionPermission (execution permission signal) is ignored.) If Blending is set and multiple motion FBs are started, BufferMode specification disabled (error code: 1AE5H) will occur.

Relevant add-ons

The following add-ons are required to use this function.

- MotionControl_General
- MotionControl_Engine
- SignalIO
- Axis
- ServoDriver_CANopen*1

*1 For using the signal type [OBJ] of the external signals

45 PROGRAM EXAMPLES

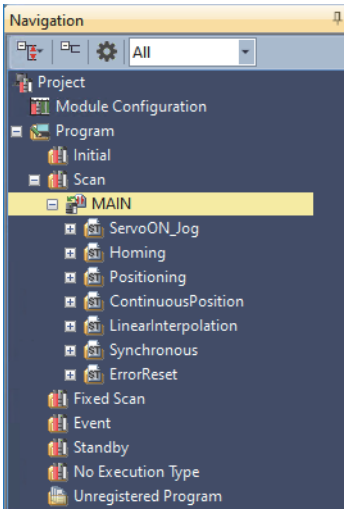
This chapter describes program examples for using motion control.

45.1 Project Structure

Program name

The following shows the program examples created in this section.

The programs are created under the "Program" ⇨ "Scan" ⇨ "MAIN" tree.

Navigation window display	Program name	Description	Reference
	ServoON_Jog	PLC READY	Page 1204 PLC READY (Program Name: ServoON_Jog)
		All axes servo ON	Page 1204 Servo ON (Program Name: ServoON_Jog)
		JOG operation	Page 1205 JOG Operation (Program Name: ServoON_Jog)
	Homing	Homing	Page 1209 Homing (Program Name: Homing)
	Positioning	Single axis positioning	Page 1211 Single Axis Positioning Control (Program Name: Positioning)
	ContinuousPositioning	Single axis continuous positioning	Page 1213 Single Axis Continuous Positioning (Program Name: ContinuousPositioning)
	LinearInterpolation	Two-axis linear interpolation control	Page 1217 Interpolation Control (Program Name: LinearInterpolation)
	Synchronous	Synchronous control	Page 1223 Synchronous Control (Program Name: Synchronous)
	ErrorReset	Error reset	Page 1232 Error Reset (Program Name: ErrorReset)

45.2 PLC READY (Program Name: ServoON_Jog)

This program prepares for motion control.

Program example

The servo ON signal (G_bSRVONCMD) is turned on after the controller is powered on and PLC READY (MotionSystem.Cd.SequenceReady) and Built-in Motion Ready [X20] are turned on.

ST program

```
//----PLC READY ON----
G_bSRVONCMD := (X20 AND MotionSystem.Cd.SequenceReady) AND NOT(G_bSRVOFF);
```

Point

For conditions where PLC READY (MotionSystem.Cd.SequenceReady) becomes TRUE/FALSE, refer to the following.

☞ Page 544 Conditions of TRUE/FALSE status

45.3 Servo ON (Program Name: ServoON_Jog)

This program performs servo ON for the real drive axes connected to the servo system.
There are two FBs that are used for servo ON: MCv_AllPower, which performs servo ON for all axes, and MC_Power, which performs servo ON for each individual axis.

FBs used

Type	FB	Description
Administrative	MC_Power	Switches a specified axis to the operation available status.
	MCv_AllPower	Switches every axis to the operation available status.

Local label

	Label Name	Data Type		Class
1	MCv_AllPower_1	MCv_AllPower	...	VAR

No.	Description
(1)	This label is automatically added when the user drags and drops the FB (MCv_AllPower) onto the program editor.

Program example

The servo ON signal, G_bSRVONCMD, is used as the all-axes servo ON signal. When executing servo OFF, turn on "G_bSRVOFF".

ST program

```
//----All axes servo ON----
MCv_AllPower_1(
//Axis:= ?AXIS_REF? ,
    Enable := TRUE ,
    ServoON := G_bSRVONCMD //Servo ON
//Busy=> ?BOOL? ,
//Error=> ?BOOL? ,
//ErrorID=> ?WORD?
);
```

45.4 JOG Operation (Program Name: ServoON_Jog)

The servo system outputs commands to a target axis and the axis moves in a specified direction while the JOG positive/reverse rotation commands are input.

FB used

Type	FB	Description
Motion	MCv_Jog	Executes JOG operation according to the command velocity.

Acceleration/deceleration processing function

This function adjusts the acceleration/deceleration of the motion control to the acceleration/deceleration curve suitable for the device.

■Overview

There are two acceleration/deceleration methods.

Acceleration/deceleration method	Description
Acceleration/deceleration specification method (Initial value)	Accelerates/decelerates the axis by the acceleration, deceleration, and jerk values specified in the FB.
Acceleration/deceleration time-fixed method	Accelerates/decelerates the axis based on the time specified in the FB regardless of the velocity.

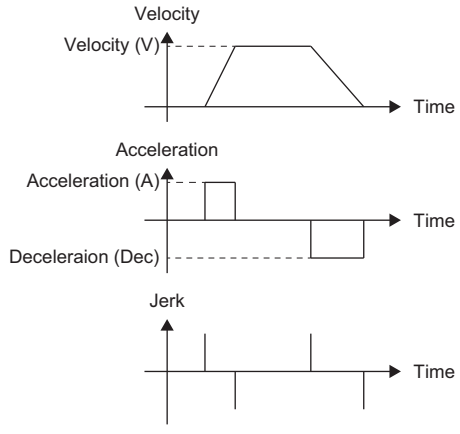
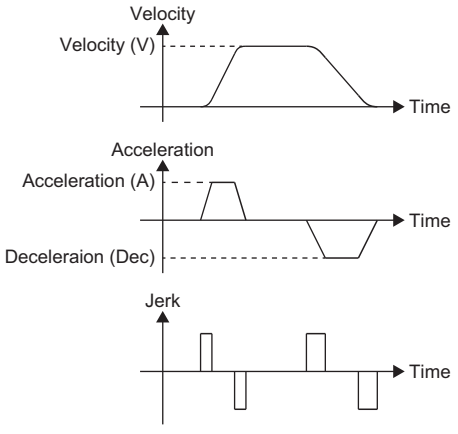
■Setting method

The acceleration/deceleration method can be set with the value input in Options of the motion control FBs, such as MCv_Jog, which belong to the motion group.

Bit	Name	Description
0 to 2	Acceleration/deceleration method setting	0: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime)
3 to 31	The function varies depending on the FB.	

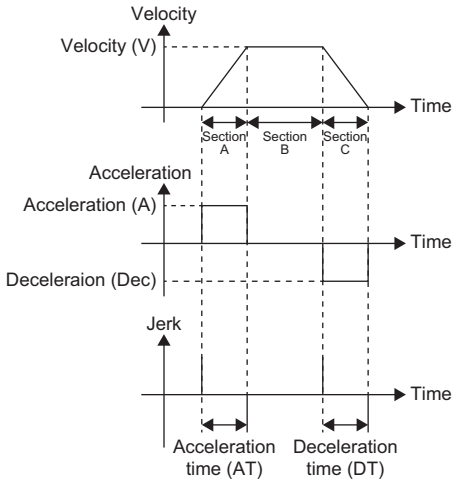
■Acceleration/deceleration specification method

Select "0: Acceleration/deceleration specification method (mcAccDec)" in Acceleration/deceleration method setting (Options: Bit 0 to 2) of the FB, and set the Acceleration, Deceleration, and Jerk inputs.

Trapezoidal acceleration/deceleration	Jerk acceleration/deceleration
When "0.0" is set for the Jerk input of the FB, the operation is referred to as trapezoidal acceleration/deceleration. The velocity creates a trapezoidal shape. 	When a value other than "0.0" is set for the Jerk input of the FB, the operation is referred to as jerk acceleration/deceleration. The velocity creates an S-curve shape. 

■Acceleration/deceleration time-fixed method

Select "1: Acceleration/deceleration time-fixed method (mcFixedTime)" in Acceleration/deceleration method setting (Options: Bit 0 to 2) of the FB, and set the acceleration time in the Acceleration input. The Deceleration and Jerk inputs are not used.



■FB input variables

The following table explains each FB input variable.

Input variable	Name	Description
Velocity	Velocity	Specify the velocity used for the FB.
Acceleration	Acceleration	Specify the acceleration used for the FB. • The unit is [U/s^2] when the method is set to "0: Acceleration/deceleration specification method (mcAccDec)". • The unit is [s] when the method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".
Deceleration	Deceleration	Specify the deceleration used for the FB. • The unit is [U/s^2] when the method is set to "0: Acceleration/deceleration specification method (mcAccDec)". • Not used when the method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".
Jerk	Jerk	Specify the jerk used for the FB. • The unit is [U/s^3] when the method is set to "0: Acceleration/deceleration specification method (mcAccDec)". • Not used when the method is set to "1: Acceleration/deceleration time-fixed method (mcFixedTime)".
Options	Options	Specify the acceleration/deceleration method using Acceleration/deceleration method setting (Bit 0 to 2). • 0: Acceleration/deceleration specification method (mcAccDec) • 1: Acceleration/deceleration time-fixed method (mcFixedTime)

Point

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected, the values for Acceleration and Deceleration are calculated using the acceleration/deceleration time as follows.

<For velocity V [U/s], acceleration time [s], and deceleration time [s]>

Velocity := (velocity V);

Acceleration := (velocity V/acceleration time);

Deceleration := (velocity V/deceleration time);

Options := (mcAccDec);

Local labels

	Label Name	Data Type		Class
1	MCv_AllPower_1	MCv_AllPower	...	VAR
2	MCv_Jog_1	MCv_Jog	...	VAR
3	MCv_Jog_2	MCv_Jog	...	VAR
4	bJog1	Bit	...	VAR
5	bJog2	Bit	...	VAR
6	bJogF1	Bit	...	VAR
7	bJogR1	Bit	...	VAR
8	bJogF2	Bit	...	VAR
9	bJogR2	Bit	...	VAR
10	leJogAcceleration	FLOAT [Double Precision]	...	VAR
11	leJogDeceleration	FLOAT [Double Precision]	...	VAR
12	leJogJerk	FLOAT [Double Precision]	...	VAR

No.	Description
(2), (3)	These labels are automatically added when the user drags and drops the FB (MCv_Jog) onto the program editor.
(4) to (12)	Register the labels manually.

Program example

Inline structured text is used to store values for the JOG velocity, acceleration, deceleration, and jerk.

The labels for the JOG positive and reverse rotation commands are input to the corresponding command inputs (JogForward and JogBackward) of the FB (MCv_Jog).

The interlock conditions are added to prevent execution of the JOG operation while other programs are running.

■Start signal

Signal name	Label name	
	Axis0001	Axis0002
JOG positive rotation command	G_bJogF1CMD	G_bJogF2CMD
JOG reverse rotation command	G_bJogR1CMD	G_bJogR2CMD

ST program

```
//----Data setting for JOG operation----
IF MCv_AllPower_1.Busy THEN
    G_leJogVelocity   := 25000.0;
    leJogAcceleration := 50000.0;
    leJogDeceleration := 50000.0;
    leJogJerk := 0.0;
END_IF;

//----Axis0001 JOG operation----
bJog1 := (G_bJogF1CMD OR G_bJogR1CMD) AND //JOG operation request
    (NOT(G_bHoming0CMD) AND
    MotionSystem.Md.Ready AND
    NOT(G_bPosCMD) AND
    NOT(G_bContPosCMD) AND
    NOT(G_bInterpolationCMD) AND
    NOT(G_bSyncCMD) AND
    NOT(MotionSystem.Md.Error));

bJogF1 := bJog1 AND NOT(G_bJogR1CMD); //JOG Positive rotation
bJogR1 := bJog1 AND NOT(G_bJogF1CMD); //JOG Reverse rotation

MCv_Jog_1(
    Axis := Axis0001.AxisRef ,
    JogForward := bJogF1 ,
    JogBackward := bJogR1 ,
    Velocity := G_leJogVelocity ,
    Acceleration := leJogAcceleration ,
    Deceleration := leJogDeceleration ,
    Jerk := leJogJerk ,
    BUSY => G_bJog1Busy
);
```

ST program

```
//----Axis0002 JOG operation----
bJog2 := (G_bJogF2CMD OR G_bJogR2CMD) AND //JOG operation request
    (NOT(G_bHoming0CMD) AND
    MotionSystem.Md.Ready AND
    NOT(G_bPosCMD) AND
    NOT(G_bContPosCMD) AND
    NOT(G_bInterpolationCMD) AND
    NOT(G_bSyncCMD) AND
    NOT(MotionSystem.Md.Error));

bJogF2 := bJog2 AND NOT(G_bJogR2CMD); //JOG Positive rotation
bJogR2 := bJog2 AND NOT(G_bJogF2CMD); //JOG Reverse rotation

MCv_Jog_2(
    Axis := Axis0002.AxisRef ,
    JogForward := bJogF2 ,
    JogBackward := bJogR2 ,
    Velocity := G_leJogVelocity ,
    Acceleration := leJogAcceleration ,
    Deceleration := leJogDeceleration ,
    Jerk := leJogJerk ,
    BUSY => G_bJog2Busy
);
```

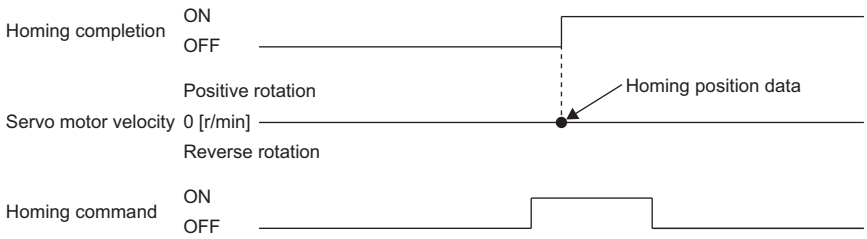
45.5 Homing (Program Name: Homing)

The homing method is set using the parameters of the servo amplifier.
This section describes the data set homing method.

Overview

The data set homing method sets the position where homing is performed as the home position.

■Time chart of data set homing method (Method37)



FB used

Type	FB	Description
Motion	MC_Home	Executes homing of the specified axis.

Local labels

	Label Name	Data Type		Class
1	MC_Home_0	MC_Home(1..3)	...	VAR
2	AxisArray	Word [Signed]	...	VAR
3	AxisArray0	Word [Unsigned]/Bit String [16-bit]	...	VAR
4	bHomingReq	Bit(1..3)	...	VAR
5	bHomingDone0	Bit(1..3)	...	VAR
6	bHomingDone	Bit(1..3)	...	VAR
7	bHomingError	Bit(1..3)	...	VAR
8	Fb_RTRIG	R_TRIG	...	VAR

No.	Description
(1)	The label is automatically added when the user drags and drops the FB (MC_Home) onto the program editor.
(2) to (8)	Register the labels manually.

Program example

This program executes homing for real drive axes Axis 1 (Axis0001) and Axis 2 (Axis0002) and virtual drive axis 1 (VirtualAxis0001). The rising edge of the label assigned to the homing signal is held and the label is input to the Execute command (Execute) of the FB (MC_Home). The start signal is turned off when the homing completion signal (the Done output of MC_Home) is turned on or when an error occurs.
The interlock conditions are added to prevent execution of the homing while other programs are running or when a system error occurs.

■Start signal

Signal name	Label name		
	Axis0001	Axis0002	VirtualAxis0001
Homing command	G_bHoming1CMD	G_bHoming2CMD	G_bHoming3CMD

ST program

```
//----Homing------
Fb_RTRIG (G_bHoming1Req, bHomingReq[1]); //Homing request Axis0001
Fb_RTRIG (G_bHoming2Req, bHomingReq[2]); //Homing request Axis0002
Fb_RTRIG (G_bHoming3Req, bHomingReq[3]); //Homing request Axis0003

FOR AxisArray := 1 TO 3 BY 1 DO
        G_bHomingCMD[AxisArray] := (bHomingReq[AxisArray] OR
            (G_bHomingCMD[AxisArray] AND
            NOT(bHomingDone[AxisArray]) AND
            NOT(bHomingError[AxisArray])) AND
             MotionSystem.Md.Ready AND
            NOT(G_bJog1Busy) AND
            NOT(G_bPosCMD) AND
            NOT(G_bContPosCMD) AND
            NOT(G_bInterpolationCMD) AND
            NOT(G_bSyncCMD) AND
            NOT(MotionSystem.Md.Error);

        AxisArray0 := INT_TO_WORD(AxisArray);
        Axis_Ref[AxisArray0].AxisNo := AxisArray0; //Axis number setting

//----Homing----
        MC_Home_0[AxisArray](
            Axis := Axis_Ref[AxisArray0],
            Execute := G_bHomingCMD[AxisArray],
            Position := 0.0 ,
            Done => bHomingDone[AxisArray],
            Error => bHomingError[AxisArray]
        );

//Homing complete
        bHomingDone0[AxisArray] := bHomingDone[AxisArray] OR bHomingError[AxisArray];
        RST (bHomingDone0[AxisArray], G_bHomingCMD[AxisArray]);

        RST (bHomingDone0[1], G_bHoming1Req);
        RST (bHomingDone0[2], G_bHoming2Req);
        RST (bHomingDone0[3], G_bHoming3Req);
        G_bHoming0CMD := G_bHomingCMD[1] OR G_bHomingCMD[2] OR G_bHomingCMD[3];
END_FOR;
```

45.6 Single Axis Positioning Control (Program Name: Positioning)

Execute positioning to the specified position by using address information.

FBs used

Type	FB	Description
Motion	MC_MoveAbsolute	Specifies the target position of the absolute position and executes positioning.
	MC_MoveRelative	Specifies the movement amount of the relative position and executes positioning.

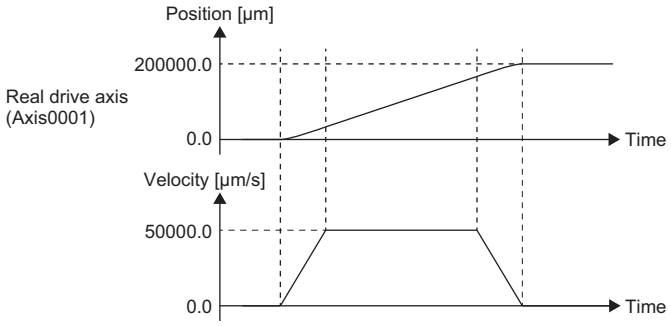
Local labels

	Label Name	Data Type		Class
1	MC_MoveRelative_1	MC_MoveRelative	...	VAR
2	leDistance	FLOAT [Double Precision]	...	VAR
3	leVelocity	FLOAT [Double Precision]	...	VAR
4	leAcceleration	FLOAT [Double Precision]	...	VAR
5	leDeceleration	FLOAT [Double Precision]	...	VAR
6	leJerk	FLOAT [Double Precision]	...	VAR
7	bPosReq	Bit	...	VAR
8	bPosDone	Bit	...	VAR
9	bDone	Bit	...	VAR
10	bBusy	Bit	...	VAR
11	bError	Bit	...	VAR
12	bCommandAborted	Bit	...	VAR
13	Fb_RTRIG	R_TRIG	...	VAR

No.	Description
(1)	This label is automatically added when the user drags and drops the FB (MC_MoveRelative) onto the program editor.
(2) to (13)	Register the labels manually.

Program example

This program executes relative positioning in the following operation pattern.



When the single axis positioning command is turned on, the positioning data is stored to each specified label. When all the data is stored, the execution request of the FB (MC_MoveRelative) is kept on by self-holding. The start signal is turned off when any of the following conditions are satisfied: the positioning is completed (the AND condition of the Done output of MC_MoveRelative and command in-position); an error occurs; or the execution is aborted.
The interlock conditions are added to prevent execution of the single axis positioning while other programs are running or when a system error occurs.

■Start signal

Signal name	Label name
Single axis positioning command	G_bPosCMD

ST program

```
//----Relative value positioning----
Fb_RTRIG (G_bPosReq, bPosReq); //Positioning request

G_bPosCMD := (bPosReq OR
    (G_bPosCMD AND
    NOT(bDone) AND
    NOT(bError) AND
    NOT(bCommandAborted))) AND
    MotionSystem.Md.Ready AND
    NOT(G_bJog1Busy) AND NOT(G_bJog2Busy) AND
    NOT(G_bHoming0CMD) AND
    NOT(G_bContPosCMD) AND
    NOT(G_bInterpolationCMD) AND
    NOT(G_bSyncCMD) AND
    NOT(MotionSystem.Md.Error);

IF G_bPosCMD THEN;
    leDistance := 200000.0;
    leVelocity := 50000.0;
    leAcceleration := 100000.0;
    leDeceleration := 100000.0;
    leJerk := 0.0;
END_IF;

//----Positioning----
MC_MoveRelative_1(
    Axis := Axis0001.AxisRef ,
    Execute := G_bPosCMD ,
    Distance := leDistance ,
    Velocity := leVelocity ,
    Acceleration := leAcceleration ,
    Deceleration := leDeceleration ,
    Jerk := leJerk ,
    Done => bDone ,
    Busy => bBusy ,
    CommandAborted => bCommandAborted ,
    Error => bError
);

//----Positioning complete----
bPosDone := (bDone AND Axis0001.Md.CmdInPos) OR bCommandAborted OR bError;
RST (bPosDone, G_bPosCMD);
RST (bPosDone, G_bPosReq);
```

45.7 Single Axis Continuous Positioning (Program Name: ContinuousPositioning)

Overview

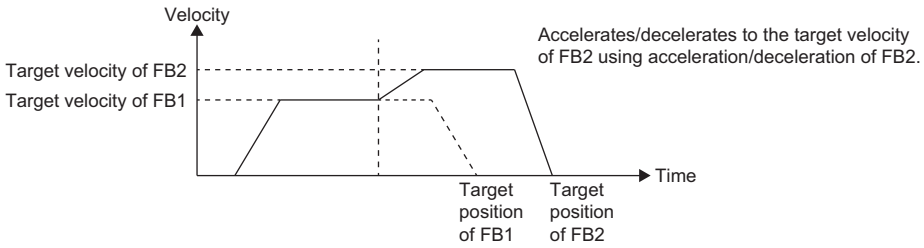
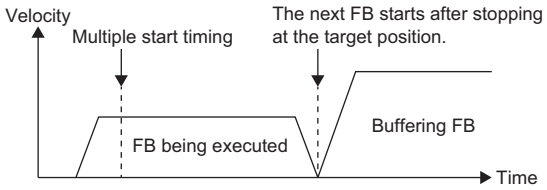
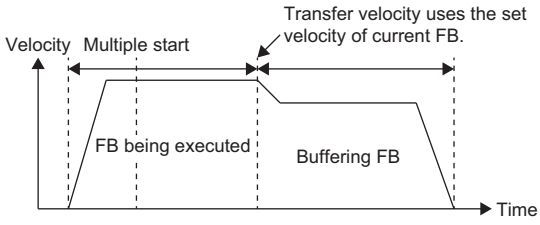
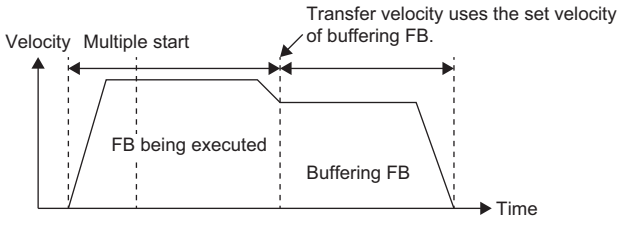
An axis can continuously execute multiple motion control FBs without stopping by buffering the next motion FB of another instance while executing the first motion control FB.

Select the buffer mode through the BufferMode input of a motion control FB.

Up to two motion FBs can be buffered on one axis.

The example in this section uses an FB (MC_MoveRelative) to perform relative value positioning.

Operation pattern of buffer mode

Buffer mode	Operation
0: mcAborting	The FB being executed is aborted (canceled), and the next FB is immediately executed. 
1: mcBuffered	The next FB is executed after the FB being executed completes (the axis decelerates to a stop). 
2: mcBlendingLow	The lower target velocity between the FB being executed and the next FB is used as the switching velocity.
3: mcBlendingPrevious	The next FB is executed after the target position of the FB being executed is reached. The target velocity is the command velocity of the next FB. 
4: mcBlendingNext	The next FB is executed after the target position of the FB being executed is reached. When the target position is reached, the velocity is switched to the command velocity of the next FB. 
5: mcBlendingHigh	The higher target velocity between the FB being executed and the next FB is used as the switching velocity.

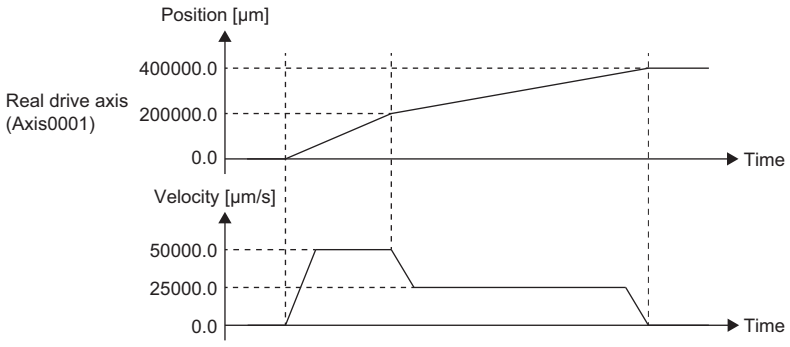
Local labels

	Label Name	Data Type		Class
1	MC_MoveRelative_1	MC_MoveRelative	...	VAR
2	MC_MoveRelative_2	MC_MoveRelative	...	VAR
3	leDistance1	FLOAT [Double Precision]	...	VAR
4	leDistance2	FLOAT [Double Precision]	...	VAR
5	leVelocity1	FLOAT [Double Precision]	...	VAR
6	leVelocity2	FLOAT [Double Precision]	...	VAR
7	leAcceleration1	FLOAT [Double Precision]	...	VAR
8	leDeceleration1	FLOAT [Double Precision]	...	VAR
9	leAcceleration2	FLOAT [Double Precision]	...	VAR
10	leDeceleration2	FLOAT [Double Precision]	...	VAR
11	leJerk	FLOAT [Double Precision]	...	VAR
12	bBusy1	Bit	...	VAR
13	bActive1	Bit	...	VAR
14	bDone2	Bit	...	VAR
15	bBusy2	Bit	...	VAR
16	TON_1	TON	...	VAR
17	bDwell_in	Bit	...	VAR
18	bDwell_out	Bit	...	VAR
19	bExecute_CP	Bit	...	VAR
20	bCommandAborted	Bit	...	VAR
21	bError	Bit	...	VAR
22	bContPosReq	Bit	...	VAR
23	Fb_RTRIG	R_TRIG	...	VAR

No.	Description
(1), (2), (16)	These labels are automatically added when the user drags and drops the FBs (MC_MoveRelative and TON) onto the program editor.
(3) to (15), (17) to (23)	Register the labels manually.

Program example

This program executes relative positioning in the following operation pattern.



When the single axis continuous positioning command is turned on, the positioning data is stored to each specified label.
When all the data is stored, the execution request of the FB (MC_MoveRelative_1) is kept on by self-holding.
The Active output of the first FB (MC_MoveRelative) is connected to the Execute input of the second FB (MC_MoveRelative), which enables buffering of the second FB while executing the first FB.
When the first FB is finished, the second FB is continuously executed. To set the dwell time, the on-delay timer (100 [ms]) is used. The on-delay timer input and the start signal are reset when any of the following conditions are satisfied: the dwell time is passed; an error occurs; or the execution is aborted.
The interlock conditions are added to prevent execution of the single axis continuous positioning while other programs are running or when a system error occurs.

■Start signal

Signal name	Label name
Single axis continuous positioning command	G_bContPosCMD

ST program

```
//----Relative value positioning----
Fb_RTRIG (G_bContPosReq, bContPosReq); //Positioning request

G_bContPosCMD := (bContPosReq OR
    (G_bContPosCMD AND
    NOT(bDone2) AND
    NOT(bError) AND
    NOT(bCommandAborted))) AND
    MotionSystem.Md.Ready AND
    NOT(G_bJog1Busy) AND NOT(G_bJog2Busy) AND
    NOT(G_bHoming0CMD) AND
    NOT(G_bPosCMD) AND
    NOT(G_bInterpolationCMD) AND
    NOT(G_bSyncCMD) AND
    NOT(MotionSystem.Md.Error);

IF G_bContPosCMD THEN;
    leDistance1 := 200000.0;
    leDistance2 := 200000.0;
    leVelocity1 := 50000.0;
    leVelocity2 := 25000.0;
    leAcceleration1 := 100000.0;
    leDeceleration1 := 100000.0;
    leAcceleration2 := 50000.0;
    leDeceleration2 := 50000.0;
    leJerk := 0.0;
END_IF;

//----Positioning + Buffer mode + Dwell----
//----Relative value positioning 1----
MC_MoveRelative_1(
    Axis := Axis0001.AxisRef ,
    Execute := G_bContPosCMD ,
    Distance := leDistance1 ,
    Velocity := leVelocity1 ,
    Acceleration := leAcceleration1 ,
    Deceleration := leDeceleration1 ,
    Jerk := leJerk ,
    Busy => bBusy1 ,
    Active => bActive1
);

//----Relative value positioning 2----
MC_MoveRelative_2(
    Axis := Axis0001.AxisRef ,
    Execute := bActive1 ,
    Distance := leDistance2 ,
    Velocity := leVelocity2 ,
    Acceleration := leAcceleration2 ,
    Deceleration := leDeceleration2 ,
    BufferMode := MC_BUFFER_MODE__mcBlendingPrevious ,
    Done => bDone2 ,
    Busy => bBusy2
);

//----FB CommandAborted output----
bCommandAborted := MC_MoveRelative_1.CommandAborted OR MC_MoveRelative_2.CommandAborted;

//----FB Error output----
bError := MC_MoveRelative_1.Error OR MC_MoveRelative_2.Error;

//----Sets the timer input with the relative value positioning 2 complete signal----
//----Sets timer input with relative value positioning 2 complete signal----
SET(bDone2, bDwell_in);

//----Dwell----
TON_1(IN := bDwell_in, PT := T#100ms, Q=> bDwell_out);
```

ST program

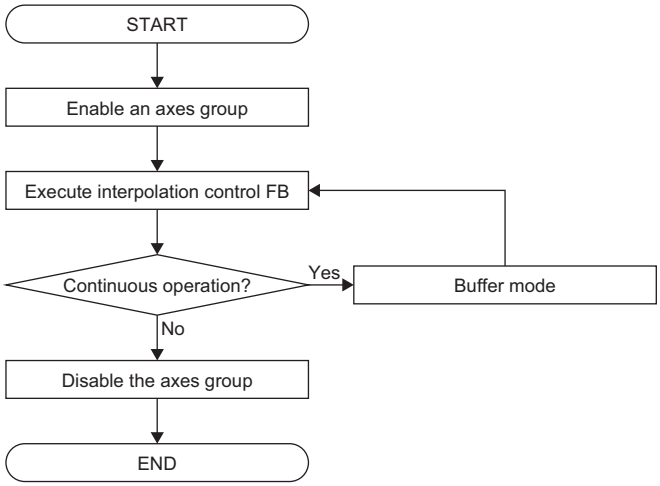
```
//----Positioning complete signal----
RST (bDwell_out OR bCommandAborted OR bError , G_bContPosCMD);
RST (bDwell_out OR bCommandAborted OR bError , G_bContPosReq);

//----Resets the relative positioning 2 complete signal hold (timer input) when the positioning is completed----
//----Resets timer input when positioning is completed----
RST(bDwell_out, bDwell_in);
```

45.8 Interpolation Control (Program Name: LinearInterpolation)

Procedure for interpolation control

The following shows the procedure flow for executing interpolation control of two or more axes.



Enabling/disabling an axes group

For axes group settings, refer to the following.

☞ Page 92 Axes group settings

To execute interpolation control, change the axes group status to "4: Standby (GroupStandby)" and enable the axes group.

FBs used

Type	FB	Description
Administrative	MC_GroupEnable	Changes the specified axes group status from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)".
	MC_GroupDisable	Changes the specified axes group status to "0: Axes group disabled (GroupDisabled)".

Interpolation control

For FBs that perform interpolation control, FBs for linear and circular interpolation control are available. Execute the following FBs after the axes group is enabled.

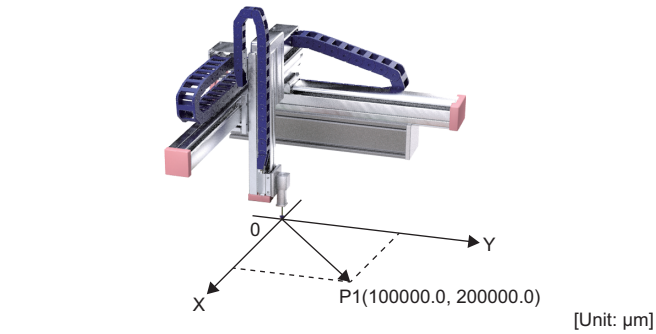
FBs used

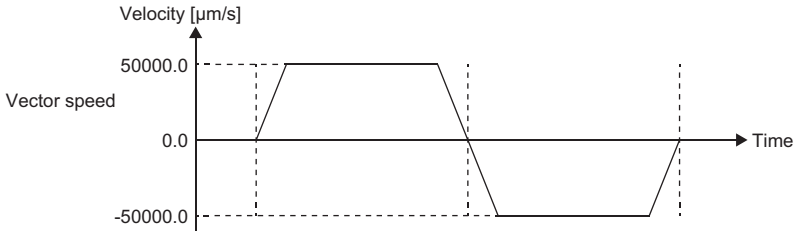
Type	FB	Description
Motion	MCv_MoveLinearInterpolateAbsolute	Specifies the target position of the absolute position of the set axes group, and executes positioning by linear interpolation control.
	MCv_MoveLinearInterpolateRelative	Specifies the movement amount of the relative position of the set axes group, and executes positioning by linear interpolation control.
	MCv_MoveCircularInterpolateAbsolute	Executes positioning with 2-axis circular interpolation using the structuring axes of the set axes group by setting the end point and sub point of the absolute position.
	MCv_MoveCircularInterpolateRelative	Executes positioning with 2-axis circular interpolation using the structuring axes of the set axes group by setting the relative position from the current position at start to the end point and sub point.

Program example for linear interpolation

Operation pattern

The machine goes back and forth between the home position (0.0, 0.0) [μm] and point P1 (100000.0, 200000.0) [μm] with linear interpolation movement.





Linear interpolation axis and movement amount settings

■LinearAxes input of MCv_MoveLinearInterpolateRelative

Set the data type of the label that connects to the LinearAxes input as INT type (Word [signed]) with "16" elements in the array.

In the sample program, the labels for wAxes[0] to wAxes[15] are used.

For the AxesGroup input, store the configuration axis numbers of the axes used for linear interpolation in wAxes starting from wAxes[0], among the configuration axes [1] to [16] set in the axes group parameter.

■Distance input of MCv_MoveLinearInterpolateRelative

Set the data type of the label that connects to the Distance input as LREAL type (double-precision real number) with "16" elements in the array.

In the sample program, the labels for lePosition[0] to lePosition[15] are used.

For AxesGroup, store the movement amount of configuration axes [1] to [16] set in the axes group parameter in lePosition[0] to lePosition[15].

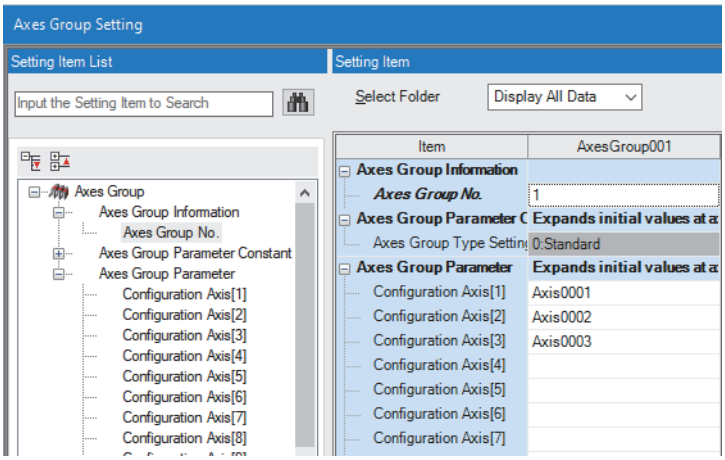
Point

Regardless of the number of the interpolation control axes, the number of elements must be "16" for the arrays used in both the LinearAxes input data type (INT type) and the Distance input data type (LREAL type).

■Setting examples

When setting the following axes group

Item	Data name
Configuration Axis[1]	Axis0001
Configuration Axis[2]	Axis0002
Configuration Axis[3]	Axis0003



Ex.

When using the following 2 axes as linear interpolation axes: configuration axis 1 (Axis0001) and configuration axis 2 (Axis0002)

wAxes[0]:= 1; //configuration axis [1]

wAxes[1]:= 2; //configuration axis [2]

lePosition[0]:= (movement amount of configuration axis 1 (Axis0001));

lePosition[1]:= (movement amount of configuration axis 2 (Axis0002));

Ex.

When using the following 2 axes as linear interpolation axes: configuration axis 2 (Axis0002) and configuration axis 3 (Axis0003)

wAxes[0]:= 2; //configuration axis [2]

wAxes[1]:= 3; //configuration axis [3]

lePosition[0]:= 0.0;

lePosition[1]:= (movement amount of configuration axis 2 (Axis0002));

lePosition[2]:= (movement amount of configuration axis 3 (Axis0003));

Local labels

	Label Name	Data Type		Class
1	MCv_MoveLinearInterpolateRelative_1	MCv_MoveLinearInterpolateRelative	...	VAR
2	MCv_MoveLinearInterpolateRelative_2	MCv_MoveLinearInterpolateRelative	...	VAR
3	MC_GroupEnable_1	MC_GroupEnable	...	VAR
4	MC_GroupDisable_1	MC_GroupDisable	...	VAR
5	wAxes	Word [Signed](0..15)	...	VAR
6	lePosition1	FLOAT [Double Precision](0..15)	...	VAR
7	lePosition2	FLOAT [Double Precision](0..15)	...	VAR
8	leVelocity	FLOAT [Double Precision]	...	VAR
9	leAcceleration	FLOAT [Double Precision]	...	VAR
10	leDeceleration	FLOAT [Double Precision]	...	VAR
11	leJerk	FLOAT [Double Precision]	...	VAR
12	bGroupEnableDone	Bit	...	VAR
13	bGroupDisableDone	Bit	...	VAR
14	bBusy1	Bit	...	VAR
15	bActive1	Bit	...	VAR
16	bDone2	Bit	...	VAR
17	bBusy2	Bit	...	VAR
18	TON_1	TON	...	VAR
19	bDwell_out	Bit	...	VAR
20	bDwell_in	Bit	...	VAR
21	bExcute_LP	Bit	...	VAR
22	bCommandAborted	Bit	...	VAR
23	bError	Bit	...	VAR
24	bInterpolationReq	Bit	...	VAR
25	Fb_RTRIG	R_TRIG	...	VAR

No.	Description
(1) to (4), (18)	These labels are automatically added when the user drags and drops the FBs (MC_GroupEnable, MCv_MoveLinearInterpolateRelative, MC_GroupDisable, and TON) onto the program editor.
(5) to (17), (19) to (25)	Register the labels manually.

Program example

When the two-axis linear interpolation control start is turned on, the positioning data is stored to each specified label.
When all the data is stored, the execution request of the FB (MC_GroupEnable_1) is kept on by self-holding.
After the axes group is enabled by the FB (MC_GroupEnable), the two FBs for relative value linear interpolation control (MCv_MoveLinearInterpolateRelative) are started in buffer mode.
The axes group is disabled when any of the following conditions are satisfied: the dwell time is passed after the positioning is completed; an error occurs; or the execution is aborted. The on-delay timer input and the start signal are reset when the axes group is disabled.
The interlock conditions are added to prevent execution of the two-axis interpolation control while other programs are running or when a system error occurs.

■Start signal

Signal name	Label name
Two-axis linear interpolation control start	G_bInterpolationCMD

ST program

```
//----2-axis linear interpolation control----
Fb_RTRIG (G_bInterpolationReq, bInterpolationReq); //Positioning request

G_bInterpolationCMD:= (bInterpolationReq OR
    (G_bInterpolationCMD AND
    NOT(bGroupDisableDone) AND
    NOT(bError) AND
    NOT(bCommandAborted))) AND
    MotionSystem.Md.Ready AND
    NOT(G_bJog1Busy) AND NOT(G_bJog2Busy) AND
    NOT(G_bHoming0CMD) AND
    NOT(G_bPosCMD) AND
    NOT(G_bContPosCMD) AND
    NOT(G_bSyncCMD) AND
    NOT(MotionSystem.Md.Error);

IF G_bInterpolationCMD THEN;
    wAxes[0]    := 1;
    wAxes[1]    := 2;
    lePosition1[0] := 100000.0;
    lePosition1[1] := 200000.0;
    lePosition2[0] := -100000.0;
    lePosition2[1] := -200000.0;
    leVelocity := 50000.0;
    leAcceleration := 50000.0;
    leDeceleration := 50000.0;
    leJerk := 0.0;
END_IF;

//----Linear interpolation control + Buffer mode--------------------
//----Linear interpolation control + Buffer mode----
//----Axes group enable----
MC_GroupEnable_1(
    AxesGroup := AxesGroup001.AxesGroupRef ,
    Execute := G_bInterpolationCMD ,
    Done => bGroupEnableDone
);

//----Linear interpolation control 1----
MCv_MoveLinearInterpolateRelative_1(
    AxesGroup := AxesGroup001.AxesGroupRef ,
    Execute := bGroupEnableDone ,
    LinearAxes := wAxes ,
    Distance := lePosition1 ,
    Velocity := leVelocity ,
    Acceleration := leAcceleration ,
    Deceleration := leDeceleration ,
    Jerk := leJerk ,
    VelocityMode := MC_INTERPOLATE_SPEED_MODE__VectorSpeed ,
    Busy => bBusy1 ,
    Active => bActive1
);
```

ST program

```
//----Linear interpolation control 2----
MCv_MoveLinearInterpolateRelative_2(
    AxesGroup := AxesGroup001.AxesGroupRef ,
    Execute := bActive1 ,
    LinearAxes := wAxes ,
    Distance := lePosition2 ,
    BufferMode := MC_BUFFER_MODE__mcBuffered ,
    Done => bDone2 ,
    Busy => bBusy2
);

//----FB CommandAborted output----
bCommandAborted := MCv_MoveLinearInterpolateRelative_1.CommandAborted OR MCv_MoveLinearInterpolateRelative_2.CommandAborted;

//----FB error output----
bError := MCv_MoveLinearInterpolateRelative_1.Error OR MCv_MoveLinearInterpolateRelative_2.Error;

//----Sets the timer input with the linear interpolation control 2 complete signal or FB execution abortion----
//Sets timer input with linear interpolation control 2 complete signal or FB CommandAborted output
SET(bDone2 OR bCommandAborted , bDwell_in);

//----Dwell----
TON_1(IN := bDwell_in, PT := T#100ms, Q => bDwell_out);

//----Axes group disable----
MC_GroupDisable_1(
    AxesGroup := AxesGroup001.AxesGroupRef,
    Execute := bDwell_out OR bError,
    Done => bGroupDisableDone
);

//----Positioning complete signal----
RST (bDwell_out OR bError, G_bInterpolationCMD);
RST (bDwell_out OR bError, G_bInterpolationReq);

//----Resets the interpolation positioning 2 complete signal hold (timer input) when the positioning is completed----
//----Resets timer input when positioning is completed----
RST(bDwell_out, bDwell_in);
```

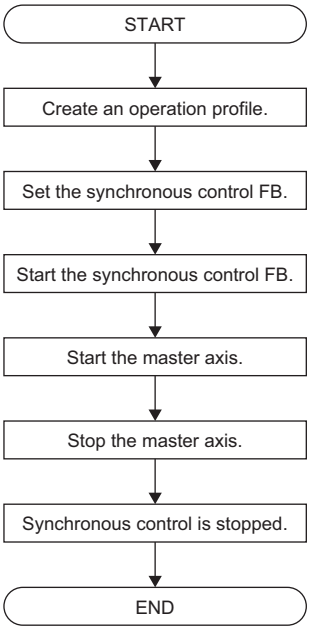
Point

When the values for the commanded velocity, acceleration, and deceleration inputs are omitted for the buffering FB, those of the previous FB are applied.

45.9 Synchronous Control (Program Name: Synchronous)

Procedures for executing synchronous control

The following shows the procedure flow for executing synchronous control.



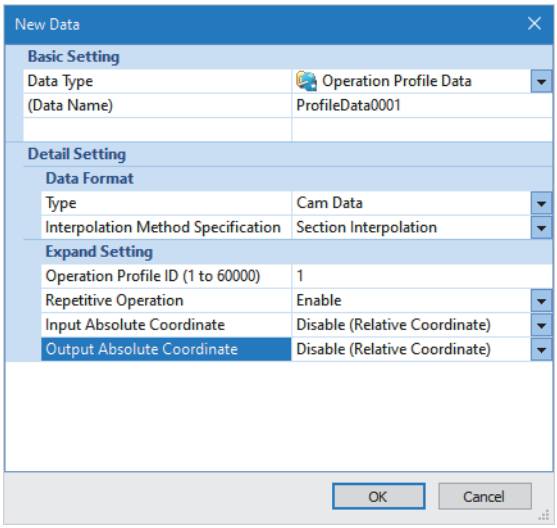
Operation profile data

Waveform data used for control are collectively called operation profile data.
This section describes how to create cam data.

Create new operation profile data

Operating procedure

1. In the Navigation window, right-click "Operation Profile Data" and select "Add New Data". The "New Data" window is displayed.



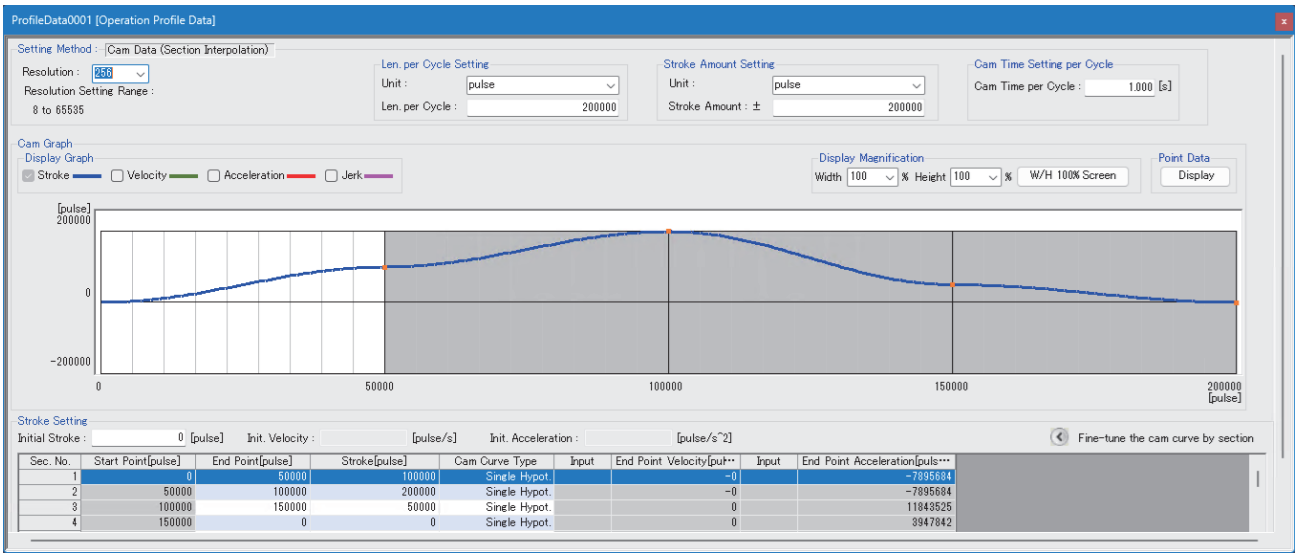
2. Set items such as the data name, type, and interpolation method specification, and click the [OK] button.
The example in this procedure uses the initial values.
The following are the items set in the expand setting.

Setting item	Description
Repetitive Operation	• Disable: Once the control is performed until the end point of the operation profile data, the control terminates. • Enable: The execution of operation profile data is continuously repeated.
Output Absolute Coordinate	• Disable (Relative coordinate): When the operation profile data (cam data) is started, an output value is calculated based on the current value. When executing a feed cam operation, select this setting. • Enable (Absolute coordinate): The output value at the time the operation profile data (cam data) is started is calculated to be always the start point for one cycle of the operation profile data. When the start point and the end point of the operation profile data are different during repetitive operation, the command is output in one operation cycle to return to the first output value at the next one cycle start.

3. The operation profile data is added to the navigation window.

Creating cam data

Set the operation profile data waveform.



The following are the items set to the operation profile data.

Item	Setting value	Description
Resolution	256	Set the resolution of the cam data.
Length per Cycle Setting	200000 (Unit: pulse)	Set the length per cycle and its unit. (Set the movement amount of the master axis for one cam cycle.)
Stroke Amount Setting	200000 (Unit: pulse)	Set the stroke amount and its unit. (Set the maximum movement amount of the slave axis for one cam cycle.)
Cam Time Setting per Cycle	1.000	Set the time for one cam cycle. This setting is used when velocity, acceleration, and jerk are calculated.
Stroke Setting	Setting values for the stroke setting	Set the stroke.

Section No.	Start point	End point	Stroke	Cam curve type
1	0	50000	100000	Single hypotenuse
2	50000	100000	200000	Single hypotenuse
3	100000	150000	50000	Single hypotenuse
4	150000	0	0	Single hypotenuse

Point

When executing linear cam operation (the same operation as the master axis, or an operation that changes the master axis velocity based on a specified velocity ratio), create operation profile data for the linear cam, or use MC_GearIn.

The operation profile data for the linear cam is not provided in the system.

Single axis synchronous control FBs

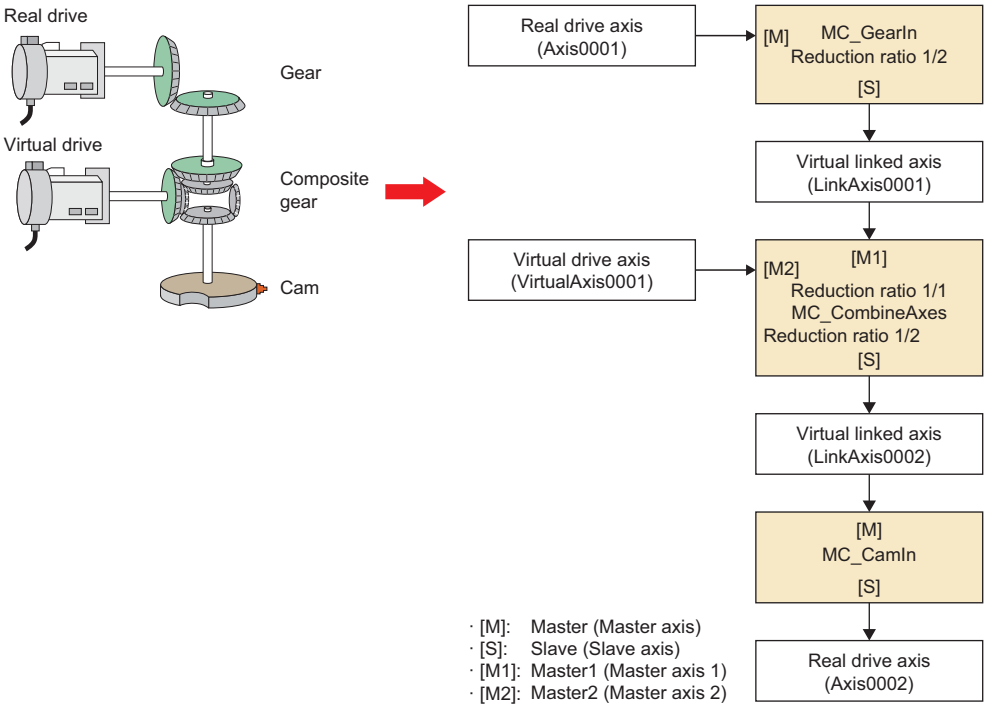
The single axis synchronous control FBs operate as software-based mechanical modules such as gears, speed change gears, and cams. These FBs transmit the position information (command) of Slave that is synchronized with Master.

FBs used

Type	FB	Description
Motion	MC_CamIn	Executes cam operation.
	MC_GearIn	Executes gear operation based on the specified velocity ratio between the master axis and the slave axis.
	MC_CombineAxes	Combines the motion of two axes by a selectable combination method and outputs the result to the third axis.
	MCv_BacklashCompensationFilter	Executes the specific filter processing to the input of Master and outputs the result to Slave.
	MCv_SmoothingFilter	
	MCv_DirectionFilter	
	MCv_SpeedLimitFilter	
	MC_Stop	Decelerates the specified axis to a stop. Used to stop the synchronous control.
Administrative	MCv_ChangeCycle	Changes the cam current value per cycle to the specified value during MC_CamIn control. It is used to compensate the cam current value per cycle into an arbitrary value.

Axes configuration

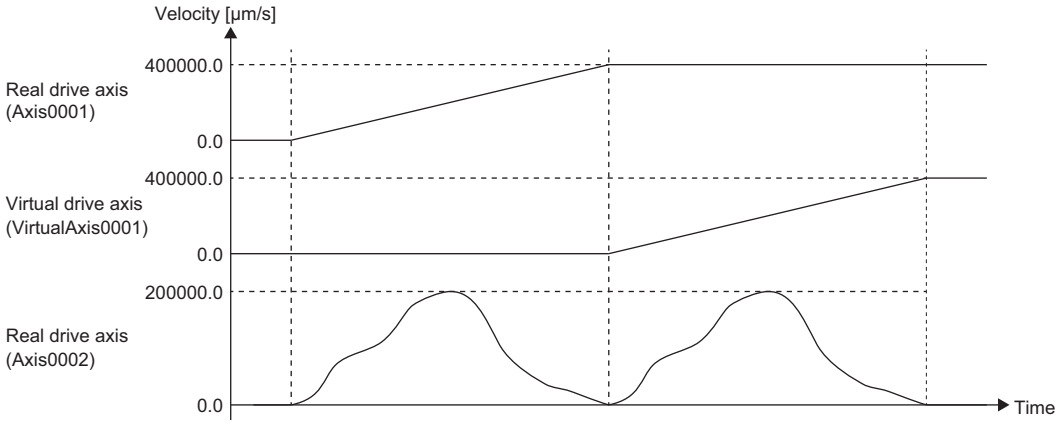
This section describes the following cam system.



Program example for synchronous control

Operation pattern

The X-axis (Axis0001) moves 400000.0 [μm] from the home position while the Y-axis (Axis0002) is operated according to the cam pattern created in the operation profile data (☞ Page 1224 Operation profile data). When the X-axis reaches the target position (400000.0 [μm]), the virtual drive axis starts operation and the Y-axis repeats the cam operation. At this time, the X-axis is stopped and only the Y-axis is operated.



Virtual drive axis and virtual linked axis

This program uses the virtual drive axis (VirtualAxis0001) and the virtual linked axes (LinkAxis0001, LinkAxis0002) in addition to the real drive axes (Axis0001, Axis0002).

The AxisRef type structure is used in the program that drives the VirtualAxis and the LinkAxis.

Local labels

	Label Name	Data Type		Class
1	MC_GearIn_1	MC_GearIn	...	VAR
2	MC_CombineAxes_1	MC_CombineAxes	...	VAR
3	MC_CamIn_1	MC_CamIn	...	VAR
4	bGearInBusy	Bit	...	VAR
5	bCombineAxesBusy	Bit	...	VAR
6	bCamInBusy	Bit	...	VAR
7	MC_MoveRelative_1	MC_MoveRelative	...	VAR
8	MC_MoveRelative_2	MC_MoveRelative	...	VAR
9	MC_Stop_1	MC_Stop	...	VAR
10	MC_Stop_2	MC_Stop	...	VAR
11	MC_Stop_3	MC_Stop	...	VAR
12	leAcceleration	FLOAT [Double Precision]	...	VAR
13	leDeceleration	FLOAT [Double Precision]	...	VAR
14	leJerk	FLOAT [Double Precision]	...	VAR
15	lePosition1	FLOAT [Double Precision]	...	VAR
16	leVelocity	FLOAT [Double Precision]	...	VAR
17	bInSync	Bit	...	VAR
18	bDone1	Bit	...	VAR
19	bBusy1	Bit	...	VAR
20	bDone2	Bit	...	VAR
21	bBusy2	Bit	...	VAR
22	bStopReq1	Bit	...	VAR
23	bStopDone1	Bit	...	VAR
24	bStopDone2	Bit	...	VAR
25	bStopDone3	Bit	...	VAR
26	bSyncMoveCMD	Bit	...	VAR
27	bExecute_S	Bit	...	VAR
28	bCommandAborted	Bit	...	VAR
29	bError	Bit	...	VAR
30	bSyncReq	Bit	...	VAR
31	Fb_RTRIG	R_TRIG	...	VAR

No.	Description
(1) to (3), (7) to (11)	These labels are automatically added when the user drags and drops the FBs (MC_GearIn, MC_CombineAxes, MC_CamIn, MC_MoveRelative, and MC_Stop) onto the program editor.
(4) to (6), (12) to (31)	Register the labels manually.

Program example

When the synchronous control start is turned on, the positioning data is stored to each specified label.
When all the data is stored, the execution request of the FB (MC_GearIn, MC_CombineAxes, and MC_CamIn) is kept on by self-holding.
When the axis status of Axis0002 is turned to "7: During synchronous operation (SynchronizedMotion)", Axis0001 (Master axis) starts positioning. At this time, Axis0002 is operated according to the specified operation profile data. When positioning of Axis0001 is completed, the virtual drive axis (VirtualAxis0001) starts positioning.
At this time, Axis0001 is stopped, but Axis0002 is operated according to the specified operation profile data.
The synchronous control is stopped by executing the FB (MC_Stop) on the real drive axis (Axis0002) and the virtual link axes (LinkAxis0001 and LinkAxis0002) when any of the following conditions are satisfied: the positioning of the virtual drive axis (VirtualAxis0001) is completed; an error occurs; or the execution is aborted. The start signal is reset when the real drive axis (Axis0002) status is out of synchronization.
The interlock conditions are added to prevent execution of the synchronous control while other programs are running or when a system error occurs.

■Start signal

Signal name	Label name
Synchronous control start	G_bSyncCMD

ST program

```
//----Synchronous control----
Fb_RTRIG (G_bSyncReq, bSyncReq); //Positioning request

G_bSyncCMD := (bSyncReq OR
    (G_bSyncCMD AND
    NOT(bStopDone1) AND
    NOT(bError) AND
    NOT(bCommandAborted))) AND
    MotionSystem.Md.Ready AND
    NOT(G_bJog1Busy) AND NOT(G_bJog2Busy) AND
    NOT(G_bHoming0CMD) AND
    NOT(G_bPosCMD) AND
    NOT(G_bContPosCMD) AND
    NOT(G_bInterpolationCMD) AND
    NOT(MotionSystem.Md.Error);

IF G_bSyncCMD THEN;
    lePosition1 := 400000.0;
    leVelocity := 50000.0;
    leAcceleration := 100000.0;
    leDeceleration := 100000.0;
    leJerk := 0.0;
END_IF;

//----Synchronous control----
//----Gear operation----
MC_GearIn_1(
    Master := Axis0001.AxisRef,
    Slave := Axis0004.AxisRef,
    Execute := G_bSyncCMD,
    RatioNumerator := 1,
    RatioDenominator := 2,
    MasterValueSource := MC_SOURCE__mcSetValue,
    Acceleration := leAcceleration,
    Deceleration := leDeceleration,
    Jerk := leJerk,
    Busy => bGearInBusy
);
```

ST program

```
//----Addition/subtraction positioning, Combining the motion of two master axes----
MC_CombineAxes_1(
    Master1 := Axis0004.AxisRef,
    Master2 := Axis0003.AxisRef,
    Slave := Axis0005.AxisRef,
    Execute := G_bSyncCMD,
    CombineMode := MC_COMBINE_MODE__mcAddAxes,
    GearRatioNumeratorM1 := 1,
    GearRatioDenominatorM1 := 1,
    GearRatioNumeratorM2 := 1,
    GearRatioDenominatorM2 := 2,
    MasterValueSourceM1 := MC_SOURCE__mcSetValue,
    MasterValueSourceM2 := MC_SOURCE__mcSetValue,
    Busy => bCombineAxesBusy
);

//----Cam operation----
MC_CamIn_1.CamTableID.ProfileID := ProfileData0001.ProfileData.ID;

MC_CamIn_1(
    Master := Axis0005.AxisRef,
    Slave := Axis0002.AxisRef,
    Execute := G_bSyncCMD,
    MasterOffset := 0.0,
    SlaveOffset := 0.0,
    MasterScaling := 1.0,
    SlaveScaling := 1.0,
    MasterStartDistance := 0.0,
    MasterSyncPosition := 0.0,
    StartMode := MC_START_MODE__mcImmediate,
    MasterValueSource := MC_SOURCE__mcSetValue,
    InSync => bInSync,
    Busy => bCamInBusy
);

//----Input axis start----
bSyncMoveCMD := G_bSyncCMD & (Axis0002.Md.AxisStatus = MC_AXIS_STATUS__SynchronizedMotion) ;

//----Relative value positioning real drive axis Axis0001----
MC_MoveRelative_1(
    Axis := Axis0001.AxisRef ,
    Execute := bSyncMoveCMD ,
    Distance := lePosition1 ,
    Velocity := leVelocity ,
    Acceleration := leAcceleration ,
    Deceleration := leDeceleration ,
    Jerk := leJerk ,
    Done => bDone1,
    Busy => bBusy1
);

//----Relative value positioning virtual drive axis Axis0003----
MC_MoveRelative_2(
    Axis := Axis0003.AxisRef ,
    Execute := bDone1 & Axis0001.Md.CmdInPos,
    Distance := lePosition1 ,
    Velocity := leVelocity ,
    Acceleration := leAcceleration ,
    Deceleration := leDeceleration ,
    Jerk := leJerk ,
    Done => bDone2,
    Busy => bBusy2
);
```

ST program

```
//----FB CommandAborted output----
bCommandAborted := MC_GearIn_1.CommandAborted OR
    MC_CombineAxes_1.CommandAborted OR
    MC_CamIn_1.CommandAborted OR
    MC_MoveRelative_1.CommandAborted OR
    MC_MoveRelative_2.CommandAborted;

//----FB error output----
bError := MC_GearIn_1.Error OR MC_CombineAxes_1.Error OR
    MC_CamIn_1.Error OR MC_MoveRelative_1.Error OR
    MC_MoveRelative_2.Error;

//----Turns on the axis stop signal when the positioning is completed, execution is aborted, or an error occurs----
//----Turns axis stop signal ON----
bStopReq1 := (bDone2 & Axis0003.Md.CmdInPos) OR bError OR bCommandAborted;

//----Synchronization done----
MC_Stop_1(
    Axis := Axis0002.AxisRef ,
    Execute := bStopReq1,
    Done => bStopDone1
);

MC_Stop_2(
    Axis := Axis0004.AxisRef ,
    Execute := bStopReq1,
    Done => bStopDone2
);

MC_Stop_3(
    Axis := Axis0005.AxisRef ,
    Execute := bStopReq1,
    Done => bStopDone3
);

//----Resets the start request signal after synchronization is completed----
//----Resets the start request signal when synchronization is completed----
RST(bStopDone1 OR MotionSystem.Md.Error, G_bSyncCMD);
RST(bStopDone1 OR MotionSystem.Md.Error, G_bSyncReq);
RST(bStopDone1 OR MotionSystem.Md.Error, bSyncMoveCMD);
RST(bStopDone1 OR MotionSystem.Md.Error, bStopReq1);

//----Positioning complete signal----
G_bSyncDone := (bStopDone2 & Axis0003.Md.CmdInPos) OR bCommandAborted OR bError ;
```

45.10 Error Reset (Program Name: ErrorReset)

This program resets the error on each axis.

FBs used

Type	FB	Description
Administrative	MC_Reset	Resets errors and warnings of the axis.
	MC_GroupReset	Resets errors and warnings of the axes group and each axis in the axes group.
	MCv_MotionErrorReset	Resets all errors and warnings of the motion system.

Local labels

	Label Name	Data Type		Class
1	MC_Reset_1	MC_Reset	...	VAR
2	MC_Reset_2	MC_Reset	...	VAR
3	MC_Reset_3	MC_Reset	...	VAR
4	MC_Reset_4	MC_Reset	...	VAR
5	MC_Reset_5	MC_Reset	...	VAR
6	MC_GroupReset_1	MC_GroupReset	...	VAR
7	MCv_MotionErrorReset_1	MCv_MotionErrorReset	...	VAR

No.	Description
(1) to (7)	This label is automatically added when the user drags and drops the FB (MC_Reset, MC_GroupReset, or MCv_MotionErrorReset) onto the program editor.

Program example

The following shows the program example for error reset.

When the error reset label is turned on, MC_Reset and MC_GroupReset are executed.

When the system error reset label is turned on, MCv_MotionErrorReset is executed.

ST program

```
//----Axis error reset----
MC_Reset_1(Axis := Axis0001.AxisRef, Execute := G_bResetCMD);
MC_Reset_2(Axis := Axis0002.AxisRef, Execute := G_bResetCMD);
MC_Reset_3(Axis := Axis0003.AxisRef, Execute := G_bResetCMD);
MC_Reset_4(Axis := Axis0004.AxisRef, Execute := G_bResetCMD);
MC_Reset_5(Axis := Axis0005.AxisRef, Execute := G_bResetCMD);

//----Axes group error reset----
MC_GroupReset_1(AxesGroup := AxesGroup001.AxesGroupRef ,Execute := G_bResetCMD);

//----Motion error reset----
MCv_MotionErrorReset_1(Execute := G_bMotionResetCMD);
```

PART 11 CC-Link IE TSN

This part consists of the following chapters.

46 CYCLIC TRANSMISSION

47 TRANSIENT TRANSMISSION

48 OTHERS

46 CYCLIC TRANSMISSION

This chapter describes periodic data communications among stations on the network using link devices.

- The link devices can be assigned in "Network Configuration Settings" under "Basic Settings". (☞ Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings))
- The link refresh is assigned in "Refresh Settings" under "Basic Settings". (☞ Page 1236 Link Refresh)

Unicast mode

Cyclic transmission operates as follows with "Communication Mode" set by the module parameter of the master station.

Communication mode	Description
Unicast	Cyclic data is sent to one station.

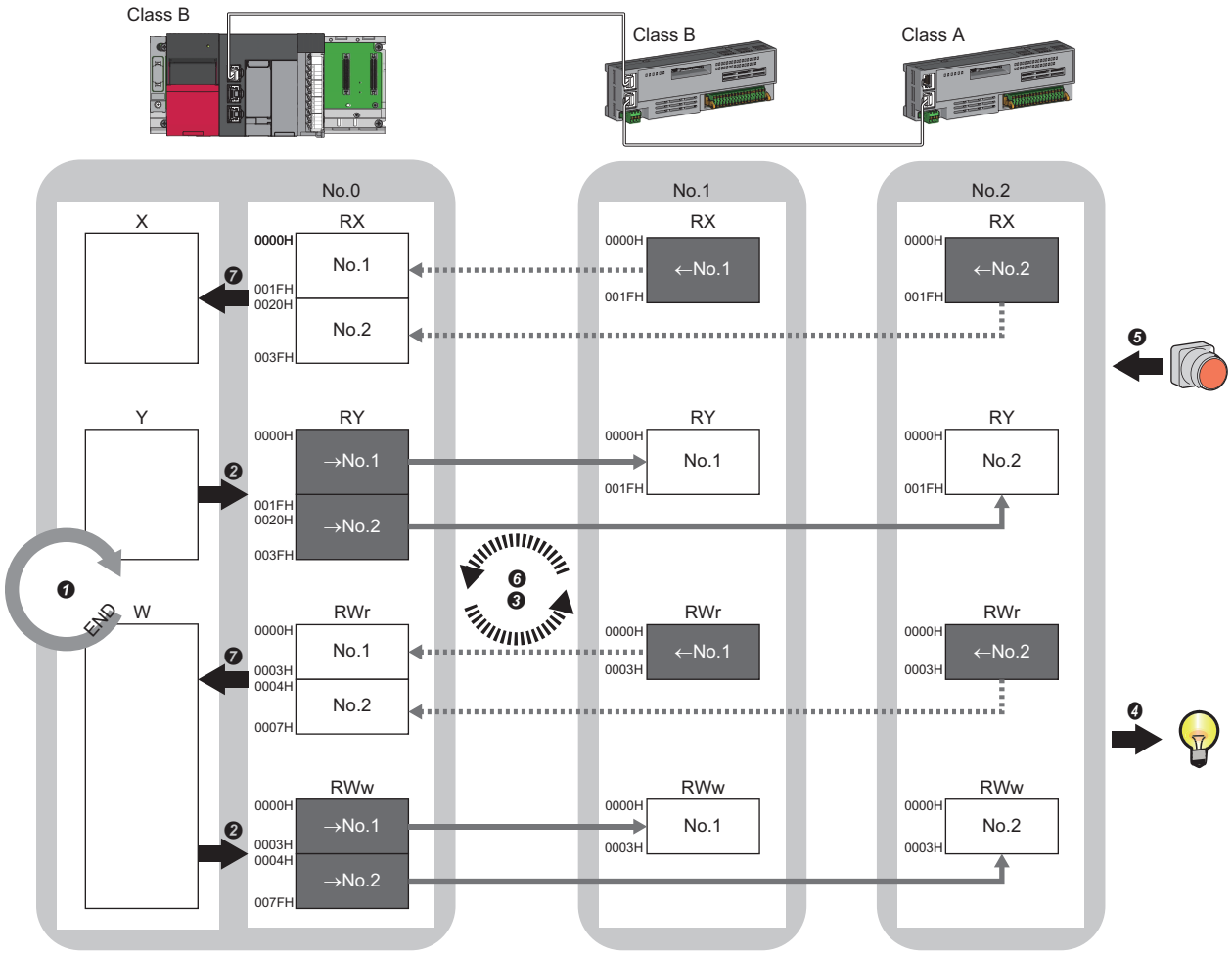
46.1 Communications Using RX, RY, RWr, and RWw

This allows data to be exchanged in units of bits and units of words between the master station and the device station.

Master station and remote stations

■Unicast mode

1:1 communications between the master station and each remote station.



No.0, No.1, No.2: Station No.0 (master station), station No.1, station No.2
→No.1, →No.2: Send range to station No.1, send range to station No.2
←No.1, ←No.2: Send range from station No.1, send range from station No.2
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- Output from the master station

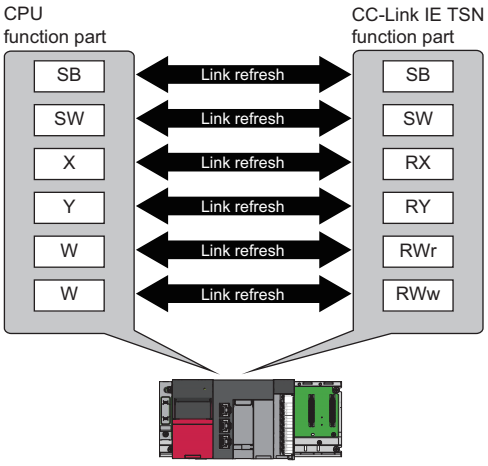
❶ The CPU function part device turns on.
❷ The status of the devices of the CPU function part is stored in the link devices (RY, RWw) of the master station by link refresh.
❸ The status of the link devices (RY, RWw) of the master station is stored in the link devices (RY, RWw) of each remote station by cyclic data transfer processing.
❹ The status of the link devices (RY, RWw) of the remote station is output to the external device.

- Input from the remote station

❺ The status of the external device is stored in the link devices (RX, RWr) of the remote station.
❻ The status of the link devices (RX, RWr) of the remote station is stored in the link devices (RX, RWr) of the master station by cyclic data transfer processing.
❼ The status of the link devices (RX, RWr) of the master station is stored in the devices of the CPU function part by link refresh.

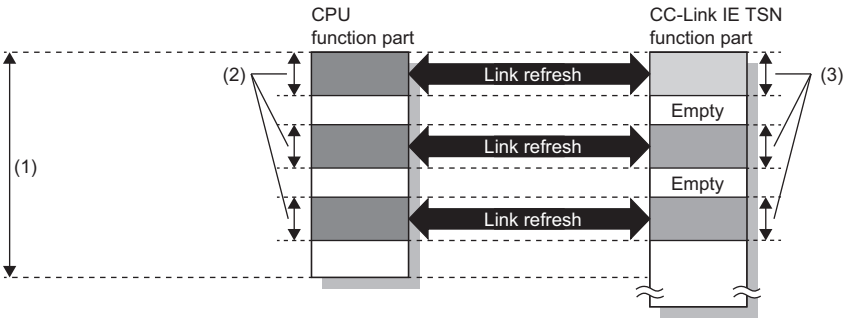
46.2 Link Refresh

This function automatically transfers data between devices in the CPU function part and link devices in the CC-Link IE TSN function part.



Concept of link refresh setting range

The link refresh is performed to the area set in "Refresh Settings" under "Basic Settings" and also set in the "CC-Link IE TSN Configuration" window.



(1) Range set in "Refresh Settings" under "Basic Settings"
(2) Actual link refresh range
(3) Range set in the "CC-Link IE TSN Configuration" window under "Basic Settings"

Precautions

■Device set to "CPU Side"

Set a device range not to overlap the one used for the following:

- "Refresh Setting" in "Basic Settings" of other network modules
- "Link Refresh Settings" in "Basic Settings" of a CC-Link master/local module
- I/O numbers used for I/O modules and intelligent function modules
- "Refresh settings" of intelligent function modules
- Module label being used (when performing refresh settings in "Refresh Settings" under "Basic Settings")

■When the link device assignment is changed in the "CC-Link IE TSN Configuration" window

Correct the set range in "Refresh Setting" of "Basic Settings".

Setting method

Assign refresh ranges between the devices described below.

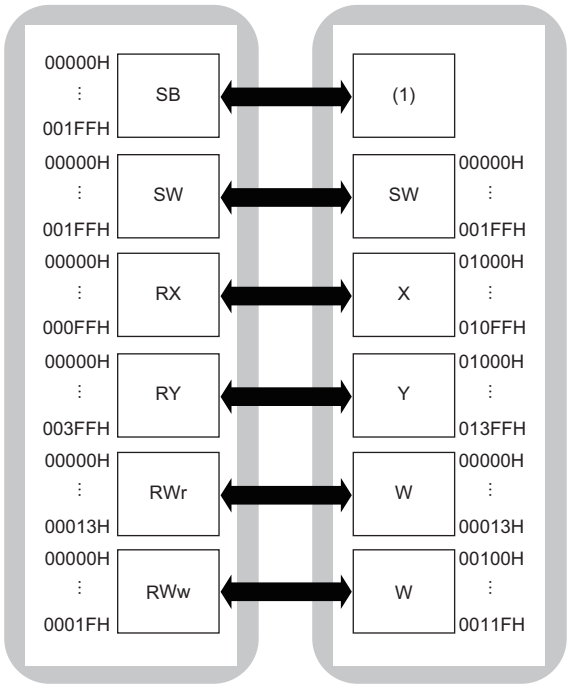
- SB, SW, link devices of the CC-Link IE TSN function part ↔ Devices of the CPU function part

Operating procedure

Set refresh in the following cases on the setting window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Refresh Settings]

Ex.



(1) Module label

1. Right-click in the setting window and select a link device assignment method from the "Device Assignment Method" menu.

- Start/End: Enter the start and end numbers of link devices. (Default)
- Points/Start: Enter the numbers of points and start numbers of link devices.

2. Set the required items.

No.	Link Side					CPU Side				
	Device Name	Points	Start	End		Target	Device Name	Points	Start	End
-	SB	4096	00000	00FFF	⇔	Module				
-	SW	512	00000	001FF	⇔	Specif	SW	512	00000	001FF
1	RX	256	00000	000FF	⇔	Specif	X	256	01000	010FF
2	RY	1024	00000	003FF	⇔	Specif	Y	1024	01000	013FF
3	RWr	20	00000	00013	⇔	Specif	W	20	00000	00013
4	RWw	32	00000	0001F	⇔	Specif	W	32	00100	0011F

3. Click the [Apply] button to finish the refresh settings.

Setting items

For — in the No. column, set the refresh ranges of the link special relay (SB) and link special register (SW). One range can be set for each SB and SW.

For No.1 to 256, set the refresh ranges of link devices (RX, RY, RWr, RWw). Up to 256 ranges can be set.

■Link Side

No.	Device Name	Points	Start	End
—	SB (Fixed)	16 to 4096 (Default: 4096)	0H to FF0H (set in increments of 16 points) (Default: 00000H)	FH to FFFH (set in increments of 16 points) (Default: 00FFFH)
—	SW (Fixed)	1 to 4096 (Default: 4096)	0H to FFFH (set in increments of 1 point) (Default: 00000H)	0H to FFFH (set in increments of 1 point) (Default: 00FFFH)
1 to 256	• RX, RY, RWr, RWw (Default: empty)	• RX, RY: 16 to 16384 • RWr, RWw: 4 to 8192 (Default: Grayout)	• RX, RY: 0H to 3FF0H (set in increments of 16 points) • RWr, RWw: 0H to 1FFCH (set in increments of 4 points) (Default: Grayout)	• RX, RY: FH to 3FFFH (set in increments of 16 points) • RWr, RWw: 3H to 1FFFH (set in increments of 4 points) (Default: Grayout)

■CPU Side

No.	Target	Device Name	Points	Start	End
—	• Module Label • Specify Device (Default: Module Label)	• Module Label: — • Specify Device (link side is SB): SB, M, L, B, D, R, ZR, RD • Specify Device (link side is SW): SW, M, L, B, D, R, ZR, RD (Default: Grayout)	• Module Label: — • Specify Device: Displayed according to setting of "Start". (Default: Grayout)	• Module Label: — • Specify Device: Device range of CPU function part (Bit devices in increments of 16 points and word devices in increments of 4 points) (Default: Grayout)	• Module Label: — • Specify Device: Displayed according to setting of "Start". (Default: Grayout)
—					
1 to 256		• Specify Device (link side is RX): X, M, L, B, D, W, R, ZR, RD • Specify Device (link side is RY): Y, M, L, B, D, W, R, ZR, RD • Specify Device (link side is RWr, RWw): M, L, B, D, W, R, ZR, RD (Default: Grayout)	• Module Label: — • Specify Device: Displayed according to setting of "Start". (Default: Grayout)	• Module Label: — • Specify Device: Device range of CPU function part (Bit devices in increments of 16 points and word devices in increments of 4 points) (Default: Grayout)	• Module Label: — • Specify Device: Displayed according to setting of "Start". (Default: Grayout)

Point

The link devices of the CC-Link IE TSN function part can be accessed from a program. (☞ Page 1241 Direct Access to Link Devices)

Transmission delay time shortening method

The following two methods are available to reduce the transmission delay time.

- Reduce the number of refresh points.
- Optimize the refresh settings.

Reduce the number of refresh points.

- In "Refresh Setting" under "Basic Settings", set only the link devices frequently used in the CPU function part as the refresh range. (☞ Page 1236 Link Refresh)
- Remove infrequently used link devices in the CPU function part from the refresh range, and directly read or write the corresponding data from the program by direct access. (☞ Page 1241 Direct Access to Link Devices)

Point

Refresh is performed in END processing of the sequence scan of the CPU function part.

Optimize the refresh settings.

1. Group device stations with the same settings for "Network Synchronous Communication" and "Communication Period Setting" in the "CC-Link IE TSN Configuration" window, and set the range of link devices assigned to that group to be continuous. A setting example is shown below.

No.	Model Name	STA#	Station Type	Network Label	RX Setting			RY Setting			RWr Setting			RWw Setting			LB Setting			LW Setting			Parameter Automatic Setting		Network Synchronous Communication	Communication Period Setting
					Points	Start	End	Points	Start	End	Points	Start	End	Points	Start	End	Points	Start	End	Points	Start	End				
0	Host Station	0	Master Station																						
1	NZ2GN12A4-16D	1	Remote Station		16	0000	000F	16	0000	000F	16	0000	000F	16	0000	000F								<Detail Setting>	Asynchronous	Basic Period
2	NZ2GN12A4-16D	2	Remote Station		16	0010	001F	16	0010	001F	16	0010	001F	16	0010	001F								<Detail Setting>	Asynchronous	Basic Period
3	NZ2GN12A4-16D	3	Remote Station		16	0020	002F	16	0020	002F	16	0020	002F	16	0020	002F								<Detail Setting>	Asynchronous	Normal-Speed
4	NZ2GN12A4-16D	4	Remote Station		16	0030	003F	16	0030	003F	16	0030	003F	16	0030	003F								<Detail Setting>	Asynchronous	Normal-Speed
5	NZ2GN12A4-16D	5	Remote Station		16	0040	004F	16	0040	004F	16	0040	004F	16	0040	004F								<Detail Setting>	Asynchronous	Low-Speed
6	NZ2GN12A4-16D	6	Remote Station		16	0050	005F	16	0050	005F	16	0050	005F	16	0050	005F								<Detail Setting>	Asynchronous	Low-Speed
7	NZ2GN12A4-16D	7	Remote Station		16	0060	006F	16	0060	006F	16	0060	006F	16	0060	006F								<Detail Setting>	Synchronous	Basic Period
8	NZ2GN12A4-16D	8	Remote Station		16	0070	007F	16	0070	007F	16	0070	007F	16	0070	007F								<Detail Setting>	Synchronous	Basic Period
9	NZ2GN12A4-16D	9	Remote Station		16	00A0	00AF	16	00A0	00AF	16	00A0	00AF	16	00A0	00AF								<Detail Setting>	Synchronous	Normal-Speed
10	NZ2GN12A4-16D	10	Remote Station		16	00B0	00BF	16	00B0	00BF	16	00B0	00BF	16	00B0	00BF								<Detail Setting>	Synchronous	Normal-Speed
11	NZ2GN12A4-16D	11	Remote Station		16	0080	008F	16	0080	008F	16	0080	008F	16	0080	008F								<Detail Setting>	Synchronous	Basic Period
12	NZ2GN12A4-16D	12	Remote Station		16	0090	009F	16	0090	009F	16	0090	009F	16	0090	009F								<Detail Setting>	Synchronous	Basic Period

- Station numbers 1 and 2: Groups where "Network Synchronous Communication" is "Asynchronous" and "Communication Period Setting" is "Basic Period"
- Station numbers 3 and 4: Groups where "Network Synchronous Communication" is "Asynchronous" and "Communication Period Setting" is "Normal-Speed"
- Station numbers 5 and 6: Groups where "Network Synchronous Communication" is "Asynchronous" and "Communication Period Setting" is "Low-Speed"
- Station numbers 7 and 8: Groups where "Network Synchronous Communication" is "Synchronous" and "Communication Period Setting" is "Basic Period"
- Station numbers 9 and 10: Groups where "Network Synchronous Communication" is "Synchronous" and "Communication Period Setting" is "Normal-Speed"
- Station numbers 11 and 12: Groups where "Network Synchronous Communication" is "Synchronous" and "Communication Period Setting" is "Low-Speed"

2. Similarly, set the device assignments to be continuous on "CPU Side".
3. Before making the refresh settings, reassign the devices at each device station using "Communication Period Interval Shortening Assignment" on the "CC-Link IE TSN Configuration" window. (☞ Page 169 Device number reassignment)

■Example of refresh settings that can shorten the communication cycle interval

No.	Link Side					CPU Side				
	Device Name	Points	Start	End		Target	Device Name	Points	Start	End
-	SB									
-	SW									
1	RX	192	00000	000BF		Specif	X	192	01000	010BF
2	RY	192	00000	000BF		Specif	Y	192	01000	010BF
3	RWr	192	00000	000BF		Specif	W	192	00000	000BF
4	RWw	192	00000	000BF		Specif	W	192	01000	010BF

- The device ranges from the start to the end of "RX Setting/RY Setting" and "RWr Setting/RWw Setting", which are assigned by "Communication Period Interval Shortening Assignment" in the "CC-Link IE TSN Configuration" window, are continuously set in the "Link Side" of the "Refresh Setting" window. In line with this, "Target" in "CPU Side" is also set to a continuous device range.
- The number of refresh settings is reduced.

■Example of refresh settings that cannot shorten the communication cycle interval

No.	Link Side					CPU Side				
	Device Name	Points	Start	End		Target	Device Name	Points	Start	End
-	SB									
-	SW									
1	RX	176	00000	000AF		Specif	X	176	01000	010AF
2	RX	16	000B0	000BF		Specif	X	16	02000	020F
3	RY	192	00000	000BF		Specif	Y	192	01000	010BF
4	RWr	192	00000	000BF		Specif	W	192	00000	000BF
5	RWw	192	00000	000BF		Specif	W	192	01000	010BF

- The device ranges of "Target" of "CPU Side" are separated between No.1 and No.2, and are not set continuously.
- The number of refresh settings is increased.

Precautions

■Latched CPU function part devices

If data in latched devices of the CPU function part are cleared to zero on a program when the programmable controller is powered off and on or reset, the data may be output without being cleared to zero, depending on the timing of the cyclic data transfer processing and refresh.

Device of CPU function part	How to disable the device data
File register (ZR)	The device value is cleared to 0 by using the device initial value of the CPU function part. (☞ Page 426 Setting device initial values)
Devices of CPU function part in latch range	Delete all the latch range settings specified in "Latch Interval Operation Setting" under "Device Latch Interval Setting" in "Memory/Device Setting" of the CPU function part.

46.3 Direct Access to Link Devices

The corresponding data is directly read or written from/to link devices of the CC-Link IE TSN function part using the program.
Specify a link device as the link direct device (J□\□) for direct access.
The link special relay (SB) and link special register (SW) can be set using module label. (☞ Page 399 LABELS)

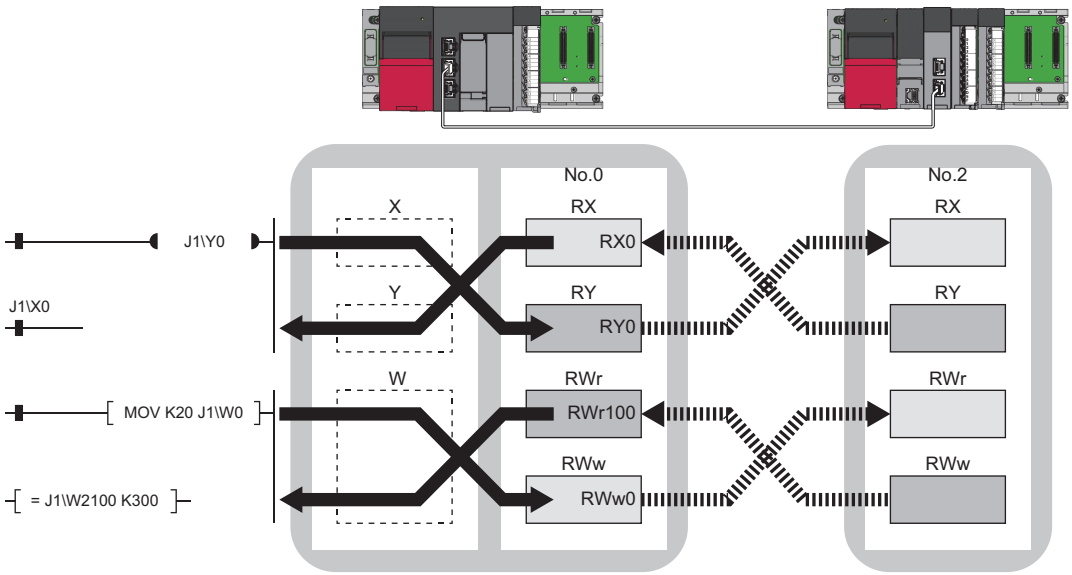
Specification method

Specify the network number and the link devices of the CC-Link IE TSN function part for reading or writing data.

J□\□
(1) (2)

(1) Network number: 1 to 239
(2) Remote input (RX): X0 to X3FFF
Remote output (RY): Y0 to Y3FFF
Remote register (RWw): W0 to W1FFF
Remote register (RWr): W2000 to W3FFF
Link special relay (SB): SB0 to SBFFF
Link special register (SW): SW0 to SWFFF

Ex.



Readable and writable range

Data can be read or written from/to the CC-Link IE TSN function part in the controller.

■Read

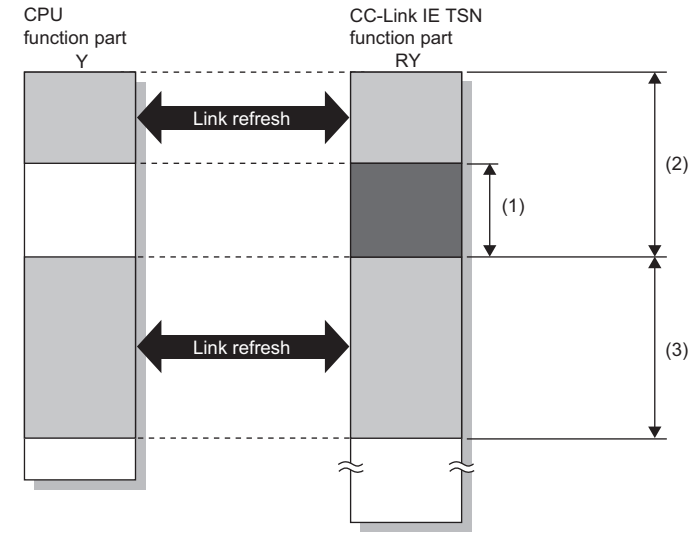
All link devices in the CC-Link IE TSN function part can be specified. (☞ Page 1241 Specification method)

■Write

The range that satisfies all of the following conditions can be specified.

- Area where data is sent to other stations and outside the refresh range (☞ Page 1235 Communications Using RX, RY, RWr, and RWw)
- Link device range in the CC-Link IE TSN function part (☞ Page 1241 Specification method)

Ex.



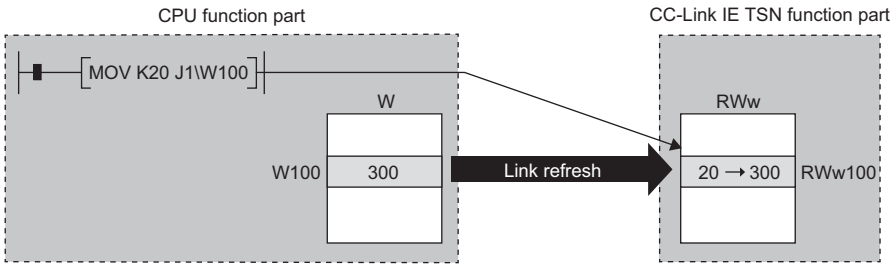
(1) Out of the refresh range (Data can be written here.)
(2) Area where data is sent to other stations
(3) Area for receiving data from other stations

Point

When writing data to the area in the refresh range, directly access the link device and write the same data in the device of the CPU function part.

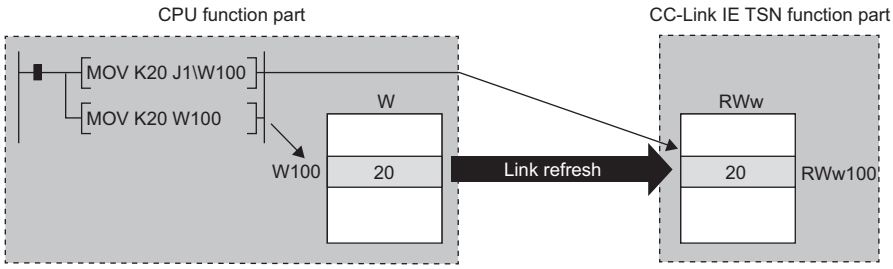
• Bad example (Directly accessing the refresh target only)

Refresh overwrites the value.



• Good example (Directly accessing the link device as well as writing the same data to the device of the CPU function part)

The value written by the direct access is reflected.



Differences from link refresh

Item	Access method	
	Link refresh	Direct access
Number of steps	1 step	2 steps
Processing speed	High speed	Low speed*1
Cyclic data assurance	Available	Not available

*1 For the instruction processing time when the link direct device (J□\□) is used, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Precautions

■Cyclic data assurance

The direct access to link devices does not provide station-based block data assurance. Use 32-bit data assurance. (☞ Page 1244 Cyclic Data Assurance)

■Mounting multiple modules of the same network number

When multiple CC-Link IE TSN master/local modules with the same network number are mounted on the base unit to which the controller is also mounted, direct access to the link device targets the CC-Link IE TSN function part in the controller.

■Link direct access to synchronous stations

Link direct access to link devices of synchronous stations cannot be used. If the link device of a synchronous station is read by link direct access, an undefined value will be read. When writing to the link device of a synchronous station by link direct access, the written value will not be transmitted from the master station to the device station.

46.4 Cyclic Data Assurance

This function assures the cyclic data assurance in units of 32 bits or station-based units.

○: Assured, ×: Not assured

Method	Description	Link refresh		Direct access to link devices	Access to buffer memory
		CPU device	Network label		
32-bit data assurance	Assures data in 32-bit units. Data is automatically assured by ensuring that RWr and RWw satisfy the assignment conditions.	○	○	○	○
Station-based block data assurance	Assures data in station-based units. Data is assured by enabling the station-based block data assurance in the parameter setting.	○*1	○*1	×	×

*1 The station-based block data assurance is not available for data of a station whose "Network Synchronous Communication" is set to "Asynchronous" and "Communication Period Setting" is set to "Normal-Speed" or "Low-Speed" in the "CC-Link IE TSN Configuration" window.

Point

When a remote station is in the network, use station-based block data assurance. If it is disabled, the functions of the remote station cannot be assured.

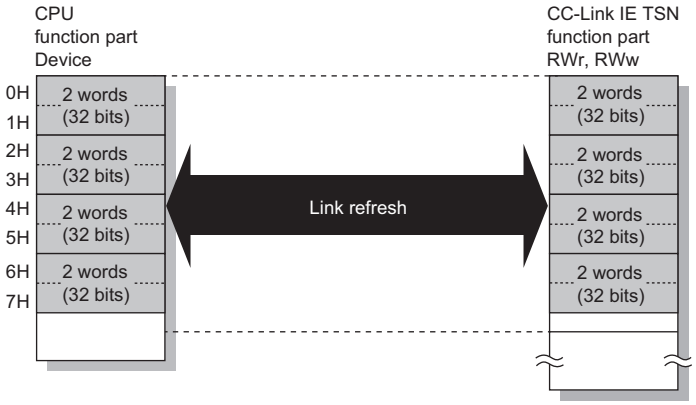
32-bit data assurance

RWr and RWw data that satisfy the following conditions can be assured in 32-bit units.

- The start device number of RWr and RWw is a multiple of 2.
- The number of points assigned to RWr and RWw is a multiple of 2.

■Data assurance at link refresh (CPU device)

By link refreshing RWr and RWw that satisfy the conditions for 32-bit data assurance, 32-bit data is also assured for the refresh target CPU device of the CPU function part.

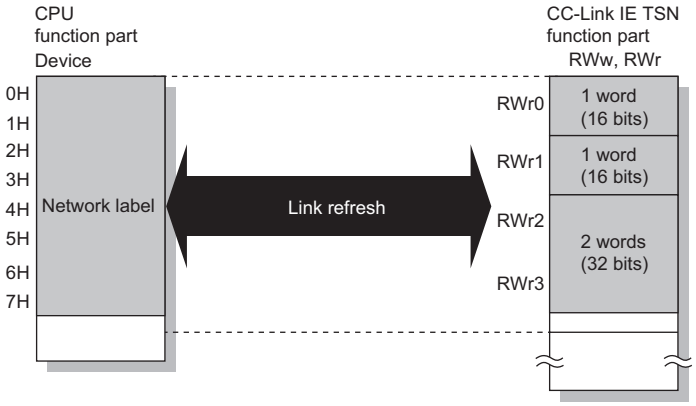


■Data assurance at link refresh (network label)

For RWr and RWw that satisfy the requirements for 32-bit data assurance, data are assured to be within 32 bits of data for network labels on a per-label (per-data) basis by satisfying the following conditions.

However, data assurance for multiple labels is not possible.

- The link device number assigned in "PDO Mapping Setting" in the "CC-Link IE TSN Configuration" window is a multiple of 2.



In the above case, RWr0, RWr1, and RWr2 + RWr3 are subject to 32-bit data assurance.
However, 32-bit data assurance for RWr0 and RWr1 combined is not possible.

■Data assurance at the time of direct access to link devices

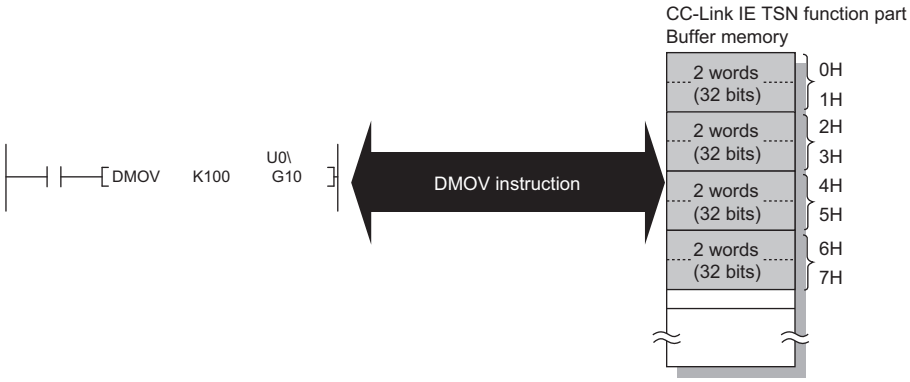
For RWr and RWw that satisfy the 32-bit data assurance conditions, 32-bit data is assured by satisfying the following conditions.

- Access using the DMOV instruction
- The start address of the buffer memory is a multiple of 2.

■Data assurance at the time of access to buffer memory

For RWr and RWw that satisfy the 32-bit data assurance conditions, 32-bit data is assured by satisfying the following conditions.

- Access using the DMOV instruction
- The start address of the buffer memory is a multiple of 2.



Station-based block data assurance

Cyclic data is assured for each station by a handshake between the CPU function part and the CC-Link IE TSN function part for a link refresh. The link device is assured as follows.

- RX, RY, RWw, and RWr data are assured for each station

■Setting

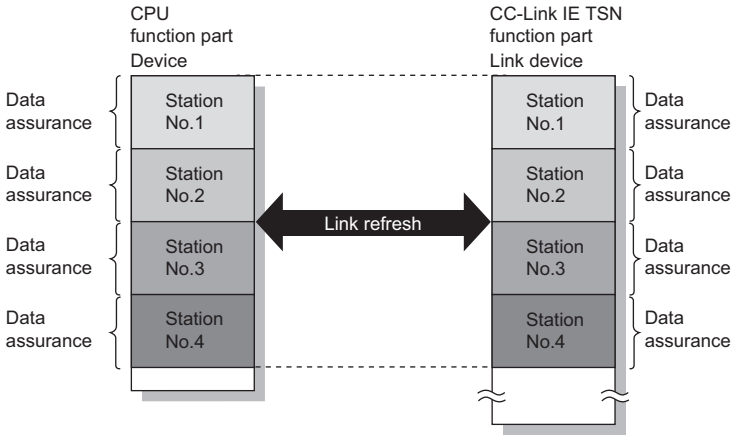
Set station-based block data assurance under "Supplementary Cyclic Settings" in "Application Settings" of the master station. Once this setting is enabled on the master station, the data for all stations is assured for each station.

Restriction

The station-based block data assurance is not available for data of a station whose "Network Synchronous Communication" is set to "Asynchronous" and "Communication Period Setting" is set to "Normal-Speed" or "Low-Speed" in the "CC-Link IE TSN Configuration" window.

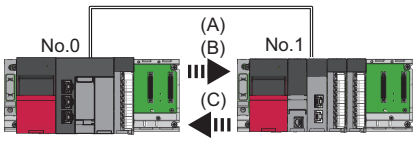
■Access to link devices

During a link refresh, data is assured for each station as shown below.



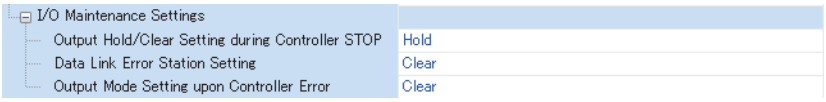
46.5 I/O Maintenance Settings

These settings hold or clear the output data when the controller is changed from RUN to STOP or when a stop error occurs, and the input data from the disconnected station.
Select whether to hold or clear the output data of No.0 or the input data from No.1 by using the following setting of (A), (B), or (C).



- Settings (A) and (B): Output is held/cleared when the controller is changed from RUN to STOP or a stop error occurs. (☞ Page 1248 Output settings during STOP or error)
- Setting (C): Input data is held/cleared from disconnected station. (☞ Page 1250 Data link error station setting)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings] ⇨ [Supplementary Cyclic Settings]



Item		Description	Setting range
I/O Maintenance Settings	Output Hold/Clear Setting during Controller STOP	Setting (A): Select whether to hold or clear output when the controller changes from RUN to STOP.	• Hold • Clear (Default: Hold)
	Data Link Error Station Setting	Setting (C): Select whether to hold or clear input data from a disconnected station to the controller.	• Clear • Hold (Default: Clear)
	Output Mode Setting upon Controller Error	Setting (B): Select whether to hold or clear output when a stop error occurs in the controller.	• Clear • Hold (Default: Clear)

Output settings during STOP or error

When the CPU/motion function of the controller is changed from RUN to STOP or stops with an error, the output is held or cleared.

Operation conditions depend on whether the module is controlled by the motion system. (☞ Page 530 Specifications of Modules on CC-Link IE TSN Configuration Controlled by the Motion System)

- Modules that is not controlled by the motion system: This setting operates when the CPU function is changed to STOP state or the program is stopped due to an error occurring in the controller.
- Modules that is controlled by the motion system: This setting operates when the motion function is changed to STOP state or the motion operation is stopped due to an error occurring in the controller.

The RUN/STOP states of the CPU function can be checked with the system monitor. (☞ Page 1680 System monitor)

The RUN/STOP states of the motion function can be checked with the labels. (☞ Page 279 Operating Statuses)

The presence of a stop error in the CPU function and motion function can be checked with the module diagnostics. (☞ Page 1681 Module diagnostics)

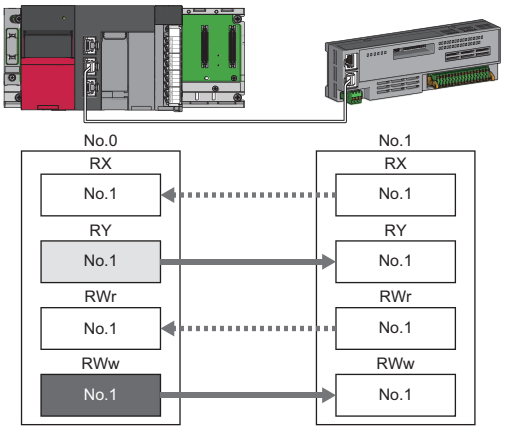
The settings are described below using setting (A) and setting (B).

- Setting (A): "Output Hold/Clear Setting during Controller STOP"
- Setting (B): "Output Mode Setting upon Controller Error"

Operation differences depending on RUN/STOP, stop error, and settings

Output (RY) is held or cleared as follows, depending on the RUN/STOP state, the presence of a stop error, and settings (A) and (B).

Output (RWw) is held regardless of the RUN/STOP state, the presence of a stop error, and settings (A) and (B).



■In the STOP state without stop error

Output (RY) operates as follows depending on setting (A) and refresh target.

Setting (A): "Output Hold/Clear Setting during Controller STOP"	Refresh target: Y	Refresh target: Other than Y (such as M and L), network label
Hold	Output (RY) is cleared.	Output (RY) is held.
Clear	Output (RY) is cleared.	Output (RY) is cleared.

■In the RUN state with stop error

Output (RY) operates as follows according to setting (B).

Setting (B): "Output Mode Setting upon Controller Error"	Refresh target: Y	Refresh target: Other than Y (such as M and L), network label
Hold	Output (RY) is held.	Output (RY) is held.
Clear	Output (RY) is cleared.	Output (RY) is cleared.

■In the STOP state with stop error

Output (RY) is held when setting (A) and setting (B) are both "Hold" as shown below.

The output is cleared if either of setting (A) or setting (B) is "Clear".

Setting (A): "Output Hold/ Clear Setting during Controller STOP"	Setting (B): "Output Mode Setting upon Controller Error"	Refresh target: Y	Refresh target: Other than Y (such as M and L), network label
Hold	Hold	Output (RY) is held.	Output (RY) is held.
Hold	Clear	Output (RY) is cleared.	Output (RY) is cleared.
Clear	Hold	Output (RY) is cleared.	Output (RY) is cleared.
Clear	Clear	Output (RY) is cleared.	Output (RY) is cleared.

Precautions

- If an engineering tool is used to force output to a device station while both settings (A) and (B) are set to "Clear", forced output becomes invalid and the output of the device station is cleared.
- If an engineering tool is used to force output to a device station while both settings (A) and (B) are set to "Hold", forced output becomes valid and the output of the device station is not held.
- If refresh targets are not set, the operation is the same as when a device refresh target other than Y is set.
- Output (RY) to the servo amplifier whose motion is not controlled is held or cleared in the same way as above, depending on the RUN/STOP state, the presence or absence of a stop error, and settings (A) and (B).
- Output (RY) to the servo amplifier controlled by the motion system is held regardless of the RUN/STOP state, the presence or absence of a stop error, and settings (A) and (B).

Data link error station setting

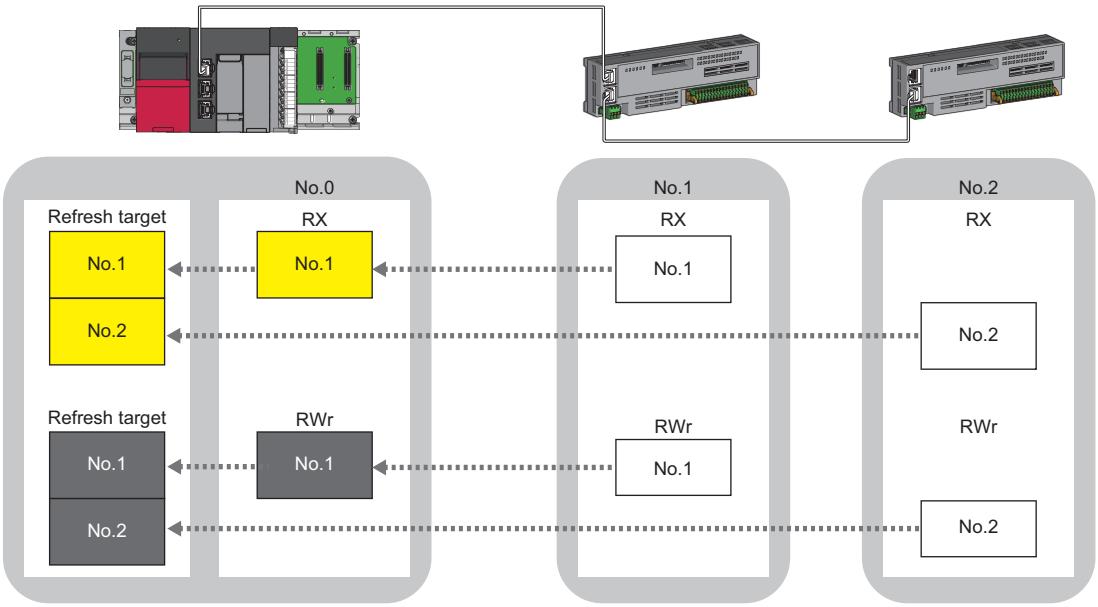
Setting (C): "Data Link Error Station Setting" selects whether to clear or hold the input from a disconnected station.

Ex.

This example shows the devices for which the "Data Link Error Station Setting" is valid when "Network Synchronous Communication" in the "CC-Link IE TSN Configuration" window is set as follows.

Device station (station No.1): Asynchronous (asynchronous station)

Device station (station No.2): Synchronous (synchronous station)



: Devices that are held or cleared according to setting (C): "Data Link Error Station Setting"

: Devices that are held regardless of setting (C)

46.6 CANopen Communications

This section describes controlling a servo amplifier that supports the CANopen profile by using the same simple operations as input/output devices.

Example: Simple positioning operation using the built-in positioning function of the servo amplifier

There are two types of CANopen communication as shown below.

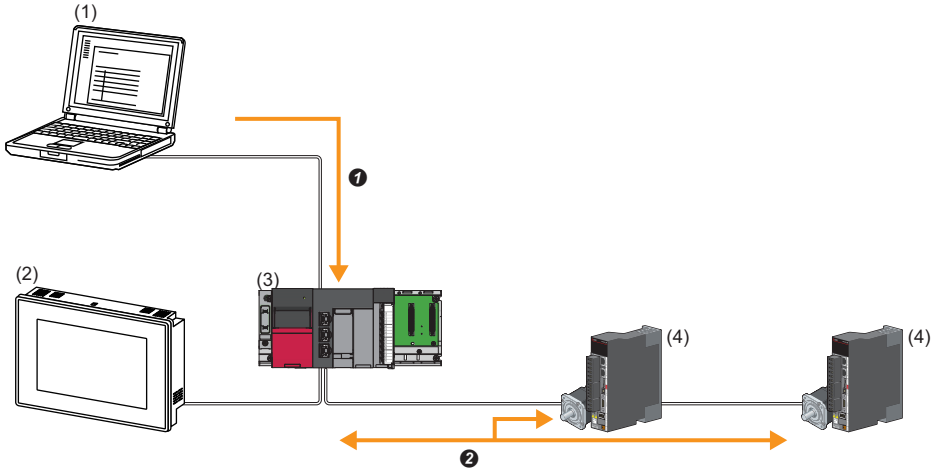
- PDO communication using cyclic transmission
- SDO communication using transient transmission

PDO communication using cyclic transmission

PDOs (object data for controlling the servo amplifier) are input and output using cyclic transmission.

Each PDO is placed on a link device in the CC-Link IE TSN function part according to the PDO mapping setting.

The PDO mapping setting is distributed to the servo amplifier when cyclic communication starts.



(1) Engineering tool
(2) HMI (Human Machine Interface)
(3) Controller
(4) Servo amplifier
❶ Writing PDO mapping settings
❷ PDO communications

Setting method

Set the parameter of "Batch Setting of PDO Mapping" or "PDO Mapping Setting" for PDO communication in the "CC-Link IE TSN Configuration" window. (☞ Page 165 PDO mapping setting)

Precautions

■PDO mapping

- When a servo amplifier is added to the device station in the "CC-Link IE TSN Configuration" window, perform "PDO Mapping Setting". Otherwise, an error occurs in the engineering tool.
- Ensure that the number of set entries does not exceed 64.
- When using the watchdog counter, set an object of the watchdog counter for both TPDO and RPDO. If the watchdog counter is not used, delete any objects of the watchdog counter from both TPDO and RPDO. (☞ Page 289 Watchdog counter)
- When writing is performed to objects assigned to a link device in the PDO mapping setting using SDO communication, the written value is overwritten by PDO communication. To write the value using SDO communication, delete the setting of the corresponding object from the PDO mapping setting.

■Watchdog counter

When using the watchdog counter, set an object of the watchdog counter for both TPDO and RPDO. If the watchdog counter is not used, delete any objects of the watchdog counter from both TPDO and RPDO. (☞ Page 289 Watchdog counter)

■SDO communication

When writing is performed to object assigned to link device in the PDO mapping setting using SDO communication, the written value is overwritten by PDO communication. To write the value using SDO communication, delete the setting of the corresponding object from the PDO mapping setting.

■Multi-axis servo amplifier

For a multi-axis servo amplifier, single module can use up to eight axes.
If nine or more axes are set, a parameter error (error code: 3ADDH) occurs, and a parameter error (multidrop number) (error code: D658H) is stored in SW004C (parameter setting status).

■Event code

After a data link, check the event history to see if a CANopen initialization failure (event code: 00C70H) has occurred.
If the failure occurs, PDO communication cannot be performed normally. Take the appropriate action according to the detailed information of the event code.

SDO communication using transient transmission

This applies to servo amplifiers controlled by the motion system. (☞ Page 530 Specifications of Modules on CC-Link IE TSN Configuration Controlled by the Motion System)

SDO communication uses the dedicated instruction SLMPSND. For details on the dedicated instruction SLMPSND, refer to the following.

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

SLMP command

The following table lists SLMP commands that can be used in SDO communication.

Command name	Command	Subcommand	Description
ReadObject (read object)	4020H	0001H	Reads object data of a device station.
WriteObject (write object)	4020H	0002H	Writes object data of a device station.
ObjectSubIDReadBlock (SubIndex continuous read)	4020H	0005H	Reads the object SubIndex continuously.
ObjectSubIDWriteBlock (SubIndex continuous write)	4020H	0006H	Writes the object SubIndex continuously.
GetOdList (get index list of objects)	4020H	0009H	Reads the index list of objects supported by the device.
GetObjectDescription (get details of object)	4020H	000AH	Reads the detailed list of object (Index).
GetEntryDescription (get details of entry)	4020H	000BH	Reads the detailed list of object (Sub index).

47 TRANSIENT TRANSMISSION

This function is used for data exchange at any timing.

- Communications using a dedicated instruction: 📖MELSEC MX Controller MX-R Model Programming Manual
- SLMP communications: ☞ Page 1254 Communications Using the SLMP

Restriction

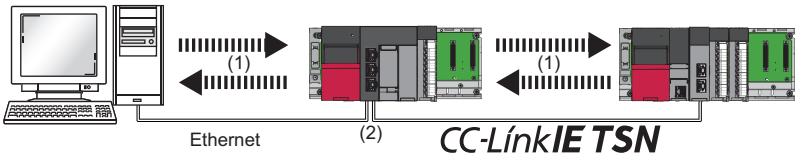
Set the send data size of transient transmission to 259 bytes maximum.

47.1 Communications Using the SLMP

This function reads/writes data from the controller and an external device such as a personal computer or HMI (Human Machine Interface) to the CPU module of the master station or local station, the devices of the CPU function part of the controller, or the buffer memory areas of the remote station via an SLMP.

The controller sends and receives (1), and relays (2) SLMP messages. For details on an SLMP, refer to the following.

📖SLMP Reference Manual



It allows seamless communications with stations of different network types.

For communications using the SLMP from the controller, use a dedicated instruction (SLMP frame send). (📖MELSEC MX Controller MX-R Model Programming Manual)

Precautions

- For communications using the SLMP, set the same communication speed for the connected station and access destination. When different communication speeds are set for the connected station and access destination, communications using the SLMP may not be possible.
- There are different specifications and restrictions for communications using the SLMP, depending on whether the port used is for CC-Link IE TSN or for Ethernet. (☞ Page 1261 Difference Between Ports for CC-Link IE TSN and Ports for Ethernet)

47.2 Routing

This function sets the communication path required for transient transmission to the stations on a different network.

Dynamic routing setting

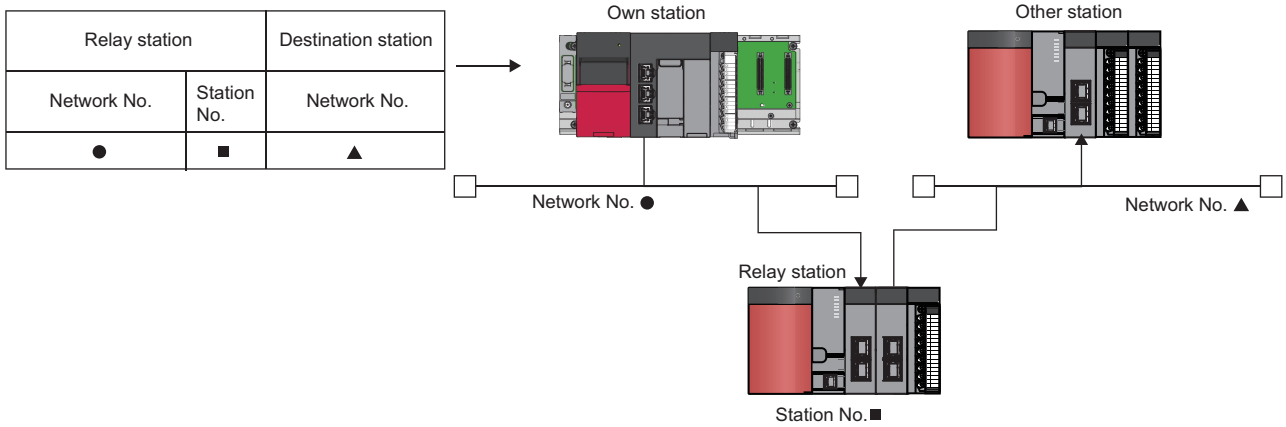
Since the controller supports dynamic routing, the communication path is automatically set by enabling the following.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings]

Item	Description	Setting range
Dynamic Routing	When communicating with different networks, select whether to enable or disable the dynamic routing function.	• Enable • Disable (Default: Enable)

Routing setting

The user can configure any communication path to perform transient transmission to stations on a different network. This setting can be used when the system has a network module which does not support dynamic routing or when it is necessary to clearly specify a communication path.

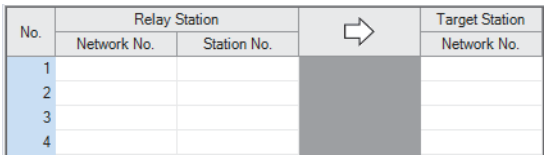


Setting method

The user must specify the following: The network number and the station number of the own network (relay station) which will be passed through to another network, and the network number of the final arrival network (destination station). The maximum 238 routing settings can be specified.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Routing Setting]

Window



Displayed items

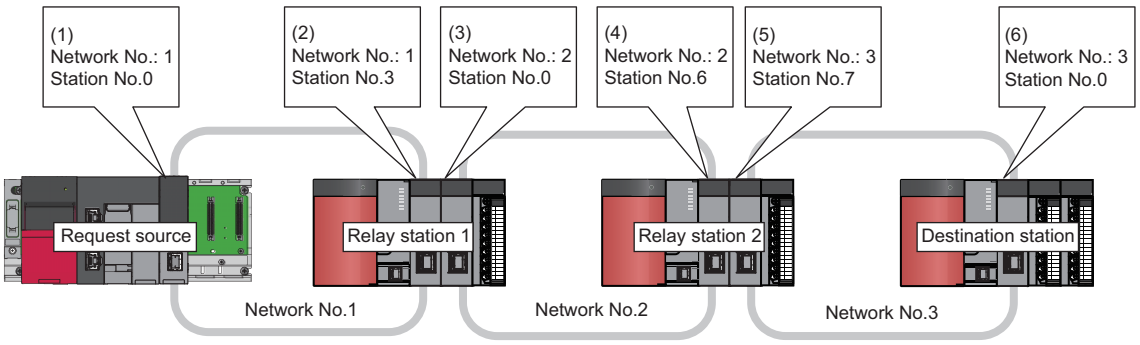
Item		Description	Setting range	Default
Relay Station	Network No.	Sets the network number of the first relay station to pass through to the destination station.	1 to 239	—
	Station No.	Sets the station number of the first relay station to pass through to the destination station.	0 to 120	—
Target Station	Network No.	Sets the network number of the final arrival network.	1 to 239	—

Setting example

The following is an example of the routing setting.

Ex.

Transient transmission from the request source (Network No.1) to the target (Network No.3) via Network No.2



Station	Request route	Response route
Request source	(1) Relay station: Network No. 1, Station No. 3; Destination station: Network No. 3 The data is transferred to the relay station (2) of the own network to go to the network No.3.	(1)
Relay station 1	(2) (3) Relay station: Network No. 2, Station No. 6; Destination station: Network No. 3 The data is transferred to the relay station (4) of the own network to go to the network No.3.	(2) (3) The data has been transferred to the network No.1, and is to be transferred to (1).
Relay station 2	(4) (5) The data has been transferred to the network No.3, and is to be transferred to (6).	(4) (5) Relay station: Network No. 2, Station No. 0; Destination station: Network No. 1 The data is transferred to the relay station (3) of the own network to go to the network No.1.
Destination station	(6)	Relay station: Network No. 3, Station No. 7; Destination station: Network No. 1 The data is transferred to the relay station (5) of the own network to go to the network No.1.

48 OTHERS

48.1 Reserved Station Setting

A reserved station is a device station that is set in the parameters and included as a station in the network when its number is counted. This station is reserved for future network expansion and is not actually connected. Therefore, it is not detected as a faulty station despite being not connected. (☞ Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings))

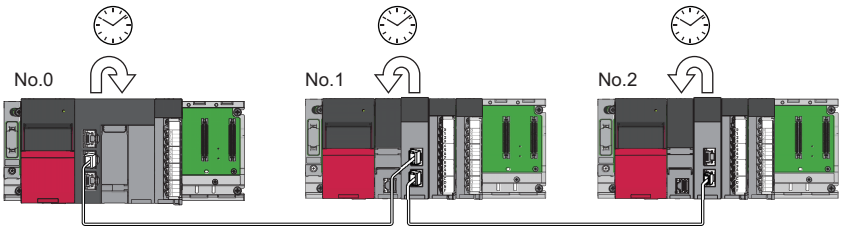
By setting a reserved station, link device assignment will not change even if the device station is connected (or the reservation is cleared). Therefore, modification of the program is not required.

48.2 Error Invalid Station Setting

An error invalid station is a device station that is set to be not detected as a faulty station by the master station. It is also set when a device station is to be replaced during a data link. (☞ Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings))

48.3 Time Synchronization

This function synchronizes the time of device stations with the time synchronization source (controller of the master station).



Setting method

The time synchronization is set with the buffer memory. (☞ Page 2066 Time synchronization)

Point

When the controller is used as the master station, do not connect time synchronization devices whose time synchronization priority is 0 to 15.

A priority is a value that is assigned to a time synchronization device from the devices in a network to determine the grandmaster. The smaller the value, the higher the priority.

For the priority verification method and setting method, refer to the manual of the time synchronization device.

MEMO

PART 12 Ethernet

This part consists of the following chapters.

49 SLMP COMMUNICATION

50 SIMPLE CPU COMMUNICATION FUNCTION

51 PREDEFINED PROTOCOL COMMUNICATIONS

52 SOCKET COMMUNICATIONS

53 FTP FUNCTIONS

54 WEB SERVER FUNCTION

55 OPC UA COMMUNICATION FUNCTION

56 OTHERS

49 SLMP COMMUNICATION

SLMP communications are available among devices that can receive/send messages with the SLMP control procedure. The controller processes and transfers data following instructions (command) from the external device, so the controller only needs the open/close processing and does not require a program for data communications. (☞ Page 1264 List of Valid Commands)

- When setting up a communication route that crosses the trust boundary, the communication contents can be protected by using the encrypted communication function. (☞ Page 1558 Encrypted Communication Function)
- For communications using the SLMP from the controller, use a dedicated instruction (SLMP frame send and encrypted SLMP frame send). (📖MELSEC MX Controller MX-R Model Programming Manual)

For SLMP communications, refer to the following.

📖SLMP Reference Manual

49.1 Applications

This section describes the applications of SLMP communications.

Data read/write

Data read/write can be executed for the following data. With this, the external device can monitor the operation of the controller, analyze data, and control production.

- Controller device or global label
- Buffer memory of the intelligent function module

File read/write

Files such as parameter files stored in a controller can be read/written. Files in a controller can be managed on an external device.

Controller remote control

A controller can be remotely controlled from the external device using remote operations.

Access to the programmable controller on another station via other network

In systems with CC-Link IE Controller Network, CC-Link IE Field Network, MELSECNET/H, MELSECNET/10 or Ethernet, the programmable controller on another station can be accessed from the external device via the network. However, when connecting the external device to the controller, other stations cannot be accessed via network such as CC-Link IE Controller Network and CC-Link IE Field Network.

For details on the settings required for accessing other stations, refer to the following.

☞ Page 1255 Routing

49.2 Difference Between Ports for CC-Link IE TSN and Ports for Ethernet

There are different specifications and restrictions as shown below for communications using the SLMP, depending on whether the port used is for CC-Link IE TSN or for Ethernet. The port position is from P1 to P3. (☞ Page 50 MX-R Model)

○: Supported, ×: Not supported

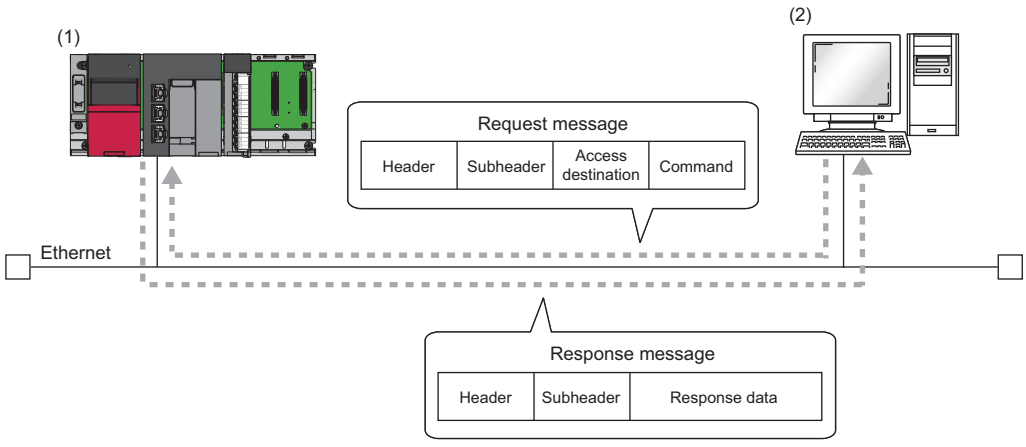
Item		Port for CC-Link IE TSN	Port for Ethernet
Encrypted communication (TLS, DTLS)		×	○
Port number used		• 5000 (1388H): Auto-open UDP port • 5010 (1392H): Unencrypted communication (UDP) • 5011 (1393H): Unencrypted communication (TCP)	• 5005 (138DH): Auto-open UDP port • Specified No.: Unencrypted communications (TCP, UDP) • Specified No.: Encrypted communication (TLS, DTLS)
3E frame		○ (Binary code, ASCII code)	○ (Binary code)
4E frame		○ (Binary code, ASCII code)	○ (Binary code)
Station number extension frame		○ (Binary code)	×
Dedicated instruction (SLMP frame send)	G(P).SLMPSND	○	○
	J(P).SLMPSND	○	×
	SP.SLMPSND	×	○
Dedicated instruction (encrypted SLMP frame send)	G(P).SLMPSNDC	×	○

Precautions

When UDP or DTLS is used as the communication protocol, problems such as loss of data and data arrival order interchange may occur. If such a problem occurs, consider using the TCP or TLS protocol.

49.3 Communication Structure

When a message is sent from the external device to the controller using the SLMP message format, the controller executes a processing corresponding to the received message. During communications, the controller functions as a server and the external device (terminals such as a personal computer) functions as the client. The server (controller) automatically returns a response message suitable for the request message received from the client.



(1) Server side: Controller
(2) Client side: External device

49.4 Data Communication Procedures

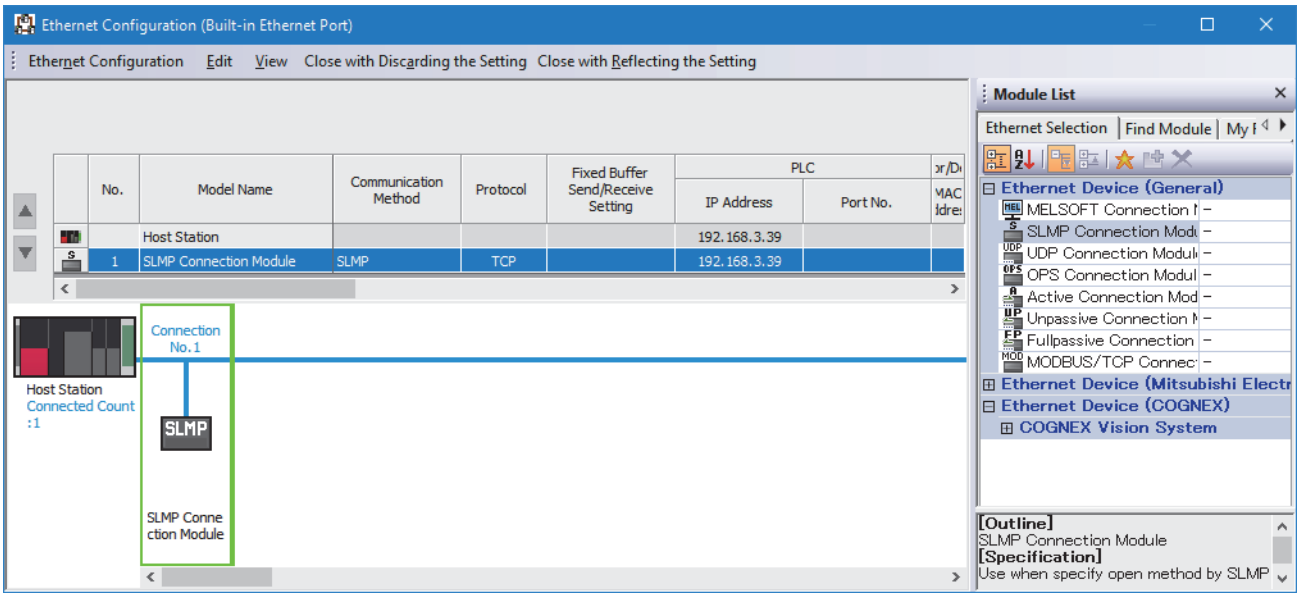
This section describes the procedures for communicating with SLMP.

1. After the module parameters are set, the system checks that the initial processing of the controller has ended normally. ('Initial status' (U3E0\G683.0): On)
2. Perform the open processing to establish a connection between the controller and external device.
3. After the connection is established, the SLMP messages are sent from the external device.
4. Close the connection when communications are finished.

Setting method

Set in "External Device Configuration" of "Basic Settings" in "Module Parameter (Ethernet)". (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

1. Select "SLMP Connection Module" in "Module List" and drag it to the list of devices or device map area.



2. Set the other items to the connection if required.

Point

To set encrypted communications (TLS/DTLS), refer to the following.

☞ Page 1558 Encrypted Communication Function

Precautions

Note that if encrypted communication (TLS/DTLS) is interrupted due to cable disconnection or other issues, communication may not be possible even after recovery.

If communication fails while the own station is operated as a server device, close the server device connection using the SOCCLOSE instruction, then open it again using the SOCOPEN instruction.

Communications using an auto-open UDP port

The auto-open UDP port is used for communications with SLMP.

The auto-open UDP port is a UDP port that automatically opens and closes at the following timing. When this port is used, communications are enabled when the initial processing is completed. Communications can be performed without a program regardless of the connection open status.

■Open/close timing

After the controller initial processing completes, the port automatically opens according to the registered parameter settings. The port automatically closes when the power for the controller-equipped station turns off or is reset.

Point

- When the initial processing ends normally, the controller enables communications using an automatic open UDP port, and waits for a communication request to the controller on the own station. (Automatic open)
- The controller accepts and processes requests from anywhere as long as they are addressed to the controller itself.
- If a communication request is received from an external device, the corresponding port number is occupied until that processing ends. Even if another communication request is accepted during this time, the communication processing will be waited.

49.5 List of Valid Commands

The following table lists the commands that can be executed from the external device to the controller. For details on each command, refer to the following.

📖SLMP Reference Manual

☐ in the following sub-command field differs according to the specified device.

Item		Command	Sub command	Description
Type	Operation			
Device	Read	0401	00☐1	Reads value from the bit devices (consecutive device No.) in one-point units.
			00☐0	• Reads values from the bit device (consecutive device No.) in 16-point units. • Reads value from the word devices (consecutive device No.) in one-word units.
			00☐3	Reads value from the bit devices (consecutive device No.) in one-point units.
			00☐2	• Reads values from the bit device (consecutive device No.) in 16-point units. • Reads value from the word devices (consecutive device No.) in one-word units.
	Write	1401	00☐1	Writes value to the bit devices (consecutive device No.) in one-point units.
			00☐0	• Writes value to the bit devices (consecutive device No.) in 16-point units. • Writes value to the word devices (consecutive device No.) in one-word units.
			00☐3	Writes value to the bit devices (consecutive device No.) in one-point units.
			00☐2	• Writes value to the bit devices (consecutive device No.) in 16-point units. • Writes value to the word devices (consecutive device No.) in one-word units.
	Read Random	0403	00☐0	Specifies the device number and reads value from the word devices in one-word units or two-word units. This can be specified with inconsecutive device No.
			00☐2	Specifies the device number and reads value from the word devices in one-word units or two-word units. This can be specified with inconsecutive device No.
	Write Random	1402	00☐1	Specifies the device No. to bit device in one-point units and writes value. This can be specified with inconsecutive device No.
			00☐0	• Specifies the device No. to bit device in 16-point units and writes value. This can be specified with inconsecutive device No. • Specifies the device No. to word device in one-word units or two-word units and writes value. This can be specified with inconsecutive device No.
			00☐3	Specifies the device No. to bit device in one-point units and writes value. This can be specified with inconsecutive device No.
			00☐2	• Specifies the device No. to bit device in 16-point units and writes value. This can be specified with inconsecutive device No. • Specifies the device No. to word device in one-word units or two-word units and writes value. This can be specified with inconsecutive device No.
	Entry Monitor Device	0801	00☐0	Registers the device to be read by Execute Monitor (command: 0802).
			00☐2	
	Execute Monitor	0802	0000	Reads the value of device registered by Entry Monitor Device (command: 0801).
	Read Block	0406	00☐0	Reads data by treating n points of word devices or bit devices (one point is equivalent to 16 bits) as one block and specifying multiple blocks. This can be specified with inconsecutive device No.
			00☐2	
	Write Block	1406	00☐0	Writes data by treating n points of word devices or bit devices (one point is equivalent to 16 bits) as one block and specifying multiple blocks. This can be specified with inconsecutive device No.
			00☐2	
Label	Array Label Read	041A	0000	Reads data from array type labels or labels whose structure members are the array.
	Array Label Write	141A	0000	Writes data to array type labels or labels whose structure members are the array.
	Read Random	041C	0000	Specifies labels and reads the data.
	Write Random	141B	0000	Specifies labels and writes data.
Memory	Read	0613	0000	Reads the buffer memory data of the own station (SLMP-compatible device).*1
	Write	1613	0000	Writes the data in the buffer memory of the own station (SLMP-compatible device).*1
Remote Control	Remote Run	1001	0000	Executes the remote RUN to the access destination module.
	Remote Stop	1002	0000	Executes the remote STOP to the access destination module.
	Remote Pause	1003	0000	Executes the remote PAUSE to the access destination module.
	Remote Latch Clear	1005	0000	Executes the Remote Latch Clear to the access destination module.
	Remote Reset	1006	0000	Executes the Remote RESET to the access destination module.
	Read Type Name	0101	0000	Reads the model name and model code of the access destination module.

Item		Command	Sub command	Description
Type	Operation			
File	Read Directory/ File	1810	0040	Reads file list information.
	Search Directory/ File	1811	0040	Reads the presence of the specified file, file No., and file size.
	New File	1820	0040	Reserves storage area for the specified file.
	Delete File	1822	0040	Deletes a file.
	Copy File	1824	0040	Copies the specified file.
	Change File State	1825	0040	Changes file attributes.
	Change File Date	1826	0040	Changes the file creation date.
	Open File	1827	0040	Locks a file so that the content of the file is not changed by other devices.
	Read File	1828	0000	Reads the data of a file.
	Write File	1829	0000	Writes the contents in a file.
	Close File	182A	0000	Cancels the file lock by open processing.
Self Test		0619	0000	Tests whether the communications with external devices is normally executed or not.

*1 This type cannot be used for the port for CC-Link IE TSN. (☞ Page 50 MX-R Model)

50 SIMPLE CPU COMMUNICATION FUNCTION

Device data is sent and received between a controller connected via Ethernet and another controller or a CPU module.



Restriction

Before using this function, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

External devices capable of communication

The following table lists the external devices capable of communication and indicates whether encrypted communications are available.

Communication destination	Whether encrypted communication is available	Reference
MELSEC MX Controller MX-R Model (built-in Ethernet)	○	Page 1270 MELSEC MX Controller MX-R Model (built-in Ethernet)
MELSEC MX Controller MX-F Model (built-in Ethernet)	○	Page 1271 MELSEC MX Controller MX-F Model (built-in Ethernet)
MELSEC iQ-R (built-in Ethernet)	×	Page 1272 MELSEC iQ-R (built-in Ethernet)
MELSEC-Q (built-in Ethernet)	×	Page 1273 MELSEC-Q (built-in Ethernet), MELSEC-Q (Ethernet module)
MELSEC-L (built-in Ethernet)	×	Page 1274 MELSEC-L (built-in Ethernet), MELSEC-L (Ethernet module)
MELSEC iQ-F (built-in Ethernet)	×	Page 1275 MELSEC iQ-F (built-in Ethernet)
MELSEC iQ-L (built-in Ethernet)	×	Page 1275 MELSEC iQ-L (built-in Ethernet)
MELSEC-Q (Ethernet module)	×	Page 1273 MELSEC-Q (built-in Ethernet), MELSEC-Q (Ethernet module)
MELSEC-L (Ethernet module)	×	Page 1274 MELSEC-L (built-in Ethernet), MELSEC-L (Ethernet module)
MELSEC-A/AnS (Ethernet Module)	×	Page 1276 MELSEC-A/AnS (Ethernet Module)
MELSEC-FX3 (Ethernet Block/Adapter)	×	Page 1277 MELSEC-FX3 (Ethernet Block/Adapter)
SLMP Corresponding Device (QnA Compatible 3E Frame)	×	Page 1277 SLMP-compatible device (QnA-compatible 3E frame)

For encrypted communication settings, refer to the following.

☞ Page 1278 Encrypted communication settings

Setting data and range

The following table lists the setting ranges when the transfer source and transfer destination are the own station.

Target	Classification	Type	Remarks
Device*1	Bit	X (0 to 2FFFH), Y (0 to 2FFFH), M (0 to 167747583), L (0 to 32767), F (0 to 32767), B (0 to 9FF9FFFH), TS/TC (0 to 9319295)*3, STS/STC (0 to 9319295)*3, CS/CC (0 to 9319295)*3, SB (0 to 9FF9FFFH), SM (0 to 4495)	Configure the setting in increments of 16. Specify 0 or a multiple of 16 as the start number.
	Word	D (0 to 10484223), W (0 to 9FF9FFH), TN (0 to 9319295), STN (0 to 9319295), CN (0 to 9319295), SW (0 to 9FF9FFH), SD (0 to 4495), R (0 to 32767)*2, ZR (0 to 10452991)*2, RD (0 to 4194303)	Configure the setting in increments of 1.

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting".
*3 This device can be specified only when "Write" is set for "Communication Pattern".

Own station port number

Set the number when any of the following is selected as the communication destination.

- MELSEC-A/AnS (Ethernet Module)
- MELSEC-FX3 (Ethernet Block/Adapter)
- SLMP Corresponding Device (QnA Compatible 3E Frame)

Item	Setting range	Setting details	Default
Own station port number	1 to 4999, 5010 to 65534	Specify the port number of the own station.	Empty

Point

- In communications where the communication destination other than "MELSEC-A/AnS (Ethernet Module)", "MELSEC-FX3 (Ethernet Block/Adapter)", or "SLMP Corresponding Device (QnA Compatible 3E Frame)" is set, port numbers 61696 to 65534 are dynamically used for the own station port numbers. Therefore, when using this function, do not set 61696 to 65534 to the own station port numbers for the connection establishment instruction (SP.SOCOPEN). Otherwise, the instruction may be completed with an error.
- Port numbers 1 to 1023 are typically reserved port numbers (WELL KNOWN PORT NUMBERS) and 61440 to 65534 are used by other communication functions, so 1024 to 4999 or 5010 to 61439 should be used for the own station port numbers.
- When specifying the same communication destination in multiple settings, set different own station port numbers.

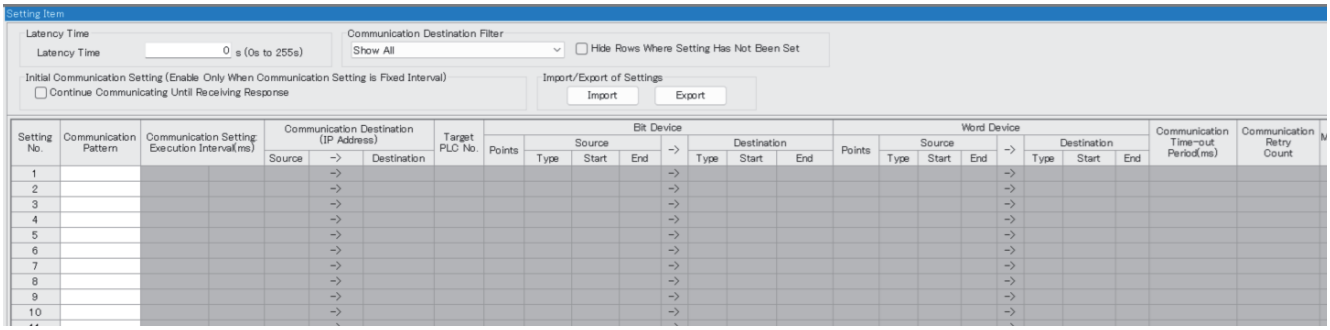
50.1 Setting Method

This section describes how to set up simple CPU communication.

1. Set "Enable" for "To Use or Not to Use Simple CPU Communication Setting" in "Simple CPU Communication Setting" under "Application Settings". (☞ Page 193 Simple CPU Communication Setting)

[Navigation window] ⇨ [Parameter] ⇨ Target module ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Application Settings] ⇨ [Simple CPU Communication Setting]

2. Double-click "<Detailed Setting>" of the "Simple CPU Communication Setting" to display the following window.



3. After setting the items, write the module parameters to the controller of the own station, and reset or power off and on the controller to start the simple CPU communication.

Communication pattern

Select the communication pattern from the following items.

Setting item	Description
Read	Read the data of the specified destination device (transmission source) to the specified device of the own station (transmission destination).
Write	Write the data of the specified device of the own station (transmission source) to the specified destination device (transmission destination).

Communication Setting: Execution Interval

Select the communication timing from the following items.

Setting item		Description	Setting range
Fixed Interval	—	Data are communicated between the devices at a specified execution interval.	—
	Execution Interval	Execution interval is set.	10ms to 65535ms (in increments of 1ms)
On Request		Data are sent and received only upon request.	—

Point

- Actual time of execution interval may be longer than the value of the setting because the time is affected by the specified communication destinations or Ethernet line congestion. For the preventive measures, refer to the following.

☞ Page 1739 When the simple CPU communication function is used

- If latency time is set, data communication is started after the latency time has passed. (☞ Page 1285 Latency Time)

Setting for each communication destination

MELSEC MX Controller MX-R Model (built-in Ethernet)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable model
MELSEC MX Controller MX-R Model (built-in Ethernet)	MELSEC MX Controller MX-R Model

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP, DTLS	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	1 to 4999, 5010 to 65534	The port number can be specified only when DTLS is specified as the protocol. Specify the port number of the communication destination that can communicate using DTLS. In addition, if the IP address is the same for each setting, specifying the same port number is prohibited.	Empty

■Data that can be communicated and range

When setting the amount of data that can be communicated, ensure that the maximum number of words per setting is 512 (8192 bits maximum, 512 words maximum) and 8192 words in total for all the settings.

Target	Classification	Type	Remarks
Device*1	Bit	X (0 to 2FFFH), Y (0 to 2FFFH), M (0 to 167747583), L (0 to 32767), F (0 to 32767), B (0 to 9FF9FFFH), TS/TC (0 to 9319295)*3, STS/STC (0 to 9319295)*3, CS/CC (0 to 9319295)*3, SB (0 to 9FF9FFFH), SM (0 to 4495)	Configure the setting in increments of 16. Specify 0 or a multiple of 16 as the start number.
	Word	D (0 to 10484223), W (0 to 9FF9FFH), TN (0 to 9319295), STN (0 to 9319295), CN (0 to 9319295), SW (0 to 9FF9FFH), SD (0 to 4495), R (0 to 32767)*2, ZR (0 to 10452991)*2, RD (0 to 4194303)	Configure the setting in increments of 1.

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".

■Setting for the communication destination number

Item	Setting range	Setting details	Default
Target PLC No.	Not specified (fixed)	Specifies the target number for the communication destination. It will be the connected station when "Not Specified" is selected.	Not Specified

MELSEC MX Controller MX-F Model (built-in Ethernet)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable model
MELSEC MX Controller MX-F Model (built-in Ethernet)	MELSEC MX Controller MX-F Model

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP, DTLS	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	1 to 4999, 5010 to 65534	The port number can be specified only when DTLS is specified as the protocol. Specify the port number of the communication destination that can communicate using DTLS. In addition, if the IP address is the same for each setting, specifying the same port number is prohibited.	Empty

■Data that can be communicated and range

When setting the amount of data that can be communicated, ensure that the maximum number of words per setting is 512 (8192 bits maximum, 512 words maximum) and 8192 words in total for all the settings.

Target	Classification	Type	Remarks
Device*1	Bit	X (0 to 2FFFH), Y (0 to 2FFFH), M (0 to 67084287), L (0 to 32767), B (0 to 3FF9FFFH), TS/TC (0 to 3726879)*3, STS/STC (0 to 3726879)*3, CS/CC (0 to 3726879)*3, SB (0 to 3FF9FFFH), SM (0 to 9999)	Configure the setting in increments of 16. Specify 0 or a multiple of 16 as the start number.
	Word	D (0 to 4192767), W (0 to 3FF9FFH), TN (0 to 3726879), STN (0 to 3726879), CN (0 to 3726879), SW (0 to 3FF9FFH), SD (0 to 9999), R (0 to 32767)*2, ZR (0 to 4161535)*2, RD (0 to 262143)	Configure the setting in increments of 1.

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".

MELSEC iQ-R (built-in Ethernet)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC iQ-R (built-in Ethernet)	MELSEC iQ-R series CPU module

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	Setting not possible	—	—

■Data that can be communicated and range

The following table lists the maximum number of points when the NZ2MC-16MBS is connected to the R120CPU. The number of points differs depending on the CPU module used, whether to use or not an extended SRAM cassette, or the type of the extended SRAM cassette.

Target	Classification	Type
Device*1	Bit	X (0 to 2FFFH), Y (0 to 2FFFH), M (0 to 161882111), L (0 to 32767), F (0 to 32767), B (0 to 9A61FFFH), TS/TC (0 to 8993439)*3, STS/STC (0 to 8993439)*3, CS/CC (0 to 8993439)*3, SB (0 to 9A61FFFH), SM (0 to 4095)
	Word	D (0 to 10117631), W (0 to 9A61FFH), TN (0 to 8993439), STN (0 to 8993439), CN (0 to 8993439), SW (0 to 9A61FFH), SD (0 to 4095), R (0 to 32767)*2, ZR (0 to 10027007)*2, RD (0 to 1048575)

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".

■Setting for the communication destination number

Item	Setting range	Setting details	Default
Target PLC No.	PLC No. 1 to 8	Specifies the target number for the communication destination. It will be the connected station when "Not Specified" is selected.	Not Specified

MELSEC-Q (built-in Ethernet), MELSEC-Q (Ethernet module)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC-Q (built-in Ethernet)	Built-in Ethernet port QCPU
MELSEC-Q (Ethernet module)	QCPU on which an Ethernet interface module can be mounted

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	Setting not possible	—	—

For MELSEC-Q (built-in Ethernet), configure the MELSOFT connection settings (connection settings) for the communication destination.

[PLC Parameter] ⇨ [Built-in Ethernet Port Setting] ⇨ [Open Setting]

For MELSEC-Q (Ethernet module), configure the Ethernet settings for the communication destination.

[Network Parameter] ⇨ [Ethernet] ⇨ [Operation Setting]

In addition, set the third octet of the request source IP address for the network number.

[Network Parameter] ⇨ [Ethernet/CC IE/MELSECNET]

■Data that can be communicated and range

The following table lists the maximum number of points when the Q4MCA-8MBS is connected to the Q26UDVCPU. The number of points differs depending on the CPU module used, whether to use or not an extended SRAM cassette, or the type of the extended SRAM cassette.

Target	Classification	Type
Device*1	Bit	X (0 to 1FFFH), Y (0 to 1FFFH), M (0 to 61439), L (0 to 32767), F (0 to 32767), B (0 to EFFFH), TS/TC (0 to 32767)*3, STS/STC (0 to 32767)*3, CS/CC (0 to 32767)*3, SB (0 to 7FFFH), SM (0 to 2047)
	Word	D (0 to 4910079)*4, W (0 to 4AEBFFH)*4, TN (0 to 32767), STN (0 to 32767), CN (0 to 32767), SW (0 to 7FFFH), SD (0 to 2047), R (0 to 32767)*2, ZR (0 to 4849663)*2

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".
*4 The maximum number of points when D (extended data register) or W (extended link register) is set

■Setting for the communication destination number

Item	Setting range	Setting details	Default
Target PLC No.	PLC No. 1 to 8	Specifies the target number for the communication destination. It will be the connected station when "Not Specified" is selected.	Not Specified

MELSEC-L (built-in Ethernet), MELSEC-L (Ethernet module)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC-L (built-in Ethernet)	Built-in Ethernet port LCPU
MELSEC-L (Ethernet module)	LCPU on which an Ethernet interface module can be mounted

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	Setting not possible	—	—

For MELSEC-L (built-in Ethernet), configure the MELSOFT connection settings (connection settings) for the communication destination.

[PLC Parameter] ⇨ [Built-in Ethernet Port Setting] ⇨ [Open Setting]

For MELSEC-L (Ethernet module), configure the Ethernet settings for the communication destination.

[Network Parameter] ⇨ [Ethernet] ⇨ [Operation Setting]

In addition, set the third octet of the request source IP address for the network number.

- For GX Works3

[Module Parameter] ⇨ [Communications by Network No./Station No.]

- For GX Works2

[Network Parameter] ⇨ [Ethernet/CC IE/MELSECNET]

■Data that can be communicated and range

The following table lists the maximum number of points for the L26CPU. The number of points varies depending on the CPU module used.

Target	Classification	Type
Device*1	Bit	X (0 to 1FFFH), Y (0 to 1FFFH), M (0 to 61439), L (0 to 32767), F (0 to 32767), B (0 to EFFFH), TS/TC (0 to 25471)*3, STS/STC (0 to 25471)*3, CS/CC (0 to 25471)*3, SB (0 to 7FFFH), SM (0 to 2047)
	Word	D (0 to 421887), W (0 to 66FFFH), TN (0 to 25471), STN (0 to 25471), CN (0 to 25471), SW (0 to 6FFFH), SD (0 to 2047), R (0 to 32767)*2, ZR (0 to 393215)*2

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".

MELSEC iQ-F (built-in Ethernet)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC iQ-F (built-in Ethernet)	MELSEC iQ-F series CPU module

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	Setting not possible	—	—

■Data that can be communicated and range

The following table lists the maximum number of points for the L26CPU. The number of points varies depending on the CPU module used.

Target	Classification	Type
Device*1	Bit	X (0 to 1777*4), Y (0 to 1777*4), M (0 to 32767), L (0 to 32767), F (0 to 32767), B (0 to 7FFFH), TS/TC (0 to 1023)*3, STS/STC (0 to 1023)*3, CS/CC (0 to 1023)*3, SB (0 to 7FFFH), SM (0 to 9999)
	Word	D (0 to 7999), W (0 to 7FFFH), TN (0 to 1023), STN (0 to 1023), CN (0 to 1023), SW (0 to 7FFFH), SD (0 to 11999), R (0 to 32767)*2

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".
*4 Octal notation is used.

MELSEC iQ-L (built-in Ethernet)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC iQ-L (built-in Ethernet)	MELSEC iQ-L series CPU module

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	Setting not possible	—	—

■Data that can be communicated and range

The following table lists the maximum number of points when the NZ2MC-16MBS is connected to the R120CPU. The number of points differs depending on the CPU module used, whether to use or not an extended SRAM cassette, or the type of the extended SRAM cassette.

Target	Classification	Type
Device*1	Bit	X (0 to 2FFFH), Y (0 to 2FFFH), M (0 to 14065663), L (0 to 32767), F (0 to 32767), B (0 to D69FFFH), TS/TC (0 to 781407)*3, STS/STC (0 to 781407)*3, CS/CC (0 to 781407)*3, SB (0 to D69FFFH), SM (0 to 4095)
	Word	D (0 to 879103), W (0 to D69FFFH), TN (0 to 781407), STN (0 to 781407), CN (0 to 781407), SW (0 to D69FFFH), SD (0 to 4095), R (0 to 32767)*2, ZR (0 to 819199)*2, RD (0 to 1048575)

*1 A local device cannot be specified.
*2 Data is read or written following the "File Register Setting" of the communication destination.
*3 This device can only be specified when "Read" is set for "Communication Pattern".

MELSEC-A/AnS (Ethernet Module)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC-A/AnS (Ethernet Module)	ACPU on which an Ethernet interface module can be mounted

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	256 to 65534	Specifies the port number of the communication destination.	Empty
Own station port number	1 to 4999, 5010 to 65534	Specifies the port number of the own station.	Empty

In addition, create a program for the communication destination and set the DIP switch on the front of the module.
Create an initial processing program and set the above IP address, port number, and "UDP" for the communication method to enable communications using the MC protocol according to the communication specifications.
Set "1 (On)" for Bit 15 and Bits 0 to 7 (bits corresponding to the connection numbers to be used) of Area for communication instruction during stop (address 496 (1F0H)) of the buffer memory.*1

*1 Set it to execute this function while the communication destination CPU module is in the STOP state or stop error state.

The DIP switch setting (change condition setting) on the front of the module is as follows.

- SW2 (data code setting): Off (communication with binary code)
- SW7 (CPU communication timing): On*2 (Even in the RUN state, writing is performed from another node.)

*2 When this function is executed while the communication destination CPU module is in the RUN state, turn on this switch.

■Data that can be communicated and range

The following table lists the maximum number of points for the A4UCPU. The number of points varies depending on the CPU module used.

Target	Classification	Type
Device	Bit	X (0 to 7FFH), Y (0 to 7FFH), M (0 to 8191, 9000 to 9255), B (0 to FFFH)
	Word	D (0 to 6143, 9000 to 9255), W (0 to FFFH), R (0 to 8191)

MELSEC-FX3 (Ethernet Block/Adapter)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
MELSEC-FX3 (Ethernet Block/Adapter)	• FX3U and FX3UC CPUs with which an Ethernet Block can be mounted • FX3S, FX3G, FX3GC, FX3U, and FX3UC CPUs with which an Ethernet Adapter can be mounted

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	1025 to 5548, 5552 to 65534	Specifies the port number of the communication destination.	Empty
Own station port number	1 to 4999, 5010 to 65534	Specifies the port number of the own station.	Empty

Configure the Ethernet settings for the communication destination.

[Network Parameter] ⇨ [Ethernet] ⇨ [Operation Setting]

Set "Communication Data Code" of "Ethernet Port" to "Binary Code".

Configure the following settings for the number of communication destination devices in the "Open Setting".

- Protocol: "UDP"
- Open system: "MC protocol"

■Data that can be communicated and range

The following table lists the maximum number of points for the A4UCPU. The number of points varies depending on the CPU module used.

Target	Classification	Type
Device	Bit	X (0 to 377*1), Y (0 to 377*1), M (0 to 7679, 8000 to 8511), B (0 to 8191)
	Word	D (0 to 8511), W (0 to 32767)

*1 Octal notation is used.

SLMP-compatible device (QnA-compatible 3E frame)

■Models that can be specified as communication destinations (connectable models)

Category	Connectable models
SLMP-compatible device (QnA-compatible 3E frame)	• SLMP-compatible device (No serial number) • MC protocol 3E frame-compatible device

■Settings related to communication destinations

Item	Setting range	Setting details	Default
IP address	0.0.0.1 to 223.255.255.254	Specifies the IP address of the communication destination.	Empty
Protocol	UDP	Specifies the communication method (protocol) to be used when communicating with external devices.	Empty
Port number	1 to 4999, 5010 to 65534	Specifies the port number of the communication destination.	Empty
Own station port number	1 to 4999, 5010 to 65534	Specifies the port number of the own station.	Empty

■Data that can be communicated and range

Applicable devices differ depending on the device. For applicable devices, refer to the manual for the device used.

The device types that can be set are X, Y, M, L, F, B, T (TS*1, TC*1, TN), ST (STS*1, STC*1, STN), C (CS*1, CC*1, CN), SB, SM, D, W, SW, SD, R, and ZR. The accessible device range of the communication destination is the range which can be specified with the subcommand (00.1, 00.0) of the SLMP (QnA-compatible 3E frame of the MC protocol).

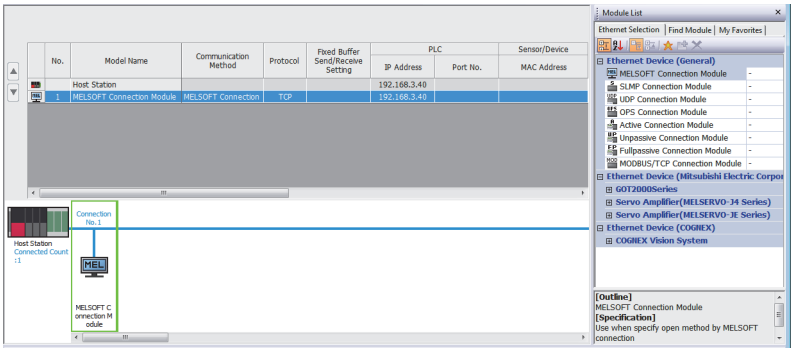
*1 This device can only be specified when "Read" is set for "Communication Pattern".

Encrypted communication settings

To encrypt simple CPU communication between controllers, the following setting is also required.

External device configuration

Specify the connection destination for encrypted communication in the external device configuration of the communication destination.



1. Add "MELSOFT Connection Module", and enter "DTLS" for the protocol and the port number.

Creating a server certificate

Use the engineering tool of the communication destination to create a server certificate. (☞ Page 1561 "Certificate Management" window)

Reading or writing a server certificate

Use the engineering tool to read the server certificate of the communication destination and write it to the own station. (☞ Page 1564 "Certificate Management" window)

Import/export of settings

Import/export the simple CPU communication setting parameters from/to a CSV file.

Export

1. Click the [Export] button in the "Setting Item" window under "Simple CPU Communication Setting".
2. Input the file name and click the [Save] button in the "Export to File" window.
3. Edit the exported CSV file as necessary. The description displayed the "Setting Item" window under "Simple CPU Communication Setting" can be edited.

Point

The following describes the detailed format in the CSV file.

- The file format is Unicode (UTF-16 Little Endian with BOM).
- "\t" (tab) delimits between the items.
- Each item enclosed in double quotation marks (").
- If the item includes double quotation marks (), double quotation marks (") in the items are displayed as two double quotation marks ("").
- A return is set at the end of the line. The return code is CR+LF.

Precautions

In the CSV file, strings displayed in the "Setting Item" window under "Simple CPU Communication Setting" may be replaced with other strings. The following table lists the items to be replaced with another string.

Item	Engineering tool	CSV file
IP Address Input Format*1	Decimal	DEC
	Hexadecimal	HEX
Device Assignment Method*2	Points/Start	Points/Start
	Start/End	Start/End
Initial Communication Setting	With check for the initial communication setting	Enable
	Without check for the initial communication setting	Disable
Communication Pattern	Read	Read
	Write	Write
Communication Setting	On Request	0
	Fixed Interval	1
Communication Destination Setting: Device Type	MELSEC MX Controller MX-R Model (built-in Ethernet)	15
	MELSEC MX Controller MX-F Model (built-in Ethernet)	14
	MELSEC iQ-R (built-in Ethernet)	16
	MELSEC iQ-L (built-in Ethernet)	20
	MELSEC iQ-F (built-in Ethernet)	19
	MELSEC-Q (built-in Ethernet)	17
	MELSEC-L (built-in Ethernet)	18
	MELSEC-Q (Ethernet module)	22
	MELSEC-L (Ethernet module)	23
	MELSEC-A/AnS (Ethernet Module)	25
	MELSEC-FX3 (Ethernet Block/Adapter)	26
	SLMP Corresponding Device (QnA Compatible 3E Frame)	30
Target PLC No.	Not Specified	0
	PLC No.1 to 8	1 to 8

*1 The IP address is imported in positional notation of the IP address input format of the CSV file.

*2 The device range (number of points/start number/end number) of the transfer source device is set in the device assignment method of the CSV file.

Import

1. Click the [Import] button in the "Setting Item" window under "Simple CPU Communication Setting".
2. Select the file name and click the [Save] button in the "Import to File" window.
3. Click the [OK] button.
4. The data in the CSV file is reflected in the "Setting Item" window under "Simple CPU Communication setting".

Point

For the file format at import, follow the following format.

- "\t" (tab) can be used as a delimiter between items.
- Enclose items including delimiters and return codes in double quotation marks.

Precautions

- When imported, all the original settings are cleared. Export and save the settings as necessary.
- Do not insert or delete lines or change the value of the item to an invalid value in the CSV file. An error message is displayed and the settings cannot be imported.
- Import the CSV file whose data has been set from the 10th line onward.

Executing simple CPU communication

This section describes the operation of simple CPU communication.

Operation during simple CPU communication

■Operation of the own station

Since the own station operates without depending on the operating status of the controller, simple CPU communication is performed even when the controller is in STOP state because of a stop error. However, when an initial communication error occurs, only the communication for the corresponding setting number is stopped, and the settings where no error occurred will continue to operate.

If the communication destination responds at the timing of END processing of the controller, data is transferred to the system area for simple CPU communication.

■Operation of the communication destination

The operation differs depending on the communication destination.

Communication destination	Data operation in one setting
Controller MX-R Model (built-in Ethernet) Controller MX-F Model (built-in Ethernet) MELSEC iQ-R (built-in Ethernet) MELSEC-Q (built-in Ethernet) MELSEC-L (built-in Ethernet) MELSEC iQ-F (built-in Ethernet) MELSEC iQ-L (built-in Ethernet)	The data in one setting is sent simultaneously, except under the following conditions: • A bit device (TS, TC, STS, STC, CS, and CC) and a word device are specified simultaneously.*1 (In this case, the data are sent at different timing.)
MELSEC-Q (Ethernet module) MELSEC-L (Ethernet module)	The data specified with a bit device or a word device in one setting are sent simultaneously. However, if both a bit device and a word device are set for the same setting number, the bit device and word device are sent at different timing.
MELSEC-A/AnS (Ethernet Module)	The data are sent simultaneously when the data size in one setting is as follows*1: • When "Write" is set to "Communication Pattern": Bit device of 640 points or less, word device of 256 points or less • When "Read" is set to "Communication Pattern": Bit device of 2048 points or less, word device of 256 points or less
MELSEC-FX3 (Ethernet Block/Adapter)	The data are sent simultaneously when the data size in one setting is as follows*1: • When "Write" is set to "Communication Pattern": Bit device of 160 points or less, word device of 64 points or less • When "Read" is set to "Communication Pattern": Bit device of 512 points or less, word device of 64 points or less
SLMP Corresponding Device (QnA Compatible 3E Frame)	The data specified with a bit device or a word device in one setting are sent simultaneously. However, if both a bit device and a word device are set for the same setting number, the data of each device is communicated at different timing.*1

*1 The read/write order when transmissions occur at different timings is as follows:
·When "Communication Pattern" is set to "Read": Bit device → Word device
·When "Communication Pattern" is set to "Write": Word device → Bit device

Operations when the communication setting is "Fixed Interval"

After the system is powered off and on or the controller is reset, communication starts.

After data is sent to the communication destination, if no response is received from the communication destination or an error occurs (or an error response is received), the system makes retries when the timeout time has elapsed. (☞ Page 1285 Communication Time-out Period/Communication Retry Count/Monitoring Time At Error)

Point

- After the system is powered off and on or the controller is reset, the system starts preparation processing. If an error occurs in the preparation processing, data will not be sent or received. In this case, the CPU buffer memory area of Simple CPU communication status stores AH (Communications impossible).
- When the latency time is set, the communications will start after the latency time has elapsed. (☞ Page 1285 Latency Time)
- The operations in the initial communication vary depending on the setting details of the initial communication setting. When the initial communication setting is not set and no response is received from the communication destination, an error occurs and data are not sent or received. (The fixed interval communication is not performed during the monitoring time at error.) (☞ Page 1286 Initial Communication Setting)
- If multiple setting numbers are set for the same communication destination, the operations are as follows: When Communication Setting is set to "Fixed Interval" and retries occur in the processing of one setting number, communications on the other setting numbers set for the same communication destination will not be performed at the execution interval. When Communication Setting is set to "On Request", communications cannot be performed while the CPU buffer memory area of Simple CPU communication status is 6H (monitoring).

Operations when the communication setting is "On Request"

After the system is powered off and on or the controller is reset, communication starts when the CPU buffer memory area of Request to start communication at request is turned off and on. After the data are sent and received, the system automatically turns off the CPU buffer memory area of Request to start communication at request, and changes Simple CPU communication status to 2H (waiting for the request).

After data is sent to the communication destination, if no response is received from the communication destination or an error occurs (or an error response is received), the system makes retries when the timeout time has elapsed. (☞ Page 1285 Communication Time-out Period/Communication Retry Count/Monitoring Time At Error)

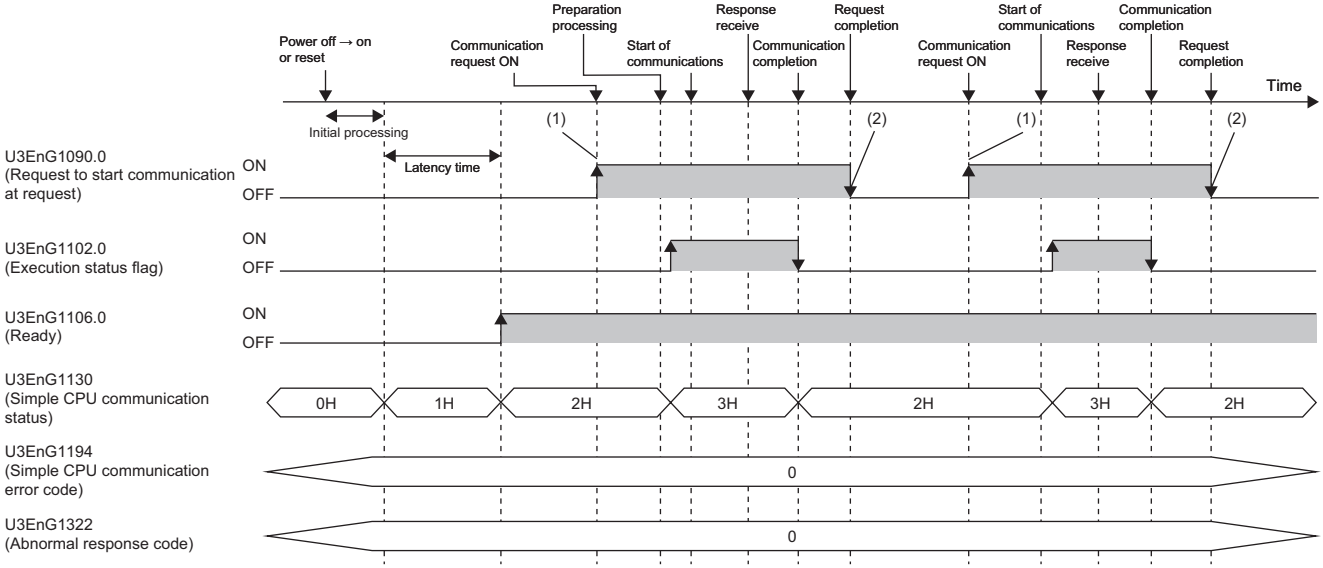
Point

- After the system is powered off and on or the controller is reset, the system starts preparation processing. If an error occurs in the preparation processing, data will not be sent or received. In this case, the CPU buffer memory area of Simple CPU communication status stores AH (Communications impossible).
- When the latency time is set, the communications will start after the latency time has elapsed. During the latency time, the CPU buffer memory area of Request to start at request is ignored even when it is turned on. (☞ Page 1285 Latency Time)
- During the initial execution of communications*1, the processing time is longer because it includes the preparation processing, such as checking the availability of the communication destination.
- After Request to start communication at request is turned on, another request will be ignored even when the CPU buffer memory area of Request to start communication at request is turned off and on by a program.
- The updates for the following operations do not occur simultaneously: when the execution status flag is turned on, when Request to start communication at request is turned on, and when Simple CPU communication status becomes 3H (communicating). The updates for the following operations may not occur simultaneously if the scan time is long: when the execution status flag is turned off, when Request to start communication at request is turned off, and when Simple CPU communication status becomes 2H (waiting for the request).
- If the scan time is long, the on and off of the execution status flag are updated simultaneously, which may disable the program to detect the flags.
- When multiple setting numbers are set for the same communication destination, if an error is detected in one of the settings, the error will also occur in the other setting numbers set for the same communication destination. In addition, when "Communication Setting" of the same communication destination is set to "Fixed Interval", communications cannot be performed while the CPU buffer memory area of Simple CPU communication status is 6H (monitoring).

*1 This refers to any initial executions with the communication setting "On Request" where the same communication destination is set, or the execution immediately following one that completed with an error. In addition, this also refers to the execution under the following conditions: Another setting number set for the same communication destination with its communication setting "Fixed Interval" exists, and all the "Fixed Interval" settings are in the stop status. (This does not apply when the communication setting "Fixed Interval" is 3H (communicating).)

Ex.

Operation of Request to start communication at request of setting No.1



(1) The buffer memory area is turned on by the program.

(2) The buffer memory area is turned off by the system.

Communication Time-out Period/Communication Retry Count/Monitoring Time At Error

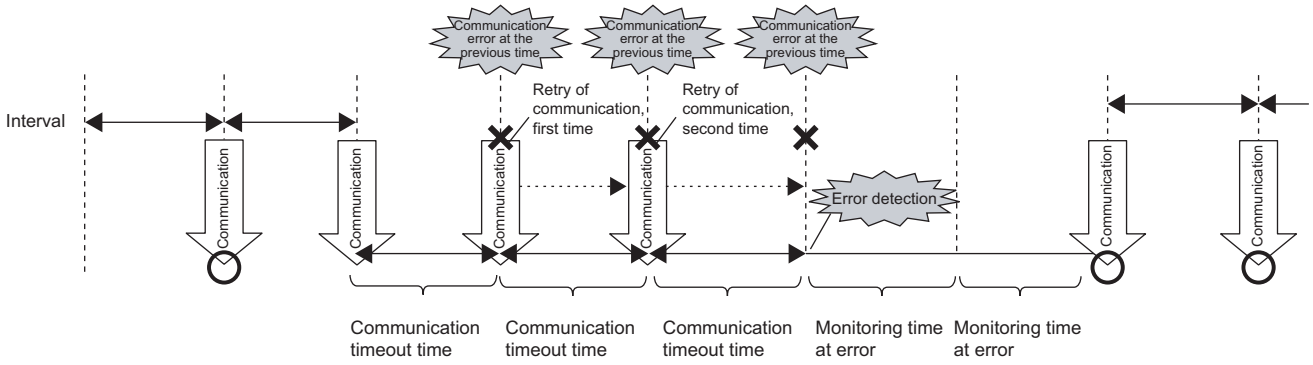
When the communication destination does not respond or returns an error response, the communication will be retried (resent) after the time-out period has passed.

When Communication Setting is "Fixed Interval", an error is detected after communications are performed for the communication retry count + 1 times, then the fixed interval communication is performed during the monitoring time at error. If the communication destination responds after these communications, the communications at the execution interval specified with the parameters are restarted.

When Communication Setting is "On Request", an error is detected after communications are performed for the communication retry count + 1 times, then simple CPU communication status becomes "2H: waiting for the request".

Ex.

Error detection timing when 2 is set for the communication retry count



Point

The error is detected if the communication destination does not respond or communications fail by when the following time has passed: (communication retry count + 1) × communication time-out period

Latency Time

By setting the latency time, the start timing in the communications can be switched in the following cases.

- To prevent an error due to the overlap of the start timing in the communications
- To start communications after the communication destination is ready for the communications

During the latency time, "Preparing" is indicated in the communication status.

Point

When the latency time is set, the communications of the setting numbers where Communication Setting is set to "Fixed Interval" will not be performed during the latency time, and the communications will start after the latency time has elapsed. For the setting numbers where "Communication Setting" is set to "On Request", if Request to start communication at request is turned on during the latency time, the communications will start after the latency time has elapsed.

Initial Communication Setting

The operation can be set when the communication destination does not respond (including that the communication destination has the different IP address or is not started) at the initial communication.
By using this setting, communications can be started at the timing when the external device is connected or powered on after starting simple CPU communications even if the external device is not connected or powered off at starting the simple CPU communications.

Point

This setting is disabled when the communication setting is set to "On Request". This setting is also disabled when the communication setting is set to "Fixed Interval" if simple CPU communication status is other than the following.

- 3H: Communicating
- 5H: Retry being executed
- 6H: Monitoring

50.2 Checking the Simple CPU Communication Status

The simple CPU communication status can be checked with the buffer memory or diagnostic functions.

How to check using the buffer memory

The simple CPU communication status can be checked with the storage status of the corresponding setting number in the following CPU buffer memory areas.

Item		Address	Remarks
Request to start communication at request		U3En\G1090 to 1093	1090.0: Setting No.1 to 1093.F: Setting No.64
Request to stop fixed interval communication		U3En\G1094 to 1097	1094.0: Setting No.1 to 1097.F: Setting No.64
Request to restart fixed interval communication		U3En\G1098 to 1101	1098.0: Setting No.1 to 1101.F: Setting No.64
Execution status flag		U3En\G1102 to 1105	1102.0: Setting No.1 to 1105.F: Setting No.64
Ready		U3En\G1106 to 1109	1106.0: Setting No.1 to 1109.F: Setting No.64
Simple CPU communication status	0H: Unset	U3En\G1130 to 1193	1130: Setting No.1 to 1193: Setting No.64
	1H: Preparing		
	2H: Waiting for the request		
	3H: Communicating		
	4H: Communication stop		
	5H: Retry being executed		
	6H: Monitoring		
	AH: Communications impossible		
Simple CPU communication error code		U3En\G1194 to 1257	1194: Setting No.1 to 1257: Setting No.64
Execution interval (current value)		U3En\G1258 to 1321	1258: Setting No.1 to 1321: Setting No.64
Abnormal response code		U3En\G1322 to 1385	1322: Setting No.1 to 1385: Setting No.64

For details on the values to be stored in the CPU buffer memory, refer to the following.

☞ Page 2049 Simple CPU communication function

Point

When the "MELSEC-A/AnS (Ethernet Module)" or "MELSEC-FX3 (Ethernet Block/Adapter)" is set to the communication destination, if an error response is received from the communication destination, the buffer memory area of Simple CPU communication error code stores the error code, CFB4H, and the buffer memory area of Abnormal response code stores the codes returned from the external device.

Request to stop/restart fixed interval communication

When the simple CPU communication status of the corresponding setting number in the CPU buffer memory is either of the following, communications can be stopped by turning off and on the stop request of the corresponding setting number.

- 3H: Communicating
- 5H: Retry being executed
- 6H: Monitoring

Point

- This setting is disabled when the communication setting is set to "On Request". This setting is also disabled if Simple CPU communication status is other than the above when the communication setting is set to "Fixed Interval".
- When the stop request is turned off and on, the communications will stop at the timing of sending data in the next execution interval. Therefore, if the communication destination does not respond with the stop request accepted, the communications will stop after the communication time-out period has passed. When the retry is being executed, the communications will stop after the communication time-out period has passed without depending on the retry count.
- When an error occurs during stop in another setting numbers set for the same communication destination, the value will not be stored in the simple CPU communication error code of the setting number itself.

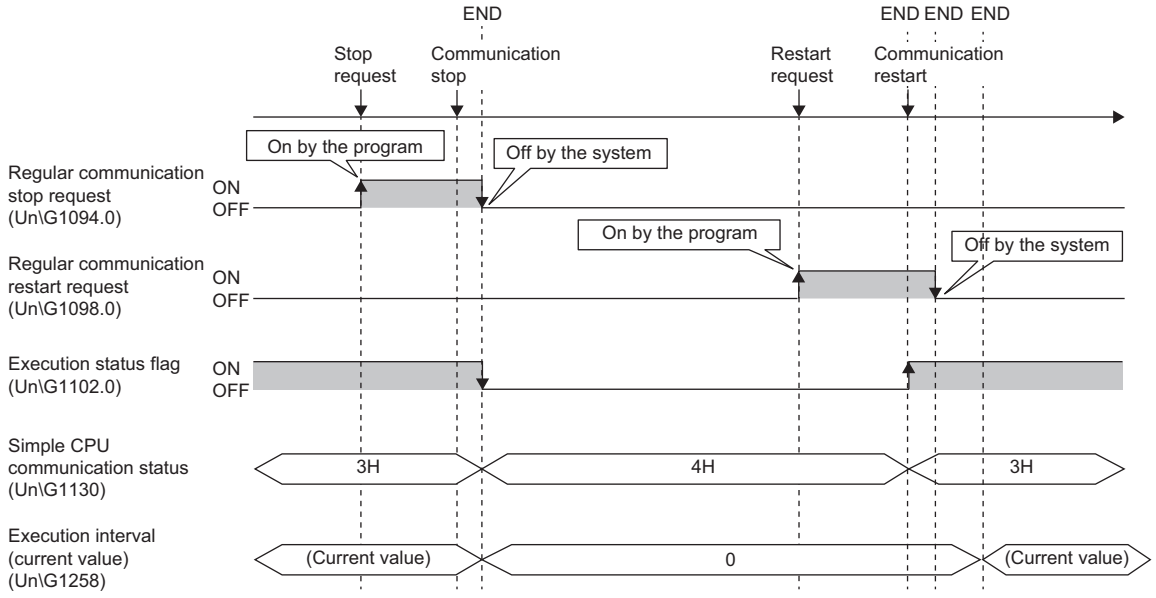
When the simple CPU communication status of the corresponding setting number in the CPU buffer memory is "4H: Communication stop", communications can be restarted by turning off and on the restart request for the corresponding setting number. (If the status is other than "4H: Communication stop", the restart request is invalid.)

Point

While another setting number that is set for the same communication destination has an error, the communication cannot be restarted.

Ex.

The operation at communication stop/restart request for the setting No.1



Checking with "simple CPU communication diagnostics"

The communication status of the simple CPU communication function can be checked with "Simple CPU Communication Diagnostics".

For details, refer to the following.

☞ Page 1289 Checking with "simple CPU communication diagnostics"

50.3 Precautions

This section provides precautions for the simple CPU communication function.

Incomplete data reception and timeout

Because the load of Ethernet communication becomes heavy during the simple CPU communication, if the other communication (MELSOFT connection or SLMP) is simultaneously performed by using UDP, the data reception of UDP may not be completed, resulting in a timeout error. Therefore, to perform other communications during the simple CPU communication, the communication using TCP is recommended.

Execution interval setting

The execution interval (Communication Setting: "Fixed Interval") and the time until communication completion (Communication Setting: "On Request") in the simple CPU communication function will differ according to the load rate of the Ethernet line, the operating status of other communication functions (such as MELSOFT connection, SLMP communication, socket communication function), the scan time of the communication destination, and the system configuration. Thus, the set execution interval or time required to complete communication may be increased.

To perform communication at the set execution interval, set a sufficient execution interval. If checking the execution interval is required, perform actual communications and check it with the "Simple CPU Communication Diagnostics" window.

Duplication of own station port numbers

The simple CPU communication cannot be performed in the following cases.

- The own station port number set in simple CPU communication and the own station port number of the controller set in the external device configuration are the same.
- The own station port number set in the simple CPU communication and the one set in another function such as the socket communication are the same.

Set different own station port numbers. For the setting numbers other than the one in which a communication error occurs, communications are performed after the preparation processing is completed normally.

Module type and IP address of communication destination

Before setting the parameters, check the module type and IP address of the communication destination and the protocol to be used for communication. Simple CPU communication cannot be performed when preparation processing is not completed because the communication destination does not exist (an incorrect IP address is specified) or due to incorrect device type or protocol settings.

Communication destination device

Check the type and range of the device to be read or written in the communication destination.

Especially, when "Write" is set to "Communication Pattern", the control data of the communication destination may be overwritten, resulting in malfunction.

Remote password

The simple CPU communication is not performed when a remote password is set for the communication destination. Clear the remote password.

Same communication destination setting

If multiple setting numbers are set for the same communication destination and an error occurs in one of the settings, the error also occurs in other setting numbers set for the same communication destination, resulting in the disabling of communications.

If an error occurs in a module set to "Fixed Interval" during communications and "6H: monitoring" in Simple CPU communication status of the setting number while both "Fixed Interval" and "On Request" are set in the "Communication Setting", the communication will not start even when Request to start communication at request of the error setting number is turned on.

However, Simple CPU communication status of the setting number, where "Communication Setting" is set to "Fixed Interval", is either "4H: communication stop" or "AH: communications impossible", the communication will start by turning on Request to start communication at request of the setting number where "Communication Setting" set to "On Request".

In addition, when the RnPCPU (in redundant mode) is used, an individual IP address is set for each Ethernet port of the system A and B, where the MELSEC-FX3 (Ethernet block/adapter) or MELSEC-A/AnS (Ethernet module) is set as the same communication destination. Therefore, an error will not be detected between such communication settings.

File register (R, ZR)

When using the file register (R, ZR) for the device on the own station, always assign the device within the setting range. The simple CPU communication of the setting number which exceeds the setting range due to a stop error of the own station cannot be performed.

When a stop error occurs, communications continue for the setting numbers that do not exceed the setting range and those with a different communication destination.

Special relay (SM) and special register (SD)

Do not write any data to the special relay (SM) and the special register (SD) that are set on the system side. Doing so may cause a system failure or communication failure.

When communicating with controller where user authentication function is enabled

In the operation setting other than user authentication target of the communication destination MELSEC MX Controller, set "Do not apply" for the read/write device/label. (☞ Page 1536 User Authentication Function)

When encrypted communication (DTLS) is abnormal

During encrypted communication (DTLS), if the communication lines become unconnected due to reasons such as disconnection of a connection cable and the simple CPU connection status is changed to "6H: Monitoring", communication may not resume even if the communication lines are restored. Therefore, prevent disconnection during communication. If communication is not possible, take the following action for the server device.

- Turn off and on Open request signal (Un\G7873 to Un\G7876) for the corresponding connection, then open the connection again.

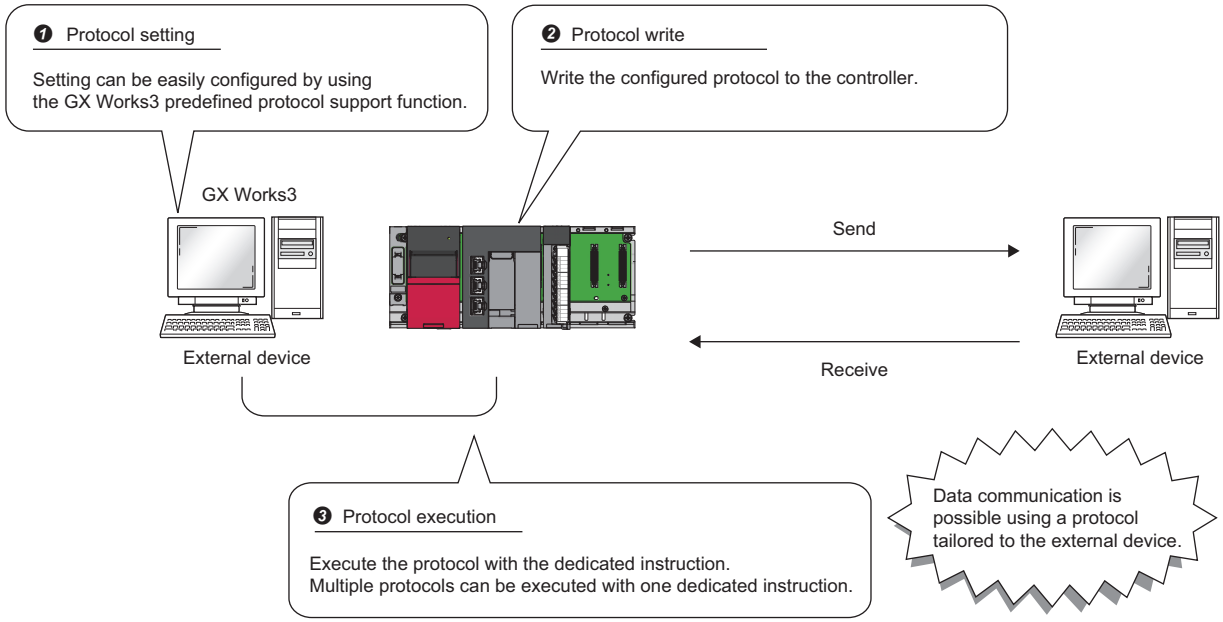
51 PREDEFINED PROTOCOL COMMUNICATIONS

Data can be exchanged between the external device (such as measuring instrument and bar code reader) and the controller according to the protocol of the external device. Data that varies according to communication session can be handled by incorporating a device or buffer memory into the communication packet.

Set the protocol required for communications with the external device using the engineering tool. The protocol can be set by selecting from the predefined protocol library, or it can be created and edited.

This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)

The predefined protocol support function of the engineering tool does not support encrypted communications. Therefore, use the SLMP frame send instruction (SLMPSNDC instruction) that can use the encrypted SLMP frame send to execute the encrypted SLMP command by using the predefined protocol support function instruction (ECPRTCL instruction).



Point

The number of protocols and packets that can be registered is as follows.

- Protocols: 128 maximum
- Packets: 256 maximum
- Packet data area size: 12288 bytes maximum

When the number of packets reaches the upper limit, protocols cannot be added even if the number of protocols has not reached the upper limit. If the packet data area size reaches the upper limit, protocols and packets cannot be added even if the number of protocols and packets has not reached the upper limit.

51.1 Applicable Connections

The connections No.1 to 64 of the Ethernet port can be used for the communications using the predefined protocol.

Precautions

- When two or more ECPRTCL instructions are executed at the same time for the same connection, the later instruction is ignored and not executed until the earlier instruction is completed.
- If the user authentication function of the controller is enabled, an error (error code 4300H) occurs when the predefined protocol support function instruction (ECPRTCL instruction) of the engineering tool is executed.
- When the TCP/TLS connection is closed from the client (active connection module) side, the connection cannot be re-opened until at least 65 seconds have elapsed since the closure.

51.2 Data Communication Procedures

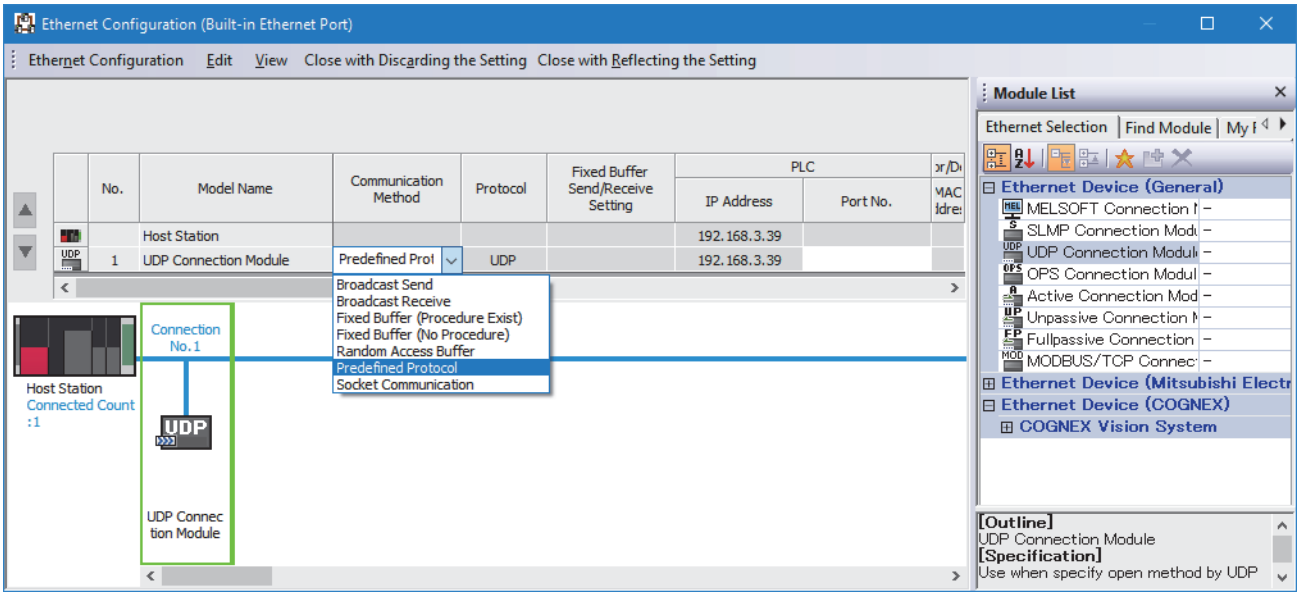
By using the predefined protocol support function, data can be exchanged with the external device using the following procedure.

1. Select, create, or edit the protocol with the predefined protocol support function, and write the protocol setting data. (☞ Page 1294 Creating the protocol setting data)
2. Select the external device to be connected from the "Module List" in "External Device Configuration" and drag it to the list of devices or device map area. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]

External device name	Description
UDP Connection Module	Select this option to communicate with the external device using UDP.
Active Connection Module	Select this option to perform the open processing to the external device from the controller (Active open) and communicate using TCP.
Unpassive Connection Module	Select this option to receive the open processing from an unspecified external device (Unpassive open) and communicate using TCP.
Fullpassive Connection Module	Select this option to receive the open processing from a specified external device (Fullpassive open) and communicate using TCP.

3. Set "Communication Method" for the external device to "Predefined Protocol".



4. Set the other parameters required for communications in the connection.
5. Write the parameters to the controller and check the normal completion of initial processing. ('Initial status' (U3E0\G683.0): On)
6. Perform the open processing to establish a connection between the controller and external device.
7. Execute the protocol with the ECPRTCL instruction. For details, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

8. Close the connection when communications are finished.

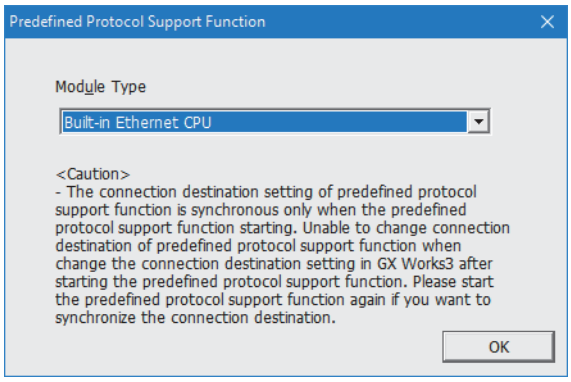
Point

The communication data code is binary code communications regardless of the selected settings.

Creating the protocol setting data

Use the predefined protocol support function to create the protocol setting data.

[Tool] ⇨ [Predefined Protocol Support Function]

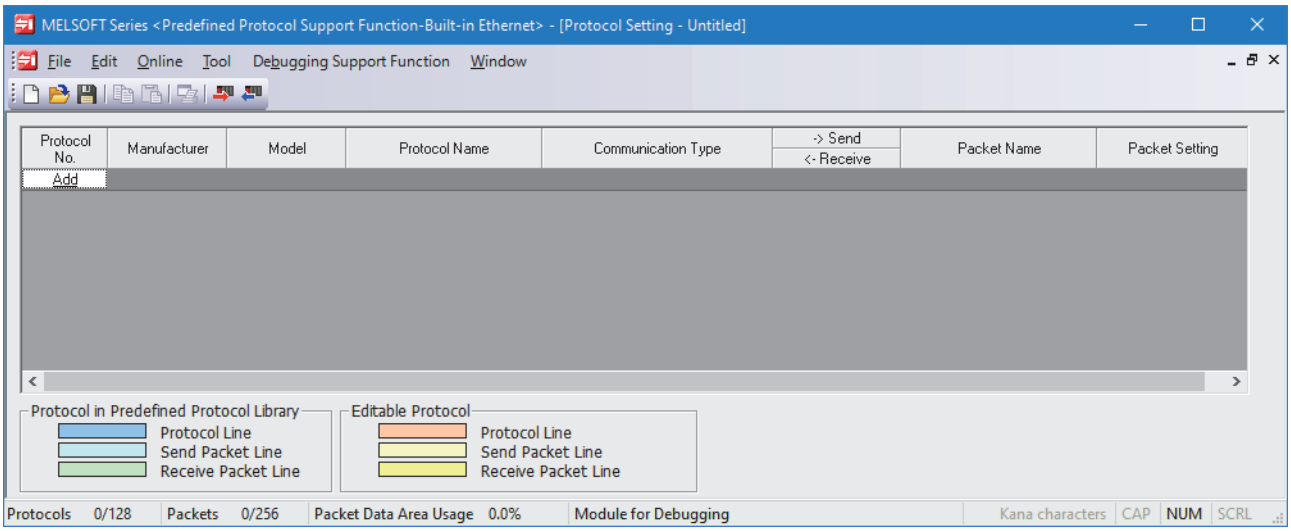


1. Select the module for which to create the protocol setting data.

■Newly creating the protocol setting data

Newly create the protocol setting data.

[File] ⇨ [New]

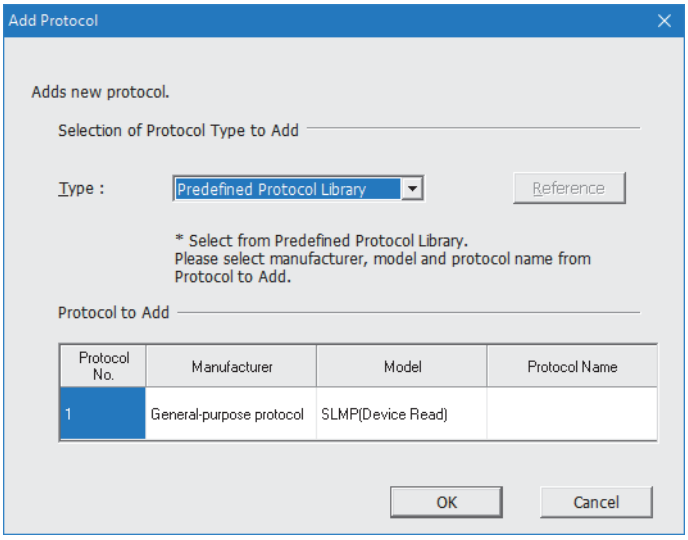


Item	Description
Protocol No.	Displays the protocol number used with the dedicated instruction in the program.
Manufacturer	Displays the name of the manufacturer of the device for which the protocol is being set.
Model	Displays the model of the protocol to be set.
Protocol Name	Displays the name of the protocol to be set.
Communication Type	Displays the communication type of the protocol to be set. Send Only: Sends one send packet once. Receive Only: If there is a matching packet among the up to 16 registered received packets, it is received. Send & Receive: After sending one send packet, if there is a matching packet among the up to 16 registered received packets, it is received.
→Send/←Receive	Displays the packet send direction. →: For send ←(1) to (16): For receive, the received packet number is displayed in parentheses.
Packet Name	Displays the packet name.
Packet Setting	Displays the validity of variables in the packet elements and the variable setting state. If the variable is not set, there are no elements, or there is an element error, the protocol is not written to the controller. No Variable: When there is no variable in the elements Variable Set: When all variables have been set Variable Unset: When there is even one unset variable Element Unset: When there are no elements in an editable protocol Element error: When elements do not satisfy requirements

■Adding protocol

Add protocol.

[Edit] ⇨ [Add Protocol]



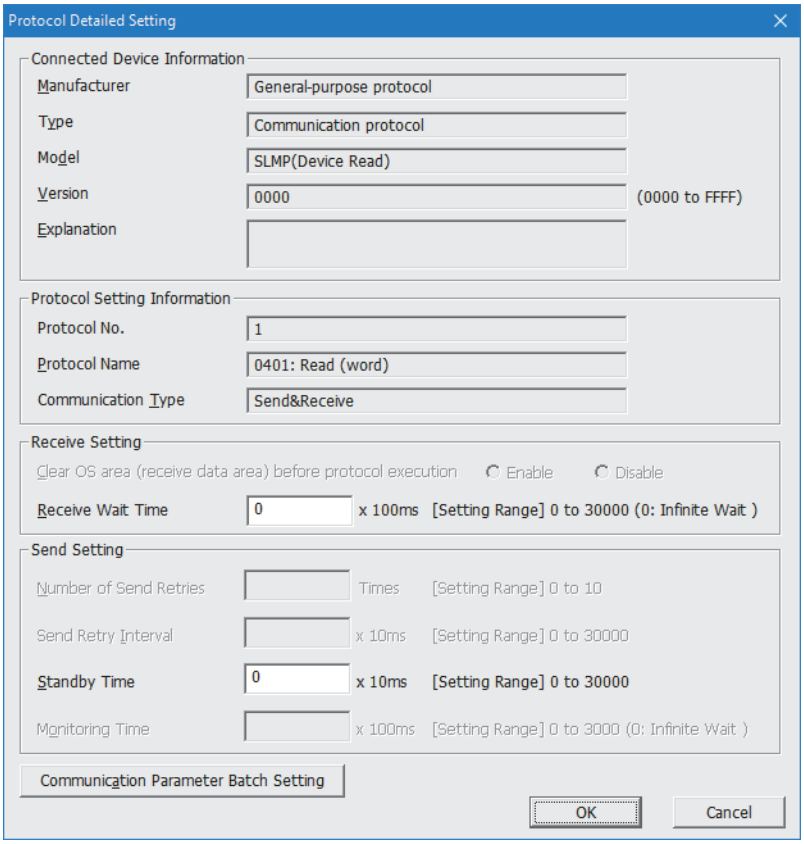
Item	Description	Setting range
Type	Select the type of protocol to be added.	• Predefined Protocol Library • User Protocol Library • Add New
Protocol No.	Select the protocol number to be added.	1 to 128
Manufacturer*1	Set the manufacturer of the protocol to be added.	—
Model*1	Set the type of protocol to be added.	—
Protocol Name*1	Set the name of the protocol to be added.	—

*1 The name can be set only when "Predefined Protocol Library" is selected for "Type".

■Protocol Detailed Setting

Set the protocol send/receive parameters.

"Protocol Setting" window ⇨ Select a protocol ⇨ [Edit] ⇨ [Protocol Detailed Setting]



Item		Description
Connected Device Information*1	Manufacturer	Set the protocol manufacturer.
	Type	Set the protocol device type.
	Model	Set the protocol model.
	Version	Set the protocol device version.
	Explanation	Set a description of the protocol device.
Protocol Setting Information*1	Protocol No.	The protocol number for the selected protocol is displayed.
	Protocol Name	Set the protocol name.
	Communication Type	Set the protocol communication type.
Receive Setting	Receive Wait Time	Set the waiting time after the module enters waiting state for receive data. If communications with the external device is disabled because of a disconnection and matching packet data is not received within the specified time, the module judges that an error has occurred and cancels the receive data wait state.
Send Setting	Standby Time	Set the waiting time from when the protocol set for the module enters the execution state to when the data is actually sent. This allows adjusting the time until the external device enters the receive enable state to match the send timing of the module.

*1 The setting cannot be changed if the protocol was selected from the predefined protocol library.

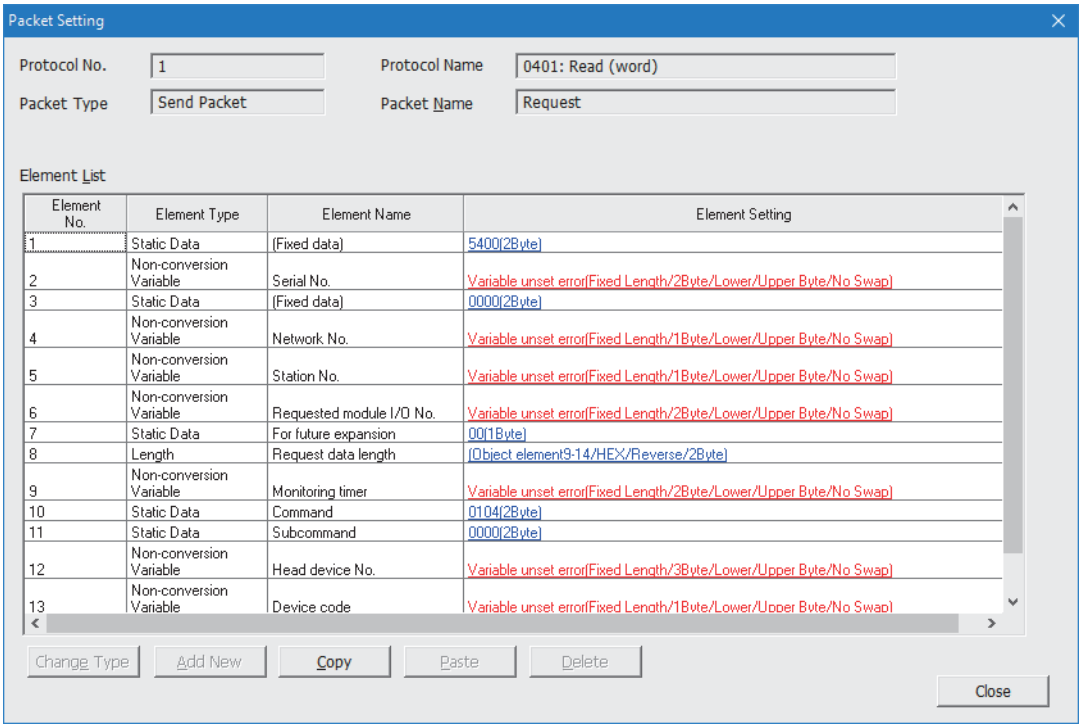
Point

Send/receive parameters can be set for multiple protocols by clicking the [Communication Parameter Batch Setting] button and setting the range of the set protocol numbers, receive settings, and send settings.

■Packet setting

Set the configuration of the send/receive packets on the "Packet Setting" window.

"Protocol Setting" window ⇨ Packet to be set



The above window opens when "Predefined Protocol Library" is selected on the "Add Protocol" window.

When "Add New" or "User Protocol Library" has been selected, configure the packets with the [Change Type] button and [Add New] button.

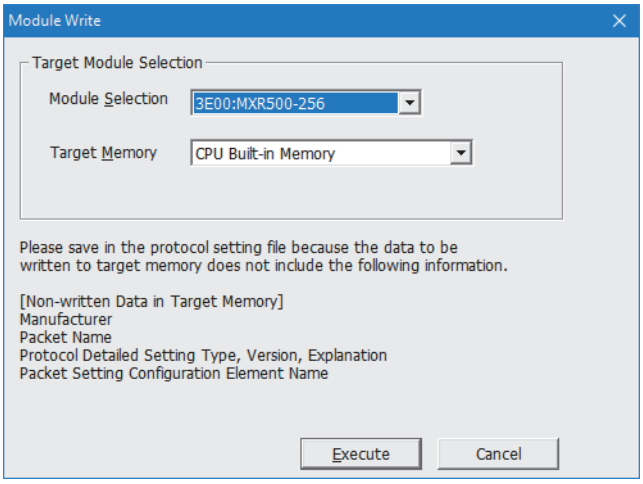
For details on the packet elements, refer to the following.

☞ Page 1301 Packet Elements

■Writing the protocol setting data

Write the protocol setting data to the controller.

[Online] ⇨ [Write to Module]



Select the module and memory into which the protocol setting data is to be written, and write data.

When writing to the controller, the protocol setting data is written into the module extension parameters.

Point

The following data is not written as the protocol setting data, so it will not be displayed even when read. However, when the protocol is selected from the predefined protocol library, the following data can be displayed.

- Manufacturer
- Packet Name
- Protocol Detailed Setting Type, Version, Explanation
- Packet Setting Configuration Element Name

After writing the protocol setting data, the setting data are enabled at the following timing.

- When the system is powered off and on
- When the controller is reset
- When the operating status of the controller is switched from STOP to RUN

The predefined protocol settings written in the SD memory card can be transferred to the controller memory by using boot operation. For details on boot operation, refer to the following.

☞ Page 325 Boot operation

■When the protocol setting data are written into multiple target memory

When the protocol setting data are written into multiple target memory, the following operation will take place.

○: The protocol setting data are written., ×: The predefined protocol data are not written.

Target memory		Operation
Controller	SD memory card	
○	×	As soon as the protocol setting data are enabled, the predefined protocol settings are overwritten by the predefined protocol settings in the controller memory or SD memory card.
×	○	
○	○	Operation follows settings in "Module Extended Parameter" under "Setting of File/Data Use or Not in Memory Card" of the "Memory Card Parameter" window. Also, as soon as the protocol setting data are enabled, the predefined protocol settings are overwritten by the predefined protocol settings in the controller memory or SD memory card.

Point

By writing the protocol setting data to the built-in memory, the same protocol setting can be used even after module change.

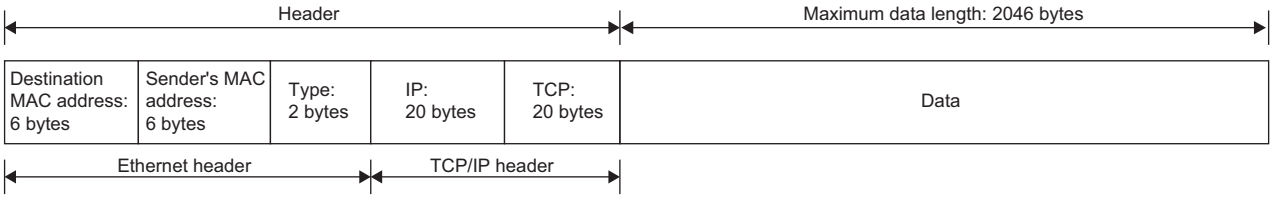
When capacity of the built-in memory is insufficient, write data to an SD memory card.

Although the protocol setting data can also be written to the intelligent function module, the data must be written again when the module is changed.

51.3 Protocol Communication Type

The packets sent to the external device when a processing is executed and the receive packets of the external device are registered in the protocol.
The packet elements set with the predefined protocol support function are the data section of the packets that are actually sent and received.
This section describes an example of the packet configuration. For details on the packet elements, refer to the following.
☞ Page 2143 Operation Image and Data Structure of Predefined Protocol

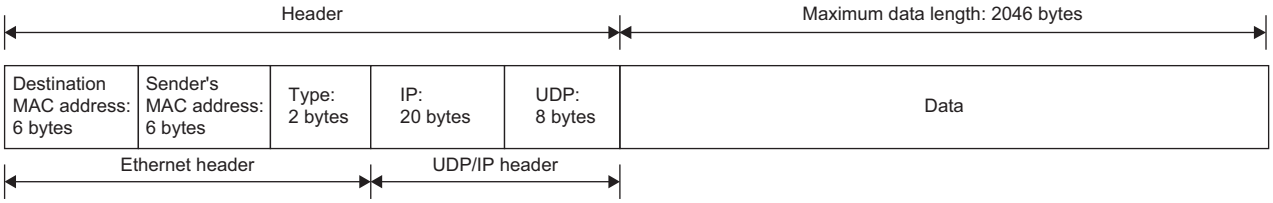
For TCP/IP



■Precautions for Passive open

- When the controller is connected to the external device with Passive open, the IP address of the connected external device or the port number of the external device can be retrieved with the SOCCINF instruction. (☞ Page 1321 Dedicated Instructions)

For UDP/IP



With the predefined protocol support function, data is exchanged with the external device with the procedures (communication type) shown below.
For details on the communication type operation, refer to the following.
☞ Page 2143 Operation Image and Data Structure of Predefined Protocol

Communication type	Description
Send Only	The send packet is sent once.
Receive Only	If there is a packet that matches within the maximum of 16 registered receive packets, the packet is received.
Send & Receive	After sending the send packets, if there are packets that match the up to 16 registered receive packets, the packets are received.

■Precautions for UDP/IP communications

- Use the SOCCSET instruction to change the external device with the controller. (☞ Page 1321 Dedicated Instructions)

■Precautions for broadcast communications

- When the controller receives the data with broadcast receiving, the IP address of the sending external device or the port number of the external device can be retrieved with the SOCCINF instruction. (☞ Page 1321 Dedicated Instructions)

51.4 Packet Elements

The packet is created with a combination of packet elements.

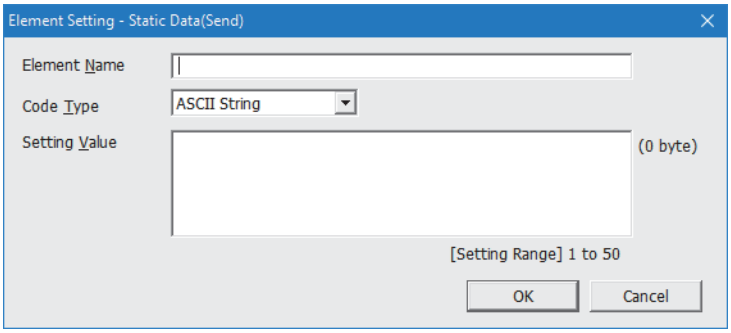
Up to 32 elements can be set in one packet. One packet can have a maximum data length of 2046.

This section describes the details of the packet elements.

For examples of the packet element data, refer to the following.

☞ Page 2143 Operation Image and Data Structure of Predefined Protocol

Static data



Use when there are specific codes and character strings, such as commands, in the packet.

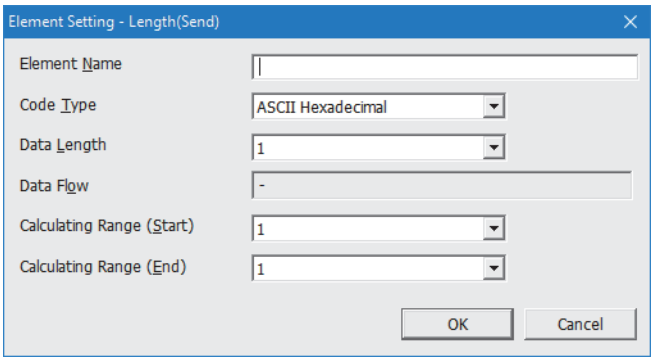
- When sending: The specified code and character string are sent.
- When receiving: The received data is verified.

Multiple static data elements can be placed anywhere in the data part.

The following table lists the items.

Item	Description	Remarks
Element Name	Set the element name.	—
Code Type	Select a data type of the setting value. ASCII String/ASCII Control Code/HEX	—
Setting Value	Set data within 1 to 50 bytes. Code type and setting range are as follows: • ASCII String: 20H to 7EH • ASCII Control Code: Control code of 00H to 1FH and 7FH • HEX: Hexadecimal data of 00H to FFH	Setting example ASCII String: "ABC" ASCII Control Code: STX HEX: FFFF

Length



The length code is used when there is an element that indicates the data length in the packet.

- When sending: Automatically calculates the data length in the specified range, and adds it to the packet. Then, the data is sent.
- When receiving: From the received data, the data (value) corresponding to the length is verified as the data length in the specified range.

Length elements can be placed anywhere in the data part.

Multiple length elements can be set placed in one packet.

The following table lists the items.

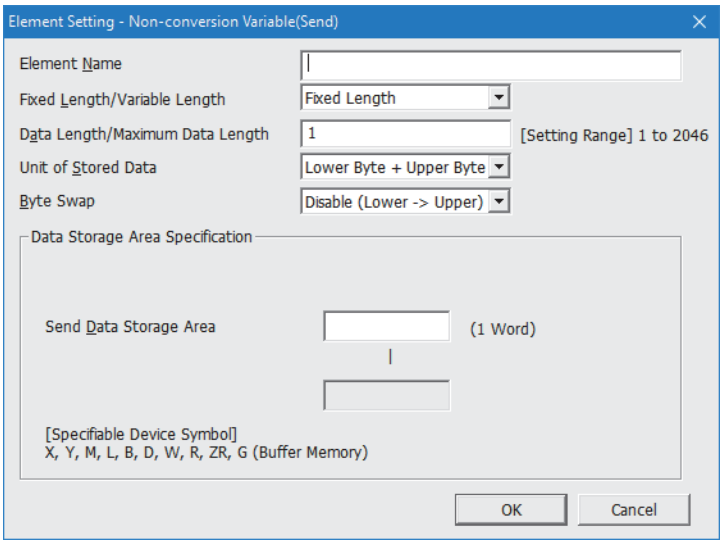
Item		Description		Remarks
Element Name		Set the element name.		—
Code Type		Select the data length type. ASCII Hexadecimal/HEX		—
Data Length		Select the data length on the line. The range is 1 to 4 bytes.		—
Data Flow		Forward Direction (Upper Byte → Lower Byte)	When sending: Sends the calculated length in order from the upper byte. When receiving: Receives the data in order from the upper byte.	This cannot be set if the data length is 1 byte.
		Reverse Direction (Lower Byte → Upper Byte)	When sending: Sends the calculated length in order from the lower byte. When receiving: Receives the data in order from the lower byte.	
		Byte Swap (by Word)*1	When sending: Swaps the bytes in word units and sends the calculated length. When receiving: Swaps the bytes in word units and receives the data.	
Calculating Range	Start	Select the start packet element number for the range to be calculated. The range is 1 to 32.		—
	End	Select the end packet element number for the range to be calculated. The range is 1 to 32.		

*1 This can be selected only when the data length is set to 4 bytes.

Point

- If there are no elements other than length, an element error occurs. (When using length, one or more elements other than length are required.)
- If the calculation result exceeds the number of digits set with "Data Length", the excessive digit value is discarded (invalidated). For example, if the data length is 2 bytes and the data size calculation results are "123" bytes, the data length will be "23".
- If there is a non-conversion variable (variable length)/non-verified reception (character length variable) after the length, and that section is not included in the length calculating range, arrange the static data immediately after the non-conversion variable/non-verified reception.
- When the code type setting is "ASCII Hexadecimal", a mismatch will occur if a character string other than "0" to "9", "A" to "F", and "a" to "f" is received.
- Use "0" to "9" or "A" to "F" when converting to ASCII characters during send.
- When arranging multiple length elements, none of the length calculating range may overlap.
- When arranging multiple length elements, the previous length calculating range may not exceed the arranged length.
- A length element cannot be arranged at the final position of the packet elements.

Non-conversion variable



Use this type to send data in the device or buffer memory of the controller as part of the send packet, or to store part of the receive packet in the device or buffer memory of the controller.
Multiple non-conversion variable can be arranged in one packet.
The following table lists the items.

Item	Description	
Element Name	Set the element name.	
Fixed Length/ Variable Length	Fixed Length	The data whose length is fixed is sent and received.
	Variable Length	When sending: The data length is specified at the time of the protocol execution and the data is sent. When receiving: The data whose length is variable is received.
Data Length/ Maximum Data Length	Set the data length of the send/receive data. (For a variable length, set the maximum data length that can be specified for the data length storage area.) The range is 1 to 2046.	
Unit of Stored Data	Lower Byte + Upper Byte	When sending: Each one word (2 bytes) data in the data storage area is sent in the order of the lower byte to the upper byte. When receiving: The receive data is stored to the data storage area in the order of the lower byte to the upper byte.
	Lower Bytes Only	When sending: Each lower byte data in the data storage area is sent. The controller ignores the upper byte data. When receiving: The receive data is stored to each lower byte in the data storage area. The controller stores 00H in the upper byte.
Byte Swap	Disable (Lower → Upper)/Enable (Upper → Lower)	When sending: When "Enable (Upper → Lower)" is selected, data in the upper byte and lower byte are swapped by one word (2 bytes) and sent. When "Unit of Stored Data" is "Lower Byte + Upper Byte" and "Data Length" is an odd number of bytes, the upper byte is sent at transmission of the last one byte. When "Unit of Stored Data" is "Lower Bytes Only" and "Data Length" is an odd number of bytes, data without any byte swap is sent at transmission of the last one byte. When receiving: When "Enable (Upper → Lower)" is selected, data in the upper byte and lower byte are swapped by word and sent. When "Unit of Stored Data" is "Lower Byte + Upper Byte" and "Data Length" is an odd number of bytes, the last one byte is stored to the upper byte. When "Unit of Stored Data" is "Lower Bytes Only" and "Data Length" is an odd number of bytes, the last one byte is stored without any byte swap.
Data Storage Area Specification	Specify the start device for storing the variable value. The settable devices are listed below. Inner user*1*2 • Input (X) • Output (Y) • Internal relay (M) • Latch relay (L) • Link relay (B) • Data register (D) • Link register (W) File register*2 • File register (R, ZR)	

*1 Do not set local devices.
*2 Set within the device range specified with "Device/Label Memory Area Setting" in "Memory/Device Setting" of "CPU Parameter".

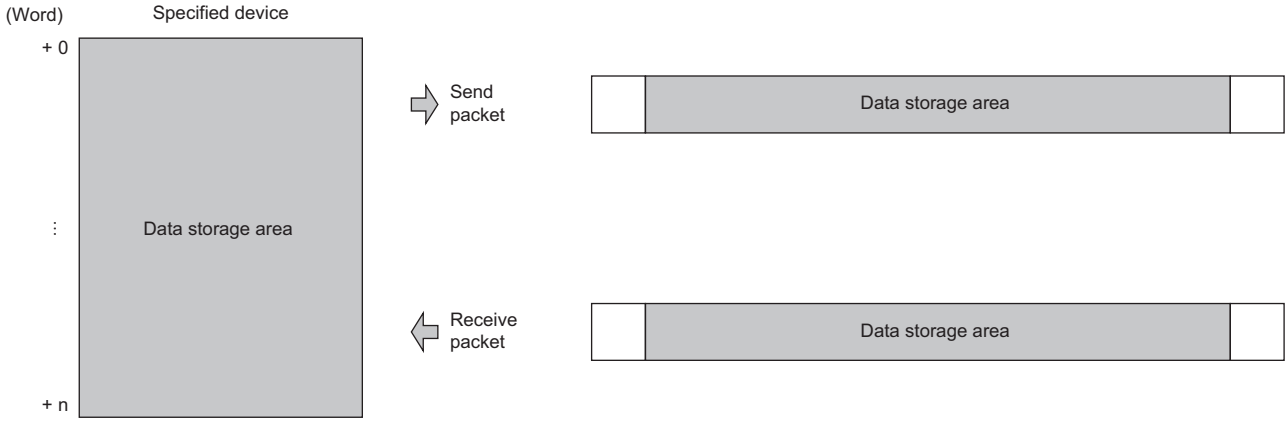
The following figures show the configuration of the data storage area.

■When "Fixed Length/Variable Length" is "Fixed Length"

The area after the device number specified on the "Element Setting" window becomes the data storage area.

The occupied data storage area differs according to the "Unit of Stored Data".

- When "Lower Byte + Upper Byte" is selected, the same size as the data length is occupied. (However, when the data length of a send packet is an odd number, the upper byte (lower byte for "Byte Swap") of the end device is not sent. When the data length of a receive packet is an odd number, the last data is stored with one byte of 00H.)
- When "Lower Bytes Only" is selected, a size twice the data length is occupied.



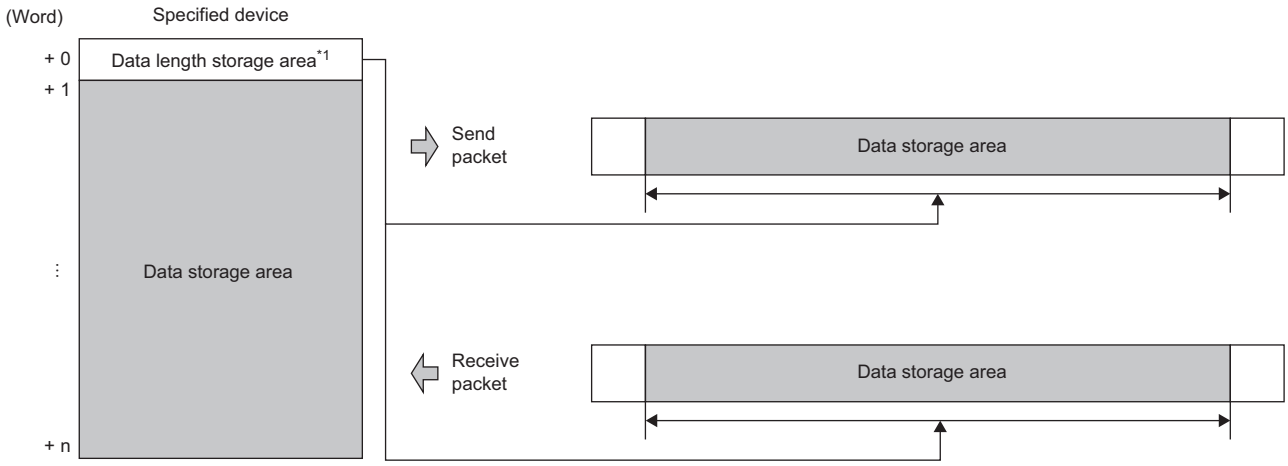
For send packet: Send data is stored by the program.

For receive packet: Receive data is stored by the controller.

■When "Fixed Length/Variable Length" is "Variable Length"

The area after the device number specified on the "Element Setting" window + 1 becomes the data storage area.
The occupied data storage area differs according to the "Unit of Stored Data".

- When "Lower Byte + Upper Byte" is selected, the same size as the data length + one word (length for the data length storage area) are occupied. (However, when the data length of a send packet is an odd number, the upper byte (lower byte for "Byte Swap") of the end device is not sent. When the data length of a receive packet is an odd number, the last data is stored with one byte of 00H.)
- When "Lower Bytes Only" is selected, a size twice the data length + one word (for data length storage area) is occupied.



For send packet: Send data is stored by the program.
For receive packet: Receive data is stored by the controller.

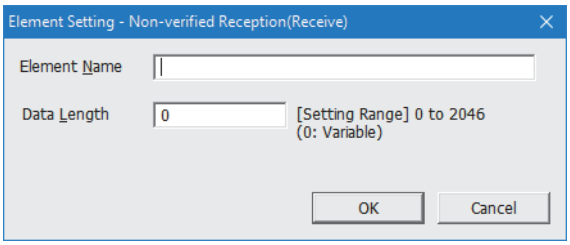
*1 The data length unit is fixed to byte.

Point

When "Fixed Length/Variable Length" is "Variable Length" and the configuration is set as follows, an error occurs:

- An element other than static data is placed behind a non-conversion variable element when non-conversion variable is out of the length calculating range or when there is no length element (except for when non-conversion variable is placed at the end of the packet elements).
- Multiple non-conversion variable elements are placed in the length calculating range, while a length element is not placed.
- A non-conversion variable element is placed before a length element in the length calculating range.

Non-verified reception



Use this when receive data include unnecessary data.

If the receive packet contains non-verified reception, the controller skips over the specified number of characters.

Multiple non-verified reception elements can be set in one packet.

The following table lists the items.

Item	Description		Remarks
Element Name	Set the element name.		—
Data Length	0 (Number of characters variable)	Set this when the number of characters that are not verified differs in each communication session.	—
	1 to 2046 (specified number of characters)	Set the number of characters that are not verified.	

Point

When "Data Length" is set to 0, an error will occur if the following layout is used.

- An element other than static data is placed behind a non-verified reception element when non-verified reception is out of the length calculating range or when there is no length element (except for when non-verified reception is placed at the end of the packet elements).
- Multiple non-verified reception elements are placed in the length calculating range, while a length element is not placed.
- A non-verified reception element is placed before a length element in the length calculating range.

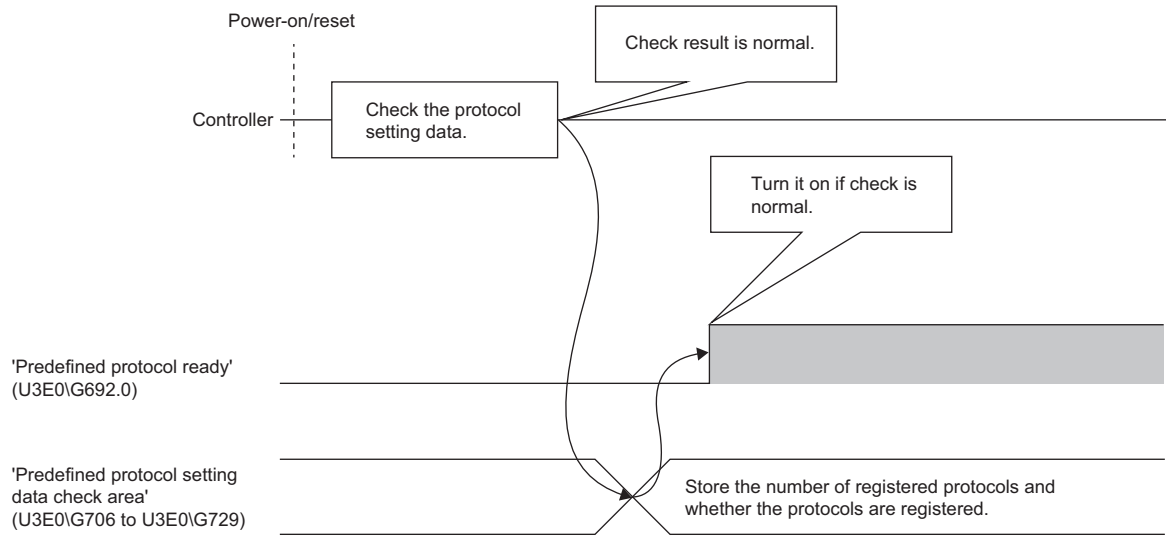
51.5 Execution Conditions of Predefined Protocol Communications

The predefined protocol communications can be executed when 'Predefined protocol ready' (U3E0\G692.0) is on.
This section describes the operation of 'Predefined protocol ready' (U3E0\G692.0).

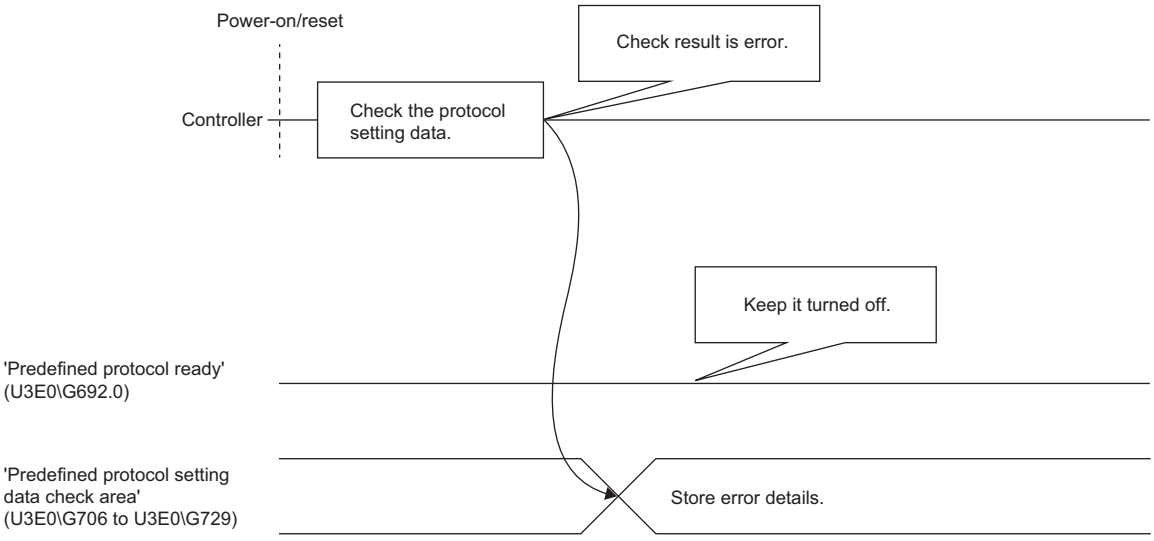
When the system is powered on or reset

If protocol setting data is written, the controller checks the protocol setting data when the system is powered on or reset.
If the protocol setting data is normal, the controller turns on 'Predefined protocol ready' (U3E0\G692.0), and enables execution of the protocol.
'Predefined protocol ready' (U3E0\G692.0) is used as the interlock signal for executing the protocol.
If the protocol setting data is abnormal, 'Predefined protocol ready' (U3E0\G692.0) remains off, and the details of the error are stored in 'Predefined protocol setting data check area' (U3E0\G706 to U3E0\G729).
If protocol setting data is not written, the protocol setting data is not checked, and 'Predefined protocol ready' (U3E0\G692.0) remains off.
Whether the protocol setting data is registered or not can be checked with 'Number of registered protocols' (U3E0\G714) and 'Protocol registration' (U3E0\G722 to U3E0\G729).

■When protocol setting data is normal



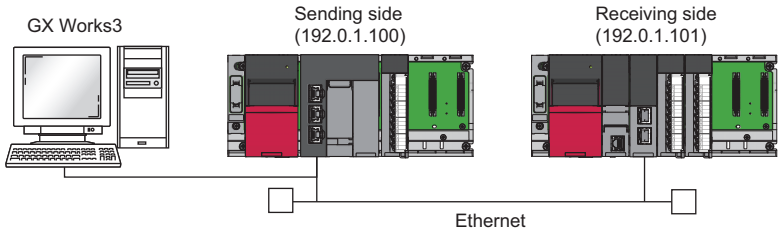
■When protocol setting data is abnormal



51.6 Example of Predefined Protocol Communications

This section describes an example of predefined protocol communications using UDP.

System configuration



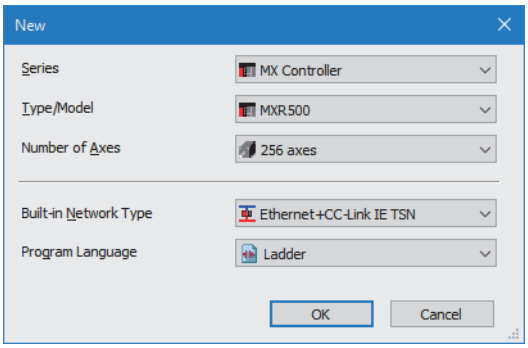
Parameter settings

Connect the engineering tool to the controller and set the parameters.

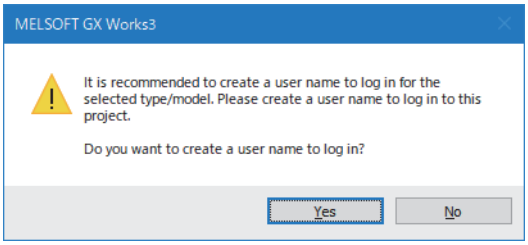
■Sending side

1. Start the engineering tool.
2. Set the controller as follows.

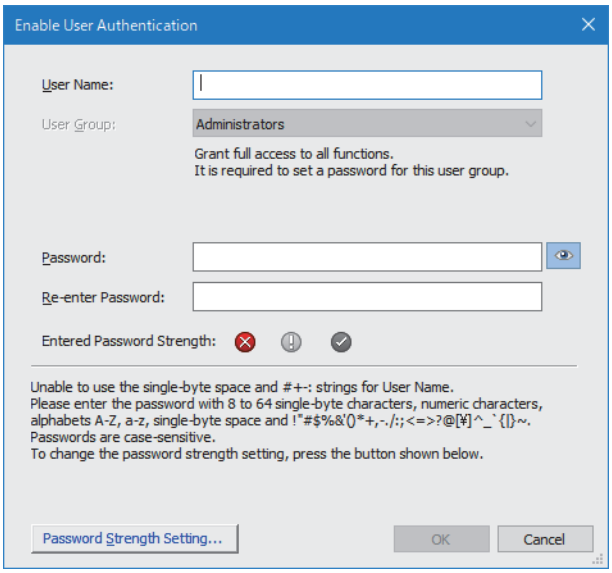
[Project] ⇨ [New]



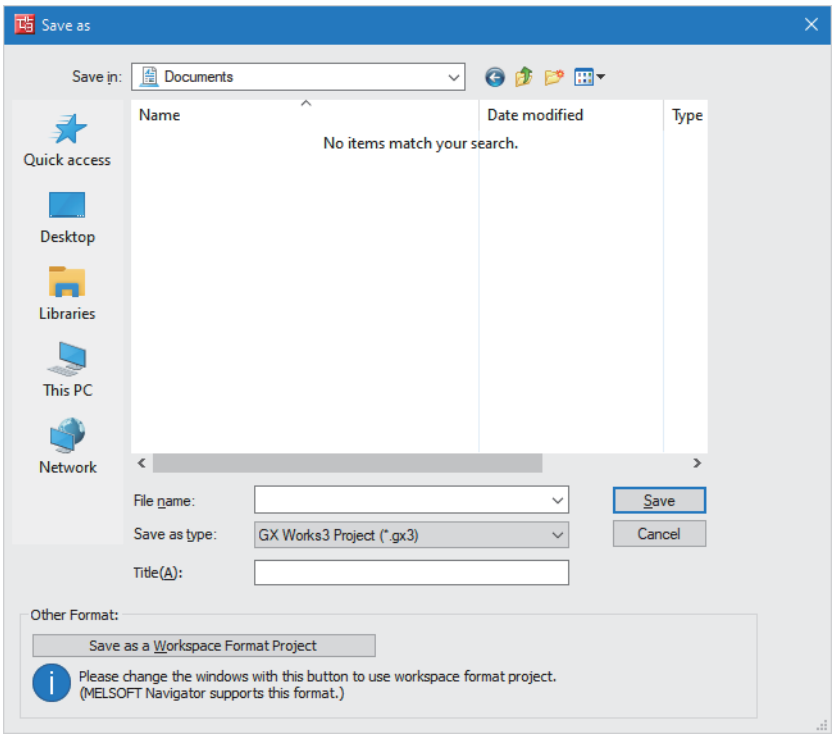
3. Click the [Yes] button.



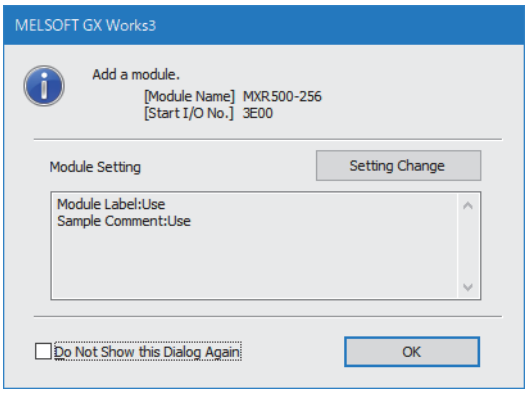
4. Set each item and click the [OK] button.



5. Set each item and click the [Save] button.



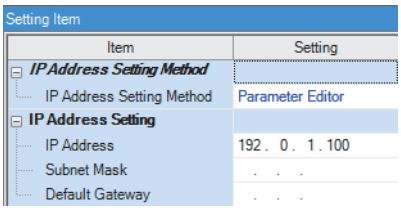
6. Click the [Setting Change] button to use the module label.



7. Click the [OK] button to create the project.

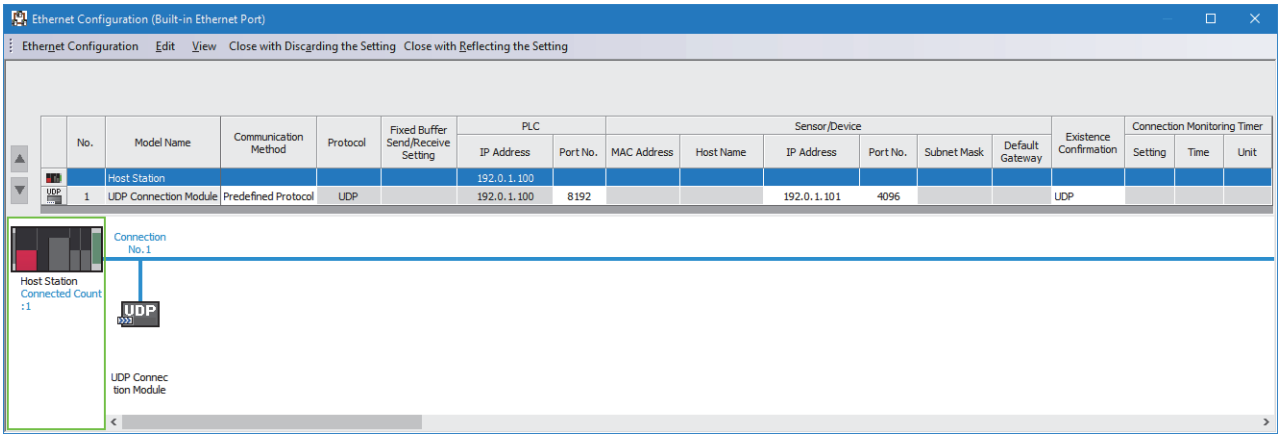
8. Set the items in "Required Settings" as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings]



9. Set "External Device Configuration" as follows.

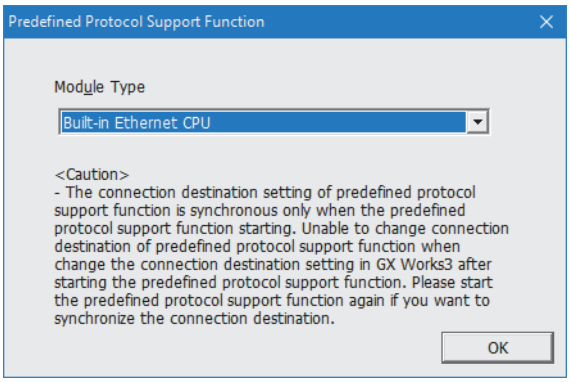
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]



10. Start the predefined protocol support function.

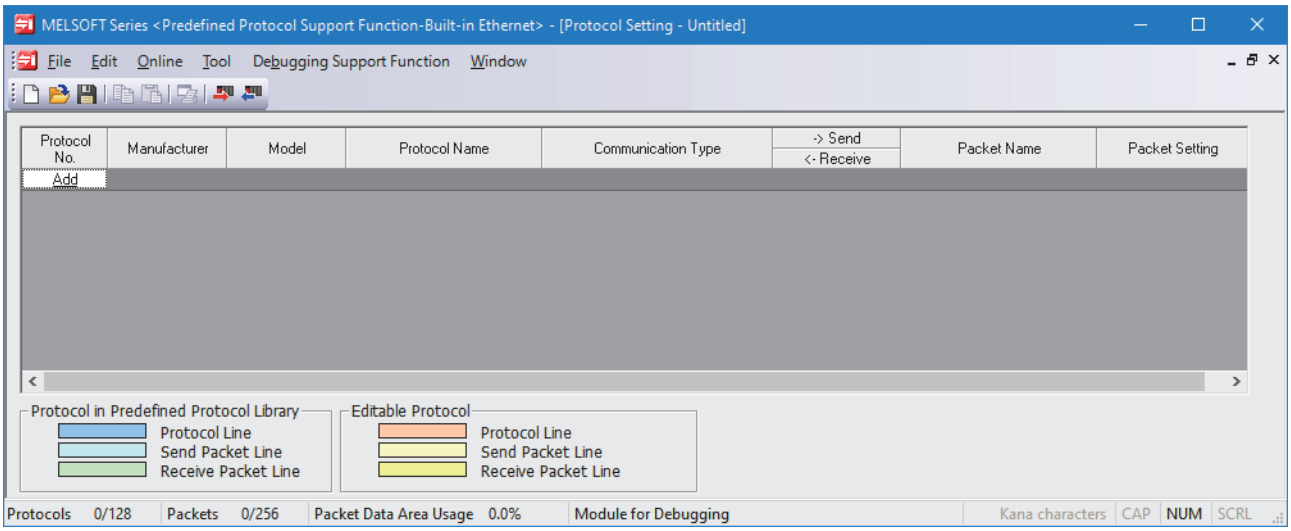
[Tool] ⇨ [Predefined Protocol Support Function]

11. Select "Built-in Ethernet CPU" for "Module Type" and click the [OK] button.



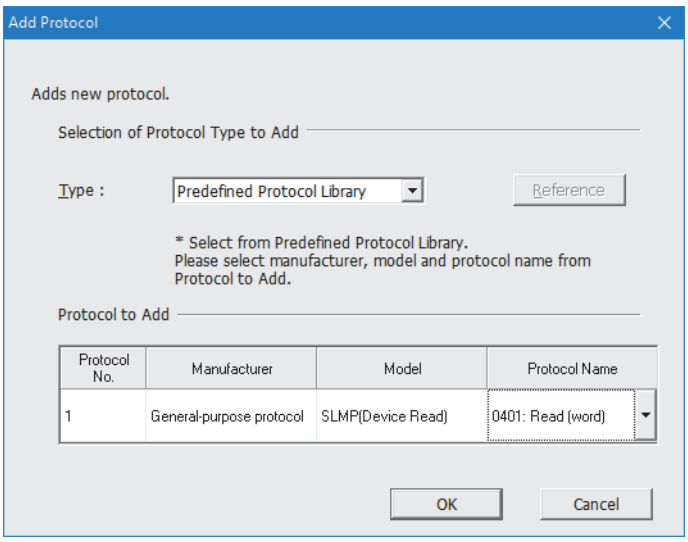
12. Newly create the protocol setting.

[File] ⇨ [New]



13. Set the protocol as follows.

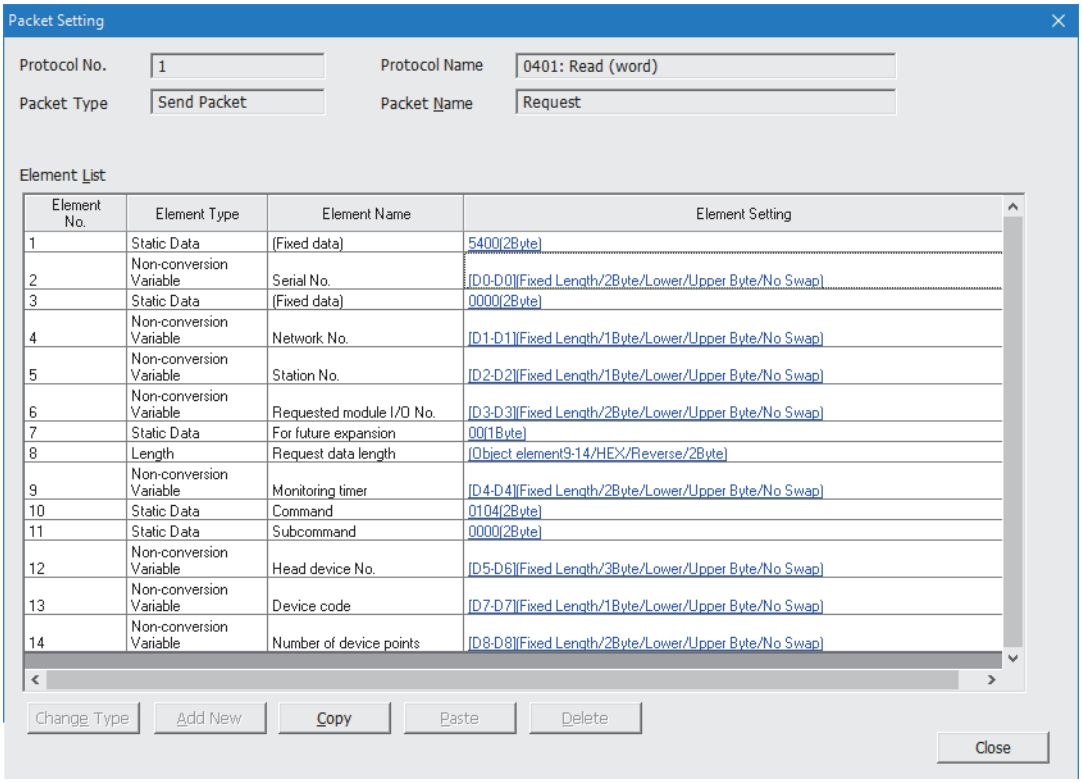
[Edit] ⇨ [Add Protocol]



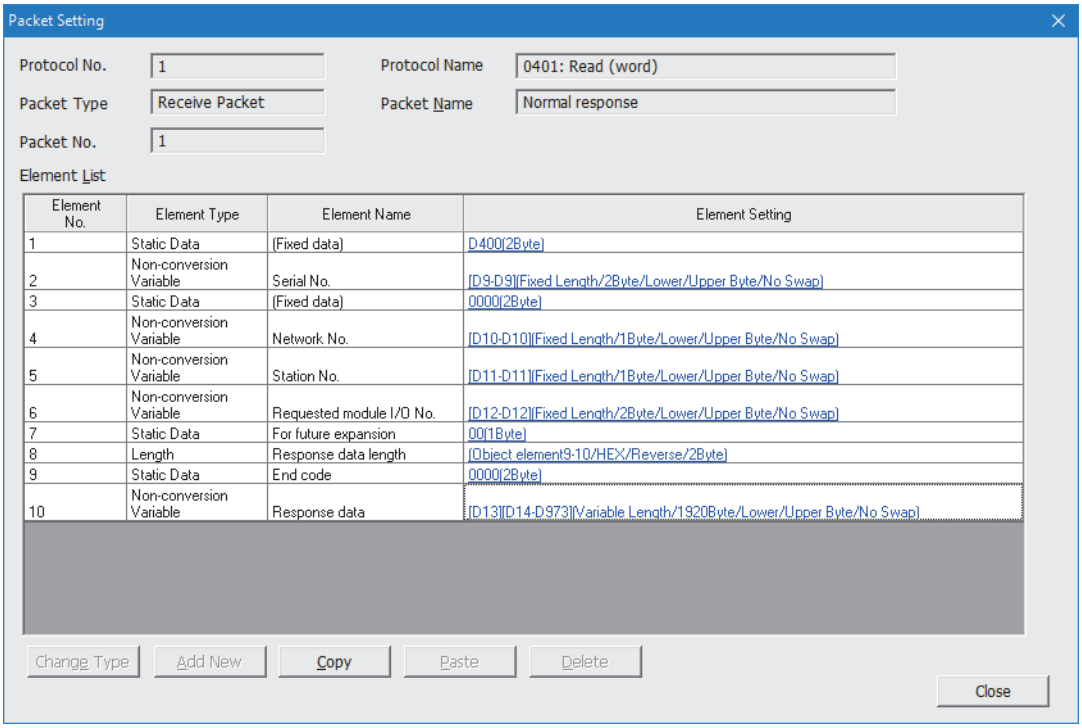
14. Set each packet as follows.

"Protocol Setting" window ⇨ Packet to be set

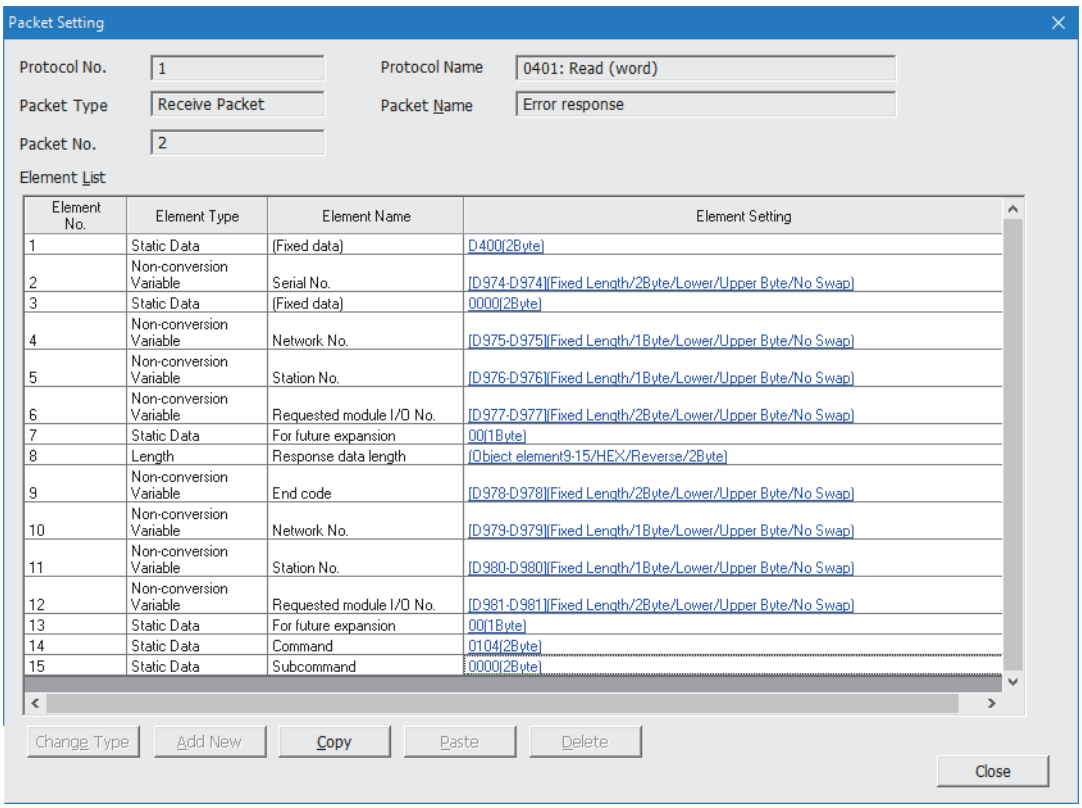
• Request



• Normal response

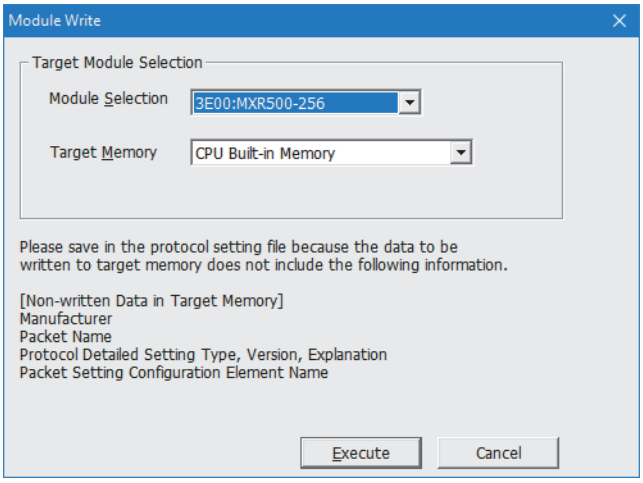


• Error response



15. Write the protocol setting data to the controller.

[Online] ⇨ [Write to Module]



16. Write the set parameters to the controller. Then reset the controller or power off and on the system.

[Online] ⇨ [Write to PLC]

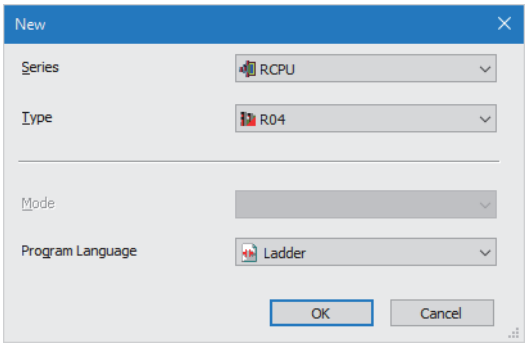
Point

In this example, default values were used for parameters that are not shown above.

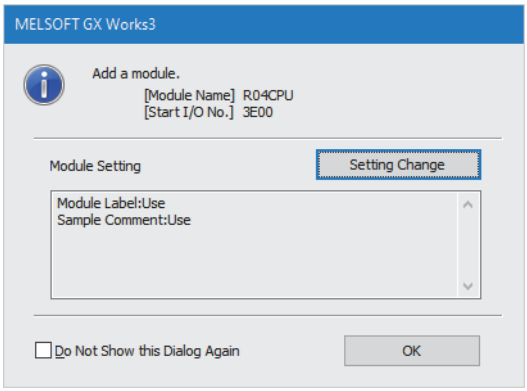
■Receiving side

1. Set the CPU module as follows.

[Project] ⇨ [New]



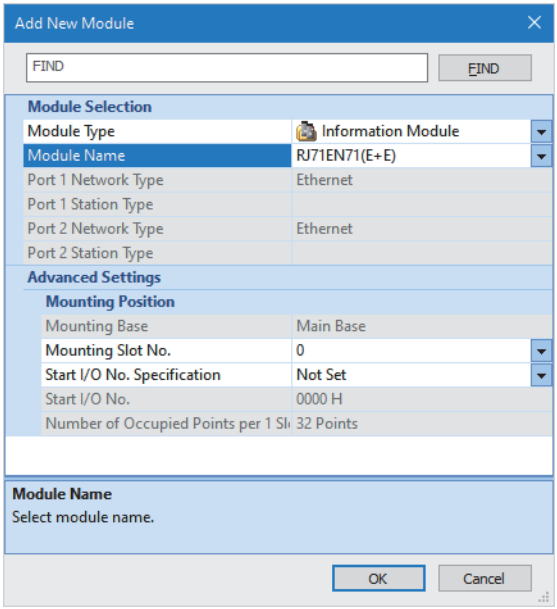
2. Click the [Setting Change] button in the following window and set the item to use module labels.



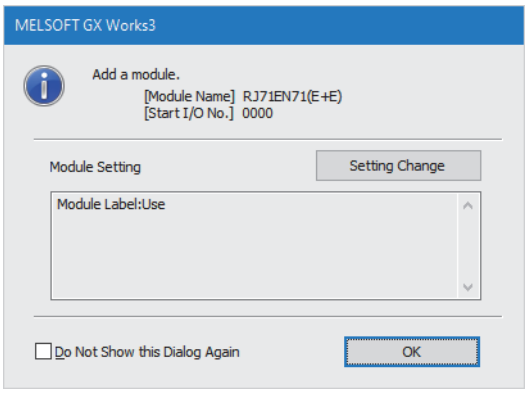
3. Click the [OK] button to add the module labels of the CPU module.

4. Set the RJ71EN71 as follows.

Navigation window ⇨ [Parameter] ⇨ [Module Information] ⇨ Right-click ⇨ [Add New Module]

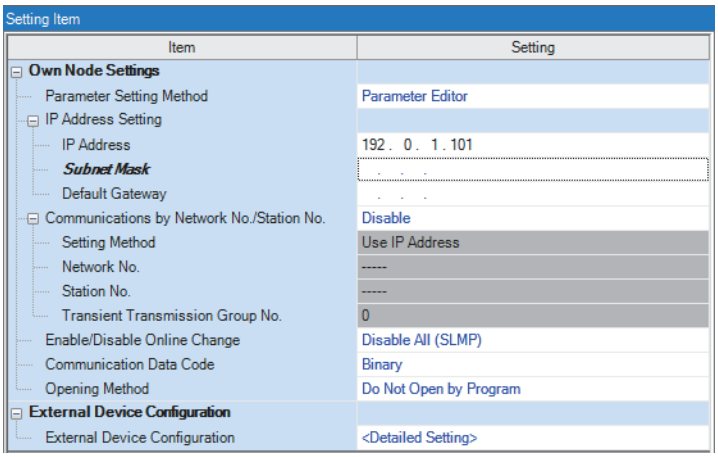


5. Click the [OK] button to add the module labels of the RJ71EN71.



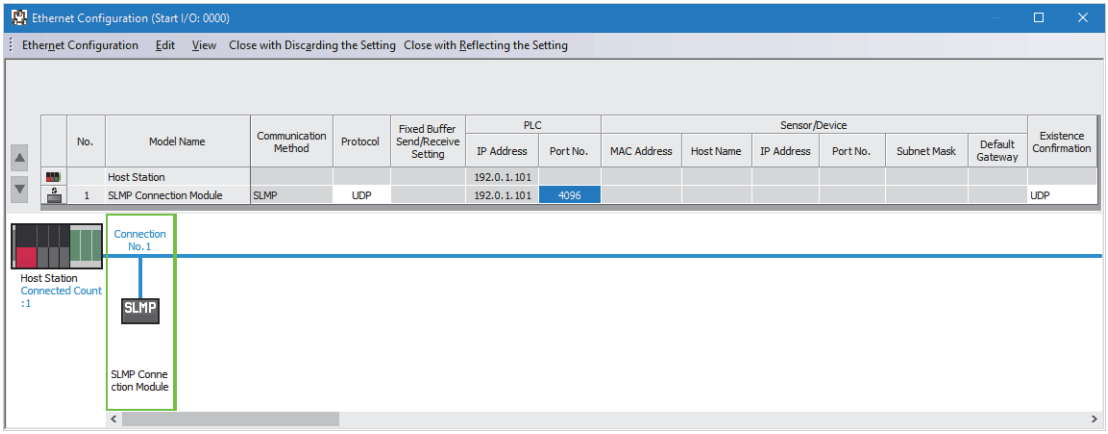
6. Set the items in "Basic Settings" as follows.

Navigation window ⇨ [Parameter] ⇨ [Module Information] ⇨ [RJ71EN71] ⇨ [Port 1 Module Parameter (Ethernet)] ⇨ [Basic Settings]



7. Set the network configuration as follows.

Navigation window ⇨ [Parameter] ⇨ [Module Information] ⇨ [RJ71EN71] ⇨ [Port 1 Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]



8. Write the set parameters to the CPU module. Then reset the CPU module or power off and on the system.

[Online] ⇨ [Write to PLC]

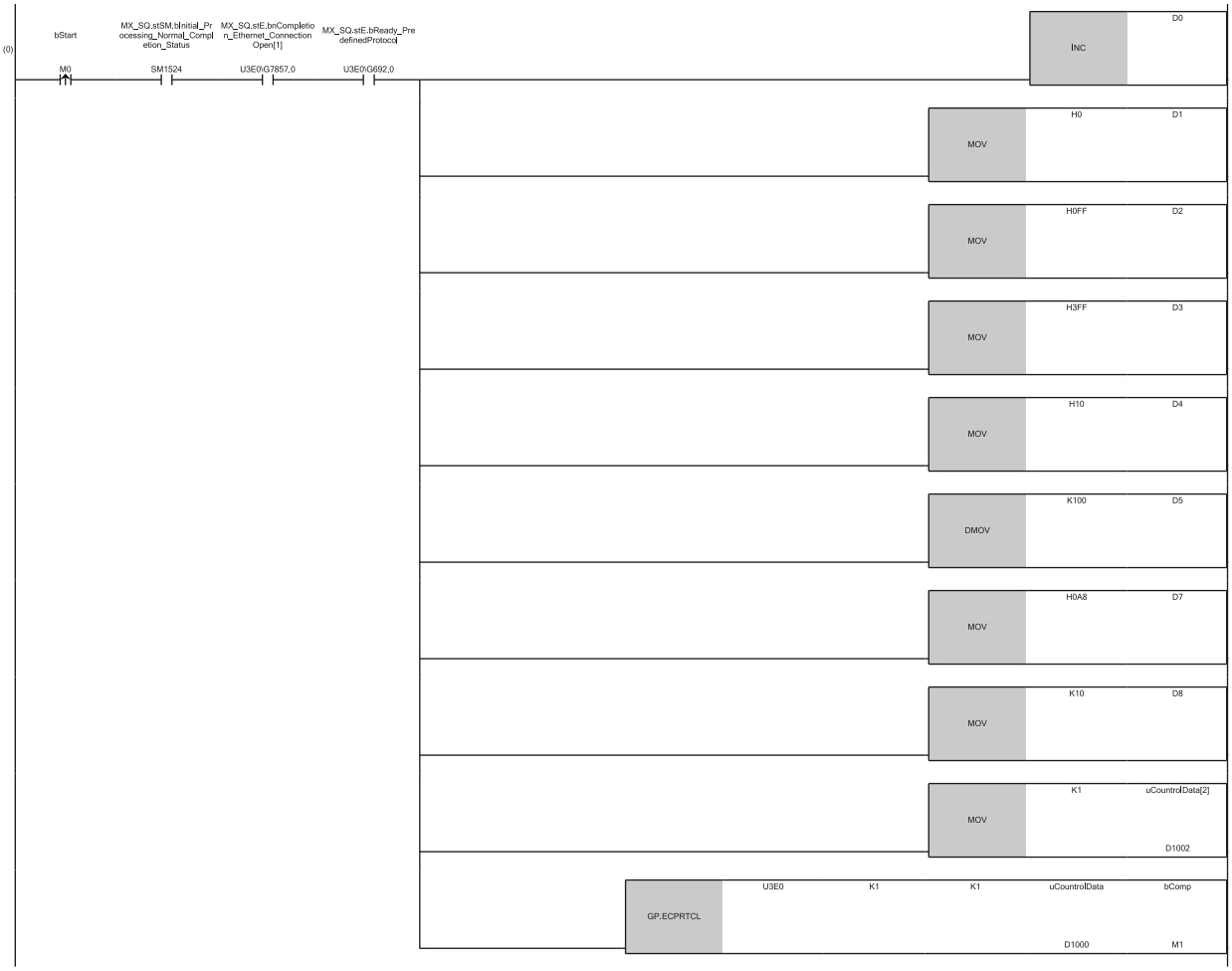
Point

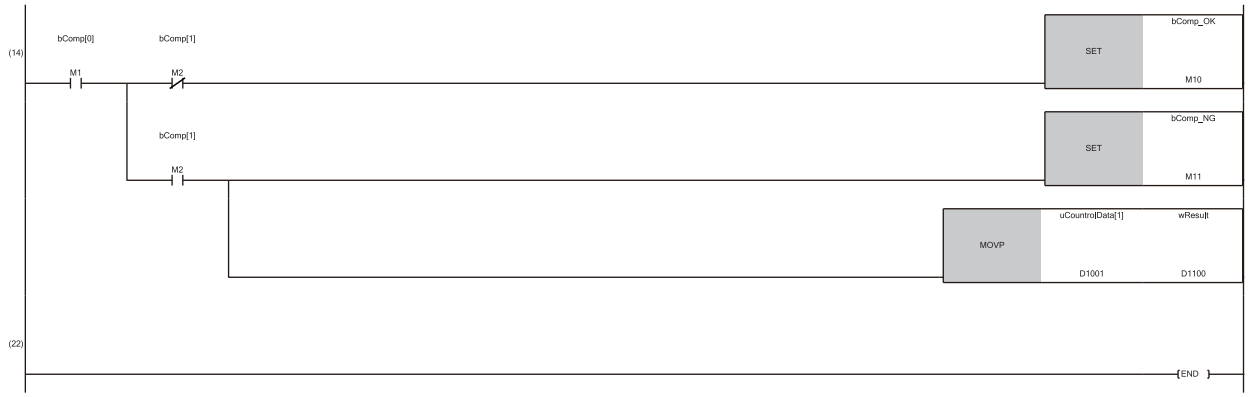
In this example, default values were used for parameters that are not shown above.

Program example

Classification	Label name	Description	Device
Module label	MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]	Open completion signal connection No.1	U3E0\G7857.0
	MX_SQ.stSM.bInitial_Processing_Normal_Completion_Status	Initial processing successful completion state	SM1524
	MX_SQ.stE.bReady_PredefinedProtocol	Predefined protocol ready	U3E0\G692.0
Label to be defined	Define global labels as shown below:		

	Label Name	Data Type		Class	Assign (Device/Label)
1	bStart	Bit	...	VAR_GLOBAL	M0
2	bComp	Bit(0..1)	...	VAR_GLOBAL	M1
3	bComp_OK	Bit	...	VAR_GLOBAL	M10
4	bComp_NG	Bit	...	VAR_GLOBAL	M11
5	uCountrolData	Word [Unsigned]/Bit String [16-bit](0..17)	...	VAR_GLOBAL	D1000
6	wResult	Word [Signed]	...	VAR_GLOBAL	D1100





(0) When 'bStart' (M0) is turned on, the protocol is executed by the ECPRTCL instruction and D100 to D109 of the receiving side CPU module are read and stored in D14 to D23 of the sending side controller.
'bComp_OK' (M10) is turned on when the protocol completed successfully.

The following data is stored as a protocol setting data in D0 to D8.

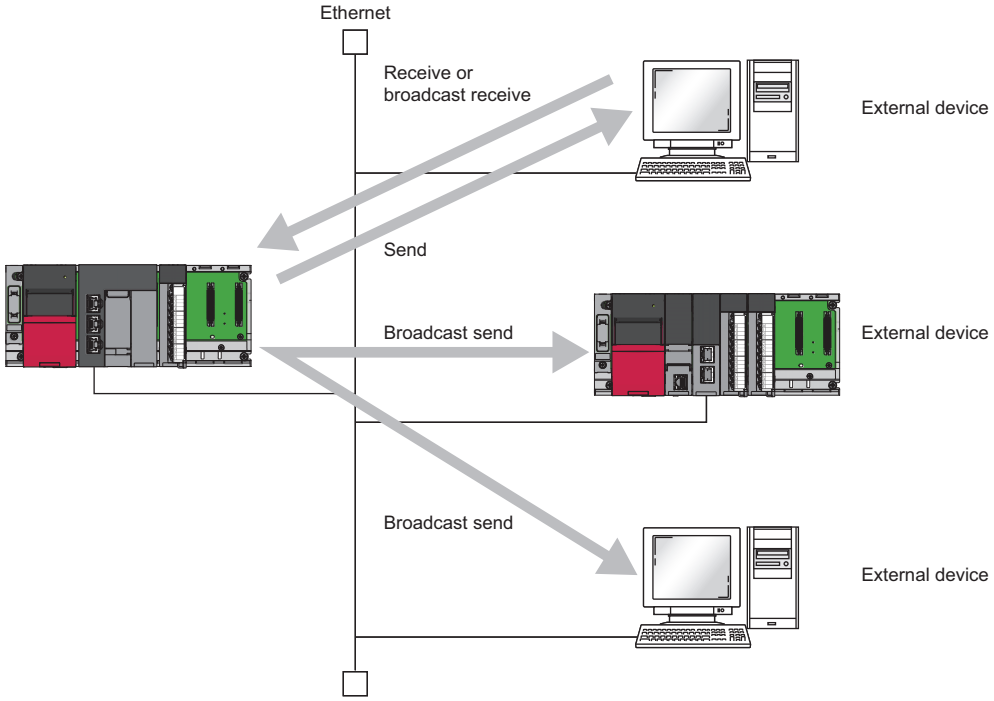
Device number	Element name	Setting value	Description
D0	Serial No.	—	The number increases one by one each time 'bStart' (M0) is turned on.
D1	Network No.	0H	Because the access destination is the connected station (own station), 0H is stored as the request destination network number.
D2	Station No.	FFH	Because the access destination is the connected station (own station), FFH is stored as the request destination station number.
D3	Requested destination module I/O No.	3FFH	Because the access destination is the receiving side CPU module (control CPU of the receiving side RJ71EN71), 3FFH is stored.
D4	Monitoring timer	10H	The monitoring timer is set to 4 seconds. (Unit: 250ms)
D5 to D6	Start device No.	100	To read D100 to D109, start device number is set to 100.
D7	Device code	A8H	To read D100 to D109, device code is set to A8H.
D8	Number of device points	10	To read 10 points from D100 to D109, number of device points is set to 10.

Point

In this program example, a receiving side program is not required.

52 SOCKET COMMUNICATIONS

Use this setting to perform one-to-one bidirectional communication with an external device, or to perform one-to-many unidirectional communication.
Using dedicated instructions, any data (up to 10238 bytes) can be sent/received via TCP, UDP, TLS, and DTLS with an external device connected through Ethernet. Encrypted communication is possible using TLS and DTLS for a communication route that crosses the trust boundary.
This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)



Available protocols

■TCP

This protocol establishes a connection with the external device for reliable data exchange. (☞ Page 1323 Communications Using TCP)

■UDP

This protocol is simple, as it does not perform sequencing or re-send control. (☞ Page 1326 Communications Using UDP)

■TLS

This protocol uses TCP/IP to perform encrypted communication with the external device.
It checks the following items before starting communication.

- IP address and port number of the external device
- IP address and port number on the controller side
- Which side will open the connection, the external device or the controller (Active open or Passive open)?

■DTLS

This protocol uses UDP to perform encrypted communication with the external device.
It checks the following items before starting communication.

- IP address and port number of the external device
- IP address and port number on the controller side
- Which side will open the connection, the external device or the controller (Active open or Passive open)?

Precautions

When UDP or DTLS is used as the communication protocol, problems such as loss of data and data arrival order interchange may occur. If such a problem occurs, consider using the TCP or TLS protocol.

52.1 Setting Method

Configure the settings in the "External Device Configuration" window. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

1. Select the external device to be connected in "Module List" and drag it to the list of devices or device map area.

External device name	Description
UDP Connection Module	Select this option to communicate with the external device using UDP.
Active Connection Module	Select this to perform the open processing to the external device from the controller (Active open) and communicate using TCP/TLS/DTLS.
Unpassive Connection Module	Select this to receive the open processing from an unspecified external device (Unpassive open) and communicate using TCP/TLS/DTLS.
Fullpassive Connection Module	Select this to receive the open processing from a specified external device (Fullpassive open) and communicate using TCP/TLS/DTLS.

2. Set "Communication Method" for the external device to "Socket Communication".
3. Set the other parameters required for communications in the connection.

Point

To set encrypted communications (TLS/DTLS), refer to the following.
☞ Page 1558 Encrypted Communication Function

Precautions

Note that if encrypted communication (TLS/DTLS) is interrupted due to cable disconnection or other issues, communication may not be possible even after recovery.
If communication fails while the own station is operated as a server device, close the server device connection using the SOCCLOSE instruction, then open it again using the SOCOPEN instruction.

52.2 Dedicated Instructions

The dedicated instructions used for socket communications are as follows.

Instruction symbol	Processing details
GP.SOCOPEN	Establishes a connection.
SP.SOCOPEN	
GP.SOCCLOSE	Closes the connection.
SP.SOCCLOSE	
GP.SOCRCV	Reads the receive data from the external device.
SP.SOCRCV	
G.SOCRCVS	
S.SOCRCVS	
GP.SOCSND	Sends data to the external device.
SP.SOCSND	
GP.SOCCINF	Reads connection information
SP.SOCCINF	
GP.SOCCSET	Changes the communication target
SP.SOCCSET	
GP.SOCRMODE	Changes the connection receive mode.
SP.SOCRMODE	
G(P).SOCRDATA	Reads the specified size of data from the socket communications receive data area.
S(P).SOCRDATA	

Point

If the instruction has a completion device, do not change the various data (such as control data and request data) specified with the executed instruction until execution of the instruction is completed.

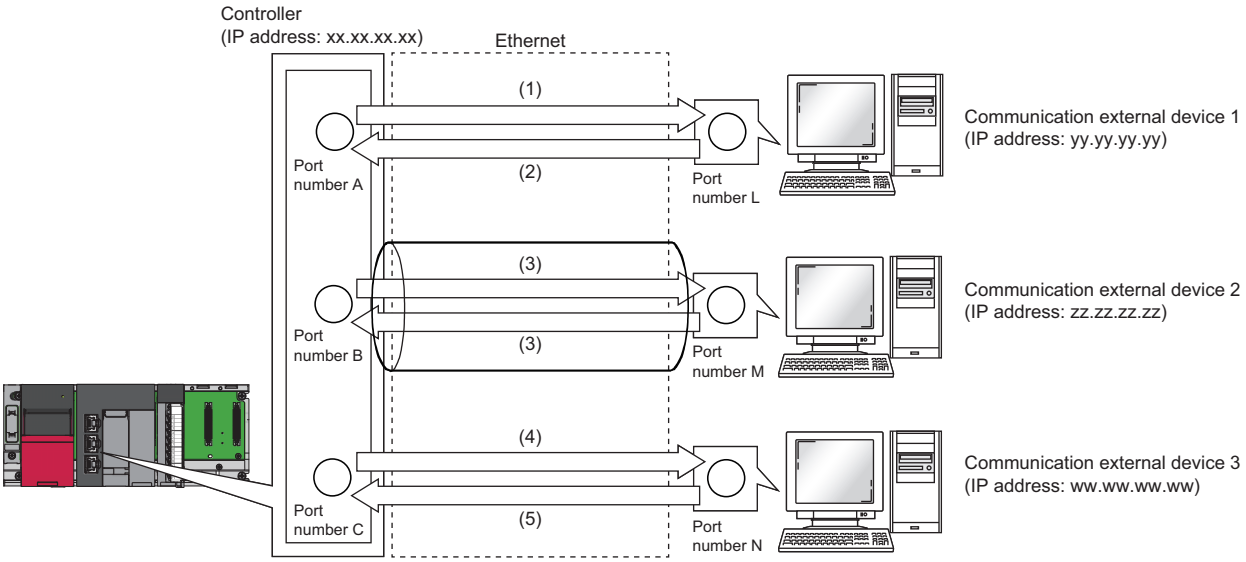
52.3 Applicable Connections

The following connections can be used for data exchange with socket communications.

Port	Usable connections
Port for Ethernet	Connection No.1 to 64

52.4 Communication Structure

With socket communications, port numbers that identify the communication are used to enable multiple communication sessions with the external device. They are used for both TCP and UDP.
For send: Specify controller port number as the send source and the destination port number as the send destination.
For receive: Specify the controller port number, and read the data sent to that port.



(1) Sending UDP data from port number A of the controller to port number L of the external device 1
(2) Sending UDP data from port number L of the external device 1 to port number A of the controller
(3) Sending data with TCP/IP connection
(4) Sending UDP data from port number C of the controller to port number N of the external device 3
(5) Sending UDP data from port number N of the external device 3 to port number C of the controller

Open processing necessity depending on connection setting

Protocol	Open system	Open method setting	Open processing	Remarks
TCP	Active open	—	Required	—
	Passive open	Do Not Open by Program	Not required*1	Ready to open (Closed)
		Open by Program	Required	—
UDP	—	Do Not Open by Program	Not required*1	Opened automatically
		Open by Program	Required	—
TLS	Active open	—	Required	—
	Passive open	Do Not Open by Program	Not required*1	Ready to open (Closed)
		Open by Program	Required	—
DTLS	Active open	—	Required	—
	Passive open	Do Not Open by Program	Not required*1	Ready to open (Closed)
		Open by Program	Required	—

*1 If it was closed by the program, open processing needs to be performed again.

52.5 Communications Using TCP

TCP is a protocol that establishes a connection of the external device to perform reliable data exchange.

Check the following items before performing socket communications using TCP.

- IP address and port number of the external device
- IP address and port number on the controller side
- Which side will open a connection, the external device side or the controller side (Active open or Passive open)?

TCP connection operation

TCP connection includes Active open and Passive open.

First, the device on TCP connection wait side performs Passive open with the specified port number.

The device on TCP connection side specifies the port number waiting in the Passive open side, and executes Active open.

This enables the TCP connection, the connection is established, and data can be exchanged.

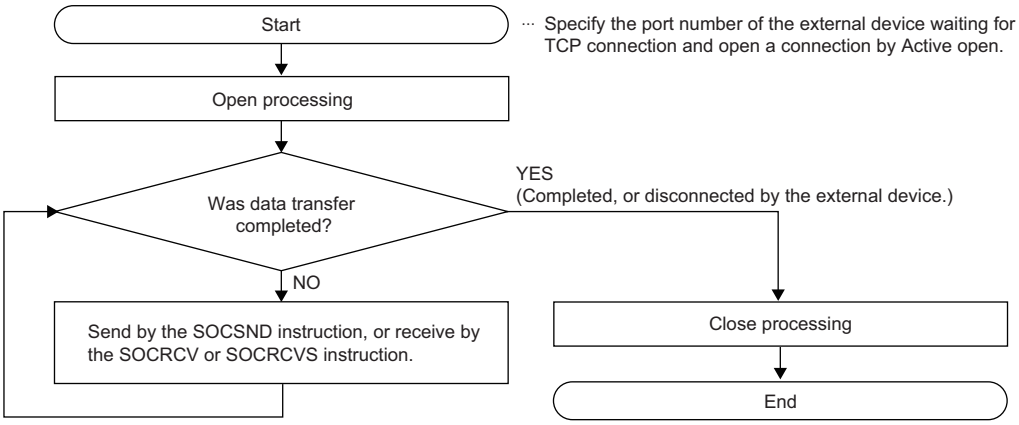
Point

The terms for Active open and Passive open may differ according to external devices.

- Active open: TCP connection side, client side, connect side, and others
- Passive open: TCP connection wait side, server side, listen side, and others

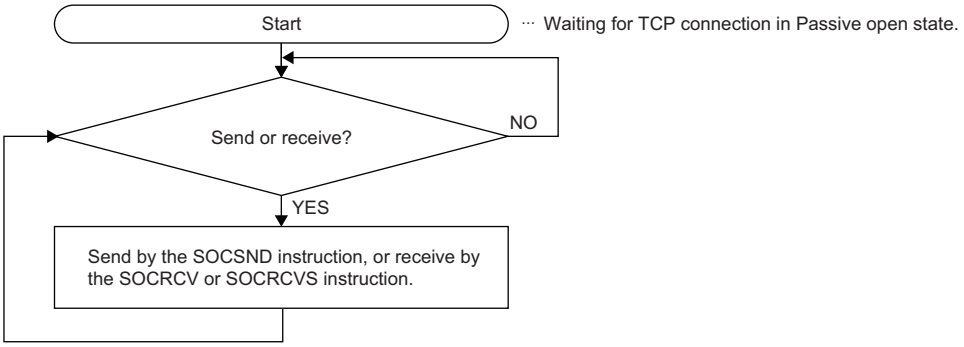
■Active open

The following figure shows the flow of data exchange using Active open.



■Passive open

The following figure shows the flow of data exchange using Passive open.



Precautions for TCP communications

■Conditions for closing

In TCP communications, in addition to the close request from the external device, 'Open completion signal' (U3E0\G7857 to U3E0\G7860) turns off and communications are closed in the following cases.

- When alive check function times out
- When forced close is received from external device

■TCP connection elements

The TCP connection is managed with the following four elements. Only one connection containing the same four elements can be created at one time. To use multiple TCP connections simultaneously, ensure that one of the four elements is different.

- Controller side IP address
- Controller side port number
- IP address of the external device side
- Port number of the external device side

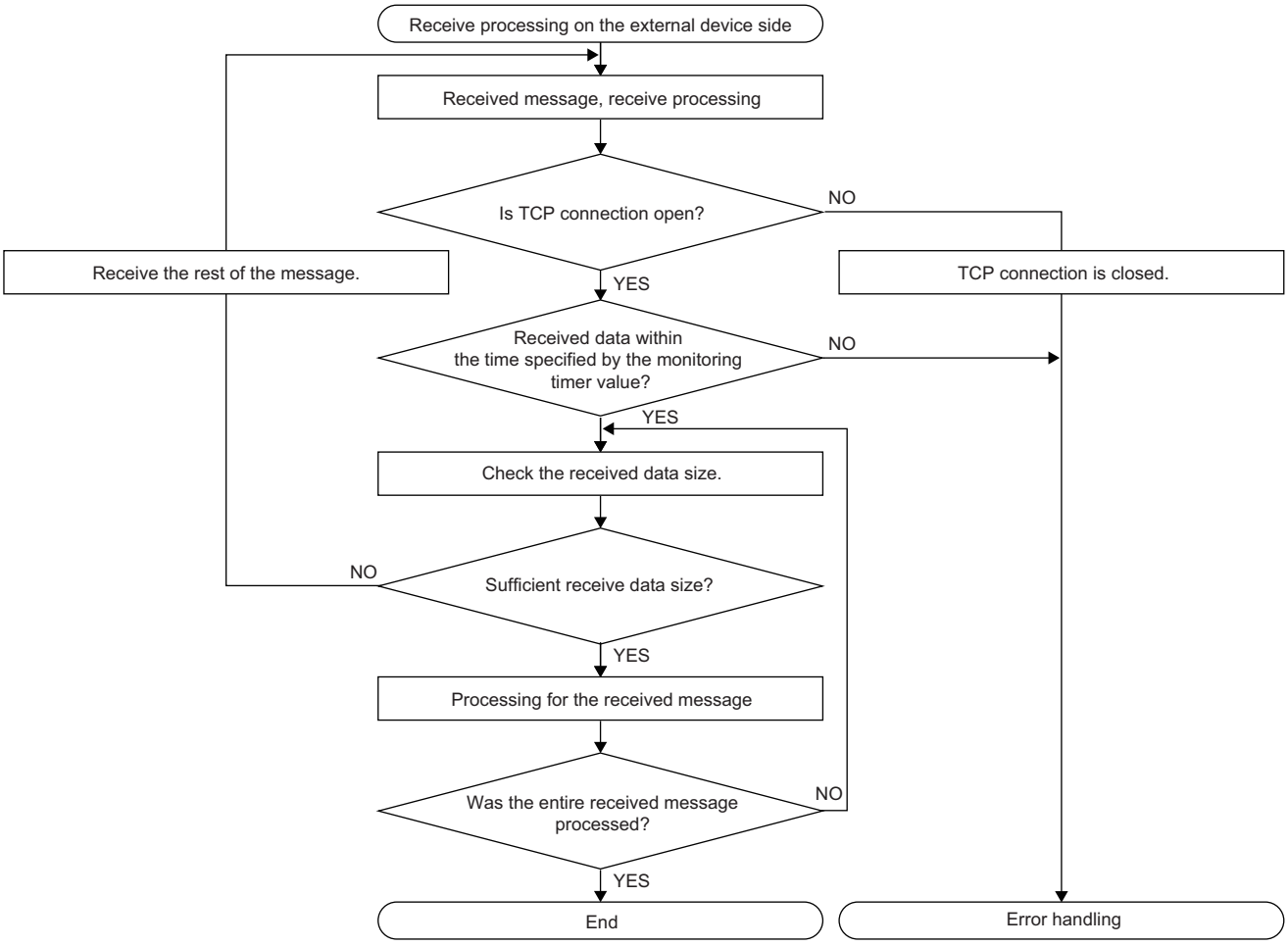
However, if "Unpassive Connection Module" or "Fullpassive Connection Module" is selected, set the port number of the controller to be different. In addition, one of the other three elements also has to be different.

■Checking the receive data length

There is no concept of delimiting the communication data during communications with TCP. Thus, the continuously sent data may be merged on the receiving side, or the data sent in a group may be split on the receiving side. If necessary, the receiving side must check the receive data length and perform the processing.

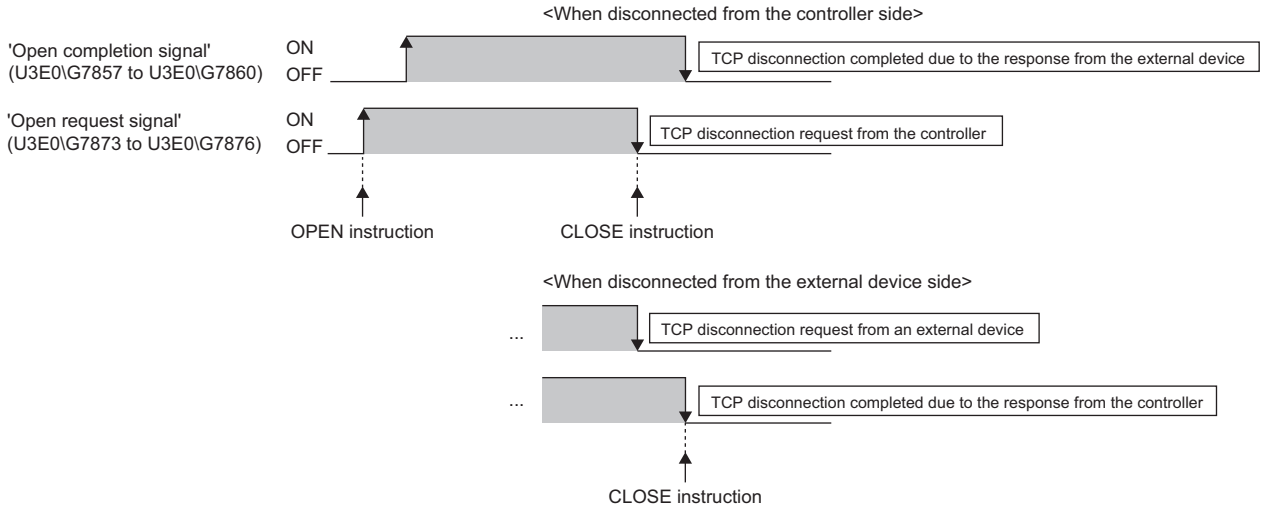
If the data length is determined when receiving on the controller side, using the fixed-length mode is recommended.

When receiving on the external device side, check the receive data length and perform the processing as shown below.



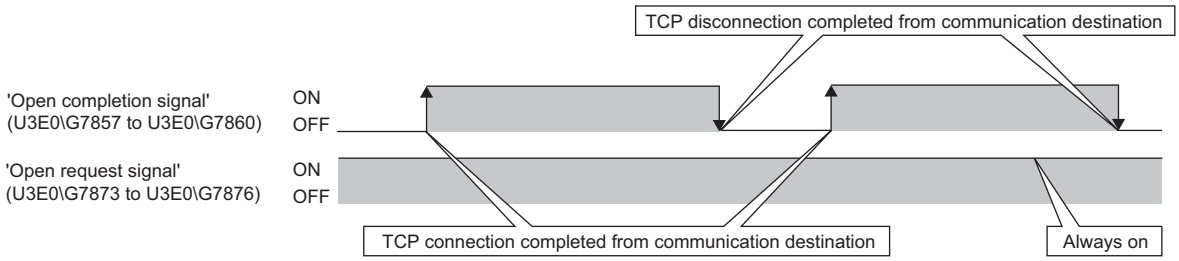
■Precautions for Active open

Use 'Open completion signal' (U3E0\G7857 to U3E0\G7860) and 'Open request signal' (U3E0\G7873 to U3E0\G7876) in the program to create an interlock circuit. The on/off timing for the open completion signal and open request signal is shown below.



■Precautions for Passive open

- Use 'Open completion signal' (U3E0\G7857 to U3E0\G7860) and 'Open request signal' (U3E0\G7873 to U3E0\G7876) in the program to create an interlock circuit. The on/off timing for the open completion signal and open request signal is shown below.



- When the controller is connected to the external device with Passive open, the IP address of the connected external device or the port number of the external device can be retrieved with the SOCCINF instruction.
- With TCP, one external device is connected with one connection. To connect with multiple external devices with the same own station port number, provide a connection for each external device. If more external devices than the prepared number of connections are connected, the connection will be disconnected immediately.
- Connect from the external device after the controller enters the open standby state. The TCP connection request received from the external device between CPU startup completion and open wait state causes an error, and forced close connection is returned to the external device. In this case, wait for the controller to enter the open wait state and then retry from the external device.
- Do not execute the GP.SOCCLOSE instruction in the program. If the GP.SOCCLOSE instruction is executed, the open completion signal and open request signal for the corresponding connection will turn off. The close processing will be executed and send/receive will be disabled. To re-open a closed connection, execute the GP.SOCOPEN instruction.

52.6 Communications Using UDP

Communications with UDP use a simple protocol without sequencing or re-send control.
Check the following items before performing socket communications using UDP.

- IP address and port number of the external device
- IP address and port number on the controller side

Precautions for UDP communications

- Loss of data, data arrival order interchange, and others could be occur. Consider using TCP if there are problems.
- Even if the communication line between the controller and external device is not connected because of a connected cable disconnection and others, the data send processing may end normally. Thus, providing a communication procedure and sending/receiving data is recommended.
- Use the GP.SOCCSET instruction to change the external device with the controller.
- 'Open completion signal' (U3E0\G7857 to U3E0\G7860) and 'Open request signal' (U3E0\G7873 to U3E0\G7876) for the connection set to UDP are always on.
- Do not execute the GP.SOCCLOSE instruction in the program. If the GP.SOCCLOSE instruction is executed, the open completion signal and open request signal for the corresponding connection will turn off. The close processing will be executed and send/receive will be disabled. To re-open a closed connection, execute the GP.SOCOPEN instruction.
- Even if 'Open completion signal' (U3E0\G7857 to U3E0\G7860) is turned on, data sending may fail. If data sending fails, send the data again.

52.7 Broadcast Communications

Broadcast communication is a communication method that does not specify the external device. Data is exchanged between all Ethernet-equipped module stations and external devices on the same Ethernet to which the controllers are connected.

Item	Description
Broadcast Send	The same data is sent to all Ethernet devices on the same Ethernet.
Broadcast Receive	The data sent with broadcast send is received.

Setting method

Configure the settings in the "External Device Configuration" window. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

1. Select "UDP Connection Module" in "Module List" and drag it to the list of devices or device map area.
2. Set "Communication Method" for the external device to "Broadcast Send" or "Broadcast Receive".
3. Set the other parameters required for communications in the connection.

Precautions

- Decide the dedicated port number for broadcast communications in the system, and use that number.
- Access via a router is not permitted when using broadcast send.
- The external device connected on the same Ethernet must carry out a read/discard processing if the message received with broadcast receiving is not required.
- When the controller receives the data with broadcast receiving, the IP address of the sending external device or the port number of the external device can be retrieved with the SOCCINF instruction.

52.8 Precautions

This section describes the precautions for exchanging data with socket communications.

Port number

Port numbers 1 to 1023 are typically reserved port numbers (WELL KNOWN PORT NUMBERS) and 61440 to 65534 are used by other communication functions, so 1024 to 4999 or 5010 to 61439 should be used for the own station port numbers. In addition, if ports are used for other functions, do not use the ports for this function. (☞ Page 2191 Port Numbers Used by the System)

Reading received data

If 'Socket communications receive status signal' (U3E0\G7889 to U3E0\G7892) is on, read the received data. The communication could be affected if large amounts of data are not read out for a while.

In encrypted communications, if the receive data is not read without performing the receive procedure, the encrypted communication disconnection request cannot be received from the external device. As a result, the encrypted communication cannot be disconnected from the external device.

Accessing a file during communications

The controller prioritizes the file access processing over the Ethernet communication processing. Thus, if the file is accessed with FTP, the engineering tool, and so on, during socket communications, the socket communication processing could be delayed.

To access a file while monitoring the response time on the external device using socket communications, add the time required for accessing the file to the monitoring time.

Module FB and dedicated instruction

- When performing the open processing using the module FB or dedicated instruction, start sending and receiving data after the module FB or dedicated instruction is completed.
- Multiple module FBs or dedicated instructions to one connection cannot be simultaneously executed. When multiple module FBs or dedicated instructions are simultaneously executed, no operation is performed for the module FB or dedicated instruction executed later. Execute again after the module FB or dedicated instruction in execution is completed.

Re-opening after connection close

When the TCP/TLS connection is closed from the client (active connection module) side, the connection cannot be re-opened until at least 65 seconds have elapsed since the closure.

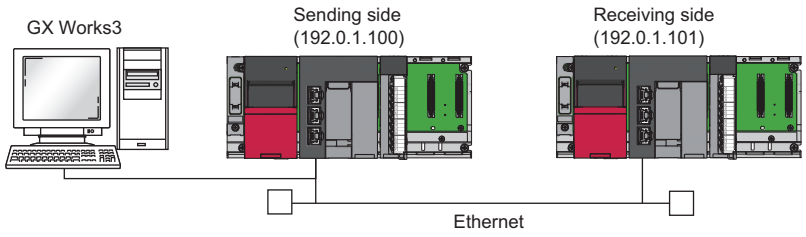
If a wait interval cannot be provided before re-opening, it is recommended to change the own station port number and open the connection. (☞ Page 1342 Communication example of re-open processing)

52.9 Communication Example

Socket communication example

This section describes the socket communications examples using Active open of TLS communications.

System configuration



Parameter settings

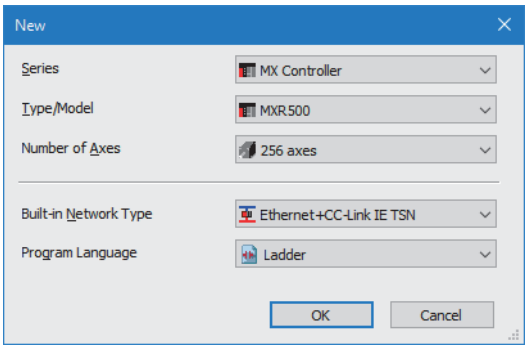
Connect the engineering tool to the controller and set the parameters.

■Setting a sending side (client)

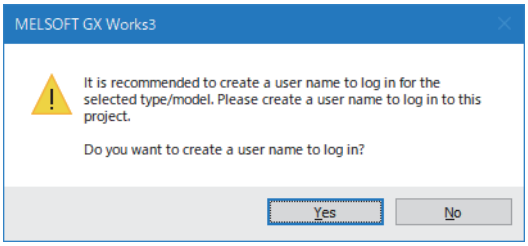
1. Start the engineering tool.

2. Set the controller as follows.

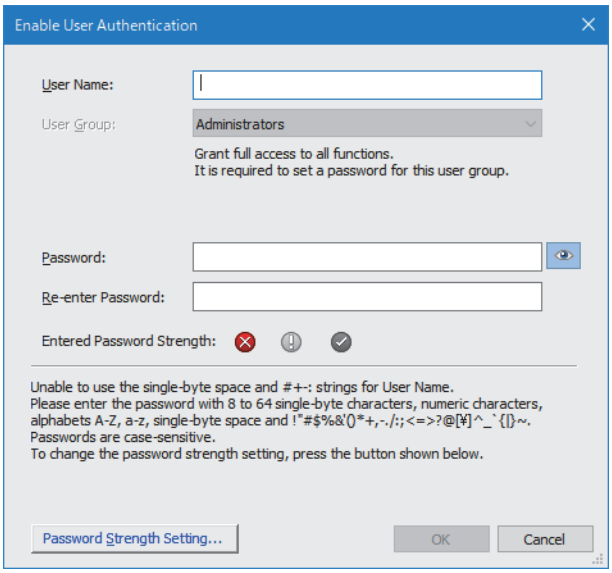
[Project] ⇨ [New]



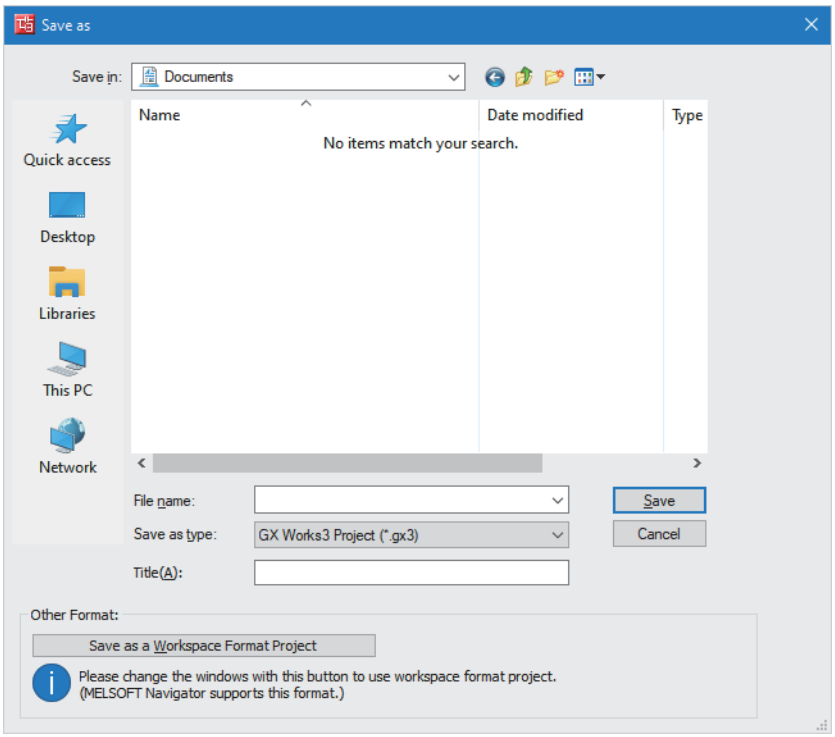
3. Click the [Yes] button.



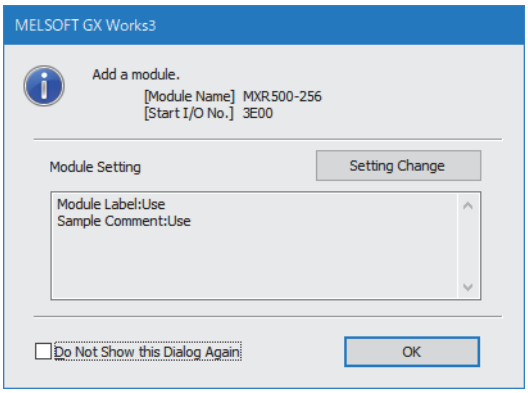
4. Set each item and click the [OK] button.



5. Set each item and click the [Save] button.



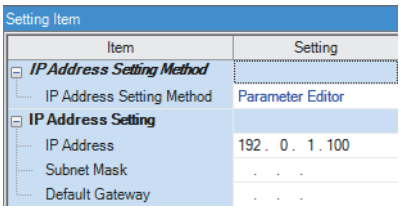
6. Click the [Setting Change] button to use the module label.



7. Click the [OK] button to create the project.

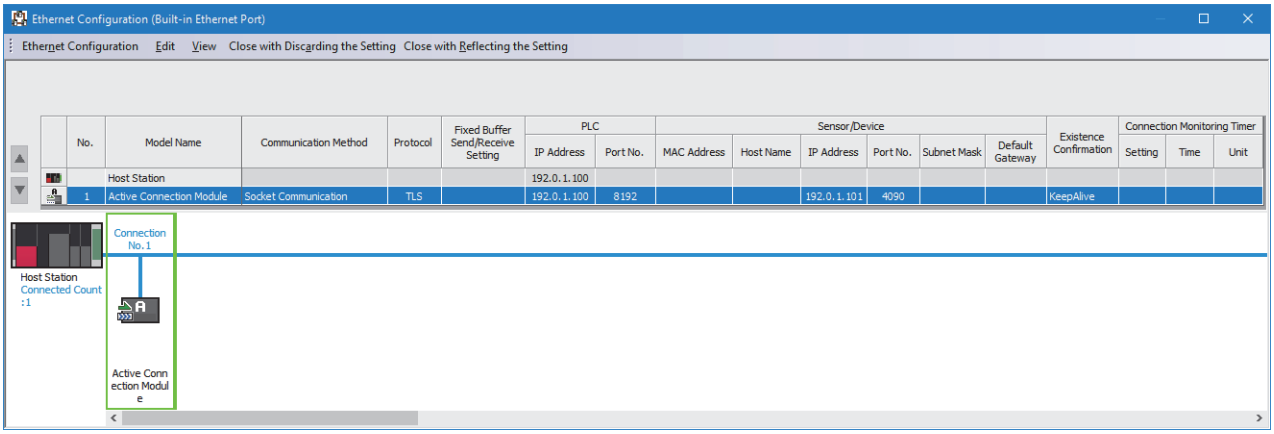
8. Set the items in "Required Settings" as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings]



9. Set "External Device Configuration" as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]



10. Write the set parameters to the controller. Then reset the controller or power off and on the system.

[Online] ⇨ [Write to PLC]

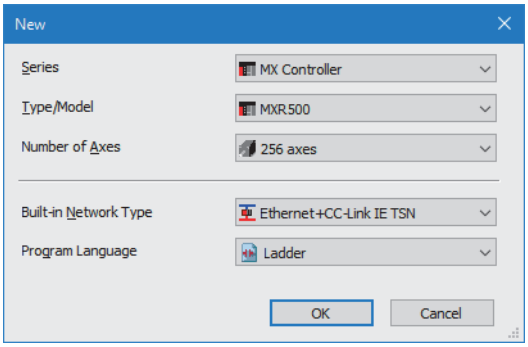
Point

In this example, default values were used for parameters other than those shown above.

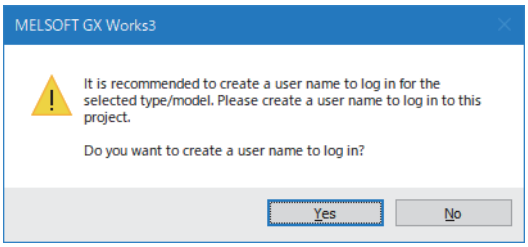
■Setting a receiving side (server)

1. Start the engineering tool.
2. Set the controller as follows.

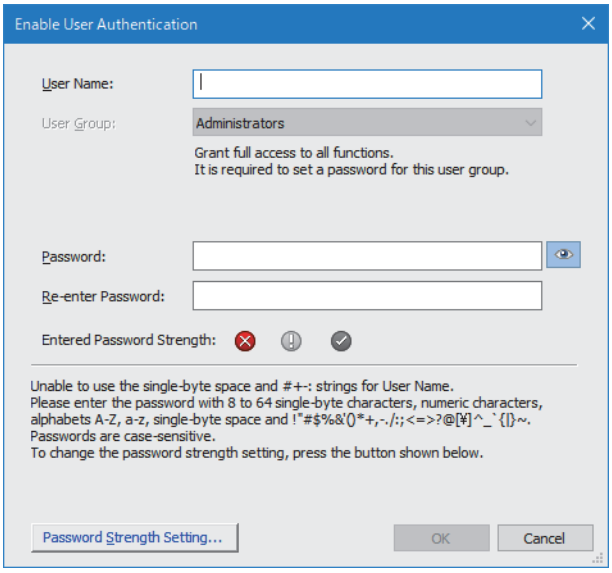
[Project] ⇨ [New]



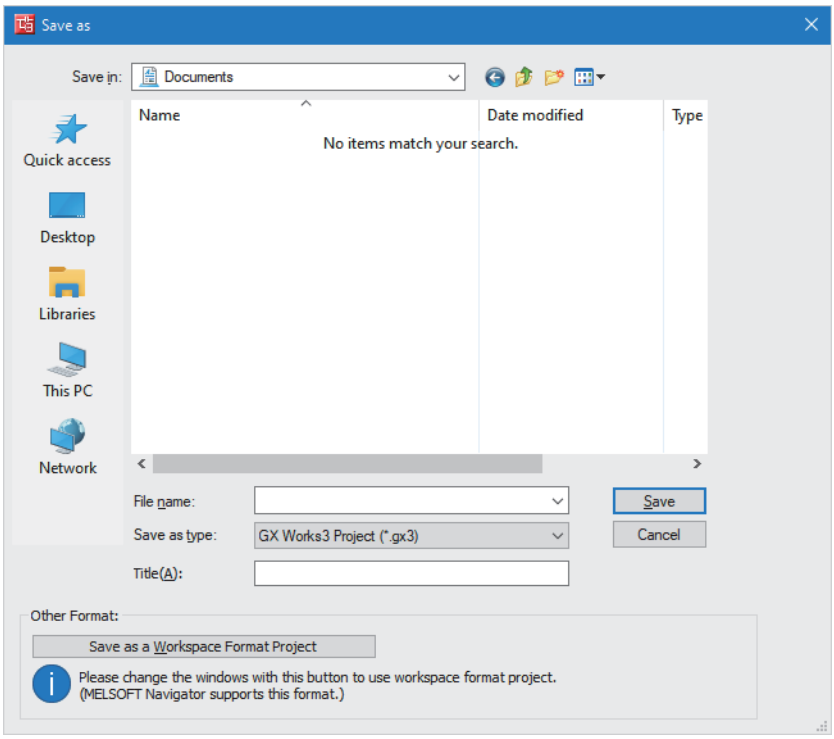
3. Click the [Yes] button.



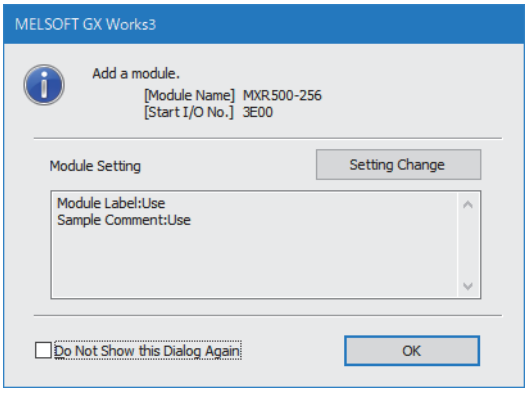
4. Set each item and click the [OK] button.



5. Set each item and click the [Save] button.



6. Click the [Setting Change] button to use the module label.



7. Click the [OK] button to create the project.

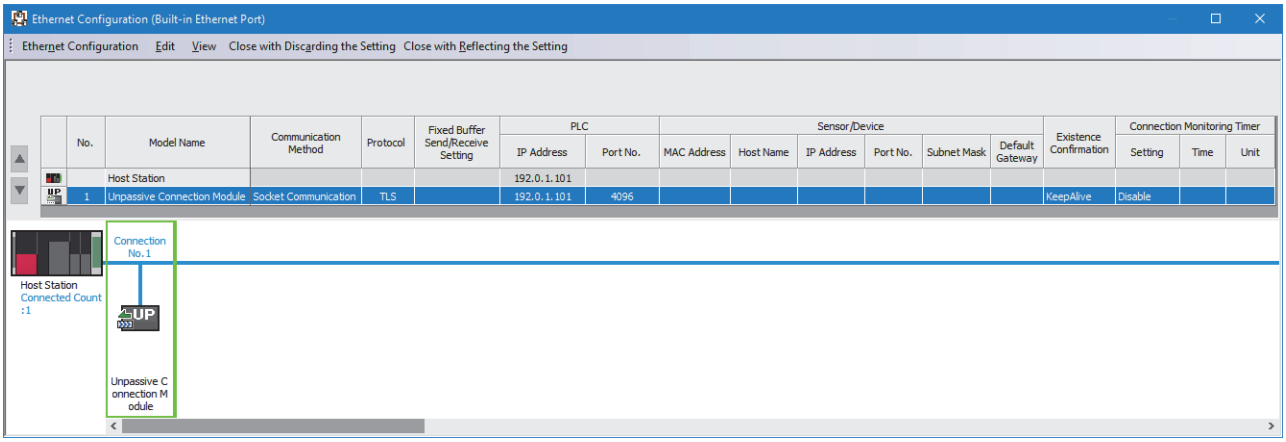
8. Set the items in "Required Settings" as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings]

Item	Setting
IP Address Setting Method	
IP Address Setting Method	Parameter Editor
IP Address Setting	
IP Address	192 . 0 . 1 . 101
Subnet Mask	
Default Gateway	

9. Set "External Device Configuration" as follows.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]



10. Write the set parameters to the controller. Then reset the controller or power off and on the system.

[Online] ⇨ [Write to PLC]

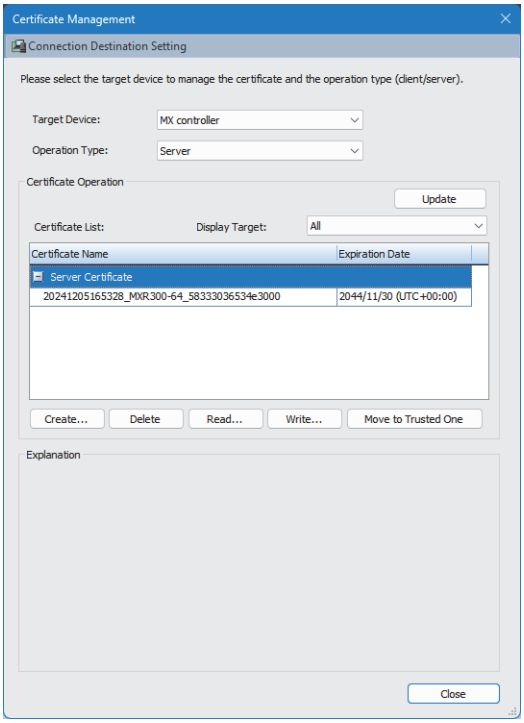
Point

In this example, default values were used for parameters other than those shown above.

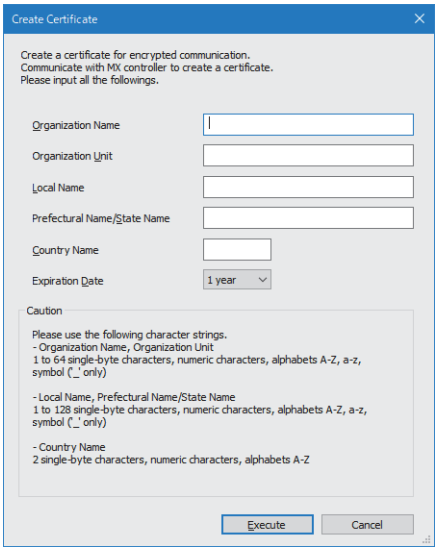
■Creating a digital certificate

1. Connect the controller on the receiving side (server) to the engineering tool.
2. In the digital certificate management window, click the [Create] button.

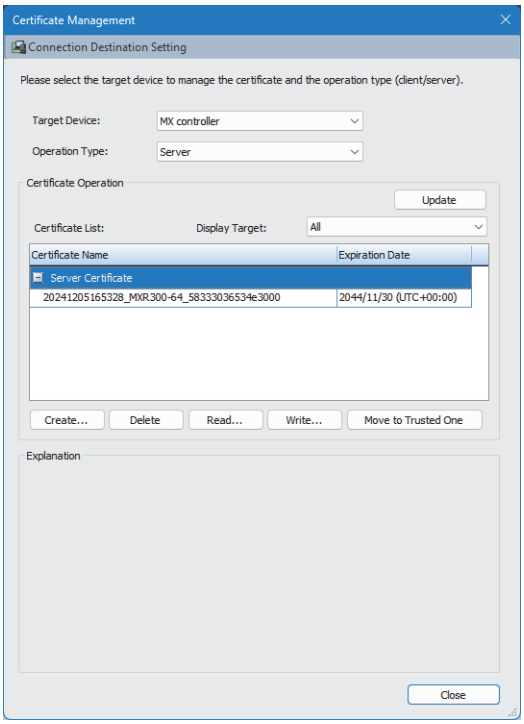
[Project] ⇨ [Security] ⇨ [Certificate Management]



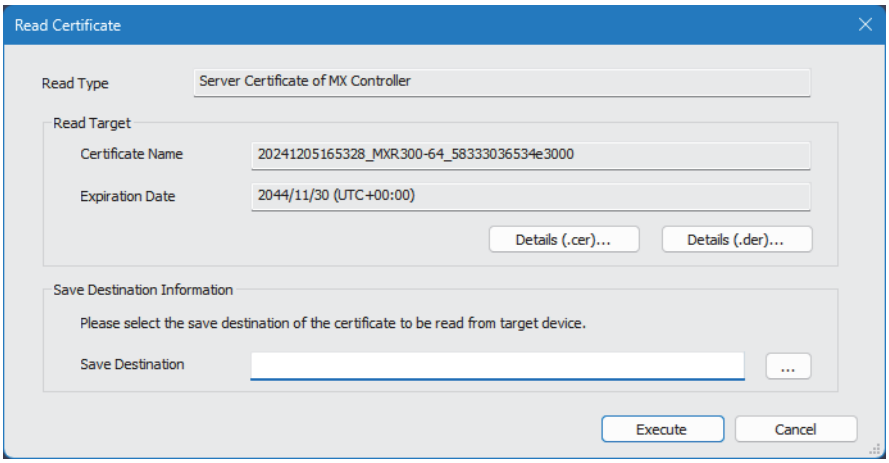
3. Set each item and click the [Execute] button.



4. Select the created certificate, and click the [Read] button.



5. Set the save destination, and click the [Execute] button.

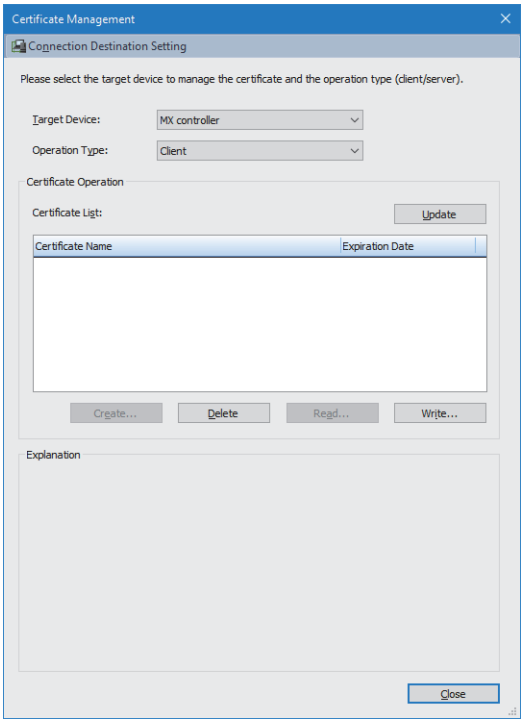


6. Reset the controller or power off and on the system.

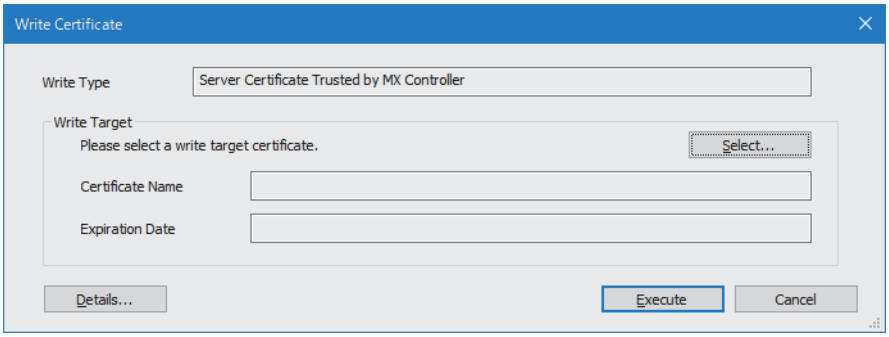
■Writing a digital certificate

1. Connect the controller on the sending side (client) to the engineering tool.
2. In the digital certificate management window, click the [Write] button.

[Project] ⇨ [Security] ⇨ [Certificate Management]



3. Click the [Select] button, and select the certificate saved on the controller of the receiving side (server).



4. Click the [Execute] button.

Sending side (client) program example

■List of labels used

Category	Label name	Description	Device
Module label	MX_SQ.stSM.bInitial_Processing_Normal_Completion_Status	Initial processing successful completion state	SM1524
	MX_SQ.stE.uStatus_HUB_Connection_D.0	Connection status	U3E0\G243.0
	MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]	Open completion signal connection No.1	U3E0\G7857.0
	MX_SQ.stE.bnStatus_Ethernet_ConnectionOpenExecution[1]	Open request connection No.1	U3E0\G7873.0
Label to be defined	Define global labels as shown below:		

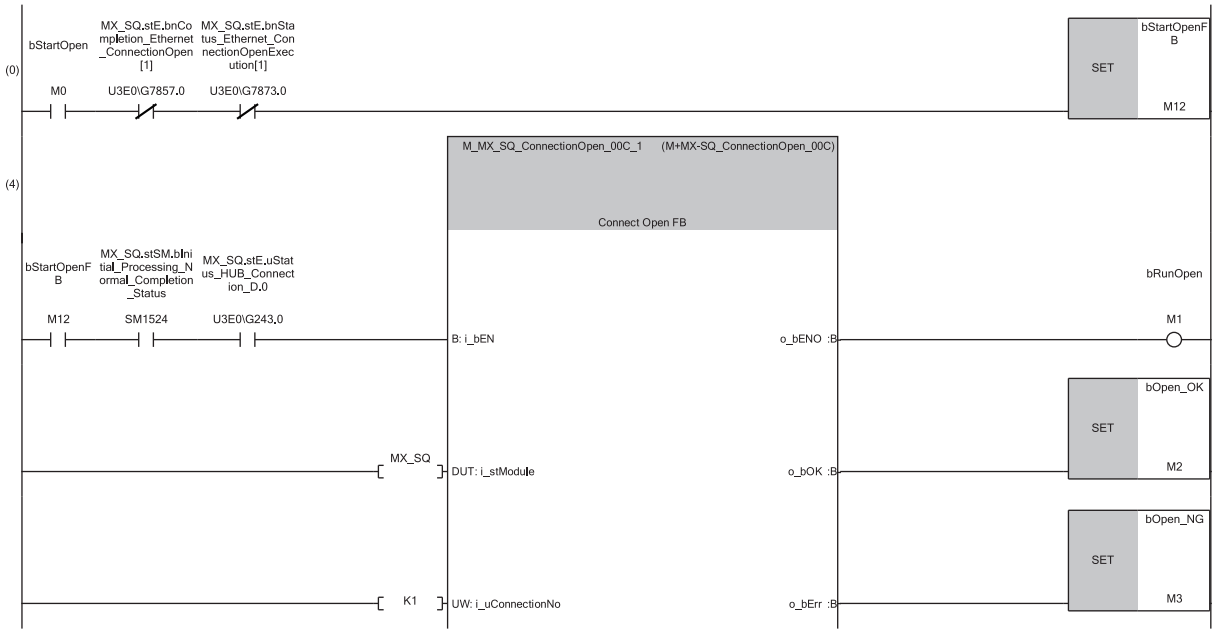
	Label Name	Data Type		Class	Assign (Device/Label)
1	bStartOpen	Bit	...	VAR_GLOBAL	M0
2	bRunOpen	Bit	...	VAR_GLOBAL	M1
3	bOpen_OK	Bit	...	VAR_GLOBAL	M2
4	bOpen_NG	Bit	...	VAR_GLOBAL	M3
5	bStartSend	Bit	...	VAR_GLOBAL	M4
6	bRunSend	Bit	...	VAR_GLOBAL	M5
7	bSend_OK	Bit	...	VAR_GLOBAL	M6
8	bSend_NG	Bit	...	VAR_GLOBAL	M7
9	bStartClose	Bit	...	VAR_GLOBAL	M8
10	bRunClose	Bit	...	VAR_GLOBAL	M9
11	bClose_OK	Bit	...	VAR_GLOBAL	M10
12	bClose_NG	Bit	...	VAR_GLOBAL	M11
13	bStartOpenFB	Bit	...	VAR_GLOBAL	M12
14	bStartCloseFB	Bit	...	VAR_GLOBAL	M13
15	uOpenErrID	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	D0
16	uSendErrID	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	D1
17	uCloseErrID	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	D2
18	uSendData	Word [Unsigned]/Bit String [16-bit](0..3)	...	VAR_GLOBAL	D1000

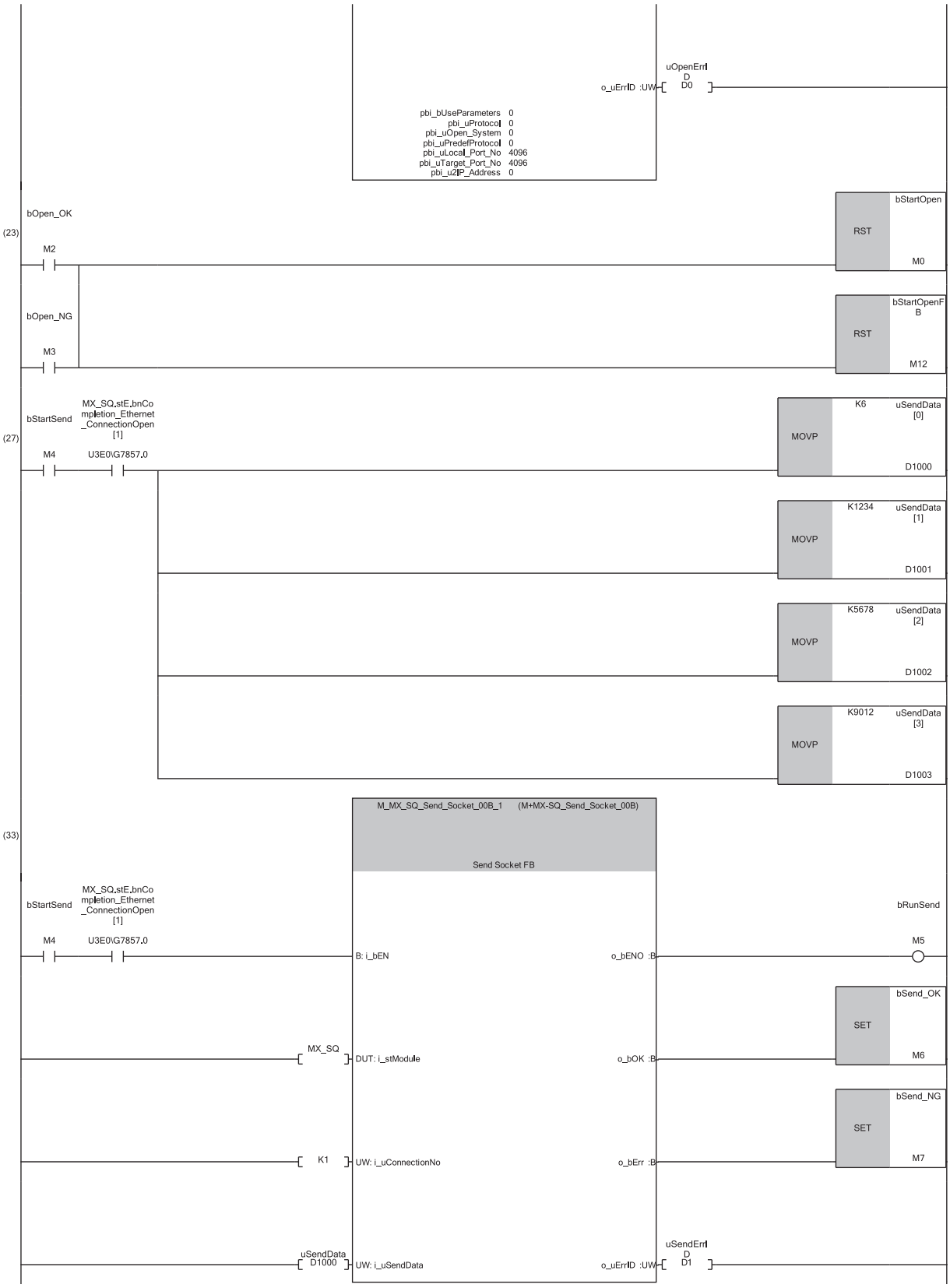
■FBs

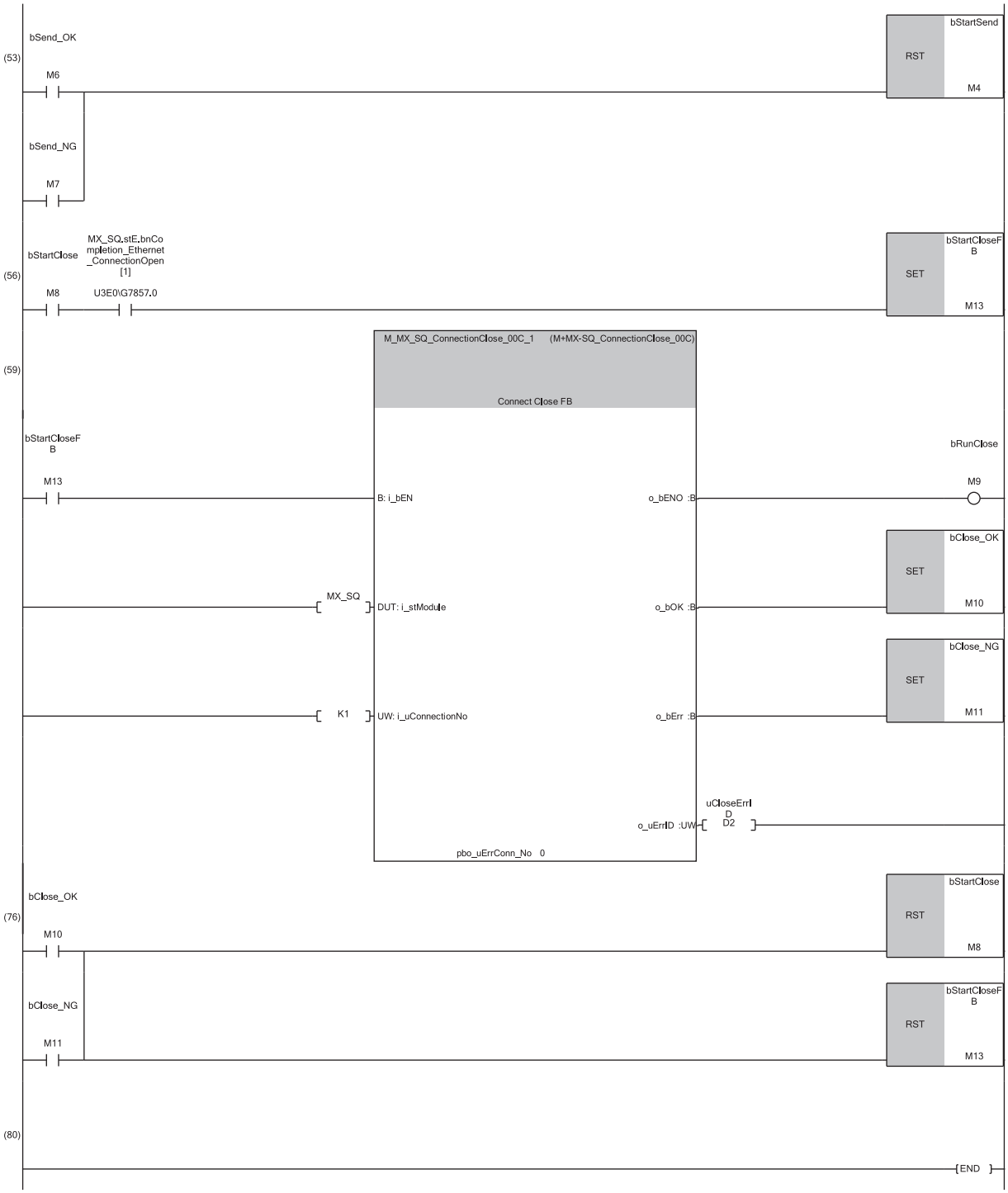
The following shows FBs to be used in the program example.

- M+MX-SQ_ConnectionOpen
- M+MX-SQ_Send_Socket
- M+MX-SQ_ConnectionClose

■Program




uOpenErrID
D
D0
o_uErrID :UW
pbi_bUseParameters 0
pbi_uProtocol 0
pbi_uOpen_System 0
pbi_uPredefProtocol 0
pbi_uLocal_Port_No 4096
pbi_uTarget_Port_No 4096
pbi_u2IP_Address 0
bOpen_OK
(23)
M2
RST
bStartOpen
M0
bOpen_NG
M3
RST
bStartOpenFB
M12
bStartSend
MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]
(27)
M4
U3E0\G7857.0
MOVP
K6
uSendData[0]
D1000
MOVP
K1234
uSendData[1]
D1001
MOVP
K5678
uSendData[2]
D1002
MOVP
K9012
uSendData[3]
D1003
M_MX_SQ_Send_Socket_00B_1 (M+MX-SQ_Send_Socket_00B)
Send Socket FB
(33)
bStartSend
MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]
M4
U3E0\G7857.0
B: i_bEN
o_bENO :B
bRunSend
M5
MX_SQ
DUT: i_stModule
o_bOK :B
SET
bSend_OK
M6
K1
UW: i_uConnectionNo
o_bErr :B
SET
bSend_NG
M7
uSendData
D1000
UW: i_uSendData
o_uErrID :UW
uSendErrID
D
D1



(0) When 'bStartOpen' (M0) is turned on, the open processing of connection No.1 is performed.
When the open processing is completed successfully, 'bOpen_OK' (M2) is turned on.

(27) When 'bStartSend' (M4) is turned on, the send data is stored in 'Send data' (D1000 to D1003) and data is sent to the receiving side (server).
When the data send is completed successfully, 'bSend_OK' (M6) is turned on.

(56) When 'bStartClose' (M8) is turned on, the close processing of connection No.1 is performed.
When the close processing is completed successfully, 'bClose_OK' (M10) is turned on.

Receiving side (server) program example

■List of labels used

Category	Label name	Description	Device
Module label	MX_SQ.stSM.bInitial_Processing_Normal_Completion_Status	Initial processing successful completion state	SM1524
	MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]	Open completion signal connection No.1	U3E0\G7857.0
	MX_SQ.stE.bnCompletion_Ethernet_ReceiveSocket[1]	Socket communications receive status signal connection No.1	U3E0\G7889.0
Label to be defined	Define global labels as shown below:		

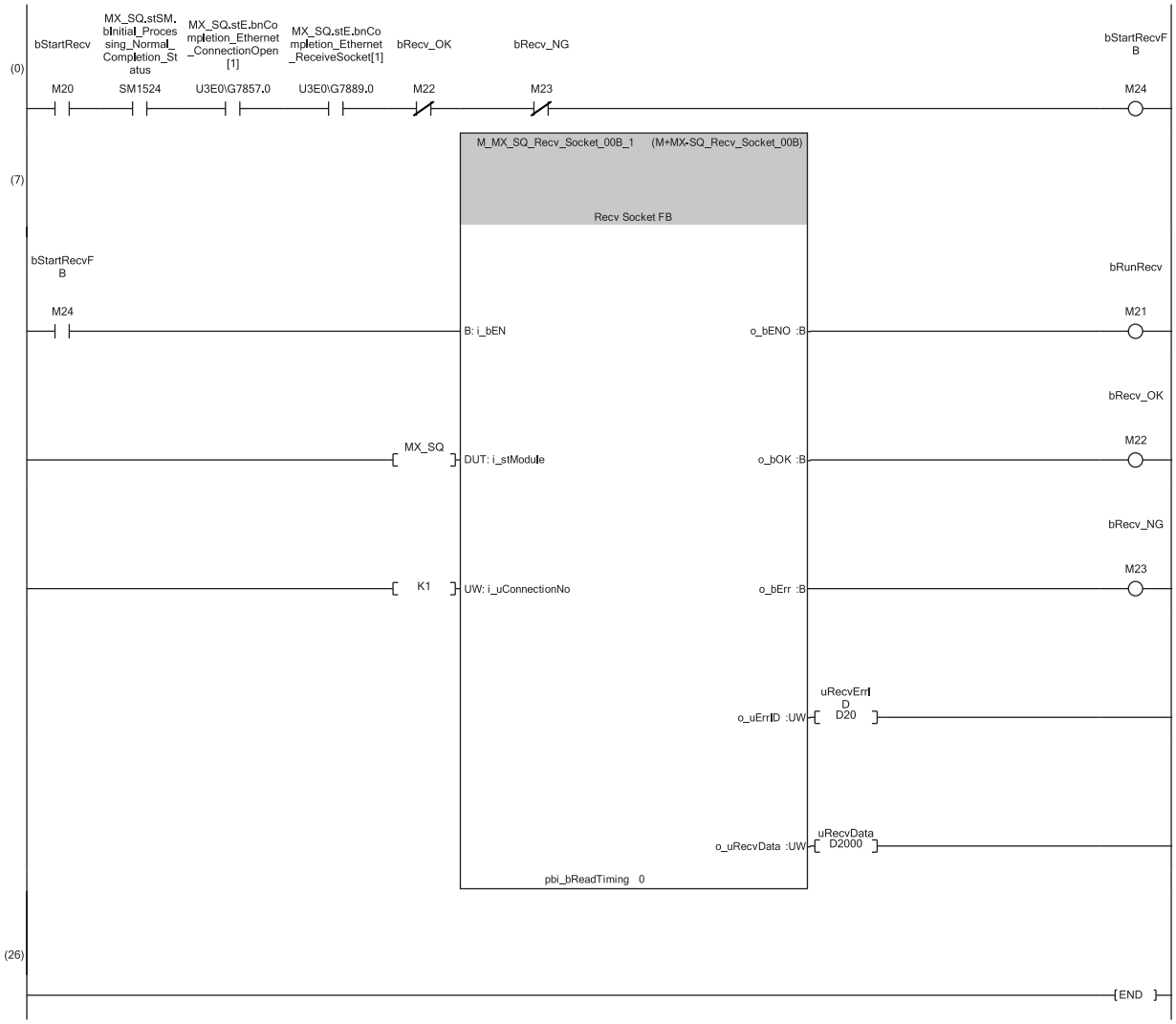
	Label Name	Data Type		Class	Assign (Device/Label)
1	bStartRecv	Bit	...	VAR_GLOBAL	M20
2	bRunRecv	Bit	...	VAR_GLOBAL	M21
3	bRecv_OK	Bit	...	VAR_GLOBAL	M22
4	bRecv_NG	Bit	...	VAR_GLOBAL	M23
5	bStartRecvFB	Bit	...	VAR_GLOBAL	M24
6	uRecvErrID	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	D20
7	uRecvData	Word [Unsigned]/Bit String [16-bit](0..3)	...	VAR_GLOBAL	D2000

■FBs

The following shows FBs to be used in the program example.

- M+MX_SQ_Recv_Socket

■Program



(0) When 'bStartRecv' (M20) is turned on, the data sent from the sending side (client) is received and stored in 'uRecvData' (D2000 to D2003). When the data receive is completed successfully, 'bRecv_OK' (M22) is turned on.

Point

To receive data at shorter intervals than the scan time, add the normally closed contact of 'bRecv_OK' (M22) and 'bRecv_NG' (M23) to the execution conditions of FB for receiving as shown in the above program.
When there is no normally closed contact of 'bRecv_OK' (M22) and 'bRecv_NG' (M23), 'bStartRecvFB' (M24) does not turn on and the FB for receiving may not be executed.

Communication example of re-open processing

This section shows communication examples that dynamically change the own station port number within the range of 1024 to 4999, using TCP Active open. To execute re-open in less than 65 seconds after a connection close, create a program by referring to this communication example.

System configuration

The same system configuration is used as that of the socket communications example. (☞ Page 1328 Socket communication example)

Parameter settings

Connect the engineering tool to the controller and set the parameters.
In this communication example, without creating a user to log in (with user authentication disabled), only the required parameters that differ from the communication example using the socket communication and their setting details are provided. (☞ Page 1328 Socket communication example)

■Setting a sending side (client)

Configure the settings in the "Ethernet Configuration" window as below.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]

	No.	Model Name	Communication Method	Protocol	Fixed Buffer Send/Receive Setting	PLC		Sensor/Device						Existence Confirmation
						IP Address	Port No.	MAC Address	Host Name	IP Address	Port No.	Subnet Mask	Default Gateway	
		Host Station				192.0.1.100								
	1	Active Connection Module	Socket Communi	TCP		192.0.1.100	1024			192.0.1.101	1024			KeepAlive

Point

- The setting is used to secure the connection number to be used for the SOCOPEN instruction.
- Set "Model Name", "Communication Method", and "Protocol" according to the window above.
- As the values in "Port No." under "PLC" and "IP Address" and "Port No." under "Sensor/Device" are to be set by the control data of the SOCOPEN instruction, these mentioned items can be set to a tentative value at this point.

■Setting a receiving side (server)

Configure the settings in the "Ethernet Configuration" window as below.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Basic Settings] ⇨ [External Device Configuration]

	No.	Model Name	Communication Method	Protocol	Fixed Buffer Send/Receive Setting	PLC		Sensor/Device						Existence Confirmation	Connection Monitoring Time	
						IP Address	Port No.	MAC Address	Host Name	IP Address	Port No.	Subnet Mask	Default Gateway		Setting	Time
		Host Station				192.0.1.101										
	1	Unpassive Connection Module	Socket Communi	TCP		192.0.1.101	1024							KeepAlive	Disable	

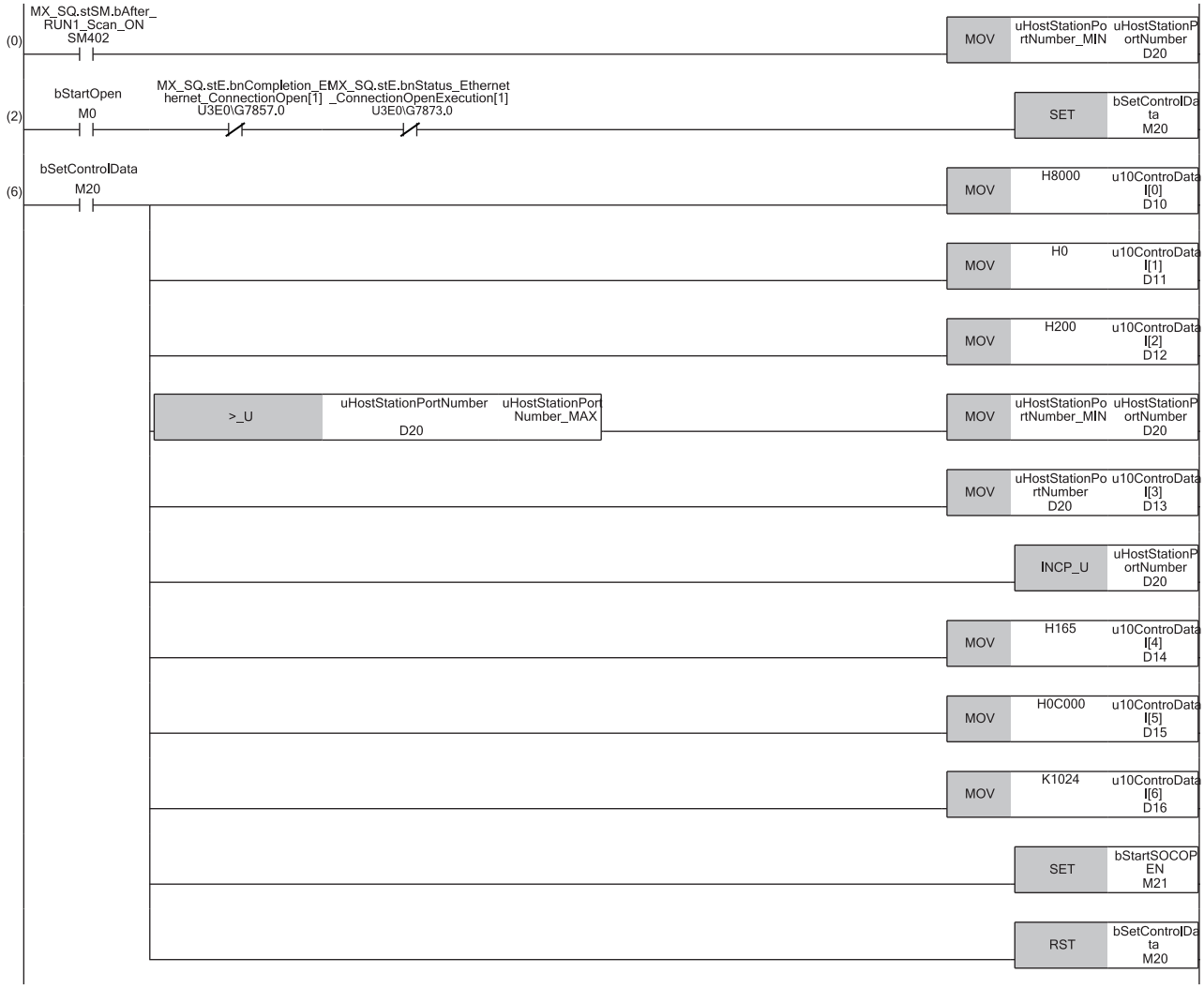
Sending side (client) program example

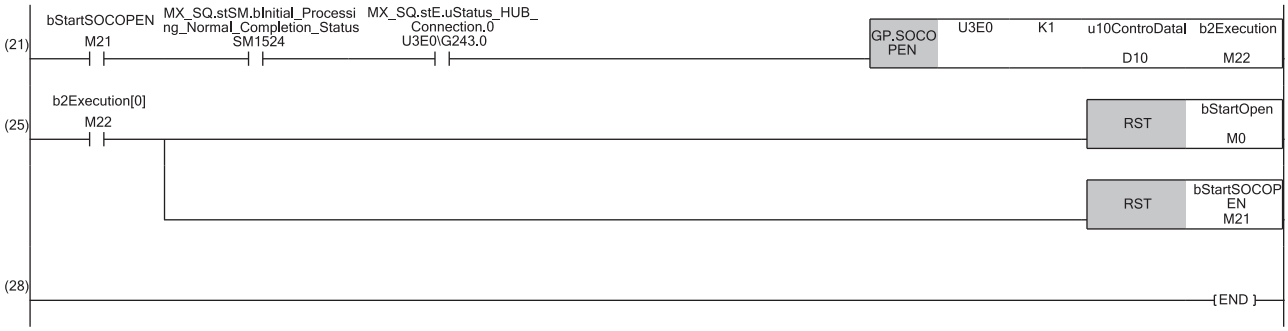
■List of labels used

Classification	Label name	Description	Device
Module label	MX_SQ.stSM.bAfter_RUN1_Scan_ON	After RUN, ON for 1 scan only	SM402
	MX_SQ.stSM.bInitial_Processing_Normal_Completion_Status	Initial processing successful completion state	SM1524
	MX_SQ.stE.uStatus_HUB_Connection_D.0	Connection status	U3E0\G243.0
	MX_SQ.stE.bnCompletion_Ethernet_ConnectionOpen[1]	Open completion signal connection No.1	U3E0\G7857.0
	MX_SQ.stE.bnStatus_Ethernet_ConnectionOpenExecution[1]	Open request signal connection No.1	U3E0\G7873.0
Label to be defined	Define global labels as shown below:		

Label Name	Data Type		Class	Assign (Device/Label)
bStartOpen	Bit	...	VAR_GLOBAL	M0
bSetControlData	Bit	...	VAR_GLOBAL	M20
bStartSOCOPEN	Bit	...	VAR_GLOBAL	M21
b2Execution	Bit(0.1)	...	VAR_GLOBAL	M22
u10ControDatal	Word [Unsigned]/Bit String [16-bit](0.9)	...	VAR_GLOBAL	D10
uHostStationPortNumber	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL	D20
uHostStationPortNumber_MIN	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL_CONSTANT	
uHostStationPortNumber_MAX	Word [Unsigned]/Bit String [16-bit]	...	VAR_GLOBAL_CONSTANT	

■Program





(0) Set the initial value 1024 to 'Own station port number' (D20).

(2) When 'Open direction' (M0) is turned on, 'Control data of the SOCOPEN instruction' (M20) turns on and the open processing starts.

(6) Set the following values to 'Control data of SOCOPEN' (D10 to D19) and turn on 'SOCOPEN execution instruction' (M21).
- 'Execution type/completion type' (D10): 8000H (open specified details by the control data)
- 'Application setting area' (D12): 0200H (TCP, use the socket communications, active)
- 'Own station port number' (D13): The value is changed every time it is opened within the range of 1024 to 4999.
- 'Destination IP address' (D14, D15): C0000165H (192.0.1.101)
- 'Destination port number' (D16): 1024

(21) Execute the SOCOPEN instruction and open connection No.1.

(25) When the SOCOPEN instruction is completed, 'SOCOPEN execution completed' (M22) turns on for 1 scan.

Receiving side (server) program example

The program on the receiving side (server) is not required.

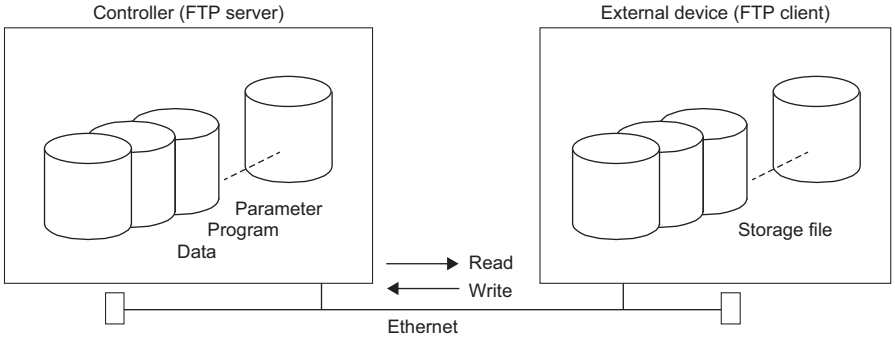
53 FTP FUNCTIONS

53.1 FTP Server

The server function of FTP (File Transfer Protocol) used to transfer files with the external device is supported. The external device with FTP client function can easily and directly access files in the controller.
It also supports FTPS (File Transfer Protocol over SSL/TLS), which is an encrypted communication function. When setting up a communication route that crosses the trust boundary, the communication contents can be encrypted and protected by using the encrypted communication function.
This setting can be used only for Ethernet ports. See below for port allocation.
☞ Page 50 MX-R Model

File operation

The following operations can be executed on the controller files from the external device with FTP client function.



- Reading of file from controller (download)
- Writing of file to controller (upload)
- Browsing file names in the controller, and deleting files

Supported communication modes

The FTP server can use the following communication modes.

PORT mode (active mode)

Data transfer port connection is made from the FTP server side.
The data transfer port is connected to port 20 for encrypted communications and non-encrypted communications.
When connecting in this mode, the firewall setting for the data transfer port on the FTP client side must be canceled in advance.

PASV mode

Data transfer port connection is made from the FTP client side, connecting with any port.
When connecting in this mode, the firewall settings for all ports used for data transfer on the FTP server side must be canceled in advance.

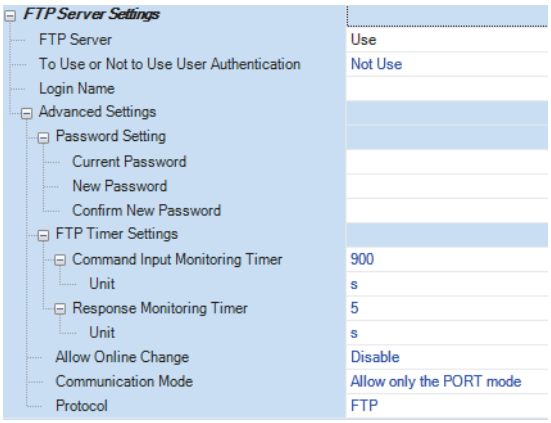
Point

Disabling the firewall has the risk of vulnerability (unauthorized access to the port whose firewall settings have been disabled).
When setting up a firewall on the FTP server side or a firewall that crosses the trust boundary, set it so that only the PORT mode (active mode) is permitted.

FTP server settings

Set the file transfer function (FTP server).

Window



Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [FTP Server Settings]

Displayed items

Item		Description	Setting range
FTP Server		Set whether to use the file transfer function (FTP server).	• Not to Use • Use (Default: Not Use)
To Use or Not to Use User Authentication		Set whether to use user authentication on the FTP server. If this setting is set to "Use", the login name and password setting items cannot be entered.	• Not Used • Use (Default: Not Use)
Login Name*1		Set the login name to be used for file transfer request (login) from the external device.	32 characters maximum (single-byte alphanumeric characters, symbols*2) (Default: None)
Advanced Settings	Password Setting*1	Set the password for the external device to request file transfer (login) to the controller.	☞ Page 1348 Password Setting
	FTP Timer Settings	Set the following timers used for the file transfer function (FTP server). • Command Input Monitoring Timer • Response Monitoring Timer	☞ Page 1348 FTP Timer Settings
	Allow Online Change	Select whether to enable online change from the external device using the file transfer function (FTP server).	• Disable • Enable (Default: Disable)
	Communication Mode	Set the communication mode.	• Allow only the PORT mode • Allow both of PORT/PASV modes (Default: Only the PORT mode is allowed.)
	Protocol	Set the operating protocol.	• FTP • FTPS • FTP/FTPS (Default: FTP)

*1 Clicking the [Check] or [Apply] button without setting the login name and password will result in an error.

*2 "$" is excluded.

Password Setting

■Current Password

Enter the current password for login to the controller.

■New Password, Confirm New Password

Enter the new password in "New Password" and "Confirm New Password" when changing the password.

Set a password within 6 to 32 single-byte characters. Number, alphabet, special character (?,!&\%#*) can be used.

FTP Timer Settings

■Command Input Monitoring Timer

Set the monitoring time for the controller to monitor the command input time from the FTP client.

It is recommended to use the default value (900s) for this timer value as much as possible.

When changing the setting value, determine the command input monitoring timer value upon consulting with the administrator of the external device or system.

Set a value within the following range.

Unit	Setting range
s	1 to 16383 (Default: 900s)
ms	100 to 16383000 (in increments of 100ms)

The FTP connection is disconnected if there is no command input from the FTP client side within the time of the command input monitoring timer value after the FTP client login.

When restarting the file transfer, start over from the login operation again.

■Response Monitoring Timer

Set the monitoring time from when the controller receives a command from the external device until the file operation is completed.

It is recommended to use the default value (5s) for this timer value as much as possible.

When changing the setting value, determine the response monitoring timer value upon consulting with the system administrator.

Set a value within the following range.

Unit	Setting range
s	1 to 16383 (Default: 5s)
ms	100 to 16383000 (in increments of 100ms)

Data communication procedures

This section describes the settings for FTP communications.

Controller settings

To use the file transfer function (FTP server), set "Use" for "FTP Server" in "FTP Server Settings" under "Application Settings".

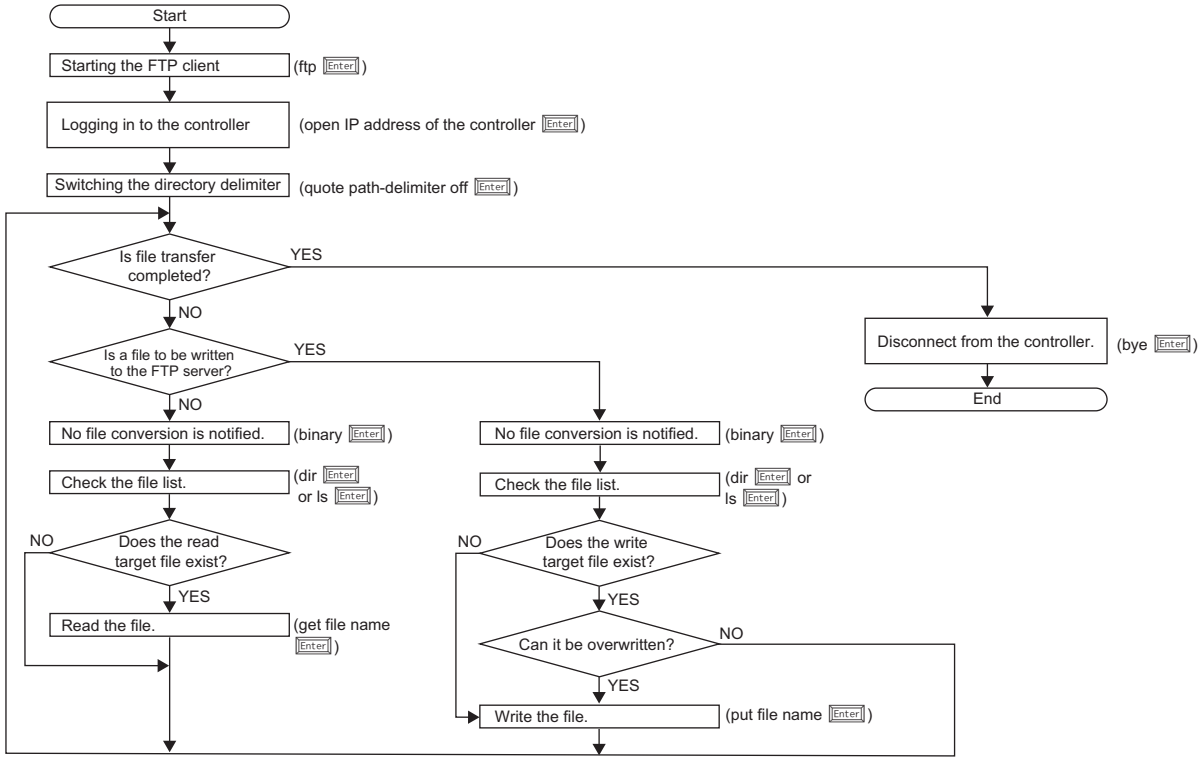
☞ Page 1347 FTP server settings

To use encrypted communications, set the protocol version for encrypted communications and create a server certificate required for authentication.

☞ Page 1558 Encrypted Communication Function

Operations on external device (Windows standard FTP client) side

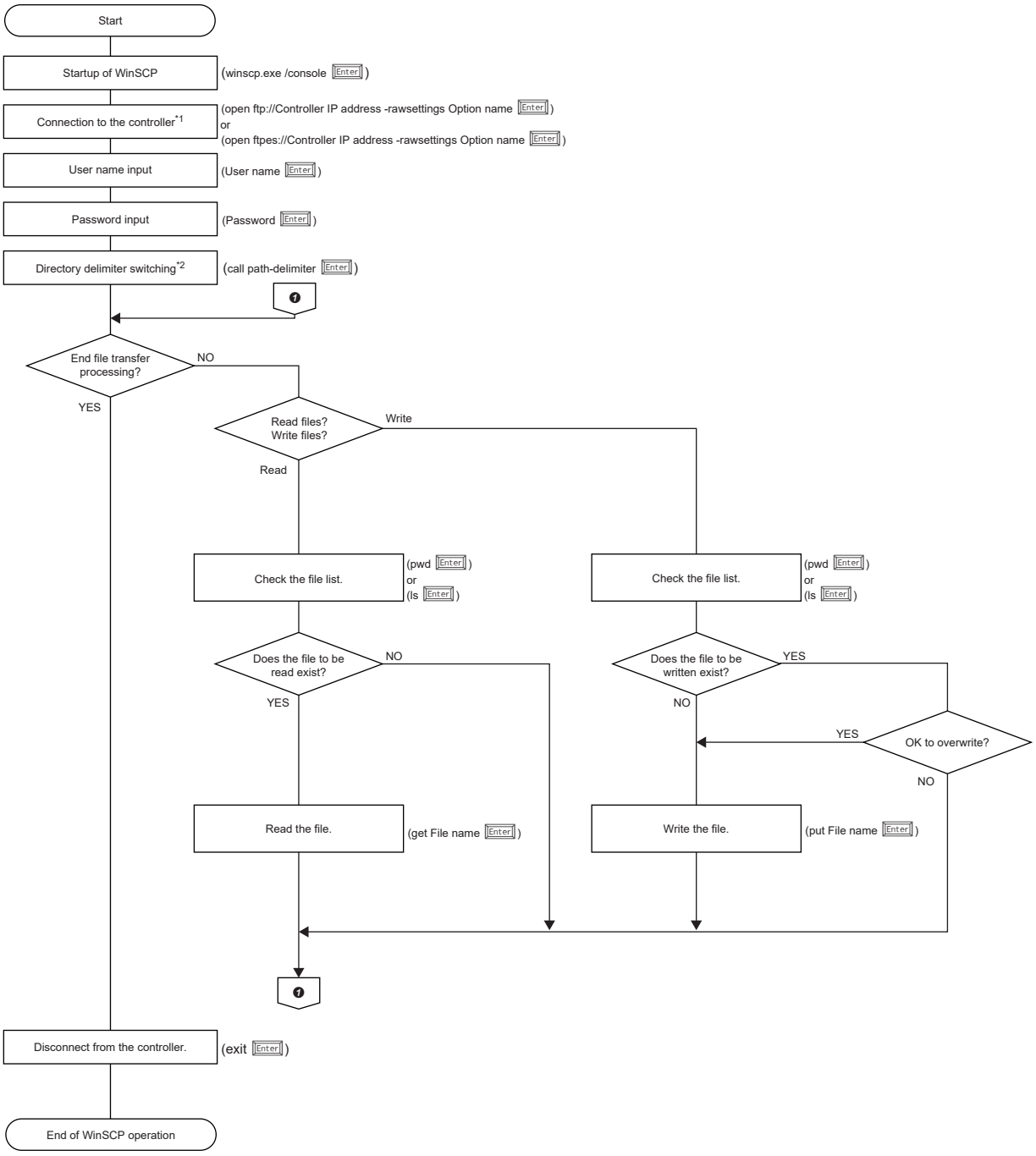
This section describes the procedures and required processes on the external device side for using the file transfer function (FTP server) of the controller. The FTP commands and input format used for the operation are shown in the explanation. ("Enter" means to input CR, Enter or the Return key.)



Operations on the external device side (FTP server using WinSCP)

This section describes the WinSCP connection method for using the file transfer function (FTP server) of the controller. The FTP commands and input format used for the operation are shown in the explanation. ("Enter" means to input CR, Enter or the Return key.)

Note that the following explanation assumes that WinSCP is operated from the console. To establish a connection from the GUI, turn on SM1512 and change the directory delimiter to [/] beforehand.

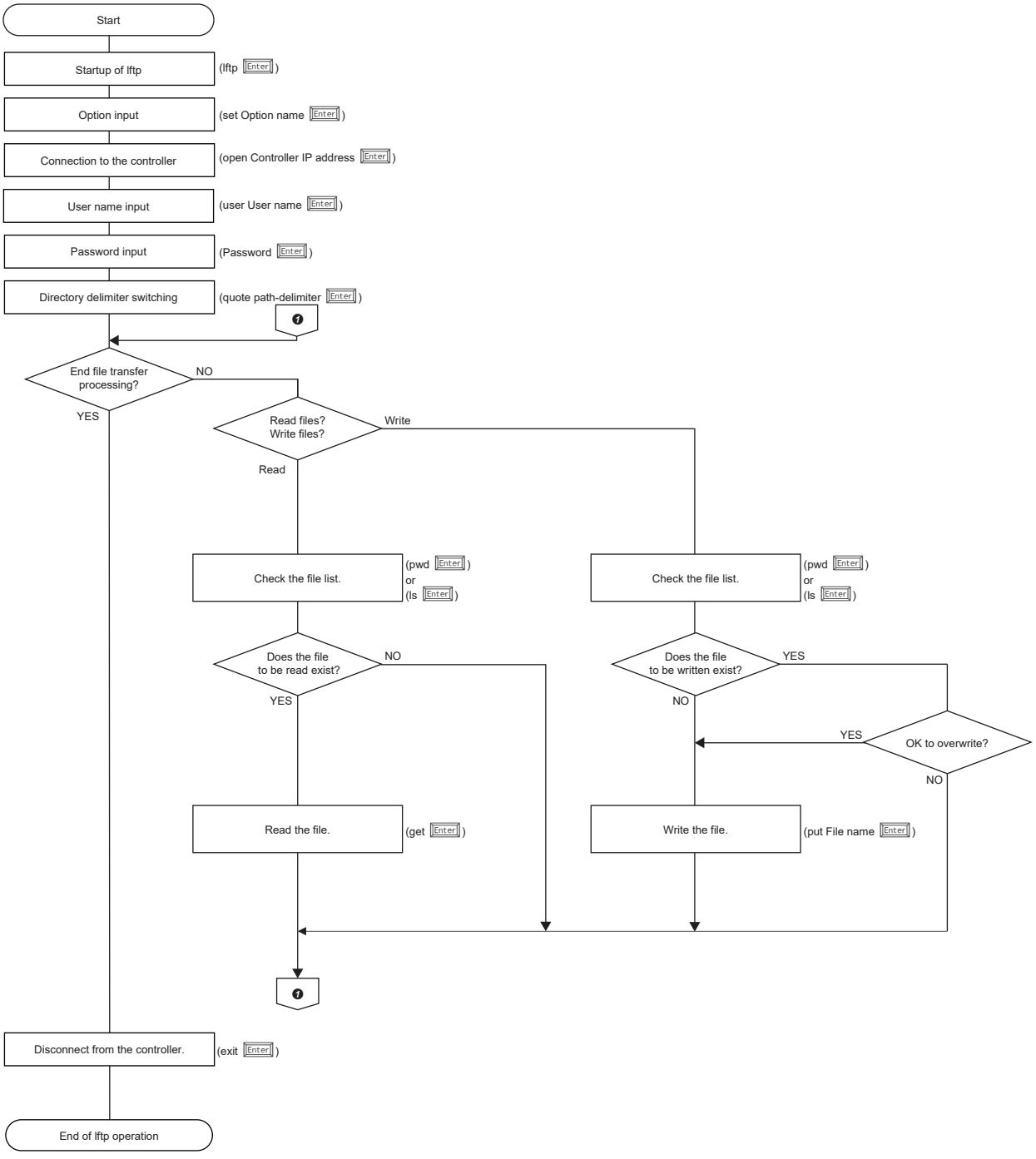


*1 Use open ftp:// for non-encrypted connections and open ftpes:// for encrypted connections. The option settings also differ. (☞ Page 1361 Setting items for WinSCP)
Example: Non-encrypted, passive mode connection, MLSD command disabled, and directory cache disabled
open ftp://192.168.3.39 -passive -rawsettings FtpUseMlsd=1 CacheDirectoryChanges=0

*2 This FTP command is used for changing the directory delimiter to [/]. The delimiter can also be changed using a special relay. (☞ Page 1356 Directory delimiter change)

Operations on the external device side (FTP server using lftp)

This section describes the lftp connection method for using the file transfer function (FTP server) of the controller. The FTP commands and input format used for the operation are shown in the explanation. ("Enter" means to input CR, Enter or the Return key.)



*1 The option settings differ between non-encrypted and encrypted connections. (☞ Page 1363 Setting items for lftp)

*2 This FTP command is used for changing the directory delimiter to [/]. The delimiter can also be changed using a special relay. (☞ Page 1356 Directory delimiter change)

Login to FTP server

This section describes the operations from starting the FTP client to logging in to the FTP server.

1. Start FTP from the Microsoft® Windows® command prompt.
2. Enter "ftp".
3. Enter "open Controller IP address".
4. Enter the login name.
5. Enter the password.

Use the login name and password that are set in "FTP Server Settings" under "Application Settings". When the controller (FTP server) receives the login name and password from the external device (FTP client), it checks that the login name and password are correct.

If the login name and password are correct, file transfer to the controller is permitted. If not, file transfer is not permitted.

Files that can be transferred with FTP

For the files that can be transferred (read, write, deleted) with the file transfer function (FTP server), refer to the file operation available which is described in the following manual.

☞ Page 340 File operation available

FTP commands

FTP command list

The FTP client side commands supported by the controller are shown below.

■RFC definition commands

Command	Function
APPE	Adds a file.
AUTH	Negotiates the encryption protocol (SSL/TLS) to use.
CDUP	Moves to the parent directory.
CWD	Moves to a specified directory.
DELE	Deletes a file.
HELP	Returns a list of commands.
LIST	Returns file information and a list of directories.
MKD	Creates a directory.
MODE	Sets the transfer mode (stream, block, compression).
NLST	Returns a list of files.
NOOP	It is a dummy packet that does nothing.
OPTS	Sets an extended function. (only for UTF-8 mode)
PASS	Specifies a password.
PASV	Connects in passive mode.
PORT	Connects in port mode.
PROT	Sets the data channel protection level. (Supports clear/private data connections.)
PWD	Returns the current directory information.
QUIT	Terminates a connection.
RETR	Reads a file.
RMD	Deletes a directory.
RNFR	Renames a file or directory. (Rename from...)
RNTO	Renames a file or directory. (Rename to...)
SITE	Sends Pure-FTPD definition commands that are not defined by RFC.
STOR	Writes a file.
STRU	Sets the structure of a file to be transferred.
TYPE	Sets the transfer mode (ASCII, binary mode).
USER	Specifies a user name.
XCUP	Moves to the parent directory.
XCWD	Moves to a specified directory.
XMKD	Creates a directory.
XPWD	Returns the current directory information.
XRMD	Deletes a directory.

■Windows standard FTP client commands

○: Executable[*1], ×: Not executable[*2]

Command	Function	Controller state		
		STOP	RUN	
			Enable[*3]	Disable[*3]
binary[*4]	Notifies that the file will be transferred without conversion.	○	○	○
bye	Closes and ends the connection with the FTP server.	○	○	○
close	Closes the connection with the FTP server.	○	○	○
delete	Deletes controller files.	○	○[*5]	×
dir	Displays controller file information.	○	○	○
get	Reads files from the controller.	○	○	○
ls	Displays the controller file name.	○	○	○
mdelete	Deletes controller files.	○	○[*5]	×
mdir	Stores controller file information in a file.	○	○	○
mget	Reads files from the controller.	○	○	○
mls	Stores the name of the file stored in the controller as log data in the file on the FTP client side.	○	○	○
mput	Writes a file to the controller.	○	○	×
open	Connects to the FTP server.	○	○	○
put	Writes a file to the controller.	○	○	×
pwd	Displays the current directory of the controller.	○	○	○
quit	Closes and ends the connection with the FTP server.	○	○	○
quote change	Displays or changes controller file attributes. (Cannot be used when the user authentication function is enabled)	○	○	×
quote path-delimiter	Changes the directory delimiter of the file path of the controller from "\" to "/". (☞ Page 1356 Directory delimiter change)	○	○	○
quote path-delimiter off	Turn off file setting changing for the file path name when a file is specified by "path-delimiter". (☞ Page 1356 Directory delimiter change)	○	○	○
quote path-delimiter status	Displays the setting status of the file path name when a file is specified. (☞ Page 1356 Directory delimiter change)	○	○	○
rename	Changes the controller file/directory name.	○	○	×
user	Enter the controller user name and password.	○	○	○

*1 The command may not be executed depending on the file type. (☞ Page 1352 Files that can be transferred with FTP)

*2 If executed, the process completes with an error.

*3 This state indicates the "Allow Online Change" setting in "FTP Server Settings" under "Application Settings". If an illegal command is executed while online change is disabled, the process completes with an error.

*4 The controller is set to transfer the file automatically without conversion. (Binary code fixed)

*5 The parameter file and program file cannot be deleted when the controller is in RUN state.

Specifying an FTP command

This section describes the method of specifying the files specified with the FTP command on the FTP client (external device side) supported by the controller.

With the controller, the drive name and file name are distinguished when specifying the file.

When specifying a file with FTP, specify the target file with the following arrangement.*1

Item	Description
Specification format	[Drive name:\]File name.Extension
Specification example	3:\MAINSEQ1.QDR
Specification details	Refer to the following. ☞ Page 1355 Drive name (drive No.),Page 1355 Folder name, file name, and extension

*1 The default directory delimiter is "\". To change the directory delimiter to "/", refer to the following.
☞ Page 1356 Directory delimiter change

Point

The section enclosed in square brackets [ ] in the specification format can be omitted.

■Drive name (drive No.)

Specify the drive name of the target memory for transferring the file.

For the correspondence of the target memory and drive names, refer to the following.

☞ Page 331 Drive Number Definition for Memory

If the drive name is omitted, the relative path from the current directory is specified. If, however, FTP server function file path name switching is enabled, the setting is valid. (☞ Page 1356 Directory delimiter change)

The current directory immediately after logging in to the FTP server is 4:\.

■Folder name, file name, and extension

- Specify the folder name, file name, and extension according to the specifications. (☞ Page 335 File/folder specifications)
- When using an FTP command that can be used for multiple files, specify the file name and extension with the wild card "*" or "?". (Depending on the FTP client, there may be additional restrictions to the characters that can be used for the file name.)

* Any string (including none) from the position specified with "*" will be considered as matching the target file condition.*1

?: Any character (excluding "." and none) at the position specified with "?" will be considered as matching the target file condition. ("?" can be used multiple times.)

1 The "" wildcard character is in the format "file name.extension", and can be used to specify one file name and one extension. (The "." part cannot be specified as a wildcard.)
If "*" is specified without ".", the file name that does not include an extension will be subject to wildcard determination.

Ex.

Here are specification examples when the following files are included.

- AAAA
- ABCDE
- ABCD.BIN
- ABCDE.CSV
- ABCDE.CER

(Example 1) To specify all files: "*.*"

→Result: AAAA, ABCDE, ABCD.BIN, ABCDE.CSV, ABCDE.CER

(Example 2) To specify files with name starting with "A" and an extension starting with "C": "A*.C*"

→Result: ABCDE.CSV, ABCDE.CER

(Example 3) To specify files without extension: "*"

→Result: AAAA, ABCDE

■HELP command operations

- HELP command specified without argument: Returns a list of FTP commands.
- HELP command specified with argument (argument = command name): Returns the operation method for the specified command.

Directory delimiter change

The controller can change the directory delimiter of the file path from "\" to "/".
In addition, the omission of the drive number in the file path name can be set.

Change procedure	Description
Switching by special relay	Changing the special relay SM1512 (FTP server function file path name switching setting enable flag) changes the directory delimiter. This method is used when FTP clients use only Linux OS and "/" is to be set for the directory delimiter.
Using the FTP command	Specifying the subcommand (path-delimiter) for the quote command changes the directory delimiter of the file path name of the controller. This method is used when FTP clients use Windows OS or Linux OS and the directory delimiter is to be changed every time the server is accessed by the client.

The following table lists how to specify controller files after changing the directory delimiter to "/".

Item	Description
Specification format	[Drive name:/]File name.Extension
Example	3:/MAINSEQ1.QDR

- After the directory delimiter is changed to "/", directory delimiter commands including "\" can be received by the controller. However, the directory delimiter that is sent from the controller is "/".
- When changing the directory delimiter again, the contents set later are valid.
- When executing an FTP command to specify a file path name using an FTP client with Linux, the same folder configuration must be used for the controller and the personal computer.
- The name can be specified either with or without a leading "/".

Point

Since WinSCP and lftp do not have the leading "/", always specify the path in a format with the leading "/" for FTP clients that handle the path as a relative path.

■Switching by special relay

- Turning on SM1512 (FTP server function file path name switching setting enable flag) changes the directory delimiter of the controller file path name to "/".
- While SM1512 is on, the directory delimiter change is valid. Turning off SM1512 clears the change and returns the directory delimiter from "/" to "\".

For details on the special relay, refer to the following.
☞ Page 1949 List of Special Relay (SM) Areas

Restriction

Do not turn on or off SM1512 while the FTP command is being executed. Doing so may cause malfunction.

■Switching by the FTP command

- When executing the "quote" command with a subcommand of the path-delimiter [mode], the directory delimiter of the controller file path name is changed from "\" to "/". Inputting the setting value to [mode] enables omission of the drive number in the file path.
- Executing the path-delimiter off command clears the setting.
- Executing the path-delimiter status command enables the current settings to be checked.

FTP command (Sub command of the quote command)	Function
path-delimiter	Changes the setting of the file path name when a file is specified. (After executing the command, SM1512 is turned on.)
path-delimiter off	Turns off file setting changing for the file path name when a file is specified.
path-delimiter status	Displays the setting status of the file path name when a file is specified.

For details on the quote command, refer to the following.
☞ Page 1357 Details of FTP command

Point

The current settings can also be checked using SM1512 (FTP server function file path name switching setting enable flag).

Details of FTP command

This section describes the FTP commands on the FTP client side supported by the controller, and the methods of using those commands.

Point

- Note that depending on the client side FTP application, some of the FTP commands may not operate as described in this manual. Refer to the manual for the FTP client, and check the functions, operation methods, or others.
- The specification format and result of the command may differ depending on the FTP client used.
- The section enclosed in square brackets [ ] in the specification format can be omitted.

■FTP server support commands

The following table lists the commands available when Windows standard FTP client software is used.

Command name	Description	
binary	Function	Notifies the FTP server that the file will be transferred without conversion. The return code and kanji codes are also not converted. The controller is automatically configured to this setting.
	Specification format	binary (abbreviated: bin)
bye	Function	Closes the connection with the FTP server and ends the FTP.
	Specification format	bye
	Same function	quit
close	Function	Closes the connection with the FTP server.
	Specification format	close
delete	Function	Deletes files stored in the controller.
	Specification format	delete "file path name"
	Example	When deleting files stored in the SD memory card delete 2:\MAINSEQ1.PRG
	Similar command	mdelete
dir	Function	Displays the file name, date of creation and volume of files stored in the controller.
	Specification format	dir [file/directory path name]
	Example	When displaying the detailed information of files stored in the data memory dir 4:\
	Similar command	ls
get	Function	Reads files from the controller.
	Specification format	get "source file path name" [destination file path name]
	Example 1	When reading files stored in the SD memory card and store with same file name get 2:\MAINSEQ1.PRG
	Example 2	When reading files stored in the SD memory card and store with different file name get 2:\SEQ1BAK.PRG SEQ\SEQ10LD.PRG
	Caution	• If the destination file path name (FTP client side) is not specified, the file is stored in the FTP client side with the same file name as the source file name (controller side). • The transfer destination is in the currently connected directly when FTP is started and connected.
ls	Function	Displays the name of files stored in the controller.
	Specification format	ls [file/directory path name]
	Example	When displaying the name of files stored in the data memory ls 4:\
	Similar command	dir
	Caution	When the command is executed in an FTP client with Linux OS, the results are the same as the dir command. (The mls command corresponds to the ls command for an FTP client with Windows OS.)

Command name	Description	
mdelete	Function	Deletes files stored in the controller. When deleting multiple files, specify the file name and extension in the file path name with wild cards (*, ?).
	Specification format	mdelete "file path name" (abbreviated mdel)
	Example	When deleting all files with "CSV" extension from files stored in SD memory card mdelete 2:*.CSV
	Similar command	delete
mdir	Function	Stores the detailed information (file name, date of creation, volume) of the file stored in the controller in the FTP client side file as log data.
	Specification format	mdir source file/directory path name Destination file path name
	Example	When storing the detailed information of file stored in data memory into 20120702.LOG file mdir 4:\ 20120702.LOG
	Note	• If the destination file path name is not specified, the file is stored with the file name determined by the FTP application on the FTP client side. • The transfer destination is in the currently connected directly when FTP is started and connected.
	Similar command	mls
mget	Function	Reads files from the controller. When reading multiple files, specify the file name and extension in the file path name with wild cards (*, ?). Receive is checked before transferring each file.
	Specification format	mget "file path name"
	Example	When reading all files with "CSV" extension from files stored in SD memory card mget 2:*.CSV
	Note	The read file is stored with the same file name in the FTP client side. The storage destination is in the current connection directory when the FTP is started and connected.
mls	Function	Stores the name of the file stored in the controller as log data in the file on the FTP client side.
	Specification format	mls Source file/directory path name Destination file path name
	Example	When storing the file name of file stored in SD memory card into 20120702.LOG file mls 2:\ 20120702.LOG
	Note	• If the destination file path name is not specified, the file is stored with the file name determined by the FTP application on the FTP client side. • The transfer destination is in the currently connected directly when FTP is started and connected.
	Similar command	mdir
mput	Function	Writes a file to the controller. When writing multiple files, specify the file name and extension in the file path name with wild cards (*, ?). Send is checked before transferring each file.
	Specification format	mput "source file path name"
	Example	When writing all files with "PRG" extension mput *.PRG
	Note	The storage destination file name is the same as the FTP client side.
open	Function	Specifies the host name or IP address and port number on the FTP server side, and connects with the FTP server.
	Specification format	open "host name" [port number] open "IP address" [port number] • Host name: Host name set with Microsoft® Windows® hosts file • IP address: IP address of the FTP server side • Port number: Control port number to be used by the FTP server side for FTP connection (If omitted, port number 21 will be used.)
	Example 1	When specifying the host name and connecting to the FTP server open HOST
	Example 2	When specifying the IP address and connecting to the FTP server open 192.0.1.254
	Caution	The IP address can be specified to create a connection when starting the FTP.
put	Function	Writes a file to the controller.
	Specification format	put "source file path name" [destination file path name]
	Example 1	When writing the param.PRM file to the SD memory card with the same file name put param.PRM 2:\param.PRM
	Example 2	When writing the param.PRM file to the SD memory card with a different file name put param.PRM 2:\param1.PRM
	Note	If the directory is not specified with the source file path name (FTP client side), the file in the current directory is written.

Command name	Description	
pwd	Function	Displays the current directory of the controller.
	Specification format	pwd
quit	Function	Closes the connection with the FTP and quits the FTP.
	Specification format	quit
	Similar command	bye
quote	Function	Sends the subcommands of the FTP server (controller dedicated subcommands).
	Specification format	quote
	Example	quote change
	Note	Only controller dedicated subcommands can be specified. Refer to the following. (☞ Page 1357 Details of FTP command)
rename	Function	Changes the controller file/directory name.
	Specification format	rename "old file/directory path name" "new file/directory path name" (abbreviated: ren)
	Example	When changing the name of a file stored in the SD memory card rename 2:\param.PRM 2:\param1.PRM
	Note	• Different drives can also be specified for old file/directory path name and new file/directory path name. However, the directory name cannot be changed for different drives. • The following response code appears when the file is successfully renamed. 350 RNFR accepted - file exists, ready for destination 250 File successfully renamed or moved
user	Function	Inputs the user name and password for the connected FTP server.
	Specification format	user "user name" [FTP password] • User name: Login name set in the module parameter (Ethernet) of the controller or user name created with the user authentication function • FTP password: FTP password set in the module parameter (Ethernet) of the controller, or password corresponding to the user name created with the user authentication function
	Example 1*1	When specifying the user name user FTPSERVER
	Example 2*1	When specifying the user name and password user FTPSERVER FTPSERVER_1234ABcd
	Note	User names and FTP passwords that can be specified differ according to the setting value of "To Use or Not to Use User Authentication" in the module parameter (Ethernet) of the controller. • "To Use or Not to Use User Authentication" is set to "Not to Use": The user name and password set in the module parameter (Ethernet) of the controller • "To Use or Not to Use User Authentication" is set to "Use": The user name created with the user authentication function and password associated with the user name

*1 In this example, the login name is "FTPSERVER" and the password is "FTPSERVER_1234ABcd".

■Controller dedicated subcommands

This section describes the controller dedicated subcommands that are added to "quote" command of the FTP command and sent.

Command name	Description	
change[*1]	Function	Displays or changes attributes of files stored in the controller.
	Specification format 1	When displaying the file attributes quote change file/Directory path name One of the following is displayed as the execution results when the process ends normally. • When specified file is read-only: -----R • When specified file is writable and readable: -----W
	Specification format 2	When changing the file attributes quote change file/Directory path name attribute Specify the attributes with one of the following methods. • When changing to a read-only file: r • When changing to a writable and readable file: w
	Example 1	When displaying the attributes of files stored in the SD memory card quote change 2:\PRG1.PRG
	Example 2	When changing the attributes of files stored in the SD memory card quote change 2:\PRG1.PRG r
	Note	The directory supports only the display of attributes.
path-delimiter	Function	Changes the directory delimiter of the file path name when a file is specified.
	Specification format	quote path-delimiter The following appears as the execution results when the command ends normally. 200 path-delimiter is ON (mode)
path-delimiter off	Function	Clears the setting change of the file path name by the path-delimiter.
	Specification format	quote path-delimiter off The following appears as the execution results when the command ends normally. 200 path-delimiter is OFF
path-delimiter status	Function	Displays the setting status of the file path name when a file is specified.
	Specification format	quote path-delimiter status The following appears as the execution results when the command ends normally. • When ON is set: 200 path-delimiter is ON • When OFF is set: 200 path-delimiter is OFF

*1 This name cannot be used when the user authentication function is enabled.

Precautions

Precautions for designing system

Configure the system (such as configuration of interlock circuits in the program) so that the entire system always functions properly during file transfer to the operating system and during status control of the programmable controller.

FTP client

- The FTP command specifications may differ from those in this manual depending on the FTP client. In this case, refer to the manual for the FTP client and check the functions and operation methods.
- Specify the IP address for the FTP command without zero fill. (Do not set "1" as "001".)
- The Windows® standard FTP client software does not support encrypted communications. For encrypted communications, use FTP client software that supports encrypted communications.

Example of FTP client software	Support for encrypted communications
Windows® standard FTP client	Not available
WinScp (Free software that runs on Windows® operating system)	Available
Lftp (Free software that runs on UNIX® operating system)	Available

■Setting items for WinSCP

The following table shows WinSCP option setting examples for file transfer from WinSCP to an FTP server of the controller.

Setting items required to use WinSCP (with/without encryption)			
Setting item	**Setting value**	**Explanation**	**Remarks**
-rawsettings	Setting item name	Specifying various settings	Refer to the following table for "-rawsettings option".
-passive	on: Connection in passive mode	Connection method setting	An open command option
	off: Connection in active mode		

Setting items (-rawsettings option) required to use WinSCP (without encryption)			
Setting item	**Setting value**	**Explanation**	**Remarks**
AddressFamily	0: Automatic	Internet protocol version	Set 0 or 1 because the controller does not support IPv6.
	1: IPv4		
	2: IPv6		
FtpUseMlsd	0/on: Valid	Enabling/Disabling of the MLSD command	When this item is valid, the ls command will be sent using a MLSD command that is not supported by the controller. Therefore, explicitly set 0 or off.
	1/off: Invalid		
	2/auto: Automatic		
CacheDirectoryChanges	0: Invalid	Enabling/Disabling of the directory cache function	When this value is set to 1, the file information of the directory is stored as a cache and the subsequent processing is not required, resulting in optimal communication processing performance. However, if the accessed directory is deleted, the information remains in the cache. Therefore, an error may not occur even if the directory is accessed again. To avoid this case, set to 0.
	1: Valid		

Setting items (-rawsettings option) required to use WinSCP (with encryption)			
Setting item	**Setting value**	**Explanation**	**Remarks**
AddressFamily	0: Automatic	Internet protocol version	Set 0 or 1 because the controller does not support IPv6.
	1: IPv4		
	2: IPv6		
FtpUseMlsd	0/on: Valid	Enabling/Disabling of the MLSD command	When this item is valid, the ls command will be sent using a MLSD command that is not supported by the controller. Therefore, explicitly set 0 or off.
	1/off: Invalid		
	2/auto: Automatic		
MinTlsVersion	3: SSL3.0	SSL/TLS minimum version	Specify 12 or 13 because the controller supports TLS1.2 and TLS1.3. Note that the TLS version of the controller depends on the encrypted communication version setting configured in the module parameter (Ethernet) of the engineering tool.
	10: TLS1.0		
	11: TLS1.1		
	12: TLS1.2		
	13: TLS1.3		

Setting items (-rawsettings option) required to use WinSCP (with encryption)			
Setting item	**Setting value**	**Explanation**	**Remarks**
MaxTlsVersion	3: SSL3.0	SSL/TLS maximum version	Specify 12 or 13 because the controller supports TLS1.2 and TLS1.3. Note that the TLS version of the controller depends on the encrypted communication version setting configured in the module parameter (Ethernet) of the engineering tool.
	10: TLS1.0		
	11: TLS1.1		
	12: TLS1.2		
	13: TLS1.3		
CacheDirectoryChanges	0: Invalid	Enabling/Disabling of the directory cache function	When this value is set to 1, the file information of the directory is stored as a cache and the subsequent processing is not required, resulting in optimal communication processing performance. However, if the accessed directory is deleted, the information remains in the cache. Therefore, an error may not occur even if the directory is accessed again. To avoid this case, set to 0.
	1: Valid		

■Setting items for lftp

The following table shows the lftp option setting examples for file transfer from lftp to an FTP server of the controller.

Setting item	Setting value	Explanation	Remarks
ftp:passive-mode	true: Connection in passive mode	Connection method setting	Set true for connection in passive mode and set false for connection in active mode.
	false: Connection in active mode*1		
net:max-retries	0 and after	Retry count for FTP command execution failures	When this item is set to 0 or blank, the retry will continue endlessly until the command succeeds. Since an FTP command that always fails will endlessly repeat the retry, always set a value of 1 or larger.
net:timeout	0 and after	Time until timeout	Set the timeout time for the response from the server.
ftp:ssl-auth*2	SSL: SSL is set.	AUTH command setting	Set TLS because the controller supports TLS communications.
	TLS: TLS is set.		
ftp:ssl-force*2	true: Enable	Whether to send passwords when the server does not support SSL/TLS	If this option is not set, the passwords will be sent in plain text when SSL/TLS is unsupported, so set enable (true).
	false: Disable		
ftp:ssl-allow	true: Enable	Encrypted communication settings	Set false when not using encryption.
	false: Disable		
cache:enable	true: Enable	Enabling/Disabling of the directory cache function	When this value is set to true, the file information of the directory is stored as a cache and the subsequent processing is not required, resulting in optimal communication processing performance. However, if the accessed directory is deleted, the information remains in the cache. Therefore, an error may not occur even if the directory is accessed again. To avoid this case, set to false.
	false: Disable		
log:enabled	true: Enable	Communication log display setting	When this item is enabled, the warning notification message specified in "Warning Notification Message Setting" in the "User Authentication Setting" window is displayed at logon. (☞ Page 1548 User authentication setting)
	false: Disable		
ssl:check-hostname*2	true: Enable	Whether to verify host names	Set true when verifying the host name associated with the certificate, and set false when not verifying the host name.
	false: Disable		
ftp:ssl-protect-list*2	true: Enable	Whether to request SSL for file list transfers	Set true when using encrypted communications.
	false: Disable		
ftp:ssl-protect-data*2	true: Enable	Whether to request SSL for data transfers	Set true when using encrypted communications.
	false: Disable		
ssl:verify-certificate*2	true: Enable	Whether to verify SSL certificates	Set true when verifying the SSL certificate, and set false when not verifying the certificate.
	false: Disable		
net:reconnect-interval-base	1	Reconnection time for FTP command failures	In lftp, retry is automatically performed when the command fails.*3 When the setting value is default, retry is performed 30 seconds later. To shorten the retry time, change the setting value to 1.
net:reconnect-interval-max	1	Reconnection time for FTP command failures (maximum value)	
net:reconnect-interval-multiplier	1	Every time a retry is performed, reconnection is performed at a multiplier of the time of net:reconnect-interval-base.	

*1 When lftp is used in a virtual environment such as WSL, the connection using PORT mode may be disabled.
Set "Communication Mode" of the module parameter to "Allow both of PORT/PASV modes", and set the option "ftp:passive-mode" to true.

*2 Only for lftp (with encryption)

*3 When executing the command, an error (421 1 users (the maximum) are already logged in, sorry) may occur due to lftp specifications, but the command can be normally executed when retried.

Point

Note that CDUP and XCUP commands cannot be normally executed.

Processing on the controller

- Do not power off or reset it, or insert/eject the SD memory card during file access. The file could be damaged if these are attempted.
- For the same file, file operation from peripheral devices and file transfer function (FTP server) operation cannot be executed simultaneously. If executed simultaneously, a communication error occurs and the process is interrupted (the same applies to online operations such as online change, since they involve file operations). If the processing has been halted, re-execute the processing before quitting the file transfer function (FTP server). However, operations on different files can be executed simultaneously.

Communication processing

- If a timeout error occurs during file transfer, the line with the FTP server is closed (disconnected). To restart file transfer, log in to the controller again using the FTP client.
- The existence of the external device is checked with the FTP connection.
- The file transfer processing time will differ according to the following factors: the load rate (line congestion status) of the Ethernet line, the number of connections used simultaneously (communication processing of other connections), and the system configuration (distance between the FTP server and FTP client, and how to access the controller).
- Only one external device (FTP client) can log into the controller at one time. If a connection is attempted from another FTP client in the login state, an error will occur without establishing the connection.
- If another communication function (MELSOFT connection or SLMP) is simultaneously executed with UDP during file transfer with FTP, an error such as timeout may occur. Either communicate after the file is transferred, or use TCP for communication.

File write

- An existing file can be overwritten.
- A file with read-only attributes or a file locked by the function except for FTP cannot be written. If attempted, a write error occurs.
- A file cannot be transferred for writing when the SD memory card is protected. If attempted, a write error occurs.
- When the file register is set as a refresh device, do not perform any writing or deletion to the corresponding drive.
- The number of files that can be written into the specified drive is maximum [maximum number of files that can be written] - one file. For details on the maximum number of files that can be written to the controller, refer to the following.

☞ Page 210 PERFORMANCE SPECIFICATIONS

File deletion

- Decide the timing for deleting the files for the entire system including the controller and engineering tool.
- Files with read-only attributes and files that are locked by a function other than FTP cannot be deleted. An error will occur if attempted.
- The file cannot be deleted if the SD memory card is protected. An error will occur if attempted.

FTP password

The FTP password can be reset with the following procedure when it is lost.

1. Read the parameters from the controller with the engineering tool.
2. Click the [Restore the Default Settings] button in "Application Settings" to return all "Application Settings" to the default values.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings]

3. Set the "FTP Server Settings" and "Application Settings" again.
4. Write the set parameters to the controller.
5. Enable the parameters by powering off and on or resetting the controller.

Point

If the FTP password is lost, reset all items in "Application Settings" in addition to "FTP Server Settings".

Setting a firewall on the FTP client side

If the communication mode is PORT mode and FTP communications are blocked by the firewall settings on the FTP client side, communications from the FTP server are not possible. Check the firewall settings, enable FTP communications and then access the FTP server.

Command input monitoring timer

Even if "To Use or Not to Use User Authentication" is set to "Use", "Logoff Judgment Time Setting" of the user authentication function is not applied to this function, and the command input is monitored based on "Command Input Monitoring Timer" set in the parameter of this function.

After logging in to the FTP server, if a command is executed while the Ethernet cable is unplugged, the connection may be disconnected due to a communication timeout on the FTP client side. In this case, logging in to the FTP server can be attempted again when the command input monitoring timer expires.

Response monitoring timer

When operation of files such as program (.PRG) and FB file (.PFB) is performed in the controller with a large program capacity, a timeout may occur due to long processing time on the controller. If a timeout occurs, increase the response monitoring timer value. (☞ Page 1348 Response Monitoring Timer)

Execution of the file transfer function (FTP server) during execution of another function

The file transfer function (FTP server) cannot be executed while the controller backup/restoration function or iQ Sensor Solution data backup/restoration function is being executed. Execute the function again after the backup/restore is completed.

Directory operations

- When attempting to delete a directory by using the RMD or XRMD command, the directory cannot be deleted if any file exists in the directory to be deleted.
- Only SD memory cards (drive 2) and data memory (drive 4) are drives where a directory can be created using the MKD or XMKD command. A directory cannot be created on other drives.

Maximum number of characters for password

The maximum number of password characters that can be entered with the Windows standard FTP client is 32 characters. When using the user authentication function to use an FTP server, set the password in the user information to 32 characters or less or use an FTP client (such as lftp or WinSCP) that allows the entry of passwords exceeding 32 characters.

Supported characters

FTP servers support only the characters supported by SJIS.

Changing the logged-in user authentication

The login status remains if "To Use or Not to Use User Authentication" is set to "Not Use" when logging into the FTP server and the setting is changed to "Use" during the operation. However, the login cannot be executed in subsequent attempts.

FTP client warning notification message

When the setting details are specified in "Warning Notification Message Setting" in the "User Authentication Setting" window, a warning notification message is displayed at logon. However, the message is not displayed in the following FTP clients. (☞ Page 1548 User authentication setting)

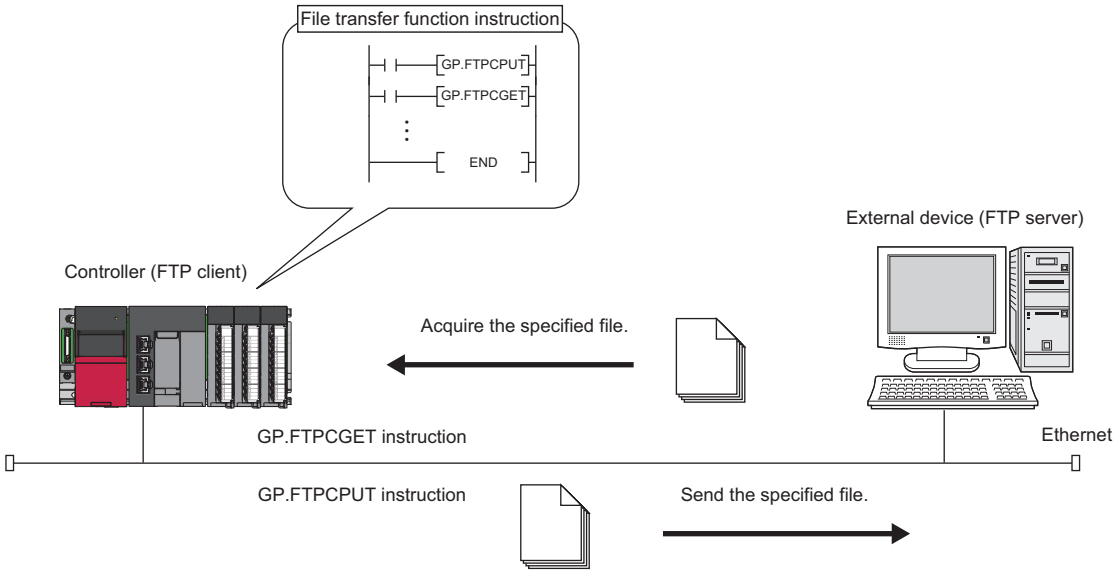
FTP client	Message display	Remarks
Windows standard CLI	Provided	—
WinSCP	Not provided	—
lftp	Not provided	Displayed if the display setting of the communication log is enabled at startup. (☞ Page 1363 Setting items for lftp)

53.2 FTP Client

Enables the controller, as an FTP client, to transfer files to an FTP server connected over Ethernet by using the file transfer function instructions. *1

It also supports FTPS (File Transfer Protocol over SSL/TLS), which is an encrypted communication function. When setting up a communication route that crosses the trust boundary, the communication contents can be encrypted and protected by using the encrypted communication function.

This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)



*1 An FTP server is required to use the file transfer function (FTP client). For details on the server, refer to the manual for the server used.

File transfer specifications

The following table lists the file transfer specifications of the file transfer function (FTP client).

Item	Description	Reference for encrypted communication
FTP server whose operation has been checked by Mitsubishi Electric	Microsoft® Internet Information Services (IIS) • Target OS: Windows Server 2019 Standard	Page 1368 Setting example for encrypted communication with the FTP server using IIS
	Pure-FTPd (v1.0.47) • Target OS: Debian GNU/Linux 10 (Buster)	Page 1373 Setting example of encrypted communications with FTP server using Pure-FTPd
Number of connectable FTP servers	1	
Source file name	Up to 255 characters including the folder path (including extension)	
Destination folder path	255 characters maximum	
File size (1 file)	Maximum 4G-1 (4, 294, 967, 295) bytes	
FTP transfer mode	Binary mode	

Precautions

If the following conditions are satisfied, the size of the file that can be transferred by the GP.FTPCPUT instruction is 14000 bytes or less per file. If a file exceeding 14000 bytes is specified, an error occurs.

- "Use" is set for "To Use or Not to Use Encrypted Communication" in "FTP Client Settings".
- "TLS1.3" or "TLS1.3/TLS1.2" is set for "TLS" in "Version Setting for Encrypted Communication".

Encrypted communication settings

This section provides a setting example for encrypted communication with the FTP server, which was verified by Mitsubishi Electric.

Setting example for encrypted communication with the FTP server using IIS

The following operating environment applies when using a self-signed server certificate.

- OS: Windows Server 2019 Standard
- FTP server: Microsoft® Internet Information Services (IIS)

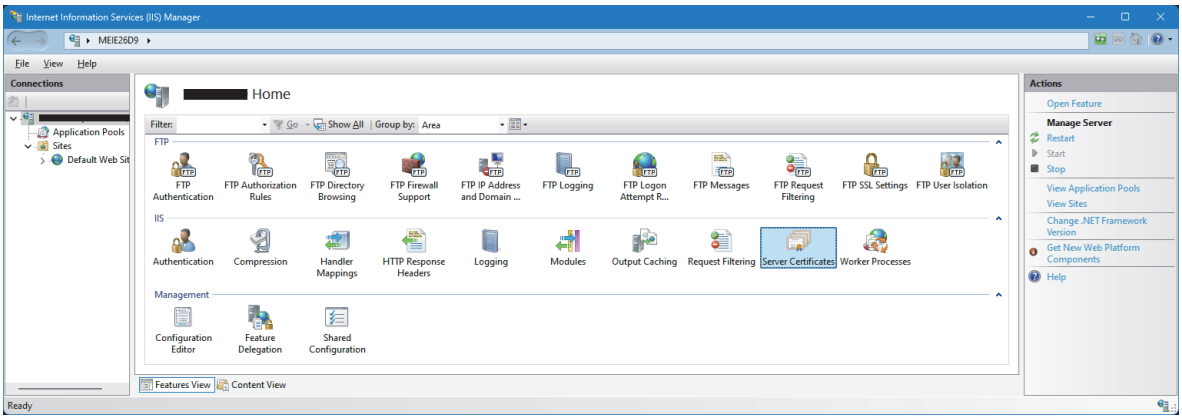
For the IIS setting method, refer to the IIS manual.

Restriction

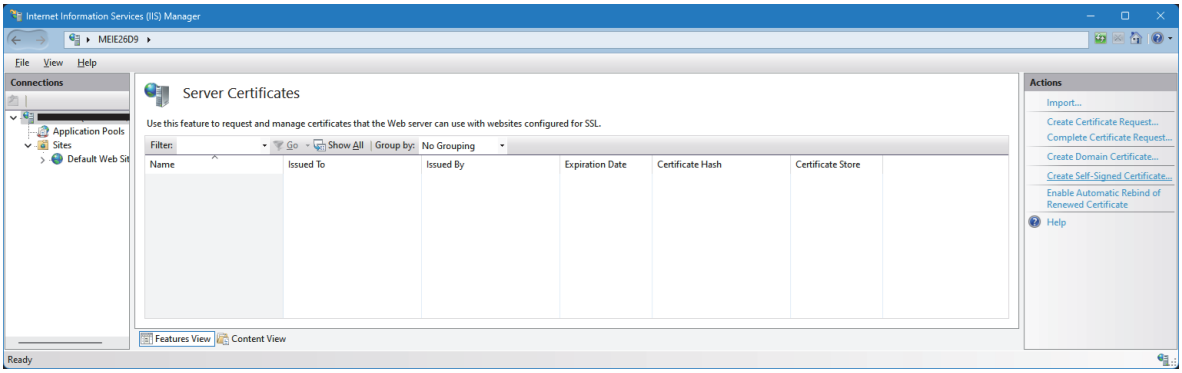
For encrypted communications using IIS on Windows Server 2019 Standard, the controller supports only TLS1.2.
Therefore, select "TLS1.2" or "TLS 1.3/TLS 1.2" for "Version Setting for Encrypted Communication" of "Security" under "Application Settings". If "TLS 1.3" is selected, the FTP client cannot perform encrypted communications properly.

■Creating a self-signed server certificate

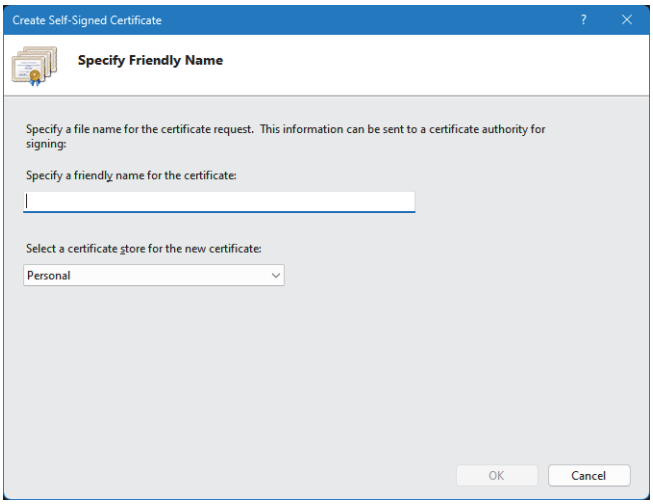
1. Start Internet Information Services (IIS) Manager and double-click "Server Certificates" in the home window.



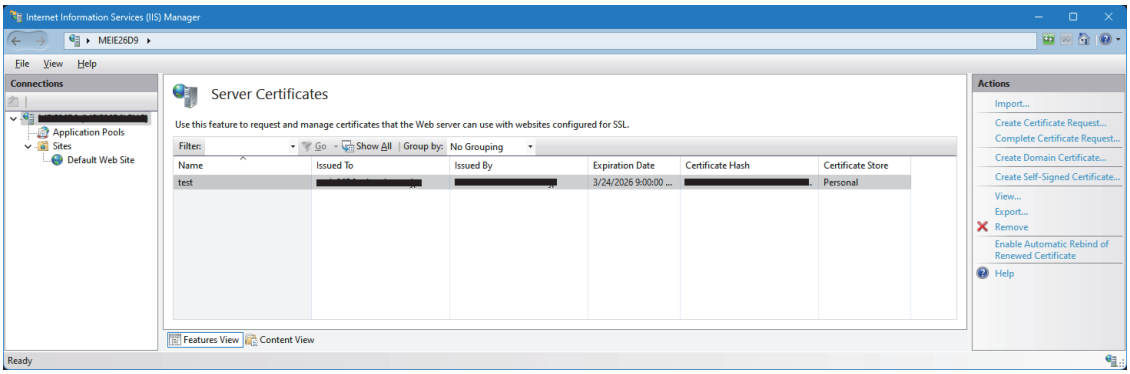
2. In "Actions" on the right side of the "Server Certificates" window, select "Create Self-Signed Certificate".



3. Enter an appropriate name in "Specify a friendly name for the certificate" and click the [OK] button.

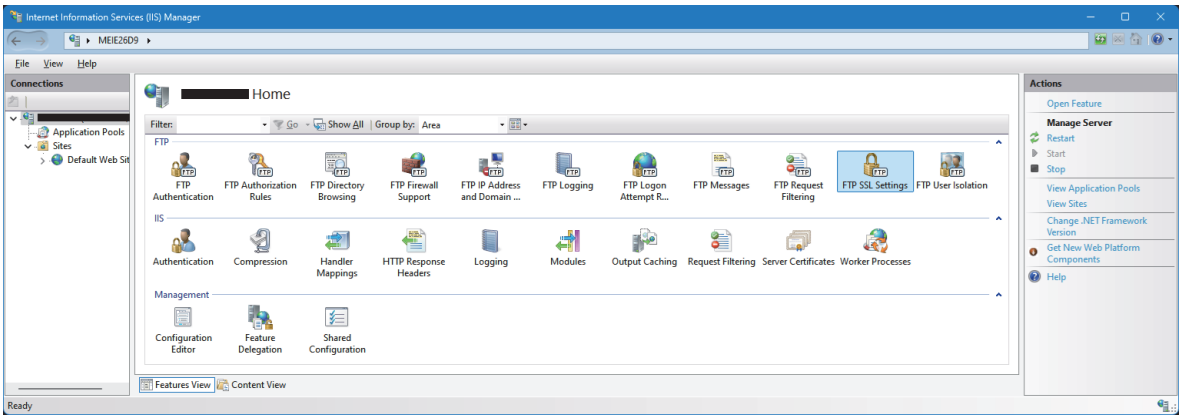


4. Check that the self-signed server certificate has been created.



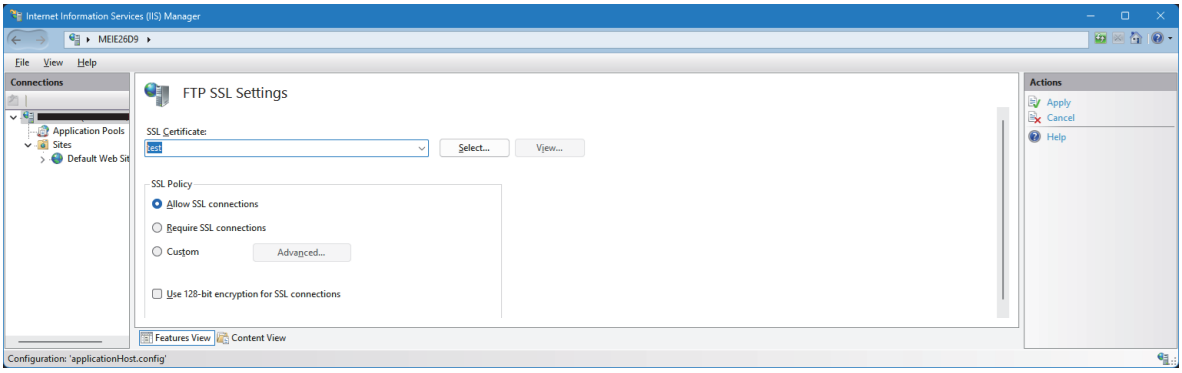
■Setting to enable encrypted communication

1. Double-click "FTP SSL Settings" in the home window.



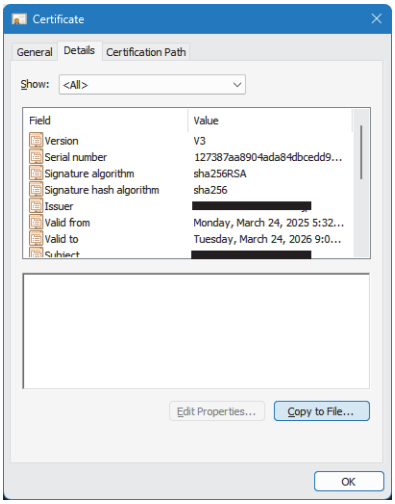
2. Set "SSL Certificate" and "SSL Policy", and click "Apply". For "SSL Certificate", select the server certificate that has been created. Set "SSL Policy" according to the purposes listed below.

- To accept both encrypted and plain text communication connections: Select "Allow SSL connections".
- To accept only encrypted communication connections: Select "Require SSL connections".

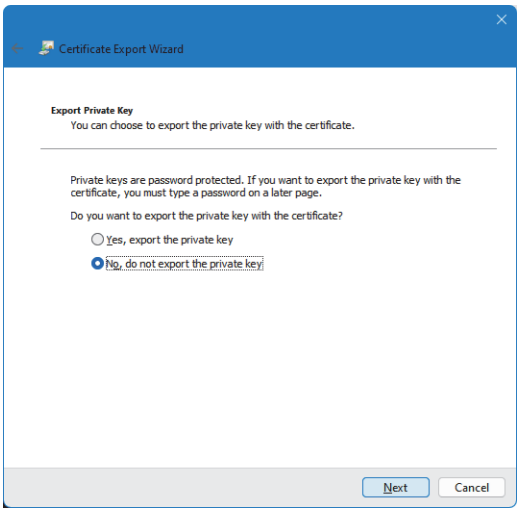


■Exporting the server certificate

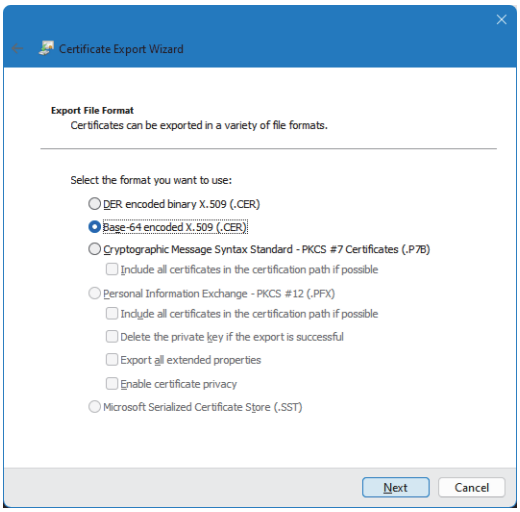
1. In the "Server Certificates" window, double-click the created server certificate to open the "Certificate" window shown below. In the [Details] tab, click the [Copy to File] button.



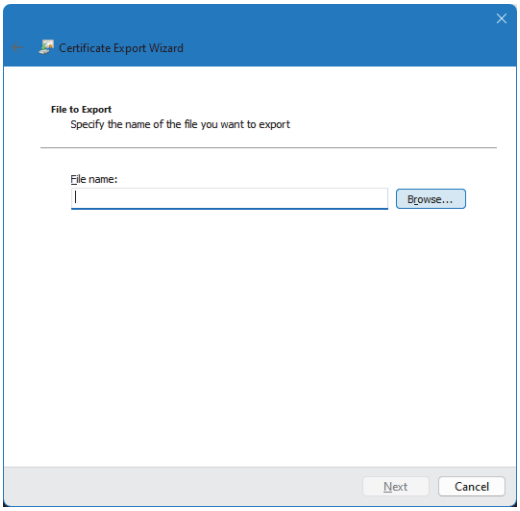
2. When the "Certificate Export Wizard" window appears, click the [Next] button.
3. Select "No, do not export the private key" and click the [Next] button.



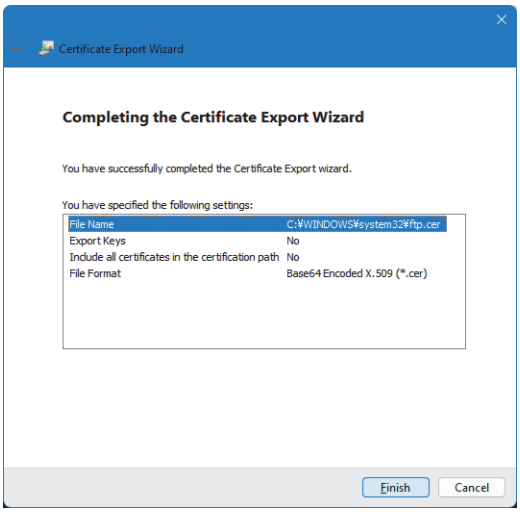
4. Select "Base 64 encoded X.509(.CER)" and click the [Next] button.



5. Enter the file name of the server certificate in "File name", specify the storage location using the [Browse] button, and click the [Next] button.



6. When the following window appears, click the [Finish] button.



Setting example of encrypted communications with FTP server using Pure-FTPd

The following operating environment applies when using a self-signed server certificate.

- OS: Debian GNU/Linux10(buster)
- FTP server: Pure-FTPd v1.0.47
- Encrypted communication library: OpenSSL1.1.1n

For the Pure-FTPd setting method, refer to the Pure-FTPd manual.

■TLS version settings

In Pure-FTPd, the supported TLS version can be changed by editing the following two setting values within /etc/ssl/openssl.

- MaxProtocol: The maximum supported version of the TLS protocol (TLSv1.3 or TLSv1.2)
- MinProtocol: The minimum supported version of the TLS protocol (TLSv1.3 or TLSv1.2)

Note that changing this setting will also affect the TLS version of other functions that use OpenSSL.

1. To support TLS1.3 only, edit the values as follows.

MaxProtocol = TLSv1.3

MinProtocol = TLSv1.3

2. Enter the following command to restart Pure-FTPd.

sudo service pure-ftpd restart

Point

For "Version Setting for Encrypted Communication" of "Security" under "Application Settings" of the controller, select the setting value that matches the TLS protocol version set in the steps above. If the values mismatch, the FTP client cannot perform encrypted communications properly.

■Creating a self-signed server certificate

1. Enter the following command to extract the self-signed server certificate.

sudo openssl req -x509 -nodes -newkey rsa:1024 -keyout /etc/ssl/private/pure-ftpd.pem -out /etc/ssl/private/pure-ftpd.pem

For the required input items listed below, enter the appropriate values.

- Country Name (2 letter code) [AU]: Country name
- State or Province Name (full name) [Some-State]: Organization (Prefecture name)
- Locality Name (eg, city) []: City name
- Organization Name (eg, company) [Internet Widgits Pty Ltd]: Organization name
- Organizational Unit Name (eg, section) []: Name of the department in the organization
- Common Name (e.g. server FQDN or YOUR name) []: FQDN address of the server
- Email Address []: Administrator e-mail address

■Setting to enable encrypted communication

1. Enter the following command to enable encrypted communications for Pure-FTPd.

sudo echo [Setting value] > /etc/pure-ftpd/conf/TLS

Enter the following value in the [Setting value] field.

- To accept only encrypted communication connections: 2
- To accept both encrypted and plain text communication connections: 1

2. Enter the following command to restart Pure-FTPd.

sudo service pure-ftpd restart

■Exporting the server certificate

1. Export the created server certificate (pure-ftpd.pem) to a personal computer on which the engineering tool will be used.
For example, enter the following command when transferring files using SCP with PowerShell.

scp [User name]@[IP address of the FTP server]:/etc/ssl/private/pure-ftpd.pem [Absolute path of the storage location]

After entering the command, enter the following.

- When "Are you sure you want to continue connecting (yes/no/[fingerprint])?" is displayed: yes
- When "[User name]@[FTP server IP address]'s password:" is displayed: The password corresponding to the user name

2. Open the exported server certificate in a text editor and delete the following content.

From -----BEGIN PRIVATE KEY-----

until -----END PRIVATE KEY-----

3. Change the extension of the created server certificate from ".pem" to ".cer".

Transferable files

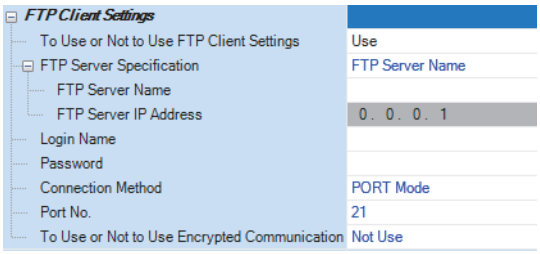
For files that can be transferred using the file transfer function (FTP client), refer to the file operation available which is described in the following manual.

☞ Page 340 File operation available

FTP client settings

Set the file transfer function (FTP client).

Window



Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [FTP Client Settings]

Displayed items

Item	Description	Setting range
To Use or Not to Use FTP Client Settings	Set whether to use the file transfer function (FTP client) or not.	• Not Use • Use (Default: Not Use)
FTP Server Specification	Set the specification method of the FTP server.	• FTP Server Name • FTP Server Address (Default: FTP Server Name)
FTP Server Name	Set the FTP server name (domain name) of the connection destination.	1 to 256 characters (single-byte alphanumeric characters and symbols[*1]) (Default: —)
FTP Server IP Address	Set the IP address of the FTP server of the connection destination in the decimal format.	0.0.0.1 to 223.255.255.254 (Default: 0.0.0.1)
Login Name	Set the login name for login to the FTP server.	1 to 32 characters (single-byte alphanumeric characters and symbols[*1]) (Default: —)
Password	Set the password for login to the FTP server.	0 to 32 characters (single-byte alphanumeric characters and symbols[*1]) (Default: —)
Connection Method	Set the connection method of the FTP server.	• PORT Mode • PASV Mode (Default: PORT Mode)
Port No.	Set the port number for control of the FTP server.	1 to 65535 (Default: 21)
To Use or Not to Use Encrypted Communication	Set whether to use encrypted communications.	• Not Used • Use (Default: Not Use)

*1 Excluding the following symbols:
()"$'

Procedure for executing the file transfer function (FTP client)

To execute the file transfer function (FTP client), set an FTP client and an FTP server in parameters, and execute a file transfer function instruction.
Follow the procedures described below.

Setting an FTP server

1. Set the login name, password, and home directory for the FTP client to the FTP server. In addition, a right to access (read/write) files is given to the users. When performing encrypted communications, read the server certificate from the FTP server and import it to the controller. (📖 Manual for the server used)

Point

The controller cannot be specified as the FTP server.

Setting an FTP client

1. Set the IP address of the controller used as an FTP client. (☞ Page 190 IP Address Setting)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings] ⇨ [IP Address Setting]

2. Set "Use" for "To Use or Not to Use FTP Client Settings" in "FTP Client Settings" under "Application Settings".
For details on other setting items in "FTP Client Settings", refer to the following.
☞ Page 1375 FTP client settings

3. Set "Use" for "To Use or Not to Use DNS Server Settings" in "DNS Settings" under "Application Settings" as needed.
For details on other setting items in "DNS Settings", refer to the following.
☞ Page 1437 DNS settings

4. To use encrypted communications, set the following.

Item	Setting
Server certificate settings	Certificate (server certificate) to be used ☞ Page 1561 "Certificate Management" window
Version Setting for Encrypted Communication	Protocol version to be used ☞ Page 1575 Version setting for encrypted communication

5. Set the connection timeout time with the FTP server as needed. (☞ Page 1771 Timer settings for data communication)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Timer Settings for Data Communication] ⇨ [Detailed Setting] ⇨ [TCP ULP Timer]

Executing a file transfer function instruction

Use the dedicated instructions to execute the file transfer function (FTP client).

■File transfer function instruction

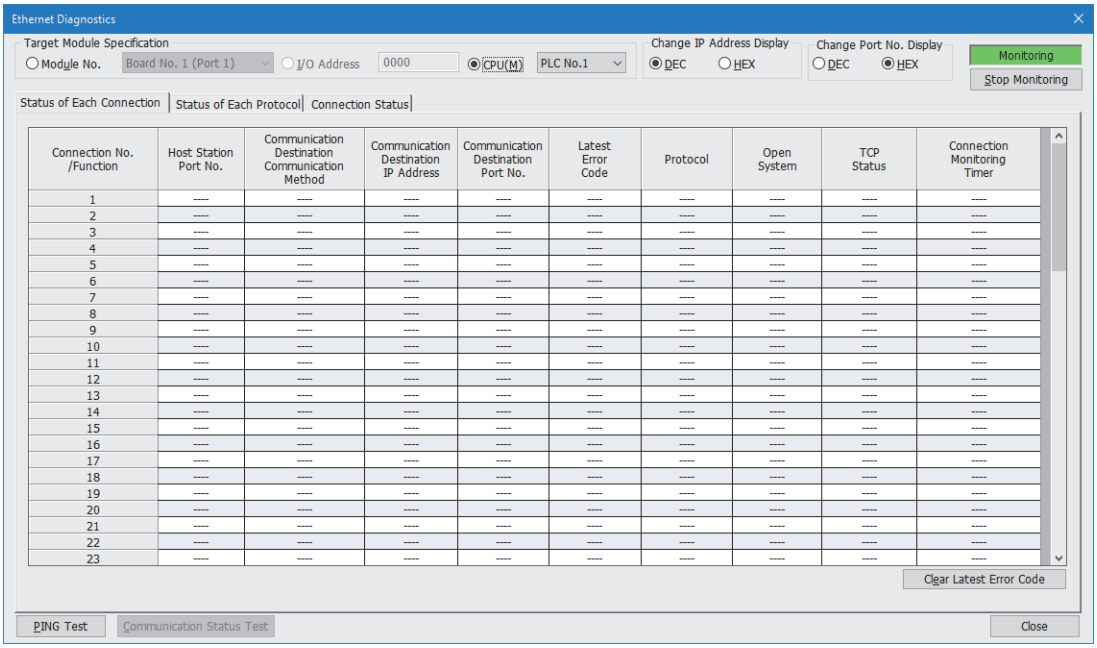
Instruction symbol	Processing details
• GP.FTPCPUT • SP.FTPPUT	Sends files in the controller (FTP client) to the folder path of the specified FTP server.
• GP.FTPCGET • SP.FTPGET	Retrieves files on the FTP server to the folder path of the specified controller (FTP client).

■Precautions

- To retrieve the file register from the FTP server, execute the "put" command of the FTP server function while the controller is in a STOP state.

Checking the file transfer function (FTP client) status

The status of the function can be checked with "Status of Each Connection" on the "Ethernet Diagnostics" window. (☞ Page 1708 Status of each connection)



Precautions

Communication error when retrieving transfer files

If a large capacity file is retrieved by execution of the GP.FTPCGET instruction, a communication error may occur due to an increase of the transfer processing load. When transferring a large capacity file, extend a connection time (timeout period) in parameters for the FTP server so that no communication error occurs.

When the state changes from RUN to STOP during file transfer

Even if the state changes from RUN to STOP during file transfer, transfer continues until it is completed.

SD memory card forced disable

If the SD memory card forced disable function is executed, use of the SD memory card is disabled in the middle of the transfer processing, causing an immediate stop of the processing. Check that the transfer processing has been completed, and execute the function.

Simultaneous execution of the file transfer function instruction and another function

The following functions and file transfer function (FTP client) instruction cannot be executed simultaneously. Ensure that they are not simultaneously executed before executing.

- Controller data backup/restoration function
- iQ Sensor Solution data backup/restoration function

File operation from the external device during file transfer

Do not manipulate the files from an external device, such as an engineering tool, while transferring the files.
If the file is manipulated from another device while transferring the files, the external device may issue an error. If the processing has been halted due to an error, re-execute the processing after the file transfer operation.

Communication processing

If another communication function (MELSOFT connection or SLMP) is simultaneously executed with UDP during file transfer with FTP, an error such as timeout may occur. Either communicate after the file is transferred, or use TCP for communication.

Deleting unnecessary files

If a cable is disconnected, the system is powered off, or the controller is reset during the file transfer, delete unnecessary files (such as a temporary file and undefined files) in the FTP server. Then, execute file transfer again.

FTP server setting when executing file transfer function instruction

If the temporary file creation setting (bit 3) during file transfer in the usage setting area of the GP.FTPCPUT instruction is set to 0: Create, enable replacing when renaming in the FTP server settings before executing the instruction. Alternatively, delete the file with the same name as the transferred file on the FTP server side.

Supported characters

FTP clients support only the characters supported by SJIS.

Operation when failed to access the FTP server during file transfer

When the FTP server cannot be accessed during file transfer, a timeout will occur after a period up to twice the time set in "TCP ULP Timer" in "Timer Settings for Data Communication".

54 WEB SERVER FUNCTION

This function displays HTML and objects (such as images) in response to requests from a client (Web browser).
The controller can be accessed over the network from a tablet or smartphone browser, allowing operation and display, and enabling monitor control from a remote location. Users can also create custom web pages by combining their own images and other content.

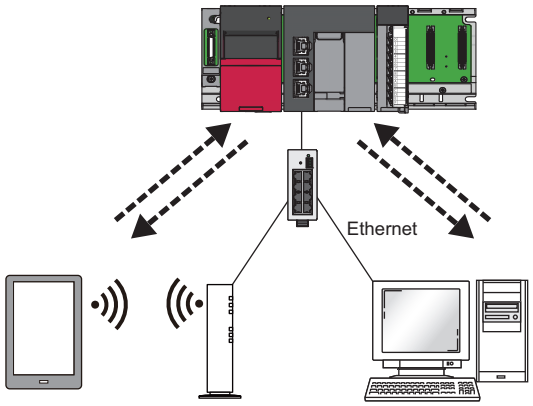
Restriction

Before using this function, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

Operations available with the Web server function

■Displaying controller status and reading/writing device data from a Web browser

The controller can be monitored and controlled remotely from locations such as a work site or office using a tablet or smartphone. Access rights can also be restricted using the logon management function.



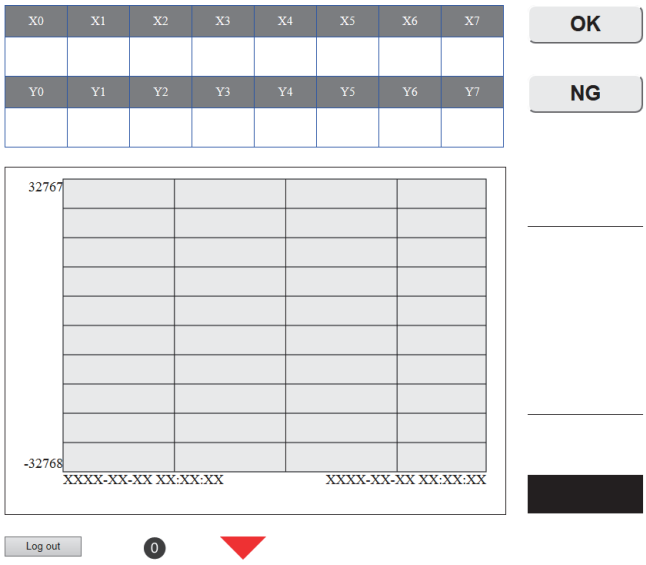
Point

Incorporate measures other than this function if the programmable controller system's safety must be maintained against illegal access from an external device. Mitsubishi shall not be held liable for any system problems that may occur from illegal access. The user authentication of the Web server function is one method of preventing illegal access (such as program or data destruction) from an external device. It does not completely prevent illegal access.
Examples of measures for illegal access are given below.

- Install a firewall
- Install a personal computer as a relay station, and control the relay of send/receive data with an application program
- Install an external device for which the access rights can be controlled as a relay station (Contact the network provider or equipment dealer for details on the external devices for which access rights can be controlled.)

■To create an original Web page (user Web page)

An original Web page can be created by users. The created Web page can be displayed on a Web browser as a user Web page. The layout and functions to be displayed on the Web page can be set freely.

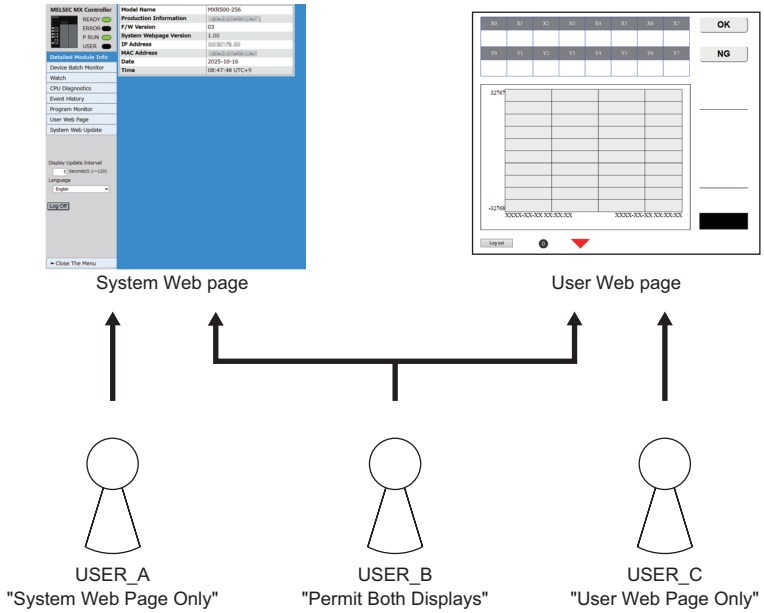


Restriction

An SD memory card is required to display a user Web page.

■To restrict Web server operations/display for each account

User authentication with a user name and password prevents an unauthorized access. Displaying the system Web page and user Web page and writing to the device can be restricted for each account as well.



54.1 Web Server Function Specifications

Web server function specifications

The following shows the Web server function specifications.

Item	Description
Number of users that can simultaneously logs on	8
HTTPS support	Supported
Own station port number	Default: HTTP: 80, HTTPS: 443 (variable)
Supported language	• Japanese • English • Chinese (Simplified) The user Web page supports multiple languages.
Supported character code	UTF-8
Number of accounts	4*1

*1 When the account settings of the user authentication function are used, the number of log-ons set in the user authentication function is applied.

Client operating environment

Operation of the Web server function has been verified on the following clients.

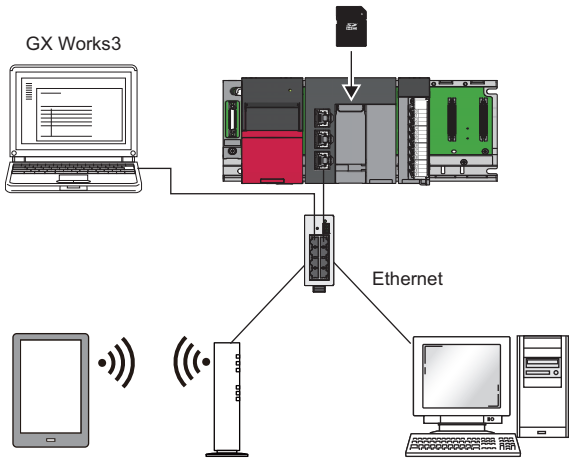
Terminal	OS	Browser	Browser version
Personal computer	Microsoft® Windows®	Microsoft® Edge	130.0
		Google Chrome	102.0
Tablet Smartphone	Android®	Mobile Google Chrome	127.0
	iOS®	Mobile Safari	17.6
GOT3000	—	GOT3000 Series User's Manual (Utility & Maintenance Functions)	

Point

Use a Web browser that supports HTML5, CSS3, and JavaScript for the Web server function.

54.2 System Configuration

This section describes the system configuration to use the Web server function.



Model name	Description
Controller	A controller equipped with the Web server function
Engineering tool (GX Works3)	Software for configuring settings to enable/disable the Web server function and set user authentication.
Web browser	An HTTP client on devices such as a tablet, smartphone, or GOT3000
Router/hub/wireless LAN	A network configuration that can connect to an Ethernet network is required to use them for the Web server function.
SD memory card	An SD memory card for the user Web page or program monitor

54.3 Operation Method/Procedure

This section describes the basic prerequisites and usage procedures for the Web server function. The Web server function allows access to the Web server from a browser after setting parameters using the engineering tool.

Prerequisites for use

- The device (such as a personal computer) with a Web browser installed must be able to communicate with the controller over Ethernet.
- JavaScript and cookies must be enabled in the Web browser.
- The system Web page must be written. (☞ Page 1383 Downloading the system Web page library)

User operation procedure

1. Prepare the engineering tool and a device where a Web browser can be used.
2. Configure the controller module parameters with the engineering tool. (☞ Page 1384 Module parameter setting)
3. Parameter settings are reflected when the controller is powered off and on or reset.
4. Access the controller from the Web browser, and write the system Web page to the controller. (☞ Page 1387 Writing the system Web page, ☞ Page 1388 How to access the Web server)
5. Log on to the Web server. (☞ Page 1389 Logging on to the Web server)
6. Log off from the Web server. (☞ Page 1389 Logging off from the Web server)

Downloading the system Web page library

For the system Web page library, please consult your local Mitsubishi representative.
Please consult your local Mitsubishi representative.

Item	Model	Name of the downloaded file
System Web page for MELSEC MX Controller MX-R Model Web server function	CPU-SYSTEM_WEB_MXR	cpu-system_web_mxr.zip

Module parameter setting

Before using the Web server function, set parameters with the engineering tool.

IP address settings

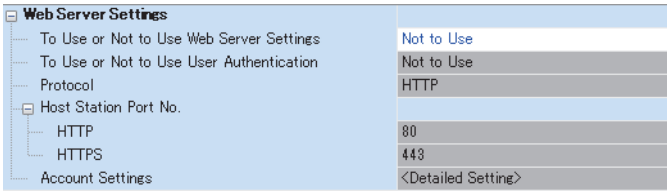
Set the IP address of the controller. For the IP address setting, refer to the following.

☞ Page 190 IP Address Setting

Web server settings

Configure the Web server settings.

[Navigation window] ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Web Server Settings] ⇨ [Account Settings]



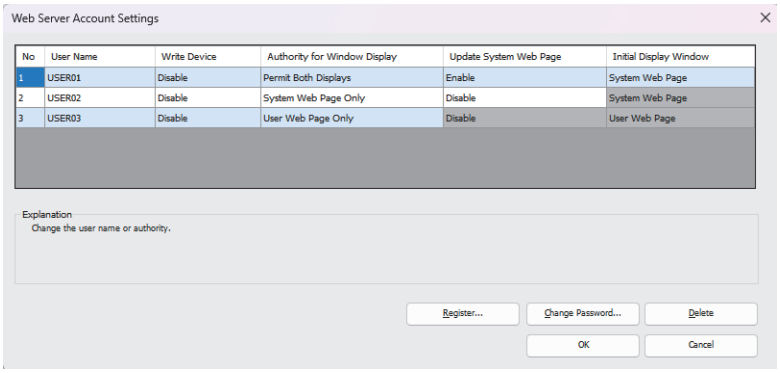
Item		Description	Setting range
To Use or Not to Use Web Server Settings		Select whether to use the Web server function.	• Not Use • Use (Default: Not Use)
To Use or Not to Use User Authentication		Select whether to use the account settings of the user authentication function. Selecting "Use" will disable "Account Settings".	• Not Use • Use (Default: Not Use)
Protocol		Set the protocol to be used by the Web server. "HTTP/HTTPS" allows both the HTTP and HTTPS protocols to be used.	• HTTP • HTTPS • HTTP/HTTPS (Default: HTTP)
Own station port number	HTTP	Set the port number to be used by the HTTP protocol.	80, 1024 to 4839, 4841 to 4999, 5010 to 61439, 64512 to 65534 (Default: 80)
	HTTPS	Set the port number to be used by the HTTPS protocol.	443, 1024 to 4839, 4841 to 4999, 5010 to 61439, 64512 to 65534 (Default: 443)
Account Settings		Set the account and password for the Web server function.	☞ Page 1385 Web server account settings

■Encrypted communication settings

In "Protocol" of the Web server settings, if "HTTPS" or "HTTP/HTTPS" is specified and encrypted communication (HTTPS) is required, a server certificate must be created. (☞ Page 1558 Encrypted Communication Function)

■Web server account settings

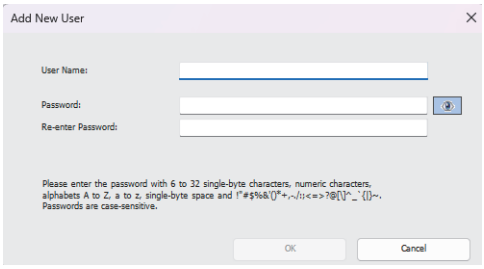
Set up an account for the Web server.



Item	Description	Setting range
No.	An account No. of each user for the Web server is displayed.	1 to 4
User Name	A user name to be used for the authentication at the access to the Web server is displayed. Click the user name to change it.	1 to 20 one-byte characters (alphanumeric characters and symbols)
Write Device	Enable or disable changing the value in the device test window. (☞ Page 1393 Device test)	• Disable • Enable (Default: Disable)
Authority for Window Display	Enable or disable access to the system Web page or user Web page.	• System Web Page Only • User Web Page Only • Permit Both Displays (Default: System Web Page Only)
Update System Web Page	Enable or disable updates of the system Web page. This item can be set when "Permit Both Displays" or "System Web Page Only" is set for "Authority for Window Display".	• Disable • Enable (Default: Disable)
Initial Display Window	Set a window that is displayed first after the user logs on. The setting range depends on the setting of "Authority for Window Display".	• System Web Page • User Web Page (Default: System Web Page)
[Register] button	Click this button to register a new user.	—
[Change Password] button	Click this button to change a password.	—
[Delete] button	Click this button to delete a selected user	—

• Adding a new user

Click the [Register] button in the "Web Server Account Settings" window to display the "Add New User" window.



Item	Description	Setting range
User Name	Input a user name to be used for the authentication at the access to the Web server. This parameter is case-sensitive. For the characters available for the user name, refer to the following.	1 to 20 one-byte characters (alphanumeric characters and symbols)
Password	Input a password to be used for the authentication at the access to the Web server. This parameter is case-sensitive. For the characters available for the password, refer to the following.	6 to 32 one-byte characters (alphanumeric characters and symbols)
Re-enter Password	Input a password for confirmation. Input the same password as the newly set password. The available characters are the same as those for "Password".	6 to 32 one-byte characters (alphanumeric characters and symbols)

The following table lists the characters that are available for the user name and password.

Type	Character
One-byte alphanumeric characters (upper-case/lower-case characters)	0 to 9, A to Z, a to z
Symbols	A one-byte space, !, ", #, $, %, &, ', (,), *, +, ,, -, ., /, :, ;, <, =, >, ?, @, [, \,], ^, _, `, {, |, }, ~

Writing the system Web page

The system Web page must be written to the controller when the Web server function is used for the first time.
Use the following procedure to write the system Web page.

1. Consult your local Mitsubishi representative to get the system Web page file.
2. Decompress the system Web page file (zip file).
3. Set the decompressed system Web page file for the input form of the system Web page.
4. Click the [Execute] button.

How to access the Web server

Input the following address in the address bar of a Web browser.
http(s)://[IP address of the Web server (controller)]/

Ex.



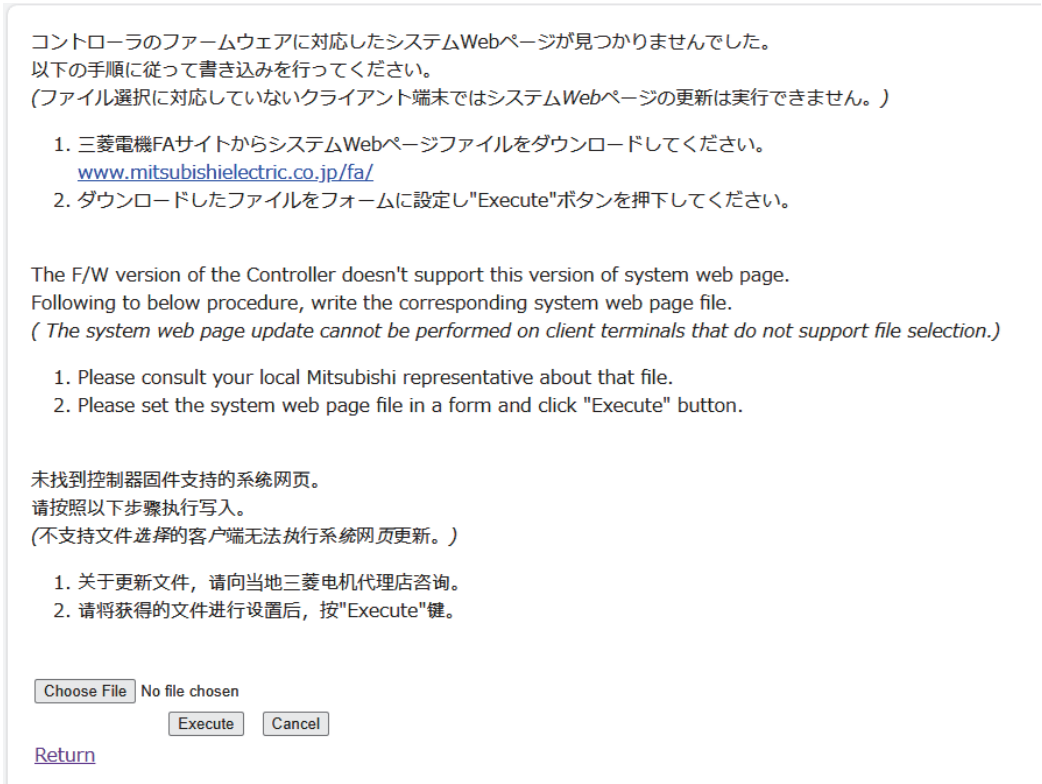
If the own station port number has been changed from the default (HTTP: 80, HTTPS: 443), input the following address.
http(s)://[IP address of the Web server (controller)]:[Own station port number]/

Ex.



Point

- To access the Web server (controller) with a domain name specified, resolve the name on the client side in advance.
- Do not directly specify the URL of each page after logon to access the Web server. Doing so displays an incorrect window, and prevents collection of information from the Web server.
- If the following window appears after the access, follow the messages on the window to write the system Web page file to the controller.



Logon/logoff

Logging on to the Web server

Accessing the Web server displays the logon (user authentication) window.

To log on to the Web server, input the user name and password which are set with the engineering tool, and click the [Log on] or [Login] button.

For the user name and password settings, refer to the following.

☞ Page 1385 Web server account settings



Point

- If logon fails 10 times in succession, logon to the account is disabled for a certain time.*1
- If there is no communication for five minutes after logon, the user will be automatically logged off.*1
- Logon/logoff using different browsers on a single terminal are recognized as logon/logoff using different terminals. Similarly, logon/logoff using a secret window or private window on a single browser are recognized as logon/logoff using different terminals.

*1 When the Web server settings of the user authentication function are used, the specifications and settings of the user authentication function are applied.

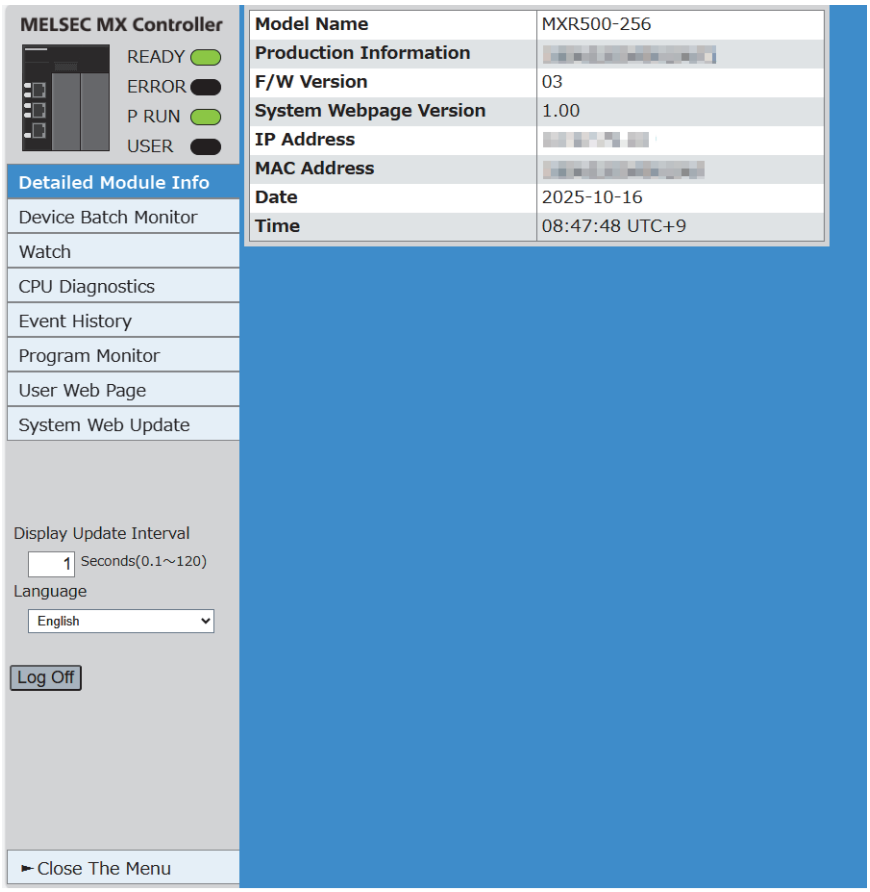
Logging off from the Web server

To log off from the Web server, always use the [Log off] or [Logout] button. Do not log off by using other methods such as the [×] button on a Web browser.

If an account logs off without using the [Log off] or [Logout] button, the logon information remains for a certain time, and thus the other users may not be able to log on. (☞ Page 1737 When using the Web server function)

54.4 Function Details

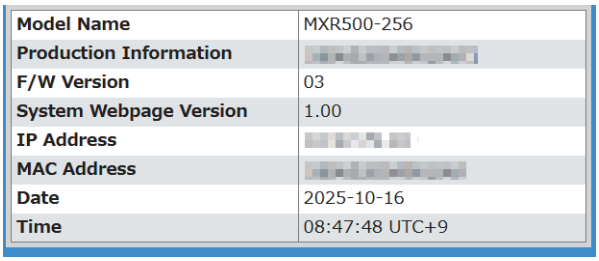
Monitoring, diagnostics, or other operations of the controller can be performed by switching to each window from the menu.



Item	Description
Detailed module information	Information related to the controller, such as the model name, production information, firmware version, system Web page version, IP address, and MAC address, is displayed. This window is displayed as the initial display window after logon. (☞ Page 1391 Detailed Module Information (Module Information))
Device Batch Monitor	Devices and buffer memory areas can be monitored in a batch. (☞ Page 1392 Device batch monitor)
Watch	Devices and buffer memory areas can be monitored individually for each point. (☞ Page 1394 Watch)
CPU Diagnostics	Existing errors can be checked. (☞ Page 1395 CPU Diagnostics)
Event History	The event history retrieved from the controller (such as the date and time of occurrence, event code, and detailed information) is displayed. (☞ Page 1396 Event history)
Program Monitor	The HTML, JavaScript, and image files generated by the engineering tool are written to the SD memory card, and the program is monitored on the Web browser.
User Web Page	An original Web page created by users can be displayed on a Web browser by using HTML, JavaScript, and image files. (☞ Page 1401 User Web Page) When "System Web Page Only" is set to "Authority for Window Display" with the engineering tool, this item is not displayed.
System Web Update	The system Web page can be updated by writing the system Web page file to the controller. (☞ Page 1399 System Web page update) When "Disable" is set to "Update System Web Page" with the engineering tool, this item is not displayed.
Display Update Interval	Set the interval for refreshing monitor items of each function on the system Web page to the latest information. Set the value from 0.1 to 120 seconds. (☞ Page 1399 Display update interval)
Language	The display language of the system Web page can be switched to the selected language. (☞ Page 1400 Language switcher)
[Log off] button	Click this button to log off from the system Web page.

Detailed Module Information (Module Information)

Information related to the controller, such as the model name, production information, firmware version, system Web page version, IP address, and MAC address, is displayed. This window is displayed as the initial display window after logon.



Model Name	MXR500-256
Production Information	[redacted]
F/W Version	03
System Webpage Version	1.00
IP Address	[redacted]
MAC Address	[redacted]
Date	2025-10-16
Time	08:47:48 UTC+9

Item	Description
System Web Page Version	The version of the system Web page is displayed. The number before the point indicates the major version, and the number after the point indicates the minor version.

Point

The time, time zone, and whether daylight saving time is set or not are displayed in "Time". "DST" is displayed only while daylight saving time is set. For setting the time zone, refer to the following.

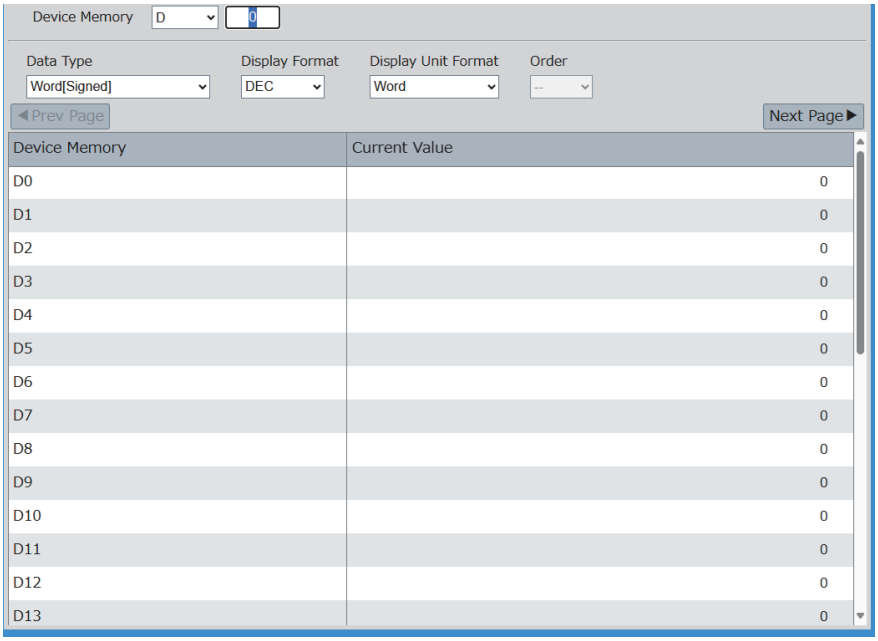
☞ Page 1941 Daylight saving time function

Device Monitor

Devices can be monitored, or their values can be changed.

Device batch monitor

Devices and buffer memory areas can be monitored in a batch. The display format differs depending on the specified device.



■Monitoring example

1. Select a device to be monitored from "Device Memory" at the upper section of the window.
2. Enter the start device number.
3. Select a value for "Data Type", "Display Format", "Display Unit Format", and "Order". The drop-down lists of "Data Type", "Display Format", "Display Unit Format", and "Order" differ depending on the device.
4. After selecting them, press Enter.

Point

The current values of the device areas being monitored are refreshed automatically at the interval specified in "Display Update Interval" on the menu.

■Available devices

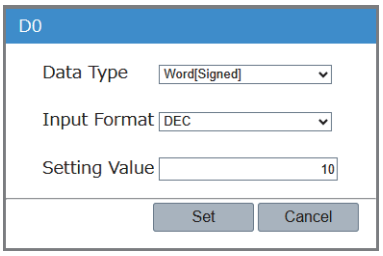
Device
X, Y, M, L, B, F, SB, V, T, ST, LT, LST, C, LC, D, W, SW, DX, DY, SM, SD, Jn\X, Jn\Y, Jn\B, Jn\SB, Jn\W, Jn\SW, Un\G, U3En\G, Z, LZ, R, ZR, RD

■Changing current values

☞ Page 1393 Device test

Device test

Click the current value of the device and the device test window appears. The current value can be changed in this window.



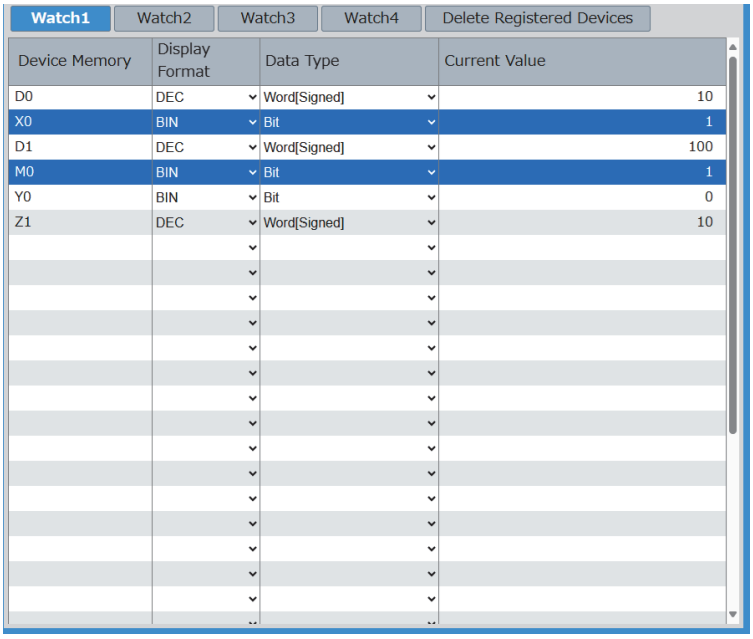
1. Click the current value of the device area to be changed to display the device test.
2. Specify a value for "Data Type" and "Input Format", and then input a new value in "Setting Value".
3. Click the [Set] button to display the confirmation window for writing the setting value.
4. Click the [Yes] button in the confirmation window for writing the setting value to write the setting value.

Point

To display the device test, set "Write Device" of the account currently logged on as "Enable" in advance. (☞ Page 1385 Web server account settings)

Watch

Devices and buffer memory areas can be monitored individually for each point.



Item	Description
[Watch] button	The device areas to be monitored can be registered in "Watch1" to "Watch4". Use of the "Watch1" to "Watch4" windows enables device areas to be monitored for different purposes.
[Delete Registered Devices] button	The device areas registered in the "Watch1" to "Watch4" windows can be deleted in a batch.

Monitoring example

1. Enter the device area to be monitored and press Enter. When Enter is pressed, "Display Format", "Data Type", and "Current Value" are entered automatically.
2. Select a value for "Display Format" and "Data Type", and press Enter. The drop-down lists of "Display Format" and "Data Type" differ depending on the device.

Point

- Up to 32 lines can be displayed in one page.
- The current values of the device areas being monitored are refreshed automatically at the interval specified in "Display Update Interval" on the menu.

Available devices

Device
X, Y, M, L, B, F, SB, V, T, ST, LT, LST, C, LC, D, W, SW, DX, DY, SM, SD, Jn\X, Jn\Y, Jn\B, Jn\SB, Jn\W, Jn\SW, Un\G, U3En\G, Z, LZ, R, ZR, RD

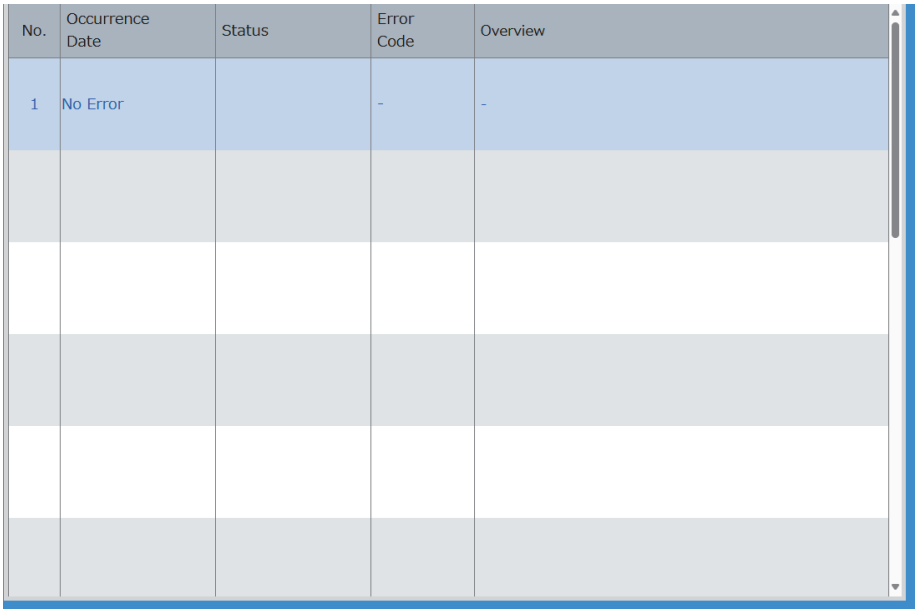
Changing current values

When the current value of a device area is clicked, the device test window appears and the value can be changed. (☞ Page 1393 Device test)

When the device test is displayed from a "Watch" window, the current value at the timing when the device test appears is displayed.

CPU Diagnostics

Existing errors can be checked. Up to 16 records are displayed.



Click the [Detail] button to check the detailed information of the error.

The following table lists the overview of the detailed information window for errors.

Item	Description
Overview	The overview (name) of the error is displayed.
Detailed Information	Up to three detailed information sets corresponding to the error code selected are displayed. "—" is displayed when no information to display exists.
Cause	The error details and error cause are displayed.

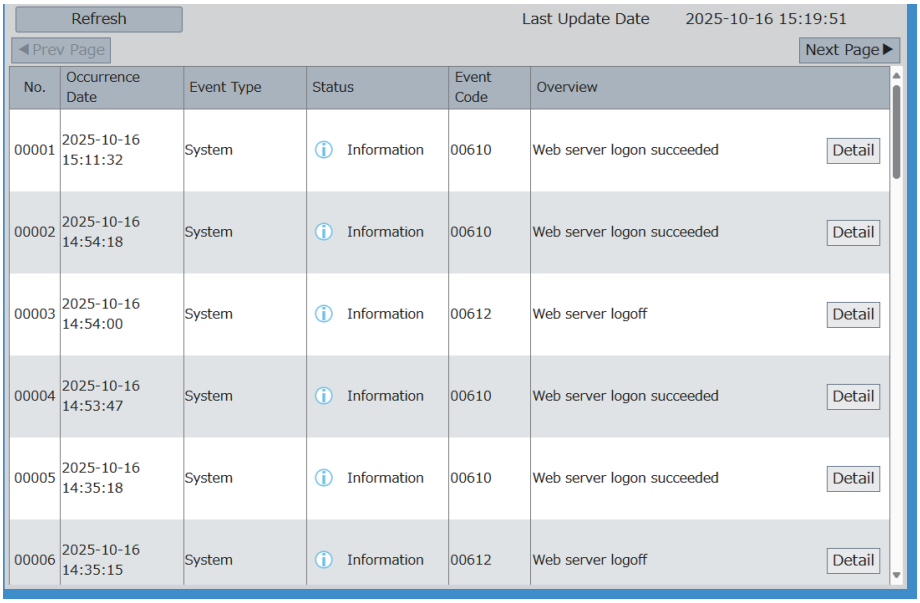
Point

- The data in the CPU diagnostics is refreshed automatically at the interval specified in "Display Update Interval" on the menu.
- Since the date and time of error occurrence is based on the time set in the controller, it may be different from the time set in the personal computer used.

Event history

The event history retrieved from the controller (such as the date and time of occurrence, event code, and detailed information) is displayed. Up to 32 records are displayed in one page.

Note that the event history cannot be cleared in the Web server function. Clear it with the engineering tool. (GX Works3 Operating Manual)



Item	Description
[Prev Page] button, [Next Page] button	The 32 records before or after the records displayed in the current page are displayed.
[Refresh] button	The event history is retrieved from the controller and the window is refreshed. The latest 32 registered events are displayed in the first page after the refresh. The event history is retrieved from the save destination of the event history selected in "Event History Setting" of the engineering tool.
Last Update Date	The time retrieved from the controller is displayed when the window is switched from another window to the "Event History" window or when the [Refresh] button is clicked for the last time. When the event history has not been refreshed, it will be blank. The display format is as follows: YYYY-MM-DD hh: mm: ss (YYYY: year, MM: month, DD: day, hh: hour, mm: minute, ss: second)

Click the [Detail] button to display the detailed information of the event. The following table lists the overview of the detailed information window.

Item	Description
Detailed Information	Up to three detailed information sets corresponding to the event code selected are displayed. "—" is displayed when no information to display exists.
Cause	The event description is displayed.

Point

- If any event was lost, it is displayed as "*HST LOSS*".
- The Web server function does not cover the event history of modules other than the controller. To check the event history of a module other than the controller, use the engineering tool.

Refresh timing of the event history

"Event History" is not refreshed at the interval specified in "Display Update Interval" on the menu.

"Event History" is refreshed when:

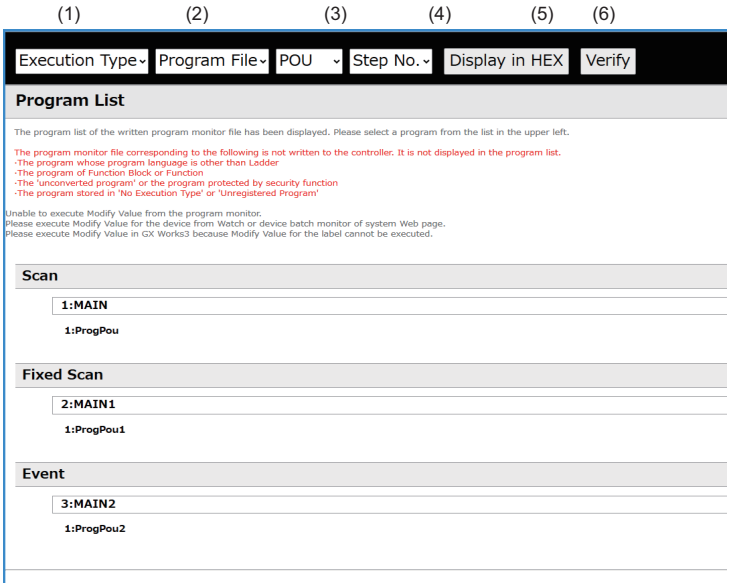
- "Event History" is selected on the menu.
- The [Refresh] button is clicked.

Program monitor

The HTML, JavaScript, and image files generated by the engineering tool are written to the SD memory card, and the program is monitored on the Web browser. The only programming language that can be monitored is ladder language.
It is also possible to check whether the program written to the controller matches the program monitor file.

Restriction

To use the program monitor, an SD memory card is required.



When the program monitor is selected from the system Web page, the monitor is displayed with the upper and lower parts divided as shown in the image above. In the initial state, the lower part shows a program list.
By selecting a program from the above list, the lower part will show the program.

No.	Item	Description
(1)	Execution Type	Select the execution type of the program to be displayed.
(2)	Program File	Select the program file to be displayed.
(3)	POU	Select the POU to be displayed.
(4)	Step No.	Select the start step number of the program to be displayed.
(5)	Display in DEC/HEX	Press the button to switch between decimal and hexadecimal display for the current value being monitored.
(6)	Verify	Press the button to check for any difference between the programs in the program monitor file and those running in the controller. A message will appear according to the result.

Point

To display the program monitor window from the system Web page, enable the program monitor file write function in the option settings of the engineering tool. (☞ Page 1398 Operating procedure)

Operating procedure

This section describes the procedure to use the program monitor of the Web server function.

1. Enable the program monitor file write function. In the option settings of the engineering tool, set "Yes" for "Write HTML when Writing a Program" under "Web Server Function (HTML Program Monitor)".

[Tool] ⇨ [Options] ⇨ "Online" ⇨ "Write to PLC" ⇨ "Operational Setting" ⇨ "Web Server Function (HTML Program Monitor)" ⇨ "Write HTML when Writing a Program"

Point

"Number of Steps for Splitting Files (Ladder) for Monitoring" can be used to set the number of program splitting steps. By increasing the number of splitting steps, the size of the program displayed on one page can be increased. However, as the program size of one page increases, it may take a long time to load the page and update monitor values.

2. Write the program monitor file for program monitoring to the controller. The program monitor file is written to the controller in the following way: Select "Write to PLC" or "Online Program Change" from the engineering tool to display the window to select which program monitor file to write, then select "Yes" in the window.

Point

Writing a program monitor file may take some time depending on the size of the program in the project. By writing a program monitor file when debugging is complete and avoid writing it during debugging, the file writing time can be reduced.

3. Display the window from "Program Monitor" on the system Web page.

Precautions

The following shows precautions to take when using the program monitor of the Web server function.

- Once the program write window closes in the engineering tool, the writing process is complete. After that, the controller expands the file and performs an update to be ready for program monitoring.
- Do not power off or reset the controller while a program is written or updated. Doing so will cause the program monitor page not to be displayed correctly. In that case, write the program monitor file again from the engineering tool. If the controller is powered off or reset in any of the following states, the program file will be updated again at the next power-on. Whether writing/updating is in progress and whether the update has failed can be checked by checking b0 (Program monitor file write status flag) and b1 (Program monitor file update failure flag) of SD2396.
  - The program monitor file is being updated in the controller.
  - The update of the program monitor file has failed in the controller.
- A program monitor file cannot be written from another engineering tool while a program monitor file is written or updated. If writing is started from another engineering tool during writing/updating, an error will occur and the writing process will be interrupted. Perform writing from another engineering tool after writing/updating is complete.
- Program monitor files for programs that meet any of the following conditions are not written.
  - Programs not created in the ladder diagram
  - Function blocks or function programs
  - Unconverted programs
  - Programs for projects where user authentication is enabled
  - "No Execution Type" programs
  - Unregistered programs

User Web page

An original Web page can be created by users.
To use the user Web page, write the created Web page to the SD memory card. (☞ Page 1401 User Web Page)

Restriction

An SD memory card is required to display a user Web page.

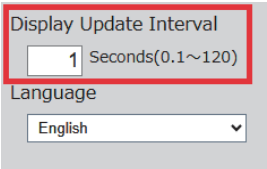
System Web page update

The system Web page can be updated.

1. Obtain the latest system Web page file from your local Mitsubishi representative.
2. Click the "Choose File" button and specify the obtained system Web page file.
3. Press the "Execute" button to write the system Web page file to the controller.

Display update interval

Set the interval for refreshing monitor items of each function on the system Web page to the latest information.



Setting procedure

The setting procedure is as follows:

1. Enter a value in "Display Update Interval".
2. Press Enter. Pressing Enter refreshes the window and starts to refresh the display at the interval entered.

Without pressing Enter, the setting is not reflected, and therefore the display is refreshed at the interval before the change.

Items refreshed at the interval specified in "Display Update Interval"

The items refreshed at the interval specified in Display Update Interval" are as follows:

- Time of detailed module information
- Device Batch Monitor
- Watch
- CPU Diagnostics
- Program monitor

The event history is not refreshed at the interval specified in "Display Update Interval". (☞ Page 1396 Refresh timing of the event history)

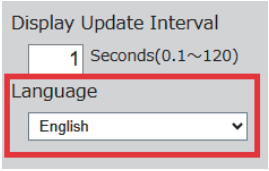
Point

- When another Ethernet communication or other processing whose communication load is high is being performed at the same time, the refreshing cycle may be longer than the set value.
- If the response is not received within the interval set in "Display Update Interval" due to high communication processing load in the controller or a problem in the communication path, information on the window is not refreshed. (☞ Page 1737 When using the Web server function)

Language switcher

The display language of the system Web page can be switched to the selected language.

- Japanese
- English
- Chinese (Simplified)



54.5 User Web Page

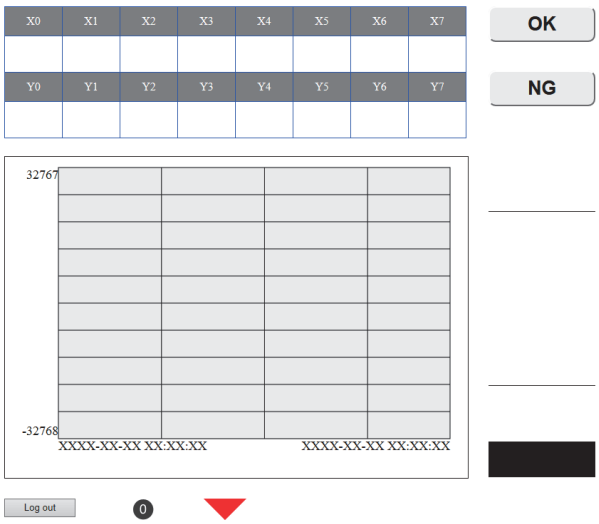
A user Web page is a Web page on which the layout and displayed functions can be freely configured. Use the User Web Page Design Tool to create an original Web page and write it to the controller.
For information on the User Web Page Design Tool, refer to the following.
User Web Page Design Tool Operating Manual

Restriction

An SD memory card is required to display a user Web page.

Display example of a user Web page

The following figure shows a display example of a user Web page.



Procedure

The procedure for using the user Web page is as follows:

1. In the engineering tool, grant the logged-on user permission to display the user Web page. (Page 1385 Web server account settings)
2. Use the User Web Page Design Tool to create an original Web page.
(User Web Page Design Tool Operating Manual)
3. Store the user Web page on the SD memory card.
4. To perform encrypted communication (HTTPS) with the Web server function parameters reflected to the controller and "HTTPS" or "HTTP/HTTPS" specified, enable the server certificate (Page 1558 Encrypted Communication Function).
5. Access the user Web page. (Page 1402 How to access the user Web page)
6. After checking the display and operation of the user Web page, log off from the page. (Page 1402 Logoff from the user Web page)

Point

Before using the Web server function, enable JavaScript and cookies in settings of a Web browser.

Accessing User Web Page

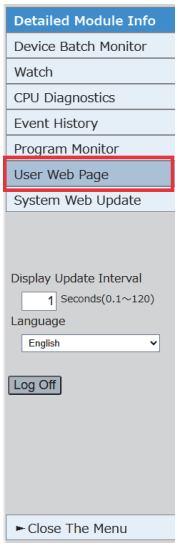
Access the user Web page from the Web browser.

How to access the user Web page

Access the user Web page with one of the following methods.

■Access from the system Web page

Click "User Web Page" on the system Web page to access the user Web page.*1



*1 To display the items of "User Web Page" on the system Web page, specify an html file that defines the default page of the user Web page and the storage location as shown below directly under the SD memory card.
\WWW\USER\index.html

■Access by inputting the URL directly in the address bar

Input the following address in the address bar of a Web browser.
http(s)://[IP address of the Web server (controller)]/USER/[Default page name]

Ex.



If the own station port number has been changed from the default (HTTP: 80, HTTPS: 443), input the following address.
http(s)://[IP address of the Web server (controller)]:[Own station port number]/USER/[Default page name]

Point

Do not directly specify the URL of each page after logon to access the Web server. Doing so displays an incorrect window, and prevents collection of information from the Web server.

■Direct access to the user Web page after logon

Set "Initial Display Window" to "User Web Page" in the account setting to display the user Web page after logging on to the Web server.

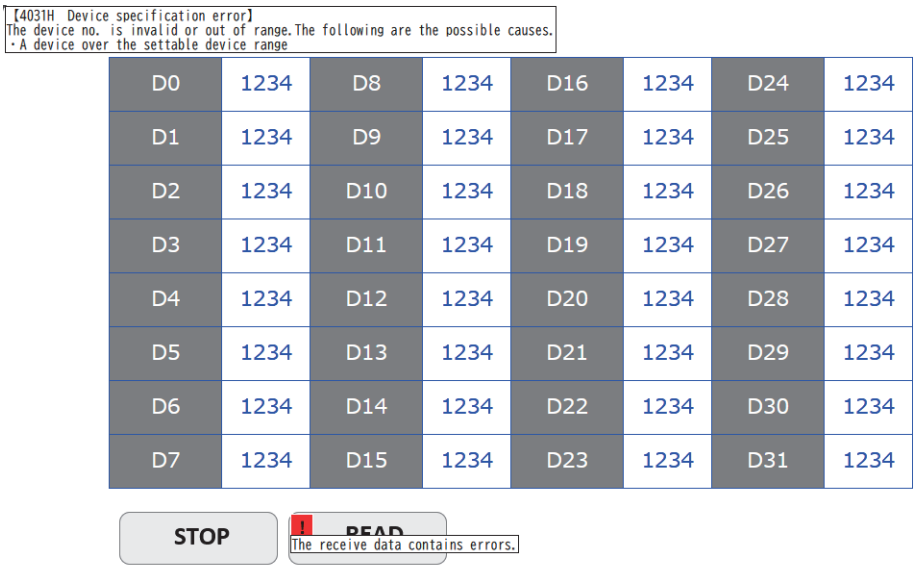
Logoff from the user Web page

When the user logs off from the user Web page, the user logon page appears. If no user logon page exists, an error message appears. To log off from the user Web page, always use the [Log off] or [Logout] button. Do not log off by using other methods such as the [×] button on a Web browser. If an account logs off without using the [Log off] or [Logout] button, the logon information remains for a certain time, and thus the other users may not be able to log on. (☞ Page 1737 When using the Web server function)

54.6 Error message

Display example of error messages

If an object of the user Web page is used incorrectly, a button to notify the user of an error is displayed at the upper left of the object when the user Web page is displayed. The error message related to the common processing which is not limited to the object is displayed at the upper left of the window.



Click the button to display the detailed information of the error.

■List of error messages of the user Web page

The following table lists error messages, causes, and action of the user Web page.

Description	Cause	Action
The receive data contains errors.	The receive data contains errors.	Check that the controller and the client terminal are properly connected and update the Web page.
You were logged off. Log on and try again.	The user has been logged off. (Communications are disconnected.)	Check that the controller and the terminal are properly connected and log on again.
Specified devices are invalid. The following are the possible causes. • A device such as pointer and constant • Unsupported device	Device names are incorrect.	Check parameters of each object to see if any device name is specified incorrectly.
Specified device No. is invalid. The following are the possible causes. • A device over the settable device range of CPU parameter	Device numbers and buffer memory addresses are out of range or not numeric values. The device range is incorrect.	Check parameters of each object to see if any device number and buffer memory address are specified incorrectly.
Specified modules do not exist. Check the modules.	The module numbers are incorrect. An error has occurred in communications with intelligent function modules.	Check parameters of each object to see if any module number is specified incorrectly. Check that there are no power-offs or errors in extension units.

54.7 PRECAUTIONS

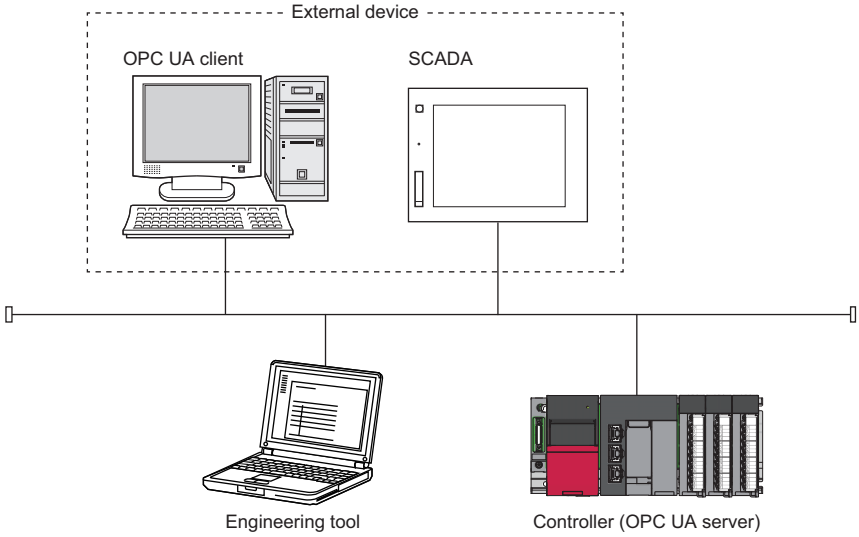
The following lists the precautions regarding the Web server function.

- If the Web browser is closed by clicking the × button, logon information remains for a certain period. When creating a user Web page, a logoff button must be placed on the page.
- Information may not be refreshed within the specified display update interval due to high communication processing load in the controller or a problem in the communication path. To refresh information at the specified display update interval without fail, reduce the communication processing load in the controller or review the network configuration.
- The response performance of Web pages varies according to the following causes.
  - Load factor of an Ethernet line (Congestion degree of a line)
  - Number of connections that are used simultaneously (Refresh processing of other connections)
  - Network configuration
  - Use with other Ethernet port functions (such as the file transfer function and simple CPU communication function)
- When a new HTTP client tries to connect while the maximum number of HTTP clients that can simultaneously log on is connected, the response performance may deteriorate.
- Up to 32 points of device values can be read from the user Web page at one time. If the number of values exceeds the limit, the read values may not fit within one scan. On the other hand, device values can be written one point at a time. If multiple points of values for a single program element are attempted to be written at once, each value may be written in separate scans.
- Do not directly specify the URL of each page after logging on, as the window may not display correctly and information may not be retrieved from the Web server.
- When encrypted communication (HTTPS) is not used, use this function within the factory LAN environment. If the controller is connected directly to the Internet, communications may be intercepted, or JavaScript may be tampered with, potentially allowing access to system memory. Therefore, use security measures for the controller, such as HTTPS, user authentication function, and IP filter.
- Web pages or alert messages may not be displayed correctly due to data cached by the browser or browser specifications. In this case, reload the page, restart the browser, or clear the cache.
- Because the communication timeout time depends on the browser specifications, it may not match the timeout time of the Web server. The design of the error window differs depending on the browser.
- Even if a program monitor file or system Web page file is written or updated, no message or other notification is sent to a Web browser displaying the Web page before the update. To view the updated Web page, reload the page.
- Program parts protected with a block password can be written to the program monitor file after authentication. Therefore, in the program monitor, program parts protected with a block password can be monitored without password authentication.
- If the user Web page that was used with the MELSEC iQ-R series or MELSEC iQ-F series is accessed from the MELSEC MX Controller MX-R Model, the operation may differ from the conventional one. Therefore, use the User Web Page Design Tool to create a user Web page appropriate for the series in use.

55 OPC UA COMMUNICATION FUNCTION

55.1 OPC UA Communication Function

The server function of OPC UA (OPC Unified Architecture), which is a protocol for exchanging data with an external device, is supported. The external device with the OPC UA client function can access to labels of the controller.



The following shows the OPC UA server function of the controller.

- Data Access function
- Security function
- User authentication function

For details, refer to the following.

☞ Page 1424 OPC UA server function list

Specifications

This section describes the specifications of the OPC UA server function.

Performance specifications

Item		Specifications
OPC UA version		1.04
Profile		☞ Page 1407 OPC UA server specifications
Address space	Maximum number of nodes that can be published in address space setting	25000
	Maximum capacity of address spaces	30MB
	Setting data	☞ Page 1410 Address space specifications
	Polling cycle	10 to 10000ms
	Maximum number of read nodes	10000 per request
	Maximum number of write nodes	3000 per request
	Maximum Variable data size (total of all nodes)*1	2MB
User authentication		☞ Page 1426 User authentication function
Maximum number of simultaneous sessions		15
Maximum number of subscriptions		Total of all sessions: 100
Maximum number of monitor items		300 per subscription
Connection setting	Security policy	☞ Page 1426 Security Policy
	Security mode	☞ Page 1426 Security Mode
Session timeout		10000 to 180000ms

*1 Variable data size is the total size corresponding to each data type of labels that can be published in the address space. (☞ Page 1410 A label that can be published in address spaces)

OPC UA server specifications

■Available profile

The following table lists profiles supported by this function.

- Embedded 2017 UA Server Profile

Item	Description
Address Space Model	Address Space Atomicity
	Address Space Base
	Address Space Full Array Only
Attribute Services	Attribute Read
	Attribute Write Values
Base Information	Base Info Core Structure
	Base Info GetMonitoredItems Method
	Base Info ResendData Method
	Base Info Type System
Discovery Services	Discovery Find Servers Self
	Discovery Get Endpoints
Method Services	Method Call
Monitored Item Services	Monitor Basic
	Monitor Items 2
	Monitor QueueSize_1
	Monitor Value Change
	Monitor Items 10
	Monitor Items 100
	Monitor MinQueueSize_02
	Monitor Triggering
	Monitored Items Deadband Filter
Protocol and Encoding	Protocol UA TCP
	UA Binary Encoding
	UA Secure Conversation
Security	AsymmetricEncryptionAlgorithm_None
	AsymmetricSignatureAlgorithm_None
	KeyDerivationAlgorithm_None
	Security None CreateSession ActivateSession
	SecurtyPolicy_None_Limits
	SymmetricEncryptionAlgorithm_None
	SymmetricSignatureAlgorithm_None
	Security Invalid user token
	Security User Name Password
	Security Default ApplicationInstance Certificate
	Security Policy Required
Session Services	Session Base
	Session General Service Behaviour
	Session Minimum 1
	Session Minimum 2 Parallel
Subscription Services	Subscription Basic
	Subscription Minimum 1
	Subscription Publish Discard Policy
	Subscription Publish Min 02
	Subscription Minimum 02
	Subscription Publish Min 05

Item	Description
View Services	View Basic
	View Minimum Continuation Point 01
	View RegisterNodes
	View TranslateBrowsePath

• Security Policy

This function supports the following security policies.

Item	Description
Security Policies	SecurityPolicy - None
	SecurityPolicy - Basic128Rsa15
	SecurityPolicy - Basic256
	SecurityPolicy - Basic256Sha256
	SecurityPolicy - Aes128-Sha256-RsaOaep
	SecurityPolicy - Aes256-Sha256-RsaPss

• IdentityTokens

This function supports the following IdentityTokens.

Item	Description
IdentityTokens	User Token - Anonymous
	User Token - User Name Password

■Available services

The following table lists the services defined by OPC UA Version 1.04 and the available services provided by this function.

○: Available, ×: Not available

Service set name	Service name	Availability
Discovery	FindServers	○
	FindServersOnNetwork	×
	GetEndpoints	○
	RegisterServer	×
	RegisterServer2	×
SecureChannel	OpenSecureChannel	○
	CloseSecureChannel	○
Session	CreateSession	○
	ActivateSession	○
	CloseSession	○
	Cancel	×
NodeManagement	AddNodes	×
	AddReferences	×
	DeleteNodes	×
	DeleteReferences	×
View	Browse	○
	BrowseNext	○
	TranslateBrowsePathsToNodeIds	○
	RegisterNodes	×
	UnregisterNodes	×
Query	QueryFirst	×
	QueryNext	×
Attribute	Read	○
	HistoryRead	×
	Write	○
	HistoryUpdate	×
Method	Call	○
MonitoredItem	CreateMonitoredItems	○
	ModifyMonitoredItems	○
	SetMonitoringMode	○
	SetTriggering	○
	DeleteMonitoredItems	○
Subscription	CreateSubscription	○
	ModifySubscription	○
	SetPublishingMode	○
	Publish	○
	Republish	○
	TransferSubscriptions	×
	DeleteSubscriptions	○

Address space specifications

The address space of the controller is compatible with the structures defined by the facets of Controller Operation Server Facet in PLCopen and BlockDevice_Server_Facet in OPC UA for devices.

The following table lists details of each facet.

Category	Facet name	Compatible compliance unit
PLCopen	Controller Operation Server Facet	All mandatory compliance units and "Ctrl References" for optional compliance units
OPC UA for devices	DI BaseDevice Server Facet	All mandatory compliance units
	DI BlockDevice Server Facet	All mandatory compliance units

The following table lists "NamespaceURI" used for an address space.

Index	NamespaceURI	Description
0	http://opcfoundation.org/UA/	Namespace of OPC UA
1	urn:Mitsubishi:MXROpcUa	Specific namespace of this function
2	http://opcfoundation.org/UA/DI/	Namespace in OPC UA for Devices
3	http://PLCopen.org/OpcUa/IEC61131-3/	Namespace in PLCopen OPC UA Information Model

■A label that can be published in address spaces

The controller can publish the global labels that satisfy the following conditions in the address space.

- Set "Available" for access from external devices.
- Set a class other than VAR_GLOBAL_CONSTANT.

- Primitive type

The following table lists whether or not each data type is published and the corresponding OPC UA data types for labels that can be set in the engineering tool.

○: Available, ×: Not available

Data type in the engineering tool	Publishable	Data type in OPC UA	Variable data size (byte)	Available device assignment
Bit	○	Boolean	1	• Without bit specification: X, Y, M, L, B, V, F, SB, SM, Jn\X, Jn\Y, Jn\B, Jn\SB • With bit specification: D, W, SW, SD, R, ZR, RD, Un\G, U3En\G, Jn\W, Jn\SW
Word [unsigned]/bit string [16 bits]	○	WORD*1	2	D, W, SW, SD, R, ZR, RD, Un\G, U3En\G, Jn\W, Jn\SW
Double word [unsigned]/bit string [32 bits]	○	DWORD*1	4	
Word [signed]	○	Int16	2	
Double word [signed]	○	Int32	4	
Single-precision real number	○	Float	4	D, W, SW, SD, R, ZR, RD, Un\G, U3En\G, Jn\W, Jn\SW
Double-precision real number	○	Double	8	
Time	×	—	—	—
String	○	STRING*1*2	516*4	D, SW, SD, R, ZR, RD
String [Unicode]	○	String*3	516*4	
Pointer	×	—	—	—
Timer	×	—	—	—
Counter	×	—	—	—
Long counter	×	—	—	—
Retentive timer	×	—	—	—
Long retentive timer	×	—	—	—
Long timer	×	—	—	—

*1 This type is defined in the PLCopen information model, and a node ID exists in index 2 of Namespace. (Example) WORD type: ns = 2, id = 3002

*2 Since MaxStringLength property is provided, if WriteRequest exceeding the specified number of strings is issued from an OPC UA client, BadOutOfRange is returned instead of being reflected in the label.

*3 If WriteRequest exceeding the specified number of strings is issued from an OPC UA client, the excess strings are truncated and the remaining strings are reflected.

*4 Data is converted to 516 bytes regardless of the character string length.

• Structure type

This function can publish the labels of the structure type.

When "Expose structure members as components" is set in the address space setting, the members of structure variables can also be published in the address space as individual component variables. (Default: Enable)

The following table lists the differences depending on whether "Expose structure members as components" is enabled or not.

Item	Expose structure members as components	
	Enable (default)	**Disable**
Data access	The OPC UA client can individually access each member in the structure variables. The client also can access structure variables as a single node.	The OPC UA client can access structure variables as only a single node.
Number of nodes (with upper limit)	Increases.	Decreases.
Address space capacity	Increases.	Decreases.

Point

When the structure type label is published, disabling "Expose structure members as components" can reduce the number of nodes and capacity of the address space in the address space setting.

• Array type

This function can publish arrays of labels for the basic data types (if they are publishable). The maximum number of array elements is 10240 regardless of the data types and the number of dimensions is only one-dimension.

The array is published as a single node. When the values of array variables are accessed using OPC UA service, the OPC UA client can access to array elements in the specified range by specifying the index range.

The array index of the OPC UA server function of the controller always starts from 0.

When an array starting from an index other than 0 that is set in the engineering tool is published to the address space of the OPC UA server function, the index of the element is changed to start from 0.

The following table lists an index setting example of the array element.

Item	Engineering tool	Address space to be published by the OPC UA server function
Array definition	Includes the array start value and the array end value. Example: Array (2..3)	Includes the number of elements. Example: Array (2)
Element index	1: [2] 2: [3]	1: [0] 2: [1]

• FB type

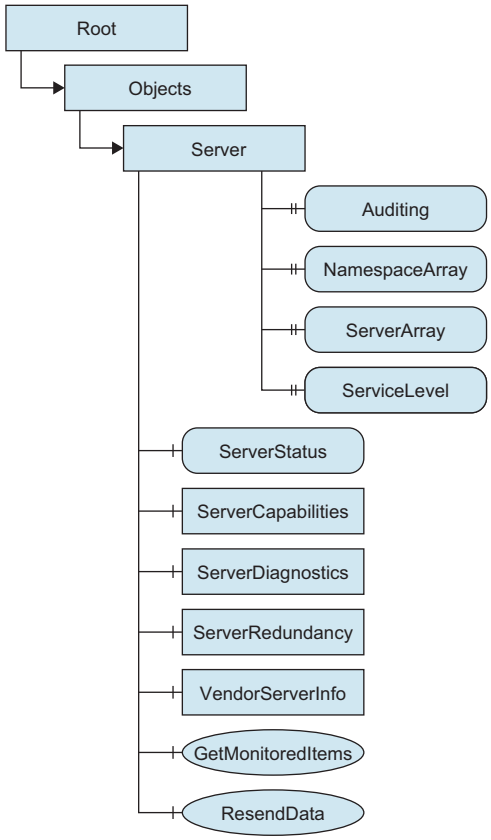
With this function, the FB definitions of the engineering tool are displayed as an ObjectType node in the address space, including the following variables: input variables, output variables, internal variables, and external variables.

The FB instance is displayed as an Object node in the address space.

■Server object node

The OPC UA server function publishes server objects that provide information on the current status, settings, and performance of the server to the address space.

The following shows the server object structure.

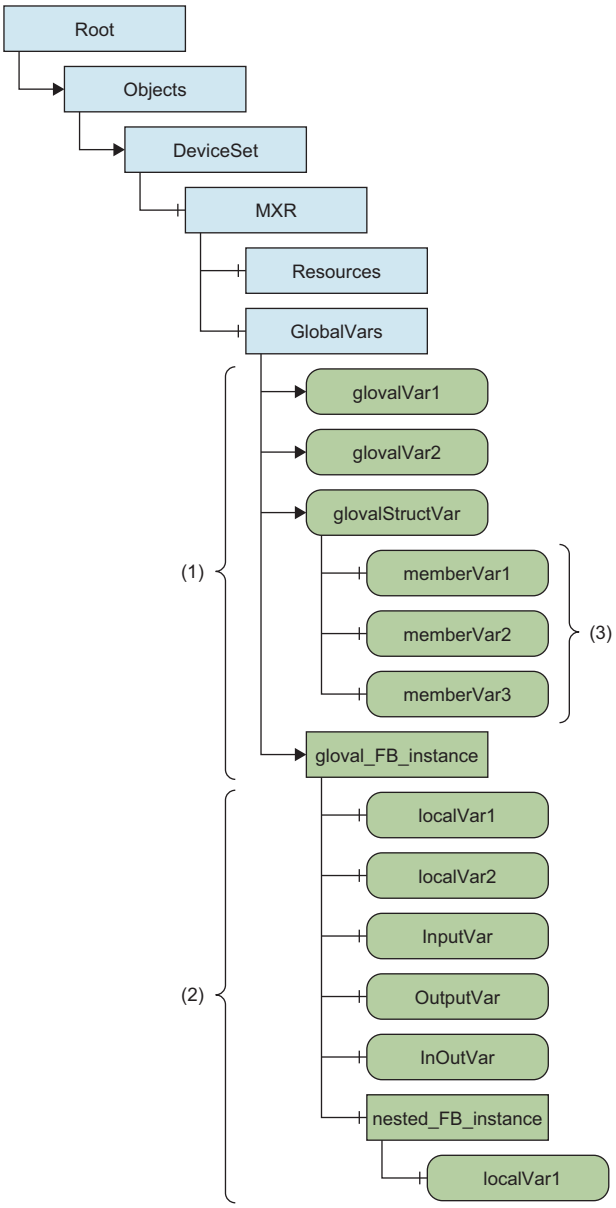


The following table lists the components of the server object.

Component name	Description	Remarks
Auditing	Indicates whether the server is generating an audit event.	Fixed to False. This item does not support an audit event.
NamespaceArray	Indicates the array of NamespaceURI to be used by the server.	For details, refer to the following. ☞ Page 1410 Address space specifications
ServerArray	Indicates the array of the server URI.	Only one entry is used for the local server URI.
ServiceLevel	Indicates the server ability to provide data to OPC UA clients.	Fixed to 255.
ServerStatus	Indicates the information on the server status.	Example: Product name, manufacturer, software version, and other information
ServerCapabilities	Indicates the information on the server performance.	Example: Operation restriction, supported profile, list of software certificates, and other information
ServerDiagnostics	Indicates the diagnostic information of the server.	—
ServerRedundancy	Indicates the redundant performance provided by the server.	The controller does not support redundancy. Fixed to "none" for the value of RedundancySupport property.
VendorServerInfo	Indicates the vendor-specific information of the server.	Blank
GetMonitoredItems	Indicates a method that acquires information related to the monitor item registered in Subscription.	—
ResendData	Indicates a method that acquires the latest value of the monitor item registered in Subscription.	—

■User node

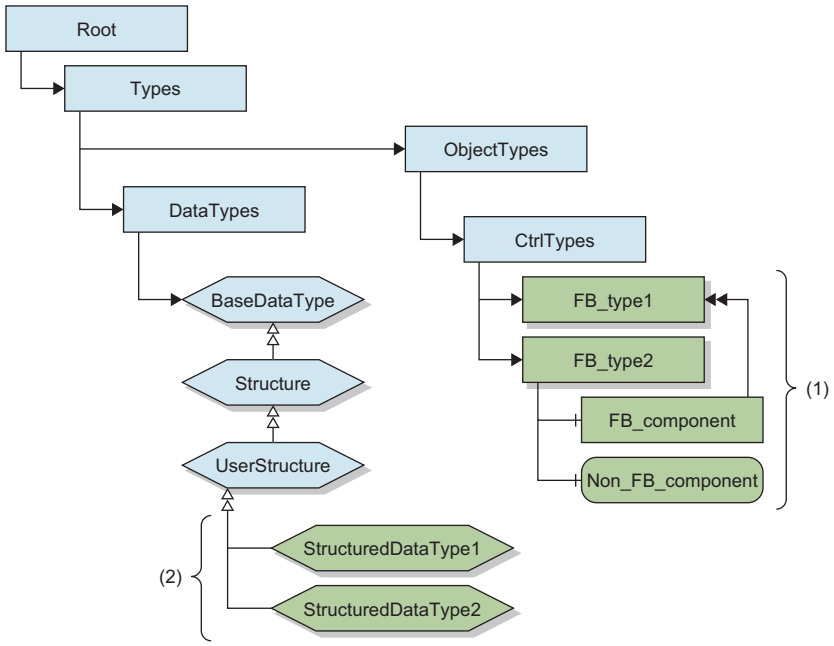
The following shows a part of the address space in which an instance of the user-defined project element exists.
The structure shown below is defined by the PLCopen information model and follows a structure of the controller resource.



The following table lists the corresponding project elements in an engineering tool to the user-defined node.

No.	Element	Corresponding project element in an engineering tool	Remarks
(1)	Control variable (global)	Global label	Multiple groups of the global labels cannot be held. All global variables are stored in a single "GlobalVars" object.
(2)	Control variable (local)	FB local label	—
(3)	Member of structure type control variable	Structure label member	When "Expose structure members as components" is enabled, this element is published in an address space.

The following shows a part of the address space in which the user-defined data types and FB definitions exist.



The following table lists the corresponding project elements in an engineering tool to the user-defined node.

No.	Element	Corresponding project element in an engineering tool	Remarks
(1)	Child component of CtrlTypes	FB definition	—
(2)	Sub type of UserStructure	Structure definition	—

Procedure of OPC UA server startup

Configure OPC UA server settings in the module parameter (Ethernet). This section describes the connection procedures to the OPC UA server.

Operating procedure

1. IP address setting

Configure the IP address setting of P3 (for Ethernet port). (☞ Page 190 IP Address Setting)

2. OPC UA server setting

Configure the settings related to the OPC UA server. (☞ Page 1416 OPC UA Server Settings)

3. Address space setting

Set labels to be published in an address space. (☞ Page 1418 Address Space Setting)

4. Controller settings

Write module parameters to the controller.

Write the module parameters. Then reset and clear the reset on the controller or power off and on the system.

5. Checking a connection

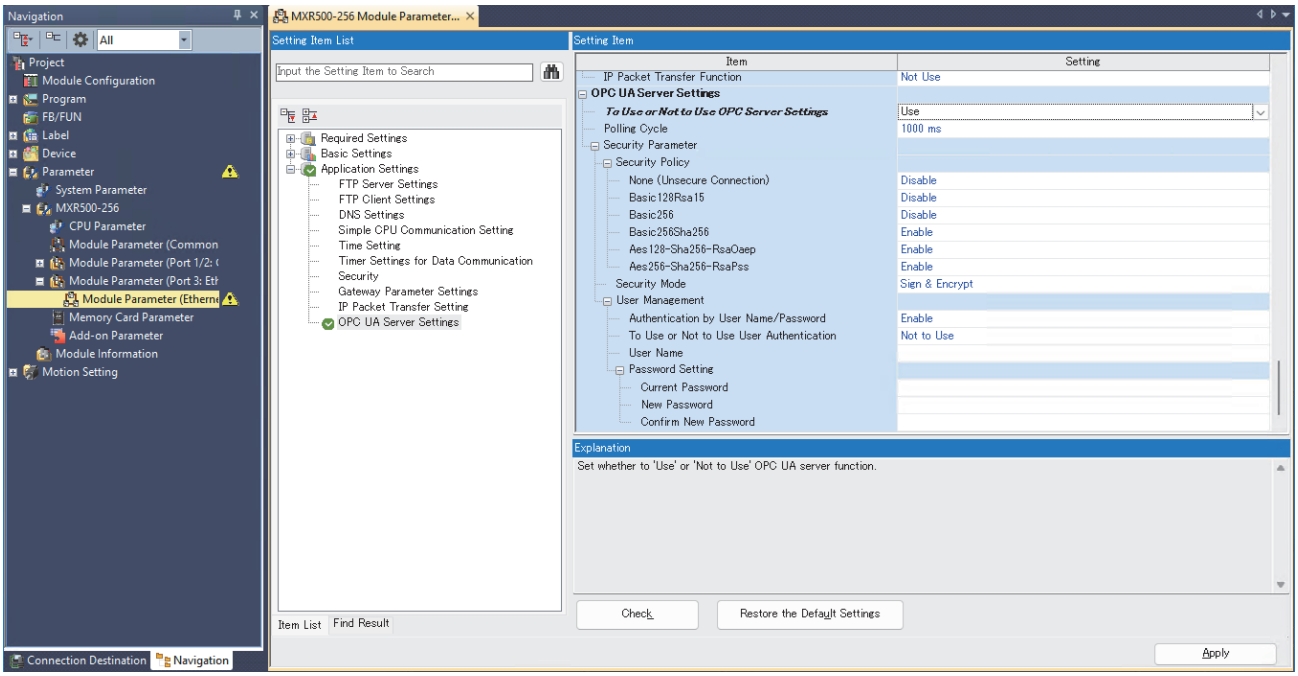
Check whether the OPC UA client can access to the OPC UA server.

For the operation method of the OPC UA client, refer to the manual for the OPC UA client to be used.

OPC UA Server Settings

Set "To Use or Not to Use OPC Server Settings" to "Use". (Default: Not Use)

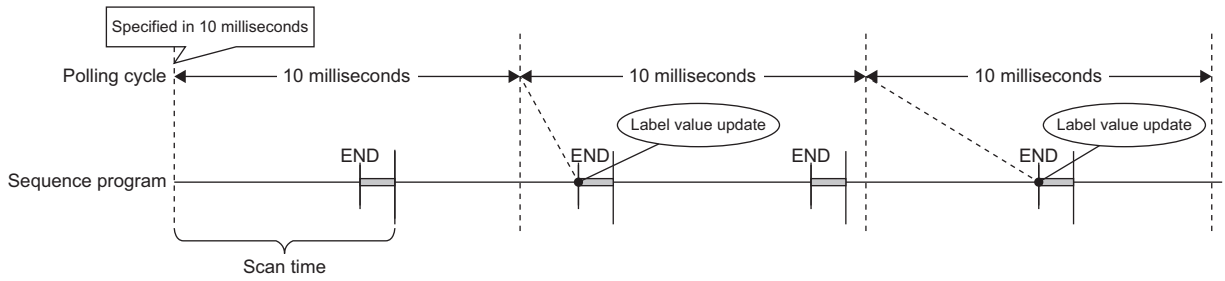
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [OPC UA Server Settings]



■Polling Cycle

Set a value for "Polling Cycle" in increments of 10ms. (Default value "1000ms", setting range "10 to 10000ms")

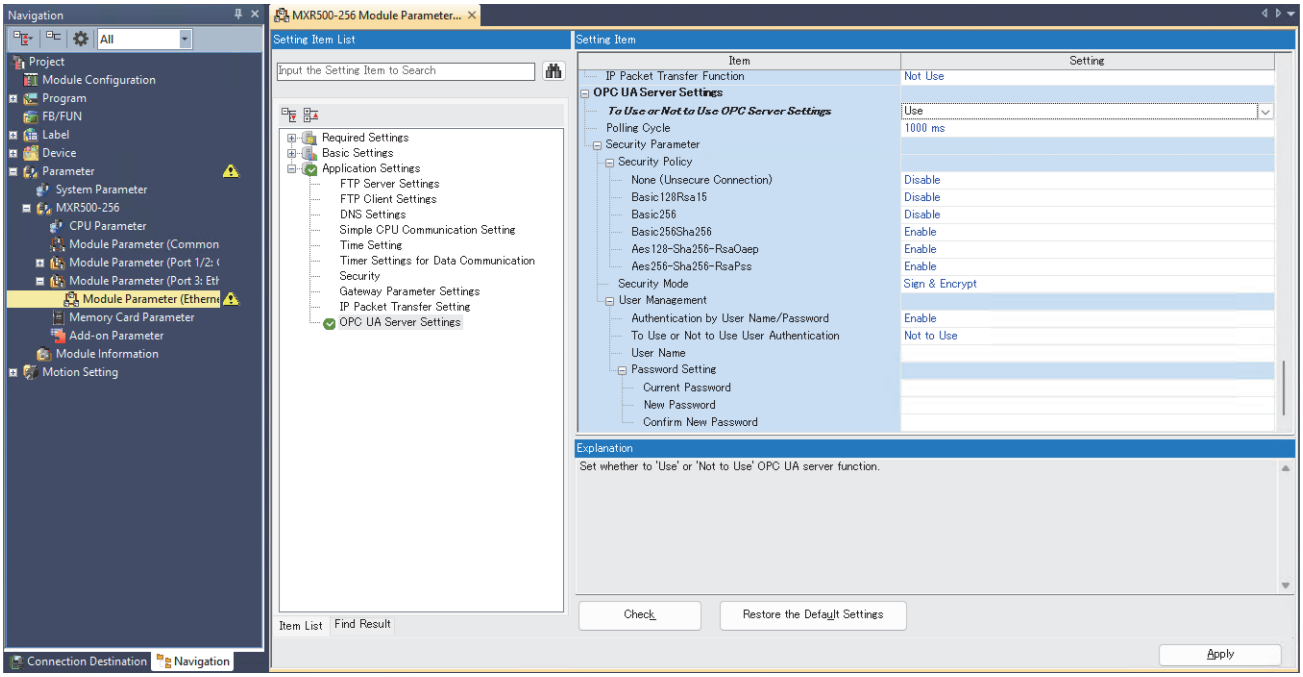
In "Polling Cycle", the values of the labels registered in the address space are updated at END after the specified time has elapsed. Therefore, set the scan time to be less than the polling cycle. When the scan time is longer than the polling cycle time, the label value is updated only once at END even if the polling cycle occurs multiple times in the same scan.



■Security Parameter

Set the security parameters.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [OPC UA Server Settings] ⇨ [Security Parameter]



Item		Description	Setting range	Default value
Security Policy	None (Unsecure Connection)*1	Set "Enable" or "Disable" for the connection whose "Security Policy" is "None (Unsecure Connection)".	• Enable • Disable	Disable
	Basic128Rsa15	Set "Enable" or "Disable" for the connection whose "Security Policy" is "Basic128Rsa15".	• Enable • Disable	Disable
	Basic256	Set "Enable" or "Disable" for the connection whose "Security Policy" is "Basic256".	• Enable • Disable	Disable
	Basic256Sha256	Set "Enable" or "Disable" for the connection whose "Security Policy" is "Basic256Sha256".	• Enable • Disable	Enable
	Aes128-Sha256-RsaOaep	Set "Enable" or "Disable" for the connection whose "Security Policy" is "Aes128-Sha256-RsaOaep".	• Enable • Disable	Enable
	Aes256-Sha256-RsaPss	Set "Enable" or "Disable" for the connection whose "Security Policy" is "Aes256-Sha256-RsaPss".	• Enable • Disable	Enable
Security Mode		Set "None", "Sign", or "Sign & Encrypt" for "Security Mode".	• None • Sign • Sign & Encrypt	Sign & Encrypt
User Management	Authentication by User Name/ Password*2	Set "Enable" or "Disable" for "Authentication by User Name/Password". If this item is set to "Disable", "To Use or Not to Use User Authentication", "User Name", and the items in "Password Setting" cannot be entered.	• Enable • Disable	Enable
	To Use or Not to Use User Authentication	Set whether the user authentication is used for the OPC UA server function or not. If this item is set to "Use", "User Name" and the items in "Password Setting" cannot be entered.	• Not to Use • Use	Not to Use
	User Name	Set the user name for logging in to the OPC UA server.	Single-byte alphanumeric characters 1 to 32 characters	None*3
	Password Setting	Set the password for logging in to the OPC UA server.	Single-byte alphanumeric characters, symbols 6 to 32 characters	None*3

*1 When "To Use or Not to Use User Authentication" is set to "Use", the connection cannot be established by specifying "None" in "Security Policy".

*2 Even if "Authentication by User Name/Password" is enabled, when the security policy is set to None in the OPC UA client, only Anonymous can be connected.

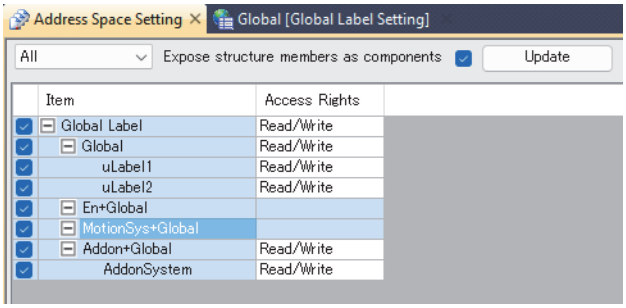
*3 Clicking the [Check] or [Apply] button without setting the user name and password will display an error dialog in the engineering tool.

Point

To set the password for the first time, set "Current Password" to blank.

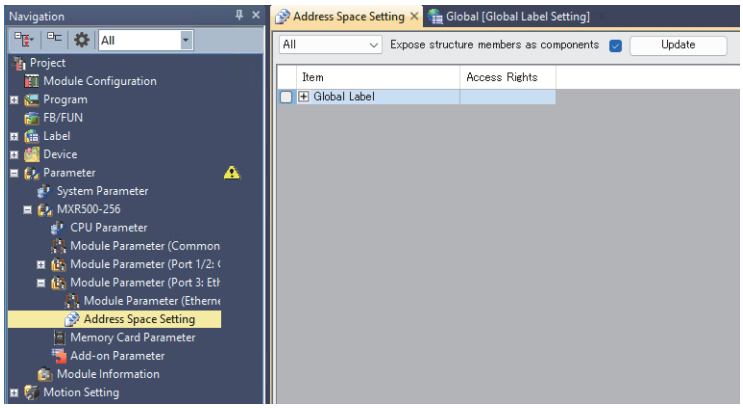
Address Space Setting

Set labels to be published in an address space.

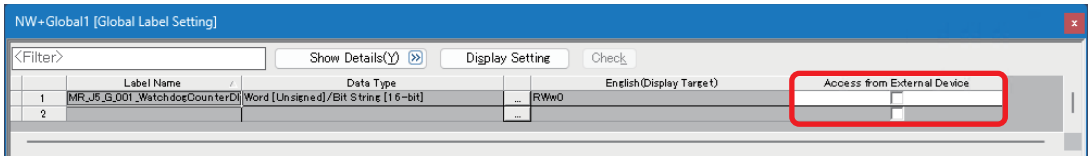


Point

- Set "To Use or Not to Use OPC Server Settings" to "Use" and click the "Apply" button to display "Address Space Setting" in the navigation tree.



- Labels that are selected in "Access from External Device" in the global label editor are targeted in the address space setting.

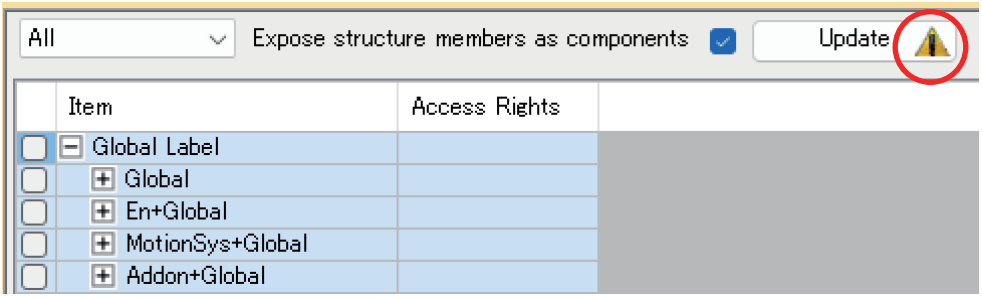


- Aliases that refer to FB type labels and structure labels (including structure members) are not displayed in the address space.

Item	Description	Setting range	Default value
Drop-down list	Select the label to be displayed in the list.	• All • Checked • Unchecked	All
Expose structure members as components	Select this item when structure members are published as components in the address space. When this item is selected, the OPC UA client can access each member of the structures. When this item is deselected, the client can access as only a single node to the structure. (The client cannot access to the individual members.) Structure members are not displayed in this window regardless of whether the checkbox is selected or not.	• Unchecked • Checked	Checked
Update	Reads the information on the global label whose "Access from External Device" checkbox is selected in the label editor of the engineering tool and displays the latest information.	—	—
Item	Displays the names of the global labels and their parent objects that have been enabled for access by external devices in the project of the engineering tool.	• Item name • Label name	—
Checkbox	Select labels to be published in the address space.	• Unchecked • Partially checked • All checked	Unchecked
Access Rights	Set the access rights to label values. When "Read" is set, only reading can be performed. When "Read/Write" is set, reading and writing can be performed.	• Read/Write • Read	Read/Write

■When synchronization of the address space setting is required

When any of the following conditions is satisfied, an icon indicating that the address space setting needs to be synchronized is displayed on the [Update] button.

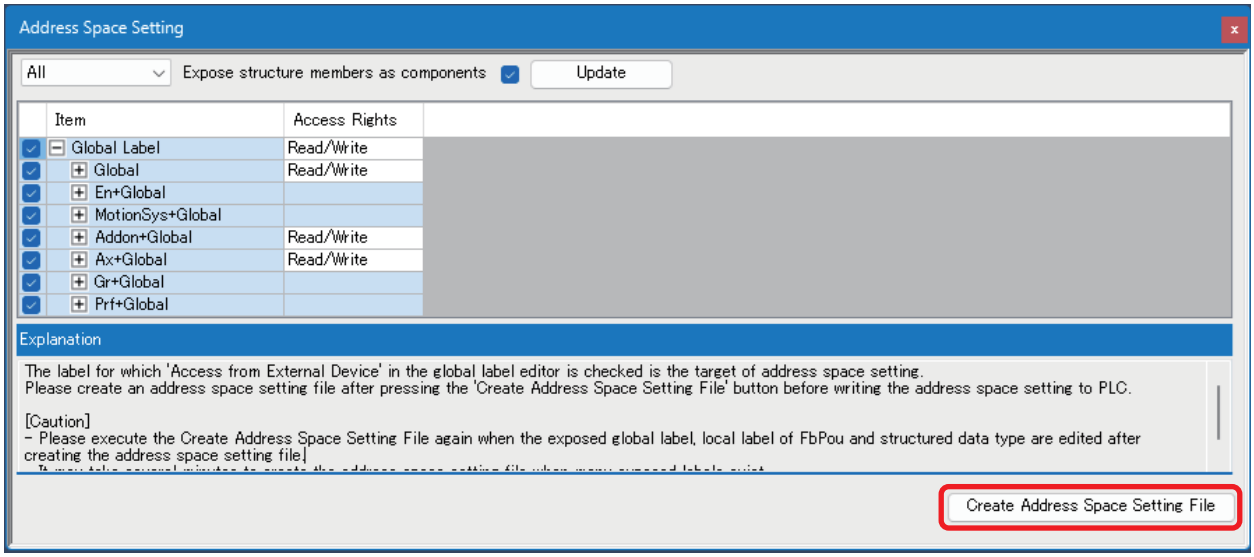


Click the [Update] button to reflect the latest global label settings to the address space setting.

- A global label, a local label of the function block, or a structure member was edited.
- A global label was newly created or deleted, or the name was changed.
- A function block was newly created or deleted, the name was changed, or the property details were changed.
- A structure was deleted or the name was changed.

■Creating an address space settings file

Click the [Create Address Space Setting File] button to create an address space setting file before writing the address space settings to the programmable controller.



OPC UA server startup/stop

The following shows how to startup/stop the OPC UA server.

When the OPC UA server stop is requested, the controller closes the sessions of all OPC UA clients first before transitioning to the stop state.

Since the socket assigned to the port of the OPC UA server is closed during stop state, all new connections are rejected.

How to startup/stop the OPC UA server	Operation type	Reference
Startup with power-on	Startup	☞ Page 1421 Startup with power-on
Startup/stop by using the engineering tool	Startup/stop	☞ Page 1421 Startup/stop by using the engineering tool
Startup/stop by using the buffer memory	Startup/stop	☞ Page 1422 Startup/stop by using the buffer memory

Startup with power-on

If the settings of the OPC UA server have been configured, the OPC UA server automatically starts when the controller is powered on. If an error is detected at startup, an error related to self-diagnosis is detected.

Startup/stop by using the engineering tool

Startup/stop the OPC UA server by using the engineering tool. For details, refer to the following.

☞ Page 1712 OPC UA server diagnostics

Startup/stop by using the buffer memory

■When the OPC UA server start is requested

The following shows the operation of the buffer memory when the OPC UA server start is requested.

When 'OPC UA server start request' (U3E0\G11403.0) is on, the OPC UA server start is requested.

When the OPC UA server start request is completed*1, 'OPC UA server start request' (U3E0\G11403.0) turns off.

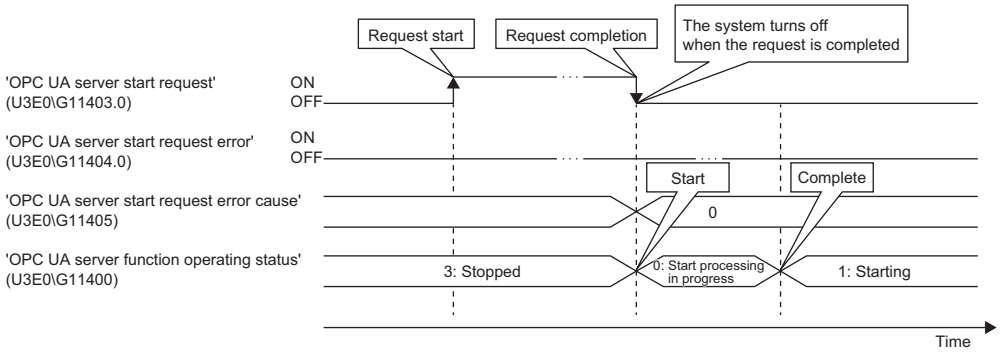
If the OPC UA server fails to start, 'OPC UA server start error' (U3E0\G11404.0) turns on and the error cause will be stored in 'OPC UA server start error cause' (U3E0\G11405).

*1 The start request will be completed even if the OPC UA server fails to start.

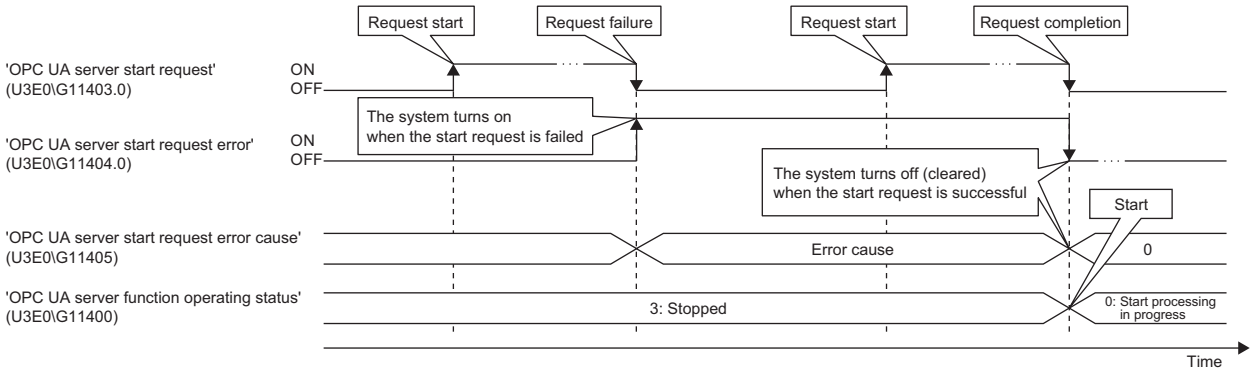
For details on the stored value of 'OPC UA server start error cause' (U3E0\G11405), refer to the following.

☞ Page 1850 Error Codes Returned to Request Source During Communications (4000H to 4FFFH)

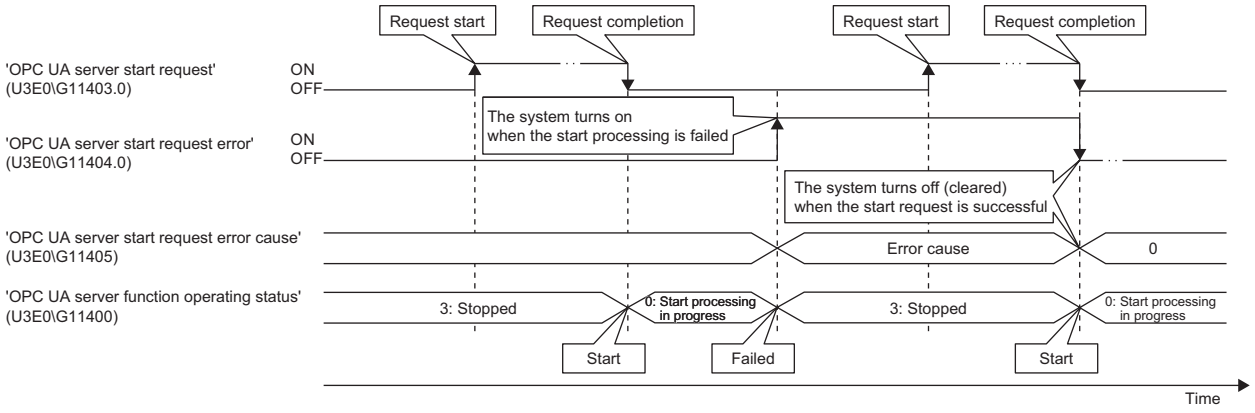
• Success



• Start request failure → Success



• Start processing failure → Success



■When the OPC UA server sop is requested

The following shows the operation of the buffer memory when the OPC UA server stop is requested.

When 'OPC UA server stop request' (U3E0\G11406.0) is on, the OPC UA server stop is requested.

When the OPC UA server stop request is completed*1, 'OPC UA server stop request' (U3E0\G11406.0) turns off.

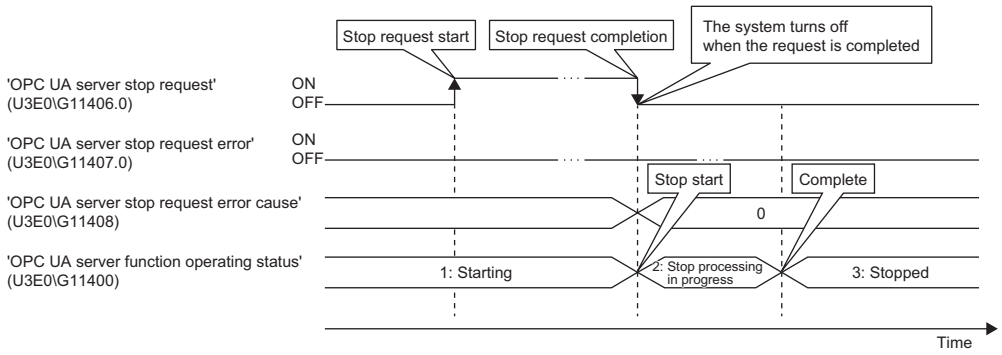
If the OPC UA server fails to stop, 'OPC UA server stop error' (U3E0\G11407.0) turns on and the error cause will be stored in 'OPC UA server stop error cause' (U3E0\G11408).

*1 The stop request will be completed even if the OPC UA server fails to stop.

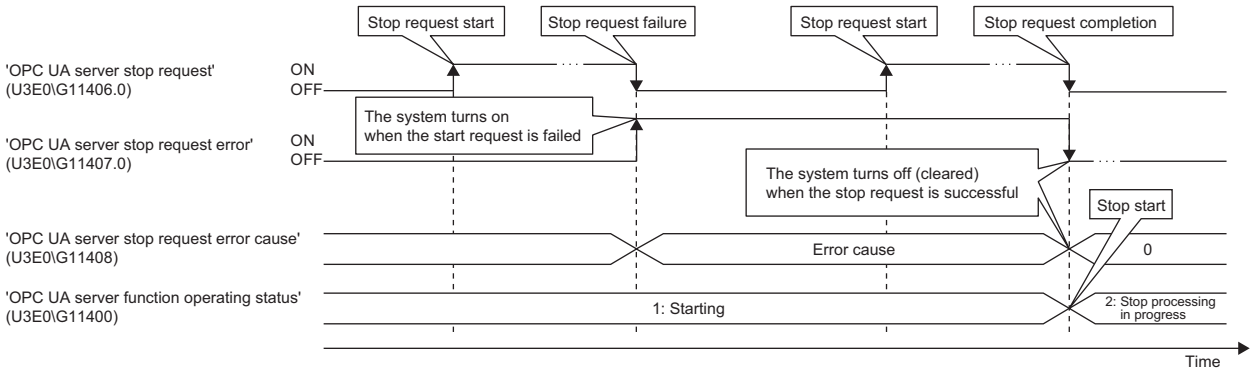
For details on the stored value of 'OPC UA server stop error cause' (U3E0\G11408), refer to the following.

☞ Page 1850 Error Codes Returned to Request Source During Communications (4000H to 4FFFH)

• Success



• Failure → Success



Point

The operating status of this function can be checked as follows:

• 'OPC UA server function operating status of the buffer memory area' (U3E0\G11400)

• OPC UA server diagnostics status

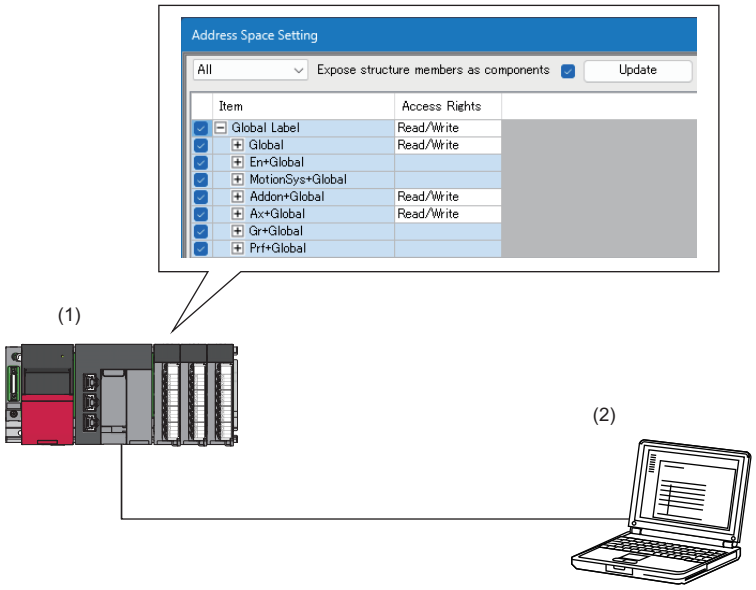
OPC UA server function list

The following shows the OPC UA server function list of the controller.

Item	Description	Reference
Data Access function	A function that allows the OPC UA client to access labels registered in the address space.	Page 1424 Data Access function
Security function	A function that sets security for a connection between the OPC UA server and an OPC UA client.	Page 1426 Security function
User authentication function	A function that sets user authentication for a connection between the OPC UA server and an OPC UA client.	Page 1426 User authentication function

Data Access function

The Data Access function is a function that allows the OPC UA client to access labels configured by the engineering tool.
The values of the label registered in the address space is updated based on the set polling cycle.
The functions related to Data Access are compliant with "Standard DataChange Subscription 2017 Server Facet" of the OPC UA specification.



(1) Controller (OPC UA server)
(2) OPC UA client

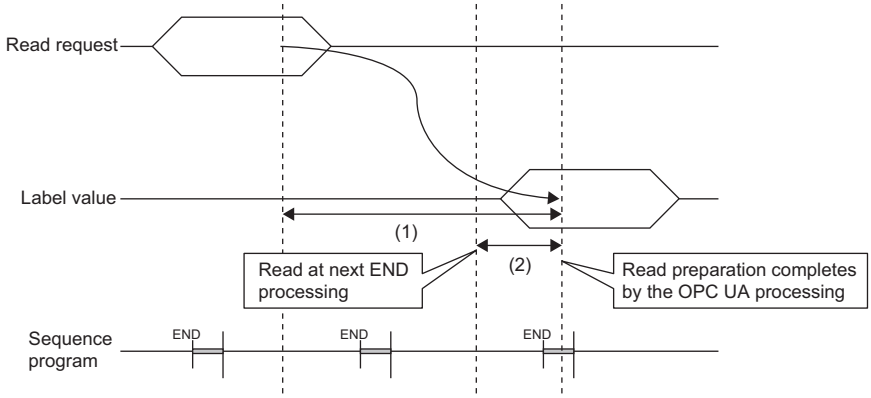
■Data type

For labels to be registered in the address space, set the access target labels and data types. For accessible labels and usable data types, refer to the following.

☞ Page 1410 Address space specifications

■Data read timing by the request from the OPC UA client (Read)

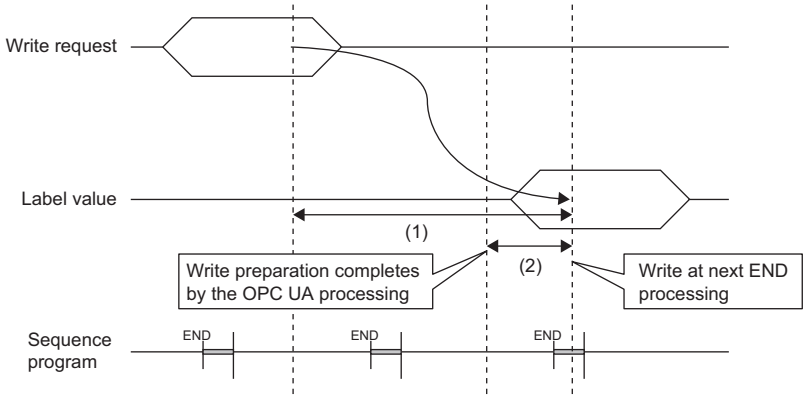
When an OPC UA client issues a label value read request in the address space, the label value is read at the following timing: the communication time and the OPC UA processing time have been delayed from the request timing of the OPC UA client.



(1) Communication time + OPC UA processing
(2) END processing waiting time

■Data write timing by the request from the OPC UA client (Write)

When an OPC UA client issues a label value write request in the address space, the label value is written at the following timing: the communication time and the OPC UA processing time have been delayed from the request timing of the OPC UA client.



(1) Communication time + OPC UA processing
(2) END processing waiting time

Security function

The security function is a function that sets security for a connection between the OPC UA server and an OPC UA client.

■Security Policy

The following shows the supported security policies.

- None (Unsecure Connection)
- Basic128Rsa15
- Basic256
- Basic256Sha256
- Aes128-Sha256-RsaOaep
- Aes256-Sha256-RsaPss

Each security policy can be enabled or disabled in any combination. When all security policies are disabled, an error dialog is displayed in the engineering tool.

■Security Mode

The following table lists the supported security modes and each behavior.

Security mode	Behavior
None	None, Sign, and Sign & Encrypt are enabled.
Sign	Sign, and Sign & Encrypt are enabled.
Sign & Encrypt	Sign & Encrypt is enabled.

All security modes that are stronger than the set security modes are enabled.

The order of strength is as follows.

None < Sign < Sign & Encrypt

User authentication function

The user authentication function is a function that sets user authentication for a connection between the OPC UA server and an OPC UA client.

■Authentication by user name/password

There are two login methods: Login with the user name and password specified in the OPC UA server settings and login with the user information (user name and password) of the controller.

If the user authentication function of the controller is enabled, login with the user information of the controller is required. For details, refer to the following.

☞ Page 1417 Security Parameter

■Authentication using a certificate

When the OPC UA server is accessed from an OPC UA client, authentication using a certificate is performed.

Item	Description
Server certificate	The server certificate is managed in the window shared with the encrypted communication function.
Client certificate	The client certificate is managed in the window shared with the encrypted communication function. Only DER format certificates are handled in OPC UA communications.

For details, refer to the following.

☞ Page 1558 Encrypted Communication Function

Precautions

The following shows the precautions for the OPC UA server function.

Structures

■A subscription for a structure type label when a structure member is published as a component.

When a node with a structure type label is registered in the subscription, the read/write values from/to a node in the structure member may differ from the result read from the subscription.

■Reading of structure type nodes and array type nodes

If the number of members in the structured type node or the number of elements in the array type node is large, the label values may be read or written in segments over multiple scans. Therefore, data inconsistency may occur between the structured type label members and the array type label elements.

Operation when the number of read/write nodes per request is large

If the number of read/write nodes per request is large, the label values may be read or written in segments over multiple scans. Therefore, data inconsistency may occur.

Combination with other functions

■Writing data to the programmable controller and online change

The server must be stopped when the module parameter or address space setting is written to the programmable controller or the online change is executed.

When editing a label published in the address space setting and writing the global label assignment information, write the address space setting file at the same time. If only the global label assignment information is written, the server start or the read/write requested from the OPC UA client may fail.

If a node is read from or written to the OPC UA client while the global label assignment information file is being written to the programmable controller or the online change is being executed, BadCommunicationError will be returned to the OPC UA client.

Point

If BadCommunicationError is received when a node is read from or written to the OPC UA client, writing to the programmable controller or the online change may be executed. Retry the operation after a while.

The following table lists the operation when only the global label assignment information is written.

Label change type	Conditions			Label change example	Operation at startup following data writing during server stop	Response to the read/write request to the corresponding node after writing data during server operation[*1]
Add	Label name			Blank → Label	Normal startup	No combination[*2]
Change[*3]	Label name			Label → Label1	Startup failure (1913H/4A37H error)	BadCommunicationError
	Data type	Primitive data type		Bit → Word [unsigned]	Startup failure (1913H/4A37H error)	BadCommunicationError
		Structures	Structure	Str1 → Str2	Startup failure (1913H/4A37H error)[*4]	BadCommunicationError[*4]
			Member	Data type of Label2 in Label1.Label2: Bit → Word [unsigned]	Startup failure (1913H/4A37H error)	BadCommunicationError
		FB	FB	FbPou1 → FbPou2	Startup failure (1913H/4A37H error)[*5]	BadCommunicationError[*5]
			Local label	Data type of Label2 in Label1.Label2: Bit → Word [unsigned]	Startup failure (1913H/4A37H error)	BadCommunicationError
		Array	Element	Label [2] → Label [3] Label [0..1] → Label [1..2]	Startup failure (1913H/4A37H error)	BadCommunicationError
			Dimension	Label → Label [1]	Startup failure (1913H/4A37H error)	BadCommunicationError
	Class	GLOBAL ⇔ RETAIN		VAR_GLOBAL → VAR_GLOBAL_RETAIN	Normal startup	Normal response
		GLOBAL/RETAIN⇨CONSTANT		VAR_GLOBAL → VAR_GLOBAL_CONSTANT	Startup failure (1913H/4A37H error)	BadCommunicationError
		CONSTANT⇨GLOBAL/RETAIN		VAR_GLOBAL_CONSTANT → VAR_GLOBAL	No combination[*6]	No combination[*2]
	Assignment device		Add	Blank → D0	Normal startup[*7]	Normal response[*7]
			Change	D0 → D1	Normal startup[*7]	Normal response[*7]
			Delete	D0 → Blank	Normal startup	Normal response
	Initial value[*8]		Add	Blank → 1	Normal startup	Normal response
			Change	1 → 2	Normal startup	Normal response
			Delete	1 → Blank	Normal startup	Normal response
	Access from external devices			Possible → Not possible	Startup failure (1913H/4A37H error)	BadCommunicationError
				Not possible → Possible	No combination[*6]	No combination[*2]
Delete[*3]	Label name			Label → Blank	Startup failure (1913H/4A37H error)	BadCommunicationError

*1 If any of the nodes causes the BadCommunicationError status, the OPC UA server function error (label communication file error) (error code 1913H) occurs.

*2 There is no combination because labels do not exist in the address space and they are not requested by OPC UA clients.

*3 The type is used when the label published in the address space setting is changed or deleted. (Except for the types with no combination)

*4 If the member names and data types of structure members do not change, the structure can be started at the next server startup when the server is stopped. In addition, reading/writing is available for the structure members whose member names and data types do not change while the server is operating.
Note that the data type name before the change is still displayed in the address space even after the data type of the structure itself is changed. To match the data type name with the definition of the global label setting, write the address space setting file to the controller after clicking the [Update] button in the address space settings.

*5 If the label names and data types of the FB local labels do not change, the FB can be started at the next server startup when the server is stopped. In addition, reading/writing is available for the local labels whose label names and data types do not change while the server is operating.
Note that the data type name before the change is still displayed in the address space even after the data type of FB itself is changed. To match the data type name with the definition of the global label setting, write the address space setting file to the controller after clicking the [Update] button in the address space settings.

*6 Since labels do not exist in the address space, the functions normally starts with the same state before the change.

*7 If the new device is an unsupported device, a start failure or BadCommunicationError occurs.

*8 If a node is read from or written to the OPC UA client while writing to the programmable controller or the online change is being executed, BadCommunicationError will not be returned to the OPC UA client.

Operations of other functions that request the OPC UA server stop

If the following operations are requested while the OPC UA server is operating, the engineering tool will display a dialog to select whether to stop the OPC UA server or the operation.

- Writing to the programmable controller and the online change for the module parameter or address space setting
- Deleting data in the programmable controller for the module parameter or address space setting

Operating other functions that are unavailable during OPC UA server startup

If the following functions are executed during the OPC UA server startup processing, the executed functions result in Security function error (OPCUA server function) (error code 4471H) or File related error (error code 41DBH).

- Writing the program memory to the programmable controller and online change
- Deleting the program memory in the programmable controller
- Memory initialization for the program memory
- All information initialization of controller
- Writing user and user group management information
- Changing user passwords

All information initialization during OPC UA server startup

If all information are initialized during the OPC UA server startup, the OPC UA server is forcibly stopped.

Port number to be used for the OPC UA server

The port number to be used for the OPC UA server is 4840. To use this function, do not set this port number for the external device connection configuration setting.

For details, refer to the following.

☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting)

Connection using "None" in the security policy

When the security policy is set to "None" in the connection setting of the OPC UA client, only Anonymous can be connected.

Combination with the user authentication function

If the user management information is changed during the OPC UA server startup, restart the OPC UA server. Otherwise, login to the OPC UA server cannot be executed until the server is restarted.

Display of a warning message of the user authentication function

Even if "To Use or Not to Use User Authentication" is set to "Use" and the server is started with a warning message configured in the notification message setting in the user authentication function, a warning message is not displayed when the user name is entered in the OPC UA client.

Session timeout

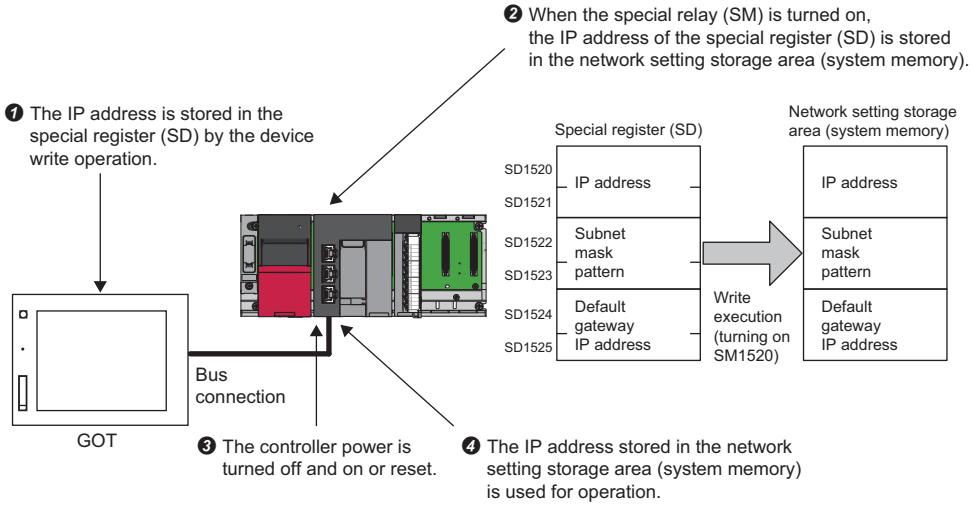
If "To Use or Not to Use User Authentication" is set to "Use", "Logoff Judgment Time Setting" of the user authentication function is not applied to this function. Therefore, the session ends after the session timeout time set for each session has elapsed.

56 OTHERS

56.1 Network Setting Change Function

The network settings (such as IP address) of the controller are changed without changing the parameter settings.

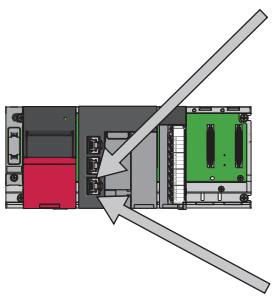
This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)



IP address of the controller

The value set with the module parameters during initial processing is set as the IP address of the controller. When this function is used, the IP address set during initial processing is the value stored in the network setting storage area instead of the value set in the parameters.

Ex.



[When parameters are used]

Controller

IP address	192.168.3.39
Subnet mask pattern	255.255.255.0
Default gateway IP address	192.168.3.254

The IP address of the parameter file is set.

Parameter file
Module parameter

IP address	192.168.3.39
Subnet mask pattern	255.255.255.0
Default gateway IP address	192.168.3.254

[When the network setting change function is used]

Controller

IP address	192.168.3.40
Subnet mask pattern	255.255.255.0
Default gateway IP address	192.168.3.254

The IP address of the network setting storage area (system memory) is set.

Parameter file
Module parameter

IP address	192.168.3.39
Subnet mask pattern	255.255.255.0
Default gateway IP address	192.168.3.254

Network setting storage area (system memory)

IP address	192.168.3.40
Subnet mask pattern	255.255.255.0
Default gateway IP address	192.168.3.254

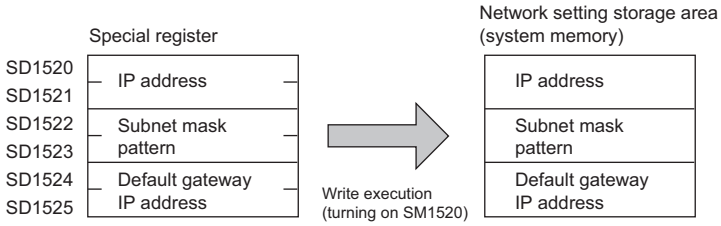
Point

If the setting value is not written in the network setting storage area, the operation use the following default values.

- IP address: 192.168.3.39
- Subnet mask setting: 255.255.255.0
- Default gateway: 0.0.0.0

Writing and clearing the IP address

The IP address value is written into the network setting storage area (system memory). The write and clear operations are performed with the special relay and special register.

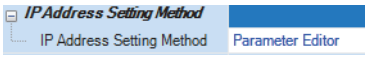


How to use

To use the network setting change function, set "IP Address Setting Method" to "Set in Network Setting Change Function".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Required Settings] ⇨ [IP Address Setting]

IP Address Setting Method



Item	Description	Setting range
IP Address Setting Method	Select the method for setting the IP address of own station.	• Parameter Editor • Set in Network Setting Change Function (Default: Parameter Editor)

Write operation

Follow the steps below.

1. Store the values to be written in SD1516 and SD1520 to SD1525.

Device	Description	Value
SD1516	Special register for specifying the target port of the network setting change function	2H
SD1520	Special register for storing the IP address (lower) to be written to the network setting storage area	IP address (lower)
SD1521	Special register for storing the IP address (upper) to be written to the network setting storage area	IP address (upper)
SD1522	Special register for storing subnet mask (lower) to be written to the network setting storage area	Subnet mask (lower)
SD1523	Special register for storing subnet mask (upper) to be written to the network setting storage area	Subnet mask (upper)
SD1524	Special register for the default gateway (lower) storage to be written to the network setting storage area	Default gateway (lower)
SD1525	Special register for the default gateway (upper) storage to be written to the network setting storage area	Default gateway (upper)

2. Turn on 'Network setting write request' (SM1520).

3. Check the write results with the following special relay and special register.

Device	At normal completion	At abnormal completion
'Network setting write request' (SM1520)	Off	Off
'Network setting write error' (SM1521)	Off	On
'Network setting write error cause' (SD1526)	—	Stores the cause of the error

4. Power off and on or reset the controller.

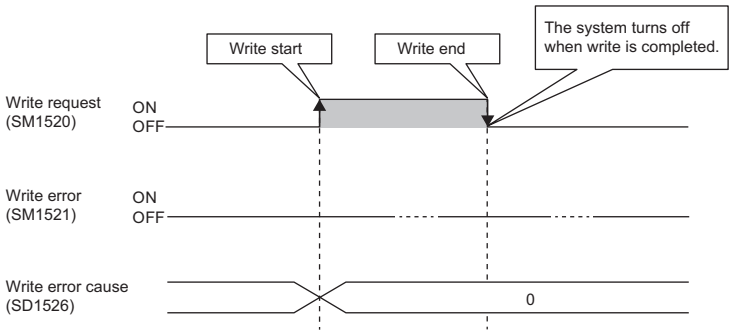
5. If the IP address stored in the network setting storage area (system memory) is a valid value, the stored IP address is set as the IP address of the controller. (If the value is invalid or not set, the default value will be set as the IP address of the controller.)

6. Check the IP address with the buffer memory. (☞ Page 2041 Own node IP address)

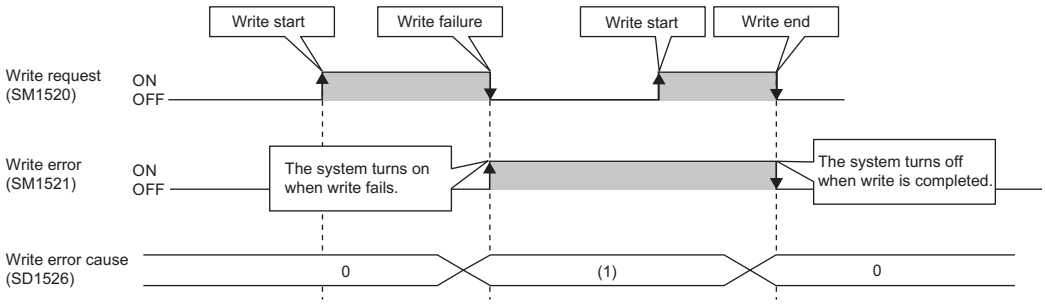
■Operation of the special relay and special register

This section shows the operation of the special relay and special register when writing to the network setting storage area.

- Operation at normal completion



- Operation at abnormal completion



(1) Error cause: The system stores a value until write failure and the system clears the value until write completion.

■Cause of error at abnormal completion

- If writing to the network setting storage area (system memory) of the controller is not completed normally, the cause of the error is stored in 'Network setting write error cause' (SD1526).

Stored value	Cause of error
100H	The value for the IP address setting exceeds the setting range.
101H	The default gateway value is out of the setting range.
102H	The network address value of the default gateway or gateway IP address is different from the network address of the own node IP address.
106H	The IP address written in the network setting storage area is the same with that of the other port.
200H	An error occurred during write.
300H	Write processing cannot be performed because the controller backup/restoration function is being executed.
400H	Writing was started during the clear processing.
500H	The value of 'Target port setting' (SD1516) is out of the setting range during write processing.
600H	"Set in Network Setting Change Function" is not selected for the IP address setting method of the module parameter.

Clearing operation

When the clearing operation is executed, the operation uses the default values of the network settings.

■Execution procedure

1. Specify the port to be cleared using 'Target port setting' (SD1516).

Device	Description	Value
SD1516	Special register for specifying the target port of the network setting change function	2H

2. Turn on 'Network setting clear request' (SM1522).

3. Check the write results with the following special relay and special register.

Device	At normal completion	At abnormal completion
'Network setting clear request' (SM1522)	Off	Off
'Network setting clear error' (SM1523)	Off	On
'Network setting clear error cause' (SD1527)	—	Stores the cause of the error

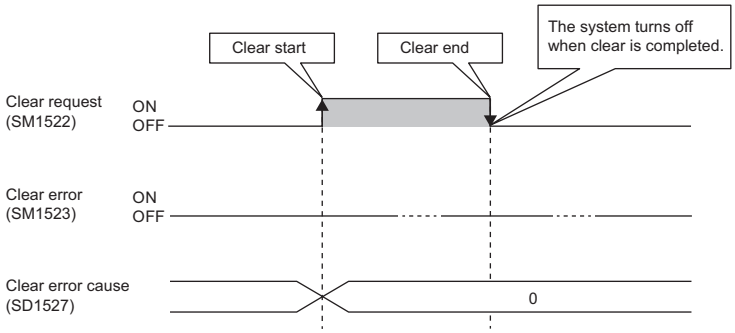
4. Power off and on or reset the controller.

5. Check the IP address with the buffer memory. (☞ Page 2041 Own node IP address)

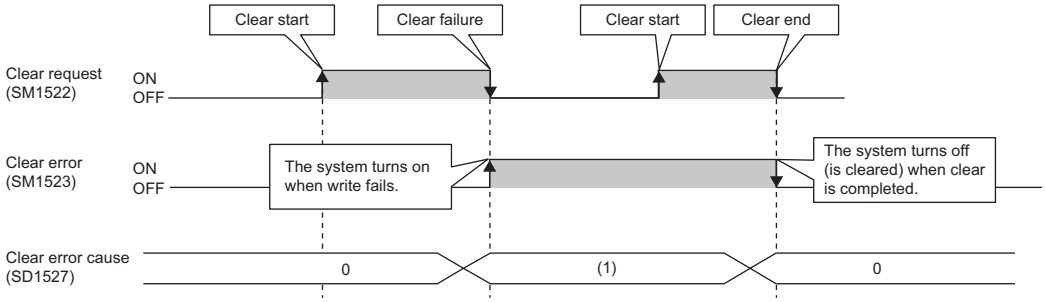
■Operation of the special relay and special register

The operation of special relay and special register when clearing the IP address storage area is shown below.

• Operation at normal completion



• Operation at abnormal completion



(1) Error cause: The system stores a value until clear failure and the system clears the value until clear completion.

■Cause of error at abnormal completion

If the network setting storage area is not cleared correctly, the cause of the error is stored as follows:

Storage location	Stored value	Cause of error
'Network setting clear error cause' (SD1527)	200H	Error occurred during clearing.
	300H	Clear processing cannot be executed because the controller data backup/restoration function is being executed.
	400H	Clear processing cannot be executed because write processing is being executed.
	500H	The value of 'Target port setting' (SD1516) is out of the setting range during clear processing.
	600H	"Set in Network Setting Change Function" is not selected for the IP address setting method of the module parameter.

Checking the IP address

Checking with the buffer memory

Check with the following buffer memory areas.

Item	Buffer memory
Own node IP address	U3E0\G50 to U3E0\G51
Subnet mask	U3E0\G60 to U3E0\G61
Default gateway IP address	U3E0\G64 to U3E0\G65

Checking with module diagnostics

Check by using the [Module Information List] tab of the "Module Diagnostics" window. (☞ Page 1681 Module diagnostics)

Checking the operating status

Whether operation is performed with the IP address in the IP address storage area can be checked with 'Network setting information' (U3E0\G258).

- 0H: Operation according to parameter settings
- 2H: Operation according to the default value of the network setting change function
- 3H: Operation according to the setting value of the network setting change function

Precautions

The following describes precautions on the network setting change function.

Power off and reset operation

Do not power off or reset while writing to or clearing the network setting storage area. The values may not be applied to the network setting storage area. Power off or reset after checking the falling edge of the network setting storage area write request or network setting storage area clear request.

Write processing and clear processing execution timing

- Executing the write or clear processing to the network setting storage area may not be possible if an operation that turns off and on, or on and off an network setting storage area write request or network setting storage area clear request in a short time is performed.
- If the network setting storage area write request is turned off and on again while writing to the network setting storage area, the write processing that was executed first will complete normally, and the following write operation will be ignored. (This also applies to the clear operation.)
- If the network setting storage area clear request is turned off and on while writing to the network setting storage area, the clear operation results in an error. (This applies to the write operation if writing is executed during the clear processing.)
- If the network setting storage area write request and network setting storage area clear request are both turned off and on while writing to the network setting storage area, the write operation is given priority and the clear operation results in an error.

Module replacement

When replacing a module that uses the network setting change function, perform either of the following operations.

- Write data to the controller of the replacement destination by using the controller data backup/restoration function. (☞ Page 1622 CONTROLLER DATA BACKUP/RESTORATION FUNCTION)
- Execute the network setting change function on the controller of the replacement destination. (☞ Page 1432 How to use)

Point

The network setting change function changes the network settings (IP address, subnet mask, and default gateway) independently of parameter settings. When the read data is written to the controller of the replacement destination, the default network settings (IP address, subnet mask, default gateway) are set without writing the settings of the network settings change function.

Execution of the network setting change function during execution of another function

When the network setting change function is executed during execution of the controller data backup/restoration function, an error (write error cause 300H) occurs. (☞ Page 1433 Cause of error at abnormal completion)
Execute the function again after the backup/restore is completed.

Simultaneous execution of network setting change function from multiple devices

If the network setting change function is used simultaneously from multiple devices such as GOTs and engineering tool, the intended settings may not be achieved. Therefore, do not use it simultaneously from multiple devices.
After using the network setting change function, check the buffer memory to see if the IP address, subnet mask, and default gateway have become the setting values.

56.2 DNS Client Function

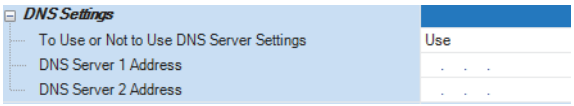
This function queries the DNS server for the IP address based on the server name set in the file transfer function (such as FTP client). Using the returned IP address, each client function performs communication processing.
This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)

DNS settings

Set the IP address of the DNS server in the following cases.

- When "FTP Server Specification" in "FTP Client Settings" is set to "FTP Server Name"
- When "Specify SNTP Server" in "Time Setting" is set to "SNTP Server Name"

Window



Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [DNS Settings]

Displayed items

Item	Description	Setting range
To Use or Not to Use DNS Server Settings	Set whether to use the DNS server or not.	• Not to Use • Use (Default: Not Use)
DNS Server 1 Address	Set the IP address of the DNS server 1 in the decimal format.	0.0.0.1 to 223.255.255.254
DNS Server 2 Address	Set the IP address of the DNS server 2 in the decimal format.	0.0.0.1 to 223.255.255.254

Point

When "To Use or Not to Use DNS Server Settings" is set to "Use", set either one or both "DNS Server 1 Address" and "DNS Server 2 Address".

56.3 Discard Received Data at CPU STOP

Received data from the communication destination by using socket communications is discarded when the status of the controller is changed from RUN to STOP (PAUSE).
This setting can be used only for Ethernet ports. (☞ Page 50 MX-R Model)

Setting method

This function can be changed to enable/disable by changing directly 'Discard received data at CPU STOP setting area' (U3E0\G275, U3E0\G2721 to U3E0\G2724) with a program.

Precautions

- This function becomes enabled when each connection is set to on.
- If the controller stops while the socket communication reception status signal is on, the system discards the received data and turns off the socket communication reception status signal.
- This setting is invalid if the connection is not a function for discarding received data when the controller is stopped.
- For Ethernet port connections No.1 to 16, if either 'Discard received data at CPU STOP setting area" (U3E0\G275) or 'Discard received data at CPU STOP setting area' (U3E0\G2721) is set, both will be set, and the setting for discarding received data at STOP for that connection is enabled.

PART 13 DATA COLLECTION

This part consists of the following chapter.

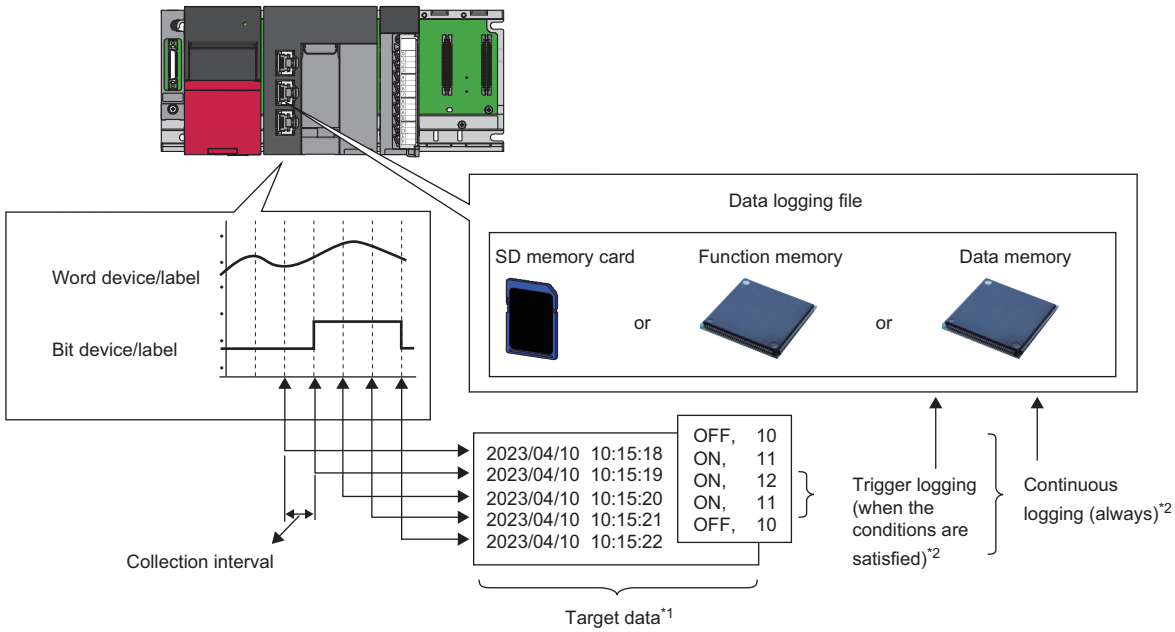
57 DATA LOGGING FUNCTION

58 SEQUENCE SCAN SYNCHRONIZATION SAMPLING FUNCTION

57 DATA LOGGING FUNCTION

This function collects data at a specified interval or a desired timing and stores them as a file on the SD memory card. Data memory or function memory can be specified as the save destination for the collected data. This enables data logging without using an SD memory card.

The entire data logging function allows the entry of up to 10 data logging settings. The settings are identified by numbers 1 to 10, and each setting can be operated simultaneously.



*1 For details on the data to be collected, refer to the following. (☞ Page 1444 Data to Be Collected)

*2 For details on continuous logging and trigger logging, refer to the following. (☞ Page 1453 Logging Types)

Point

For the procedures for operating and configuring this function in CPU Module Logging Configuration Tool, refer to the following.

📖 CPU Module Logging Configuration Tool Version 1 Operating Manual

Before using the data logging function, check the version of the GX LogViewer used. (☞ Page 125 Applicable Software)

57.1 Data Logging Procedure

This section describes the data logging procedure.

Procedure	Description
1. Installing CPU Module Logging Configuration Tool	Install CPU Module Logging Configuration Tool. CPU Module Logging Configuration Tool/GX LogViewer Installation Instructions (BCN-P5999-0506) For the supported version of CPU Module Logging Configuration Tool, refer to the following. Page 125 Applicable Software
2. Launching CPU Module Logging Configuration Tool	Launch CPU Module Logging Configuration Tool.
3. Importing a project	When specifying a label as the target data, import the project of the engineering tool to CPU Module Logging Configuration Tool.
4. Data logging setting	Configure the data logging setting. CPU Module Logging Configuration Tool Version 1 Operating Manual
5. Common settings (auto logging common setting)	If auto logging is used, configure the common settings (auto logging common settings). Page 1513 Auto logging common setting
6. Inserting an SD memory card and powering on	When the storage destination of the data logging files is the SD memory card, insert an SD memory card into the controller, and power up the module.
7. Connecting to personal computer	Connect the controller to a personal computer.
8. Writing the data logging setting	Write the data logging setting to the SD memory card or data memory.
9. Starting data logging	Switch the controller to RUN state to start the data logging.
10. Reading the data logging file	Stop the data logging and read the data logging file.
11. Checking the read file	Check the file into which data has been read.

Point

- To start data logging, always click the [Start] button in the "Logging Status and Operation" window of CPU Module Logging Configuration Tool. The data logging cannot be started even when the setting is written and power is turned off and on or the controller is reset (except for the auto logging).
- For the operation procedures for CPU Module Logging Configuration Tool, refer to the following.

CPU Module Logging Configuration Tool Version 1 Operating Manual

57.2 Specifications

This section describes the data logging specifications.

Item			Specifications	Reference
Number of data logging settings			10	—
Data collection	Collection interval		• Each scan • Time specification • Condition specification (device/label specification) • Network communication cycle synchronization • After the execution of specified program	Page 1448 Data Collection Conditions
	Number of points for collection		Maximum of 10240 (1024 per setting)	
Logging type			• Continuous logging • Trigger logging	Page 1453 Logging Types
Data processing	Trigger logging	Trigger condition	• Event occurrence • Fixed cycle • Condition specification (device/label change specification)	Page 1454 Operating procedure for trigger logging
		Trigger logging range	Number of records specified before and after the trigger establishment	
		Number of trigger establishments (number of events that can be handled as trigger)	• The number of times specification: 1 to 32767 • Number of save files specification: Not restricted	
		Number of records	■No. of records (before trigger) 0 to 999999[*1*2] ■No. of records (after trigger) 1 to 1000000[*1*2]	

Item			Specifications	Reference
File output	File name		Additional information plus file number	Page 1460 Data Logging File
	File storage format		• Unicode text file • CSV file (Shift-JIS) • CSV file (Unicode) • Binary file • JSON file	
	Data type		• Bit • Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number • String • Numeric string • Time	
	Output format	Unicode text file	• Bit • Decimal format • Hexadecimal format • Decimal fraction format • Exponential format • String • Time	
		• CSV file (Shift-JIS) • CSV file (Unicode)	• Bit • Decimal format • Hexadecimal format • Decimal fraction format • Exponential format • String • Time	
		Binary file	• Bit • Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number • String • Numeric string • Time	
		JSON file	JSON	
Storage location of data logging files			• SD memory card • Data memory • Function memory	Page 1504 Switching to a storage file
Output file handling	Storage file switching	File switching timing	• Number of records • File size • Condition specification	Page 1503 Switching to a storage file
		Maximum number of storage files	• Number of files to be saved: 1 to 65535 • Maximum value not specified: Not restricted	
Logging start condition setting			This function sets data logging operations when entering into RUN mode after the data logging setting is registered.	Page 1511 Logging Start Condition Setting
Auto logging			When inserting an SD memory card, which holds data logging setting, into the controller, data logging automatically starts based on the data logging setting information stored on the SD memory card.	Page 1512 Auto Logging
SD memory card replacement			SD memory cards can be replaced using the SD memory card forced disable function even when the data logging is in progress.	Page 1517 SD Memory Card Replacement

*1 The total number of pre-trigger and post-trigger records is a maximum of 1000000 records.
A maximum of 999999 records can be set for pre-trigger records. However, the maximum number of records that can be set is determined by the number of collected data records and the capacity of the internal buffer used by the logging function.

*2 When function memory or data memory is specified, the total number of pre-trigger records (setting range: 0 to 49999) and the post-trigger records (setting range: 1 to 50000) is a maximum of 50000 records.

57.3 Data to Be Collected

This section describes the data to be collected by data logging.

Number of data points

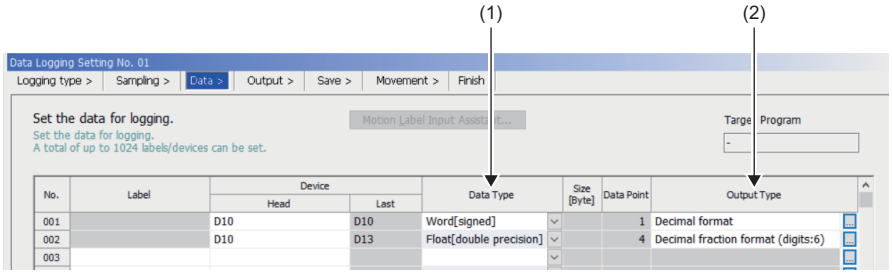
The data logging function can collect up to 10240 data records. (10 settings × 1024 records)*1

*1 Duplicate data records are counted as distinct.

Data type and output format

Specify the data type and output format for one type of collected data.

The following tables list the data types and output formats and whether or not each data specification method can be set.



Setting item		Description	Availability	
			Label	Device
(1)	Data Type	Limits the value of collected data.	Not possible*1	Possible
(2)	Output format	Format to be used when data is output to the data logging file.	Possible	Possible

*1 Setting is not possible because it follows the data type of the label.

The following table shows the number of data points and the output format for each data type.

Data type	Number of data points	Output format
Bit	1	—
Word (signed)	1	■For binary file format • Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number ■For JSON file format Selection not possible ■For formats other than the above • Decimal format • Decimal fraction format (specification of digits after the decimal point: 0 to 14) • Exponential format (specification of digits after the decimal point: 0 to 14)
Double word (signed)	2	
Word (unsigned)	1	■For binary file format • Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number ■For JSON file format Selection not possible ■For formats other than the above • Decimal format • Hexadecimal format • Decimal fraction format (specification of digits after the decimal point: 0 to 14) • Exponential format (specification of digits after the decimal point: 0 to 14)
Double word (unsigned)	2	
Single-precision real number	2	■For binary file format • Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number ■For JSON file format Selection not possible ■For formats other than the above • Decimal format • Decimal fraction format (specification of digits after the decimal point: 0 to 14) • Exponential format (specification of digits after the decimal point: 0 to 14)
Double-precision real number	4	
String[*2]	Specified size/2[*3]	—
Numeric string	Specified size/2[*3]	
Time	2	

*2 The entered character code are output.

*3 The specified size can be 1 to 256. If the specified size is an odd number, the number of data records is rounded to the next higher integer.
For example, the number of data records is 3 if the specified size is 5.

The following table lists data types that can be specified when the collected data is specified by device.

Data	Data types that can be specified
Bit device	Bit
Word device with bit specified	
Word device	• Word (signed) • Double word (signed) • Word (unsigned) • Double word (unsigned) • Single-precision real number • Double-precision real number • String • Numeric string • Time
Double-word device	• Double word (signed) • Double word (unsigned) • Single-precision real number • Double-precision real number • String • Numeric string • Time
Bit device with digit specification (K1 to K4)	Word (unsigned)
Bit device with digit specification (K5 to K8)	Double word (unsigned)

Data to be collected

The following table lists the data to be collected.

Data	Description
Global device	Target global devices can be specified.
Local device	In a single data logging setting, only the local device of a single program can be specified.
Global label	Target global labels can be specified.
Local label	In a single data logging setting, only the local label of a single program can be specified.

Point

- When specifying a label, save the project of the engineering tool that contains the label in advance because the project is imported into CPU Module Logging Configuration Tool.
- To specify the local devices of multiple programs, specify them in different data logging settings.
- To specify the local labels of multiple programs, specify them in different data logging settings.

Devices to be collected

The following table lists the devices that can be specified as the collected data.

Type	Device[*1]
Bit device[*2]	X, DX, Y, DY, M[*4], L, F, SM, V[*4], B, SB, T (contact)[*4*5], T (coil)[*4*5], ST (contact)[*4*5], ST (coil)[*4*5], C (contact)[*4*5], C (coil)[*4*5], LT (contact)[*4*5], LT (coil)[*4*5], LST (contact)[*4*5], LST (coil)[*4*5], LC (contact)[*4*5], LC (coil)[*4*5], FX, FY, Jn\X[*6], Jn\Y[*6], Jn\SB[*6], Jn\B[*6]
Word device[*3]	T (current value)[*4], ST (current value)[*4], C (current value)[*4], D[*4], SD, W, SW, RD, R, ZR, Z, FD, Un\G, Jn\W[*6], Jn\SW[*6], U3En\G[*6]
Double-word device	LT (current value)[*4], LST (current value)[*4], LC (current value)[*4], LZ

*1 An index modified device and indirectly specified device cannot be specified.
*2 For bit devices, digit specification is allowed for K1 to K8 only.
*3 For word devices, bit specification is allowed.
*4 To specify the local device, use "Program name/#Device name". (Example: "MAIN/#M1")
*5 To specify these devices with CPU Module Logging Configuration Tool, use T (contact): TS, T (coil): TC, ST (contact): STS, ST (coil): STC, C (contact): CS, C (coil): CC, LT (contact): LTS, LT (coil): LTC, LST (contact): LSTS, LST (coil): LSTC, LC (contact): LCS, and LC (coil): LCC.
*6 The synchronous station link device cannot be specified by Jn\☐ (link direct device). For details, refer to the following.
☞ Page 1530 Synchronous station

Labels to be collected

The following table lists the labels that can be specified to be collected. [*1*2]

Type	Class	Data type
Global label	• VAR_GLOBAL • VAR_GLOBAL_RETAIN	■Primitive data type/array[*7] • Bit[*4] • Word (signed)[*5] • Double word (signed) • Word (unsigned)[*5] • Double word (unsigned) • Single-precision real number • Double-precision real number • Time • String • Timer type[*6] • Retentive timer type[*6] • Counter type[*6] • Long timer type[*6] • Long retentive timer type[*6] • Long counter type[*6] ■Structure[*8]
Local label[*3*9]	• VAR • VAR_RETAIN	

*1 A label with a name of 256 characters or less can be specified. When the local label is specified (program block name/label name), the "program block name/" part is counted as the number of characters.
*2 Only labels in the read project of the engineering tool can be specified.
*3 Specify the label with "Program block name/Label name". (Example: "ProgPou/label_w1")
*4 Digit-specified labels cannot be specified.
*5 Bits can be specified.
*6 For the label of timer type and counter type, specify the element name. (S: contact, C: coil, N: current value)
Global label example: "label_w1.S"
Local label example: "ProgPou/label_w1.S"
*7 Specify the array element. If the array element is not specified, it is handled as the start of the array ([0]). (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*8 Specify the structure member. (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*9 When a local label of a function block is specified, the collected data is set to an undefined value.

Point

When specifying a label, save the project of the engineering tool that contains the label in advance because the project is imported into CPU Module Logging Configuration Tool.

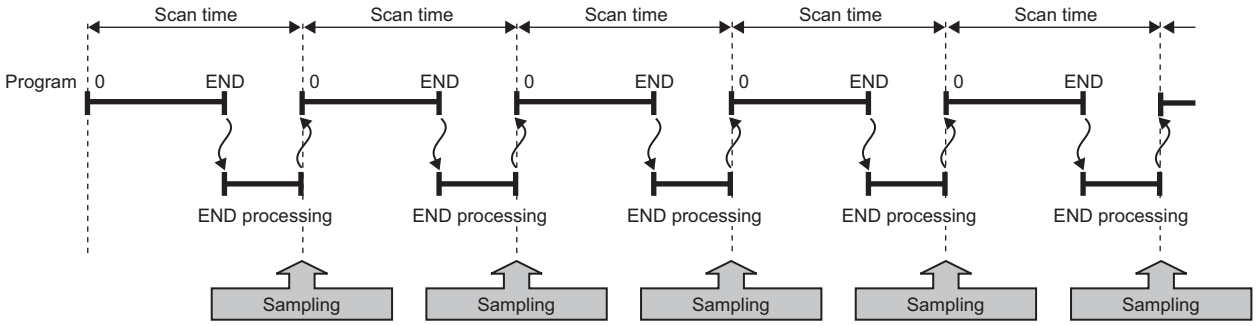
57.4 Data Collection Conditions

This section describes the timing when data is collected and the conditions under which data is collected.

Data collection conditions		Description
Each scan		Collects data during the END processing of each scan.
Time specification	Data collection during the END processing after specified time interval	Collects data during the END processing after specified time interval.
Condition specification	Device/label change specification	Collects data when the monitored data meets the specified condition during the END processing.
Network communication cycle synchronization		Collects data at specified cycle intervals.
After the execution of specified program		Collects data after executing the specified program.

Each scan

Data are collected during the END processing of each scan.



Time specification

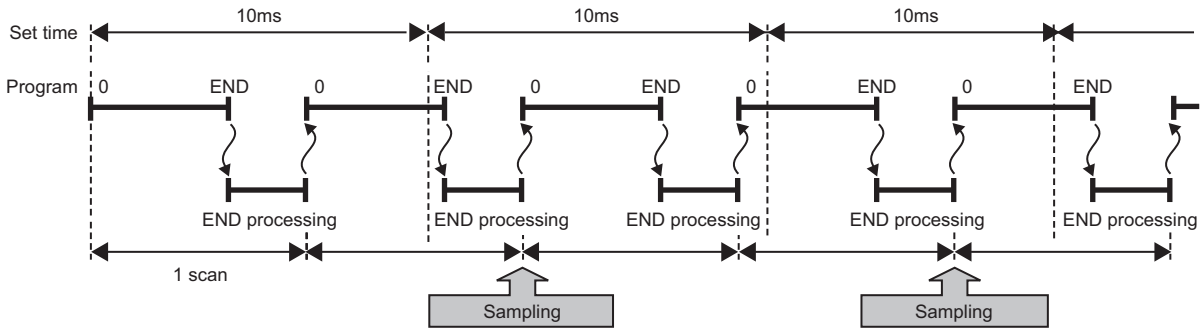
Specify the collection time interval. Specify the timing of data collection using advanced settings as well.

Data collection during the END processing after specified time interval

This option causes data collection to be performed at the timing of the END processing rather than during the course of program execution. Ensure that the "Scan time" is less than "Time specification". If the scan time is longer than the specified time and the collection interval or the collection timing occurs more than once during the same scan, data is collected only once during the END processing. Data collection is performed on a scan by scan basis, which is the same behavior as when "Each scan" is used.

Ex.

10 milliseconds (10ms)



Condition specification

Specify the data collection timing according to the device/label data conditions.
The data name or the constant value can be specified for the comparison data used in the conditional formula.

Device/label specification

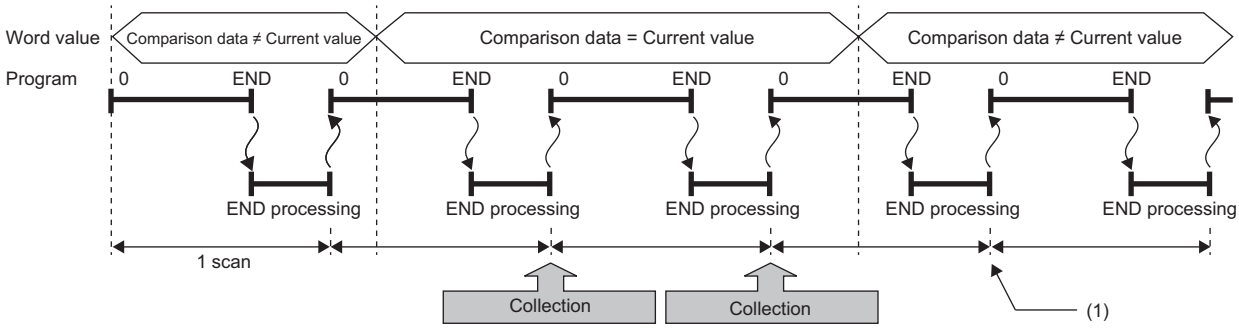
Data are collected when the monitored data meets the specified condition during the END processing.

■To collect data continuously while the conditions are met

The following conditional formula causes the data logging function to collect data continuously while the conditions are met:

- =: When the current value of the monitored data is equal to the comparison data
- ≠: When the current value of the monitored data is not equal to the comparison data
- ≥: When the current value of the monitored data is equal to or larger than the comparison data
- >: When the current value of the monitored data is larger than the comparison data
- ≤: When the current value of the monitored data is equal or smaller than the comparison data
- <: When the current value of the monitored data is smaller than the comparison data

Ex.
When the conditional formula is =



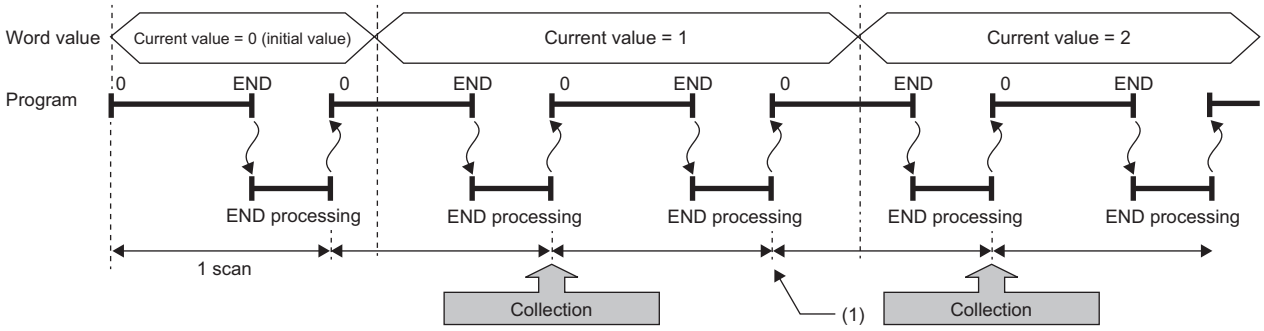
(1) During the END processing, the data logging function does not collect data because the conditions are not met.

■To collect data only when the state changes

The following conditional formula causes the data logging function to collect data only during the END processing for the scans where the conditional formula is met. It does not collect data for any single scan where the conditional formula is not met during the END processing (even if the conditional formula is met before the END processing is initiated).

- ↑: When the specified data turns off and on
- ↓: When the specified data turns on and off
- At change: When the current value of the specified data changes

Ex.
When the conditional formula is At change



(1) The data logging function does not collect data because there has been no change in state since the last scan.

■Specifying the monitored data and comparison data

The following table lists the devices that can be specified as the monitored data and comparison data.

If a device other than a specifiable device or a non-specifiable device modification is specified, input to CPU Module Logging Configuration Tool is not possible.

To specify monitored data and comparison data by using the device, specify the data type of the device.

The data types that can be selected include bit/word (unsigned), word (signed), double word (unsigned), double word (signed), single-precision real number, and double-precision real number.

Set them so that the data types of the monitored data and the comparison data match.

Type		Device*1
Device	Bit device*2	X, Y, M*4, L, F, SM, V*4, B, SB, T (contact)*4*5, ST (contact)*4*5, C (contact)*4*5, LT (contact)*4*5, LST (contact)*4*5, LC (contact)*4*5, FX, FY, Jn\X, Jn\Y, Jn\SB, Jn\B
	Word device*3	T (current value)*4, ST (current value)*4, C (current value)*4, D*4, SD, W, SW, RD, R, ZR, Z, FD, Un\G, Jn\W, Jn\SW, U3En\G
	Double-word device	LT (current value)*4, LST (current value)*4, LC (current value)*4, LZ

*1 An index modified device and indirectly specified device cannot be specified.
*2 For digit-specified bit devices, only K1 to K8 can be specified.
*3 For word devices, bit specification is allowed.
*4 To specify the local device, use "Program name/#Device name". (Example: "MAIN/#M1")
*5 To specify these devices with CPU Module Logging Configuration Tool, use T (contact): TS, ST (contact): STS, C (contact): CS, LT (contact): LTS, LST (contact): LSTS, and LC (contact): LCS.
*6 When specifying link devices assigned to the synchronous station of the CC-Link IE TSN function, refer to the following.
☞ Page 1530 Synchronous station

The following table lists the labels that can be specified as the monitored data and comparison data.

A label other than a specifiable label or a non-specifiable label modification cannot be input.

When specifying a label for monitored data and comparison data, the data type of the label is automatically determined by the specified label.

Type		Class	Data type
Label*11	Global label	• VAR_GLOBAL • VAR_GLOBAL_RETAIN	■Primitive data type • Bit*7 • Word (signed)*8 • Double word (signed) • Word (unsigned)*8 • Double word (unsigned) • Single-precision real number • Double-precision real number • Timer type*12 • Retentive timer type*12 • Counter type*12 • Long timer type*12 • Long retentive timer type*12 • Long counter type*12 ■Array*9 ■Structure*10
	Local label*13	• VAR • VAR_RETAIN	

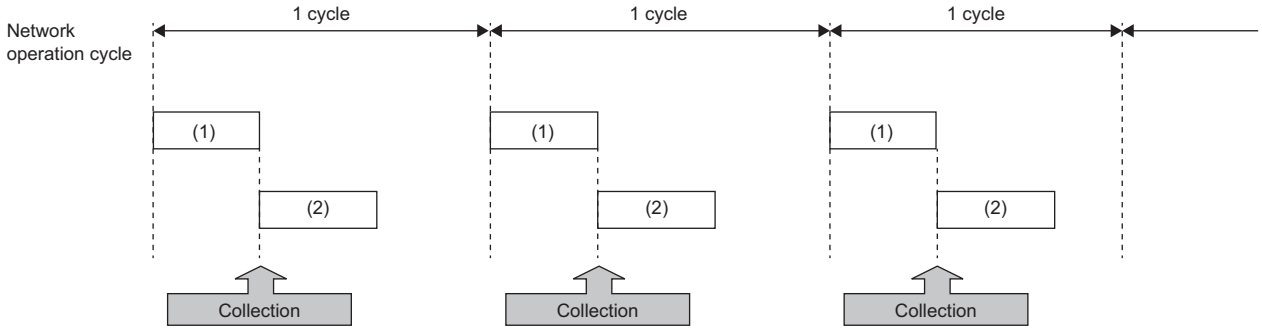
*7 Digit-specified labels cannot be specified.
*8 Bits can be specified.
*9 Specify the array element. If the array element is not specified, it is handled as the start of the array ([0]). (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*10 Specify the structure member. (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*11 Only labels of a program block in the read project of the engineering tool can be specified.
*12 Only the contacts and current values can be specified.
*13 When a local label of a function block is specified, the monitoring data and comparison data are set to an undefined value.

Network communication cycle synchronization

Data is collected at intervals synchronized with the specified network communication cycle.

Ex.

Set to synchronize with basic cycle

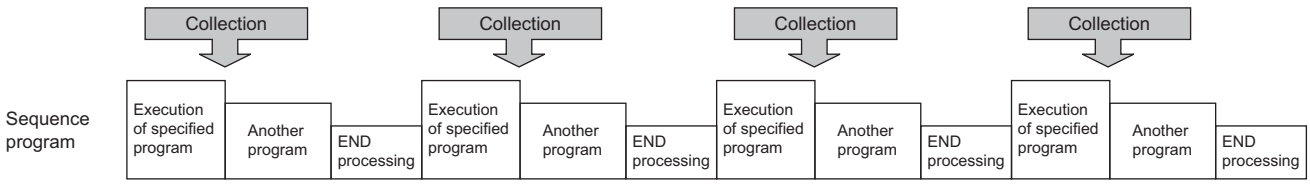


(1) Event execution type program
(2) Motion operation

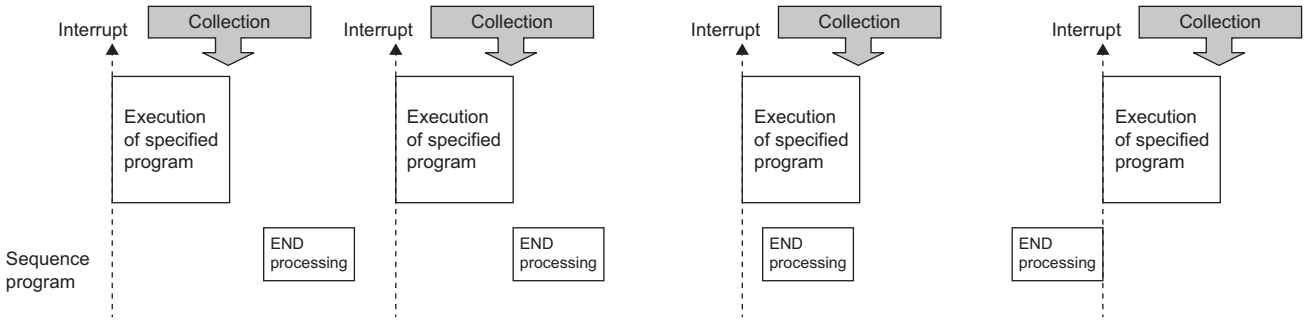
After the execution of specified program

Data is collected after the specified program is executed.

• Scan execution type



• Interrupt program



Point

• When collecting data of an event execution type program that synchronizes with the network communication cycle, select "Network Communication Period Synchronization" for the collection condition. If "After the execution of specified program" is selected for the collection condition and a name of an event execution type program that synchronizes with the network communication cycle is specified, an error (4273H) occurs at the start. (An error occurs at the beginning when synchronized with any of the following: synchronized with the basic cycle, synchronized with medium speed, and synchronized with low speed.)

• If the interrupt program exists within the same program as the standard program, specify one of the following program names that extracts only the interrupt program.

❶ A program in which an event execution type program with 'Interrupt Occurrence' selected as the trigger type is created and the contents of the interrupt program are written.

❷A program in which a standby execution type program is created and an interrupt program including an interrupt pointer is written

• When logging is started with both interrupt and standard programs written in the same program, the processing time of each program increases because each data is collected after the execution of the standard program and the interrupt program.

57.5 Logging Types

The following table describes available methods of data collection:

Logging type	Data collection method	Application
Continuous logging	Continuously collects specified data at specified interval or timing.	Allows the user to continuously monitor the content of specified data.
Trigger logging	Collects specified data at specified interval or timing and extracts a specified number of data records before and after the satisfaction of a trigger condition.	Allows the user to monitor the content of specified data before and after the satisfaction of a trigger condition.

Operating procedure for continuous logging

In continuous logging, the controller stores specified data in its internal buffer at a specified collection interval or timing and, at the time of a file save operation, it saves the data in a data logging file residing in the storage memory.

1. Write the settings to the function memory, data memory, or SD memory card using CPU Module Logging Configuration Tool.
2. Operate CPU Module Logging Configuration Tool to start data logging. The data logging settings are registered and continuous logging begins. (The special relay (data logging start) turns on.)
3. Data collection finishes upon reaching the number of files to be saved that was specified as part of the "Stop" setting configured in "Operation when exceeds the number of files". (Logging settings inside the controller remain intact.)
4. Specify the desired file in the storage memory to read the results of data logging.

Point

In continuous logging, data logging files are continuously created, thus allowing the data logging results to be read any time without having to wait for the completion of collection.

To stop continuous logging

The user can completely stop data logging by instructing CPU Module Logging Configuration Tool to stop data logging and unregister the data logging settings stored in the controller. (The special relay (data logging start) turns off.)

To suspend/resume continuous logging

The user can suspend data logging with the data logging settings remaining intact by doing either of the following:

- Instruct CPU Module Logging Configuration Tool to suspend data logging (the special relay (data logging start) turns off).
- Turn on and off the special relay (Data logging suspend/resume flag).

To resume continuous logging from suspension, do either of the following:

- Instruct CPU Module Logging Configuration Tool to resume data logging (the special relay (data logging start) turns on).
- Turn off and on the special relay (Data logging suspend/resume flag).

Operating procedure for trigger logging

In trigger logging, the controller stores specified data in its internal buffer at a specified collection interval or timing; it extracts a specified number of data records before and after the satisfaction of a trigger condition and saves the extracted data in a data logging file residing in the storage memory. Note that data collection is performed not only at the specified collection interval or timing but also when a trigger condition is met. In addition, once a trigger condition is met, any subsequent trigger conditions are ignored.

1. Write the settings to the SD memory card, function memory, or data memory using CPU Module Logging Configuration Tool.
2. Instruct CPU Module Logging Configuration Tool to start data logging. The data logging settings are registered and trigger logging begins. (The special relay (data logging start) turns on.)
3. Wait until the trigger condition is met. (Trigger standby)
4. The data specified in CPU Module Logging Configuration Tool is collected. (Trigger condition met)
5. Data collection is completed by collecting as much data as the number of records specified in CPU Module Logging Configuration Tool and writing the collected data into the storage memory.
6. Trigger logging is completed when the number of times logging that was set in CPU Module Logging Configuration Tool is reached. (Logging settings inside the controller remain intact.)
7. Specify the desired file in the storage memory to read the results of data logging.

Trigger condition

The following table lists the conditions to be used as a trigger.

For each setting, AND conjunction or OR conjunction of each condition can be selected, and up to 32 trigger conditions can be specified for each setting. In addition, determination of trigger occurrence is performed during END processing.

Trigger condition*1		Description
Event occurrence		Triggered by the occurrence of a specified event or error
Fixed cycle		The trigger condition is satisfied at each specified cycle.
Condition specification	Device/label change specification	A trigger occurs when the monitored data meets the specified condition.

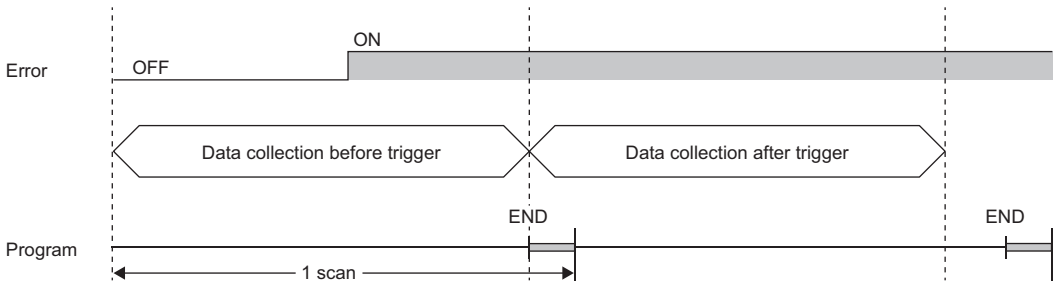
*1 It is recognized as a trigger, even if data collection has never been performed.

■Event occurrence

Data is collected when triggered by the occurrence of the applicable event or error in the controller.

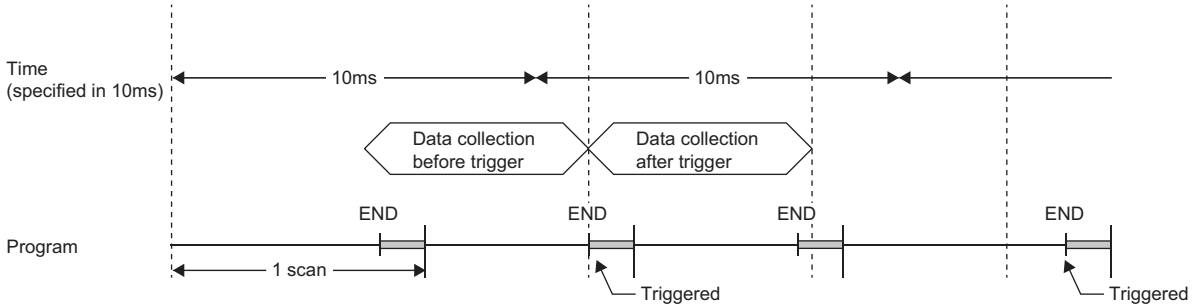
Multiple or all event codes can be set with "-" (hyphens) and "," (commas) between the events to be used as the trigger condition.

However, events with event codes 00700H to 007FFH are ignored even if the trigger condition is satisfied. Therefore, data collection cannot be performed when triggered by the occurrence of event codes 00700H to 007FFH.



■Fixed cycle

Collect data with a specified time interval as the trigger.



■Device/label change specification

A trigger occurs when the monitored data meets the specified condition.

Conditional formula	Description
↑	When the specified data turns off and on
↓	When the specified data turns on and off
=	When the monitored data is equal to the comparison data, regardless of whether or not its current value is equal
≠	When the monitored data is not equal to the comparison data, regardless of whether or not its current value is equal
≥	When the monitored data is greater than or equal to the comparison data, regardless of whether or not its current value is equal
>	When the monitored data is greater than the comparison data, regardless of whether or not its current value is equal
≤	When the monitored data is less than or equal to the comparison data, regardless of whether or not its current value is equal
<	When the monitored data is less than the comparison data, regardless of whether or not its current value is equal
At change	When the current value of the specified data changes

• Specifying the monitored data and comparison data

For the monitored data and the comparison data used for the device/label change specification, the devices and labels listed in the following tables can be specified.

The data types that can be selected include bit/word (unsigned), word (signed), double word (unsigned), double word (signed), single-precision real number, and double-precision real number.

If double word (unsigned) or double word (signed) is specified, a trigger occurs only when as much data as one double word is written. No trigger occurs when only the upper or lower word of a double word is written. Set them so that the data types of the monitored data and comparison data match.

Type		Device*1
Device	Bit device*2	X, Y, M*4, L, F, SM, V*4, B, SB, T (contact)*4*5, ST (contact)*4*5, C (contact)*4*5, LT (contact)*4*5, LST (contact)*4*5, LC (contact)*4*5, FX, FY
	Word device*3	T (current value)*4, ST (current value)*4, C (current value)*4, D*4, SD, W, SW, RD, R, ZR, FD
	Double-word device	LT (current value)*4, LST (current value)*4, LC (current value)*4

*1 An index modified device and indirectly specified device cannot be specified.
*2 For bit devices, digit specification is not supported.
*3 For word devices, bit specification is allowed.
*4 To specify the local device, use "Program name/#Device name". (Example: "MAIN/#M1")
*5 To specify these devices with CPU Module Logging Configuration Tool, use T (contact): TS, ST (contact): STS, C (contact): CS, LT (contact): LTS, LST (contact): LSTS, and LC (contact): LCS.

If a label other than a specifiable label or a non-specifiable label modification is specified, input to CPU Module Logging Configuration Tool is not possible.
When specifying a label for monitored data and comparison data, the data type of the label is automatically determined by the specified label.
If double word (unsigned) or double word (signed) is specified, a trigger occurs only when as much data as one double word is written. No trigger occurs when only the upper or lower word of a double word is written.

Type		Class	Data type
Label*6*7	Global label	• VAR_GLOBAL • VAR_GLOBAL_RETAIN	■Primitive data type/array*13 • Bit*9 • Word (signed)*10 • Double word (signed) • Word (unsigned)*10 • Double word (unsigned) • Single-precision real number • Double-precision real number • Timer type*11*12 • Retentive timer type*11*12 • Counter type*11*12 • Long timer type*11*12 • Long retentive timer type*11*12 • Long counter type*11*12 ■Structure*14
	Local label*8*15	• VAR • VAR_RETAIN	

*6 A label with a name of 256 characters or less can be specified. When the local label is specified (program block name/label name), the "program block name/" part is counted as the number of characters.
*7 Only labels in the read project of the engineering tool can be specified.
*8 Specify the label with "Program block name/Label name". (Example: "ProgPou/label_w1")
*9 Digit-specified labels cannot be specified.
*10 Bits can be specified.
*11 Only the contacts and current values can be specified.
*12 For the label of timer type and counter type, specify the element name. (S: contact, N: current value)
Global label example: "label_w1.S"
Local label example: "ProgPou/label_w1.S"
*13 Specify the array element. If the array element is not specified, it is handled as the start of the array ([0]). (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*14 Specify the structure member. (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)
*15 When a local label of a function block is specified, the monitoring data and comparison data are set to an undefined value.

To stop trigger logging

The user can completely stop data logging by instructing CPU Module Logging Configuration Tool to stop data logging and unregister the data logging settings stored in the controller. (The special relay (data logging start) turns off.)

To suspend/resume trigger logging

The user can suspend data logging with the data logging settings remaining intact by doing either of the following:

- Instruct CPU Module Logging Configuration Tool to suspend data logging (the special relay (data logging start) turns off).
- Turn on and off the special relay (Data logging suspend/resume flag).

To resume trigger logging from suspension, do either of the following:

- Instruct CPU Module Logging Configuration Tool to resume data logging (the special relay (data logging start) turns on).
- Turn off and on the special relay (Data logging suspend/resume flag).

Trigger count

Set the number of times to wait for the next trigger after a trigger occurs and data is collected.

When a trigger occurs, data for the specified number of records is output to the file.

When the specified number of triggers occur, collection is automatically completed.

Setting item	Setting range
Number of times specification	1 to 32767
Number of save files specification	None

■If the setting value specifies the number of times

Executes repeatedly at the number of specified times.

When exceeding the number of files specified to the number of saved files, the setting of "Operation when exceeds the number of files" will be ignored, and the data will be overwritten.

■If the setting value specifies the number of saved files

Trigger logging is executed repeatedly without limit, according to the number of saved files and the "Operation when exceeds the number of files".

☞ Page 1508 When the maximum number of storage files to be saved is exceeded

Number of records

Specify the number of records to be collected before and after the satisfaction of a trigger condition.

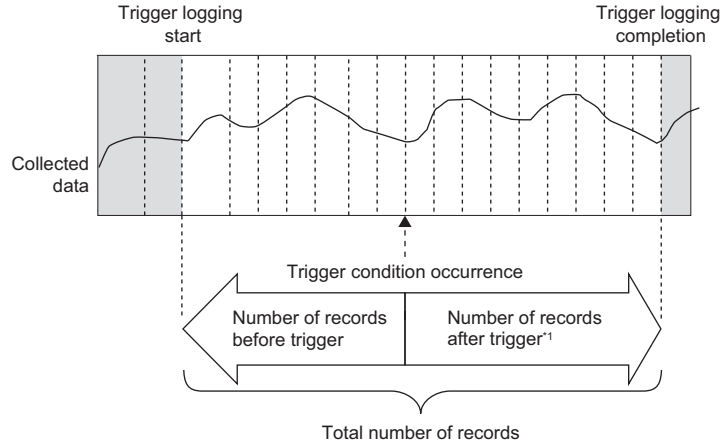
When trigger type is specified, the number of data (number of records) to be collected is determined by the data and the following settings.

Setting item	Description	Setting range Save destination: SD memory card, function memory, data memory
Internal buffer capacity	Specify the internal buffer capacity to be used for each logging setting number.	—
Data collection range No. of records (before trigger)	Data collection range with regards to the trigger. Specify the amount of data, in number of records, to collect before the trigger.	0 to 999999*1*2
Data collection range No. of records (after trigger)	Data collection range with regards to the trigger. Specify the amount of data, in number of records, to collect during and after a trigger occurrence.	1 to 1000000*1*2
Data collection range Total No. of records	Total number of records before, during, and after trigger occurrence	1 to 1000000*2

*1 The total number of pre-trigger and post-trigger records is a maximum of 1000000 records.
A maximum of 999999 records can be set for pre-trigger records. However, the maximum number of records that can be set is determined by the number of collected data records and the capacity of the internal buffer used by the logging function.

*2 When function memory or data memory is specified, the total number of pre-trigger records (setting range: 0 to 49999) and the post-trigger records (setting range: 1 to 50000) is a maximum of 50000 records.

The relationship between each setting with regards to the trigger is shown below.



*1 This number includes the record exactly at the time when the trigger condition is met.

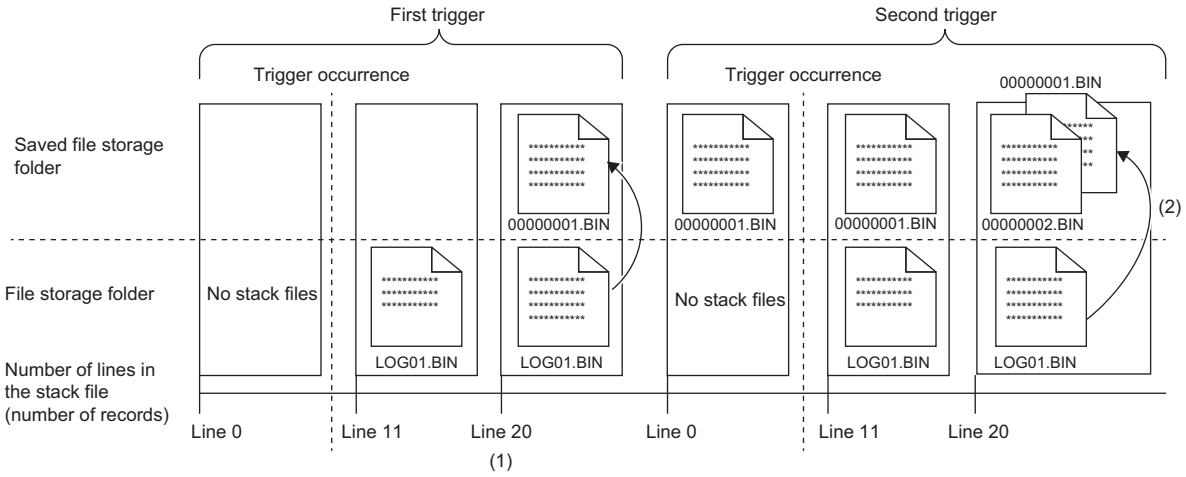
Point

After starting data logging, if the trigger condition is met before data collection of the specified number of records (before trigger) is completed, the number of sampled records will be less than the specified.

When the trigger type is specified, the storage file will be switched at the timing when the number of collected data records reaches the total number of records in the data collection range.

Ex.

For before trigger: 10 records, after trigger: 10 records



Point

The total number of records set for the number of records is the storage file switching condition for when trigger logging is specified. However, if the following is applicable after the trigger condition is established, the file will be switched, even if the number is less than the set total number of records.

- The status changes from RUN to STOP, operation is suspended, or operation is stopped.
- Logging is started while a stack file exists.

57.6 Data Logging File

This section describes data logging files.

Storage format of data logging files

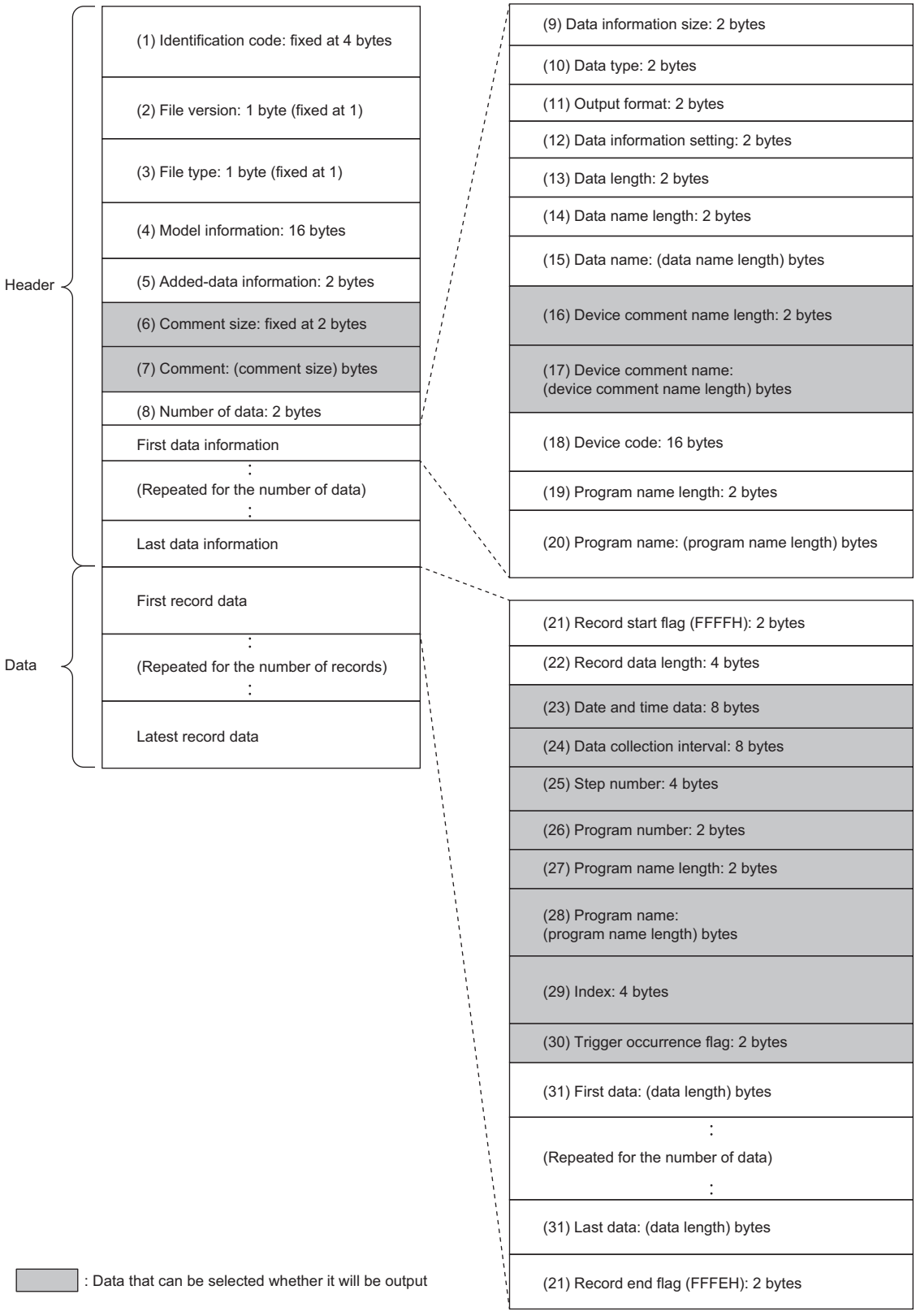
The following storage formats are available for data logging files.

File format		Application	Reference
Binary file format		Comparing the Unicode text file format, the size of files is small and therefore quicker access to files is provided. GX LogViewer is also available for displaying data. The offline monitor function of the engineering tool can be used.	Page 1461 Binary file output format
Unicode text file format		This is a file format which can be opened in generic-purpose application programs. GX LogViewer is also available for displaying data. If the program name or device comment uses characters that can only be represented in Unicode, use this format to specify Unicode characters (2 bytes) when specifying character strings for device values such as condition specifications.	Page 1465 Unicode text file output type
CSV file format	Shift-JIS	This is a file format which can be opened in generic-purpose application programs. GX LogViewer is also available for displaying data. Use this format in the following cases. • When only ASCII characters or characters that can be represented by Shift-JIS are used for label names, program names, and device comments • When specifying ASCII characters or Shift-JIS (1 byte or 2 bytes) while specifying the character string for device values such as condition specifications • When used to replace QnUD(P)VCPU	Page 1471 CSV file output format (Shift-JIS)
	Unicode	This is a file format which can be opened in generic-purpose application programs. GX LogViewer is also available for displaying data.	Page 1477 CSV file output format (Unicode)
JSON file format		The file format is appropriate for data operation on the host computer. GX LogViewer is also available for displaying data.	Page 1483 JSON file output format

Binary file output format

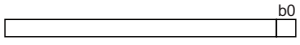
The following figure shows the configuration of the binary format and details of each data.

- File format example



• Details of each data

No.	Item	Description	Size (byte)
(1)	Identification code	"MXDB" (fixed) is always output to identify the file.	4
(2)	File version	"1" is displayed as the file version.	1
(3)	File type	The logging information is output. (fixed to 1: Continuous/trigger logging)	1
(4)	Model information	The module model name that output binary file is output. The module model name is output to the first half, and 0x00 is output to the last half. For example, for the MXR300-16, "MXR300-16" is output to the first nine bytes, and 0x00 is output to the last seven bytes. (ASCII format)	16
(5)	Added-data information	The output selection setting for the data that can be output is output.  b0 1: Output date and time data. 0: Do not output date and time data. b1 1: Output a data collection interval. 0: Do not output a data collection interval. b2 1: Output an execution step No. 0: Do not output an execution step No. b3 1: Output an execution program name and No. 0: Do not output an execution program name or No. b4 1: Output a trigger flag. 0: Do not output a trigger flag. b5 1: Output index. 0: Do not output index. b6 1: Output device comments. 0: Do not output device comments. b7 1: Output comments. 0: Do not output comments. b9 1: Output device comments for each program. 0: Do not output device comments for each program.	2
(6)	Comment size	The comment length of (7) Comment is output.	2
(7)	Comment	The comment specified in the setting is output in Unicode.	2 to 512
(8)	Number of collected data	The number of data points of the data information ((10) to (20)) for data logging is output.	2
(9)	Data information size	The total size of the data information ((10) to (20)) for data logging is output.	2
(10)	Data type	The numeric value shown below is output depending on the data type. 0000H: Bit 0001H: Word (signed) 0002H: Double word (signed) 0003H: Word (unsigned) 0004H: Double word (unsigned) 0005H: Single-precision real number 0006H: Double-precision real number 0007H: String 0008H: Numeric string 0009H: Time	2
(11)	Output format	The same numerical value as the value in (10) Data type is output. However, when the data type is bit, character string, numeric string, or time, FFFFH is output because the output type cannot be specified.	2
(12)	Data information setting	Information is output on whether each target setting item is being output.  b2 0: No device comment output 1: Device comment output available b3 0: No device code output 1: Device code output available b4 0: No program information output 1: Program information output available	2
(13)	Data length	The data length of data is output. When the data type is the bit type, it will be output as two bytes.	2
(14)	Data name length	The length of the data name specified in the setting is output.	2
(15)	Data name	The data name specified in the setting is output in Unicode.	2 to 578

No.	Item	Description	Size (byte)
(16)	Device comment name length	For settings that output device comments, the device comment name length of setting item (17) device comment name is output, and b2 of setting item (12) data information setting is set to 1. If the device comment is set not to be output, the setting item (12) data information setting b2 becomes 0, and this item will not be output.	2
(17)	Device comment name	For settings that output device comments, the device comment name specified in the settings is output in Unicode. For settings that display device comments for each program, the comment with the specified comment number in the device comment file for each program is output only for the local device. When the device comment file for each program or the comment of the corresponding program does not exist, the comment of the device comment file is output. (If only labels are specified for the logging target, they cannot be specified.)	0 to 2048
(18)	Device code	The device code of the device/label is output For file version 1, the setting item (12) data information setting b3 is set to 1.	16
(19)	Program name length	If there is even one local device or label among the devices/labels specified in the settings, the setting item (12) data information setting b4 is set to 1. If only global devices are specified as the devices/labels in the settings, the setting item (12) data information setting b4 becomes 0, and this item will not be output. When a local device or local label is specified, the program name length of setting item (20) program name is output, and when a global device or global label is specified, 0 is output.	2
(20)	Program name	The specified program name (no extension) is output in Unicode. (When a global device or global label is specified, the program name is not output.)	0 to 120
(21)	Record start flag, record end flag	The flags for identifying the start and end of the record are output. The FFFFH is output for record start while the FFFEH is output for record end as the fixed flag.	2
(22)	Record data length	The total size of (23) Day and time data to (30) Last data is output.	4
(23)	Date data	The Day and time data is output. b15 b0 M Y h D s m ms Y: Year (last 2 digits) M: Month (1 to 12) D: Day (1 to 31) h: Hour (0 to 23) m: Minute (0 to 59) s: Second (0 to 59) ms: Millisecond (0 to 999)	8
(24)	Data collection interval	The time interval from the previous collection time to the current collection time is output. (Unit: μs, Display range: 1 to 100000000000 (When it exceeds the max value, it returns to "1" and incrementing runs again.)) After logging collection is started, 0 is stored at the first collection.	8
(26)	Program No.	The program No. executed on the engineering tool at the timing in which data was collected is output. ☞ Page 1498 Execution program number	2
(27)	Program name length	The length of the program name to be output in (28) Program name is output. If (28) Program name is the same as the previous output data, "0" is output.	2
(28)	Program name	The program name (no extension) that is executed at the time interval and timing in which data was collected is output in Unicode. If the execution program name is the same as the previous output data, the execution program name becomes blank. ☞ Page 1498 Execution program name	0 to 200
(29)	Index	The index number ranging from 1 to 4294967295 of data, which was collected by the data logging function, is output. When it exceeds the max value, it returns to "1" and incrementing runs again. If missing occurs in processing data, index will be reassigned from 1 again.	4
(30)	Trigger occurrence flag	The trigger occurrence information is output.  b0 1: A trigger has occurred. 0: No trigger has occurred.	2

No.	Item	Description	Size (byte)
(31)	Data	Data collected by the data logging function is output corresponding to (13) Data length and (10) Data type. • When bits are specified: bit On = 1 and bit Off = 0 are output. • When word type (signed/unsigned) or double-word type (signed/unsigned) is specified: the data values are output in the specified unit. • When single-precision real number or double-precision real number is specified: data value is output in the specified unit. (☞ Page 1497 Number of records) • When character string type is specified: the character string with the specified size is output. If the character string terminator "0" exists in the middle of data, NULL is generated on from said point onward until the terminator of the specified size. • When numeric string type is specified: the data value with the specified size is output. • When time is specified: T#-24d20h31m23s648ms to T#24d20h31m23s647ms is output.	• Bit: 2 • Word (signed/unsigned): 2 • Double word (signed/unsigned): 4 • Single-precision real number: 4 • Double-precision real number: 8 • String/numeric string: 1 to 256 • Time: 4

Unicode text file output type

This section describes the format specifications of the Unicode text file output type and output content of each data.

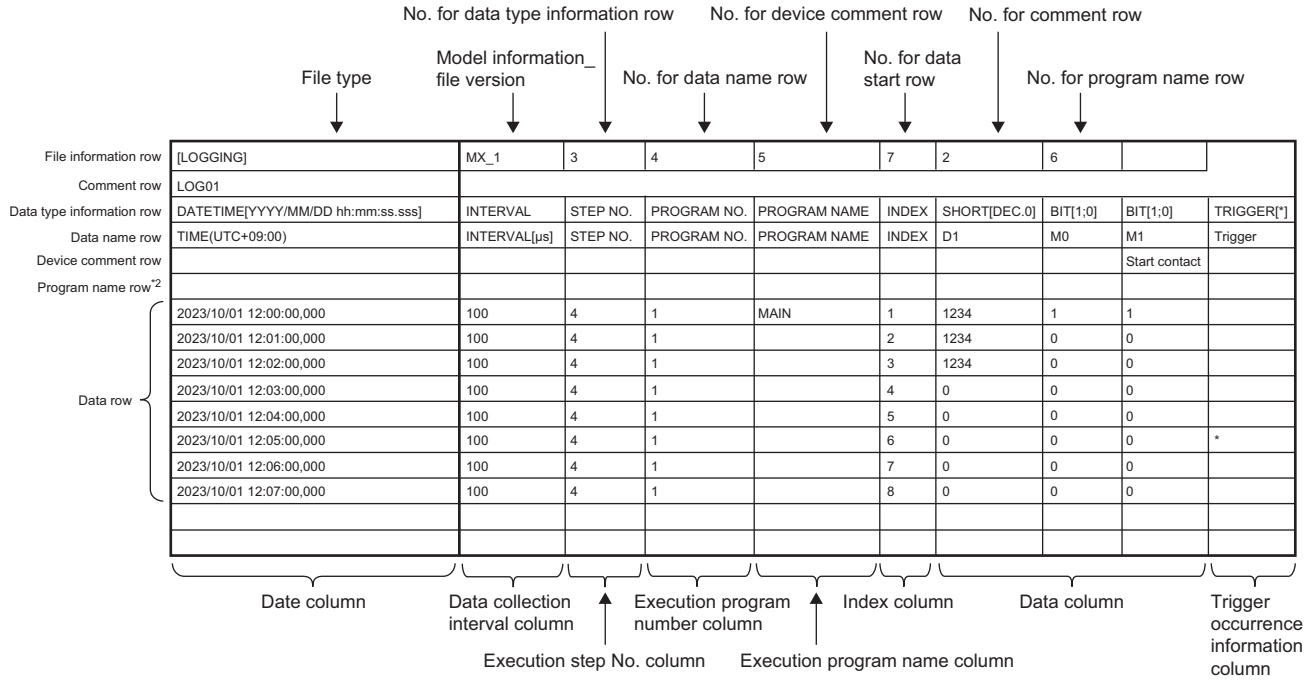
- Format specifications

Item	Description
Delimiter	Tab
Return code	CRLF (0x0D, 0x0A)
Character code	Unicode
Character encoding schema	UTF-16 (Little-Endian)
Field data	Not enclosed by double quotation marks (" ") Double quotation marks (" ") and commas (,) cannot be used in each data.*1

*1 When double quotation marks (" "), commas (,), and/or return codes (CR, LF, CR + LF) are included in the output data, the following processing occurs:
· When the data includes commas (,), whole data is enclosed by double quotation marks (" ").
· When the data includes double quotation marks (" "), another set of double quotation marks will be appended to each of them.
· When the data includes return codes, the data is output with the return code replaced with a space.

- File format example

Output items can be specified. (CPU Module Logging Configuration Tool Version 1 Operating Manual)



• Output content for each data

<File information row>

File-related information is displayed.

Item	Description	Size
File type	[LOGGING] is output.	18 bytes
Model information_file version	MX for the model information and 1 for the file version are output. For example, "MX _1" is output for the MXR300-16.	8 bytes
Data type information row number	Numerical value indicating the position of the data type information row from the top of the file is placed.	2 bytes
No. for data name row	Numerical value indicating the position of the data name row from the top of the file is placed.	2 bytes
No. for device comment row	Numerical value indicating the position of the device comment row from the top of the file is placed.	2 bytes
No. for data start row	Numerical value indicating the starting position of the data row from the top of the file is placed.	2 bytes
No. for comment row	Numerical value indicating the position of the comment row from the top of the file is placed. When the comment row is not output, this field is blank.	0 to 2 bytes
No. for program name row	Numerical value indicating the position of the program name row from the top of the file is placed.	2 bytes

Ex.

The total size of the file information row can be obtained by the following equation: (when comment is output)

18 (file type) + 8 (model information_file version) + 2 (data type information row number) + 2 (data name row number) + 2 (device comment row number) + 2 (data start row number) + 2 (comment row number) + 2 (program name row number) + 12 (number of tabs) + 4 (CR + LF)

= 54 bytes

<Comment row>

Comments are displayed.

Item	Description	Size
Comment	Comment specified in CPU Module Logging Configuration Tool is output (Up to 256 characters is output.*1 If no comment is set, the comment line is not output.)	0 to 512 bytes

*1 Double quotation marks (" "), commas (,), and semicolons (;) cannot be used.

Ex.

The total size of the comment row can be obtained by the following equation:

Character size of the specified comment (depending on the specified string) + 4 (CR + LF)

<Data type information row>

The data type for each column is displayed. This information is output in the following format: (Data type) [(Additional information)].

Item	"Data type" output content	Size	"Additional information" output content	Size
Date column	DATETIME	16 bytes	Format is output. [YYYY/MM/DD hh:mm:ss.sss]	6 to 68 bytes
Data collection interval column	INTERVAL	16 bytes	No additional information	0 bytes
Execution program number column	PROGRAM NO.	22 bytes		
Execution program name column	PROGRAM NAME	24 bytes		
Index column	INDEX	10 bytes		
Data column	Bit type: BIT	6 bytes	Bit type: [1;0]	10 bytes
	16-bit integer (unsigned): USHORT	12 bytes	The following are selectable. (However, hexadecimal format can only be selected for unsigned integers.) • When decimal format is specified: [DEC.0] 14 bytes • When hexadecimal format is specified: [HEX] 10 bytes • When decimal fraction format is specified: [DEC.number of digits after the decimal point] 14 to 16 bytes (depending on the number of digits after the decimal point) • When exponential format is specified: [EXP.(number of digits after the decimal point)] 14 to 16 bytes (depending on the number of digits after the decimal point)	
	16-bit integer (signed): SHORT	10 bytes		
	32-bit integer (unsigned): ULONG	10 bytes		
	32-bit integer (signed): LONG	8 bytes		
	Single-precision floating point (32-bit): FLOAT	10 bytes		
	Double-precision floating point (64-bit): DOUBLE	12 bytes		
	Character string type: STRING	12 bytes	Character string type, numeric string type: the specified data length value (unit: bytes) is output.	6 to 10 bytes
	Numeric string type: RAW	6 bytes		
	Time: TIME	8 bytes	No additional information	0 bytes
Trigger occurrence information column	TRIGGER	14 bytes	[(string occurred)] is output (semicolons (;), double quotation marks (" "), and commas (,) cannot be used).	6 to 516 bytes

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data (signed 16-bit integer, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

(16 + 46) (date column) + 16 (data collection interval column) + 22 (execution program number column) + 24 (execution program name column) + 10 (index column) + (10 + 14) × 128 (data column) + 264 (number of tabs) + 4 (CR + LF)

= 3474 bytes

<Data name row>

The data name for each column is displayed.

Item	Description	Size
Date column	TIME (time zone) is output.	28 bytes
Data collection interval column	INTERVAL[μs] is output.	24 bytes
Execution program number column	PROGRAM NO. is output.	22 bytes
Execution program name column	PROGRAM NAME is output.	24 bytes
Index column	INDEX is output.	10 bytes
Data column	The specified data name is output.	2 to 578 bytes*1
Trigger occurrence information column	Trigger is output.	14 bytes

*1 When the data column is specified and the multidimensional array label is specified, if the index of the array includes comma (,), the data size will increase than the data name string size.

Ex.

The size of the data name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

28 (date column) + 24 (data collection interval column) + 22 (execution program number column) + 24 (execution program name column) + 10 (index column) + (6 × 128) (data column) + 264 (number of tabs) + 4 (CR + LF)

= 1122 bytes

<Program name row>

The program name row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When the collected data is a local device or local label, the specified program name (no extension) is displayed. When the collected data is a global device or global label, this field is blank.	0 to 120 bytes
Trigger occurrence information column	No output (blank).	0 bytes

Ex.

The size of the program name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index". Also, devices from D200 to D214 are specified as the local device of the program No.1 of "MAIN".)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 8 × 28) (data column) + 264 (number of tabs) + 4 (CR + LF)

= 492 bytes

<Device comment row>

The device comment row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When "Output device comments for data" is selected in the output setting, the comment with the specified comment number is displayed. When "Output each program device comment" is selected, the comment with the specified comment number in the device comment file for each program is output only for the local device. When the device comment file for each program or the comment of the corresponding program does not exist, the comment of the device comment file is output. When comments are not output, this field is blank.	0 to 2048 bytes*1
Trigger occurrence information column	No output (blank).	0 bytes

*1 When "Output device comment" is selected in "Device comment output" of the output settings and double quotation marks (" ") and/or commas (,) are included in a device comment, the size of data in use becomes larger than the size of the character string of the device comments.

Ex.

The size of the device comment row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index", and "Device comment output" is specified (only for devices from D200 to D214).)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 14 × 15) (data column) + 264 (number of tabs) + 2 (CR + LF)

= 478 bytes

<Data row>

The collected data value is displayed. All the data items collected during a single collection is displayed in a single row.

Item	Description	Size
Date column	Information is output according to the data row output character string specified in the format.	2 to 64 bytes
Data collection interval column	The time interval from the previous collection time to the current collection time is output. If the maximum display range is exceeded, the count returns to 1 and starts again to output a new time interval (unit: μs, display range: 1 to 100000000000).	2 to 24 bytes
Execution program number column	The program No. executed on the engineering tool at the time interval and timing in which data was collected is output. ☞ Page 1498 Execution program number	2 to 6 bytes
Execution program name column	The program name (no extension) executed on the engineering tool at the time interval and timing in which data was collected is output. If the execution program name is the same as the previous output data, the execution program name becomes blank. ☞ Page 1498 Execution program name Since the program name is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as "." (period).	0 to 200 bytes
Index column	A value which increments in ascending order from 1 is output. When it exceeds the upper limit, it returns to 1 and increments again (range: 1 to 4294967295).	2 to 20 bytes
Data column	When bits are specified: bit On = 1 and bit Off = 0 are output.	2 bytes
	When unsigned/signed word type is specified: data value is output according to the specified output type.	• Decimal format: 2 to 12 bytes • Hexadecimal format: 2 to 8 bytes • Decimal fraction format: 2 to 42 bytes • Exponential format: 10 to 42 bytes
	When unsigned/signed double word type, single-precision real number, or double-precision real number is specified: data value is output according to the specified output type.	• Decimal format: 2 to 22 bytes*1 • Hexadecimal format: 2 to 16 bytes • Decimal fraction format: 2 to 52 bytes*1 • Exponential format: 10 to 44 bytes
	When character string is specified: the specified character string is output.	2 to 256 bytes
	When numeric string is specified: the character string which represented by the hexadecimal in increments of a byte is output without clearance.	4 to 1024 bytes
	When time is specified: T#-24d20h31m23s648ms to T#24d20h31m23s647ms is displayed.	26 to 40 bytes
Trigger occurrence information column	The specified character string is output when the trigger occurs. In other cases, no character string is output.	0 to 512 bytes

*1 When single-precision real number or double-precision real number is specified, if the numerical value to be output does not fall into the range -10000000000.0000 to 10000000000.0000, it is displayed in an exponential format whose number of digits in the decimal part is nine.

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data from D100 to D227 (unsigned word type, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

46 (date column) + 24 (data collection interval column) + 6 (execution program number column) + 200 (execution program name column) + 20 (index column) + (12 × 128) (data column) + 264 (number of tabs) + 4 (CR + LF)

= 2100 bytes

CSV file output format (Shift-JIS)

The following table lists the format specifications of the CSV file output format (Shift-JIS) and output content of each data.

• Format specifications

Item	Description
Delimiter	Comma (,)
Return code	CRLF (0x0D, 0x0A)
Character code	ASCII
Character encoding schema	Shift-JIS
Field data	Not enclosed by double quotation marks (" ") Double quotation marks (" ") and commas (,) cannot be used in each data.*1

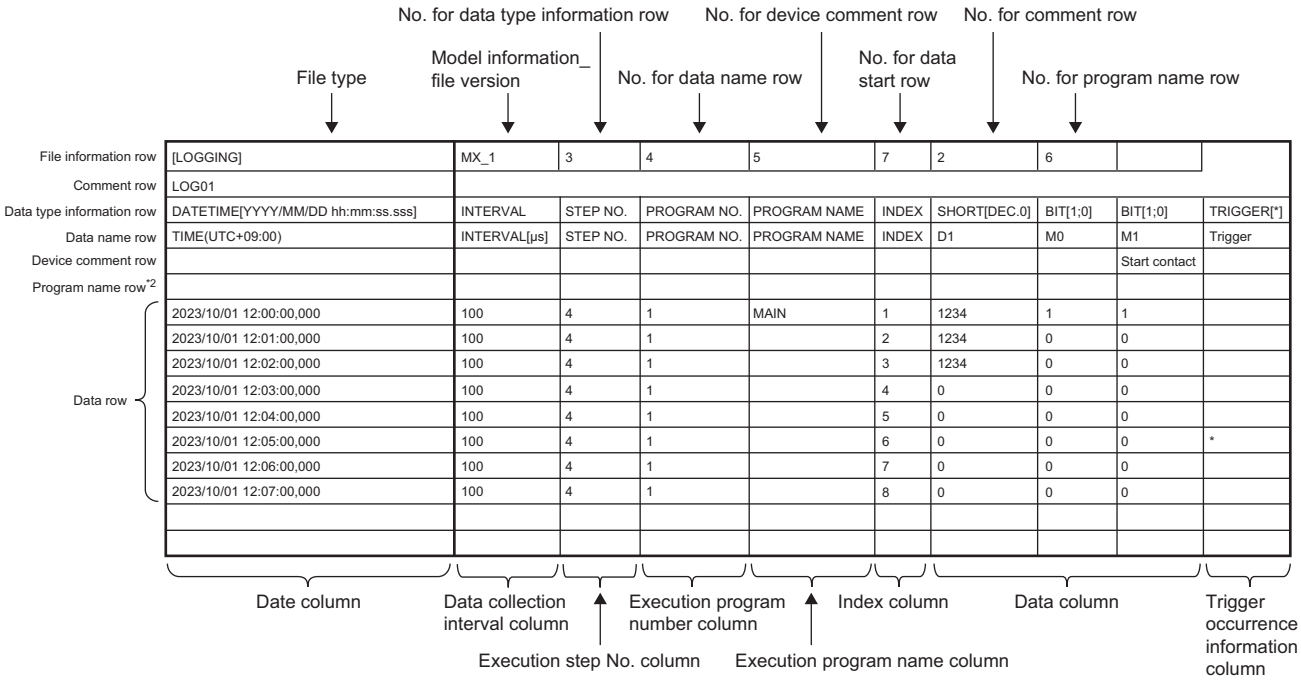
*1 When double quotation marks (" "), commas (,), and/or return codes (CR, LF, CR + LF) are included in the output data, the following processing occurs:
· When the data includes commas (,), whole data is enclosed by double quotation marks (" ").
· When the data includes double quotation marks (" "), another set of double quotation marks will be appended to each of them.
· When the data includes return codes, the data is output with the return code replaced with a space.

Point

Use ASCII characters and characters that can be represented by Shift-JIS for the program name and device comment.

• File format example

Output items can be specified. (CPU Module Logging Configuration Tool Version 1 Operating Manual)



• Output content for each data

<File information row>

File-related information is displayed.

Item	Description	Size
File type	[LOGGING] is output.	9 bytes
Model information_file version	MX for the model information and 1 for the file version are output. For example, "MX _1" is output for the MXR300-16.	4 bytes
Data type information row number	Numerical value indicating the position of the data type information row from the top of the file is placed.	1 byte
No. for data name row	Numerical value indicating the position of the data name row from the top of the file is placed.	1 byte
No. for device comment row	Numerical value indicating the position of the device comment row from the top of the file is placed.	1 byte
No. for data start row	Numerical value indicating the starting position of the data row from the top of the file is placed.	1 byte
No. for comment row	Numerical value indicating the position of the comment row from the top of the file is placed. When the comment row is not output, this field is blank.	0 to 1 bytes
No. for program name row	Numerical value indicating the position of the program name row from the top of the file is placed.	1 byte

Ex.

The total size of the file information row can be obtained by the following equation: (when comment is output)

9 (file type) + 6 (model information_file version) + 4 (data type information row number) + 1 (data name row number) + 1 (device comment row number) + 1 (data start row number) + 1 (comment row number) + 1 (program name row number) + 6 (number of commas) + 2 (CR + LF)

= 27 bytes

<Comment row>

Comments are displayed.

Item	Description	Size
Comment	Comment specified in CPU Module Logging Configuration Tool is output (Up to 256 characters is output.*1 If no comment is set, the comment line is not output.) Since the comment is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as periods (.).	0 to 512 bytes

*1 Double quotation marks (" "), commas (,), and semicolons (;) cannot be used.

Ex.

The total size of the comment row can be obtained by the following equation:

Character size of the specified comment (depending on the specified string) + 2 (CR + LF)

<Data type information row>

The data type for each column is displayed. This information is output in the following format: (Data type)[(Additional information)].

Item	"Data type" output content	Size	"Additional information" output content	Size
Date column	DATETIME	8 bytes	Format is output. [YYYY/MM/DD hh:mm:ss.sss]	3 to 34 bytes
Data collection interval column	INTERVAL	8 bytes	No additional information	0 bytes
Execution program number column	PROGRAM NO.	11 bytes		
Execution program name column	PROGRAM NAME	12 bytes		
Index column	INDEX	5 bytes		
Data column	Bit type: BIT	3 bytes	Bit type: [1;0]	5 bytes
	16-bit integer (unsigned): USHORT	6 bytes	The following are selectable. (However, hexadecimal format can only be selected for unsigned integers.) • When decimal format is specified: [DEC.0] 7 bytes • When hexadecimal format is specified: [HEX] 5 bytes • When decimal fraction format is specified: [DEC.number of digits after the decimal point] 7 to 8 bytes (depending on the number of digits after the decimal point) • When exponential format is specified: [EXP.(number of digits after the decimal point)] 7 to 8 bytes (depending on the number of digits after the decimal point)	
	16-bit integer (signed): SHORT	5 bytes		
	32-bit integer (unsigned): ULONG	5 bytes		
	32-bit integer (signed): LONG	4 bytes		
	Single-precision floating point (32-bit): FLOAT	5 bytes		
	Double-precision floating point (64-bit): DOUBLE	6 bytes		
	Character string type: STRING	6 bytes	Character string type, numeric string type: the specified data length value (unit: bytes) is output.	3 to 5 bytes
	Numeric string type: RAW	3 bytes		
	Time: TIME	4 bytes	No additional information	0 bytes
Trigger occurrence information column	TRIGGER	7 bytes	[(string occurred)] is output (semicolons (;), double quotation marks (" "), and commas (,) cannot be used). Since the string occurred is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as asterisks (*).	3 to 514 bytes

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data (signed 16-bit integer, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

(8 + 25) (date column) + 8 (data collection interval column) + 11 (execution program number column) + 12 (execution program name column) + 5 (index column) + (5 + 7) × 128 (data column) + 132 (number of commas) + 2 (CR + LF)

= 1737 bytes

<Data name row>

The data name for each column is displayed.

Item	Description	Size
Date column	TIME (time zone) is output.	14 bytes
Data collection interval column	INTERVAL [μs] is output.	12 bytes
Execution program number column	PROGRAM NO. is output.	11 bytes
Execution program name column	PROGRAM NAME is output.	12 bytes
Index column	INDEX is output.	5 bytes
Data column	The specified data name is output. Since the data name is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as periods (.).	2 to 578 bytes*1
Trigger occurrence information column	Trigger is output.	7 bytes

*1 When the data column is specified and the multidimensional array label is specified, if the index of the array includes comma (,), the data size will increase than the data name string size.

Ex.

The size of the data name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

14 (date column) + 12 (data collection interval column) + 8 (execution program number column) + 12 (execution program name column) + 5 (index column) + (4 × 128) (data column) + 132 (number of commas) + 2 (CR + LF)

= 697 bytes

<Program name row>

The program name row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When the collected data is a local device or local label, the specified program name (no extension) is displayed. When the collected data is a global device or global label, this field is blank. Since the program name is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as periods (.).	0 to 120 bytes
Trigger occurrence information column	No output (blank).	0 bytes

Ex.

The size of the program name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index". Also, devices from D200 to D214 are specified as the local device of the program No.1 of "MAIN".)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 4 × 15) (data column) + 132 (number of commas) + 2 (CR + LF)

= 194 bytes

<Device comment row>

The device comment row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When "Output device comments for data" is selected in the output setting, the comment with the specified comment number is displayed. When comments are not output, this field is blank. Since the device comment is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as periods (.).	0 to 2048 bytes*1
Trigger occurrence information column	No output (blank).	0 bytes

*1 When "Output device comment" is selected in "Device comment output" of the output settings and double quotation marks (" ") and/or commas (,) are included in a device comment, the size of data in use becomes larger than the size of the character string of the device comments.

Ex.

The size of the device comment row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index", and "Device comment output" is specified (only for devices from D200 to D214).)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 7 × 15) (data column) + 132 (number of commas) + 2 (CR + LF)

= 239 bytes

<Data row>

The collected data value is displayed. All the data items collected during a single collection is displayed in a single row.

Item	Description	Size
Date column	Information is output according to the data row output character string specified in the format.	1 to 32 bytes
Data collection interval column	The time interval from the previous collection time to the current collection time is output. If the maximum display range is exceeded, the count returns to 1 and starts again to output a new time interval (unit: μs, display range: 1 to 100000000000).	1 to 12 bytes
Execution program number column	The program No. executed on the engineering tool at the time interval and timing in which data was collected is output. ☞ Page 1498 Execution program number	1 to 3 bytes
Execution program name column	The program name (no extension) executed on the engineering tool at the time interval and timing in which data was collected is output. If the execution program name is the same as the previous output data, the execution program name becomes blank. ☞ Page 1498 Execution program name Since the program name is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as "." (period).	0 to 120 bytes
Index column	A value which increments in ascending order from 1 is output. When it exceeds the upper limit, it returns to 1 and increments again (range: 1 to 4294967295).	1 to 10 bytes
Data column	When bits are specified: bit On = 1 and bit Off = 0 are output.	1 byte
	When unsigned/signed word type is specified: data value is output according to the specified output type.	• Decimal format: 1 to 6 bytes • Hexadecimal format: 1 to 4 bytes • Decimal fraction format: 1 to 21 bytes • Exponential format: 3 to 21 bytes
	When unsigned/signed double word type, single-precision real number, or double-precision real number is specified: data value is output according to the specified output type.	• Decimal format: 1 to 11 bytes*1 • Hexadecimal format: 1 to 8 bytes • Decimal fraction format: 1 to 26 bytes*1 • Exponential format: 3 to 22 bytes
	When character string is specified: the specified character string is output.	1 to 256 bytes
	When numeric string is specified: the character string which represented by the hexadecimal in increments of a byte is output without clearance.	1 to 256 bytes
	When time is specified: T#-24d20h31m23s648ms to T#24d20h31m23s647ms is displayed.	13 to 20 bytes
Trigger occurrence information column	The specified character string is output when the trigger occurs. In other cases, no character string is output. Since the trigger occurrence information is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as asterisks (*).	0 to 512 bytes

*1 When single-precision real number or double-precision real number is specified, if the numerical value to be output does not fall into the range -10000000000.0000 to 10000000000.0000, it is displayed in an exponential format whose number of digits in the decimal part is nine.

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data from D100 to D227 (unsigned word type, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

23 (date column) + 12 (data collection interval column) + 3 (execution program number column) + 100 (execution program name column) + 10 (index column) + (6 × 128) (data column) + 132 (number of commas) + 2 (CR + LF)

= 1050 bytes

CSV file output format (Unicode)

The following table lists the format specifications of the CSV file output format (Unicode) and output content of each data.

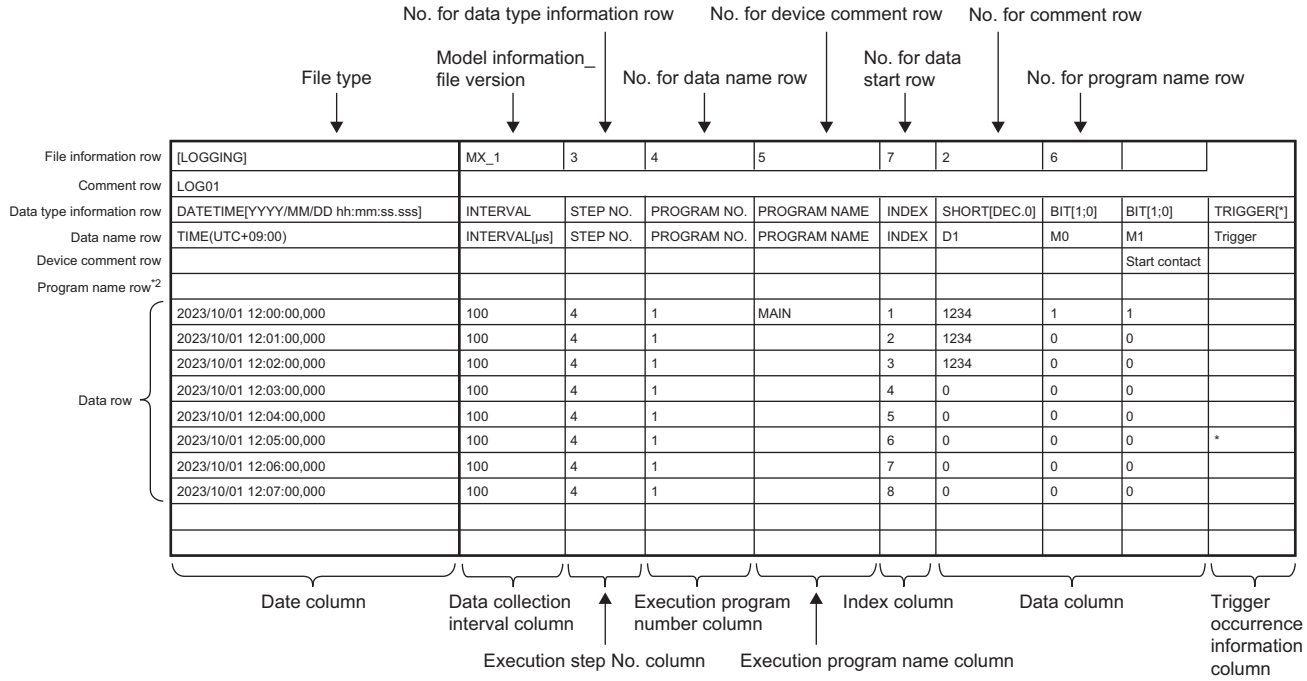
- Format specifications

Item	Description
Delimiter	Tab
Return code	CRLF (0x0D, 0x0A)
Character code	Unicode
Character encoding schema	UTF-16 (Little-Endian)
Field data	Not enclosed by double quotation marks (" ") Double quotation marks (" ") and commas (,) cannot be used in each data.*1

*1 When double quotation marks (" "), commas (,), and/or return codes (CR, LF, CR + LF) are included in the output data, the following processing occurs:
· When the data includes commas (,), whole data is enclosed by double quotation marks (" ").
· When the data includes double quotation marks (" "), another set of double quotation marks will be appended to each of them.
· When the data includes return codes, the data is output with the return code replaced with a space.

- File format example

Output items can be specified. (CPU Module Logging Configuration Tool Version 1 Operating Manual)



• Output content for each data

<File information row>

File-related information is displayed.

Item	Description	Size
File type	[LOGGING] is output.	18 bytes
Model information_file version	MX for the model information and 1 for the file version are output. For example, "MX _1" is output for the MXR300-16.	8 bytes
Data type information row number	Numerical value indicating the position of the data type information row from the top of the file is placed.	2 bytes
No. for data name row	Numerical value indicating the position of the data name row from the top of the file is placed.	2 bytes
No. for device comment row	Numerical value indicating the position of the device comment row from the top of the file is placed.	2 bytes
No. for data start row	Numerical value indicating the starting position of the data row from the top of the file is placed.	2 bytes
No. for comment row	Numerical value indicating the position of the comment row from the top of the file is placed. When the comment row is not output, this field is blank.	0 to 2 bytes
No. for program name row	Numerical value indicating the position of the program name row from the top of the file is placed.	2 bytes

Ex.

The total size of the file information row can be obtained by the following equation: (when comment is output)

18 (file type) + 8 (model information_file version) + 2 (data type information row number) + 2 (data name row number) + 2 (device comment row number) + 2 (data start row number) + 2 (comment row number) + 2 (program name row number) + 14 (number of commas) + 4 (CR + LF)

= 54 bytes

<Comment row>

Comments are displayed.

Item	Description	Size
Comment	Comment specified in CPU Module Logging Configuration Tool is output (Up to 256 characters is output.*1 If no comment is set, the comment line is not output.)	0 to 512 bytes

*1 Double quotation marks (" "), commas (,), and semicolons (;) cannot be used.

Ex.

The total size of the comment row can be obtained by the following equation:

Character size of the specified comment (depending on the specified string) + 4 (CR + LF)

<Data type information row>

The data type for each column is displayed. This information is output in the following format: (Data type) [(Additional information)].

Item	"Data type" output content	Size	"Additional information" output content	Size
Date column	DATETIME	16 bytes	Format is output. [YYYY/MM/DD hh:mm:ss.sss]	6 to 68 bytes
Data collection interval column	INTERVAL	16 bytes	No additional information	0 bytes
Execution program number column	PROGRAM NO.	22 bytes		
Execution program name column	PROGRAM NAME	24 bytes		
Index column	INDEX	10 bytes		
Data column	Bit type: BIT	6 bytes	Bit type: [1;0]	10 bytes
	16-bit integer (unsigned): USHORT	12 bytes	The following are selectable. (However, hexadecimal format can only be selected for unsigned integers.) • When decimal format is specified: [DEC.0] 14 bytes • When hexadecimal format is specified: [HEX] 10 bytes • When decimal fraction format is specified: [DEC.number of digits after the decimal point] 14 to 16 bytes (depending on the number of digits after the decimal point) • When exponential format is specified: [EXP.(number of digits after the decimal point)] 14 to 16 bytes (depending on the number of digits after the decimal point)	
	16-bit integer (signed): SHORT	10 bytes		
	32-bit integer (unsigned): ULONG	10 bytes		
	32-bit integer (signed): LONG	8 bytes		
	Single-precision floating point (32-bit): FLOAT	10 bytes		
	Double-precision floating point (64-bit): DOUBLE	12 bytes		
	Character string type: STRING	12 bytes	Character string type, numeric string type: the specified data length value (unit: bytes) is output.	6 to 10 bytes
	Numeric string type: RAW	6 bytes		
	Time: TIME	8 bytes	No additional information	0 bytes
Trigger occurrence information column	TRIGGER	14 bytes	[(string occurred)] is output (semicolons (;), double quotation marks (" "), and commas (,) cannot be used). Since the string occurred is stored in Unicode, the data is converted to ASCII and Shift-JIS. If any characters that cannot be converted to ASCII or Shift-JIS are specified, the conversion fails and those characters will be output as asterisks (*).	6 to 516 bytes

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data (signed 16-bit integer, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

(16 + 46) (date column) + 16 (data collection interval column) + 22 (execution program number column) + 24 (execution program name column) + 10 (index column) + (10 + 14) × 128 (data column) + 264 (number of commas) + 4 (CR + LF)

= 3474 bytes

<Data name row>

The data name for each column is displayed.

Item	Description	Size
Date column	TIME (time zone) is output.	28 bytes
Data collection interval column	INTERVAL [μs] is output.	24 bytes
Execution program number column	PROGRAM NO. is output.	22 bytes
Execution program name column	PROGRAM NAME is output.	24 bytes
Index column	INDEX is output.	10 bytes
Data column	The specified data name is output.	2 to 578 bytes*1
Trigger occurrence information column	Trigger is output.	14 bytes

*1 When the data column is specified and the multidimensional array label is specified, if the index of the array includes comma (,), the data size will increase than the data name string size.

Ex.

The size of the data name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

28 (date column) + 24 (data collection interval column) + 22 (execution program number column) + 24 (execution program name column) + 10 (index column) + (6 × 128) (data column) + 264 (number of commas) + 4 (CR + LF)

= 1122 bytes

<Program name row>

The program name row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When the collected data is a local device or local label, the specified program name (no extension) is displayed. When the collected data is a global device or global label, this field is blank.	0 to 120 bytes
Trigger occurrence information column	No output (blank).	0 bytes

Ex.

The size of the program name row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date", "Data sampling interval", "Execution program number", "Execution program name", and "Index". Also, devices from D200 to D214 are specified as the local device of the program No.1 of "MAIN".)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 8 × 15) (data column) + 264 (number of commas) + 4 (CR + LF)

= 388 bytes

<Device comment row>

The device comment row for each column is displayed.

Item	Description	Size
Date column	No output (blank).	0 bytes
Data collection interval column		
Execution program number column		
Execution program name column		
Index column		
Data column	When "Output device comments for data" is selected in the output setting, the comment with the specified comment number is displayed. When comments are not output, this field is blank.	0 to 2048 bytes*1
Trigger occurrence information column	No output (blank).	0 bytes

*1 When "Output device comment" is selected in "Device comment output" of the output settings and double quotation marks (" ") and/or commas (,) are included in a device comment, the size of data in use becomes larger than the size of the character string of the device comments.

Ex.

The size of the device comment row is determined by the following equation when data logging of 128 data points from D100 to D227 is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index", and "Device comment output" is specified (only for devices from D200 to D214).)

0 (date column) + 0 (data collection interval column) + 0 (execution program number column) + 0 (execution program name column) + 0 (index column) + (0 × 100 + 14 × 15) (data column) + 264 (number of commas) + 4 (CR + LF)

= 478 bytes

<Data row>

The collected data value is displayed. All the data items collected during a single collection is displayed in a single row.

Item	Description	Size
Date column	Information is output according to the data row output character string specified in the format.	2 to 64 bytes
Data collection interval column	The time interval from the previous collection time to the current collection time is output. If the maximum display range is exceeded, the count returns to 1 and starts again to output a new time interval (unit: μs, display range: 1 to 100000000000).	2 to 24 bytes
Execution program number column	The program No. executed on the engineering tool at the time interval and timing in which data was collected is output. ☞ Page 1498 Execution program number	2 to 6 bytes
Execution program name column	The program name (no extension) executed on the engineering tool at the time interval and timing in which data was collected is output. If the execution program name is the same as the previous output data, the execution program name becomes blank. ☞ Page 1498 Execution program name	0 to 200 bytes
Index column	A value which increments in ascending order from 1 is output. When it exceeds the upper limit, it returns to 1 and increments again (range: 1 to 4294967295).	2 to 20 bytes
Data column	When bits are specified: bit On = 1 and bit Off = 0 are output.	2 bytes
	When unsigned/signed word type is specified: data value is output according to the specified output type.	• Decimal format: 2 to 12 bytes • Hexadecimal format: 2 to 8 bytes • Decimal fraction format: 2 to 42 bytes • Exponential format: 10 to 42 bytes
	When unsigned/signed double word type, single-precision real number, or double-precision real number is specified: data value is output according to the specified output type.	• Decimal format: 2 to 22 bytes*1 • Hexadecimal format: 2 to 16 bytes • Decimal fraction format: 2 to 52 bytes*1 • Exponential format: 10 to 44 bytes
	When character string is specified: the specified character string is output.	2 to 256 bytes
	When numeric string is specified: the character string which represented by the hexadecimal in increments of a byte is output without clearance.	4 to 1024 bytes
	When time is specified: T#-24d20h31m23s648ms to T#24d20h31m23s647ms is displayed.	26 to 40 bytes
Trigger occurrence information column	The specified character string is output when the trigger occurs. In other cases, no character string is output.	0 to 512 bytes

*1 When single-precision real number or double-precision real number is specified, if the numerical value to be output does not fall into the range -10000000000.0000 to 10000000000.0000, it is displayed in an exponential format whose number of digits in the decimal part is nine.

Ex.

The size of the data type information row is determined by the following equation when data logging of 128 points of data from D100 to D227 (unsigned word type, decimal format) is performed. (The following sections in the "Output" window are set to be output: "Date" (the output format is YYYY/MM/DD hh:mm:ss.sss), "Data sampling interval", "Execution program number", "Execution program name", and "Index".)

46 (date column) + 24 (data collection interval column) + 6 (execution program number column) + 200 (execution program name column) + 20 (index column) + (12 × 128) (data column) + 264 (number of commas) + 4 (CR + LF)

= 2100 bytes

JSON file output format

The following table lists the format specifications of the JSON file output format and output content of each data.

- Format specifications

Item	Description
Delimiter	Compatible with international standard RFC8259
Return code	No line breaks
Character code	Unicode
Character encoding schema	UTF-8 BOM
Field data	Compatible with international standard RFC8259

*1 When double quotation marks (" ") and/or commas (,) are included in the output data, a backslash is added before the data.

- File format example

```
{
  "FileType":"LOGGING"                    (Common header section)
  "Ver":"1.00"
  "Creator":"MX"
  "Comment": "Logging function"

  "Recod"
  {
    "MXSettingInfo":                      (Logging setting information section)
    {
      "LOGGING":                          (Common items)
      {
      }
      "SAVEFILEINFO":                     (Storage file information)
      {
      }
      "COLLECTCONDITION":                 (Collection condition)
      {
      }
      "SAVESWITCHCONDITION":              (File switching condition)
      {
      }
      "TRIGGERCONDITION":[                (Trigger condition)
        {
        }
      ]
      "DATA":[                            (Trigger condition data)
        {
        }
      ]
    }
    "DataInfo":[                          (Logging data information section)
      {
        (Information about output items and collected data is stored.)
      }
    ]
    "Data":[                              (Logging data section)
      [ ],
      [ ],  (Data about output items and collected data is stored.)
      [ ]
    ]
  }
}
```

• Output content for each data

<Common header items>

Item	Key name	Data type	Output content
File type	FileType	String	Output is fixed to [LOGGING].
File version	Ver	String	Major version, minor version 1.00 (fixed)
Model information	Creator	String	MX indicating model information is output.
Comment	Comment	String	Comment specified in CPU Module Logging Configuration Tool is output (Up to 256 characters. When no comment is set, this field is blank.)

<Data logging information (key name: Record)>

Item	Key name	Data type	Output content
Logging setting information section	□SettingInfo	String	"Data logging setting" and "Trigger condition" are stored. MX indicating model information is output to the □ in the key name, becoming "MXSettingInfo".
Logging data information section	DataInfo	String	Device/label information that was set in the collection settings is stored.
Logging data section	Data	String	The collected data is stored.

<Logging setting information section (key name: Model information + SettingInfo)>

Item		Key name	Data type	Output content
Logging setting information section		□SettingInfo	String	"Data logging setting" and "Trigger condition" are stored. MX indicating model information is output to the □ in the key name, becoming MXSettingInfo.
(1)	Common items	LOGGING	String	Data logging setting information is stored.
(2)	Storage file information	SAVEFILEINFO	String	Storage folder and information added to the storage file name are stored.
(3)	Collection conditions	COLLECTCONDITION	String	Information on collection conditions is stored.
(4)	File switching condition	SAVESWITCHCONDITION	String	File switching condition is stored.
(5)	Trigger condition	TRIGGERCONDITION	String	Information on trigger conditions is stored.
(6)	Trigger condition data	DATA	String	The device/label name and data type that was specified by the trigger condition are stored.

(1) Common items (key name: LOGGING)

The following table lists information to be output to common items.

Item	Key name	Data type	Output content
Logging name	NAME	String	Data logging name: "LOG**" (** Setting No.) is fixed and stored.
Logging type	TFFLGTP	String	• CONT: Continuous logging • TRIGGER: Trigger logging
Start condition	STARTCONDITION	String	• AUTO: Starting automatically upon initial completion • RUN: Starting automatically at transition to RUN • MANUAL: Start by user operation.
End condition	STOPCONDITION	String	• OTHER: Stop when transitioning to a state other than RUN • MANUAL: Stop by user operation
Data storage location	SAVESTORAGE	String	• SD: SD memory card • FUNCMEM: Function memory • DATAMEM: User memory
File format	TFFFILE	String	JSON (fixed)
Trigger type (complex condition)	TRGCOMPTYPE	String	• When (TFFLGTP = TRIGGER) is selected: OR / AND • Other than the above: Blank
Number of trigger logging	TRIGGERTIME	Numerical value	• When (TFFLGTP = TRIGGER) is selected When the number of files to save is selected: 0 (fixed) When the number of times is specified: 1 to 32767 • Other than the above: Fixed to 0
No. of records (before trigger)	LLNBEFOR	Numerical value	• When (TFFLGTP = TRIGGER) is selected: 0 to 999999 • Other than the above: Fixed to 0
No. of records (after trigger)	LLNAFTER	Numerical value	• When (TFFLGTP = TRIGGER) is selected: 1 to 1000000 • Other than the above: Fixed to 0
Total No. of records	LLNTOTAL	Numerical value	• When (TFFLGTP = TRIGGER) is selected: 1 to 1000000 • Other than the above: Fixed to 0
Number of files to be saved	SAVFNUM	Numerical value	• When (maximum value not specified) is selected: 0 (fixed) • When (maximum number of files) is selected: 1 to 65535
When the maximum number of files is exceeded	SAVFNUMTYPE	String	• When (TFFLGTP = CONT) OVERWRITE: Overwrite STOP: Stop • When (TFFLGTP = TRIGGER): Blank

The following example is information to be output to common items.

```
"LOGGING":
{
    "NAME":"LOG01";
    "TFFLGTP":"TRIGGER";
    "STARTCONDITION":"AUTO";
    "STOPCONDITION":"MANUAL";
    "SAVESTORAGE":"DATAMEM";
    "TFFFILE":"JSON";
    "TRGCOMPTYPE":"AND";
    "TRIGGERTIME":"32767";
    "LLNBEFOR":"1000";
    "LLNAFTER":"1000";
    "LLNTOTAL":"2000";
    "SAVFNUM":"65535";
    "SAVFNUMTYPE":"";
}
```

(2) Storage file information (key name: SAVEFILEINFO)

The following table lists the information to be output to storage file information.

Item	Key name	Data type	Output content
Storage location path	SAVFLDNAMEDETLFRMT	String	Storage destination path (example: LOGGING/LOG01)
Storage folder additional information	ADDFOLDERNAME	String	• DATE: Date • TIME: Time • DATETIME: Date and time • Blank: Not specified
Additional information setting for storage file name	ADDFILETYPE	String	• SIMPLE: Simple setting • OPTIONAL: Optional setting
Storage file additional information	ADDFILENAME	String	■ADDFILETYPE = SIMPLE • FOLDERNAME: Folder name • DATE: Date • TIME: Time • FOLDERNAMEDATE: Folder name + date • FOLDERNAMETIME: Folder name + time • FOLDERNAMEDATETIME: Folder name + date + time • DATETIME: Date + time • Blank: Not specified ■ADDFILETYPE = OPTIONAL Blank
Date type additional information	ADDSTATE	String	• SWITCH: Date to establish file switching condition • MAKE: File creation date • Blank: Not specified
Device value additional information	ADDDEVINFO	BOOL	■ADDFILETYPE = SIMPLE false: No additional information ■ADDFILETYPE = OPTIONAL • true: With additional information • false: No additional information
Device name	DEVNAME	String	■ADDDEVINFO= true • Specified device name (example: M0, SD1, W1F) • Other than the above: Blank
Device data type	DATA	String	■ADDDEVINFO= true • WORD: Word [unsigned] • STRING: String • Other than the above: Blank
Number of collected data	DATANUM	Numerical value	The number of digits/number of characters is stored.
Format	FORMAT	String	■ADDFILETYPE = SIMPLE Blank ■ADDFILETYPE = OPTIONAL • No additional device value information: YYYYMMDD_ddd_YYY_LOG01 • With additional device value information: XXX_YYYYMMDD_ddd_YYY_LOG01

The following example is information to be output to storage file information.

```
"SAVEFILEINFO":
{
    "SAVFLDNAMEDETLFRMT":"LOGGING/LOG01";
    "ADDFOLDERNAME":"DATE";
    "ADDFILETYPE":"OPTIONAL";
    "ADDFILENAME":"TIME";
    "ADDSTATE":"SWITCH";
    "ADDDEVINFO":"true";
    "DEVNAME":"W1F";
    "DATA":"WORD";
    "FORMAT":"XXX_YYYYMMDD_ddd_YYY_LOG01";
}
```

(3) Collection condition (key name: COLLECTCONDITION)

The following table lists information to be output to the collection condition.

Item	Key name	Data type	Output content
Collection interval	TYPE	String	• SCAN: Each scan • TIME: Time specification • BASESYNC: Basic cycle • MIDSYNC: Medium speed synchronization • LOWSYNC: Low speed synchronization • AFTERPRG: After executing the program • DATACMP: Condition specification
Time specification	COLLECTTIME	Numerical value	■TYPE = TIME • 1 to 86400000 [ms] • Other than the above: Fixed to 0
Program name to be specified after the execution of specified program	AFTERPRGNAME	String	■TYPE = AFTERPRG Program name to be specified after the execution of specified program
Data type	DATATYPE	String	■TYPE = DATACMP • GLOBALDEVICE: Global device • LOCALDEVICE: Local device • GLOBALLABEL: Global label • LOCALLABEL: Local label ■Other than the above Blank
Comparison condition	DATAOPE	String	■TYPE = DATACMP • EQUAL: [=] • NOTEQUAL: [≠] • GREATERTHANEQUAL: [≥] • GREATERTHAN: [>] • LESSTHANEQUAL: [≤] • LESSTHAN: [<] • RISINGEDGE: [↑] • FALLINGEDGE: [↓] • DATACHANGE: [At change] ■Other than the above Blank
Device/label name	NAME	String	■TYPE = DATACMP Device name/label name (example: D0, M0, LABEL) ■Other than the above Blank
Base number specification	BASENUM	String	■TYPE = DATACMP • DEC: Decimal • HEX: Hexadecimal • Blank: Not specified ■Other than the above Blank
Comparison type	CMPDATA	String	■TYPE = DATACMP • DATA: Data comparison • CONST: Constant comparison ■Other than the above Blank
Data type	DATA	String	■TYPE = DATACMP • BIT: Bit • SWORD, UWORD: Word • SDWORD, UDWORD: Double word • FLOAT: Single-precision real number • DFLOAT: Double-precision real number ■Other than the above Blank
Constant value	DATA2CONST	Numerical value	■TYPE = DATACMP • CMPDATA = CONST Constant value (bit): Specify 0/1 Constant value (DATACHANGE [At change]): 0 (fixed) • CMPDATA = DATA 0 (fixed) ■Other than the above 0 (fixed)

Item	Key name	Data type	Output content
Data type	DATA2TYPE	String	■CMPDATA = DATA • GLOBALDEVICE: Global device • LOCALDEVICE: Local device • GLOBALLABEL: Global label • LOCALLABEL: Local label ■Other than the above Blank
Device/label name	DATA2NAME	String	■CMPDATA = DATA Device name/label name (example: D0, M0, LABEL) ■Other than the above Blank

The following example is information to be output to the collection condition.

```
"COLLECTCONDITION":
{
    "TYPE":"DATACMP";
    "COLLECTTIME":"0";
    "AFTERPRGNAME":"";
    "DATATYPE":"GLOBALLABEL";
    "DATAOPE":"GREATERTHANEQUAL";
    "NAME":"COLLECTFLG";
    "BASENUM":"DEC";
    "CMPDATA":"DATA";
    "DATA":"UWORD";
    "DATA2CONST":"-1";
    "DATA2TYPE":"GLOBALDEVICE";
    "DATA2NAME":"#D100";
}
```

(4) File switching condition (key name: SAVESWITCHCONDITION)

The following table lists information to be output to the file switching condition.

Item	Key name	Data type	Output content
File switching timing	SWITCHTYPE	String	• RECORDNUM: Number of records • FILESIZE: File size • DATACMP: Condition specification • Blank: Not specified
Number of file switches	SAVSWICTMNRECNUM	Numerical value	■SWITCHTYPE = RECORDNUM 1 to 1000000: Number of records ■SWITCHTYPE = FILESIZE 10 to 16384 [KB]: File size ■SWITCHTYPE = DATACMP 0 (fixed) ■Other than the above 0 (fixed)
Data type	DATATYPE	String	■SWITCHTYPE = DATACMP • GLOBALDEVICE: Global device • LOCALDEVICE: Local device • GLOBALLABEL: Global label • LOCALLABEL: Local label ■Other than the above Blank
Comparison condition	DATAOPE	String	■SWITCHTYPE = DATACMP • EQUAL: [=] • NOTEQUAL: [≠] • GREATERTHANEQUAL: [≥] • GREATERTHAN: [>] • LESSTHANEQUAL: [≤] • LESSTHAN: [<] • RISINGEDGE: [↑] • FALLINGEDGE: [↓] • DATACHANGE: [At change] ■Other than the above Blank
Device/label name	NAME	String	■SWITCHTYPE = DATACMP Device name/label name (example: D0, M0, LABEL) ■Other than the above Blank
Base number specification	BASENUM	String	■SWITCHTYPE = DATACMP DEC: Decimal HEX: Hexadecimal Blank: Not specified ■Other than the above Blank
Comparison type	CMPDATA	String	■SWITCHTYPE = DATACMP CONST: Constant comparison ■Other than the above Blank
Data type	DATA	String	■SWITCHTYPE = DATACMP • BIT: Bit • SWORD, UWORD: Word • SDWORD, UDWORD: Double word • FLOAT: Single-precision real number • DFLOAT: Double-precision real number ■Other than the above Blank
Constant value	DATA2CONST	Numerical value	■When SWITCHTYPE = DATACMP and CMPDATA = CONST Constant value • bit: Specify 0/1 • DATACHANGE (At change): 0 (Fixed) ■Other than the above -1 (fixed)

The following example is information to be output to the file switching condition.

```
"SAVESWITCHCONDITION":
{
    "SWITCHTYPE":"";
    "SAVSWICTMNRECNUM":"0";
    "DATATYPE":"";
    "DATAOPE":"";
    "NAME":"";
    "BASENUM":"";
    "CMPDATA":"";
    "DATA":"";
    "DATA2CONST":"-1";
}
```

(5) Trigger condition (key name: TRIGGERCONDITION)

The following table lists information to be output to the trigger condition.

Item	Key name	Data type	Output content
Trigger setting number	NO	Numerical value	1 to 32
Condition type	TYPE	String	• DATACMP: Condition specification • CYCLE: Fixed cycle • EVENTHISTORY: Event history
DATA number	DATA1	Numerical value	■TYPE = DATACMP 1 to 64: DATA object number ■Other than the above 0 (fixed)
Comparison condition	DATAOPE	String	■TYPE = DATACMP • EQUAL: [=] • NOTEQUAL: [≠] • GREATERTHANEQUAL: [≥] • GREATERTHAN: [>] • LESSTHANEQUAL: [≤] • LESSTHAN: [<] • RISINGEDGE: [↑] • FALLINGEDGE: [↓] • DATACHANGE: [At change] ■Other than the above Blank
Base number specification	BASENUM	String	■TYPE = DATACMP • DEC: Decimal • HEX: Hexadecimal • Blank: Not specified ■Other than the above Blank
Comparison type	CMPDATA	String	■TYPE = DATACMP • DATA: Data comparison • CONST: Constant comparison ■Other than the above Blank
DATA number	DATA2	Numerical value	■CMPDATA = DATA 1 to 64: DATA object number ■Other than the above 0 (fixed)
Constant value	DATA2CONST	Numerical value	■CMPDATA = CONST Constant value • bit: Specify 0/1 • DATACHANGE (At change): 0 (Fixed) ■Other than the above 0 (fixed)
Fixed cycle time	CYCLTIME	Numerical value	■TYPE = CYCLE 1 to 86400000ms ■Other than the above 0 (fixed)
Event code	EVENTCODE	String	■TYPE = EVENTHISTORY Event code ■Other than the above Blank

The following example is information to be output to the trigger condition.

```
"TRIGGERCONDITION":[
    {
        "NO":"1";
        "TYPE":"CYCLE";
        "DATA1":"0";
        "DATAOPE":"";
        "BASENUM":"";
        "CMPDATA":"";
        "DATA2":"0";
        "DATA2CONST":"0.";
        "CYCLTIME":"86400000";
        "EVENTCODE":"";
    },
    {
        "NO":"2";
        "TYPE":"EVENTHISTORY";
        "DATA1":"0";
        "DATAOPE":"";
        "BASENUM":"";
        "CMPDATA":"";
        "DATA2":"0";
        "DATA2CONST":"0.";
        "CYCLTIME":"0";
        "EVENTCODE":"H1A00-H1BFF,H1C41,H1C45";
    },
    {
        "NO":"3";
        "TYPE":"DATACMP";
        "DATA1":"1";
        "DATAOPE":"LESSTHAN";
        "BASENUM":"HEX";
        "CMPDATA":"DATA";
        "DATA2":"2";
        "DATA2CONST":"0.";
        "CYCLTIME":"0";
        "EVENTCODE":"";
    }
]
```

(6) Trigger condition data (key name: DATA)

The following table lists information to be output to the trigger condition data.

Item	Key name	Data type	Output content
Trigger information number	NO	Numerical value	1 to 64: Serial number
Data type	DATATYPE	String	• GLOBALDEVICE: Global device • LOCALDEVICE: Local device • GLOBALLABEL: Global label • LOCALLABEL: Local label
Device/label name	NAME	String	Device name/label name (example: D0, M0, LABEL)
Data type	DATA	String	• BIT: Bit • SWORD, UWORD: Word • SDWORD, UDWORD: Double word • FLOAT: Single-precision real number • DFLOAT: Double-precision real number

The following example is information to be output to the trigger condition data.

```
"DATA":[
    {
        "NO":"1";
        "DATATYPE":"GLOBALLABEL",
        "NAME":"[VAR]MotionSystem.Md.OperationCycle[1].ProcessingTime",
        "DATA":"UDWORD"
    },
    {
        "NO":"1",
        "DATATYPE":"GLOBALDEVICE",
        "NAME":"M0",
        "DATA":"UDWORD";
    },
    {
        "NO":"1",
        "DATATYPE":"LOCALDEVICE",
        "NAME":"#D100",
        "DATA":"UDWORD"
    }
]
```

<Data logging information section (key name: DataInfo)>

Item	Key name	Data type	Output content	
Type Order	Type Order	String Numerical value	(1)	TIME: Day and time
			(2)	INTERVAL: Data collection interval
			(3)	PRGNO: Execution program number
			(4)	PRGNAME: Execution program name
			(6)	INDEX: Index
			(7)	DATA: Data
			(8)	TRIGGER: Triggered information
			1 to N (N: Number of data): Corresponding column number in the Data part	

(1) TIME

Item	Key name	Data type	Output content
Time information type	TimeType	String	ABS_TIME: Absolute value
Time Zone	TimeZone	String	Standard time zone
Time format	DateFormat	String	Date format

(2) INTERVAL

Item	Key name	Data type	Output content
Unit	IntervalUnit	String	Unit of time for collection interval (example: μs)

(3) PRGNO

Item name	Key name	Data type	Output content
—	—	—	—

(4) PRGNAME

Item name	Key name	Data type	Output content
—	—	—	—

(6) INDEX

Item	Key name	Data type	Output content
—	—	—	The numerical values counted up from 1 in ascending order

(7) DATA

Item	Key name	Data type	Output content
Data name	DataName	String	Displays the specified data (example: M0, #D100, W30, LABEL).
Comment	DataComment	String	—
Data type	DataType	String	Set according to the EdgeCross type. ■Bit BOOL [1;0] ■Word [signed] INT [DEC.0] ■Word [unsigned] • UINT [DEC.0] • UINT [HEX] ■Double word [signed] DINT [DEC.0] ■Double word [unsigned] • UDINT [DEC.0] • UDINT [HEX] ■Single precision floating point • REAL [DEC.7]*2 ■Double precision floating point • LREAL [DEC.14]*2 ■Character string, time, numeric string WSTRING [(data length)]
Motion unit	MotionUnit	String	Unit information when the motion control data label is specified by data name

Item	Key name	Data type	Output content
Program name	DefPrgName	Character string	The output contents differ depending on collected data. ■Local device or local label Specified program name (without extension) ■Global device or global label Blank

*2 The number of decimal digits indicates the number of significant digits compatible with IEEE 754. Rounding or a large number of digits may appear in the actual output.
For example, if it is 1.2345, 1.2345000 will not be output.

(8) TRIGGER

Item	Key name	Data type	Output content
Trigger symbol	Mark	Character	Displayed at the trigger occurrence location (example: *).

The following example is information to be output to the logging data information section.

```
"DataInfo":[
    {
        "Type":"TIME",
        "Order":"1",
        "TimeType":"ABS_TIME",
        "TimeZone":"UTC+9:00",
        "DataFormat":"YYYY/MM/DD hh:mm:ss.ssssss"
    },                                                    (1)
    {
        "Type":"INTERVAL",
        "Order":"2",
        "IntervalUnit":"us"
    },                                                    (2)
    {
        "Type":"PRGNO",
        "Order":"3",
    },                                                    (3)
    {
        "Type":"PRGNAME",
        "Order":"4"
    },                                                    (4)
    {
        "Type":"INDEX",
        "Order":"5"
    },                                                    (6)
    {
        "Type":"DATA",
        "Order":"6",
        "DataName":"M0",
        "DataComment":"",
        "DataType":"BOOL[1;0]",
        "Motion":"",
        "DefPrgName":""
    },                                                    (7)
    {
        "Type":"DATA",
        "Order":"7",
        "DataName":"#D100",
        "DataComment":"COMMENT",
        "DataType":"DINT[DEC.0]",
        "Motion":"",
        "DefPrgName":"MAIN2"
    },                                                    (7)
    {
        "Type":"TRIGGER",
        "Order":"8",
        "Mark":"*"
    }                                                     (8)
]
```

<Logging data section (key name: Data)>

Item		Output format	Output content
(1)	Date*1	String	Information is output according to the data output character string format specified in the settings.
(2)	Data collection interval	Numerical value	The time interval from the previous collection time to the current collection time is output. If the maximum display range of 100000000000 is exceeded, it returns to 1 and starts again to output a new time interval.
(3)	Execution program number	Numerical value	The program No. executed on the engineering tool at the time interval and timing in which data was collected is output. ☞ Page 1498 Execution program number
(4)	Execution program name	String	The program name (no extension) executed on the engineering tool at the time interval and timing in which data was collected is output. If the execution program name is the same as the previous output data, the execution program name becomes blank. ☞ Page 1498 Execution program name
(5)	Index	Numerical value	A value which increments in ascending order from 1 is output. If the value exceeds the upper limit of 4294967295, it returns to 1 and increments again.
(6)	Data	Character string/numerical value	Refer to the data output contents.
(7)	Trigger information	Character	The specified character string is output when the trigger occurs. In other cases, no character string is output.

*1 It may not be output depending on the output conditions.

Output content for data

Data	Data type specification	Value range
BOOL type	BOOL [1;0]	1 (On), 0 (Off)
Integer type in decimal format	INT [DEC.0]	-32768 to 32767
	UINT [DEC.0]	0 to 65535
	DINT [DEC.0]	-2147483648 to 2147483647
	UDINT [DEC.0]	-0 to 4294967295
Integer type in hexadecimal format	UINT [HEX]	0 to FFFF
	UDINT [HEX]	0 to FFFFFFFF
Real number type	REAL [DEC.<number of digits after the decimal point>]	■Single-precision real number -3.4028235E + 38 to -1.401298E-45, 0, 1.401298E-45 to 3.4028235E + 38 ■Double-precision real number -1.79769313486231570E 308 to -4.94065645841246544E-324, 0, 4.94065645841246544E-324, 1.79769313486231570E 308 ■NaN (output as character string type) ■Inf (output as character string type) ■-Inf (output as character string type)
	LREAL [DEC.<number of digits after the decimal point>]	
String	WSTRING [maximum number of characters]	A character string with the specified size is displayed.
Numeric string	WSTRING [maximum number of characters]	The character string which is represented by the hexadecimal in increments of a byte is displayed without clearance. Example: Start device D0, 4-byte numeric string type D0: 0x8A6B, D1: 0x41C2 → 6B8AC241 and then output.
Time	WSTRING [<maximum number of characters>]	T#-24d20h31m23s648ms to T#24d20h31m23s647ms

The following example is information to be output to the logging data section.

```
                    (1)                  (2)    (3)       (4)  (5)  (6)      (7)
"Data":[
        ["2000/01/08 04:12:35.480000",  0.4,  "MAIN1",  1,  0,  65535,  ""],
        ["2000/01/08 04:12:35.481000",  0.4,  "MAIN2",  2,  1,  61681,  ""],
        ["2000/01/08 04:12:35.482000",  0.4,  "MAIN1",  3,  1,  58730,  "*"],
        ["2000/01/08 04:12:35.483000",  0.5,  "MAIN3",  4,  0,  17185,  ""],
        ["2000/01/08 04:12:35.484000",  0.4,  "MAIN1",  5,  0,  42405,  ""]
]
```

Output content details

The following tables list details on the output content.

Numerical value range for output data

■Integer type

The following table lists the numerical value ranges that can be expressed for each integer type.

Output format	Lower limit	Upper limit
Word (unsigned)	0	65535
Word (signed)	-32768	32767
Double word (unsigned)	0	4294967295
Double word (signed)	-2147483648	2147483647

■Real number type

The following table lists the numerical value ranges that can be expressed for each real number type, except in JSON format.

Output format	Negative value		Positive value	
	Lower limit	Upper limit	Lower limit	Upper limit
Single-precision real number	-3.4028235E + 38	-1.401298E-45	1.401298E-45	3.4028235E + 38
Double-precision real number	-1.79769313486231570E + 308	-4.94065645841246544E-324	4.94065645841246544E-324	1.79769313486231570E + +308

The following table lists the numerical range for real number types in JSON format.

Output format	Negative value		Positive value	
	Lower limit	Upper limit	Lower limit	Upper limit
Single-precision real number	-3.40282346e38	-1.40129846e-45	1.40129846e-45	3.40282346e38
Double-precision real number	-1.7976931348923158e308	-4.9406564584124654e-324	4.9406564584124654e-324	1.7976931348923158e308

When the value of the data exceeds the numerical value range, the following rule is applied to the output.

- When the value exceeds the upper limit of the positive value, +Inf is output.
- When the value falls below the lower limit of the negative value, -Inf is output.
- When the value is between the upper limit of the negative value and the lower limit of the positive value, 0 is output.

Output format	-Inf	0	+Inf
Single-precision real number	0xff800	0x00000000	0x7800
Double-precision real number	0xfff000000000	0x00000000000	0x7f00000000

Execution program number

For the execution program number of the output data, the program No. executed on the engineering tool at the timing in which data was collected is output. Depending on the data collection timing, the execution program number will be as follows.

- When data is collected after execution of a program for which "After the execution of specified program" is specified in the collection condition or after execution of an event execution type program to be executed at a specified cycle of Network Communication Cycle Synchronization, the program number of the executed program is output.
- When data is collected at timing other than the above, "-" (or "0" for binary file format) is output as the execution program number, and the timing information is output as the execution program name.

Execution program name

The program name (no extension) that is executed at the time interval and timing in which data was collected is output as the execution program name. Depending on the data collection timing, the execution program name will be as follows. However, if the execution program name is the same as the previous output data, the execution program name is omitted and becomes blank.

- When data is collected after execution of a program for which "After the execution of specified program" is specified in the collection condition or after execution of an event execution type program to be executed at a specified cycle of Network Communication Cycle Synchronization, the program name of the executed program is output.
- When the controller operating status is other than RUN, "-" is output as the execution program name.
- When data is collected at timing other than the above, the collection timing information is output as the execution program name.

The following table lists the combinations of information to be output in the execution program name and collection timing.

Collection timing	Execution program name
Network communication cycle synchronous (basic period) interrupt	"*Network Communication Cycle (Basic Period)"
Network communication cycle synchronous (normal-speed period) interrupt	"*Network Communication Cycle (Normal-Speed)"
Network communication cycle synchronous (low-speed period) interrupt	"*Network Communication Cycle (Low-Speed)"

57.7 States of the Data Logging Function

The data logging function has the data logging state. The data logging state can be checked by CPU Module Logging Configuration Tool. (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)

Data logging states

The following table lists all the possible data logging states.

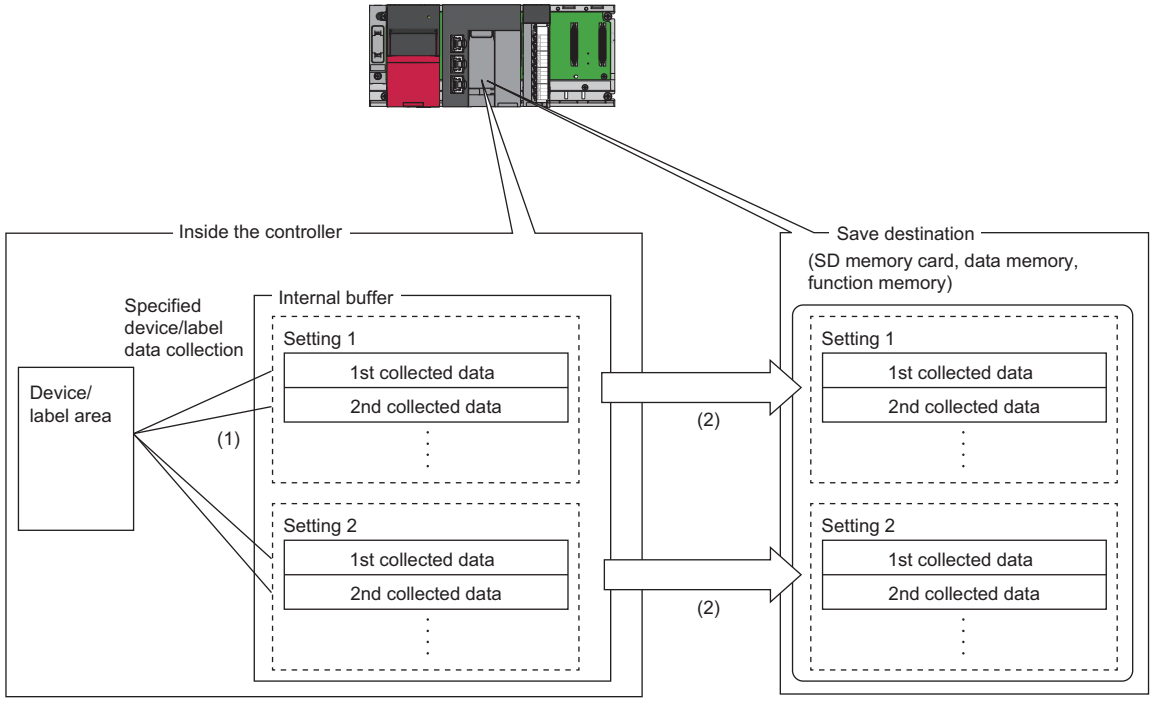
Data logging states	Description
Stop*1	Data logging settings are unregistered and data collection is inactive.
Stop (after collection)	Transition from "Collection completed" to "Stop" has occurred due to the execution of another function*2.
Stop (after error)	Transition from "Error" to "Stop" has occurred due to the execution of another function*2.
RUN waiting (no collection)	Data collection has not started because the operating status of the controller is not in the RUN state.
Start waiting (no collection)	Data collection is inactive, waiting for the start command.
Pause*1	Data logging is suspended and data collection has not yet been started. (The data logging settings remain intact.)
Condition waiting (no collection)	Data logging settings are registered and waiting for the first collection timing.
Collecting	Continuous logging is active and collecting data.
Trigger waiting (Collecting before trigger)	Data logging settings are registered, data collection is being performed, and waiting until the trigger condition is met.
Collecting after trigger	Trigger logging is active and collecting data after the trigger condition is met.
Collection completed*1	• Continuous logging: Data collection has finished upon reaching "Number of files to be saved" specified as part of the "Stop" setting configured in "Operation when exceeds the number of files". (The data logging settings remain intact.) • Trigger logging: Trigger logging has finished collecting data as much as the specified number of records. (The data logging settings remain intact.)
Error	Data logging has failed due to the occurrence of an error.

*1 CPU Module Logging Configuration Tool displays "Saving the logging data" as the data logging state until saving of collected data completes. After the completion, the state changes to each of three states.

*2 The execution of another function includes:
· Execution of data logging with the same trigger conditions (trigger conditions = the specified conditions)
· Auto logging
· Online program change

57.8 Steps Until the Collected Data Is Saved

This section describes the steps until the collected data is saved.



(1) The collected data is temporarily stored in the specified internal buffer. (☞ Page 1501 Internal buffer)
(2) The data stored in the internal buffer is stored into the save destination at the timing of a file save operation.

Internal buffer

The internal buffer is a system area used to temporarily store collected data.
The collected data is temporarily stored in the internal buffer and stored in the specified data storage destination memory at the time of a file save operation.

Internal buffer capacity setting

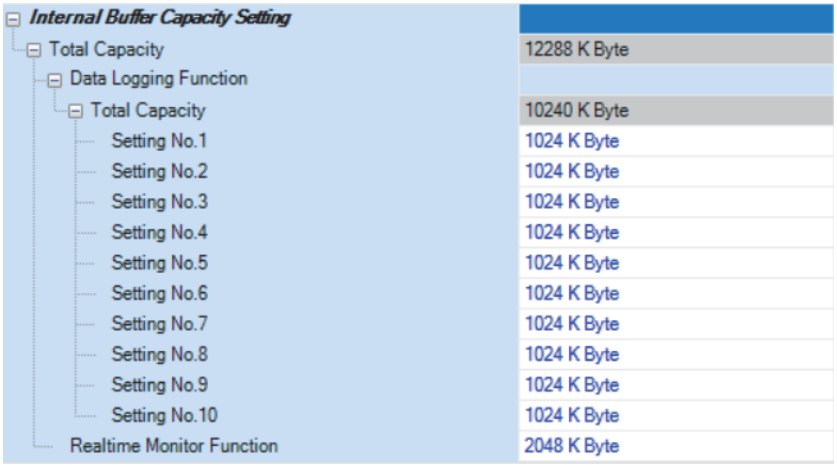
Set the capacity of the area (internal buffer) used by the system to temporarily store the results of data logging and real-time monitor collection. Set the capacity and use it for the logging function and the real-time monitor function.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Memory/Device Setting] ⇨ [Internal Buffer Capacity Setting]

For trigger logging, increasing the internal buffer capacity allows an increase in the number of collected data before trigger and also helps to prevent processing overflow. If the free space in the internal buffer is still insufficient after increasing the internal buffer capacity, use the following workarounds:

- Increase the data collection interval or timing.
- Reduce the number of data records to be collected.
- Lower the frequency of file switching.

Window



Displayed items

Item			Description	Setting range	Default
Internal Buffer Capacity Setting	Total Capacity		Displays the total capacity of the data logging function and the real-time monitor function.	—	12288K bytes
	Data Logging Function	Total Capacity	Shows the total of the internal buffer capacity used for the data logging function.	—	10240K bytes
		Setting No.1 to 10	The internal buffer capacity used for each Setting No. of the data logging settings	0K bytes, 32 to 24544K bytes (in increments of 1K bytes)*1	1024K bytes
	Realtime Monitor Function		Shows the internal buffer capacity used for the real-time monitor function.	32 to 24544K bytes (in increments of 1K bytes)*2	2048K bytes

*1 Leaving this field blank allows the setting to be unused (0K bytes).
*2 Set the total capacity used for the logging function and real-time monitor function such that it does not exceed a maximum of 24576K bytes.

Point

The internal buffer is also consumed in the real-time monitor function. Set the total of the internal buffer to no more than 24576K bytes including the internal buffer to be consumed in the real-time monitor function as well.

Amount of internal buffer consumed

This value can be calculated by multiplying "Number of data points" by 2 bytes. Note, however, that additional space is consumed by columns configured for output, as indicated below:

- Date/time column: 10 bytes
- Data collection interval column: 8 bytes
- Execution step No. column: 10 bytes
- Execution program No. column: 2 bytes
- Index column: 4 bytes

Ex.

When data logging is configured to collect as much data as one setting x 128 records and output all of the columns (i.e., maximum allowable configuration):

$128 \times 2 + (10 + 8 + 10 + 2 + 4) = 290$ bytes

Switching to a storage file

The data collected by data logging is temporarily stored in a stack file. The stack file can be switched to a storage file to free the space in the SD memory card.

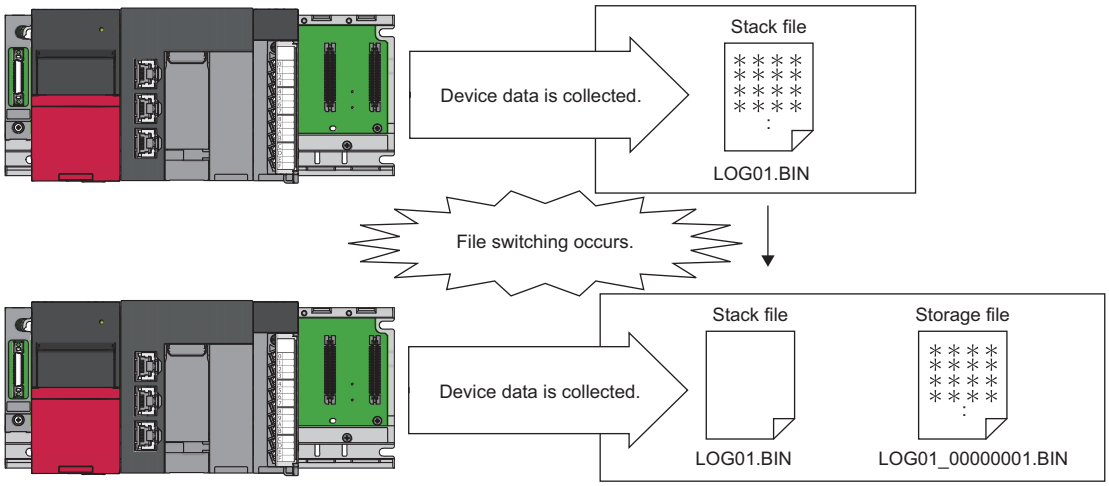
File	Description	File name
Stack file	File in which to accumulate collected data	Same name as the file storage folder ☞ Page 1504 Storage location of data logging files
Storage file	File whose name is changed from the stack file and that will be saved in the file storage folder	☞ Page 1506 Storage file name

*1 If the storage format is JSON format and the file name (including the extension and period) exceeds 64 characters, the end of the file storage folder name is truncated so that the file name (including the extension and period) stays within 64 characters.

How file switching works

File switching works as follows:

1. The controller writes collected data into a stack file (such as LOG01.BIN).
2. It changes the file name when the storage file switching condition is met. *1*2
3. It creates a new stack file.
4. It continues to write collected data into the newly created stack file.



*1 The file name format can be customized. (CPU Module Logging Configuration Tool Version 1 Operating Manual)
*2 The file number of the most recent storage file is stored in the special register (Latest storage file number).

Storage location of data logging files

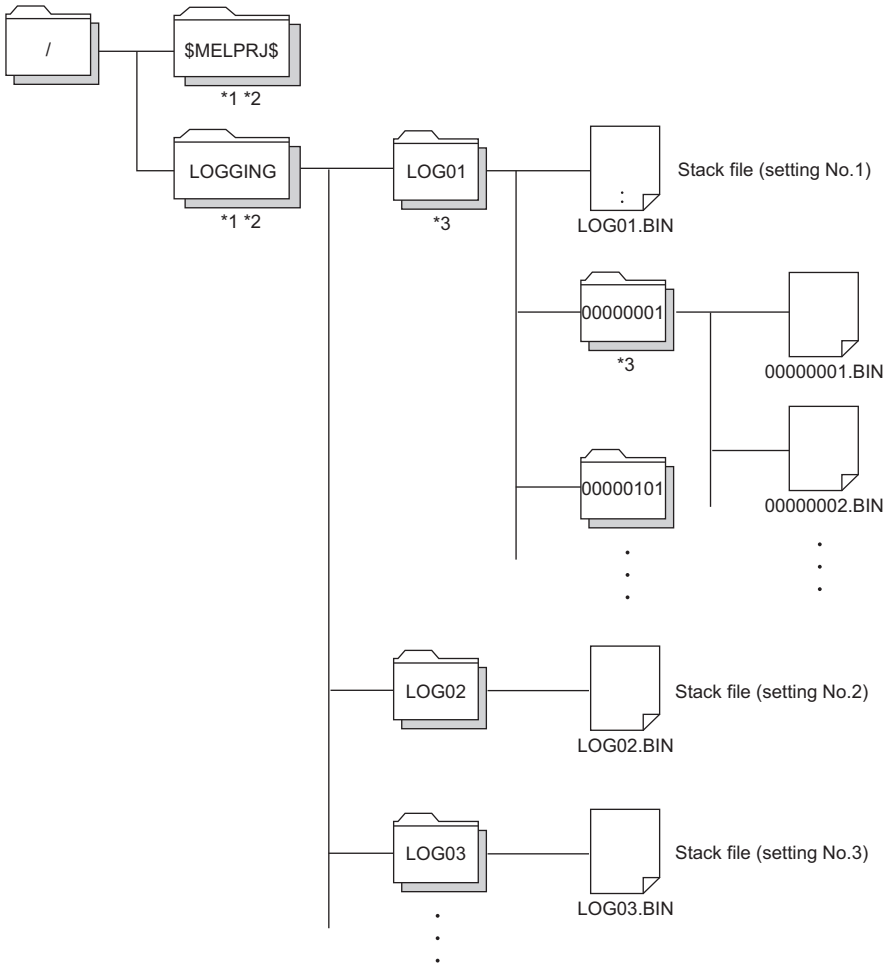
Select an SD memory card, the data memory, or the function memory for the storage location. (📖 CPU Module Logging Configuration Tool Version 1 Operating Manual)

The number of data logging settings and the number of records vary, depending on the storage location. For details, refer to the functional specifications. (☞ Page 1442 Specifications)

Restriction

Data logging into different storage locations (SD memory card, data memory, and function memory) cannot be executed simultaneously.

The folder structure is shown below.



*1 Folder names cannot be modified.

*2 Do not create folders/files under the $MELPRJ$ and LOGGING folders using a personal computer and other devices.

*3 To remove unnecessary folders, use the following methods:

· Use a personal computer.

· Logging File Operation (📖CPU Module Logging Configuration Tool Version 1 Operating Manual)

File switching condition

The following table lists the setting items that can be used to specify the file switching condition.

Setting item	Description
Number of records	Specify the number of records within the following range. • When the data storage destination memory is the SD memory card: 1 to 100000 • When the data storage destination memory is the function memory: 1 to 12000
File size*1	Specify the number of kilobytes within the following range. • When the data storage destination memory is the SD memory card: 10 to 16384K bytes • When the data storage destination memory is the function memory: 10 to 1024K bytes
Condition specification	Specify the following data. (☞ Page 1505 Condition specification) • Monitored data • Conditional formula: ↑, ↓, =, ≠, ≥, >, ≤, <, At value change • Condition values

*1 File switching occurs before the file grows beyond the specified size.

However, file switching occurs regardless of the setting when:

- the number of records has reached the maximum number;
- the file size has reached the maximum size;
- the controller is stopped or suspended/resumed; or
- data logging is started and there is an existing stack file.

Point

For trigger logging, the storage file switching condition is "Total No. of records" in the "Number of records" setting.

SM1218 (logging data storage file switching in progress) can be used to check if storage file switching is in progress.

■Condition specification

When the specified condition changes to being met, the stack file is switched to the storage file.

- Monitored data

For monitoring data, the following can be set.

The data types that can be selected include bit/word (unsigned), word (signed), double word (unsigned), and double word (signed).

Type		Device*1
Device	Bit device*2	X, Y, M*4, L, F, SM, V*4, B, SB, T (contact)*4*5, ST (contact)*4*5, C (contact)*4*5, LT (contact)*4*5, LST (contact)*4*5, LC (contact)*4*5, FX, FY
	Word device*3	T (current value)*4*5, ST (current value)*4*5, C (current value)*4*5, D*4, SD, W, SW, RD, R, ZR, FD
	Double-word device	LT (current value)*4*5, LST (current value)*4*5, LC (current value)*4*5

*1 An index modified device and indirectly specified device cannot be specified.
*2 For bit devices, digit specification is not supported.
*3 For word devices, bit specification is allowed.
*4 To specify the local device, use "Program name/#Device name". (Example: "MAIN/#M1")
*5 To specify these devices with CPU Module Logging Configuration Tool, use T (contact): TS, ST (contact): STS, C (contact): CS, LT (contact): LTS, LST (contact): LSTS, and LC (contact): LCS.

- Conditional formula

The following symbols can be specified for the conditional formula.

- ↑: When the specified data turns off and on
- ↓: When the specified data turns on and off
- =: When the current value of the monitored data is equal to the comparison data
- ≠: When the current value of the monitored data is not equal to the comparison data
- ≥: When the current value of the monitored data is equal to or larger than the comparison data
- >: When the current value of the monitored data is larger than the comparison data
- ≤: When the current value of the monitored data is equal or smaller than the comparison data
- <: When the current value of the monitored data is smaller than the comparison data
- At value change: When the current value of the specified data changes

Storage folders and storage files

The controller creates a subfolder ("storage file container folder") under the file storage folder and writes storage files to that storage file container folder. One storage file container folder can contain up to 256 storage files.

The number of files that can be contained in one file storage folder is configurable within the following range.

Setting item	Setting range
Number of files to be saved*1	1 to 65535
Maximum value not specified	No limit

*1 From the serial number attached to the file name, the number (maximum - minimum + 1) is determined as the current number of files to be saved.

When the files contained in the current storage file container folder reach the maximum number, the controller creates a new storage file container folder at the time of next storage file switching and begins writing storage files to that new folder.

Point

The base folder name of a storage file container folder is an eight-digit (hexadecimal) number. This number matches the lowest of the serial numbers of the files contained in the directory. Date and time stamps can be appended to the folder name.

■Storage file name

The following describes the storage file name. The base file name is an eight-digit (hexadecimal) serial number.*1

*1 The same number is not used in the same file storage folder. If storage files have already existed when a new storage file is created by switching a stack file to a storage file, the number added one to the largest serial number among existing storage files becomes the name of the new storage file.

The following extra information can be added to the base file name. Up to 64 characters (including an extension and the period) can be used for a file name, combining any of the following.

Extra information		Details on extra information	Remarks
Simple setting	Storage folder name	Name of a folder where storage files are stored	An underscore (_) is added between each information.
	Date	Date information in YYYYMMDD format • YYYY: Year (four digits) • MM: Month (two digits) • DD: Day (two digits)	
	Time	Time information in hhmmss format • hh: Hour (two digits) • mm: Minute (two digits) • ss: Second (two digits)	
Optional setting	String	Any string*2	—
	Date	Date information added by specifying the following strings • YYYY: Year (four digits) • YY: Year (two digits) • MM: Month (two digits) • DD: Day (two digits)	
	Day of week	Day of the week information added by specifying the following strings • ddd: Day of week (three digits) (Sunday: Sun, Monday: Mon, Tuesday: Tue, Wednesday: Wed, Thursday: Thu, Friday: Fri, Saturday: Sat)	
	Time	Time information added by specifying the following strings • hh: Hour (two digits) • mm: Minute (two digits) • ss: Second (two digits)	
	Device value	The data value of the specified device can be added to the beginning of the file name by the number of digits specified (in the range of 1 to 5).	

*2 When using an above formatted string as it is, enclose a character string with double-quotation marks (" ") to add it.
Example: When adding the character string "address" to the file name, "address" → address_00000001.bin can be used.
However, when a character string that contains double quotation marks (" ") is specified, the maximum number reduces by the number of the double quotation marks.

• Date type

A date type can be selected from the following.

Add date type	Description
Date to establish file switching condition	Date and time information when the storage file switching condition is met is added.
File creation date	Date and time information when the file is created as a stack file (when the previous file switching is executed) is added.

Point

- Processing of file switching may take time depending on the setting. In this case, a date and time, which is closer to present than the timestamp of the first record in the data logging file, is added even though "File creation date" is selected for "Add date type".
- When "File creation date" is selected for "Add date type", a second information (two digits) added to a file name is always even number.
- When specifying the save destination as data memory and transferring data from function memory to data memory, it is recommended that the date and time be appended to the filename. If logging is stopped (completed) and then restarted, the serial number of the basic file name, which is an 8-digit (hexadecimal) number, starts over from 1, and files whose file name contains only the serial number may be overwritten when transferred.

• Device value

The data value of the specified device can be added to the beginning of the file name by the number of digits specified (in the range of 1 to 5).

The timing to obtain the device value varies depending on the add date type. (☞ Page 1506 Storage file name)

The date and time when the file switching condition is met is added when "Date to establish file switching condition" is selected, and the date and time when the stack file is created is added when "File creation date" is selected.

If the device value cannot be obtained upon file switching or stack file creation, no data is added to the storage file name.

The following table describes the types of the data that can be selected for adding to the file name.

Data type	Effective data	Remarks
Word (unsigned)	Fixed decimal format (0 to 65535)*1	—
String	Single-byte alphabetical characters*2	Characters in the file format that was specified in the storage format for data logging files.

*1 If the number of digits in the device data value exceeds the specified number of digits, only the specified number of digits are displayed from the small end. If the number of digits is insufficient, the remainder is supplemented with 0.
Example 1: When the device value is K123 and five digits are specified, "00123" is displayed.
Example 2: When the device value is K12345 and three digits are specified, "345" is displayed.

*2 If the number of characters in the device data value exceeds the specified number of characters, only the specified number of characters are displayed from the beginning. If the number of characters is insufficient, the remainder is not supplemented. If invalid data is included in the specified number of characters, valid characters are displayed.
Example: When the device value is "ABC" and five characters are specified, "ABC" is displayed.
Example: When the device value is "ABCDE" and three characters are specified, "ABC" is displayed.

The following describes the devices that can be specified for a device value.

Type	Device*3
Word device	T (current value), ST (current value), C (current value), D, SD, W, SW, RD, R, ZR, Z

*3 An index modified device, indirectly specified device, and local device cannot be specified.

When the maximum number of storage files to be saved is exceeded

Either "Overwrite" or "Stop"[*1] can be selected as the action to take when the maximum number of storage files is exceeded.

*1 This settings is not configurable for trigger logging.

■When "Overwrite" is selected

When the storage file switching condition is met after the specified maximum number of storage files is exceeded, the controller deletes the file with the lowest serial number and creates a new file that has a serial number incremented by one from the highest serial number, allowing data logging to continue. In addition, if deleting the file with the lowest serial number results in an empty folder, the controller deletes that folder as well.

■When "Stop" is selected

As described in the following table, the action differs depending on when the specified maximum number of storage files is exceeded.

Occurrence timing	Occurrence condition	Behavior
When data logging is started	There exist more storage files than the specified maximum number when data logging is started.	• If an attempt is made to register the data logging settings by the start operation from CPU Module Logging Configuration Tool, an error occurs, resulting in failure to run data logging. • If an attempt is made to register[*1] the data logging settings from a tool other than CPU Module Logging Configuration Tool, a special relay area (data logging error) turns on and a special register area (data logging error cause) stores its error cause, resulting in failure to run data logging.
While data logging is running	The specified maximum number of storage files is reached due to file switching upon the satisfaction of the storage file switching condition.	Data logging stops and enters into the completion state with the data logging settings remaining intact. A special relay area (Data logging end) turns on to indicate that data logging is completed.

*1 When an attempt is made to register the data logging settings again, the controller enters into the data logging completed state. A special relay area (Data logging end) turns on to indicate that data logging is completed.

57.9 Missing Data

The term "missing data" means that some of the collected data is missing, resulting in data discontinuity.

Conditions under which missing data occurs

Missing data occurs under the following conditions:

Item	Description
Processing overflow	Processing overflow has occurred due to failure to keep up with the specified collection interval/timing.*1
Operation of the controller	The controller has been stopped and run with the logging start condition setting set to "Auto start at transition to RUN".
	The controller has been powered off and on with the logging start condition setting set to "Auto start at initial completion" or "Auto start at transition to RUN".
	The controller has been reset and run with the logging start condition setting set to "Auto start at initial completion" or "Auto start at transition to RUN".
Operation from engineering tools, CPU Module Logging Configuration Tool, and external devices via protocols such as FTP, SLMP, and MC	• When the controller is suspended and restarted, and operation for displaying the logging state is performed from CPU Module Logging Configuration Tool • File read*2, write, delete, or verification

*1 Failure to collect data at the specified collection interval/timing due to the execution of a long-running instruction (such as FMOV) does not cause processing overflow or missing data.

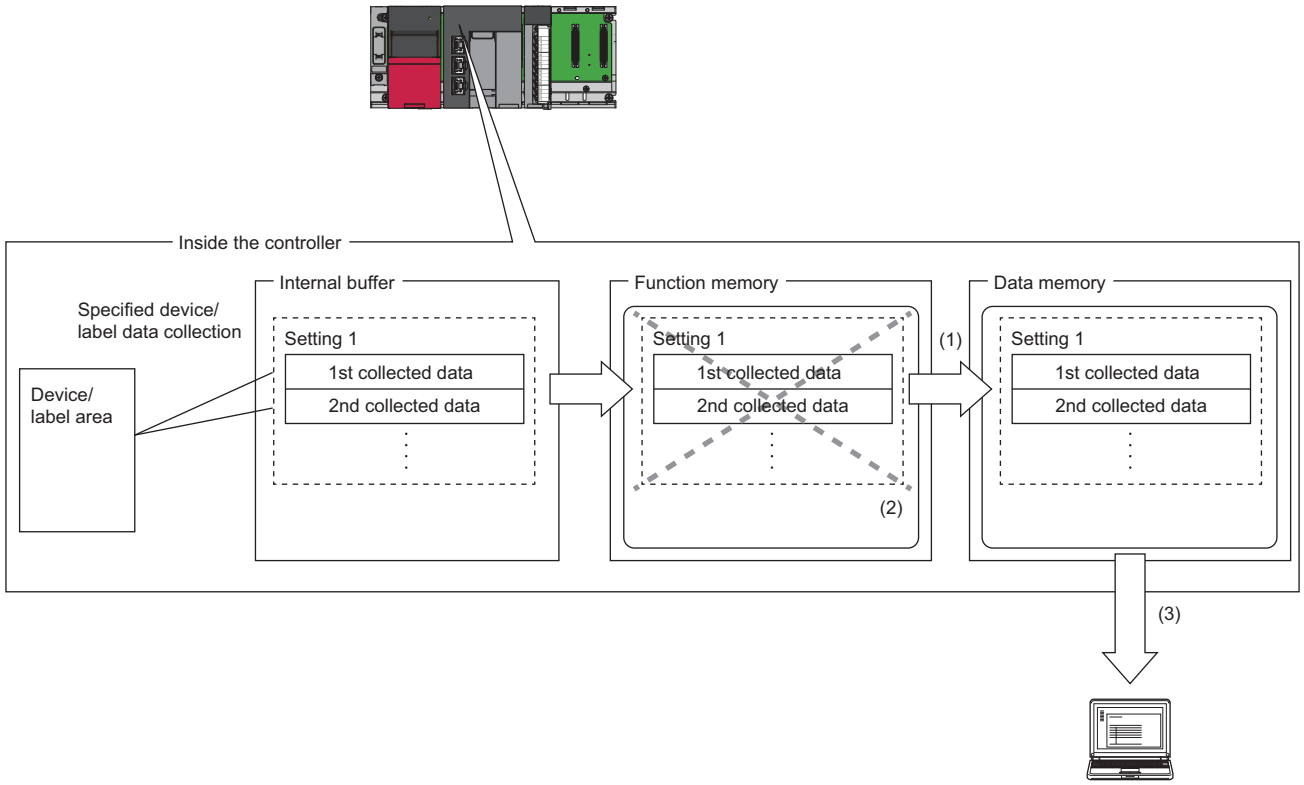
*2 The following operation also is included:
· Online operation which displays data by operation such as read from the programmable controller performed from an engineering tool (retrieval and display of a list of files on the controller)
· View of the event history (retrieval of the event history from the controller)

Processing overflow

In normal cases when the usage of the internal buffer reaches the specified maximum capacity, the controller overwrites the data stored in the storage memory on a first-in first-out basis. If the internal buffer becomes full before all of the data stored in it is saved to the storage memory, however, the controller does not overwrite the existing data and stops storing data in the internal buffer, thus resulting in missing data. This situation is referred to as processing overflow. Upon the occurrence of processing overflow, the special register area (Number of processing overflow occurrences) stores the number of times when processing overflow occurred.

57.10 Data Logging File Transfer to Data Memory

When data memory is specified as the data storage destination memory, the data is transferred from the function memory to the data memory at the logging completion or stop (including when an error occurs) as shown below.



(1) At the logging completion or stop (including when an error occurs), the data is transferred from the function memory to the data memory.
When data logging is suspended or waiting for RUN without collection, the data is not transferred to the data memory.
(2) Data in the function memory is automatically deleted after completion of the transfer.
(3) The data logging files transferred to the data memory can be read by the engineering tool or displayed by GX LogViewer.

Behavior when the free space in the data memory is full

When multiple data logging files exist in the function memory and the free space in the data memory is full by only transferring some of the files, an error occurs and the files remaining are not transferred. In this case, files that have not been transferred are not deleted from the function memory.

Starting data logging during the data transfer to the data memory

The data logging cannot be started during the data transfer to the data memory. An error occurs when starting the data logging. (☞ Page 1528 Starting data logging during the data transfer to the data memory)
An error during the data transfer to the data memory is stored in SD1217 (Data logging file transfer error cause). (☞ Page 1997 Data logging function)

57.11 Logging Start Condition Setting

After the data logging settings are registered by the start operation of data logging, set the behavior of data logging when the following user operations to switch the operating status of the controller to RUN are performed (transition to RUN). (CPU Module Logging Configuration Tool Version 1 Operating Manual)

- Powering off and on and switching the operating status of the controller to RUN
- Resetting and switching the operating status of the controller to RUN
- Switching the operating status of the controller from STOP to RUN

Point

The logging operation can be set individually for each setting number (1 to 10).

Logging start condition

The logging start conditions are as follows.

■Starting automatically upon initial completion

Data logging automatically starts when the controller is powered on or reset. However, if the start operation is performed while the controller operating status is STOP, data logging automatically starts when the status is switched from STOP to RUN.

■Starting automatically at transition to RUN

Data logging starts automatically when the controller is powered on and then enters RUN, when the controller is reset and enters RUN, or when the controller operating state changes from STOP to RUN.

■Start by user operation

The data logging status becomes "Start waiting (no collection)" after the user operation of starting data logging in CPU Module Logging Configuration Tool and switching the operating status of the controller to RUN. To start data logging, operate CPU Module Logging Configuration Tool to start data logging again.

[Online] ⇨ [Logging Status and Operation]

Point

When the auto logging is used, the logging start condition is always "Auto start at initial completion", even if the logging start condition is set to "Start by user operation". (Page 1512 Auto Logging)

Logging stop condition

The logging stop conditions are as follows.

■Stop when transitioning to a state other than RUN

When the controller operating status is RUN, data collection by logging is executed. If it transitions to any state other than RUN, logging stops.

Use this setting when the devices and labels used in motion control are not specified as the data collection target (when only devices and labels whose values do not change except during RUN are specified).

Data logging does not continue when the operating status of the controller changes from RUN to STOP or PAUSE after it has been started. The data logging status changes to "RUN waiting (no collection)" and data collection is stopped.

■Stop by user operation

Data is collected by logging regardless of the controller operating status until the user stops the logging operation. Logging stops when the user performs a stop operation.

Use this setting when the devices and labels used in motion control are specified as the data collection targets (when devices or labels whose values change even outside of RUN are specified).

57.12 Auto Logging

When inserting an SD memory card, which holds data logging setting, into the controller, data logging automatically starts based on the data logging setting information stored on the SD memory card.
By using this function, logging can be automatically executed by inserting an SD memory card, even in an environment without the CPU Module Logging Configuration Tool, when the user wants to temporarily execute logging.

How to use auto logging

This section describes how to use auto logging.

1. Prepare an SD memory card that contains data logging settings as well as common settings (auto logging common settings) in which auto logging is enabled.
2. Insert the SD memory card prepared in step 1 into the controller while it is running.
3. When the SD memory card is inserted, data logging starts automatically. *1
4. Check that auto logging is completed on the engineering tool or using the SM/SD on the controller.
5. Remove the SD memory card.

*1 Even if the logging function is already running, the auto logging function can be executed if the auto logging setting number and the logging setting number being executed are different.

Point

- Even when the data logging stop operation is performed after auto logging starts, auto logging does not end until when the SD memory card is removed.
- To use auto logging, the auto logging common setting file and data logging setting file for operation are required in the SD memory card.
- Write the auto logging common setting file to the SD memory card only when using auto logging. When auto logging is not used, delete the auto logging common setting file. (CPU Module Logging Configuration Tool Version 1 Operating Manual)

Auto logging common setting

The following window configures the required settings for using the auto logging function.

Window



Displayed items

Item			Description	Setting range	Default
Enable the auto logging function			Select this item to use auto logging.	—	Not checked
Auto logging terminate condition	Data logging stop		Select the condition to complete the auto logging operation. (☞ Page 1515 Conditions for auto logging completion)	• When all data loggings stop • When any of the data loggings stops	When all data loggings stop
	Timer	Complete with timer	Select this checkbox to stop the auto logging operation by a timer.	—	—
		Elapsed time	Specify the time interval from the start of the data logging until stopping it.	1 to 86400 seconds	

Auto logging start conditions

Auto logging starts in the following cases.

■Registering logging settings for auto logging

Logging settings are registered by inserting an SD memory card where auto logging was set. If the SD memory card is inserted while the controller is powered off, they will be registered upon completion of initialization at power-on. However, they will not be registered if any of the following conditions apply.

- SD memory card is inserted while a stop error occurs
- SD memory card is inserted during operation while data logging with the same setting number is registered or has started[*1*2].
- A stop error occurs during initial processing after the controller was powered on with the SD memory card installed

*1 When an SD memory card is inserted during operation, if the registered data logging and auto logging settings overlap, the logging settings for all auto logging will not be registered. For details, refer to the following.
☞ Page 1521 When another function is executed during the execution of the data logging function

*2 If the power is turned off and on with the SD memory card inserted, all settings for data logging that was registered or started before the power was turned off will be canceled, and the logging settings for auto logging will be registered. For details, refer to the following.
☞ Page 1522 When the data logging function is executed during the execution of another function

■Starting auto logging

After registering the logging settings for auto logging, logging starts according to the logging start operation settings and the operating status of the controller at the time of logging registration.

For the logging start conditions, refer to the following.

☞ Page 1511 Logging start condition

The following table lists start operations after logging registration by auto logging.

Logging start condition setting	Operating status of the controller when an SD memory card is inserted		
	Power-off	RUN	STOP, PAUSE
Starting automatically upon initial completion	Auto logging starts when the controller is powered on.	Auto logging starts when an SD memory card is inserted.	Auto logging starts when transitioning to the RUN state. If the controller is powered off, auto logging will start the next time the controller is turned on, regardless of the operating status of the controller.
Start by user operation[*1]			
Starting automatically at transition to RUN	Auto logging starts when the controller is powered on and then transitions from STOP to RUN, or when the controller is powered on and enters the RUN status.		Auto logging starts when transitioning to the RUN state.

*1 In auto logging, the operation is the same as when "Auto start at initial completion" is specified as the logging start condition.

Conditions for auto logging completion

Auto logging completes when a completion condition is met as described in the following table. These completion conditions can also be configured in combination with each other. When they are configured in combination, auto logging completes as soon as one of the conditions is met.

Completion condition	Description
Data logging stop	Choose one of the following: • When all data loggings stop • When any of the data loggings stops
Complete with timer	Auto logging is stopped when the specified time has elapsed after the start of data logging. Elapsed time setting range: 1 second to 86400 seconds (unit: second)

■When "Data logging stop" is selected

Auto logging is assumed to be completed if all the settings or any of auto logging stops[*1].

*1 Here the term "stop" means one of the following:
· Continuous logging: When the "Number of files to be saved" setting configured in the save setting has been exceeded and data logging has been completed.
· Trigger logging: When as much data as the number of records specified in "Number of records" has been collected, the collected data has been written to the SD memory card, and data logging has been completed.
· When the user has operated CPU Module Logging Configuration Tool to stop data logging.

Point

- If "When any of the data loggings stops" is selected, the behavior of any other data logging sessions than stopped is the same as the behavior that occurs upon the elapse of the time configured using "Complete with timer".
- When completing auto logging for continuous logging, do not select "Overwrite" for the operation at the time when the number of files exceeds the save setting because doing so results in failure to stop data logging; instead, select "Stop".

■When "Complete with timer" is selected

When the operating time since the start of data logging reaches the specified time, the controller completes auto logging by moving all the data collected so far from the internal buffer to the SD memory card. However, when the trigger condition has not been established in the trigger logging, the controller does not store any data including the collected data.

Point

The timer is cleared to 0 when auto logging is suspended and resumed by stopping and running the controller or turning off and on the controller or resetting it before the completion of auto logging. If auto logging is suspended by the turning off and on of the special relay (Data logging suspend/resume flag), the timer continues to run even while data logging is suspended.

Conditions under which auto logging does not start

Doing any of the following operations once auto logging is completed does not start auto logging:

- Turning off and on the power
- Reset
- STOP to RUN state

Behavior of auto logging that occurs when an error is generated

When an error is generated, auto logging behaves as follows:

■When an error is generated at the start of auto logging (Registration of the data logging settings has failed.)

If auto logging cannot be started (registration has failed), it behaves in the same way as when it is completed.

■When an error has occurred during the execution of auto logging

An error that occurs during the execution of auto logging does not constitute the auto logging completion condition since it does not prevent data logging from being resumed. If such an error is resulting from an online change during the execution of auto logging, however, it constitutes the auto logging completion condition because it prevents data logging from being resumed. *1

*1 Applies only when "When all data loggings stop" is selected as part of the auto logging completion condition.

57.13 SD Memory Card Replacement

SD memory cards can be replaced using the SD memory card forced disable function even while data logging is in progress.
☞ Page 324 How to forcibly disable the SD memory card with a special relay
Only the data saving to an SD memory card is stopped while this function is being executed. The data collection keeps working. (Data collection continues in accordance with the settings registered when data logging is started.)

Point

If SD memory card replacement causes processing overflow, make adjustments by changing the collection interval, internal buffer capacity, or other settings.

Behavior during SD memory card replacement

If the internal buffer becomes full during the time between SD memory card replacement and the resumption of data writes to the SD memory card, processing overflow occurs, resulting in missing data.

Storage file numbers after SD memory card replacement

The numbering of the first storage file created after SD memory card replacement differs depending on the storage file switching condition, as described in the following table.

Storage file switching condition	Storage file numbers after SD memory card replacement
Overwrite	Numbering continues from the number of the last storage file contained in the replaced SD memory card.
Stop	Numbering begins at 00000001.

Point

If the new SD memory card contains a "LOGGING" folder and its subfolders, folder deletion takes time, possibly resulting in missing data. Ensure that the new SD memory card does not contain a "LOGGING" folder.

Logging state during SD memory card replacement

SD memory cards can be replaced without depending on the current data logging state. SD memory card replacement results in the deletion of the LOGGING folder if the data logging state is other than below:

- Stop
- Stop (after collection)
- Stop (after error)

Operations during SD memory card replacement

If one of the following operations is performed during the time between the removal and installation of SD memory cards, any data collected during that time will not be stored in the new SD memory card.

- STOP to RUN state[*1]
- Turning off and on the power[*1]
- Reset[*1]
- Suspend data logging
- Stop data logging

*1 An error is generated if data logging was previously running based on the setting file contained in the replaced SD memory card.

Operations after SD memory card replacement

If the SD memory card was replaced while data logging was running based on the data logging setting file contained in the SD memory card, the data logging setting file contained in the new SD memory card is used when data logging is started by one of the following operations. If the new SD memory card does not contain the data logging setting file, data logging is not started.

- STOP to RUN state
- Power-on to RUN state
- RESET to RUN state
- Data logging start

Stack file remaining in the replaced SD memory card

Replacing an SD memory card that contains a stack file may result in the storage file remaining in the replaced SD memory card along with storage files. If the stack file is remaining in the replaced SD memory card, recover the latest data contained in the stack file by doing the following:

- Retrieve the data from the stack file and combine the data with a storage file.
- Save the stack file as a storage file.

57.14 SD Memory Card Life When the Data Logging Function Is Used

An SD memory card has a life (restriction on writing data). The following shows the calculation method of an SD memory card life when the data logging function is used. Note that the actual life of the card varies depending on the use conditions and environment. Therefore, use the calculated life as a rough standard for the replacement of the card.

Calculation formula of SD memory card life

SD memory card life (year) = Total size of data that can be written (G bytes) ÷ Size of data to be written per year (G bytes/year)

Total size of data that can be written

Capacity × Number of writes[*1]

*1 For the capacity of applicable SD memory cards and the number of writes, refer to the following.
MELSEC iQ-R Module Configuration Manual

Size of data to be written per year

The size of data to be written per year is obtained by the following formula.

Size of data to be written per year (G bytes/year) = ((DS1[*1] + 6144) × DN1 + ··· + (DSn[*1] + 6144) × DNn + (DCS1[*1] + 6144) × DCN1 + ··· + (DCSn[*1] + 6144) × DCNn) ÷ 1073741824

*1 Round up DSn and DCSn to a multiple of 512.

DSn, DNn, DCSn, and DCNn are obtained as follows.

■Data logging data size per record (DSn)

Binary file output format: Refer to the data. (☞ Page 1461 If the setting value specifies the number of saved files)

Unicode text file format: Refer to the data row. (☞ Page 1465 If the setting value specifies the number of saved files)

■Number of records for data logging per year (DNn)

Continuous logging: DNn = 60 × 60 × 24 × 365 ÷ Collection interval and timing (seconds)[*1] × Operating rate[*2]

Trigger logging: DNn = Total number of records[*3]

*1 The value that is determined depending on the condition set in "Sampling" when "Continuous logging" is selected for the logging type. (When the value is determined in milliseconds, convert the value into seconds.)

*2 Calculate the ratio using the operating time per year of the controller. For example, if the operating time per year is 5000 hours, the operating rate is calculated as follows: 5000 ÷ (24 × 365) = 0.57.

*3 The value set in "Number of logging lines" when "Trigger logging" is selected for the logging type.

■Header size of data logging (DCSn)

Binary file output format: Refer to the header. (☞ Page 1461 If the setting value specifies the number of saved files)

Unicode text file format: Refer to the file information row to device comment row. (☞ Page 1465 If the setting value specifies the number of saved files)

■Number of file switching times for the data logging per year (DCNn)

Calculate this number with an estimated number according to the save setting of the data logging and system operations. For example, when 1000 records are set in "Number of records" of "File switching timing" in the save setting and "Each scanning cycle" is specified for "Sampling interval" in the sampling setting, the time interval of the file switching is obtained by multiplying the scan time by 1000. Therefore, the number of file switching times for the data logging per year is obtained by the following formula: 60 × 60 × 24 × 365 ÷ (Scan time (second) × 1000)

57.15 Special Relay and Special Register Areas Used by the Data Logging Function

For details on the special relay and special register areas used by the data logging function, refer to the following:

- Special relay: Special relay areas relating to the data logging function (☞ Page 1961 Data logging function)
- Special register: Special register areas relating to the data logging function (☞ Page 1997 Data logging function)

57.16 Precautions to Take When Using the Data Logging Function

This section describes precautions to take when using the data logging function.

Mutual exclusion of the data logging function

This section describes the mutual exclusion of the data logging function.

■When another function is executed during the execution of the data logging function

The following table lists the cases where another function is executed during the execution of the data logging function. *1

Function that has been already executed	Function to be executed later	Behavior
Data logging function	Data logging function	When the data logging is started using CPU Module Logging Configuration Tool to the same data logging setting number via another route, the data logging to be executed later cannot be executed. However, the data logging to be executed later can be executed to a data logging setting number different from the data logging setting number currently being executed.
		For the execution of multiple data loggings, the data logging settings stored in different target memory areas cannot be executed at the same time.
	Auto logging	If the setting numbers are different, auto logging can be executed while logging is being executed. If the registered logging and auto logging setting numbers overlap, other logging setting numbers will also not be registered.
	Convert + online change	■When a label is specified as the collection start condition, data collection target, or trigger condition • When the bit of the corresponding setting No. of SD940 (Stop direction at file change on label specification) is on, changing the global label setting file (when the global label is specified) or the program file (when the local label is specified) to files different from the ones at the start operation of data logging causes a data logging error. • Convert + online change is completed.
	File batch online change	■When a label is specified as the collection start condition, data collection target, or trigger condition • When the bit of the corresponding setting No. of SD940 (Stop direction at file change on label specification) is on, changing the global label setting file (when the global label is specified) or the program file (when the local label is specified) to files different from the ones at the start operation of data logging causes a data logging error. • File batch online change is completed.
	Function specified in the internal buffer capacity setting*2	If the internal buffer capacity setting is changed to execute the subsequent function, attempting to start the subsequent function results in an error. The data logging continues to function normally.
	Controller data backup function	The controller data backup function cannot be executed while a logging setting file is being written/deleted or a logging setting is being registered/cleared.
	iQ Sensor Solution data backup/ restoration function	The iQ Sensor Solution data backup/restoration function cannot be executed while a logging setting file is being written/deleted or a logging setting is being registered/ cleared.
Auto logging	Data logging function	• Another data logging cannot be executed during the execution of the auto logging. • Even if data logging is started by using CPU Module Logging Configuration Tool, another data logging cannot be executed until the SD memory card with the auto logging setting is removed.
	Controller data backup function	The controller data backup function cannot be executed while a data logging file is being transferred to the data memory. (Error code 4C15H)

*1 The data logging function is being executed in the following states where the data logging status remains intact (collection completed and excluding an error) or when the save status is "Saving".
· RUN waiting (no collection)
· Condition waiting (no collection)
· Start waiting (no collection)
· Pause
· Collecting
· Trigger waiting (Collecting before trigger)
· Collecting after trigger
In the states other than the above, although the functions can be executed, the registration of the data logging setting executed first is canceled when the data logging function or another function is executed.

*2 The data logging function is not included here.

■When the data logging function is executed during the execution of another function

The following table lists the cases when the data logging function is executed during the execution of another function.

Function that has been already executed	Function to be executed later	Behavior
Convert + online change	Data logging function	■When a label is specified as the collection start condition, data collection target, or trigger condition • Convert + online change is completed. • The data logging cannot be executed. (An error occurs when the start operation of the data logging is performed during convert + online change.)
File batch online change		■When a label is specified as the collection start condition, data collection target, or trigger condition • File batch online change is completed. • The data logging cannot be executed. (An error occurs when the start operation of the data logging is performed during the file batch online change.)
Function specified in the internal buffer capacity setting*1		If the internal buffer capacity setting is changed to execute data logging, attempting to start data logging results in an error. The function already in execution continues to function normally.
Controller data backup function		While the controller data backup function is being executed, a logging setting file cannot be written/deleted or a logging setting cannot be registered/cleared.
iQ Sensor Solution data backup/ restoration function		While the iQ Sensor Solution data backup/restoration function is being executed, a logging setting file cannot be written/deleted or a logging setting cannot be registered/cleared.
Controller data backup function*2	Data logging function (Transfer to the data memory)	While the controller data backup function is being executed, a data logging file cannot be transferred to the data memory. (Error code 4C1FH)*1

*1 This function is executed when the trigger logging data collection is completed or data collection for the specified number of storage files is completed.

*2 The controller data backup/restoration function is executed during the execution of logging.

■When a file operation related to the data logging is performed during the execution of the data logging function

The following table lists the cases when a file operation related to the data logging is performed during the execution of the data logging function.

Target file	File operation	Behavior
Data logging setting file/common setting file	Write/delete	During execution of the data logging function, data cannot be written/deleted to/in the data logging setting file being used.
	Folder delete	Folders cannot be deleted from the $MELPRJ$ folder in which the data logging setting file is stored.
	Initialize	During execution of the data logging function, the memory storing the data logging setting file being used cannot be initialized.
Data logging file	Initialize	During execution of the data logging function, the memory storing the data logging file being used cannot be initialized.
	Folder delete	During execution of the data logging function, the folder of a logging file being accessed cannot be deleted.

■When an attempt is made to write the data logging setting file during the execution of another function

The following table lists the cases when an attempt is made to write the data logging setting file during the execution of another function.

Function that has been already executed	Behavior
Convert + online change	■When a label is specified as the collection start condition, data collection target, or trigger condition • Convert + online change is completed. • The data logging setting file cannot be written.
File batch online change	■When a label is specified as the collection start condition, data collection target, or trigger condition • File batch online change is completed. • The data logging setting file cannot be written.

Locations from which data logging can be performed

Data logging cannot be performed from multiple locations to the same setting number. The controller supports data logging performed concurrently at a maximum of 10 locations assigned to setting numbers 1 to 10.

Retention and clearance of data logging settings

After data logging is started, the registered data logging settings are latched. Thus, if the data logging is started (registered) before powering off and on or resetting the controller, register the settings again when performing the following operations to the controller; Powering off and on and switching the operating status to RUN; Resetting and switching the operating status to RUN; Switching the operating status from STOP to RUN.

As a result, data logging can be executed again with the registered data logging setting.

However, the registration of the data logging settings is canceled in the following cases. (The corresponding SM number to the data logging setting number among relevant special relay areas (data logging preparation) turns off.)

- The controller is turned off and on or is reset without an SD memory card that contains the data logging setting file.
- The replaced SD memory card does not contain the data logging setting file and the controller is turned off and on or is reset. *1

*1 If the data logging setting file contained in the replacement (new) SD memory card is different from that contained in the replaced (old) SD memory card, register the data logging setting file contained in the replacement SD memory card.

- The controller is turned off and on or is reset while an SD memory card where auto logging was set is inserted.

During data logging or auto logging, if the controller is turned off and on or reset, only the auto logging settings will be re-registered.

Behavior that occurs when trigger logging is resumed

If data logging is stopped or collection is suspended before the completion of trigger logging and subsequently data logging is run again, data collection begins from the initial state before trigger logging, rather than continuing from the last time.

Stopping/suspending data logging using CPU Module Logging Configuration Tool

After data logging is stopped or suspended from CPU Module Logging Configuration Tool, all the data in the internal buffer are saved into the target memory. If a small number of records or a small file size is specified as part of the storage file switching condition, saving data to the target memory may take longer.

Error that occurs when the data logging is started

Behavior when an error occurs at the start of the multiple data logging settings at the same time is as follows:

- If the start operation is performed by using CPU Module Logging Configuration Tool, the controller runs data logging for the setting files that have been successfully registered.
- If the auto logging is started, the controller does not run any data logging session.

Behavior upon change of the internal buffer capacity

When the internal buffer capacity is changed during execution of the data logging function, note that:

- If the internal buffer capacity for the setting number of the running data logging is left empty to disable the capacity, an error occurs when the data logging is stopped and restarted (write to the programmable controller does not cause an error).
- If the internal buffer capacity of the setting number of the running data logging is changed to a smaller value, data may be lost when the data logging is stopped and restarted.

Trigger condition at the start operation of data logging

Ensure that the trigger condition is not met during the registration of the data logging settings by the start operation of data logging. If the trigger condition is met, the data logging settings cannot be registered.

When file register is specified as device/label in condition specification

After registration of data logging, do not change the file name and block number of the file register file in the following cases; the file register is specified as the device or the global label where the file register is assigned as the label for the condition specification in the "Sampling" and "Trigger" settings. Doing so may possibly result in failure to successfully collect data logging results.

Numbering of the storage files used during data logging

■If one or more numbered storage files already exist in the file storage folder

The new file is given a file name that uses a number incremented by one from the highest number among the existing files.

■If one or more storage file folders exist but no storage files in them

A new file is stored into a folder with the lowest number and given the same number as the folder.
However, if there are 258 or more folders, a new folder is created and the file in it is given the same number as the new folder.

Behavior that occurs while collected data is stored in the target memory

If one of the following operations is performed while collected data is stored in the target memory, any unsaved data is cleared and not reflected to the results:

- Turning power of the controller off and on
- Reset

If one of the following operations is performed, unsaved data continues to be stored in the target memory:

- Changing the controller from RUN to STOP
- Suspending the data logging by turning off and on of the special relay areas SM1312 to SM1321 (Data logging setting No.1 to 10 Data logging suspend/resume flag)
- Stopping/suspending data logging from within CPU Module Logging Configuration Tool

Creating files and folders

Under the "LOGGING" folder that contains data logging setting files and data logging files, do not attempt to create files or folders using a personal computer or other device. Doing so may result in deletion of files and folders.

When collection is performed at the specified time

When "Time specification" is selected for the data collection condition and the collection at the specified time is selected rather than data collection during the END processing, check the collection interval by referring to the information reported in the collection interval column. Do not rely on the information reported in the date/time column because it may be incorrect due to clock accuracy error.

Changing the clock data

Whatever changes, such as advancing or reverting the clock, are made to the clock data of the controller during data logging, the controller performs data collection at the specified collection interval/timing, but the date/time column in the output file reports the changed clock data.

Access to an SD memory card or the function memory

If data logging is performed with a setting that the data collection interval is short or the number of records to be collected is large, access (read/write) to an SD memory card or the function memory occurs so frequently that a delay occurs in completing the access. To avoid such a delay, use the following workarounds:

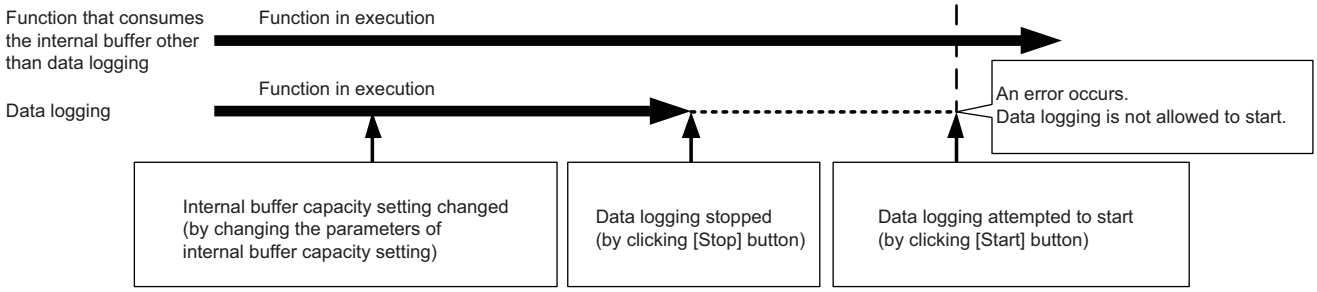
- Increase the data collection interval/timing.
- Reduce the number of data records to be collected.
- Lower the frequency of file switching.

Access to the controller during data logging

When multiple data logging settings are started at the same time (when the multiple data logging settings are registered again at the same time), or when functions other than the data logging function that require access to files on the SD memory card are executed at the same time, a time-out error may occur in communications or a dedicated instruction issued from a peripheral to the controller. Take measures such as increasing the time-out time period of the peripheral, reducing some data logging settings, and stopping the other functions.

Behavior at parameter change when functions consuming the internal buffer are active

If the internal buffer capacity setting is changed during the execution of the functions that consume the internal buffer, attempting to start data logging results in an error, where the data logging fails to start.



Behavior at parameter change (program setting (execution type))

The following shows the behavior when "Execution Type" in "Program Setting" is changed and parameters are written.

■Logging unexecuted (Complete stop status)

The program setting (execution type) is changed when the controller is powered off and on or is reset. When "After the execution of specified program" is selected as the collection start condition at the start of logging, the execution type that was specified in the program settings is checked. If the execution type is event and the collection condition is network communication cycle synchronization, an error (error code: 4273H) occurs.

■Logging being executed (Status where one or more logs have started)

When parameters are written (possible only in STOP state) while logging is being executed, the logging status becomes RUN waiting (no collection). When the status changes from STOP to RUN, the execution type specified in the program settings is checked. However, because the change timing for program settings is when the controller is powered on or is reset, an error due to a program execution type change does not occur.

Controller operation when registering the data logging

Note that the operating status of the controller is not changed until the following data logging registration or data save processing is completed. (The operating status may not be switched to STOP immediately.)

- While saving the data in the internal buffer by changing the operating status of the controller from RUN to STOP or operation to stop/pause data logging from CPU Module Logging Configuration Tool
- When the multiple data logging settings are started at the same time (when the multiple data loggings are registered again at the same time)
- When the data logging is started with any unused folders remaining in the storage memory

The waiting time for the operation status change of the controller is shortened by reducing the number of data logging settings and deleting unused folders.

Unicode text file

To view the data, use a software application with Unicode support. The data may be displayed incorrectly in a software application with no Unicode support. To open a Unicode text file with multiple lines of comments in Microsoft® Excel, be sure to drag and drop the file on the Microsoft® Excel window; otherwise, the content of the file may be displayed incorrectly in Microsoft® Excel.

Global label and local label specifications

When specifying a global label or local label, write the project that was read by CPU Module Logging Configuration Tool to the controller. Alternatively, read the project that was written to the controller and load it into CPU Module Logging Configuration Tool.

Registration of the available devices

■User device, system device, file register, and index register

The data logging settings can be registered when devices of the controller exist. When a device number outside the range is specified, an error occurs at the registration.

■Module access device (buffer memory) and link direct device

The data logging settings can be registered when the buffer memory and devices of the target module exist. When the target module is not mounted or a device number outside the range is specified even with the target module mounted, an error occurs at the registration.

■Local device

The data logging settings can be registered when the target program name and devices in the target program exist. When a device number outside the range of the target program is specified, an error occurs at the registration.

File operation during execution of data logging

This section describes file operation during execution of data logging.

Target file	File operation	Behavior
Data logging setting file	Write	During execution of data logging, it is not possible to write/delete data to/in the data logging setting file being used.
	Delete	
	Initialize	During execution of data logging, it is not possible to initialize the memory storing the data logging setting file being executed.
	Folder delete	Folders cannot be deleted from the $MELPRJ$ folder in which the data logging setting file is stored.
Data logging file	Write	During execution of data logging, it is not possible to write/delete data to/in and delete folders from the data logging setting file being used.
	Delete	
	Folder delete	
	Initialize	During execution of data logging, it is not possible to initialize the memory storing the data logging setting file being executed.

About remote operation

When remote RUN is performed while the data logging function is in the following execution status, the remote RUN may fail. In that case, wait for a while and retry remote RUN. If remote RUN still cannot be executed, check whether remote RUN is acceptable and retry remote RUN.

Execution state of data logging function	The situation to accept remote RUN
Saving data in the internal buffer into a storage location in progress	No special relay (Data logging data saving in progress) is on.
After the start operation of data logging by CPU Module Logging Configuration Tool (Registration of the data logging setting in progress)	The special relay (data logging preparation) and the special relay (data logging start) corresponding to the setting number of the data logging setting, which is being registered in the way shown in the left column, are on.
After data logging is started by auto logging (Registration of the auto logging setting in progress)	SM1200 (Auto logging setting file and registration status) is on.

RUN operation through switching operation or the RUN contact

During execution of data logging, when the status of the controller is switched from STOP to RUN with the RUN/STOP/RESET switch, or when the RUN contact that is specified in the RUN-PAUSE contact setting turns off, it may take time to return to the RUN state.

Using together with interrupt programs

When occurrence of an interrupt is specified as the data collection condition of data logging, the processing time of the interrupt program increases because the processing time of the data logging function is added.
For this reason, a WDT error may occur if an interrupt interval of I49 set in the parameter of "Interrupt Setting from Internal Timer" under "Fixed Scan Interval Setting" is too short (such as 0.05ms) and occurrence of high-speed internal timer interrupt 1 (I49) is specified as the data collection condition, since the processing time of the interrupt program becomes longer than the set interrupt period and the END instruction cannot be executed due to the continuous execution of the interrupt program.
For how to reduce processing time of interrupt programs, refer to Saving/restoring of the file register (R) block number.
(☞ Page 269 Saving/restoring of the file register (R) block number)

Data logging using the data memory as the data storage location

■Power-off or reset during data logging

During data logging, do not power off or reset the controller.

During data logging, if the controller is powered off or reset before completion of the data transfer to the data memory (before data logging is completed or stopped), all the data logging data (data logging files) in the function memory are deleted.

When data logging is restarted after power-off or reset, a new data logging file is given a file name that uses a number incremented by one from the end number of data logging file in the function memory before power-off or reset.

Data transfer to the data memory

■Free space in the data memory

When the transfer to the data memory is set, delete data by user data operation in the engineering tool to free up space in the data memory for storing the transferred data logging files.

Check the required free space for transfer to the data memory as follows.

Required free space for transfer to the data memory = Function memory capacity[*1] - Function memory free area capacity[*2].

*1 The size can be checked in SD648/SD649 (Function memory capacity).

*2 The size can be checked in SD650/SD651 (Function memory free space capacity).

■Power-off or reset during the data transfer to the data memory

- When an error occurs during the data transfer to the data memory, all data logging files in the function memory are deleted when the power is turned off or reset. Read the user data operation of the engineering tool as necessary.
- During the data transfer to the data memory, a temporary file "LOGGING_T.TMP" is created and file name is changed after completion of the file transfer. Therefore, if the controller is powered off or reset during the transfer, the temporary file may remain. In that case, delete the file by user data operation in the engineering tool.

■Starting data logging during the data transfer to the data memory

Since the data logging of the same setting number cannot be started during the data transfer to the data memory, start data logging after completion of the file transfer. Otherwise, an error occurs at the start operation of data logging.

Data in the controller when a device/label is specified

Before starting the data logging, write the following data to the controller from the engineering tool.

Device/label specification	Data required to be written
When a local device is specified	The CPU parameter including the program name specified with CPU Module Logging Configuration Tool
When a global label is specified	Project data that is read using CPU Module Logging Configuration Tool (global label setting file)
When a local label is specified	• Project data that is read using CPU Module Logging Configuration Tool (the program file with the corresponding program name) • The CPU parameter including the program name specified with CPU Module Logging Configuration Tool

In the following cases, data cannot be written with CPU Module Logging Configuration Tool.

Device/label specification	Description
When a local device is specified	• The CPU parameters do not exist in the controller. • The program name specified is not set in the program setting in the CPU parameters.
When a global label is specified	• The global label setting file does not exist in the controller. • The global label setting file in the controller and the project that is read using CPU Module Logging Configuration Tool (global label setting file) do not match.
When a local label is specified	• The CPU parameters and the program file which has the corresponding program name do not exist in the controller. • The program name specified is not set in the program setting in the CPU parameters. • The program file which has the corresponding program name in the controller and the project that is read using CPU Module Logging Configuration Tool (the program file which has the corresponding program name) do not match.

CPU parameter at the start operation of data logging

When performing data logging in which the local device or local label specifying the program name (execution order) in the program setting of the CPU parameter is specified, do not change and write the CPU parameter to the controller after writing the data logging setting file. An error occurs during data logging registration after the CPU parameter is written.
Change the internal buffer capacity in the CPU parameter used for data logging before writing the data logging setting file.

Change of the file when a label is specified

Do not perform the following operations after the registration of the data logging setting by starting the data logging or between the completion of writing the data logging setting file and the registration of the data logging setting.

Label specification	Description
When a global label is specified	Writing the global label setting file where a global label is added, changed, or deleted.
When a local label is specified	Writing a program file where a program is changed (including addition, change, and deletion of a local label).

These operations change assignment of labels, and thus the data logging may not be performed to the specified label. If a file is changed, perform either of the following operations.

- Import the project of the engineering tool to CPU Module Logging Configuration Tool again, and then write the data logging setting again.
- Read the file from the controller with "Online Data Operation" of the engineering tool. Save the project with the engineering tool and import the project to CPU Module Logging Configuration Tool again, and then write the data logging setting again.

Point

Using SD940 (Stop direction at file change on label specification) can prevent the data logging to a different file.
Turning on the bit of SD940 corresponding to the data logging setting No. being executed generates an error at the following timings.

- When the data logging is being executed: At writing a program file or global label setting file
- When the data logging is stopped or paused: At the registration of the data logging after a program file or global label setting file is written

For details on SD940, refer to the following.
☞ Page 1996 Latch area

When CSV file (Shift-JIS) is specified

When specifying a CSV file (Shift-JIS), use ASCII characters and characters that can be expressed in Shift-JIS for the program name and device comment in the engineering tool project. If a character string that cannot be expressed is used, it becomes blank when output.

Adding a character string to the storage file name

When adding a character string to the storage file name, the character string that can be handled differs depending on the specified file format. Format the character string stored in the device value according to the file format.

Synchronous station

When specifying the link device of the synchronous station, set link refresh instead of U3En\G (CPU buffer memory access device) and Jn\□ (link direct device). Also, specify the device or label of the refresh destination. When specifying the data to be collected, data collection can be synchronized with the network communication cycle synchronous interrupt program by setting the collection condition to Network Communication Cycle Synchronization.

Trigger occurrence date and time data for cases with a trigger condition (fixed cycle)

For the trigger occurrence date and time data, the date and time of the END timing at which the trigger condition was established will be stored. Therefore, a time gap due occurs from the elapsed time until the trigger occurrence at the END timing.

Therefore, when the logging for which multiple triggers are set is executed, the interval of the trigger occurrence date and time between storage files does not match the trigger (fixed cycle) interval.

Also, when the trigger condition is established in the storage file switching (including trigger detection reset) section, the trigger condition is ignored. Therefore, the time gap mentioned above will increase for the amount of time in which the trigger condition was ignored. Note that a trigger condition establishment count that was ignored from the beginning of trigger logging until the collection completion can be checked with the special register.

File switching timing of the file switching condition (condition specification)

If the file switching condition is satisfied while no record has been written to the stack file, the file switching is not performed to prevent the creation of no record storage file. For details on the file switching, refer to the following.

☞ Page 1503 Switching to a storage file

58 SEQUENCE SCAN SYNCHRONIZATION SAMPLING FUNCTION

This function collects the device data of the controller during END processing, and transfers it to the module that supports the corresponding function.

Restriction

Before using this function, check the versions of the controller and engineering tool used. (☞ Page 2196 Added or Enhanced Functions and Supported Versions)

This function is supported by the following modules.

Relevant module list

The following table shows the module with the corresponding function.

Module	Function name*1	Number of executable modules	Total number of collectable points
MES interface module	High-speed access	4	32768 points

*1 The processing time for the collection method indicated in each module function name is added to sequence scan synchronization sampling of the performance monitor.

For details on the functions and collectable data, refer to the manual for the above module.

Precautions

The total number of device points that can be collected is 32K points, but the internal memory for collecting devices within the controller is divided into a total of four blocks of 8K points each, and is allocated in blocks according to the collection setting. When using multiple modules, one block (8K points) is used even if the number of collection points set for each module is less than 8K points. Therefore, when specifying the number of collection points, consider the number of modules and blocks using this function.

The following are examples.

- 6K points used → 8K points to be assigned
- 9K points used → 16K points to be assigned

MEMO

PART 14 SECURITY

This part consists of the following chapters.

59 LIST OF SECURITY FUNCTIONS

60 PROTECTION OF INFORMATION ASSETS IN THE CONTROLLER

61 PROTECTION OF THE NETWORK CONNECTED TO THE CONTROLLER

62 PROTECTION OF CONTROLLER OPERATION

59 LIST OF SECURITY FUNCTIONS

The following table lists the security functions.

Classification	Function	Description	Security goal
Protection of information assets in the controller	User authentication function (☞ Page 1536 User Authentication Function)	Restricts which users can access the controller. User authentication also includes a function to restrict access to programs and a function to display precautions on using the controller before the user authentication is performed.	To set access restrictions according to the role of the worker
	File tampering check (☞ Page 1555 File Tamper Check Setting)	Checks that files which affect the control of the controller have not been tampered with.	To verify whether a file has been tampered with or not
	Initializing all controller information (☞ Page 1556 All Information Initialization of Controller)	Batch-erases devices/labels and files stored in non-volatile memory and some security information.	To erase the remaining data
	Controller data backup/restoration function (☞ Page 1622 CONTROLLER DATA BACKUP/RESTORATION FUNCTION)	Backs up data such as program files, parameter files, and device/label data in the controller. The data backed up can be restored as necessary.	To save data or settings in a place other than the controller
	iQ Sensor Solution data backup/ restoration function (📖iQ Sensor Solution Reference Manual)	Data backup/restoration function that can be used for iQ Sensor Solution.	
	Firmware update function (☞ Page 1650 Firmware Update Function)	Updates the firmware of the controller and the modules of the MELSEC iQ-R series.	To eliminate firmware vulnerabilities
	Event history function (☞ Page 1683 Event history)	To understand the details when an event occurs in a system that consists of controllers, displays and saves the event log.	To save and check the events that occurred
Protection of the network connected to the controller	Encrypted communication function (☞ Page 1558 Encrypted Communication Function)	The controller encrypts communication data when communicating with devices outside the trust boundary.	To prevent eavesdropping and tampering on communication data
	IP filter function (☞ Page 1582 IP Filter Function)	By identifying the IP address of the communication destination, prevents access by someone specifying an invalid IP address.	To allow access by IP addresses of specific devices only
	Default open port usage setting function (☞ Page 1585 Default Open Port Usage Setting Function)	Closes unused ports on the controller.	To close unused ports for port scans
	Band limit function against DoS-attacks (☞ Page 1588 Band Limit Function Against DoS Attacks)	Restricts the use of resources used by the controller when a DoS attack occurs.	To limit the band for DoS attacks
Protection of controller operation	Controller operation setting at error detection (☞ Page 1591 Operation Settings)	Sets the operations by the controller.	To perform the operation set in advance, even if an error occurs

Point

For examples of security risks and the measures of the MELSEC programmable controllers, refer to the following.

📖FA SYSTEM SECURITY GUIDELINE - SEPARATE VOLUME [MELSEC] -

Enhanced security setting

The parameters can be changed for the enhanced security setting as below. (📖 GX Works3 Operating Manual)

[Project] ⇨ [Security] ⇨ [Enhanced Security Setting]

MEMO

60 PROTECTION OF INFORMATION ASSETS IN THE CONTROLLER

Protection for information assets such as user programs stored in the controller is provided against theft, tampering, faulty operation, and unauthorized execution resulting from unauthorized access by an outsider.

60.1 User Authentication Function

The user authentication function permits access to the controller only to predetermined users.

Point

To utilize this function, use an engineering tool or external device that supports the user authentication function. Engineering tools and external devices that are not supported cannot access the controller.
If the target controller has the user authentication function disabled, access to the target controller is possible even if the relay controller has the user authentication function enabled. (Access from engineering tools that do not support the user authentication function and external devices is also possible.)

Precautions

If the user authentication function is enabled, a communication request from the intelligent function module to the controller (such as reading module extension parameters, and device label access) will cause an authentication error, and certain intelligent function modules will not operate normally.
Normal operation can be achieved by enabling "Communication Enabled Setting with Intelligent Function Module Without Logging on" and turning on the specified bit of the special register corresponding to the mounting position (slot) of the intelligent function module to be operated.
To operate the module extension parameters, perform this setting, use the device initial values, and pre-emptively set the special register to on for the mounting position of the intelligent function module to be operated.
Also, when activating the functions of intelligent function modules (such as device access using dedicated instructions, communication using predefined protocols, or communication using SLMP), perform this setting before the function execution to turn on the special register for the mounting position of the intelligent function module to be operated.
The following table lists modules that do not operate normally when the user authentication function is enabled.

Model
RD75P□
RD75D□
RJ71EN71
RJ71GP21(S)-SX
RJ71GF11-T2
RJ61BT11
RJ71C24(-R□)
RJ71LP21-25
RJ71BR11
RJ71GN11-□
RD81MES96N

User authentication

Users who want to access the controller must be authenticated with a user name and password.
The user name and password used for authentication must be registered as user information in the controller in advance using an engineering tool.

User information	Description	Data format when input	Input range
User name	An identifier that designates an individual user and is unique within the controller. If a user name is specified from the engineering tool, the controller can uniquely identify the user from the user name.	Unicode string*1	2 to 40 bytes (1 to 20 characters)
Password	A string to verify that the user is the person themselves	ASCII string (numbers, alphabetical characters, special characters)*2	8 to 64 bytes (8 to 64 characters)

*1 The following symbols and single-byte spaces cannot be used.
#+-:
*2 Compliant with the password policy (☞ Page 2192 Password Policy)

Combination of user authentication function and operating status

Operating status	Status of user authentication function
RUN/STOP (including stop error)/ PAUSE	The following cases are possible. • User authentication function enabled (write user management information (read/change password))/disabled • Logged-on/logged-off • User authentication setting operation
Power off to on/Reset to reset release	Writing (registering) the user management information enables the user authentication function. If the state is logged-on, then it becomes logged-off.

Operations that require authentication

Authentication is required for all online operations from external devices to the controller.

Management information (user management information and user group management information)

The user authentication function can be enabled by writing the user management information and the user group management information.
To disable it, initialize all information of the controller, power it off and on, and reset the controller.

Point

- Only the Administrators user group can write user management information and user group management information.
- After initialization of all information on the controller and until it is powered off and on and reset, the session of a user who has logged on since before the operation was executed is valid, but new log-on is not possible.

User management information

User management information is information that sets the users who can be authenticated by the controller.
On one controller, user management information can be registered for up to 128 users.
Specify the following information in the user management information.

- User name
- Password
- User group

User group management information

User group management information is information in which the operation authority of each user group is set.
On one controller, user group management information can be registered for up to 14 groups.
Specify the following information in the user group management information.

- User group name
- Operation authority

Saving user management information and user group management information

The controller saves user management information and user group management information in the system flash memory and retains it even during a power failure.
Therefore, initializing the engineering tool memory (formatting the specified drive) does not clear the user management information and user group management information.

User group

A user always belongs to one user group and can operate controllers within the scope of the operation authority granted to the user group to which the user belongs.

User group	Description	Change of operation authority
Administrators	A group to whom all operations permitted to the user are allowed	Not possible
Users	A group to whom data viewing such as file reading is allowed, but some of file writing are restricted	
User-defined group	A group defined by users. Note that only users in the Administrators group can create user-defined groups. The number of user groups that can be defined is 14. The user group name must be specified within the range of 2 to 40 characters (Unicode: 1 to 20 characters).*1	Possible

*1 The following symbols and single-byte spaces cannot be used.
#+-:

Operation authority of each user group

The following table lists the operation authority scope of each user group.

Operation			User group		
			Administrators	Users	User-defined group
Writing a file (parameter)*3	Writing data to the programmable controller		Permitted	Not permitted	Not permitted (default)
	Deleting data in the programmable controller				
Writing a file (program)*1*3	Writing data to the programmable controller		Permitted	Not permitted	Not permitted (default)
	Deleting data in the programmable controller				
	Writing to the programmable controller during RUN (program change)				
Reading a file (program)	Reading data from the programmable controller		Permitted	Permitted	Permitted (default)
	Verifying data with the programmable controller				
	Reading a program monitor file				
	Writing a program monitor file				
	Deleting a program monitor file				
CPU memory operation	Initializing (drive initialization)	Program memory initialization	Permitted	Not permitted	Not permitted (fixed)
		Data memory initialization			
		Motion data memory initialization			
		Function memory initialization			
		Initializing device/label memory			
		Initializing the SD memory card			
		Clearing the file register to zero (all files)			
		Clearing the file register to zero (specified files)			
	Clearing the entire event history				
	Initializing all controller information				
Device write (SM/SD/buffer memory)	Device/buffer memory batch monitor		Permitted	Not permitted	Not permitted (default)
	Watch				
	Writing nodes by the request from an OPC UA client				
Device write (other than SM/SD/buffer memory)*1	Device/buffer memory batch monitor		Permitted	Not permitted	Not permitted (default)
	Watch				
	Writing nodes by the request from an OPC UA client				

Operation			User group		
			Administrators	Users	User-defined group
Device read[*2]	Device/buffer memory batch monitor		Permitted	Permitted	Permitted (default)
	Watch				
	Logging	Start			
		Pause			
		Stop			
		Reading the logging setting			
		Writing the logging setting			
		Deleting the logging setting			
		Displaying logging status			
	Real-time monitor	Start			
		Stop			
	Reading nodes by the request from an OPC UA client[*5]				
Certificate operation	Creating a certificate		Permitted	Not permitted	Not permitted (fixed)
	Writing a certificate				
	Reading a certificate				
	Deleting a certificate				
User authentication operation (Administrators)	User registration/change/delete operation, password change (other persons)		Permitted	Not permitted	Not permitted (fixed)
	Reading user information				
	Releasing lockout				
	Initializing password expiry date				
	User authentication setting				
	Displaying user status list				
User authentication operation (other than Administrators)	Password change (yourself)		Permitted	Permitted	Permitted (fixed)
	Log on				
	Log off				
Diagnostics[*4]	Reading event history		Permitted	Permitted	Permitted (default)
	Sensor/equipment monitor				
	Ethernet diagnostics				
	CC-Link IE Controller Network diagnostics				
	Simple CPU communication diagnostics				
	Clearing errors				
Remote operation	STOP		Permitted	Not permitted	Not permitted (default)
	PAUSE				
	RESET				
	RUN				
Time Setting	Execution (write time)		Permitted	Not permitted	Not permitted (fixed)
Update	Firmware update		Permitted	Not permitted	Not permitted (fixed)
	Add-on installation				
System Web page window display	Displaying the system Web page window		Permitted	Permitted	Permitted (default)
User Web page window display	Displaying the user Web page window		Permitted	Permitted	Permitted (default)
System Web page update	Updating the system Web page		Permitted	Not permitted	Not permitted (default)
System Web page initial window display	Displaying the system Web page (initial window)		Permitted	Permitted	Permitted (default)
User Web page initial window display	Displaying the user Web page (initial window)		Not permitted	Not permitted	Not permitted (default)
Controller data backup/ restoration function	Controller data backup		Permitted	Not permitted	Not permitted (default)
	Controller data automatic backup				
	Controller data automatic restoration				
Performance monitor	Starting monitoring or clearing maximum value		Permitted	Permitted	Permitted (default)

Operation		User group		
		Administrators	Users	User-defined group
OPC UA server	Starting up an OPC UA server	Permitted	Not permitted	Not permitted (default)
	Stopping an OPC UA server			

*1 Granting this authority also permits reading.
*2 SM/SD/SB/SW buffer memory/label can be read even without this operation authority.
*3 Folder operations are permitted according to the operation authority to the user group for the files within the folder. This will permit users in all user groups to create a new empty folder.
*4 Note that only users from the Administrators group can use the [Create File] button in the "Module Diagnostics" window.
*5 User-defined groups without operation authority cannot connect to the OPC UA server.

Point

- Device write (SM/SD/buffer memory) operations enable security-critical operations such as changing the time settings or IP addresses, data backup/restoration, and OPC UA server startup/stop. Therefore, limit the user-defined user groups to which write operation authority is granted.
- Labels assigned to devices are classified into devices. Therefore, access is controlled by device read/write operation authority.
- Parameter write is possible only when the controller is in the STOP state. Therefore, grant remote operation authority to the user group that has been granted file write (parameter) authority, or set the RUN/STOP/RESET switch to STOP before writing the parameters.

Access to the controller

The controller performs authentication by comparing the user name and password provided by the user to the internal user management information.
If the authentication succeeds, the target user has logged on.
The controller manages the logged on/logged off status for each user.
If no online operations that require authentication are performed for a certain amount of time*1, the state automatically changes from the logged on to logged off.

Status	Description
Logged off	The controller has not authenticated the user. While logged off, the user cannot perform online operations on the controller that require authentication.
Logged on	The controller has authenticated the user. While logged on, the user can perform online operations on the controller that require authentication.

*1 The default log-off judgment time is 300 seconds. It can be changed within the range of 60 to 7200 seconds (in 1 second increments) depending on the user authentication settings.
The current value of the log-off judgment time can be checked by using the SD1469 (Logoff judgment time current value).

Number of users who can log on simultaneously

Up to 4 users can log on to the controller simultaneously.
Note that, for users whose user group is Administrators, at least one user can always log on. For users whose user group is other than Administrators, only 3 users can log on at most.
If the number of users who have logged on simultaneously reaches the maximum number of logged on users, additional users who try to log on will be notified that the number of concurrently logged-on users is over the limit (error code 431CH).
The number of logged-on users can be checked using SD1468 (Number of login users).

■When logging on to the controller multiple times with one user name

Ex.
If a user starts one engineering tool and logs on, and then the same user logs on using the same user name to access one controller, the controller considers two users to have logged on.

■When logging on to the controller using multiple engineering tools with one user name

Ex.
If three engineering tools are started and each is logged on to with the same user name to access one controller, the controller considers three users to have logged on.

Point

Log-on to the FTP server function and OPC UA server function will be managed independent of the number of users concurrently logged on to the user authentication function.
Even when the number of logged-on users for the user authentication function has reached the maximum number, logging on to the FTP server function and OPC UA server function is possible.

Log-off operation

The engineering tool can be used for log-off operation from a controller.
When a user executes the log-off operation from a controller, the controller switches the user who executed the operation to the log-off state.

Lockout

If authentication fails with the user authentication function, the corresponding user is locked out according to the password policy.

The number of consecutive authentication failures (number of consecutive unlock failures) is managed for each registered user.

If authentication fails for the same user from multiple request sources, the number of consecutive failures is incremented.

Point

- Users in the Administrators group can release the lockout of other users. (☞ Page 1547 User status display)
- The number of authentication failures until lockout and the lockout time can be changed. (☞ Page 1548 User authentication setting)

How to operate the user authentication function

When using the user authentication function of the controller, the controller and engineering tools respectively hold user management information and user group management information.
The engineering tool also saves user management information and user group management information in the project data that holds programs and parameters.

Enabling the user authentication function

The user authentication function can be enabled (offline) by performing either of the following two operations.

- Enable the function when creating a new project (default): ☞ Page 66 Creating a project
- Enable the function when editing a project after its creation:

[Project] ⇨ [Security] ⇨ [Enable User Authentication]

A user from Administrators group is registered in the "Enable User Authentication" window.

Inputting user names and passwords

When opening a project whose user authentication function is enabled, input "User Name" and "Password" in the "User Authentication" window displayed in the engineering tool.
The engineering tool uses the user name and password entered by the user when opening the project to request authentication to the controller.

■When the password held by the project and the password of the controller are different

The engineering tool displays that the project password does not match the one registered in the controller.
In this case, an administrator from the Administrators group can change the management information of the user whose password does not match by overwriting the user management information and user group management information.

■Changing passwords

Passwords can be changed by using the password change operation of the engineering tool.

Menu ⇨ [Online] ⇨ [Change Password] ⇨ [Change User Password]

Change the project password and then change the password in the controller. (When changing the password in the controller, the user must have logged on using the password before the change.)
The controller determines whether the password can be changed according to the password strength set in the user authentication settings. If the password strength is not satisfied, an error response is given, and the password is not changed.
When the controller password is changed, the expiry date of the corresponding user's password is set to the password expiration date that was set in the user authentication settings. The lockout status and the number of consecutive unlock failures are initialized.
After the password is changed, the corresponding user will be logged off and required to log on with the changed password. (When the controller has been logged on to multiple times by the corresponding user name, all users who have logged on with the user name will be logged off.)

Point

The password cannot be changed in either of the following cases.

- A user has logged on to the FTP server function.
- The OPC UA server function is in the startup process or the number of sessions on the OPC UA server is one or more.

Registering management information on user and user group

When registering user management information and user group management information onto the controller, using the engineering tool to write information to the controller writes the user management information held by the project to the controller.

■User who performs the registration operation

Users in the Administrators group must have been authenticated by the engineering tool.

■When to reflect the registered contents to the controller

Executing the information writing function onto the controller by using the engineering tool registers the user management information and user group management information to the controller.

Point

When a large number of users need to be registered, lengthen the time of the communication time check of the engineering tool.

Changing/deleting management information on user and user group

When changing the user management information and user group management information registered in the controller, changes must be made to the user management information and user group management information held by the engineering tool project.

■User who performs the change operation

Users in the Administrators group must have been authenticated by the engineering tool.

■When to reflect changes to the controller

Executing the information writing function onto the controller by using the engineering tool changes the user management information and user group management information in the controller.

■When completely deleting user management information and user group management information

Initialize all controller information. (☞ Page 1556 All Information Initialization of Controller)

■When a user has logged on to the FTP server

Users cannot change or delete the user management information or user group management information to which they belong.

Point

User management information cannot be changed for users who have logged on to the controller.

■When a user has logged on to the Web server

Users cannot change or delete the user management information or user group management information to which they belong.

■When the OPC UA server function is in the startup process or the number of sessions on the OPC UA server is one or more

Users cannot change or delete the user management information or user group management information to which they belong.

Writing management information on user and user group

The information of all users held in the engineering tool project is overwritten with the user management information and user group management information of the controller.
Also, when the user authentication function is disabled, the function is enabled by executing write.
Note that writing user management information requires the user from the Administrators group to log on to the controller.
If the password of the operator was changed, the corresponding user will be logged off and required to log on with the changed password. (When the controller has been logged on to multiple times by the corresponding user name, all users who have logged on with the user name will be logged off.)

Point

- When write is executed, the password expiration timer, lockout status, and number of consecutive unlock failures for all users, except for the user whose user name and password held by the project match the user name and password held by the controller, are initialized.
- Do not write user management information and user group management information from multiple activation sources simultaneously. Be sure to perform the writing process from one activation source.

Precautions

While overwriting user management information and user group management information, if the user management information and user group management information cannot be registered correctly due to cable disconnection, power-off, or other issues, the behavior and actions are as follows.

Cause	Behavior and action
Although registration of user management information and user group management information was not completed due to cable disconnection or other issues, the user management information and user group management information were written again.	A Security function error (user authentication) (error code: 44A4H) occurs. Reset or power off and on the controller and write user management information and user group management information again.
Although registration of user management information and user group management information was not completed due to power-off, cable disconnection, or other issues, the controller was powered off and on or was reset.	The controller will start with either of the following conditions: Only one user from Administrators group, who wrote the user management information and user group management information, is registered or the user authentication function is disabled. Write user management information and user group management information again.

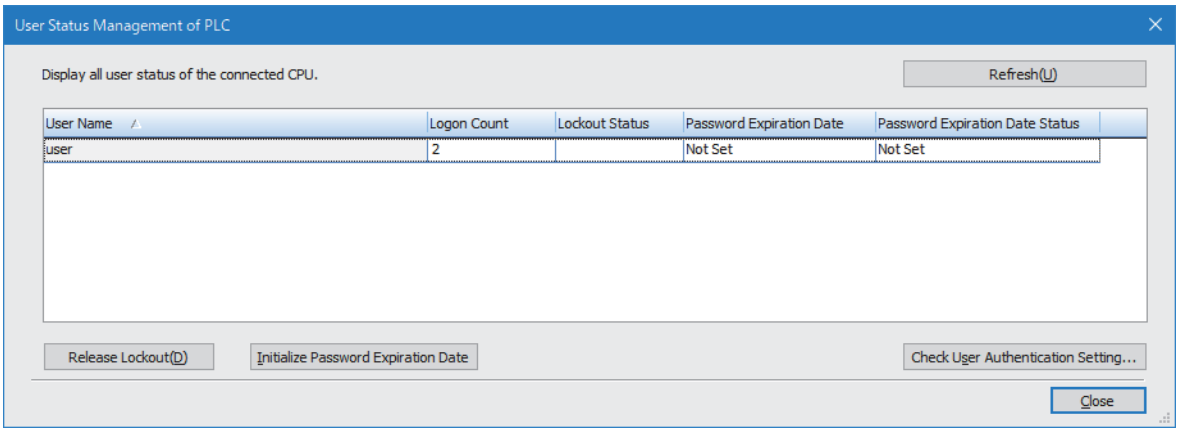
Reading management information on user and user group

Reading user management information and user group management information reads the information of all users registered on the controller to the engineering tool.
Therefore, if the user management information and user group management information in the engineering tool differ from the user management information and user group management information in the controller, executing this function will overwrite the user management information and user group management information in the engineering tool.
Note that reading user management information and user group management information requires the user from the Administrators group to log on to the controller.

User status display

The user names and the number of log-ons to the controller are displayed on the user status list display window.
It also displays user lockout status and password expiry date information.

Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [User Status Management of PLC]



An administrator from the Administrators group cannot change user management information or user group management information unless the users to be changed have logged off.
Since the user status list display window can be used to check the users currently logged on to the controller, requests can be made to authenticated users to log off from the controller.
Also, the lock on a locked out user can be released, and the password expiry date can be initialized.

■Operation method

- [Refresh] button: Reads the list again from the controller and displays it.
- [Release Lockout] button: Releases the lockout of the specified user. The number of consecutive unlock failures is also initialized.
- [Initialize Password Expiration Date] button: Initializes the expiry date of the specified user's password to the value specified in the user authentication settings.

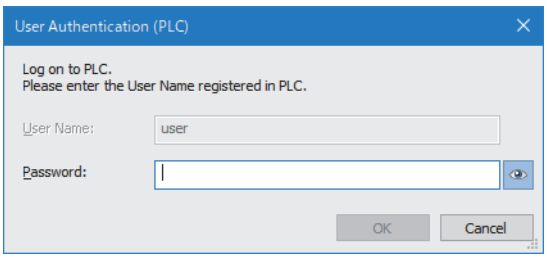
Point

This operation can only be performed by users whose user group is Administrators.
Before performing this operation, be authenticated by the controller.

Logging on to the controller

To perform operations that require authentication with the controller in the state where the user authentication function is enabled, this operation switches the controller to the log-on state.

Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [Log on to PLC]



Point

- If the password has expired, the password change window will be displayed after successfully logging on. Online operations other than changing the password cannot be performed until the password is changed.
- Log-on may fail immediately after the controller is turned off and on or reset, so wait for a few seconds before attempting to log on again.

Logging off from the controller

This operation is for logging off of the controller with the user authentication function enabled.
An administrator from the Administrators user group cannot change user management information or user group management information unless the user to be changed has logged off.
When the controller has been logged on to multiple times by a single user name from the same engineering tool, the log-off operation can only be performed on the last logged-on user. The log-off operation cannot be performed on log-ons before the last one. (Wait for auto logoff performed by the controller.)

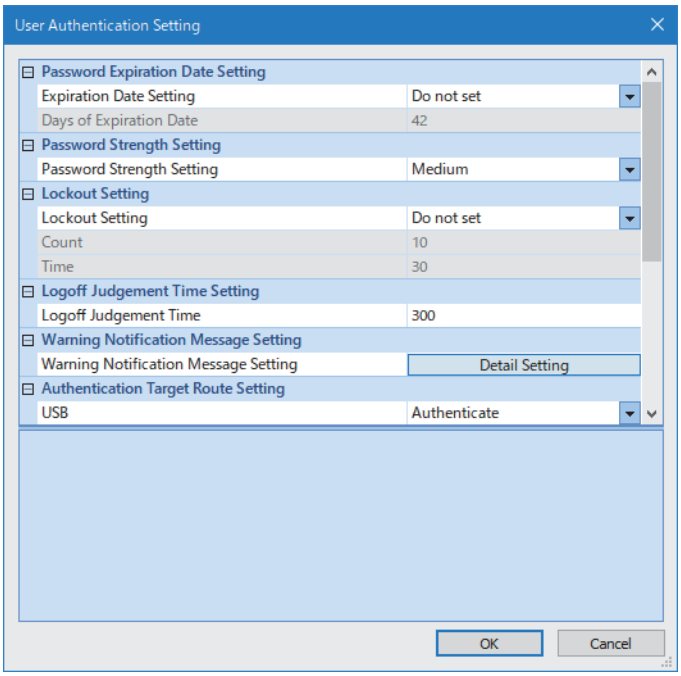
Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [Log off from PLC]

User authentication setting

Sets the user authentication.

Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [User Authentication Setting]

Window



Displayed items

Item		Description	Setting range	Remarks
Password Expiration Date Setting	Expiration Date Setting	Specify whether to set an expiry date for the password. When set, the number of days until the expiry date can be entered.	• Do not set (default) • Set	• The same password expiration date is applied to all users. • The password expiration date setting for each user is reflected when the password is changed or when the expiration date is initialized.
	Days of Expiration Date[*1]	Specify the number of days until the password expires.	1 to 999 days (Default: 42 days)	
Password Strength Setting		Specify the password strength.	• Strong (default) • Medium	• The same password strength setting is applied to all users. • The setting is reflected when the password is changed next time after the user authentication setting is written.[*7]

Item		Description	Setting range	Remarks
Lockout Setting	Lockout Setting[*5]	Specify whether to set lockout. When set, the number of authentication failures and time can be entered.	• Do not set (default) • Set	• The same lockout setting is applied to all users. • The lockout setting for each user is immediately reflected when the user authentication setting is written. However, if the setting is changed from "Set" to "Do not set", the lockout of locked-out users is not released.
	Count	Specify the number of authentication failures before locking out.	1 to 999 times (Default: 10)	
	Time	Specify the time until the lockout is released.	1 to 9999 minutes (Default: 30 minute)	
Logoff Judgment Time Setting		Specify the log-off judgment time.	60 to 7200 seconds (Default: 300 seconds)	• The same log-off judgment time is applied to all users. • The log-off judgment time setting for each user is reflected when a logged-on user logs off and logs back in, or when a logged-off user logs in next time.
Warning Notification Message Setting		Specify the warning message to display during the log-on operation.	Unicode string, 128 characters (Default: Blank)	The setting is immediately reflected when the user authentication setting is written.
Authentication Target Route Setting	USB	Specify whether to perform user authentication for communication requests from each route.	• Authenticate (default) • Do not authenticate[*2*3]	The setting is reflected when the controller is reset or turned off and on next time.
	Ethernet Port			
	TSN Port			
Operation Event Record Suppression Setting from Users Who are Not Allowed to Operate	Device Access[*4]	Specify whether to record device access by unauthorized users in the event history.	• Record (default) • Do not record	The setting is immediately reflected when the user authentication setting is written.
Operation Setting Other Than User Authentication Target	Read Device/ Label[*4*6]	Specify operations that are not the target of access control by user authentication. The operations excluded in this setting will be permissible without log-on.	• Apply (default) • Do not apply	The setting is reflected when the controller is reset or turned off and on next time.
	Write Device/ Label[*6]			
Execution Enabled Setting for Initialization of All Data Without Logging on		Set whether to enable all information initialization without log-on by performing specified operation (setting the RUN/STOP/RESET switch to STOP when a USB is connected).	• Enable (default)[*3] • Disable	
Communication permission setting with intelligent function modules without log-on		Specify whether to allow communication between the controller and intelligent function module without log-on by manipulating the special register. (Communication with the intelligent function module installed in the bit position (slot) specified with the special register is permitted without log-on.)[*2] By performing this operation, communication with GOT and SLMP devices connected to Ethernet modules and serial communication modules is possible.	• Enable (default)[*3] • Disable	

*1 The expiration time differs depending on the time zone because the expiration is determined by UTC±0. For JST (UTC+9), the expiration date is reached at 9:00 on the day following the set expiration date. A time is adjusted to daylight saving time by adding 1:00 to the time zone. Therefore, the expiration date is reached at 10:00 on the day following the set expiration date.

*2 User authentication-related operations, such as reading and writing user management information and user group management information and reading and writing user authentication settings, and the initialization of all controller information cannot be performed in the logged-off state.

*3 If all routes are set to "Do not authenticate" in the route setting for the authentication target and the communication permission setting with intelligent function modules without log-on is set to "Authenticate", an error will occur when the user authentication setting is written.

*4 Logging operations and real-time monitor operations are excluded.

*5 Even when changed from "Set" → "Do not set" in a locked out state, the lockout of other users is not released.

*6 Reading/writing nodes by the request from the OPC UA client is not included.

*7 If the user management information is overwritten but the new user management information is the same as the user management information (a set of user name, name of the user group to which the user belongs, and password) registered in the controller, the password is judged to have not been changed, and this setting is not applied.

Point

In the notification message setting, set the warning message to be displayed during log-on operation. Below are some examples.

- What equipment the user is trying to access
- What responsibilities the operator has when performing operations that impact the equipment
- That users are allowed to log on only if they agree to have their actions logged

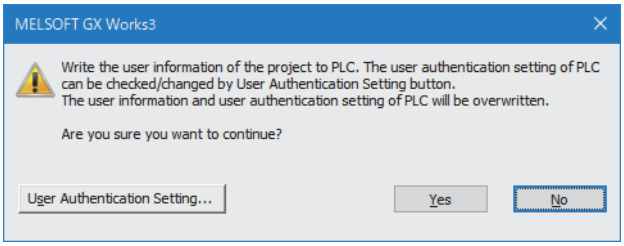
Precautions

- Before setting the password expiration date, set the time using the engineering tool or adjust the time using the SNTP client function so that the password expiration date setting operates correctly. Note that if the power to the controller is turned off for a long time, the time information will be lost. The user can log on even if the password has expired, from the time the power is turned on until the time is adjusted by the SNTP client function. Therefore, set the parameters for the SNTP client function so that "Timer Setting After Power-on and Reset" is performed.
- When "Execution Enabled Setting for Initialization of All Data Without Logging on" is set to "Disable", if a user of the Administrators group forgets the password, all information initialization cannot be executed.
- If the user wants to use the function to access the device/label (communication using SLMP, connection with GOT), set reading/writing of the device/label to operation settings that are not subject to user authentication, and turn on SM1469 (User authentication inapplicable operation enable setting). However, when the special relay is on, all external devices are allowed to access the device/label, which poses a high security risk. Therefore, turn off the special relay after using the function that accesses the device/label.
- When using the network function and motion function, set "TSN Port" in "Authentication Target Route Setting" to "Do not authenticate". Connections to external networks that may be accessed by malicious outsiders should be made using "Ethernet Port" where "Authentication Target Route Setting" is set to "Authenticate", instead of "TSN Port".
- When a user who has logged on is locked out, or when their password expires, they can still operate the controller within the scope of the operation authority granted to the user group to which they belong until they log off.

■Configuring the setting at the time of writing user management information

When writing user management information and user group management information, if the user authentication function of the controller is disabled, the user authentication settings are also written at the same time.

Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [Write User Information to PLC]



■Configuring the setting separating from user management information writing

Use the engineering tool to set "User Authentication Setting" and select whether to write the settings to the controller or to write them later.

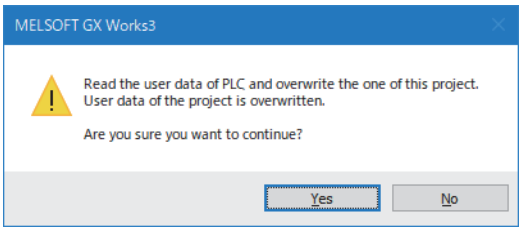
Menu ⇨ [Online] ⇨ [User Authentication Setting]

Reading user information

Read settings related to user authentication.

Administrators in the Administrators group can operate the settings if they have been authenticated by the engineering tool.

Menu ⇨ [Online] ⇨ [User Authentication] ⇨ [Read User Information from PLC]



Disabling the user authentication function

To disable the user authentication function, execute all information initialization of the controller. (☞ Page 1556 All Information Initialization of Controller)

Note that all the information in the controller is initialized.

Restrictions on using the user authentication function

This section describes restrictions on using the user authentication function.

Boot function

If the user authentication function is enabled for the controller, the boot function cannot be used.

When the user authentication function is enabled, if an SD memory card containing the boot setting parameters is inserted and the power is turned off and on or reset, the controller notifies of the boot function execution error (error code 3006H).

Operation from an external device without user authentication function

■Access via the built-in interface of the controller

If the user authentication function is enabled, access using protocols such as FTP or SLMP, which require authentication from non-compatible devices such as GOTs and general-purpose personal computers, is not possible.

When the corresponding command is sent from a non-compatible device, the controller displays an error response, indicating that an operation that requires user authentication was executed from a startup source that does not support user authentication (error code 4300H).

The following table lists accessibility of external devices.

External device		Accessibility
GOT		Inaccessible
FTP		Accessible when "To Use or Not to Use User Authentication" is set to "Use" in the FTP server function settings
Web browser		Accessible when "To Use or Not to Use User Authentication" is set to "Use" in the Web server function settings
OPC UA		Accessible when "To Use or Not to Use User Authentication" is set to "Use" in the OPC UA server function settings
SLMP		Inaccessible
Controller/ programmable controller	Socket communications	Accessible without authentication
	Simple CPU communication	Inaccessible
	Predefined protocol support	Inaccessible

Point

In the following cases, access is possible from external devices that do not support the user authentication function.

- FTP access from a route set to "Do not authenticate" in "Authentication Target Route Setting" of "User Authentication Setting" (set "To Use or Not to Use User Authentication" of "FTP Server Settings" to "Not Use".)
- OPC UA server access from a route set to "Do not authenticate" in "Authentication Target Route Setting" of "User Authentication Setting" (set "To Use or Not to Use User Authentication" of "OPC UA Server Settings" to "Not Use".)
- GOT, SLMP, and simple CPU communication access when "Authentication Target Route Setting" of "User Authentication Setting" is set to "Authenticate" and "Read Device/Label" of "Operation Setting Other Than User Authentication Target" is set to "Do not apply" (This access type enables the following operations: monitoring of device/label data by a GOT, reading of device/label data by an SLMP, and simple CPU communication pattern: read.)
- GOT, SLMP, and simple CPU communication access when "Authentication Target Route Setting" of "User Authentication Setting" is set to "Authenticate" and "Write Device/Label" of "Operation Setting Other Than User Authentication Target" is set to "Do not apply" (This access type enables the following operations: monitoring of device/label data by a GOT, reading of device/label data by an SLMP, and simple CPU communication pattern: write.)
- FTP access when "Authentication Target Route Setting" of "User Authentication Setting" is set to "Authenticate" and "To Use or Not to Use User Authentication" of "FTP Server Settings" is set to "Use"
- Web server access when "Authentication Target Route Setting" of "User Authentication Setting" is set to "Authenticate" and "To Use or Not to Use User Authentication" of "Web Server Settings" is set to "Use"
- OPC UA access when "Authentication Target Route Setting" of "User Authentication Setting" is set to "Authenticate" and "To Use or Not to Use User Authentication" of "OPC UA Server Settings" is set to "Use"

■Access via module

If the user authentication function is enabled, access using protocols such as FTP or SLMP, which require authentication from non-compatible devices such as GOTs and general-purpose personal computers, is not possible.

Point

To access from a non-compatible device, set "Communication Enabled Setting with Intelligent Function Module Without Logging on" of "User Authentication Setting" to "Enable", and turn on the bit of the special register that corresponds to the module through which the communication permission setting passes.

SD memory card (drive 2)

Do not store important data because access to files in the SD memory card is not controlled. (☞ Page 329 Precautions when using the SD memory card in an environment where unauthorized access to the SD memory card may occur)
However, access to the logging setting files (extension LAS, LIS) is controlled in accordance with the logging operation authority.

Predefined protocol support function

If the user authentication function is enabled, the predefined protocol support function cannot be used.

Clock settings and remote operation

If the user authentication function is enabled, clock settings and remote operation cannot be performed with all stations specification or group number specification. Perform clock settings and remote operation with the currently specified station.

Precautions

This section describes the precautions when using the user authentication function.

If a user forgets their password

■If the user is not an administrator

Users from the Administrators group can reset passwords by deleting the user management information of other users and re-registering them.

■If the user is an administrator

The password of a user from the Administrators group can only be changed by the user or by another user in the Administrators group.

If all administrators forget their passwords, the user management information of the controller can be initialized by using the all information initialization function of the controller. (☞ Page 1556 All Information Initialization of Controller)

Also, if the all information initialization function of the controller is used, the user authentication function of the controller is disabled.

However, the controller deletes all files stored inside the controller by executing the all information initialization function.

Processing time for operations that require user authentication

When the user authentication function is used, the processing time of the operation set as control target will increase.

For example, device/label access processing (reading one word) time is delayed by approximately 0.8ms.

To comply with IEC 62443-4-2

To use the controller in compliance with IEC 62443-4-2, perform all of the following settings for the user authentication.

Item	Description	Reference
Enabling the user authentication function	Enables the user authentication.	Page 1544 Enabling the user authentication function
Network protection	Protects the network path where the user authentication is disabled by using a firewall or others.	—
Password expiration date setting	Set "Password Expiration Date Setting" to "Set".	Page 1548 User authentication setting
Password strength	Set "Password Strength Setting" to "Strong".	
Operation setting other than user authentication target	Set "Apply" for the read/write device/label in "Operation Setting Other Than User Authentication Target".	

60.2 File Tamper Check Setting

This function checks for tampering with files that affect controller control.

Of the target files, if a file is found to have a signature value different from the preset one, an error occurs.

Target files

The following files are checked for tampering.

The error registration timing is at the time of an error occurrence.

Classification	Target file	Timing of setting signature	Timing of verification
Program memory check*1	Program file	• When writing data to the controller • When writing data using FTP file transfer • When writing files via SLMP • During boot operation*2 • At restoration • At the execution of the DEVST instruction (for device storage files only)	At reset or when the power supply is turned off and on
	FB file		
	CPU parameters		
	System parameters		
	Module parameters		
	Initial device values		
	Initial label values		
	Global label setting file		
	Network label setting file		
	Global label assignment information		
	Local label assignment information		
	Device data storage file		
Add-on	Add-on file	At the generation of the add-on image	When the add-on is loaded
Event history	Event history file*3	• When writing, clearing, or creating the event history file • When writing data using FTP file transfer • When writing files via SLMP • At restoration	At reset or when the power supply is turned off and on
Firmware update	Firmware image	At the generation of the firmware image	At firmware update
Web server	System Web page file	At the generation of the system Web page file	At reset, when the power supply is turned off and on, or at write time
Restoration	Backup file	At backup	At restoration

*1 The program memory in the SD memory card is not checked.

*2 A signature is set during the boot operation (transfer from the SD memory card to the program memory or data memory), not when data is being written to the SD memory card.

*3 The motion control event history file is not supported. (☞ Page 1754 Event history function)

Point

The tampering check of target files is always enabled.

However, the following settings are required to check event history files and backup files for tampering check.

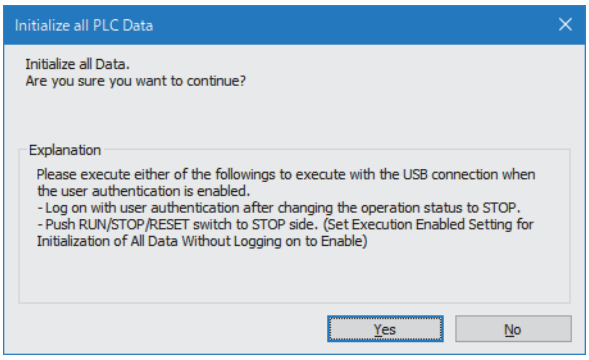
- Event history file: Specify "Check" in parameter settings (☞ Page 1755 Event history setting).
- Backup file: Register "Encryption Setting" when data is backed up (☞ Page 1632 Operating procedure).

60.3 All Information Initialization of Controller

This function clears the management information of the target files and overwrites areas, where data such as target devices and labels is stored, with 0.
It can be used for recovery purposes when the user names and passwords of the user authentication function are lost and for preventing the outflow of information assets due to data deletion.

Setting method

1. Set the operating status of the controller to STOP.
2. Log on with user authentication as a user from the Administrators group. (Not required when user authentication is invalid or when logged on as a user from the Administrators group.)
3. Using the engineering tool, select [Online] ⇨ [User Authentication] ⇨ [Initialize all PLC Data].



4. Click the [Yes] button.
5. After the initialization completion window is displayed, power off and on or reset the controller.

Point

Even when not logged on as Administrators, initialization can be performed under the following conditions.

- "Execution Enabled Setting for Initialization of All Data Without Logging on" in "User Authentication Setting" is set to "Enable".
- The controller is connected via USB.
- The RUN/STOP/RESET switch on the controller is turned to the STOP side.

Precautions

- After initialization, write the user information and programmable controller data to the controller again.
- After initialization, if the controller is reset or powered off and on, the device/label memory will revert to the default status (default capacity for each area). The device/label values are held until that point.
- Do not turn off the power to the controller during initialization. The memory may fail.
- Do not disconnect the cable connecting the controller to the engineering tool during initialization.
- If the communication between the controller and the engineering tool is interrupted during initialization due to cable disconnection or other issues, communication may not resume even after the cable is reconnected. In such cases, check the READY LED and reconnect the cable after initialization is complete. (☞ Page 1557 LED indicator)
- After initialization is completed, do not operate the controller until the power is turned off and on or reset.
- All controller information can be initialized only when the CPU operating status is STOP. (It can be executed even if the STOP state is due to a stop error.)
- When this function is executed, the initialization processing will have priority and there will be restrictions on file operations. Therefore, do not execute this function at the same time as a function that accesses files (such as writing to the controller and the backup/restoration function).
- Users who logged on before the execution of all information initialization remain logged on, and can perform the operations permitted under the operation authority of each user group. However, re-logging on after logging off, user registration/change/delete operation, password change (other persons), and reading user information are excluded.
- When executing all information initialization through the Ethernet connection, use TCP or UDP for the connection. If TLS or DTLS is used for the connection, communications with the engineering tool will not be properly performed.

LED indicator

The following table lists the LED indicator for all information initialization.

State	LED indicator		Remarks
	READY LED	ERROR LED	
Before execution of all information initialization	Green turned on/off	Red turned on/flashing/off	Depends on the controller state
During execution of all information initialization	Green flashing (every 200ms)	Red turned on/flashing/off	—
Execution completion of all information initialization	Green turned on/off	Red turned on/flashing/off	Same LED indication as before execution of all information initialization

Point

If an error occurs during execution of all information initialization, and the LED indicator of execution completion of all information initialization is different from the LED indicator before execution of all information initialization, all information initialization may not have been completed successfully.
In that case, power off and on or reset the controller, and then perform all information initialization again.

61 PROTECTION OF THE NETWORK CONNECTED TO THE CONTROLLER

Protection for the communication data flowing through an unprotected network connected to the controller is provided against eavesdropping and tampering resulting from unauthorized access by an outsider.

61.1 Encrypted Communication Function

Communication data is encrypted when the controller communicates with external devices outside the trust boundary.
It uses protocols such as TLS and DTLS as the encrypted communication protocols. The encrypted communication protocol versions are TLS1.2, TLS1.3, and DTLS1.2.

Point

- Set the correct time in advance so that the expiration date setting of the digital certificate works correctly. (☞ Page 1935 Time setting)
- Enable the user authentication function to prevent the digital certificates stored in the controller from being deleted or changed. (☞ Page 1544 Enabling the user authentication function)
- The client device needs to hold the server certificates and the server device needs to hold the client certificates for encrypted communication. Therefore, the controller (server/client) has a trusted list of server certificates/client certificates.

Communications that can be encrypted

The communications that can be encrypted by the Ethernet function of the controller are as follows.

- Connection with MELSOFT product and GOT (☞ Page 200 Connection with MELSOFT Product and GOT)
- Communications using the SLMP (☞ Page 1260 SLMP COMMUNICATION)
- Socket communications (☞ Page 1318 SOCKET COMMUNICATIONS)
- Simple CPU communication function (☞ Page 1266 SIMPLE CPU COMMUNICATION FUNCTION)
- File transfer (FTP server) (☞ Page 1345 FTP Server)
- File transfer (FTP client) (☞ Page 1367 FTP Client)
- Web server function (☞ Page 1379 WEB SERVER FUNCTION)
- OPC UA server function (☞ Page 1405 OPC UA Communication Function)

Digital certificate

A digital certificate used in encrypted communication is required for passing the public key to the external device.
Digital certificates are created in the standard format of X.509 format by using the engineering tool.
The expiration date can be set from 1 to 20 years. The default is 1 year.

Point

- To comply with IEC 62443-4-2, set the expiration date to one year.
- A year is handled as 365 days, even if the period until the expiration date contains a leap year (having a 29th day of February).

Digital certificate items

The following table lists the contents of a digital certificate in X.509 format.

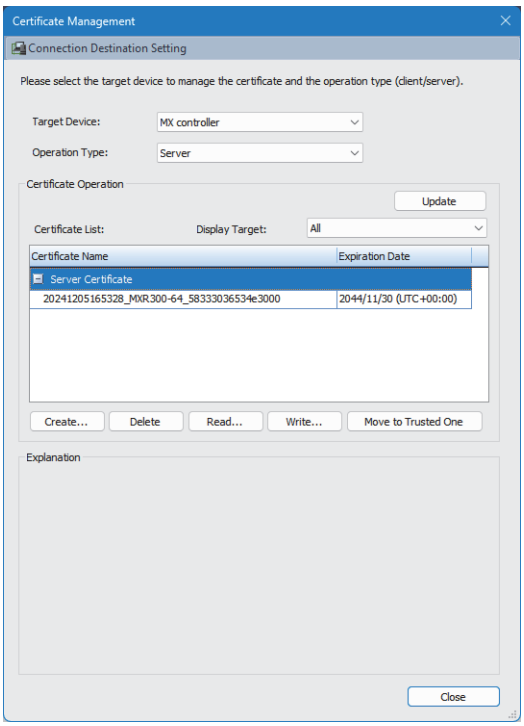
Item			Description	Contents written to the certificate	
				CER format	DER format
Pre-signed certificate (tbsCertificate)	Version (version)		Certificate version	V3	
	Serial number (serialnumber)		Positive integers that differ for each certificate	Value set by OpenSSL	
	Algorithm identifier (signature)		Algorithm used when signing a certificate	SHA256 with ECDSA	SHA256 with RSA
	Issuer (issuer)		Country name*1 (Country Name)	Character string set by user	
			State name (State or Province Name)		
			Locality name (Locality Name)		
			Organization name (Organization Name)		
			Organizational unit (Organizational Unit Name)		
			Common name (Common Name)	[Model name]_[Product number of the model for which the certificate is created]	MXR
	Validity (validity)	Start time (NotBefore)	Time of certificate creation	Time when a user creates the certificates	
		End time (NotAfter)	Certificate expiration date	The time obtained by adding the number of years set by the user to the start time	
	Subject (subject)		Name of the certificate owner (same as issuer)	Same as the character string set by the user for Issuer	
	Subject public key information (subject public key info)	Algorithm (algorithm)	Algorithm used for public key	ECDSA	RSA
		Subject public key (subject PublicKey)	Public key created	Public key created	
	Extended area (extension)	Subject alternative name (Subject Alternative Name)	IP address (IP Address)	[IP address of port 3 (P3)]	[IP address of port 3 (P3)]
			Uniform resource identifier (uniformResourceIdentifier)	—	urn:Mitsubishi:MXROpcUa
		Extended key usage (Extended Key Usage)	Purpose of use of the extended key included in the certificate	—	serverAuth
		Authority key identifier (Authority Key Identifier)	Value to identify the public key of the certificate authority that signed in the certificate	—	Identification information of the public key
		Basic constraints (basic Constraints)	Indicates whether the public key can be used to verify the signature of the certificate.	CA: TRUE	
		Purpose of key use (KeyUsage)	Purpose of use of the key included in the certificate	(KeyUsage is not granted.)	digitalSignature, nonRepudiation, keyEncipherment, dataEncipherment keyCertSign
Signature algorithm (signaturealgorithm)			Algorithm used when signing a certificate (same as algorithm identifier)	SHA256 with ECDSA	SHA256 with RSA
Signature value (signaturevalue)			Issuer's digital signature	Calculated digital signature	

*1 Specify a 2-letter country code as defined in ISO 3166-1.

"Certificate Management" window

The digital certificate management window displays the following items.

[Project] ⇨ [Security] ⇨ [Certificate Management]



Item	Description
Target Device	Select the target device. • MX controller • Personal computer
Operation Type	Select the operation type. ■When the target device is a MELSEC MX Controller • Server • Client ■When the target device is a personal computer • Client
[Update] button	Displays a list of information (file names and expiration dates) about server and client certificates.
Certificate name	Displays file names of server and client certificates.
Expiration Date	Displays expiration dates of server and client certificates.
Server Certificate/Client Certificate	Displays a list of certificates in the engineering tool.
Trusted Server Certificate	Displays server and client certificates trusted by the controller.
Rejected Client Certificate	Displays the client certificates not included in the trusted certificates, which belong to external devices whose connections have been denied.
[Create] button	When "MX controller" is selected for "Target Device" and "Server" is selected for "Operation Type": Creates a server certificate.
[Delete] button	Deletes a server or client certificate.
[Update] button	Displays a list of information (file names and expiration dates) about server and client certificates.
[Read] button	When "MX controller" is selected for "Target Device" and "Server" is selected for "Operation Type": Reads a server certificate from the controller to the engineering tool.
[Write] button	• When "MX controller" is selected for "Target Device" and "Server" is selected for "Operation Type": Writes a client certificate from the engineering tool to the controller (server). • When "MX controller" is selected for "Target Device" and "Client" is selected for "Operation Type": Writes a server certificate from the engineering tool to the controller (client). • When "Personal computer" is selected for "Target Device" and "Client" is selected for "Operation Type": Writes a server certificate in the engineering tool to the "Trusted Certificate" list.
[Move to Trusted One] button	Moves the client certificate included in the "Rejected Client Certificate" list to the "Trusted Certificate" list.

Point

Client authentication is a process that authenticates the certificate provided by a client (client certificate) for encrypted communication.

If a server or client certificate has expired, the controller outputs an error.

Use the methods below to update a server certificate.

For server device:

- Delete the server certificate to be updated.
- Create a new server certificate.
- Power off and on, or reset the controller.

For client device:

- Read the newly created server certificate from the server.
- Delete the server certificate to be updated.
- Write the read server certificate to the client device.

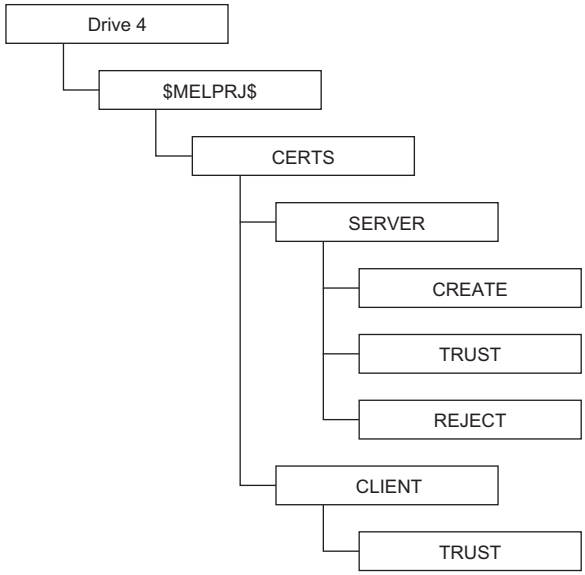
Use the methods below to update a client certificate.

For server device:

- Read the newly created client certificate from the client.
- Delete the client certificate to be updated.
- Write the read client certificate to the server device.

■Digital certificate folder structure and data backup/restoration

The following shows the folder structure related to the digital certificates.



Folders related to the digital certificates are backed up/restored as follows. (☞ Page 1622 CONTROLLER DATA BACKUP/RESTORATION FUNCTION)

○: Available, ×: Not available, —: Not applicable

Name	Description	Backup/restoration
Drive 4	Drive where digital certificates are stored	—
$MELPRJ$	Controller system folder	—
CERTS	Parent folder of the digital certificate storage folder	○
SERVER	Folder that stores certificates used when the controller operates as a server	○
CLIENT	Folder that stores certificates used when the controller operates as a client	○
CREATE	Folder that stores server certificates created by the controller	○
TRUST	Folder that stores server and client certificates judged trusted by the controller	○
REJECT	Folder that stores client certificates denied by the controller	×

Restriction

The CREATE folder is targeted for the data backup/restoration function. However, if the backed-up data is restored to a different controller instead of the one where the data was originally backed up, the server certificates in the CREATE folder cannot be used and need to be created again.

Certificates and their file formats supported by the communication functions

The following table lists the certificates and their file formats supported by the communication functions.

Communication function	Certificate type	File format
Connection with MELSOFT products and a GOT	Server certificate	CER format (PEM format)
SLMP communications		
Simple CPU communications		
Socket communications		
File transfer (FTP server)		
File transfer (FTP client)		
Communications using the Web server function		
OPC UA server function	Server and client certificates	DER format

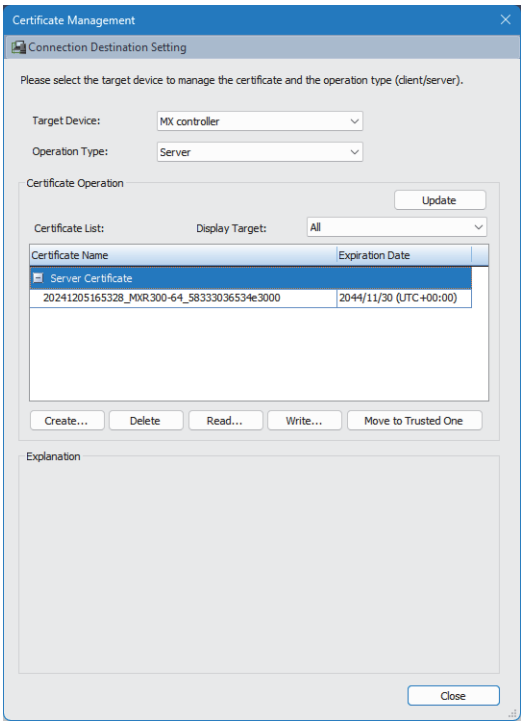
"Certificate Management" window

This section describes the operation methods for the "Certificate Management" window used to manage the server certificates/client certificates.

[Project] ⇨ [Security] ⇨ [Certificate Management]

Operation of the management window

■To display server and client certificates stored in the controller

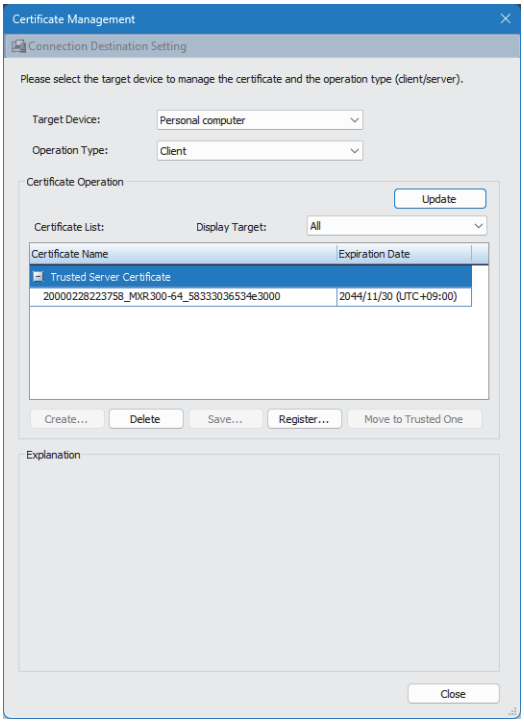


1. In the management window, select "MX controller" for "Target Device", and "Server" for "Operation Type" if the controller to be set is on the server side, and "Client" for "Operation Type" if it is on the client side.
2. Click the [Update] button to display the information of the server and client certificates stored in the connected controller.

Point

If there is a server or client certificate in the controller, click the [Update] button to perform [Read], [Delete], or [Move to Trusted One].

■To display server certificates stored on the personal computer



1. In the management window, select "Personal computer" for "Target Device" and "Client" for "Operation Type".
2. Click the [Update] button to display the information of the server certificates stored on the personal computer.

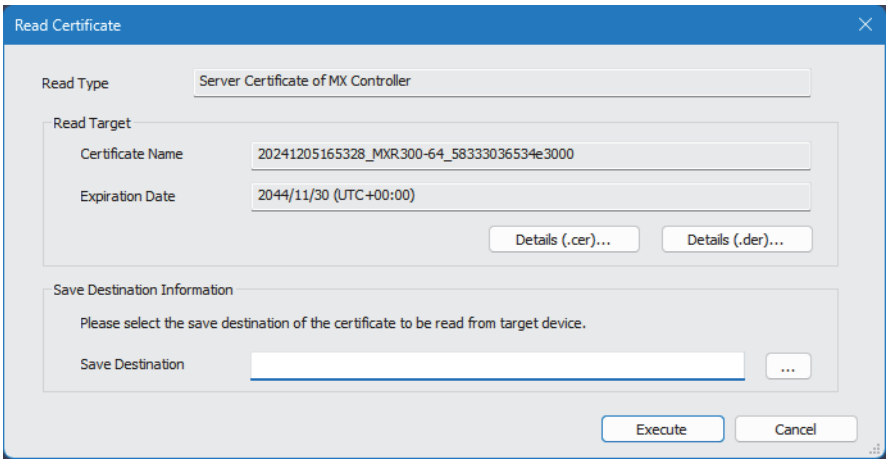
Point

If there is a server certificate in the engineering tool, click the [Update] button to perform [Delete].

Precautions

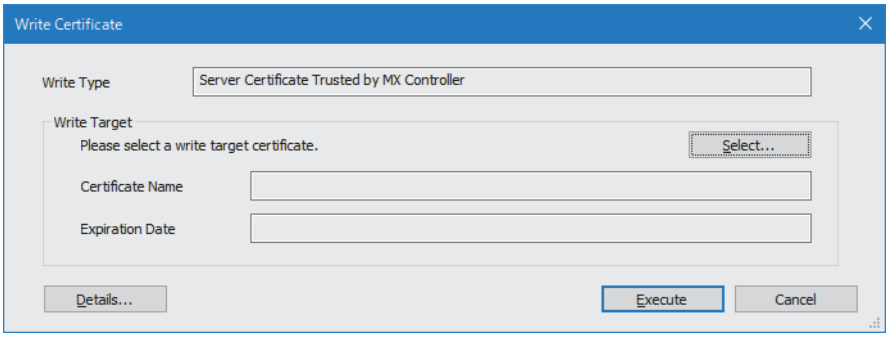
When the controller to be connected is changed while the management window is open, click the [Update] button, then perform an operation to display the certificates.

■To read server certificates



1. In the management window, select "MX controller" for "Target Device" and "Server" for "Operation Type".
2. Click the [Update] button to display the information of server certificates stored in the connected controller.
3. Select one certificate to read from the server certificates, and click the [Read] button.
4. From the displayed window, specify the file name, file type, and storage location and click the [Execute] button.
5. Click [Execute], then click the [OK] button after the reading process is completed.

■To write a server or client certificate to the controller



1. In the management window, select "MX controller" for "Target Device", and "Server" for "Operation Type" if the controller to be set is on the server side, and "Client" for "Operation Type" if it is on the client side.
2. Click the [Write] button.
3. Click the [Select] button.
4. From the displayed window, select the server or client certificate to be written to the controller and click the [Select] button.
5. Check that the selected server or client certificate information is displayed in the window, and then click the [Execute] button.
6. After the writing process is completed, click the [OK] button.

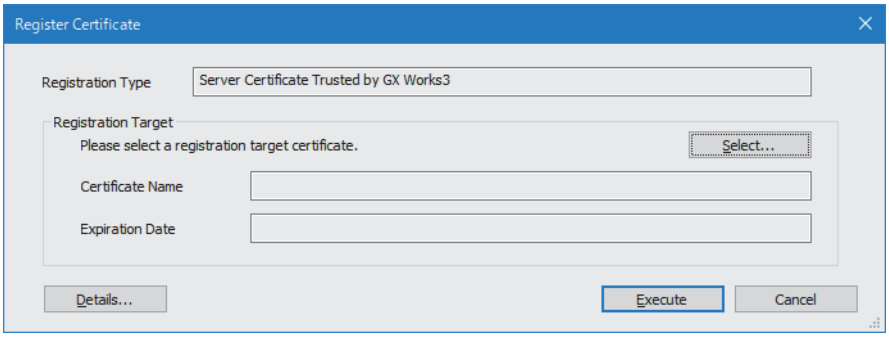
Point

- Writing cannot be performed if a server or client certificate with the same name already exists in the write-destination folder. Delete the server certificate/client certificate with the same name.
- Writing cannot be performed if the number of stored digital certificates exceeds 100. In such a case, delete the unused digital certificates.

Precautions

- Do not change the name of a digital certificate after writing it to the controller. Otherwise, encrypted communication will not be possible.
- The number of characters (including the extension) that can be written to the controller as a certificate name is 5 to 64. (The extension ".cer" is used for reading and writing by the engineering tool, but it is handled as ".pem" in drive 4 of the controller.)
- Do not write certificate names with duplicate file names (excluding extensions) to the controller.

■To write a server certificate to the personal computer



1. In the management window, select "Personal computer" for "Target Device" and "Client" for "Operation Type".
2. Click the [Register] button.
3. Click the [Select] button.
4. From the displayed window, select the server certificate to be written to the controller and click the [Select] button.
5. Check that the selected server certificate information is displayed in the window, and then click the [Execute] button.
6. After the writing process is completed, click the [OK] button.

■To delete a server or client certificate stored in the controller

1. In the management window, select "MX controller" for "Target Device", and "Server" for "Operation Type" if the controller to be set is on the server side, and "Client" for "Operation Type" if it is on the client side.
2. Click the [Update] button to display the information of the server and client certificates stored in the connected controller.
3. From the displayed window, select the server or client certificate to be deleted and click the [Delete] button.
4. After the deletion process is completed, click the [OK] button.

Precautions

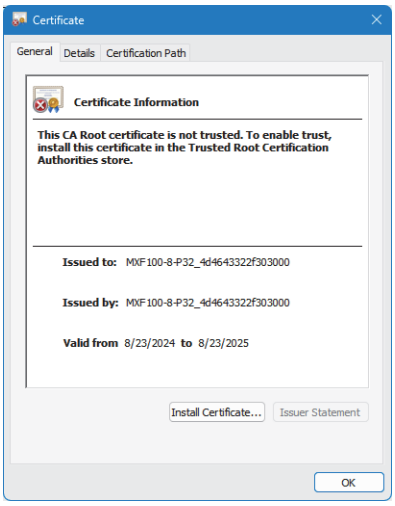
If the deletion process is performed while "Target Device" is set to "MX controller" and "Operation Type" is set to "Server", the CREATE folder (including files in the folder) is deleted, and a new CREATE folder is created.
Therefore, after the deletion process, two event histories (Folder/file deletion (event code 2A202H) and creation of new folders, writes to files/folders (event code 24200H)) are registered.

■To delete a server certificate stored on the personal computer

1. In the management window, select "Personal computer" for "Target Device". Select "Client" for "Operation Type".
2. Click the [Update] button to display the information of the server certificates stored on the personal computer.
3. From the displayed window, select the server certificate to be deleted and click the [Delete] button.
4. After the deletion process is completed, click the [OK] button.

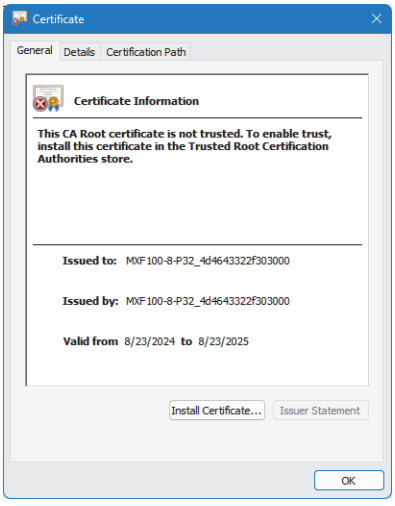
■To display the details about a server or client certificate stored in the controller

1. In the management window, select "MX controller" for "Target Device", and "Server" for "Operation Type" if the controller to be set is on the server side, and "Client" for "Operation Type" if it is on the client side.
2. Click the [Update] button to display the information of the server and client certificates stored in the connected controller.
3. From the displayed window, right-click the server or client certificate to be viewed, and select the detailed information.

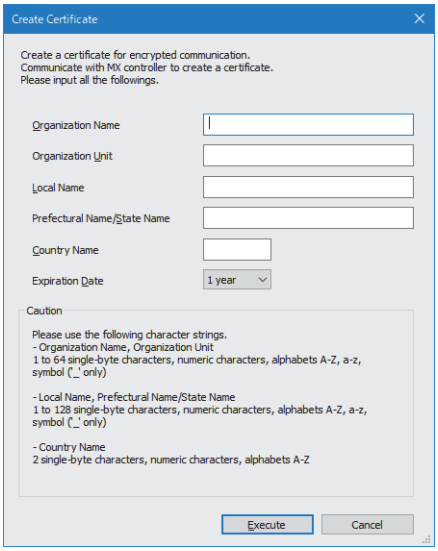


■To display the details about a server certificate stored on the personal computer

1. In the management window, select "Personal computer" for "Target Device". Select "Client" for "Operation Type".
2. Click the [Update] button to display the information of the server certificates stored on the personal computer.
3. From the displayed window, right-click the server certificate to be viewed, and select the detailed information.



■To create a server certificate to be stored in the controller



1. In the management window, select "MX controller" for "Target Device" and "Server" for "Operation Type".
2. Click the [Create] button to display the creation window.
3. Enter the items required for creating a certificate and click the [Execute] button.
4. When the confirmation window appears, click the [Execute] button to create the certificate.

Item	Description
Organization Name	Input the name of the organization.
Organization Unit	Input the organizational unit.
Local Name	Input the name of the region.
Prefectural Name/State Name	Input the name of the prefecture or state.
Country Name	Input the country name abbreviation.
Expiration Date	Select an expiration date for the certificate.

Precautions

- After creating the certificate, power off and on or reset the controller.
- When a controller server certificate has already been created, creating a server certificate deletes all server certificates in the CREATE folder from the controller, and a new server certificate will be created.
- Set the time and update the time of the controller to the latest. If the certificate is created at the default time of the controller and encrypted communication is performed with the external device operating at the latest time, the external device is judged to have expired and encrypted communication cannot be performed.
- Do not change the file name of the certificate after creating it. Otherwise, encrypted communication will not be possible.
- Create a certificate in both DER format and CER format (PEM format).
- If either of the DER format or CER format (PEM format) is deleted without using the engineering tool, the certificate will not be displayed on the certificate list. In such a case, recreate the certificate.

■To write a client certificate read from an external device to the controller

1. In the management window, select "MX controller" for "Target Device". Select "Server" for "Operation Type".

[Project] ⇨ [Security] ⇨ [Certificate Management]

2. Click the [Write] button.
3. Click the [Select] button.
4. From the displayed window, select the client certificate to be written to the controller and click the [Select] button.
5. Check that the selected client certificate information is displayed in the window, and then click the [Execute] button.
6. After the writing process is completed, click the [OK] button.

■To move a client certificate stored in the controller

1. In the management window, select "MX controller" for "Target Device". Select "Server" for "Operation Type".
2. Click the [Update] button to display the information of the server and client certificates stored in the controller.
3. Select a client certificate included in "Rejected Client Certificate" and click the [Move to Trusted One] button to move the selected certificate to "Trusted Certificate".
4. Click the [Update] button to display the information of the client certificate moved to "Trusted Server Certificate".

Precautions

- Powering off and on or resetting the controller will delete the rejected certificates.
- Client certificates whose file names exceed 64 characters are not displayed in the rejected certificate list.

Point

When the connection with an OPC UA client, the file of the client certificate to be registered as a rejected certificate is named in the format "issuer name_certificate thumbprint.extension". A certificate with a name longer than 64 characters is not displayed in the rejected certificate list.
In that case, acquire the client certificate from the OPC UA client and write it to the controller. (☞ Page 1566 To write a server or client certificate to the controller)
For the acquisition method of the client certificate, refer to the specifications of the OPC UA client used.

Operation procedure for the encrypted communication

The operating procedure differs depending on whether the controller set to perform encrypted communication has open processing with the external device.

Function	Whether processing is open or not	Reading source of server certificate	Writing target of server certificate	Reading source of client certificate	Writing target of client certificate	Reference
Connection with MELSOFT products and a GOT	Not open from the controller to be set	Controller to be set	External device*1	—	—	Page 1572 Connection with MELSOFT products and a GOT
Socket communications (UDP connection module, Unpassive connection module, Fullpassive connection module)						Page 1572 SLMP communications, socket communications, file transfer (FTP server), communications using the Web server function, and OPC UA server function
SLMP communications						
File transfer (FTP server)						
Communications using the Web server function						
OPC UA server function				External device*1	Controller to be set	
Socket communications (Active open)	Open from the controller to be set	External device	Controller to be set	—	—	Page 1573 When opening from the controller
File transfer (FTP client)						

*1 The external device also includes the controller other than the setting target controller as well as the personal computer in which the engineering tool is installed.

Connection between controller with encrypted communication and the engineering tool

■To connect via USB

Set encrypted communication for each communication function.

■To connect via Ethernet

Inside the trust boundary, set encrypted communication between the controller to be set and the engineering tool. After the setting is complete, set encrypted communication for other communication functions on the controller to be set.

Point

- After completing the above settings, set the encrypted communications with external devices other than the engineering tool.
- The setting information for encrypted communication is communicated in plain text with devices other than the engineering tool.
- If the external device is a controller, USB connection is recommended.
- If the external device is not a controller, set encrypted communication according to the method recommended by the manual of the external device.
- If the external device does not support encrypted communication, the controller cannot perform encrypted communication. Check that the external device supports encrypted communication.

Items to be checked on the external device before communication

■Socket communications

- IP address and port number of the external device
- IP address and port number of the controller side
- Use of open/close instructions used for encrypted communication

■File transfer (FTP server)

Refer to the configuration tool manual of the external device.

■File transfer (FTP client)

On the external device, open the port number used for encrypted communication.

When not opening from the controller

When not opening from the controller to which encrypted communication is to be set, follow the procedures below.

■Connection with MELSOFT products and a GOT

1. Log on to the controller with user authentication.
2. Select the TLS/ DTLS version in "Encrypted communication version setting".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Security] ⇨ [Version Setting for Encrypted Communication]

3. Set up the connection with MELSOFT products and a GOT. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))
4. Specify the communication path with the connection destination. (☞ Page 1576 When communicating with the controller in plain text)
5. Perform the following procedure when the server certificate has not been created or has expired.

- Create a server certificate. (☞ Page 1569 To create a server certificate to be stored in the controller)
- Read the server certificate from the controller. (☞ Page 1565 To read server certificates)
- Write the server certificate to MELSOFT products and a GOT. (☞ Page 1567 To write a server certificate to the personal computer)

6. Write the module parameters to the controller.
7. Specify the settings, such as a protocol, for the connection destination. (☞ Page 1577 When performing encrypted communication with the controller)
8. Close the system port.

■SLMP communications, socket communications, file transfer (FTP server), communications using the Web server function, and OPC UA server function

1. Log on to the controller with user authentication.
2. Select the TLS/DTLS version in "Version Setting for Encrypted Communication".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Security] ⇨ [Version Setting for Encrypted Communication]

3. Set each communication. (☞ Page 1260 SLMP COMMUNICATION, Page 1318 SOCKET COMMUNICATIONS, Page 1345 FTP Server, Page 1379 WEB SERVER FUNCTION, Page 1405 OPC UA Communication Function)
4. Specify the connection destination. (☞ Page 1576 Specify connection destination)
5. Perform the following procedure when the server certificate has not been created or has expired.

- Create a server certificate. (☞ Page 1569 To create a server certificate to be stored in the controller)
- Read the server certificate from the controller. (☞ Page 1565 To read server certificates)
- Write the server certificate to the external device. (☞ Page 1567 To write a server certificate to the personal computer)

6. When using the OPC UA server function, perform the following procedures.

The client certificate has not been created or has expired

- Refer to the manual for the external device and create a client certificate.
- Write the client certificate to the controller. (☞ Page 1570 To write a client certificate read from an external device to the controller)

To use the client certificate in "Rejected certificate", refer to the following.

☞ Page 1570 To move a client certificate stored in the controller

7. Write the module parameters to the controller.

When opening from the controller

1. Log on to the controller with user authentication.
2. Read the server certificate. (☞ Page 1565 To read server certificates)
3. Select the TLS/DTLS version in "Version Setting for Encrypted Communication".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Security] ⇨ [Version Setting for Encrypted Communication]

4. Set each communication. (☞ Page 1318 SOCKET COMMUNICATIONS, Page 1367 FTP Client)
5. Specify the connection destination. (☞ Page 1576 Specify connection destination)
6. Write the server certificate. (☞ Page 1566 To write a server or client certificate to the controller)
7. Write the module parameters to the controller.

Point

If the external device is a server that receives a request for encrypted communication, the controller to be set becomes a client that requests encrypted communication.

Operation for encrypted communication based on user authentication status

The following table lists whether operation is possible according to whether user authentication is enabled or disabled.

Operating procedure	User authentication is enabled		User authentication is disabled
	Users who have logged in as Administrators	Users who have logged in as a group other than Administrators/Users who have logged in without user authentication	
Version setting for encrypted communication	Can be set with the engineering tool	Cannot be set with the engineering tool	Can be set with the engineering tool
Settings for each communication function			
Specify connection destination	Can be set with the engineering tool		
Create a server certificate	Can be operated via the engineering tool	Cannot be operated via the engineering tool	Can be operated via the engineering tool
Display server and client certificates		☞ Page 1574 Availability of operation depending on the user authentication status (enabled/disabled) for each external device	
Display the details about a server or client certificate		☞ Page 1574 Availability of each operation depending on the user authentication status (enabled/disabled)	
Read a server certificate		Cannot be operated via the engineering tool	
Write a server or client certificate			
Delete a server or client certificate			
Move a client certificate to the trusted list			
Write to the controller	Write is permitted	Write is not permitted	Write is permitted
Reflect settings to the controller	Possible via power-on or reset		
Close system port	Can be set with the engineering tool	Cannot be set with the engineering tool	Can be set with the engineering tool

■Availability of operation depending on the user authentication status (enabled/disabled) for each external device

External device	User authentication is enabled		User authentication is disabled
	Users who have logged in as Administrators	Users who have logged in as a group other than Administrators/ Users who have logged in without user authentication	
Controller	Operation available	Operation not available	Operation available
Personal computer	Operation available		

■Availability of each operation depending on the user authentication status (enabled/disabled)

Operation	External device	User authentication is enabled		User authentication is disabled
		Users who have logged in as Administrators	Users who have logged in as a group other than Administrators/Users who have logged in without user authentication	
Display details from the certificate list	Controller	Operation available	Operation not available	Operation available
	Personal computer	Operation available		
Display details from the write window	Controller			
	Personal computer			

Version setting for encrypted communication

Select the TLS/DTLS version in "Version Setting for Encrypted Communication" according to the settings of the external device to which the controller connects.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Security] ⇨ [Version Setting for Encrypted Communication]

Item		Parameter
Version setting for encrypted communication	TLS	• TLS1.3 (default) • TLS1.2 • TLS1.3/TLS1.2
	DTLS	DTLS1.2

Point

- Specify the same version as the TLS/DTLS version used by the external device.
- Separately set the communication to which external device encryption is to be applied.
- When performing encrypted communication with multiple external devices, if the TLS version supported by each external device is a mixture of TLS 1.2 and TLS 1.3, set "TLS1.3/TLS1.2" in "Version Setting for Encrypted Communication". Setting it to anything else will cause encrypted communication to fail with devices that have a different version.

Specify connection destination

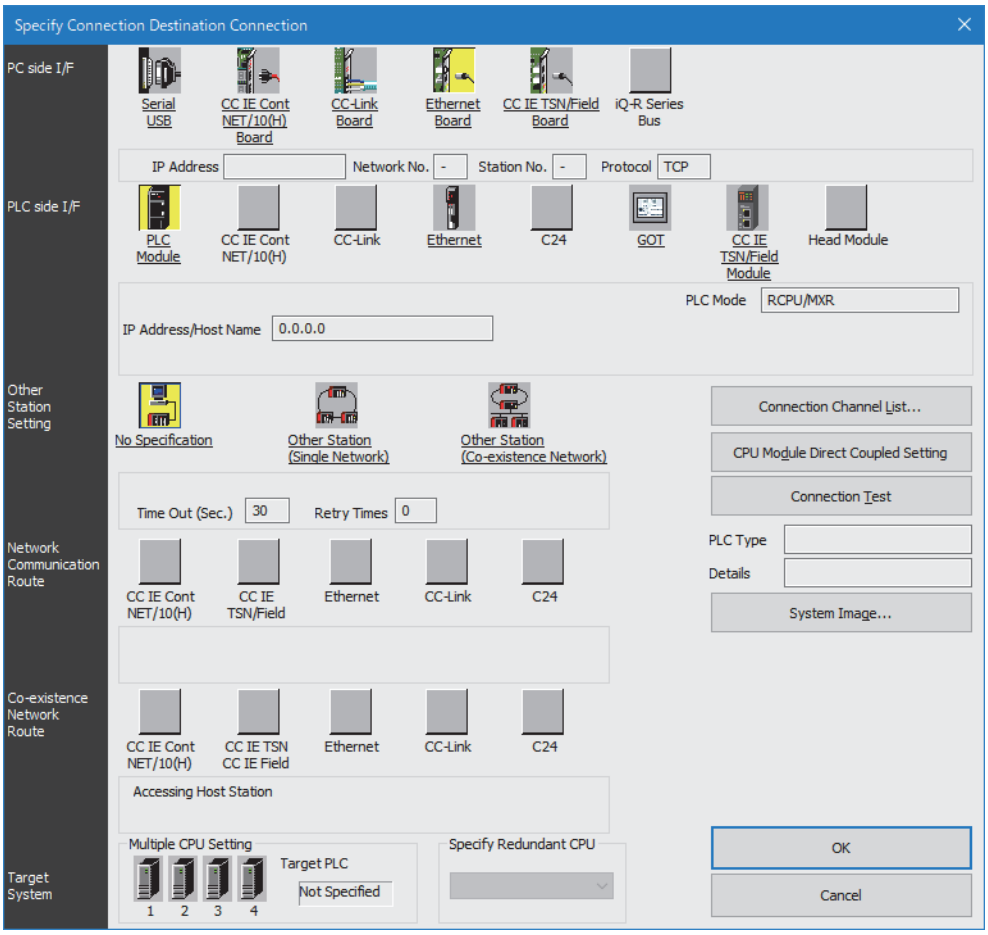
When connecting to a GOT, refer to the manual for the GOT used.

The following shows how to connect with MELSOFT products.

■When communicating with the controller in plain text

Set the communication route and click the [OK] button.

[Online] ⇨ [Current Connection Destination] ⇨ [Specify Connection Destination Connection]



Point

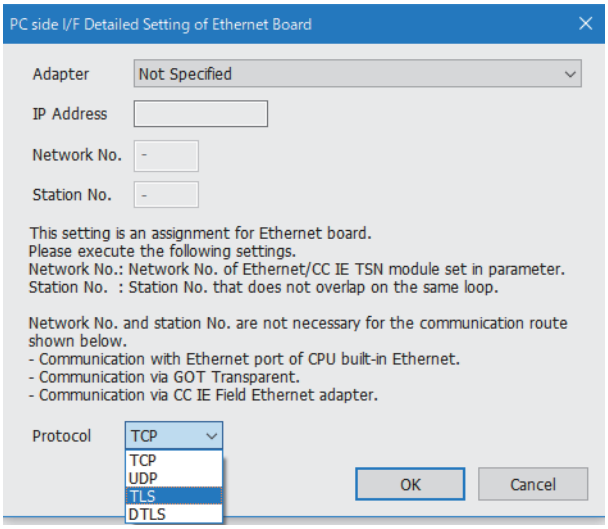
Unless settings required for encrypted communication (such as certificate setting, encrypted communication version setting) are completed, encrypted communication cannot be performed even if TLS or DTLS is selected.

■When performing encrypted communication with the controller

1. Double-click "Ethernet Board" in "PC side I/F".

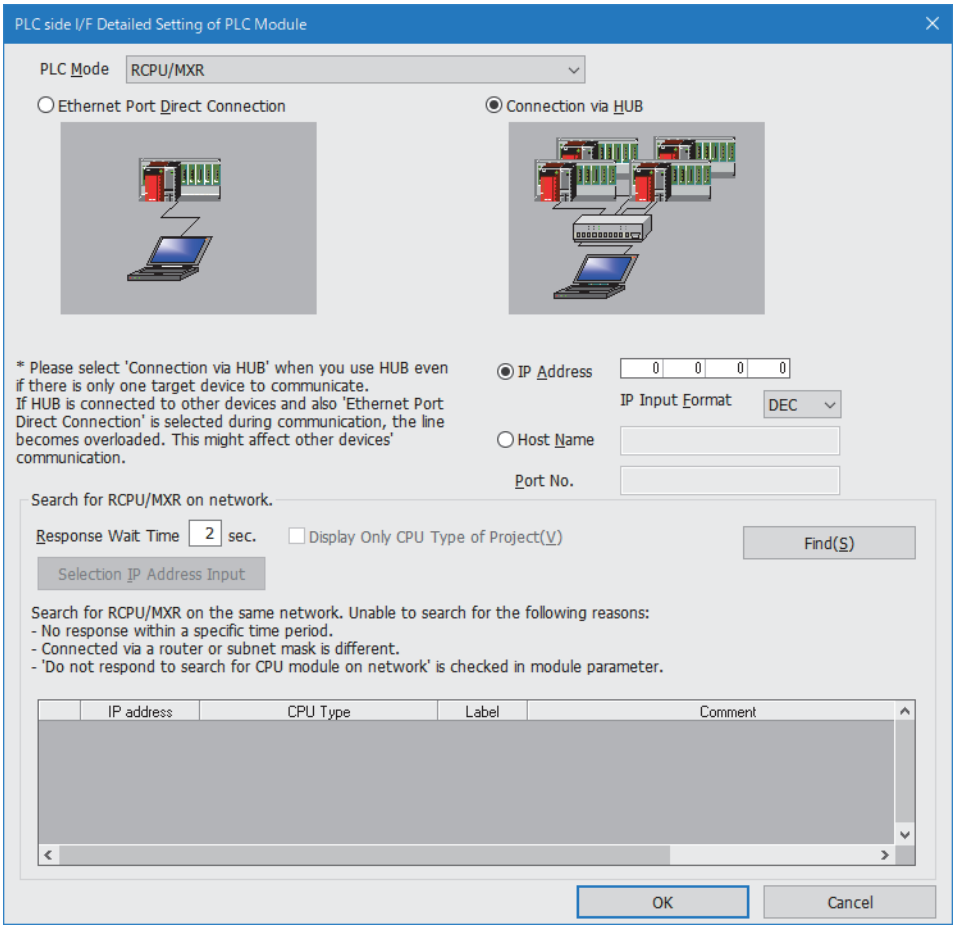
[Online] ⇨ [Current Connection Destination] ⇨ [Specify Connection Destination Connection]

2. Select "TLS" or "DTLS" from "Protocol" and click the [OK] button.



3. Double-click "PLC Module" in "PLC side I/F".

4. Select the checkbox for "Connection via HUB" and click the [OK] button.



5. Select "No Specification" in "Other Station setting".

6. Click the [OK] button.

Point

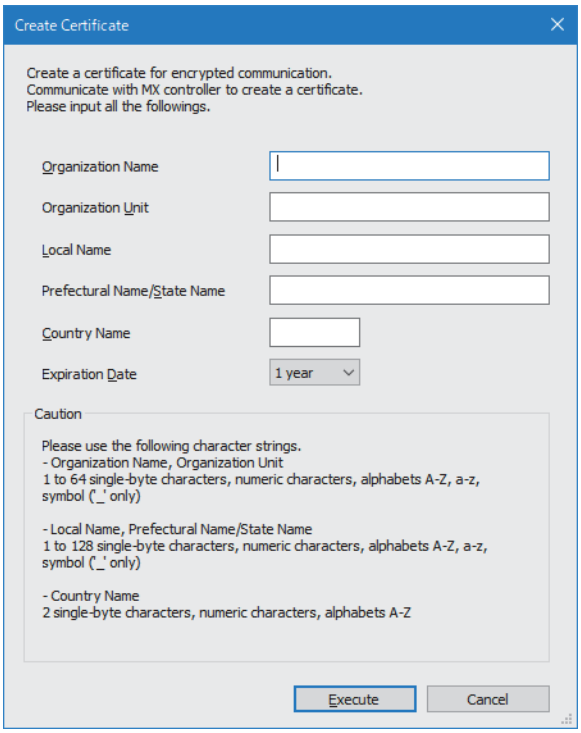
Encrypted communication using the Ethernet port direct connection is not possible.

Creating a server certificate

In the management window, select "MX controller" for "Target Device" and "Server" for "Operation Type".

From the certificate creation window, input the information required for creation. All fields are required.

[Project] ⇨ [Security] ⇨ [Certificate Management] ⇨ [Create] button



Item	Description
Organization Name	Input the name of the organization.
Organization Unit	Input the organizational unit.
Local Name	Input the name of the region.
Prefectural Name/State Name	Input the name of the prefecture or state.
Country Name	Input the country name abbreviation.
Expiration Date	Select an expiration date for the certificate.

Reading a server certificate

■When reading a server certificate from the controller

1. In the management window, select "MX controller" for "Target Device" and "Server" for "Operation Type".

[Project] ⇨ [Security] ⇨ [Certificate Management]

2. Click the [Update] button to display the information of server certificates stored in the connected controller.
3. Select one certificate to read from the server certificates, and click the [Read] button.
4. From the displayed window, specify the file name and the storage location and click the [Save] button.

■When reading a server certificate from a device other than the controller

Read the server certificate from the external device by using the setting tool of the external device.

For details, refer to the manual of the external device.

Writing a server certificate

■When writing a server certificate to the controller

1. In the management window, select "MX controller" for "Target Device" and "Client" for "Operation Type".

[Project] ⇨ [Security] ⇨ [Certificate Management]

2. Click the [Write] button.
3. Click the [Select] button.
4. From the displayed window, select the server certificate to be written to the controller and click the [Select] button.
5. Check that the selected server certificate information is displayed in the window, and then click the [Execute] button.
6. After the writing process is completed, click the [OK] button.

■To write a server certificate to the personal computer in which the engineering tool is installed

1. In the management window, select "Personal computer" for "Target Device". Select "Client" for "Operation Type".

[Project] ⇨ [Security] ⇨ [Certificate Management]

2. Click the [Register] button.
3. Click the [Select] button.
4. From the displayed window, select the server certificate to be written to the personal computer and click the [Select] button.
5. Check that the selected server certificate information is displayed in the window, and then click the [Execute] button.
6. After the writing process is completed, click the [OK] button.

■To write a server certificate to devices other than the above

Write the server certificate to the external device by using the setting tool of the external device.
For details, refer to the manual of the external device.

Moving a client certificate

The following shows how to move a client certificate of an external device to "Trusted Server Certificate" in the management window.

1. Perform encrypted communication from the external device (client) to the controller.

If the client certificate of the external device is not included in "Trusted Server Certificate", encrypted communication fails and its client certificate is registered as a denied certificate.

2. In the management window, select "MX controller" for "Target Device". Select "Server" for "Operation Type".

[Project] ⇨ [Security] ⇨ [Certificate Management]

3. Click the [Update] button to display the information of the server and client certificates stored in the controller.
4. Select a client certificate included in "Rejected certificate" and click the [Move to Trusted One] button to move the selected certificate to "Trusted Server Certificate".
5. Click the [Update] button to display the information of the client certificate moved to "Trusted Server Certificate".

Writing/reflecting settings to the controller

Write parameters to the controller.

Closing the system port

If necessary, close the system port used for communication outside the trust boundary.
Use the following methods to close it.

- Use a firewall to reject port numbers that access from outside to inside and from inside to outside of the trust boundary.
- Use the default open port usage setting function to close the port number that corresponds to the system port.

Certificate expiration check

This function periodically checks the expiration date of the server certificate/client certificate stored in the CERTS folder. (☞ Page 1563 Digital certificate folder structure and data backup/restoration)

Point

- The expiration dates of the certificates is checked when the controller starts up and every 24 hours after starting.
- If the expiration date is within 90 days or has expired, the user will be notified via an error code, event code, and buffer memory. In that case, be sure to renew the certificate before the expiration date.

Precautions

- For encrypted communications, the expired server certificate/client certificate cannot be used.
- If the CERTS folder contains a server certificate/client certificate, the function checks the expiration date even if encrypted communication is not used.
- The expiration date is checked every 24 hours, so even if the certificate expires, an error may not occur immediately.

Closing connections for encrypted communication

A connection that is set in the external device connection configuration setting can be closed by changing the value of 'Open request signal' (U3E0\G7873 to 7876).
To open the connection again, perform the normal connection open processing.

Precautions

- Check that the external device supports encrypted communication before setting the controller. If the external device does not support encrypted communication, encrypted communication cannot be performed between the controller and the external device.
- If a stop error occurs during encrypted communication between the controller and the external device, whether the communication continues or stops depends on the specifications of each communication function.
- If the certificate is deleted from the controller during encrypted communication with the external device, encrypted communication continues while the encrypted communication session is still established. If the controller or external device disconnects the session, encrypted communication will not be possible.
- If the controller with encrypted communication settings fails and is replaced with a replacement controller, set up encrypted communication again for the replacement controller. (☞ Page 1571 Operation procedure for the encrypted communication)
- If encrypted communication is performed with the replacement controller using the certificate of the failed controller, the encrypted communication will fail.
- Connect the engineering tool and the controller and manage the certificate.
- Certificates written by means other than the engineering tool cannot be used during encrypted communication.
- The controller uses the last certificate created by the engineering tool for encrypted communication. Therefore, when writing a certificate by using SLMP, commands, or FTP transfer, encrypted communication cannot be performed unless the server certificate created last is written.
- Do not write to the TRUST/REJECT/CREATE folders unless from the certificate management window of the engineering tool. Certificate management may not be performed correctly.
- If the time setting is not configured, a security function error (certificate expiration) (error code 1168H) or certificate expiration within 90 days (event code 10803H) may be mistakenly detected. Set the time from the engineering tool, SM/SD, instructions, or the SNTP client in advance.
- If a server or client certificate is deleted by operations not from the engineering tool, encrypted communications may not be properly performed.
- The maximum number of certificates that the controller can use for encrypted communication is as follows.

Folder name	Maximum number
CREATE	1*1
TRUST	100
REJECT	100*2

*1 Created DER format and CER format files are counted as one certificate.

*2 The number is checked when the [Update] button in the certificate management window is clicked and excess certificates will be deleted if the maximum number is exceeded. In that case, recently created certificates will be deleted first. Therefore, the number of available certificates stored in the REJECT folder may temporarily exceed the maximum number.

Point

If an issue where encrypted communications are not properly performed occurs, the problem can be fixed by powering off and on the controller.

61.2 IP Filter Function

The IP filter function identifies the IP address of the access source and prevents access by the unauthorized IP addresses specified.
Restrict access from connected devices by setting the IP addresses to be allowed or blocked in the parameters.

Point

To use the controller in an environment connected to a LAN line, set the IP filter function.

Precautions

The IP filter function is one means of preventing unauthorized access from external devices, but it does not completely prevent unauthorized access. Also include measures apart from this function to maintain controller and system security. Mitsubishi Electric shall not be held liable for any system problems that may occur from unauthorized access.
Examples of measures for unauthorized access are given below.

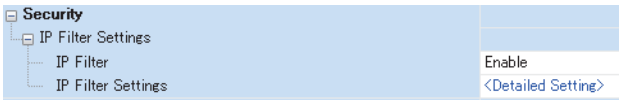
- Install a firewall
- Install a personal computer as a relay station, and control the relay of send/receive data with an application program.
- Install an external device for which the access rights can be controlled as a relay station (Contact the network service provider or equipment dealer for details on the external devices for which access rights can be controlled).

Setting procedure

1. Log on with user authentication.
2. Use the module parameters*1 of the engineering tool to select "IP Filter Settings".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings] ⇨ [Security] ⇨ [IP Filter Settings]

*1 If setting to an Ethernet port, select the "Module Parameter (Ethernet)".



Item	Description	Setting value
IP Filter	Set whether to use the IP filter function.	• Disable (default) • Enable
IP Filter Settings	Set the details related to the IP filter function.	☞ Page 1583 IP Filter Settings

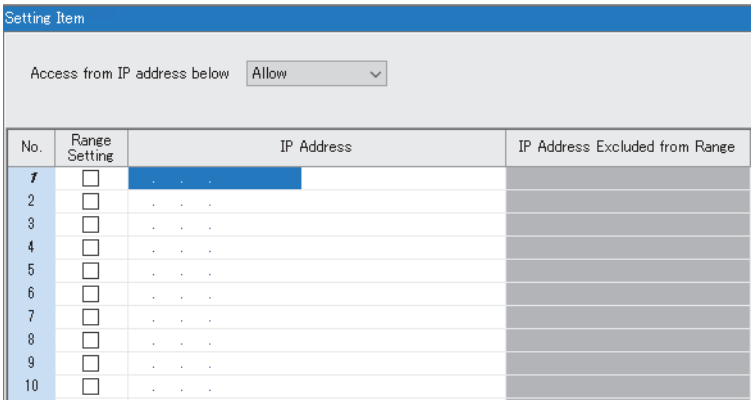
3. Set the IP addresses to be allowed or the IP addresses to be blocked.
4. Write the module parameters to the controller.
5. When the controller is turned off and on or reset, the IP filter is enabled.

Point

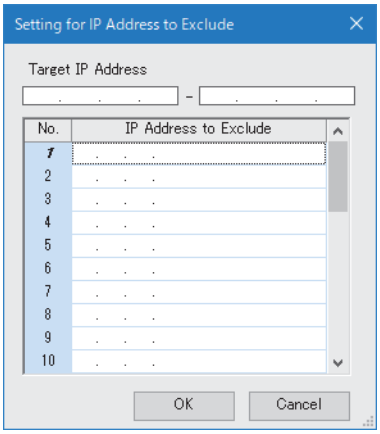
- When connecting via Ethernet, even if the connection is specified in the "External Device Configuration" under "Basic Settings" or by the program, access from the external device is allowed or blocked according to "IP Filter Settings" in "Security" under "Application Settings". For this reason, if the IP address set in "External Device Configuration" under "Basic Settings" is set to be blocked by "IP Filter Settings" in "Security" under "Application Settings", the IP filter will be enabled, and communication with the external device will be denied.
- When connecting with CC-Link IE TSN, do not set the IP addresses of the master station or device stations as blocked. When a device station using line topology is set as blocked, cyclic and transient transmissions cannot be performed on the stations that are connected after the device station that is set as blocked.

IP Filter Settings

Up to 32 accesses can be set to be allowed or blocked for one IP address of the controller.
Also, a range of IP addresses can be specified or excluded from that specified range.



Item	Description	Setting value
Access from IP address below	Select whether to allow or block access (packets) from the specified IP addresses.	• Allow (default) • Deny
Range Setting	Select this checkbox to specify a range of IP addresses to allow or block.	• Do not specify a range (default) • Specify a range
IP Address	Set the IP addresses to be allowed or blocked. When a range of IP addresses can be specified, to specify a range, select the checkbox for the range setting and specify the starting IP address and ending IP address of the range.	0.0.0.1 to 223.255.255.254 (Default: Blank)
IP Address Excluded from Range	Specify the addresses to exclude from the range. To specify IP addresses to be excluded, click the box on the right.	— (This item is not available if the checkbox for the range setting is not selected.)



Item	Description	Setting value
Setting for IP Addresses to Exclude	Set IP addresses that are excluded from the range of IP addresses that are allowed or blocked. Set the IP addresses to be excluded as individual IP addresses. (A range cannot be set.)	0.0.0.1 to 223.255.255.254 (Default: Blank)

Operation

This section describes the operation when using the IP filter function with CC-Link IE TSN.

Setting Target

Set either allow or block for all IP addresses that connect to the same network.
Even if the device station is already registered on the network configuration setting window, register the IP address of the device station.
Register the setting details to the master station, and allow or block packets received from the target IP address according to the settings.

Operation details

Even if the device station is registered on the network configuration setting window, the station to be blocked is the disconnected station, and cyclic transmission and transient transmission are not performed. It is also displayed as a disconnected station in the diagnostics window. However, Ethernet devices are not displayed in the Ethernet diagnostics window.
When a packet is received from a blocked IP address, the existence of a blocked packet can be registered in the event history, which can be checked later.
When setting in the IP filter setting window on the master station, if the IP address registered in the network configuration settings window is blocked, the following warning will be displayed.

- When the device station is set in the network configuration settings and the target IP address of the IP filter settings is blocked
- When the device station is not set in the network configuration settings, and the IP filter setting is set to "Allow" but no target IP address is set (IP filter setting is set to block all.)

Precautions

- If there is a proxy server on the LAN, block the IP address for the proxy server. If the IP address is allowed, it will not be possible to prevent access from personal computers that access the proxy server.
- To block access from an external device to another station, set the IP filter for the connected station (station connected directly to an external device).
- Even if communication settings such as SLMP, socket communications, and MELSOFT connection have been made, access will not be possible if the IP filter has been set.

61.3 Default Open Port Usage Setting Function

The default open port usage setting function can open or close the default open port number of the controller.
Also, a timeout can be set for system connections.

Concept of open/close

Properly open/close unused ports according to the security policy.
Note that leaving unused ports open is not recommended.

- Communication inside the trust boundary: Close the ports not used for routes connected to the inside of the trust boundary.
- Communication outside the trust boundary: Close all ports that can be set with this function for routes connected outside the trust boundary.

Point

- From the perspective of multi-layered defense, in addition to the open/closed settings of this function, also set up firewalls to block communication requests on ports that do not need to communicate from the outside to the inside and from the inside to the outside of the trust boundary.
- For ports that should be open when the built-in network function is used, refer to the following.

☞ Page 2191 Port Numbers Used by the System

Setting method

1. Log on with user authentication.
2. Use the module parameters of the engineering tool to set "To Set or Not to Use Default Open Port" to "Set".

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Common Setting)] ⇨ [Security] ⇨ [Setting to Use or Not to Use Default Open Port]

3. Set open/close and the system connection monitoring timer for port usage.
4. Write the module parameters to the controller.
5. Power off and on or reset the controller.

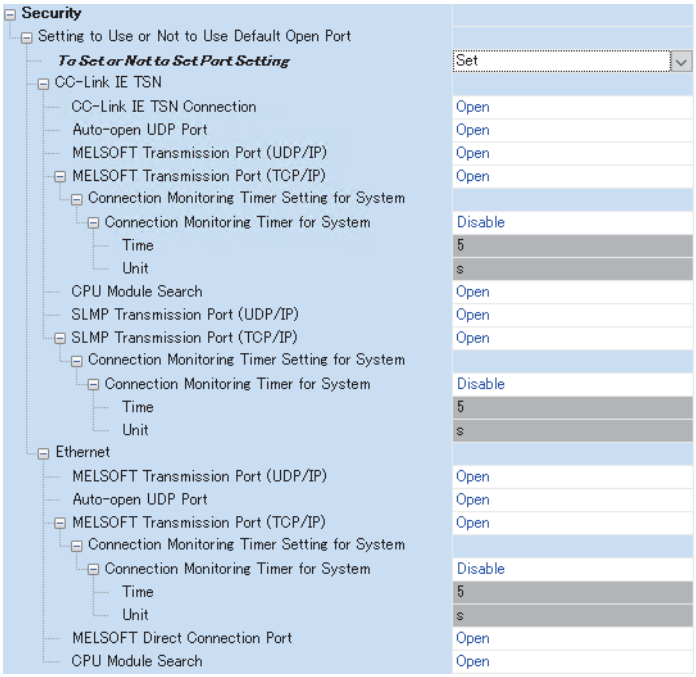
Point

- When a port is set to closed, it will be closed even if the port is set to be used by another function.
- The default value is recommended for the system connection monitoring timer.
- When changing the set value of the system connection monitoring timer, decide its value.

Setting to Use or Not to Use Default Open Port

The default open port usage setting function is configured.

Window



Displayed items

Item			Setting value
To Set or Not to Use Default Open Port			• Not Set (default) • Set
CC-Link IE TSN	CC-Link IE TSN Connection		• Open (default) • Close
	Auto-open UDP Port		
	MELSOFT Transmission Port (UDP/IP)		
	MELSOFT Transmission Port (TCP/IP)		
	Connection Monitoring Timer Setting for System	Connection Monitoring Timer for System	• Disable (default) • Enable
		Time	• 100 to 16383000ms (in increments of 100ms) • 1 to 16383s (in increments of 1s) (Default: 5)
		Unit	• s (default) • ms
	CPU Module Search[*1]		• Open (default) • Close
	SLMP Transmission Port (UDP/IP)		
	SLMP Transmission Port (TCP/IP)		
	Connection Monitoring Timer Setting for System	Connection Monitoring Timer for System	• Disable (default) • Enable
		Time	• 100 to 16383000ms (in increments of 100ms) • 1 to 16383s (in increments of 1s) (Default: 5)
		Unit	• s (default) • ms

Item			Setting value
Ethernet	MELSOFT Transmission Port (UDP/IP)		• Open (default) • Close
	Auto-open UDP Port		
	MELSOFT Transmission Port (TCP/IP)		
	Connection Monitoring Timer Setting for System	Connection Monitoring Timer for System	• Disable (default) • Enable
		Time	• 100 to 16383000ms (in increments of 100ms) • 1 to 16383s (in increments of 1s) (Default: 5)
		Unit	• s (default) • ms
	MELSOFT Direct Connection Port*2		• Open (default) • Close
	CPU Module Search*1		

*1 If setting not to respond to the CPU module on the network, set the CPU search.

*2 If prohibiting direct connection with MELSOFT, set the MELSOFT direct connection port.

61.4 Band Limit Function Against DoS Attacks

This function limits the network bandwidth of the Ethernet port to be used by the controller.

Precautions

The bandwidth limit against DoS attacks is one method of preventing unauthorized access (such as a program and data destruction) from an external device. It does not completely prevent unauthorized access.
To maintain the security (confidentiality, integrity, and availability) of the programmable controller and the system against unauthorized access, denial-of-service (DoS) attacks, computer viruses, and other cyberattacks from external devices, take appropriate measures such as firewalls, virtual private networks (VPNs), and antivirus solutions.
Examples of countermeasures against unauthorized access are shown below.

- Installation of a firewall or VPN
- Installation of a personal computer as a relay station, and control of the relay of send/receive data with an application program
- Installation of an external device for which the access rights can be controlled as a relay station (Contact the network service provider or equipment dealer for details on the external devices for which access rights can be controlled.)

Setting method

1. Log on with user authentication.
2. Use "Module Parameter (Ethernet)" of the engineering tool to set "To Set or Not to Set Band Area Limit" to "Use".

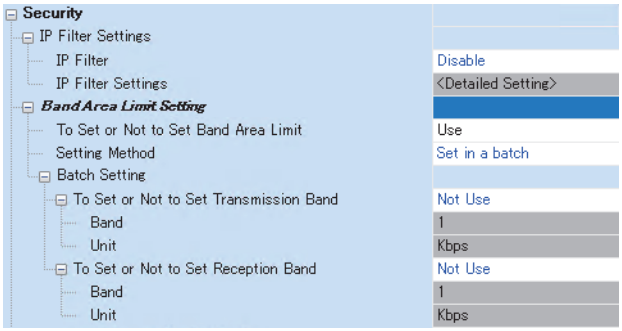
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings] ⇨ [Security] ⇨ [Band Area Limit Setting]

3. Set the required items.
4. Write the module parameters to the controller.
5. When the controller is reset or the power supply is turned off and on, the bandwidth limitation setting is enabled.

Bandwidth limit settings

The bandwidth limitation setting is configured to limit the communication bandwidth.

Window



Displayed items

Item			Description	Setting value
To Set or Not to Set Band Area Limit			Specify whether to use the bandwidth limit function.	• Not Use (default) • Use
Setting Method			Set whether to limit the bandwidth collectively or individually.	Set in a batch
Batch Setting	To Set or Not to Set Transmission Band	—	When setting the transmission band (the band where the controller transmits data), set "Use".	• Not Use (default) • Use
		Band	Set the bandwidth.	1 to 1024 (Default: 1)
		Unit	Set the bandwidth unit.	• Kbps (default) • Mbps
	To Set or Not to Set Reception Band	—	When setting the reception band (the band where the controller receives data), set "Use".	• Not Use (default) • Use
		Band	Set the bandwidth.	1 to 1024 (Default: 1)
		Unit	Set the bandwidth unit.	• Kbps (default) • Mbps

Point

- Regarding how to determine the bandwidth limit, the usage environment and system configuration determine how much bandwidth should normally be used. Therefore, when setting the bandwidth, check in advance the normal communication bandwidth in the actual usage environment by referring to 'Data size of received packets per unit time (1s) [Kbps]' (U3E0\G2032 to 2035) and 'Data size of sent packets per unit time (1s) [Kbps]' (U3E0\G2036 to 2039), and set the appropriate bandwidth. However, note that there is a limit on the data size that can be measured for 'Data size of received packets per unit time (1s) [Kbps]' (U3E0\G2032 to 2035) and 'Data size of sent packets per unit time (1s) [Kbps]' (U3E0\G2036 to 2039). (☞ Page 1775 Ethernet communication load monitor function) In addition, if the communication bandwidth cannot be checked via the buffer memory, use other packet capturing tools instead.
- For intermittent packet data communications, it may be permissible to send and receive data at up to approximately twice the set communication bandwidth.

Precautions

Access from an IP address that was set to be blocked by the IP filter function is also subject to bandwidth limitation by this function.

62 PROTECTION OF CONTROLLER OPERATION

This chapter describes the operation settings of when the controller detects an error due to receiving a DoS attack or similar issue.

62.1 Operation Settings

When the controller detects an anomaly, an error occurs.
There are two types of errors: a stop error and a continuation error. Errors can be set to either a stop error or a continuation error with the CPU parameter or system parameter.
☞ Page 1747 Controller Operation Setting at Error Detection
☞ Page 1749 Each module operation setting at error detection

Controller operation

When the controller detects an error, it will perform the following operations according to the controller operation settings at error detection.

Controller operation setting at error detection	Controller operation	
	Output	Controller operation
Stop	Hold	When the controller detects an error, it will stop operations and hold the output at its last state before the operation is stopped.
Continue	—	The controller continues operations even if it detects an error.

MEMO

PART 15 ONLINE OPERATION

This part consists of the following chapters.

63 WRITING DATA TO THE CONTROLLER

64 REMOTE OPERATION

65 MONITOR FUNCTION

63 WRITING DATA TO THE CONTROLLER

This chapter describes the functions relating to writing data to the controller.
The following are available types for writing data to the controller.

- Writing data to the programmable controller
- Online change

Writing files to the program memory

Files cannot be written to the program memory from multiple sources simultaneously. If another source is writing at the execution of writing, wait until that source has completed writing, and write the data.
To check whether another source is writing, check the event history.
The write interval is from the start of the program memory update (event code: 24203H) to the end of the program memory update (event code: 24204H) or the program memory update failure (event code: 24205H).

63.1 Writing Data to the Programmable Controller

This function writes data specified by the project of the engineering tool to the memory of the controller. For details, refer to the following.
GX Works3 Operating Manual

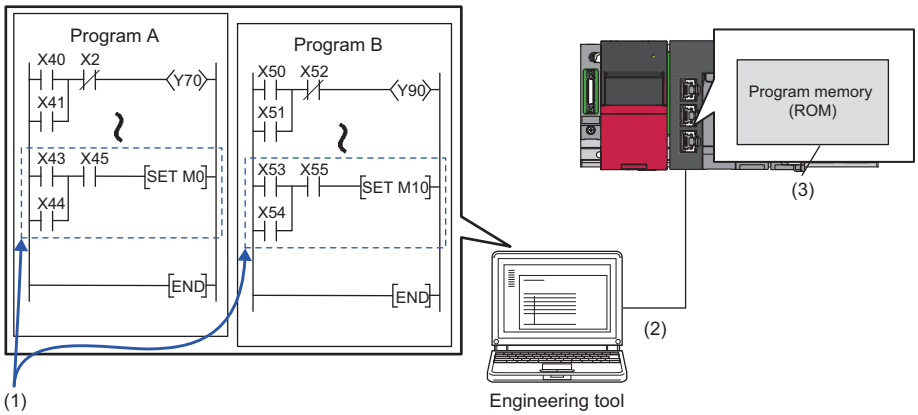
63.2 Online Change

The following table lists the types of the online change.

Type		Description	Reference
Online change	Convert + Online change	Converts and, at the same time, writes programs and data edited using the engineering tool online.	• Page 1594 Convert + Online change • GX Works3 Operating Manual
	File batch online change	Writes data in file units online.	• Page 1598 File batch online change • GX Works3 Operating Manual

Convert + Online change

Converts and, at the same time, writes programs and data edited using the engineering tool online.
Edited contents spanning multiple files or multiple portions can be written to the controller at once.



(1) Portion edited in the engineering tool
(2) The changed program is written to the running controller.
(3) The program contents in the program memory are changed.

Point

For details on the operating procedure of the Convert + Online change using the engineering tool, refer to the following.
GX Works3 Operating Manual

When a label, FB, or FUN is not edited

Within a program block, instructions and pointers (P, I) can be added, changed, or deleted.

Also, for each program component, program blocks can be added, changed, or deleted.

When a label, FB, or FUN is edited

The operation of each item when a label, FB, or FUN is edited is shown below.

■Within a program block

Editable contents within a program block are shown below.

○: Can be executed, △: Can be executed with conditions

Item				Add	Change	Delete
Program editor	Instruction			○	○	○
	Pointer (P, I)			○	○	○
	Global label			○	○	○
	Local label			○	○	○
	FB call	Global FB	Subroutine type	○	○	○
			Macro type (Module FB)	○	○	○
		Local FB	Subroutine type	○	○	○
			Macro type (Module FB)	○	○	○
	FUN call			○	○	○
Label editor	Local label definition			△*1	△*1*2	△*2

*1 When adding or changing a local label definition, any additions or changes exceeding the label area set by CPU parameter or system area used for Convert + Online change are disabled.

*2 Motion control FB instances and some structure type labels cannot be changed or deleted. Structure types that cannot be changed or deleted are the same as global labels. For details, refer to the following.

☞ Page 1596 Within the global label definition

■Within an FB definition

Editable contents within an FB definition are shown below.

○: Can be executed, △: Can be executed with conditions

Item				Add*1	Change*1	Delete*1
Program editor	Instruction			○	○	○
	Global label			○	○	○
	Local label			○	○	○
	Input and output labels (VAR_INPUT, VAR_OUTPUT, VAR_IN_OUT), public labels (VAR_PUBLIC)			○	○	○
	FB call	Global FB	Subroutine type	○	○	○
			Macro type (Module FB)	○	○	○
		Local FB	Subroutine type	○	○	○
			Macro type (Module FB)	○	○	○
	FUN call			○	○	○
Label editor	Local label definition			△*2	△*2*3	△*3

*1 To add, change, or delete an FB definition, all the programs and FB files referencing the FB file which stores the FB definition to be modified must match both on the engineering tool and in the controller.

*2 When adding or changing a local label definition, any additions or changes exceeding the label area set by CPU parameter or system area used for Convert + Online change are disabled. Furthermore, when an FB definition local label includes some structure type labels, any additions/changes exceeding the reserved area capacity of the FB instance (reserved area for adding local labels with Convert + Online change) are disabled. The reserved area capacity can be changed for each FB definition. For the changing procedure, refer to the following.

GX Works3 Operating Manual

*3 Motion control FB instances and some structure type labels cannot be changed or deleted. Structure types that cannot be changed or deleted are the same as global labels. For details, refer to the following.

☞ Page 1596 Within the global label definition

■Within an FUN definition

Editable contents within an FUN definition are shown below.

○: Can be executed

Item		Add[*1]	Change[*1]	Delete[*1]
Program editor	Instruction	○	○	○
	Local label (VAR)	○	○	○
	Input/output label (VAR_INPUT, VAR_OUTPUT)	○	○	○
	FUN call	○	○	○
Label editor	Local label definition	○	○	○

*1 To add, change, or delete an FUN definition, all the programs and FB files referencing the FB file which stores the FUN definition to be modified must match both on the engineering tool and in the controller.

■Within the global label definition

The operation within the global label definition is shown below.

○: Can be executed, △: Can be executed with conditions, ×: Cannot be executed, —: Cannot be changed

Category	Global Label name	Structure name	Add[*1*8]	Change[*1*8]	Delete[*1]	Timing for reflecting changes
User defined	Arbitrary name	Arbitrary structure name[*2]	○	△[*3]	△[*3]	Immediate
Motion system setting	MotionSys+Global	MT_SYSTEM	—	△[*6]	—	At initial state
Add-on-related	Addon+Global	ADDON_SYS_COM	—	△[*6]	—	Depends on add-on specifications
		ADDON_SYS	—	△[*6]	—	Depends on add-on specifications
		Type_AddonName_SYSTEM[*5]	—	—	—	Depends on add-on specifications
Advanced synchronization control	Adv+Global	ADV_INPUT	○	△[*6]	×	At initial state
		ADV_OUTPUT	○	△[*6]	×	At initial state
Axis	Ax+Global	AXIS_REAL AXIS_ENCODER	○	△[*6]	×	At initial state
		AXIS_VIRTUAL AXIS_VIRTUAL_ENCODER AXIS_VIRTUAL_LINK	○	△[*6]	×	Immediate
Axes group	Gr+Global	AXES_GROUP	○	△[*6]	×	Immediate
ENUM constant	En+Global	Depends on add-on specifications	—	—	—	Depends on add-on specifications
Motion I/O data	IO+Global	MC_INPUT_REF MC_OUTPUT_REF TARGET_REF	○	○[*9]	○	When the motion function section enters into RUN mode and when the motion control FB starts[*4]
		MC_TRIGGER_REF	○	△[*6*9]	×	
Operation profile data	Prf+Global	MC_CAM_REF MC_CAMSWITCH_REF MC_POSITIONING_REF	△[*7*10]	△[*7*10]	△[*7*10]	At initial state/when MC_CamTableSelect starts
Network label settings	NW+Global	Depends on network label specifications	×	×	×	At initial state

*1 To add, change, or delete a global label definition, all the programs and FB files referencing the global label definition to be changed must match both on the engineering tool and in the controller.

*2 When an operation that cannot be executed is performed on a label with the same structure type as the structure name in the table, an error occurs and stops the write processing.

*3 Motion control FB instances and labels that have a structure that cannot be changed or deleted in the table cannot be changed or deleted. Access checks from external devices and only the initial value change are available.
For the motion control FB instances, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

*4 Check the specifications of each function for the timing to reflect to the motion system.

*5 Check the specifications of each add-on.

*6 Although the content cannot be directly changed on the label editor, only the initial value can be changed from the setting window.

*7 File batch online change can be executed.

*8 When adding or changing a global label definition, any additions or changes exceeding the label area set by CPU parameter or system area used for Convert + Online change are disabled.

*9 For conditions for changing motion I/O data, refer to the following.
☞ Page 1165 Precautions

*10 Labels can be edited (added, changed, or deleted) by user-defined labels. However, the CSV files of the operation profile data are not edited (added, changed, or deleted).

Range where batch conversion and online changes are enabled

The following shows the number of labels for which Convert + Online change can be performed at once when using Convert + Online change for editing a label, FB, or FUN.

Details on the change	Range to be changed*1
Addition, deletion, and change of local labels	Within the free space*2
Addition, deletion, and change of global labels	Within the free space*2
Addition, deletion, and change of FB labels	Within the range of free space of the area where FB instances are created*3

*1 Any addition exceeding the system area used for Convert + Online change is disabled.
*2 For the free space of local labels and global labels, refer to the following.
☞ Page 319 Device/label memory
*3 For FB instance, refer to the following.
MELSEC MX Controller MX-R Model Programming Manual

Convert + Online change during boot operation

When Convert + Online change is performed while booting from the SD memory card, the corresponding files on the booting SD memory card can also be changed.

Setting the initial value for registering/changing label definition

The initial value used when registering/changing label definition can be set. (GX Works3 Operating Manual)

■Initial value setting availability

Indicates whether or not the initial value can be set when adding or changing a label.

○: Available, △: Conditionally available, ×: Not available

Label type		Label addition	Label change
Program block	Global label	○	△*1
	Local label	○	△*1
FB definition	Local label	○*2	△*1
FUN definition	Local label	×*3	×*3

*1 The initial value can be set only when a new area is assigned again.
*2 A different initial value can be set for each instance.
*3 Since the local label in FUN definition is an undefined value, initialize it by a program in the FUN definition before using it in a program.

Point

There is a restriction on the number of labels for which an initial value can be set at once. For the number of labels for which an initial value can be set at a time, refer to the following.
☞ Page 319 Device/label memory

File batch online change

This function writes programs and other data to the running controller in units of files.

For the operating procedure and the execution condition of the file batch online change, refer to the following.

GX Works3 Operating Manual

Label data when file batch online change is executed

When labels are added or changed and the file batch online change is performed, the initial value is set for the added or changed labels. Labels with no initial values set cannot be initialized, so set initial values for any added or changed labels.

Writing program files after rebuilding

The file batch online change cannot be executed for program files after rebuilding.

63.3 Precautions

This section describes the precautions on writing data to the controller.

Prohibited operation (Powering off or resetting the controller)

- Do not power off or reset the controller when writing data to the programmable controller or executing the online change. Otherwise, the operation does not complete successfully. If doing so, write the data to the programmable controller again.

Point

If the controller is powered off or reset when writing data to the programmable controller or executing the online change, latch data is not guaranteed.

- When writing to the program memory, the updated content is reflected when all files are written. Therefore, if the power is turned off or the cable is disconnected before all files are written, the written files are not reflected. Whether the writing to the program memory is completed or not can be checked in event history. (Files written after the start program memory update (event code: 24203H) event registration are reflected when the finish updating program memory (event code: 24204H) event is registered.)
  If a cable is disconnected when writing data to the programmable controller or executing the online change, reconnect the cable. If the boot source is the same, writing data to the programmable controller or the online change can be performed. In this case, a program memory update failure (event code: 24205H) is registered in the event history.
  However, if a cable is disconnected while writing the program restoration information during Convert + Online change, a message asking whether or not to retry the process is displayed on the engineering tool. If the process is retried, a program memory update failure (event code: 24205H) is not registered. (Convert + Online change resumes.) If rewriting is to be performed after suspension without retrying the process, write to the programmable controller or execute file batch online change.

Execution program change with online program change

- After registering the execution program change by the online change (event code: 00470H), the changed program is executed. However, do not power off the controller because the program is not reflected into the program memory until the finish updating program memory event (event code: 24204H) is registered. If the power is turned off before the finish updating program memory event (event code: 24204H) is registered, the changed program will not be reflected.
- The FUNCTION LED flashes normally from the execution program change by the online change (event code: 00470H) to the finish updating program memory (event code: 24204H). If the FUNCTION LED remains flashing normally due to cable disconnection or other reasons after the execution program change by the online change (event code: 00470H), perform online change again or write data to the programmable controller. To prevent the FUNCTION LED from flashing, set "b1: Checking the program restoration information write status" to off in the FUNCTION LED display setting (SD1486).

When deleting the OUT instruction which is on

When deleting the OUT instruction (coil), which is on due to the online change but not necessary for control, check that the OUT instruction is off before deleting it. If the OUT instruction is deleted without turning it off in advance, the output will be retained.

Operation from engineering tools

■Operations cannot be executed simultaneously

The online change cannot be executed simultaneously with the following operations from the engineering tool.

- Writing to the controller (excluding device data and local device data)
- Online change
- Memory initialization
- Initializing all controller information

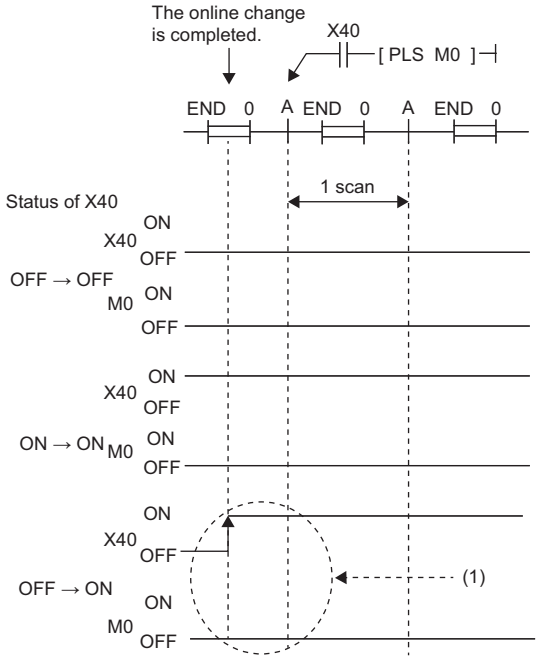
Instructions which do not operate correctly

The following table lists the instructions which do not operate correctly during online change.

Instructions which do not operate correctly	Description
Rising instruction (PLS and □P instructions)	When a rising instruction exists within the range to be changed, the rising instruction will not be executed even if the execution condition (off to on) is taken at completion of online program change.
Falling instruction (PLF and □F instructions)	When a falling instruction exists within the range to be changed, the falling instruction will not be executed even if the execution condition (on to off) is taken at completion of online program change.
SCJ instruction	If an SCJ instruction exists within the range to be changed and the execution condition is taken, the program will jump without waiting for a single scan.
STMR instruction	If an STMR instruction exists within the range to be changed, the STMR instruction will be executed.
Other signal flow memory use instruction	Even when the condition (off to on or on to off) is satisfied at the completion of an online change, the signal flow memory use instruction is not executed or stopped.

■Rising instruction

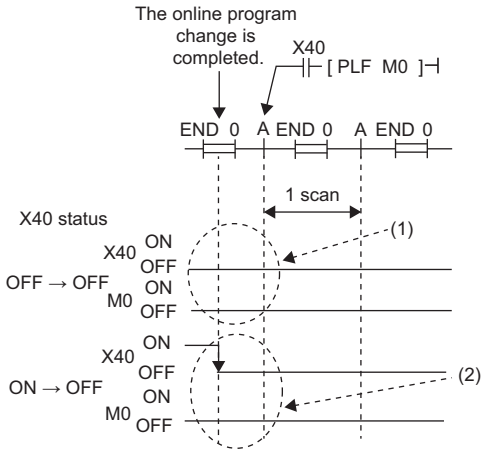
When a rising instruction exists within the range to be changed, the rising instruction will not be executed even if the rising instruction execution condition (off to on) is taken at completion of online program change.



(1) The rising instruction will not be executed even if the execution condition is off to on.

■Falling instruction

When a falling instruction exists within the range to be changed, the falling instruction will not be executed even if the falling instruction execution condition (on to off) is taken at completion of online program change.

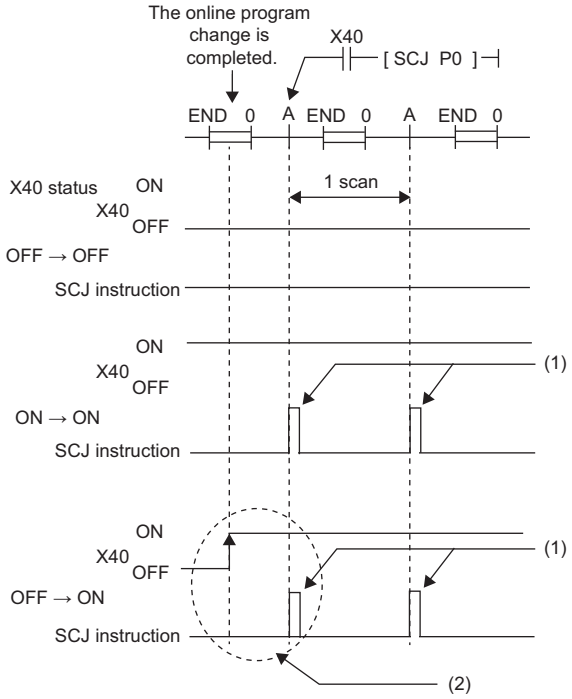


(1) The falling instruction will not be executed even if the execution condition is off to off.

(2) If a completion of the online program change and a timing of satisfying the execution condition (on to off) occur simultaneously, the falling instruction will not be executed.

■SCJ instruction

If an SCJ instruction exists within the range to be changed and the execution condition is taken at completion of online program change, the program will jump without waiting for a single scan.

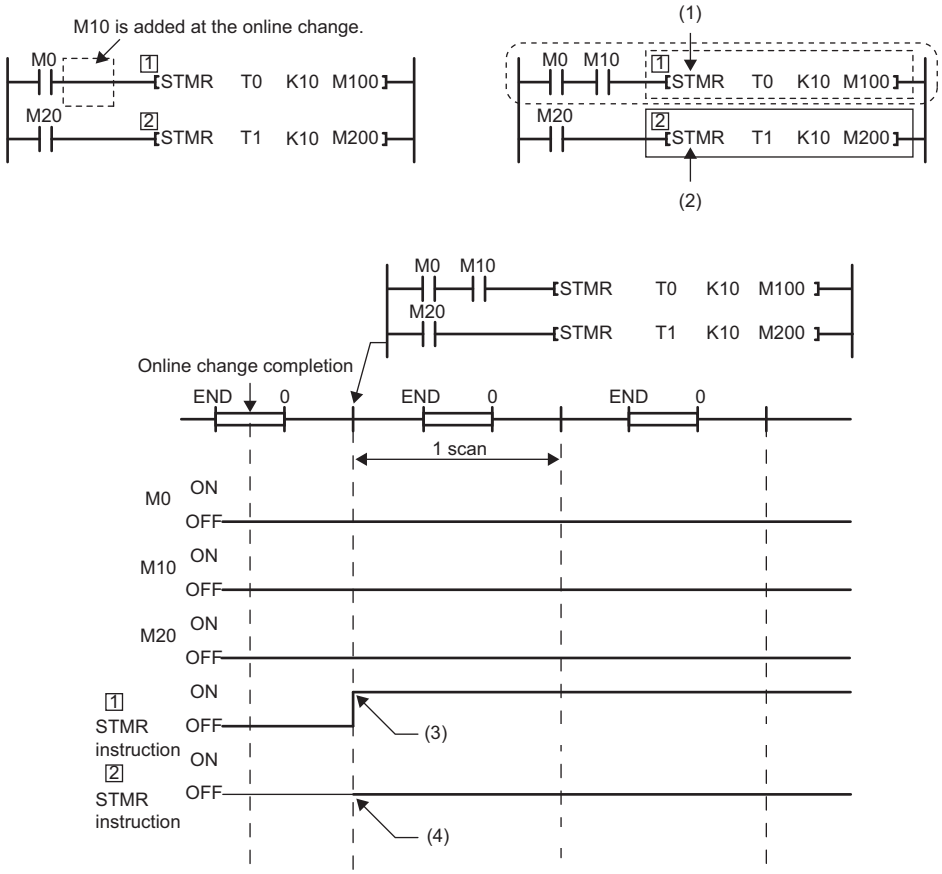


(1) The program jumps to the specified pointer.

(2) The program jumps to the specified pointer without waiting for a single scan.

■STMR instruction

If an STMR instruction exists within the range to be changed, the STMR instruction will be executed.



(1) The STMR instruction functions because the STMR instruction is included in the ladder block where the online change has been executed.
(2) The STMR instruction does not function because the STMR instruction is not included in the ladder block where the online change is executed.
(3) The instruction functions even when M0 and M10 are off.
(4) The instruction does not function.

If the target ladder block has an FB call

If an FB is called within the changed ladder block, information of the last execution, such as the rising instruction and the falling instruction within the FB definition of the called FB, is not initialized.

Program file not registered in program setting

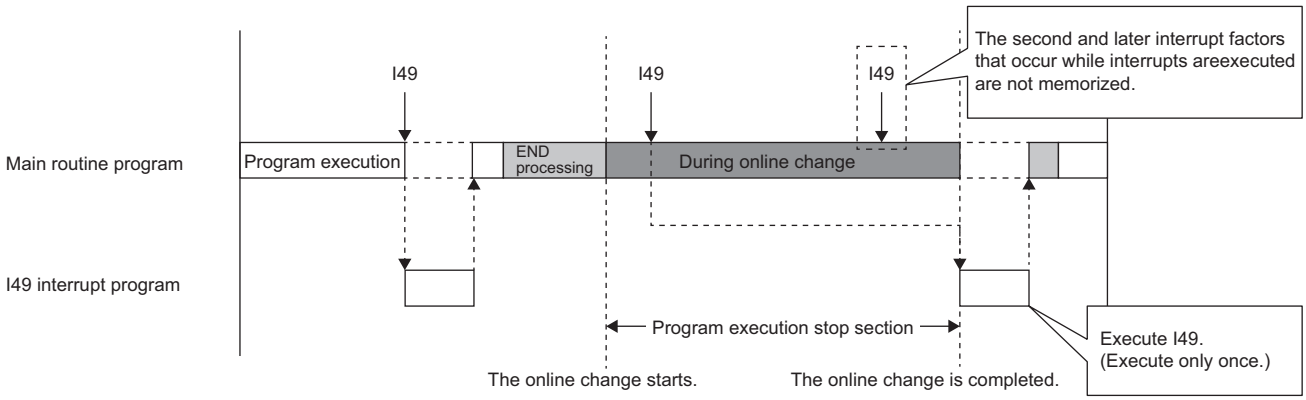
The online change cannot be executed for a program file which is not registered in parameter setting.

When the start-up of an interrupt program is delayed

When the online change is performed, the start-up of an interrupt program may be delayed. For this reason, when the synchronous interrupt program execution time is monitored (checked) on an event execution type program that uses the synchronization with the network communication cycle as a trigger, the controller may detect an error. (☞ Page 1746 Error detection setting)

Even if the interrupt factor of the interrupt program occurs multiple times while the interrupt program is waiting to be started, it will be memorized only once, regardless of the fixed scan execution mode setting.

For details on the fixed scan execution mode, refer to the following. ☞ Page 250 Fixed scan execution mode



Scan monitoring function during online changes

Some sections are not targeted for the scan monitoring while online changes are being performed, and therefore a WDT error may not be detected if the scan time set in the scan time monitoring time (WDT) setting is exceeded.

Errors occurring during an online change

When an error is detected for an instruction executed during the online change process, the program location information (sequence step No.) varies depending on the status of the online change processing. If the execution program change by the online change (event code: 00470H) is not yet registered, the program location information (sequence step No.) is that of before writing. If it is registered, the program location information (sequence step No.) is that of after writing.

Increase in scan time of online change

When global labels and local labels are added or changed, or when there are many programs and FB files to be changed or many changes, the scan time may be increased by several dozen milliseconds.

Online change during execution of another function

The online change cannot be executed during execution of the following functions. Check that the following functions are not being executed and then perform the online change.

- Controller data backup/restoration function
- OPC UA server function*1
- iQ Sensor Solution data backup/restoration function

*1 An error occurs only when the OPC UA server startup is in progress.

When multiple users execute Convert + Online change to one controller

When multiple users execute Convert + Online change to one controller, note the following:

- Use engineering tools with the same version.
- Make the option settings the same in all the engineering tools.
- To prevent program block names from duplicating due to debugs by multiple users when adding a program block or changing a program block name, select "Yes" for "Duplication Check for POU" under [Online] ⇨ [Write to PLC] or [Convert] ⇨ [Online Program Change] in the "Options" window of the engineering tool.
- For editable contents, refer to the following.

☞ Page 1595 When a label, FB, or FUN is edited

- Do not make any changes that affect other programs (for example, editing the same program by multiple users, or having a duplicate program block name or a duplicate global pointer). If one user makes such a change to a program and executes Convert + Online change to the controller, and after that, another user executes Convert + Online change for another program, the engineering tool will detect a mismatch of data in the programmable controller. In this case, verify the data in the changed program and data in the controller, and check the mismatched data. Match the data and write the program using the function to write to the programmable controller in the engineering tool, if needed.
- When editing FB/FUN or global labels, all the files referencing the target files to be edited must match both on the engineering tool and in the controller.

Note that after debugging by multiple users, an appointed person must perform the following operations: Read the project from the controller by using the read from the programmable controller function of the engineering tool, rebuild all the data, and write the project back to the controller.

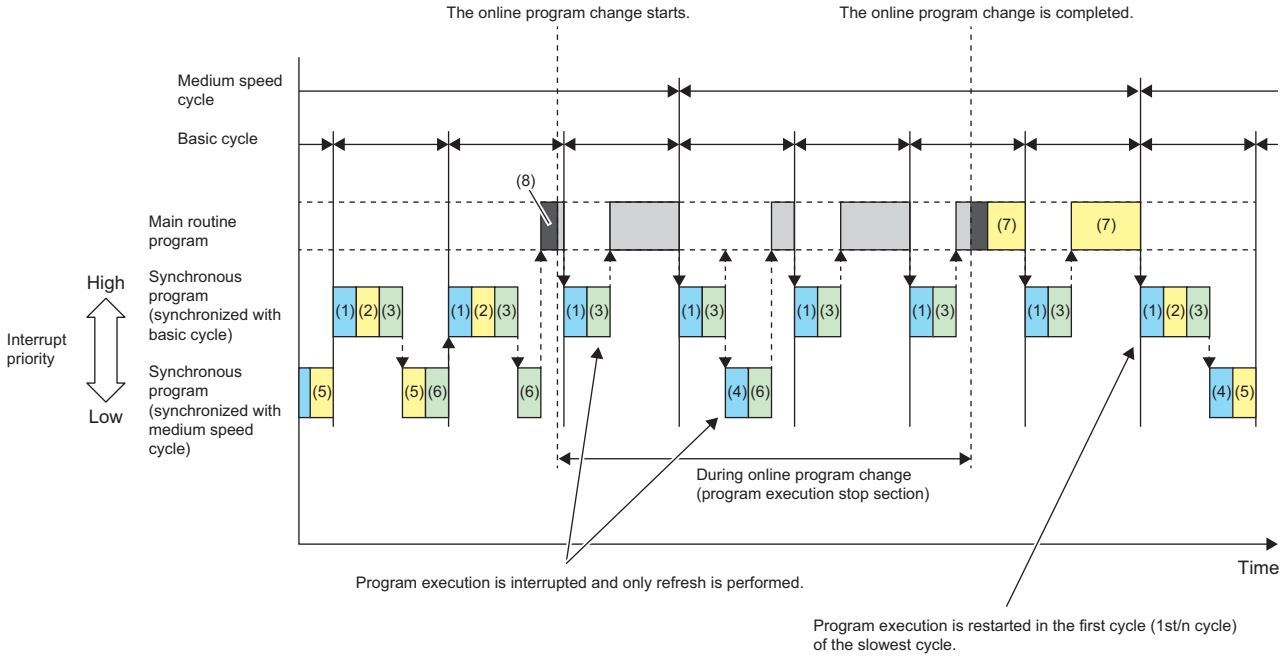
Online change during program run synchronized with network communication cycle

When an online program change is executed during an execution of a program that is synchronous with the communication cycle of the network (event execution type program that uses the synchronization with the communication cycle of the network as a trigger), the execution of the program is interrupted in some sections but the refreshing of the synchronous station is continued.

For details on refreshing that is synchronous with the communication cycle of the network, refer to the following.

☞ Page 237 Refresh synchronized with the network communication cycle

As the program is interrupted after the program being executed completes, when there is a program synchronous with multiple cycles, programs with a shorter cycle (higher-priority programs) are interrupted in order. Program execution is restarted in the initial cycle (1/n cycle) of the slowest cycle after an online program change completes.



(1) Input refresh of synchronous station
(2) Execution of synchronization program (synchronous with the basic cycle)
(3) Output refresh of synchronous station (basic cycle)
(4) Input refresh of synchronous station (medium speed cycle)
(5) Execution of synchronization program (synchronous with the medium speed cycle)
(6) Output refresh of synchronous station (medium speed cycle)
(7) Scan program execution
(8) END processing

Online change after adding a program file

Power off or reset the controller after adding a program file. If the controller is not powered off or reset, an online change may not be performed while adding a label to the added program.

Online change related to motion control

For precautions for an online change related to motion control, refer to each motion control function.

64 REMOTE OPERATION

The operating status of the controller can be changed using an engineering tool, external device using SLMP, dedicated instructions from the module, or remote contacts.
The following types of remote operation are available:

- Remote RUN/STOP
- Remote PAUSE
- Remote RESET

64.1 Remote RUN/STOP

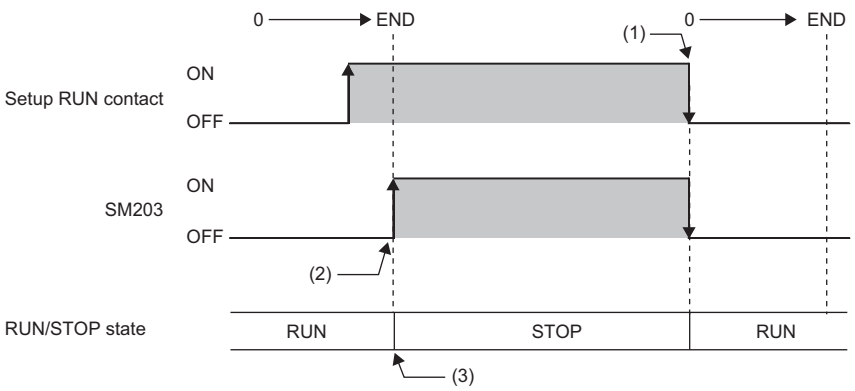
This function externally changes the controller status to RUN or STOP with the RUN/STOP/RESET switch of the controller set to RUN. This function is useful to RUN or STOP a controller located in an inaccessible place, or to RUN or STOP a controller located on the control panel by using an external signal.

Executing method

The following methods are available to execute remote RUN/STOP:

Using a contact

Set RUN contact in the RUN-PAUSE contact setting. (☞ Page 1609 Setting RUN-PAUSE Contacts)
When the END processing for the scan where the RUN contact is turned on is executed, SM203 (STOP contact) turns on to change the controller status to STOP and stop the operation. When the RUN contact is turned off, the controller exits the STOP state and resumes the program operation from the step 0.



(1) When the RUN contact is turned off, the controller status changes to RUN and the program is resumed from the step 0.
(2) SM203 turns on when the END processing for the scan where the set RUN contact is turned on is executed.
(3) When the RUN contact is turned on, the controller executes the operation until the END instruction and enters the STOP state.

Using an engineering tool

Perform remote RUN/STOP with the remote operation of the engineering tool.
For details, refer to the following.
☞ Page 1715 Remote operation

By an external device using SLMP

Perform remote RUN/STOP with the SLMP command. (SLMP Reference Manual)

Using the module dedicated instructions

Perform remote RUN/STOP with the dedicated instructions of a network module. (MELSEC MX Controller MX-R Model Programming Manual)

Operation at device/label memory clear

If remote RUN is performed with "Clear All except Latch" or "Clear All" selected for the device/label memory in the operation setting for remote RUN, the device/label initial value is reflected the next time the operating status changes from STOP (PAUSE) to RUN.

For details on the settings of the device/label initial value, refer to the following.

☞ Page 426 DEVICE/LABEL INITIAL VALUE SETTINGS

Precautions

This section describes the precautions on using remote RUN/STOP.

- When remote RUN is performed during execution of the data logging function, it may fail. In that case, wait for a while and retry remote RUN. If remote RUN still cannot be executed, check whether remote RUN is acceptable and retry remote RUN (☞ Page 1527 About remote operation)
- When the RUN contact, which is specified in the RUN-PAUSE contact setting, is turned off during execution of the data logging function, it may take time to return to the RUN state.

64.2 Remote PAUSE

This function externally changes the controller status to PAUSE with the RUN/STOP/RESET switch of the controller set to RUN. While the controller is in the RUN state, use this function to keep the ON state even when the ON state of the output (Y) is changed to STOP.

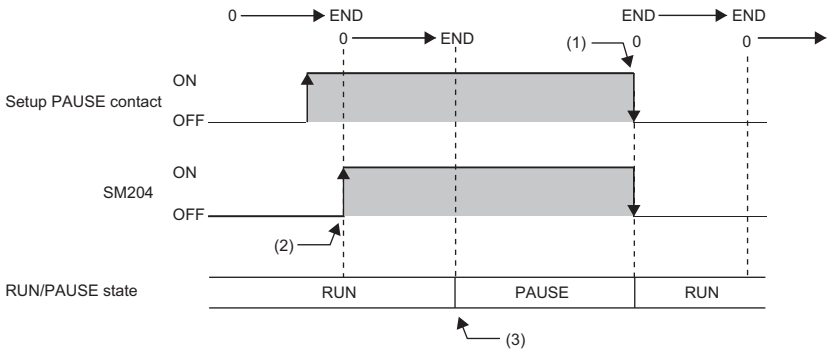
Executing method

The following methods are available to execute remote PAUSE:

Using a contact

Set PAUSE contact in "RUN-PAUSE Contact Setting". (☞ Page 1609 Setting RUN-PAUSE Contacts)

When the END processing for the scan where the PAUSE contact is turned on is executed, SM204 (PAUSE contact) turns on. When the controller executes until the END instruction for the scan next to that where the PAUSE contact is turned on, its status changes to PAUSE, and the operation stops. When the PAUSE contact is turned off, the controller exits the PAUSE status and resumes the program operation from the step 0.



(1) When the PAUSE contact is turned off, the controller exits the PAUSE state and resumes the program operation from the step 0.
(2) SM204 turns on when the END processing for the scan where the set PAUSE contact is turned on is executed.
(3) When the controller executes until the END instruction for the scan next to that where the PAUSE contact is turned on, its status changes to PAUSE, and the operation stops.

Using an engineering tool

Perform remote PAUSE with the remote operation of the engineering tool.

For details, refer to the following.

☞ Page 1715 Remote operation

By an external device using SLMP

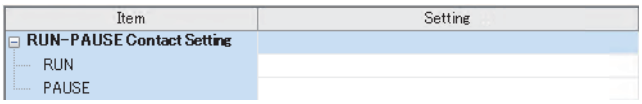
Perform remote PAUSE with the SLMP command. (SLMP Reference Manual)

64.3 Setting RUN-PAUSE Contacts

RUN-PAUSE contacts can be set. RUN-PAUSE contacts are used to perform remote RUN or STOP, or remote PAUSE using a contact.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Operation Related Setting] ⇨ [RUN-PAUSE Contact Setting]

Window



Displayed items

Item	Description	Setting range	Default
RUN	Set the contact that controls RUN for the controller.	X0 to X2FFF	—
PAUSE	Set the contact that controls PAUSE for the controller.	X0 to X2FFF	—

Point

When setting the PAUSE contact, be sure to also set the RUN contact. (The PAUSE contact cannot be set alone.)

64.4 Remote RESET

This function externally resets a controller in the STOP state (including that stopped due to an error). Even when the RUN/STOP/RESET switch of a controller is set to RUN, the controller can be reset in the STOP state.

Point

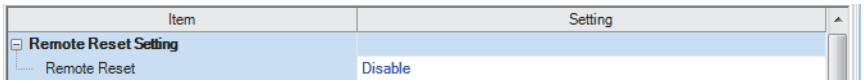
To perform the remote RESET operation when "Execution Target" of the remote operation is set to "All Stations Specified" or "Specify Group No.", the remote RESET does not operate if the controller set in "Specify Connection Destination" of the engineering tool is in the RUN state. (Even if a controller in the STOP state exists on the specified network, the remote RESET does not operate.)
In this case, set the connected controller in the STOP state using the remote STOP operation and then perform a remote RESET operation.

Remote reset setting

Performing remote RESET requires setting for enabling remote reset.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Remote Reset Setting]

Window



Displayed items

Item	Description	Setting range	Default
Remote RESET	Set whether or not to enable the remote RESET.	• Disable • Enable	Disable

Executing method

Using an engineering tool

Perform remote RESET with the remote operation of the engineering tool.

For details, refer to the following.

☞ Page 1715 Remote operation

By an external device using SLMP

Perform remote RESET with the SLMP command. (SLMP Reference Manual)

65 MONITOR FUNCTION

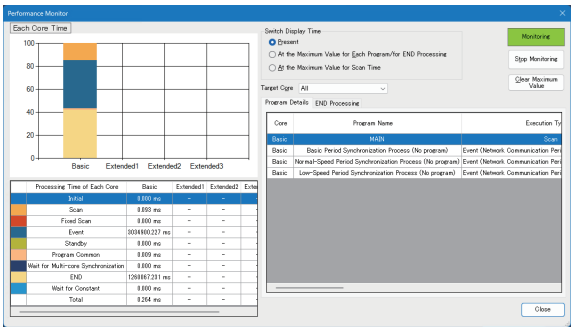
This chapter describes the functions for checking the controller operation.

Item	Description	Reference
Circuit monitor	Checks the status of the running program on the program editor.	📖GX Works3 Operating Manual
Device/Buffer Memory Batch Monitor	Checks the current values of the device and buffer memory in a batch.	
Watch	Registers a device and label and checks the current values.	
Performance Monitor	Checks the breakdown of operation cycle and load status for each core.	
Realtime Monitor	Monitors the contents of a specified device/label of the controller in real time at a specified interval or a desired timing.	📖GX LogViewer Version 1 Operating Manual
Scan Time Clear	Clears values of the scan time at any timing without stopping the controller.	• 📖 GX Works3 Operating Manual • Page 1955 Fixed scan function information
Position Data History	Saves data, such as positioning data of each axis, as history at event occurrence related to the absolute position control.	Page 1613 Position Data History

65.1 Performance Monitor

This function checks the breakdown of operation cycle and load status for each core.

[Online] ⇨ [Monitor] ⇨ [Performance Monitor]

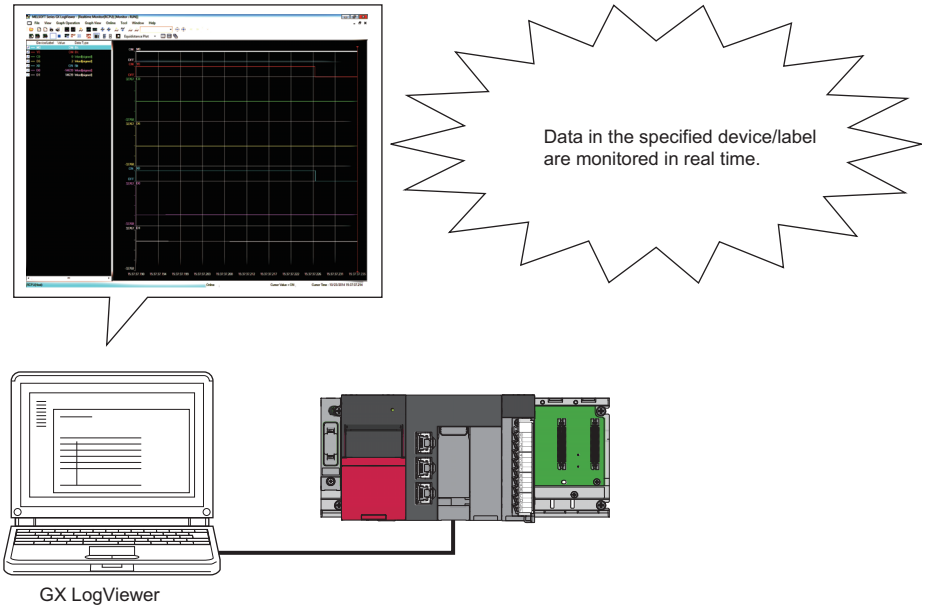


For details on performance monitor, refer to the following.

📖GX Works3 Operating Manual

65.2 Real-time Monitor

This function monitors the contents of a specified device/label of the controller in real time at a specified interval or a desired timing. Realtime monitor can be set with GX LogViewer, where the changes in values of a specified device/label can be shown graphically. Saving the set data and displayed graphs makes it possible to simplify the settings and check the graphs at a later time.



Restriction

Before using realtime monitor, check the versions of the GX LogViewer used. (☞ Page 125 Applicable Software)

For details on realtime monitor, refer to the following.

GX LogViewer Version 1 Operating Manual

Internal buffer

The collected data is temporarily stored in the internal buffer of the controller.

Increasing the set capacity of the internal buffer used for real-time monitor makes the following things possible.

- Trigger logging allows an increase in the number of collected data before trigger.
- For continuous logging or after the trigger occurrence of trigger logging, processing overflow becomes less likely to occur.

For the settings of the internal buffer capacity, refer to the following.

☞ Page 1501 Internal buffer capacity setting

Point

The internal buffer is also used for the data logging function. When setting the internal buffer capacity used for real-time monitor, be sure that total capacity of the internal buffer (including the areas used for the data logging function) does not exceed 24576K bytes.

65.3 Position Data History

The positioning data history of each axis can be monitored by the engineering tool.

[Online] ⇨ [Motion Monitor] ⇨ [Position Data History]

The related positioning data is stored in the history when the following operations are executed.

- At homing completion: 1 time
- At axis connection/axis disconnection: 20 times

For the positioning data at the axis disconnection, the data at the final backup is set. When the backup data does not exist or the backup data is an error, 0 is set for all.

The positioning data history is stored in PosHist.bin of the root path (%PROJECT_ROOT%). The file size of the positioning data history can be calculated with the following formula.

The positioning data file size (byte) = 110 + (the number of the setting axis × 2126)

Precautions

- History data can record and monitor the event occurrence time in units of ns.
- When the axis setting is not existed at power-on, the positioning data history data of nonexistent axis is deleted.
- To clear the positioning data history, delete the positioning data history file by operating the engineering tool and turn the power off and on or reset the controller.
- When the file version of the positioning data history is different, "Position Data History Update Disabled Warning" occurs and the contents of the positioning data history file are cleared. After that, the absolute position control data for one time is read, and the positioning data history file is written.
- When the drive memory of root path (%PROJECT_ROOT%) lacks its capacity, "Position Data History Update Disabled Warning" occurs and the content of the positioning data are cleared. After that, the absolute position control data for one time is read and the positioning data file is written. Also, if the memory extremely lacks its capacity and the file cannot be created, the positioning data history file is not created.

MEMO

PART 16 MAINTENANCE AND INSPECTION

This part consists of the following chapters.

66 MAINTENANCE FUNCTION LIST

67 DAILY INSPECTION

68 PERIODIC INSPECTION

69 CONTROLLER DATA BACKUP/RESTORATION FUNCTION

70 SOFTWARE UPDATE OF THE CONTROLLER

66 MAINTENANCE FUNCTION LIST

The following table lists the maintenance functions list.

Function	Description	Reference
Controller data backup/ restoration function	Backs up data such as program files, parameter files, and device/label data in the controller. The data backed up can be restored as necessary.	Page 1622 CONTROLLER DATA BACKUP/RESTORATION FUNCTION
Firmware update function	Updates the firmware of the controller and the modules of the MELSEC iQ-R series.	Page 1650 Firmware Update Function
Add-on function	Expands the controller functions by installing the add-on software package to the controller.	Page 1663 Add-on Function

MEMO

67 DAILY INSPECTION

This chapter describes items that must be inspected daily to properly use a programmable controller in optimal condition at all times.

Item	Inspection Item		Inspection method	Judgment criteria	Corrective action
1	Mounting of the base unit	Looseness of the base unit	Check that mounting screws are not loose and the cover is not dislocated.	The screws and cover must be fixed.	Retighten the screws.
2	Mounting of the module	Looseness of the module	Check that the module is mounted and the module fixing hook is fixed securely.	The module must be mounted and the module fixing hook must be fixed.	Fix the module fixing hook securely.
3	Connection status	Terminal screw loosening	Check for the terminal screw loosening.	The terminal screws must not be loose.	Retighten the terminal screws.
		Clearance between the solderless terminals	Check for the clearance between the solderless terminals.	The proper clearance must be provided between solderless terminals.	Provide the proper clearance.
		Connector loosening	Check for the cable connector loosening.	The cable connector must not be loose.	Connect the connector with no loosening securely.
4	LED status	POWER LED (power supply module)	Check that the LED is on.	The LED must be on.	When the judgment criteria is not satisfied, refer to the following and take the corrective action. 📖 User's manuals for each module
		READY LED	Check that the LED is on.	The LED must be on.	
		ERROR LED	Check that the LED is off.	The LED must be off.	
		USER LED	Check that the LED is off.	The LED must be off.	
		I/O indicator LED (I/O module)	Check that the LED is on or off.	The LED turns on when I/O signals are on. The LED turns off when I/O signals are off.	

MEMO

68 PERIODIC INSPECTION

This chapter describes items that must be inspected periodically to properly use a programmable controller in optimal condition at all times.

'Periodically' means one or two times every six months to one year.

When the equipment has been relocated or modified, or wiring layout has been changed, inspect the items as well.

Item	Inspection Item		Inspection method	Judgment criteria	Corrective action
1	Environment	Ambient temperature*1	Measure the temperature by using a thermometer.	0 to 55℃	Create the environment that satisfies the judgment criteria
		Ambient humidity	Measure the humidity by using a hygrometer.	5 to 95%RH	
		Atmosphere	Measure corrosive gases.	No corrosive gases	
2	Power supply voltage check		Measure a voltage between the terminals of 100/240VAC and 24VDC.	85 to 264VAC	Change the supply power.
				15.6 to 31.2VDC	
3	Installation	Looseness and rattling	Touch the module to check for the looseness and rattling.	The module must be mounted securely.	Retighten the screws. If the module is loose, fix the module with screws.
		Attachment of dirt and foreign matter	Check visually.	Dirt and foreign matter must not be attached.	Remove them. Clean the programmable controller.
4	Battery		Check the length of term after purchasing the battery.	The battery must not be used more than five years.	If five years have elapsed after purchase of the battery, replace it.
			Check that SM51 or SM52 is turned off using an engineering tool.	SM51 or SM52 must be off.	Replace the battery when SM51 or SM52 is on.
5	Module diagnostics		Check an event history using the module diagnostics.	There is no problem with the registered event history.	GX Works3 Operating Manual
6	Maximum scan time		Check the values of SD524 and SD525 using an engineering tool.	Maximum scan time must be within the allowable range given in the specification of the system.	Specify causes that increase the scan time. Check the operation status of the trigger signal that passes through a loop if loop positions exist in the sequence program.

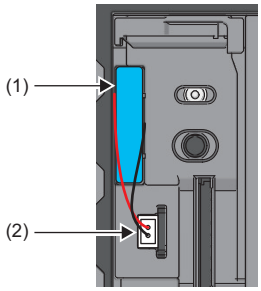
*1 The temperature in the control panel installed a programmable controller is called the ambient temperature.

68.1 Battery Replacement Procedure

The life of the battery (FX3U-32BL) is five years.
When a battery error (error code: 1090H) has been detected or five years have elapsed after purchase of the battery, replace the battery by referring to the procedure below.
Keep the controller on for 10 minutes or longer before removing the battery. Power off the controller when replacing the battery.

Battery replacement procedure

Replace the battery within three minutes.
The clock data may be erased if the time taken for the replacement exceeds three minutes.



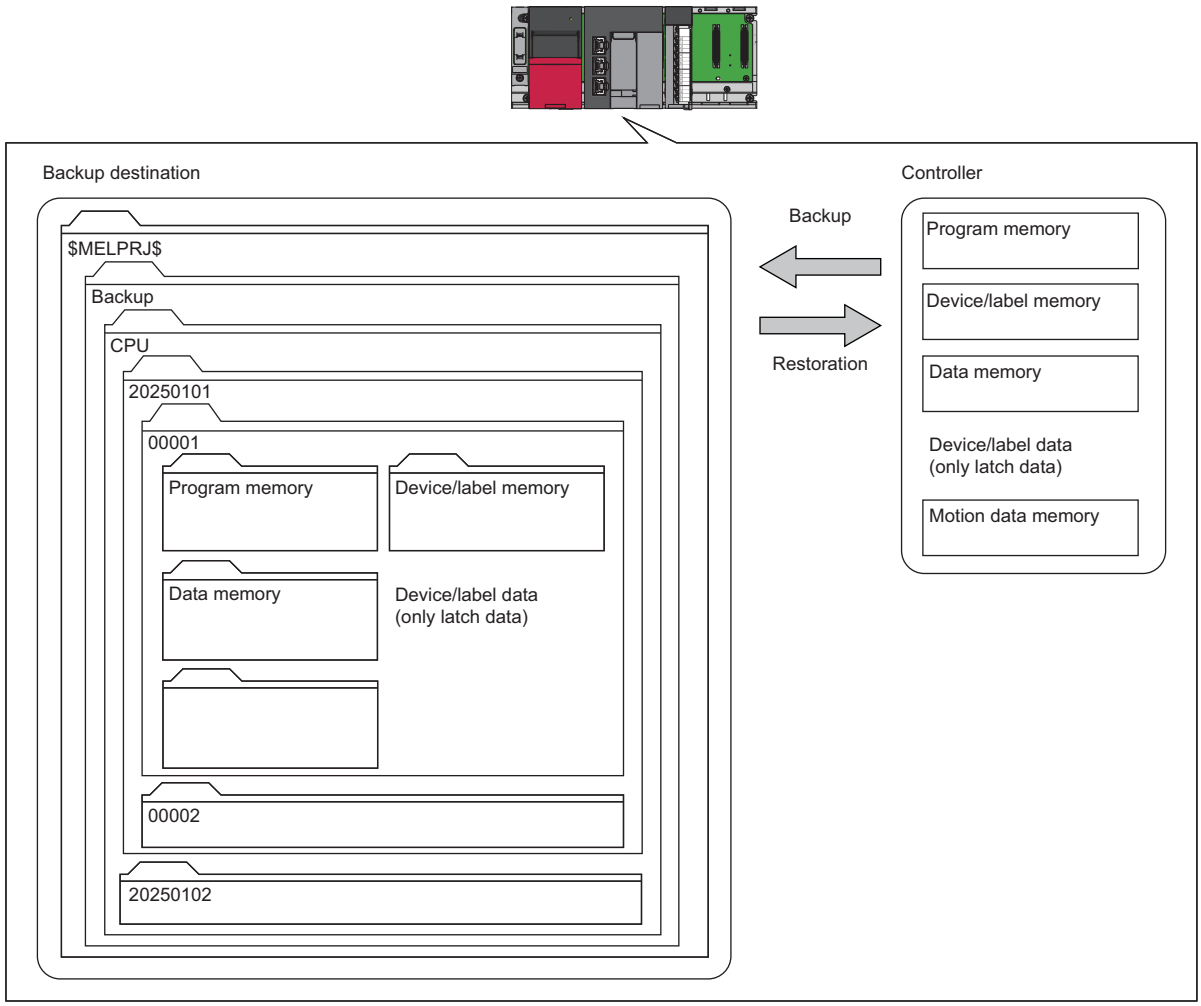
1. Power off the controller.
2. Open the switch cover on the front side of the controller.
3. Take the used battery out of the battery compartment (1) and disconnect the battery from the battery connector (2).
4. Connect the lead connector of the new battery to the battery connector (2) with the correct orientation. Insert the new battery to the battery compartment (1).
5. Close the switch cover on the front side of the controller.
6. Power on the controller.
7. Using the engineering tool, check that SM51 (Battery low latch) is off.

If SM51 is off, the battery has been replaced successfully.
If SM51 is on, the battery may not be installed properly. Repeat the procedure from step 2. If SM51 remains on, the possible cause is a hardware failure of the battery. Perform the procedure with a different battery.

69 CONTROLLER DATA BACKUP/ RESTORATION FUNCTION

This function backs up data such as program files, parameter files, and device/label data*1 in the controller.
The data backed up in the SD memory card can be restored as required.

*1 Non-latch device/label data, module access devices, and buffer memory are excluded.



Backup destination

The controller data backup/restoration function stores data in the SD memory card.

Backup method

The following table lists the methods that are available in the controller data backup/restoration function.
Backup data can only be encrypted using an engineering tool.

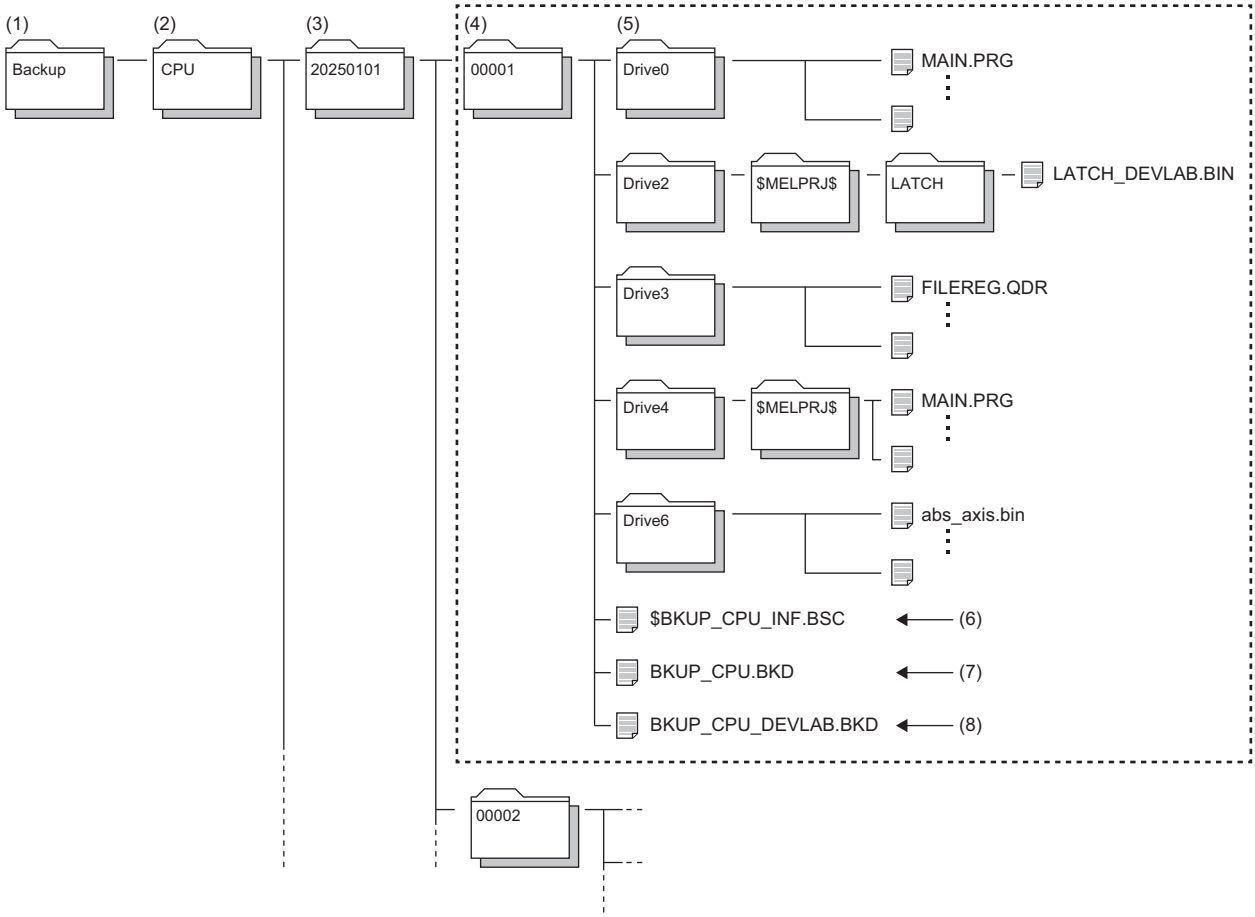
Method		Reference
Backup	Backup using engineering tool	Page 1632 Backup using engineering tool
	Backup processing triggered by turning on SM1351	Page 1633 Backup processing triggered by turning on SM1351
	Automatic backup using engineering tool	Page 1634 Automatic backup using engineering tool
	Automatic backup using SD944	Page 1636 Automatic backup using SD944
Restoration	Automatic restoration using engineering tool	Page 1644 Automatic restoration using engineering tool
	Automatic restoration using SD955	Page 1646 Automatic restoration using SD955

Point

- The restoration function modifies programs, parameters, and device/label data (latch data only) of the controller. After restoration, check the restored data carefully before an actual operation. (Check the data with an engineering tool.)
- Automatic backup is executed using either the settings of the engineering tool or those of the special relay or special register, whichever are set most recently. For example, after encrypting backup data and setting "Date and Time Specification Setting" using the engineering tool, if "Time and Day of Week Specification Setting" is set using the special relay or special register, only the automatic backup by "Time and Day of Week Specification Setting" will be executed without encryption.
- When the backup data is encrypted through automatic backup using the engineering tool, the password is saved in the system memory (non-volatile). To delete the password, re-set it by clearing the encryption setting through automatic backup using the engineering tool.

Backup data

The following figure shows the "$MELPRJ$" folder structure of backup data. The content inside the dotted box below represents a set of backup data.



No.	Type	Folder name/file name	Number of storable folders/ files	Description
(1)	Backup data folder	Backup (Fixed)	1	A folder for storing all backup data
(2)	CPU data folder	CPU (Fixed)	1	A folder for storing the backup data of the controller
(3)	Date folder	Automatically determined*1 Folder name format: YYYYMMDD • YYYY: Year when the data was backed up (four digits) • MM: Month when the data was backed up (two digits) • DD: Day when the data was backed up (two digits)	Depends on the capacity of the backup destination*2 or 1 to 100 folders	Folders for storing backup data by date. For the setting of the upper limit value for the number of backup data, the number of backup data indicates the number of date folders. (☞ Page 1630 Setting the upper limit value for the number of controller backup data)
(4)	Number folder	Automatically determined*1 Folder name: Sequentially numbered from 00001 to 32767 (five digits)	Depends on the capacity of the backup destination*2	Folders for storing information per backup data. Each backup data created on a date is stored in sequentially numbered folders.
(5)	Drive folder	Drive0 (Fixed), Drive2 (Fixed), Drive3 (Fixed), Drive4 (Fixed), and Drive6 (Fixed)	One folder in a number folder	Folders for storing folders/files on the drives of the backup source controller, sorted by drive
(6)	System file for backing up controller data	• When the backup data is encrypted: $ENC_BKUP_CPU_INF.BSC • When the backup data is not encrypted: $BKUP_CPU_INF.BSC	One folder in a number folder	Files for storing the information required at restoration of data, such as a list of data to be backed up and identification information of the controller
(7)	Backup data file for backing up controller data*3	BKUP_CPU.BKD	One folder in a number folder	Files for storing data on operations of the data logging setting
(8)	Device/label data file for backing up controller data*3	BKUP_CPU_DEVLAB.BKD	One folder in a number folder	Files for storing the device/label data (latch data only)

*1 Date folders and number folders are automatically named by the controller.
*2 When "Backup destination specification setting" or "Automatic backup destination specification setting" is set to "SD Memory Card of CPU Module" (SD963/SD964 is set to 2), the maximum number of folders that can be stored is 32767.
*3 When "Backup target data setting" is set to "Motion data only" (SD966/SD967 is set to 1), no file is created.

Backup/restoration target data

"All target data" or "Motion data only" of the controller is available for "Backup target data setting". When using special register areas, specify the value as follows. (☞ Page 1625 Backup/restoration target files)

Special register	Value and description
SD966 (Backup target data setting) SD967 (Automatic backup target data setting)	• 0: All target data • 1: Motion data only

"Restore target data setting" is set in the "Automatic Restore Detailed Setting" window or using SD954 (Restoration target data setting). (☞ Page 1643 "Restore Target Data Setting")

■Backup/restoration target drives

Target drives are Drive0 (Program memory), Drive2 (SD memory card), Drive3 (Device/label memory), Drive4 (Data memory), and Drive6 (Motion data memory).
Note that for Drive2 (SD memory card), only the latch device/label files saved when the "Save Destination Memory Setting" for the latch function is specified as "SD Memory Card" are targets of backup/restoration.

■Backup/restoration target files

○: Available, ×: Not available, —: Not applicable

File type		Backup/restoration
Program		○
FB file		○
CPU parameter		○
System parameter		○
Module parameter		○
Module extension parameter		○
Memory card parameter		×
Device comment		○
Device initial value		○
Global label setting file		○
Network label setting file		○
Initial label value file	Initial global label value file	○
	Initial local label value file	○
Global label assignment information		○
Local label assignment information		○
Operation profile data file		○
Operation profile data file additional information		○
Position data history file		○
Axis absolute position data file		○ (Motion data)*2
Axis absolute position data file (advanced synchronous control)		○ (Motion data)*2
File register		○
Event history		○
Motion control event history		○ (Motion data)*2
Device data storage file		○
General-purpose data		○
Firmware update file		—*1
Firmware update prohibition file		○
Logging setting file	Auto logging setting file	×
	Individual setting file	○
Server certificate		○*3
Client certificate		○*3
Add-on software package		×

File type	Backup/restoration
Add-on safe mode file	×
Add-on loading log file	×
Address space setting file	○
User Web page file	×
Latch device/label file	○
System Web page file	×
Program monitor file	×
Program monitor CRC file	×
Network setting change function	○
User authentication	○
Global device data	○
Local device data	○
Device station parameter file	○

All folders/files in the CPU built-in memory are backup/restoration targets.

*1 The file cannot be selected for operation (storage in the drive/memory) from the controller function. However, if the data is written by file operation such as FTP command, the data will be backed up/restored.

*2 Motion data is the data stored in the motion data memory (Drv6). The data related to the motion stored in the built-in data memory (Drv4) is included in all target data, even though it is not motion data.

*3 Availability of backup/restoration differs depending on a folder to be stored. (☞ Page 1563 Digital certificate folder structure and data backup/restoration)

■The number of backup data that can be stored in an SD memory card

When "Backup Destination Specification Setting" is set to "SD Memory Card of CPU Module", the number of folders that can be backed up/restored is 32767. This number is the same as the maximum number of number folders that can be stored in the SD memory card.

The number of files of the backup source data depends on the maximum number of files that can be stored in the model to be used or the drive.

■Backup/restoration target device data

Only latch data is stored in the backup device/label file (BKUP_CPU_DEVLAB.BKD).

Device data may be overwritten depending on the mounting status (I/O refresh) or the refresh settings.

○: Available, ×: Not available

Classification	Device name	Symbol	Backup availability	Restoration availability	Remarks
User device	Input	X	×	×	—
	Output	Y	×	×	—
	Internal relay	M	○	○	—
	Link relay	B	○	○	—
	Annunciator	F	○	○	—
	Link special relay	SB	×	×	—
	Edge relay	V	○	○	—
	Timer	T	○	○	—
	Retentive timer	ST	○	○	—
	Long timer	LT	○	○	—
	Long retentive timer	LST	○	○	—
	Counter	C	○	○	—
	Long counter	LC	○	○	—
	Data register	D	○	○	—
	Link register	W	○	○	—
	Link special register	SW	×	×	—
	Latch relay	L	○	○	—
System device	Function input	FX	×	×	—
	Function output	FY	×	×	—
	Function register	FD	×	×	—
	Special relay	SM	○	○	Areas used by the system may be overwritten at restoration. Whether or not to execute restoration can be set using bit 14 of SD955 (Restoration setting of special relay and special register).
	Special register	SD	○	○	
Link direct device	Link input	Jn\X	×	×	—
	Link output	Jn\Y	×	×	—
	Link relay	Jn\B	×	×	—
	Link special relay	Jn\SB	×	×	—
	Link register	Jn\W	×	×	—
	Link special register	Jn\SW	×	×	—
Module access device	Module access device	Un\G	×	×	—
CPU buffer memory access device	CPU buffer memory access device	U3En\G	×	×	—
Index register	Index register	Z	×	×	—
	Long index register	LZ	×	×	—
File register	File register	R	○	○	Data is backed up as a file register file.
		ZR	○	○	
Refresh data register	Refresh data register	RD	×	×	—
Nesting	Nesting	N	×	×	—
Pointer	Pointer	P	×	×	—
	Interrupt pointer	I	×	×	—

Classification	Device name	Symbol	Backup availability	Restoration availability	Remarks
Other devices	Network No. specification device	J	×	×	—
	I/O No. specification device	U	×	×	—
	Decimal constant	K	×	×	—
	Hexadecimal constant	H	×	×	—
	Real constant	E	×	×	—
	The number of character strings	—	×	×	—

■Backup/restoration target label data

Only latch data is stored in the backup device/label file (BKUP_CPU_DEVLAB.BKD).

Device data may be overwritten depending on the mounting status (I/O refresh) or the refresh settings.

○: Available, ×: Not available

Classification	Backup availability	Restoration availability
Global label (including module labels)	×	×
Global label with latch specified	○	○
Local label	×	×
Local label with latch specified	○	○

Progress of the backup/restoration processing

Progress of backup/restoration processing can be checked with the engineering tool or the following special register areas.

However, the progress of the automatic restoration cannot be checked with the special register.

Special register	Description
SD1350 (Number of uncompleted folders/ files of controller data backup/restoration)	Displays the number of remaining backup/restoration target folders and files. • When the backup/restoration processing is started, the total number of backup/restoration folders and files is stored. • When the backup/restoration processing is completed, 0 is stored.
SD1351 (Progression status of controller data backup/restoration)	Displays the progress of the backup/restoration processing in percentage (0 to 100%).

Backup destination and restoration source settings

Specify the backup/automatic backup destination with the engineering tool or special register areas.

Special register	Value and description
SD963 (Backup destination specification setting)	• 2: Save to SD memory card (Fixed)
SD964 (Automatic backup destination specification setting)	• 2: Save to SD memory card (Fixed)

Specify the restoration source with the engineering tool or a special register area.

Special register	Value and description
SD965 (Restoration source specification setting)	• 2: Restore from SD memory card (Fixed)

Encryption password and decryption password

Backup data can only be encrypted through backup or automatic backup using an engineering tool.
The password entered from the engineering tool is used for the encryption of the backup data. When restoring encrypted backup data, enter the same password used for encryption to decrypt it.
The length of the password and the characters used should satisfy password strength: Strong. (☞ Page 2192 Password Policy)
Note that expiration dates of passwords are invalid for the controller data backup/restoration function.

■Lockout due to a password input error

When the automatic restoration is set using an engineering tool, if encrypted backup data is specified and the password is entered incorrectly 10 times, lockout will occur for 30 minutes.
The number of password input errors is not counted by each encrypted backup data set, but is cumulated for all encrypted backup data sets. When a controller is reset or when the power supply is turned off and on, the count of password input errors is initialized and the lockout is cleared.

Operation of when user authentication function is enabled

When the user authentication function is enabled, encrypt the backup data through backup or automatic backup using the engineering tool. If backup is executed without encryption, a CPU module/controller data backup/restoration function error (error code 4D8DH) occurs.

69.1 Backup

Data of the specified controller can be backed up.
To comply with IEC 62443-4-2, encrypt backup data using the settings of the engineering tool.

Point

Data can be backed up even when the controller is in the RUN state.
However, when executing the backup function with the controller in the RUN state, do not change device/label data (latch data only) during data backup process. Doing so may cause data inconsistency of the device/label data and the contents of the backup data may unintentionally change.

Set the backup/automatic backup with the engineering tool or special register areas. For details on the procedure, refer to one of the following sections.

- Backup using engineering tool (☞ Page 1632 Operating procedure)
- Backup using special relay/special register areas (☞ Page 1633 Operating procedure)
- Automatic backup using engineering tool (☞ Page 1634 Operating procedure)
- Automatic backup using special relay/special register areas (☞ Page 1637 Operating procedure)

Setting the upper limit value for the number of controller backup data

When the backup processing has not been executed (when no backup data folder (CPU data folder) exists in the backup destination), the upper limit value for the number of backup data can be set.
The number of backup data in the upper limit value setting is the number of date folders.

Restriction

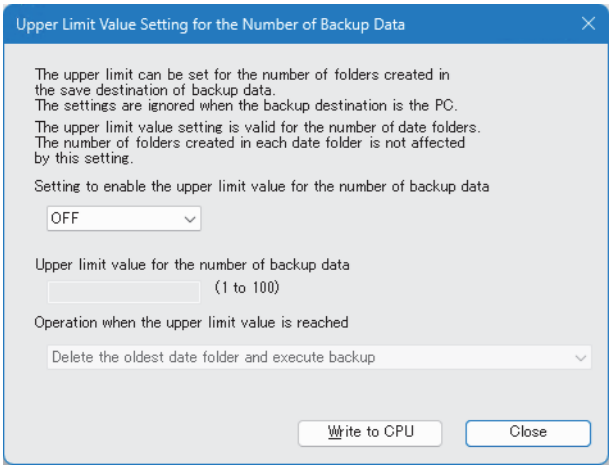
If the capacity of the backup destination is exceeded before the upper limit of the number of backup data is reached, the backup processing is completed with an error without reaching the set upper limit.
When the upper limit value setting for the number of controller backup data is enabled, secure enough free space on the drive specified as the backup destination before executing the backup operation.

■Setting with engineering tool

Set the following in the "Upper Limit Value Setting for the Number of Backup Data" window.

Online ⇨ Backup/Restore ⇨ Backup ⇨ Upper Limit Value Setting for the Number of Backup Data ⇨ [Setting] button

- Set the "Setting to enable the upper limit value for the number of backup data" to "ON".
- Enter the "Upper limit value for the number of backup data".
- Select the "Operation when the upper limit value is reached".
- Click the [Write to CPU] button.



The upper limit value setting can be disabled by setting the "Setting to enable the upper limit value for the number of backup data" to "OFF".

■Setting with special relay/special register

The upper limit value for the number of controller backup data can be set and checked using the following special register areas.

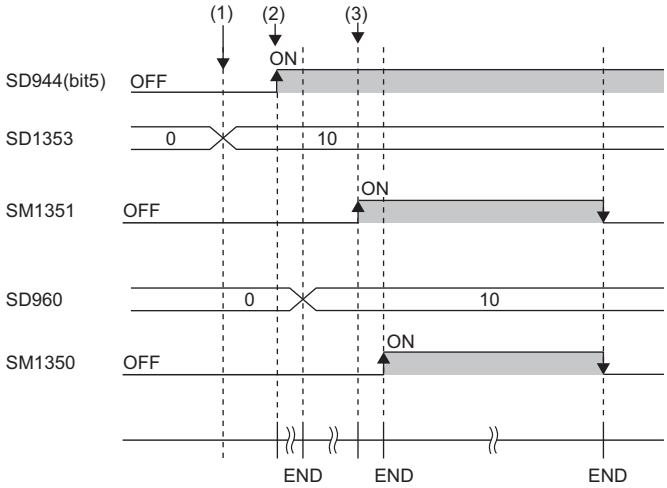
Special relay/special register	Description
SM960 (Upper limit setting flag for the number of controller backup data)	This relay specifies an operation of backup when the number of backup data reaches the upper limit value. (This relay is valid only when the bit 5 of SD944 is on.) • Off: The oldest date folder is deleted, and the backup operation continues. • On: The backup operation does not continue if the upper limit value for the number of backup data is exceeded. (In this case, the backup is completed with an error.)
Bit 5 of SD944 (backup data upper limit enable setting)	Set to enable or disable the upper limit value for the number of backup data. • Off: Disable (No limit (Date folders are created within the maximum capacity of the backup destination.)) • On: Enable
SD960 (Upper limit status for the number of controller backup data)	This register displays the value (1 to 100) set in SD1353. If the bit 5 of SD944 is off, 0 is stored in this special register (SD).
SD1353 (Setting of the upper limit value for the number of controller backup data)	Set the upper limit value (1 to 100) for the number of backup data.

■Operation of the special relay and special register

The following figure shows the operations of the special relay and special register of when the upper limit value for the number of backup data has been set.

Check the following at the timing when the bit 5 of SD944 (backup data upper limit enable setting) is turned on, and enable the upper limit value for the number of backup data.

- The backup processing has not been executed (when no backup data folder (CPU data folder) exists in the backup destination).
- The value set in SD1353 (Setting of the upper limit value for the number of controller backup data) is within the range (1 to 100).



(1) The upper limit value for the number of backup data is set. (0 → 10)
(2) The upper limit value for the number of backup data is enabled.
(3) A backup execution request is sent.

Backup using engineering tool

By performing settings with the engineering tool, data of a controller can be backed up at a desired timing.

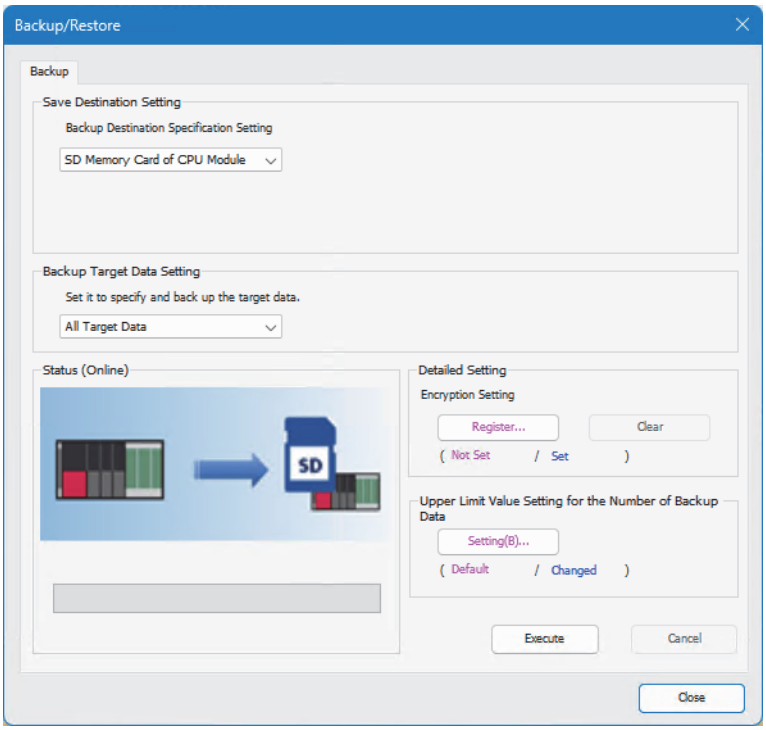
Operating procedure

Set and execute the following with the engineering tool.

Online ⇨ Backup/Restore ⇨ Backup

1. Set the following in the "Backup/Restore" window.

- Select the save destination for the backup data from "Save Destination Setting".
- Set "Backup Target Data Setting".
- To encrypt the backup data, click the [Register] button under "Encryption Setting" and set the password. (☞ Page 1629 Encryption password and decryption password)
- To set the "Upper Limit Value Setting for the Number of Backup Data", click the [Setting] button. (☞ Page 1630 Setting the upper limit value for the number of controller backup data)



2. Click the [Execute] button to execute the backup.

Backup processing triggered by turning on SM1351

Data of a controller can be backed up at a desired timing.

Operating procedure

Turn on SM1351 (Controller data backup execution request) to execute a backup.

1. Specify the backup destination with SD963. (☞ Page 1628 Backup destination and restoration source settings)

2. Specify the backup target data with SD966. (☞ Page 1625 Backup/restoration target data)

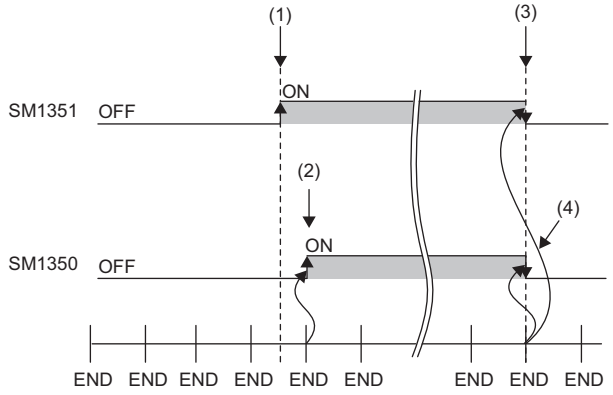
3. To set the upper limit value for the number of backup data, follow the steps below.

- Set SD1353 (Upper limit setting for the number of controller backup data sets).
- Set SM960 (Upper limit operation setting flag for the number of controller backup data sets).
- Turn on bit 5 of SD944 (Upper limit enable setting for the number of controller backup data sets).

For the upper limit value for the number of backup data, refer to the following.

☞ Page 1630 Setting the upper limit value for the number of controller backup data

4. Turn off → on SM1351 (Controller data backup execution request).



(1) A backup execution request is sent.
(2) The system turns on SM1350 (Controller data backup status flag).
(3) The system turns off SM1351 (Controller data backup execution request) after the backup processing is completed.
(4) The system turns off SM1350 (Controller data backup status flag).

If the backup processing is completed with an error and SM953 (Controller data backup error check flag) turns on, check SD953 (Backup error cause), take action, and then back up the data again if required.

Point

The execution status of the backup processing can be checked in SD1350 (Number of uncompleted folders/files of controller data backup/restoration) and SD1351 (Progression status of controller data backup/restoration). (☞ Page 1628 Progress of the backup/restoration processing)

Automatic backup using engineering tool

By performing settings with the engineering tool, data of a controller can be automatically backed up at a preset execution timing. Select the execution timing of the automatic backup from the following.

- Day and time specification
- Time and day of week specification
- At the occurrence of a stop error

Multiple execution timing settings can be set.

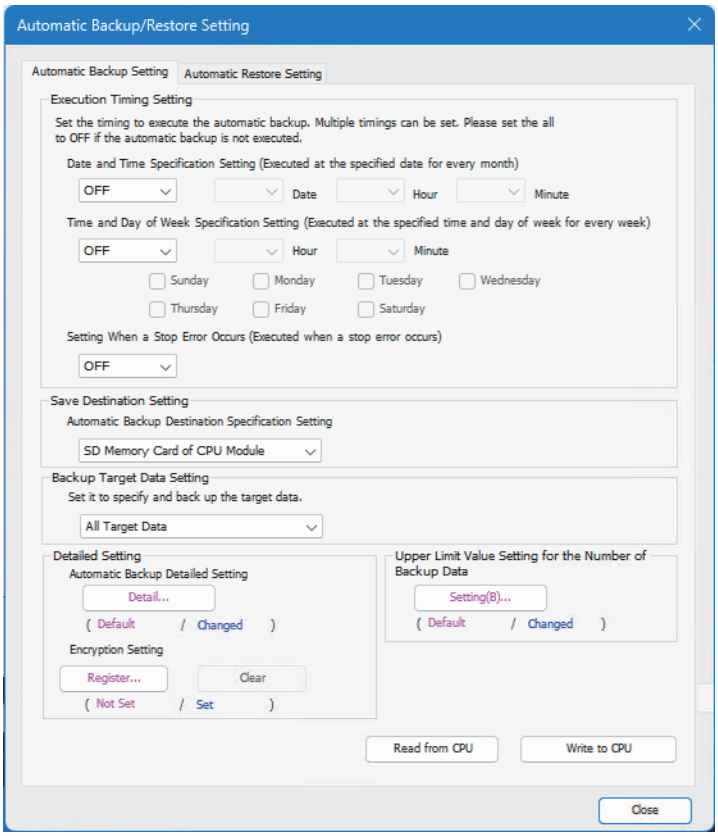
Operating procedure

Perform settings using the engineering tool.

Online ⇨ Backup/Restore ⇨Automatic Backup Setting

1. Select the following in the "Automatic Backup Setting" tab of the "Automatic Backup/Restore Setting" window.

- Under "Execution Timing Setting", select "ON" for the items that suit the situation and set the items.
- Under "Save Destination Setting", select the save destination for the backup data.
- Set "Backup Target Data Setting".
- To set the "Automatic Backup Detailed Setting", click the [Detail] button and in the "Automatic Backup Detailed Setting" window, set the "Automatic Backup Retry Enable Setting" to "ON". Set whether to retry the automatic backup when the automatic backup is executed during execution of an operation or function that cannot be executed simultaneously (☞ Page 1641 Operations and functions that cannot be performed simultaneously). The retry interval is 3 minutes and the number of retries is 10.
- To encrypt the backup data, click the [Register] button under "Encryption Setting" and set the password. (☞ Page 1629 Encryption password and decryption password)
- To set the "Upper Limit Value Setting for the Number of Backup Data", click the [Setting] button. (☞ Page 1630 Setting the upper limit value for the number of controller backup data)



2. Click the [Read from CPU] button or [Write to CPU] button and close the window.

Since automatic backup might not be able to execute at times depending on whether an operation or function that cannot be executed simultaneously is being executed, check if the backup processing has been completed with event code 20500H or SM953 (Controller data backup error check flag).

If the backup processing is completed with an error and SM953 (Controller data backup error check flag) turns on, check SD953 (Backup error cause), take action, and then back up the data again if required.

Automatic backup using SD944

Data of a controller can be automatically backed up at a preset execution timing. Select the execution timing of the automatic backup from the following.

- Day and time specification (☞ Page 1637 Operating procedure)
- Time and day of week specification (☞ Page 1638 Operating procedure)
- At the occurrence of a stop error (☞ Page 1638 Operating procedure)

Multiple execution timing settings can be set.

Point

Since the special register set for the automatic backup is a latch area, setting data is held.

Retrying the automatic backup

Set whether to retry the automatic backup when the automatic backup is executed during execution of an operation or function that cannot be executed (☞ Page 1641 Operations and functions that cannot be performed simultaneously). The retry interval is three minutes and the number of retries is 10.

Special relay/Special register	Description
SM961 (Automatic backup retry failure flag)	This relay turns on when the retry of the automatic backup is completed with an error after the retry of the automatic backup for the number of retries was attempted. This relay turns off at the start of the automatic backup. (This relay does not turn off when SM1351 (Controller data backup execution request) is on.) • Off: Retry not executed/Retry being executed • On: Retry failed
SM1356 (Retry status flag for controller data automatic backup)	This relay turns on during execution of the retry of the automatic backup. This relay turns on at the start of the retry of the automatic backup and turns off when the retry of the automatic backup is started or the retry of the automatic backup for the number of retries is attempted without execution of an operation or function that cannot be executed. • Off: Retry is not being executed. • On: Retry is being executed.
Bit 10 of SD944 (Retry execution for the automatic backup)	Set whether to retry the automatic backup. • Off: Retry is not executed. • On: Retry is executed.

The setting of the bit 10 of SD944 (Backup function setting) cannot be changed during execution of the automatic backup.

The retry setting of the automatic backup is enabled at the following timing.

- When bit 0 (Automatic backup setting by specification of day and time), bit 1 (Automatic backup setting by specification of time and day of week), or bit 15 (Automatic backup setting at occurrence of stop error) of SD944 is turned on

Operating procedure

■Operating procedure (when date and time are specified)

Data is automatically backed up on the specified date and time.

1. Specify the backup destination with SD964. (☞ Page 1628 Backup destination and restoration source settings)
2. Specify the automatic backup target data with SD967. (☞ Page 1625 Backup/restoration target data)
3. Set the upper limit value for the number of backup data. (The setting method and operating procedure for the upper limit value are the same as those for the upper limit value for the backup processing triggered by turning on SM1351.) (☞ Page 1630 Setting the upper limit value for the number of controller backup data)
4. Set the date and time with SD947 to SD949.

Special register	Description
SD947 (Day and time setting for automatic backup (day))	Set the date when the data is to be automatically backed up.
SD948 (Day and time setting for automatic backup (time))	Set the time (hour) when the data is to be automatically backed up.
SD949 (Day and time setting for automatic backup (minute))	Set the time (minute) when the data is to be automatically backed up.

5. To retry the automatic backup, turn on bit 10 of SD944. (☞ Page 1636 Retrying the automatic backup)
6. Turn on bit 0 of SD944 (Automatic backup setting by specification of day and time).

Since automatic backup might not be able to execute at times depending on whether an operation or function that cannot be executed simultaneously is being executed, check if the backup processing has been completed with event code 20500H or SM953 (Controller data backup error check flag).

If the backup processing is completed with an error and SM953 (Controller data backup error check flag) turns on, check SD953 (Backup error cause), take action, and then back up the data again if required.

Restriction

- In months that do not have the specified date, the automatic backup is not executed. For example, when SD947 has been set to "31", the months when the automatic backup is executed are January, March, May, July, August, October, and December.
- If the time less than 1 hour from the start time of daylight saving time has been set with the daylight saving time function, the automatic backup is not executed.

■Operating procedure (when time and day of the week are specified)

Data is automatically backed up on the specified time on the specified day of the week.

1. Specify the backup destination with SD964. (☞ Page 1628 Backup destination and restoration source settings)
2. Specify the automatic backup target data with SD967. (☞ Page 1625 Backup/restoration target data)
3. Set the upper limit value for the number of controller backup data. (The setting method and operating procedure for the upper limit value are the same as those for the upper limit value for the backup processing triggered by turning on SM1351. (☞ Page 1630 Setting the upper limit value for the number of controller backup data))
4. Set the time and day of the week with SD950 to SD952.

Special register	Description
SD950 (Time and day of week setting for automatic backup (hour))	Set the time (hour) when the data is to be automatically backed up.
SD951 (Time and day of week setting for automatic backup (minute))	Set the time (minute) when the data is to be automatically backed up.
SD952 (Time and day of week setting for automatic backup (day of week))	Set the day of the week when the data is to be automatically backed up. b0: Sunday, b1: Monday, b2: Tuesday, b3: Wednesday, b4: Thursday, b5: Friday, b6: Saturday

5. To retry the automatic backup, turn on bit 10 of SD944. (☞ Page 1636 Retrying the automatic backup)
6. Turn on bit 1 of SD944 (Automatic backup setting by specification of time and day of week).

Since automatic backup might not be able to execute at times depending on whether an operation or function that cannot be executed simultaneously is being executed, check if the backup processing has been completed with event code 20500H or SM953 (Controller data backup error check flag).

If the backup processing is completed with an error and SM953 (Controller data backup error check flag) turns on, check SD953, take action, and then back up the data again if required.

Restriction

If the time less than 1 hour from the start time of daylight saving time has been set with the daylight saving time function, the automatic backup is not executed.

■Operating procedure (when a stop error has occurred in the controller)

Data is automatically backed up when a stop error occurs in the controller.

1. Specify the backup destination with SD964. (☞ Page 1628 Backup destination and restoration source settings)
2. Specify the automatic backup target data with SD967. (☞ Page 1625 Backup/restoration target data)
3. Set the upper limit value for the number of controller backup data. (The setting method and operating procedure for the upper limit value are the same as those for the upper limit value for the backup processing triggered by turning on SM1351. (☞ Page 1630 Setting the upper limit value for the number of controller backup data))
4. To retry the automatic backup, turn on bit 10 of SD944. (☞ Page 1636 Retrying the automatic backup)
5. Turn on bit 15 of SD944 (Automatic backup setting at occurrence of stop error).

Since automatic backup might not be able to execute at times depending on whether an operation or function that cannot be executed simultaneously is being executed, check if the backup processing has been completed with event code 20500H or SM953 (Controller data backup error check flag).

If the backup processing is completed with an error and SM953 (Controller data backup error check flag) turns on, check SD953, take action, and then back up the data again if required.

Restriction

If a major error has occurred, the automatic backup may not be performed.

Precautions

This section describes the precautions for the backup function.

Checking backup errors

When an error has occurred, a self-diagnostic error is not detected and an error code is stored in SD953 (Backup error cause).

Prohibited operation during execution of the backup processing

Do not perform the following operations during execution of the backup processing.

- Removing/inserting an SD memory card (when "Backup Destination Specification Setting" is set to "SD Memory Card of CPU Module")
- Powering off or resetting the controller

If performed, the backup data at the backup destination will consist of the data up to the point where the backup was executed.

Do not use these data for a restoration. If these data are used, the restoration is completed with an error.

Suspending backup processing

To suspend backup processing, perform one of the following operations.

- When backing up data using the engineering tool, suspend it in the backup/restore progress window.
- Turn on SM1357 (Backup suspending request).
- Force disable the SD memory card (when "Backup Destination Specification Setting" is set to "SD Memory Card of CPU Module")

If the backup processing is suspended, backup data up to the middle of the execution will be deleted.

However, it might not be deleted if the drive of the backup destination cannot be accessed or for other reasons. Do not use such data for a restoration. If these data are used, the restoration is completed with an error.

It may take some time to suspend the backup processing using the engineering tool or by turning on SM1357 (Backup suspending request), as it will be performed after the file being backed up has been processed.

Device/label data

When executing the backup processing, do not change device/label data (latch data only) during execution of the processing. Since device/label data is divided into multiple scans and backed up, changes in the device/label data may cause data inconsistency.

Parameter settings were changed before execution of the backup processing

When programs or parameter settings were changed, check that operations are performed with the new programs and parameter settings, and then execute the backup function. If the backup processing is executed without the check of the operations with the new programs and parameter settings, the restoration processing may not be executed.

After changing parameters, power off and on or reset the controller, and execute backup operation after the written parameters have been reflected.

Changing backup target data

Do not change backup target data in the controller during execution of the backup processing. If the target data was changed during execution of the backup processing, the changes will not applied.

Special relay and special register that function as flags to execute other functions

Before executing the backup processing, turn off the special relay and special register that function as flags to execute other functions. If the backup processing is executed when they are on, the corresponding function request may turn on and the function may be executed at the restoration of data in the special relay and special register.

Setting the upper limit value for the number of controller backup data

Set the upper limit value for the number of backup data before execution of the backup processing.
When the backup processing has been executed (a CPU data folder exists in the backup destination) and bit 5 of SD944 (backup data upper limit enable setting) is turned on, the operation is completed with an error. (Error code 4C23H)
Even if the backup processing has been executed, turning off bit 5 of SD944 (backup data upper limit enable setting) can disable the upper limit value for the number of controller backup data. To set the upper limit value for the number of backup data again, turn off and on bit 5 of SD944 after changing the backup destination to another one where no CPU data folder exists or deleting the backup data folder.
Even when an upper limit value for the number of controller backup data has been set, if the maximum allowable capacity of the specified drive is exceeded, the backup processing is completed with an error, regardless of whether the number of backup data exceeds the upper limit value.
When the upper limit value setting for the number of controller backup data is enabled, secure enough free space on the specified drive before executing the backup operation.

Time required for completing the backup processing

The backup processing takes more time depending on the size of data or the number of folders/files stored in the controller, and encryption settings.

Encrypted backup

Note that if the password entered in encryption settings is forgotten, backup data encrypted using that password will not be able to be restored.
If the size of the backup data to be encrypted is large, the size of the encrypted files may exceed the temporary area capacity of the CPU and the backup operation may fail.

Size of program files or FB files

Program files or FB files to be backed up must be 60M bytes or less. If data greater than 60M bytes is backed up, a CPU module/controller data backup/restoration function error (error code 4D81H) occurs and the backup is completed with an error.

Operations and functions that cannot be performed simultaneously

While the following operations or functions are being executed, the backup processing cannot be executed.
In the same way, the following operations and functions cannot be executed during execution of the backup processing.

Operation or function		
Operation from the engineering tool	Initializing the CPU built-in memory/SD memory card	
	Clearing values (Devices, labels, file registers, latches)	
	Writing data to the programmable controller (including online change of files)	
	Deleting data in the programmable controller	
	User data operation	Writing user data
		Deleting user data
		Creating a folder
		Deleting a folder
		Changing a folder name
	Online change (online change (ladder block))	
	Event history function (Clearing event history)	
	Predefined protocol support function (Writing protocol setting data)	
	User authentication function	Writing user management information and user group management information
		Writing user authentication setting information
		Initialization of password expiration date
		Changing the password
	All controller information initialization	
	Firmware update function (Firmware update using the engineering tool) (Backup operation is not available during firmware update, while firmware update is available during backup operation.)	
Operation using CPU Module Logging Configuration Tool	Data logging function (Writing/deleting a logging setting file, registering/clearing a logging setting, stopping a logging)	
	Deleting a logging file	
Others	SLMP (Including access from module)	Clearing the remote latch (Remote Latch Clear)
		Creating a new file (New File)
		Writing data to a file (Write File)
		Deleting a file (Delete File)
		Copying a file (Copy File)
		Changing a file attribute (Change File State)
		Changing file creation date (Change File Date)
		Opening a file (Open File)*1
	File transfer from an Ethernet-equipped module (FTP server)	Writing a file (put, mput, pm-write)
		Deleting a file (delete, mdelete)
		Changing a file name (rename)
		Changing a file attribute (change)
	FTP functions in the Ethernet function part (FTP server)	
	FTP functions in the Ethernet function part (FTP client)	
	Network setting change function	
	iQ Sensor Solution data backup/restoration function	
	Data logging file transfer to data memory*2	
	Encrypted communication function (Creating, writing, deleting, and viewing a server certificate)	

*1 The operation performed only for opening a file to write data
*2 It is executed when the trigger logging data collection is completed or data collection for the specified number of storage files is completed.

Automatic backup might not be able to execute at times depending on whether an operation or function that cannot be executed simultaneously is being executed. Therefore, check if the backup processing has been executed with the event history or special relay/special register. Automatic backup can be retried when it is completed with an error (error codes 41D8H and 4C15H).

Backup during execution of the backup processing

Backup and automatic backup cannot be executed during execution of backup processing. (The latter backup processing is ignored and the backup process that is currently being executed continues.)
In that case, an error code is stored in SD968 (Duplicated backup request error cause). If the time for automatic backup comes during execution of backup processing, no error code is stored.

Data logging function and backup

When the CPU built-in memory (function memory) is specified for the data storage destination memory in the data logging function, the function memory is cleared after the controller is powered off or the reset state is cleared. Thus, data logging files are also cleared. To prevent data logging files from being lost, back up the files after the completion of file transfer by the data logging file transfer function.

Execution availability of automatic backup

- If a stop error occurs while the backup is being executed, the automatic backup based on "Setting When a Stop Error Occurs" is executed after the backup that was being executed is completed.
- If the execution timing of the automatic backup based on "Data and Time Specification Setting" or "Time and Day of Week Specification Setting" occurs during the ongoing backup process, the automatic backup based on those settings will not be executed.
- When the automatic backup based on "Date and Time Specification Setting" or "Time and Day of Week Specification Setting" is completed, it will not be executed again even if the set execution timing has not elapsed. For example, if the execution timing is set to 0:00 on January 1, the automatic backup is not executed again even if the automatic backup is completed in less than a minute and the time is still 0:00 on January 1.
- When "Date and Time Specification Setting" or "Time and Day of Week Specification Setting" is enabled, the automatic backup is immediately executed if the current time matches those settings. For example, if the execution timing is set to 0:00 on January 1 and the time to enable the setting is 0:00 on January 1, the automatic backup is immediately executed.

Backup immediately after backup completion

When a new backup starts immediately after a backup completes (including cases of failure or interruption) using the engineering tool, the result of the previously executed backup may not be displayed in the tool, and the progress of the subsequent backup may begin to be shown instead. In that case, check the execution result on the event history.

69.2 Restoration

This function restores backup data to the controller.
To comply with IEC 62443-4-2, use encrypted backup data.

Point

- Automatic restoration is executed using either the setting values of the engineering tool or those of SD955, whichever are changed most recently. For automatic restoration using SD955, the settings are determined to have been changed when bit 0 of SD955 (Automatic restoration setting) is turned on or off.
- When encrypted backup data is being restored through automatic restoration using the engineering tool, the entered decryption password is saved in the non-volatile memory of the controller. This decryption password will be deleted from the non-volatile memory after the automatic restoration is completed, regardless of whether it succeeds or fails.

Set the automatic restoration with the engineering tool or a special register area. For details on the procedure, refer to one of the following sections.

- Engineering tool (☞ Page 1644 Operating procedure)
- Special register (☞ Page 1646 Operating procedure)

"Restoration Target Date/Number Folder Setting"

Set the target to be restored from the latest data or the date folder/number folder of the backup data using the following settings.

Engineering tool		Special register
"Restore the latest data"*1		Bit 13 of SD955 (Latest data restoration) • On: Latest data restoration*1 • Off: Restoration of data specified with SD957 to SD956 or SD958
"Restore the specified data"	"Date"	SD956 to SD957 (Restoration target date folder setting) SD957 (upper in BCD code): Year, SD956 (lower in BCD code): Month and day
	"No."	SD958 (Restoration target number folder setting) Folder numbers (00001 to 32767) to be restored

*1 The latest data is the backup data with the largest number in the latest date folder.

"Restore Target Data Setting"

Set the range of data to restore with the following settings.

Engineering tool		SD954 (Restoration target data setting)
"All Target Data"		All bits off or all target bits on
"Specify Data"	"Data Except for Followings"*1	Bit 1: On
	"Device/Label Data with Latch Specified"	Bit 0: On
	"Motion Data"	Bit 2: On

*1 The data indicates all the target data except for "Device/Label Data with Latch Specified" and "Motion Data".

"Restore Special Relay/Special Register of Latch Area"

Restore the special relay and special register areas within the latch areas, or set the restoration using the following settings.

Engineering tool	Bit 14 of SD955 (Restoration setting of the special relay and special register)
"Not to restore"	Off
"Restore"	On

■Special relay and special register areas that are not restored

Even if the special relay and special register are set to be restored, the following areas will not be restored.
Special relay/special register areas for the controller data backup/restoration function are targeted.

- SM953, SM959, SM961, SM968
- SD953, SD959, SD968

Automatic restoration using engineering tool

By performing settings using the engineering tool, backup data can be automatically restored when the controller is powered on or is reset.

Operating procedure

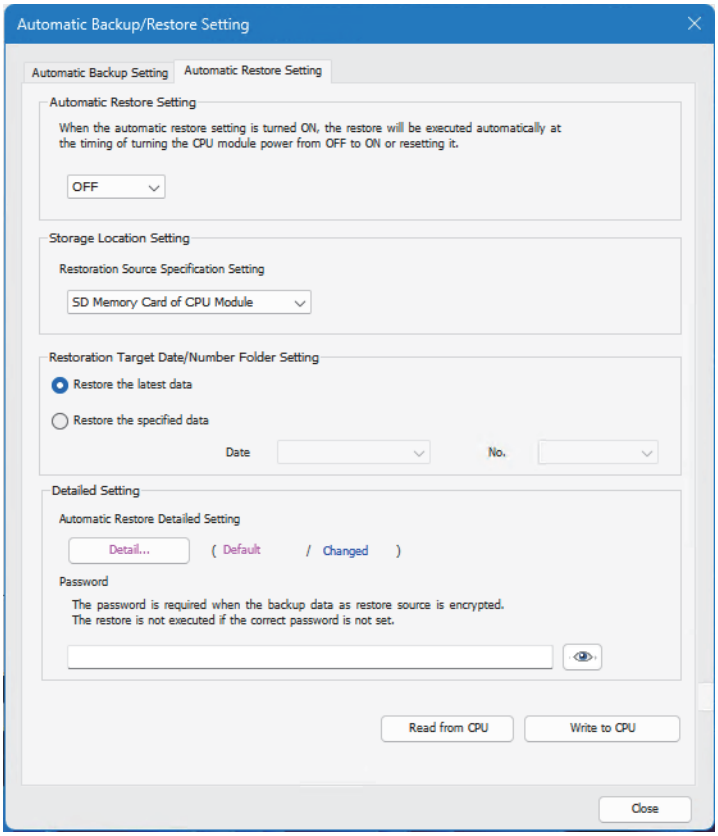
Perform settings using the engineering tool.

Before changing settings, check that the versions of the software packages required to use add-ons and the license key file match those of the backup source controller. If the versions differ, a stop error or unintended operation may occur. Verify each version in the "Add-on Management" window. (☞ Page 1664 Installation)

Online ⇨ Backup/Restore ⇨ Automatic Restore Setting

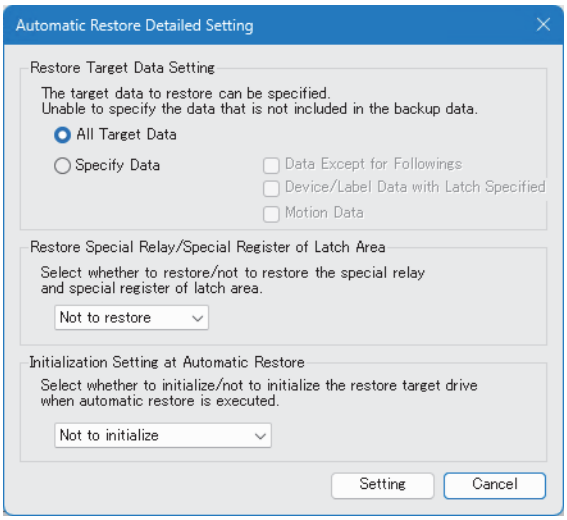
1. Set the following in the "Automatic Restore Setting" tab of the "Automatic Backup/Restore Setting" window.

- Set the "Automatic Restore Setting" to "ON".
- Under "Storage Location Setting", select the restoration source.
- Under "Restoration Target Date/Number Folder Setting", select "Restore the latest data" or "Restore the specified data". When selecting "Restore the specified data", specify the backup data with "Date" and "No.".
- To set "Automatic Restore Detailed Setting", click the [Detail] button and proceed to step 2.
- If encrypted backup data is specified, enter the decryption password under "Password". (☞ Page 1629 Encryption password and decryption password)



2. Set the following in the "Automatic Restore Detailed Setting" window and click the [Setting] button.

- Set "Restore Target Data Setting".
- Set "Restore Special Relay/Special Register of Latch Area". Note that there are special relay and special register areas that will not be restored even when "Restore" is selected. (☞ Page 1643 Special relay and special register areas that are not restored)
- Set "Initialization Setting at Automatic Restore". When "Initialize" is selected, drives other than the restoration source will be initialized at execution of the automatic restoration. This setting is enabled when "Restore Target Data Setting" is set to "All Target Data".



3. Click the [Read from CPU] button or [Write to CPU] button and close the window.

4. Reset the controller or power off and on the system to execute restoration.

Point

- After the automatic restoration is executed, "Automatic Restore Setting" is set to "OFF" regardless of whether the automatic restoration is completed successfully or with an error. Therefore, the restoration is not executed the next time when the controller is reset or the power supply is turned off and on.
- If the restoration processing is completed with an error and SM959 (Controller data restoration error check flag) turns on, check the error code with SD959 (Restoration error cause), take action, and then restore the data again if required.

Automatic restoration using SD955

Backup data is automatically restored when the power supply is turned on or is reset.

Initialization at the automatic restoration

Set whether or not to initialize drives other than the restoration source at execution of the automatic restoration by bit 1 of SD955.

This setting is enabled only when SD954 (Restoration target data setting) is set to All target data.

Bit 1 of SD955 (Initialization at automatic restoration)	Description
Off	Not initialized
On	Initialized

Operating procedure

Before changing settings, check that the versions of the software packages required to use add-ons and the license key file match those of the backup source controller. If the versions differ, a stop error or unintended operation may occur. Verify each version in the "Add-on Management" window. (☞ Page 1664 Installation)

1. Specify the restoration source with SD965 (Restoration source specification setting).
2. Set the range of data to restore with SD954 (Restoration target data setting).
3. Set a restoration target folder in the areas from SD956 to SD957 (Restoration target date folder setting) and SD958 (Restoration target number folder setting). Note that these settings are not required when bit 13 of SD955 (Restoration setting for latest data) is on.
4. Set each bit of SD955.

- Bit 1 (Initialization at automatic restoration) (☞ Page 1646 Initialization at the automatic restoration)
- Bit 13 (Restoration setting for latest data)
- Bit 14 (Restoration setting of the special relay and special register) (☞ Page 1643 "Restore Special Relay/Special Register of Latch Area")

5. Turn on bit 0 of SD955 (Automatic restoration).
6. Power off and on or reset the controller.

Point

- After the automatic restoration is executed, bit 0 of SD955 (Automatic restoration setting) is turned off regardless of whether the automatic restoration is completed successfully or with an error. Therefore, the restoration is not executed the next time when the controller is reset or the power supply is turned off and on.
- If the restoration processing is completed with an error and SM959 (Controller data restoration error check flag) turns on, check SD959 (Restoration error cause), take action, and then restore the data again if required.

Checking restoration errors

When an error occurs at the automatic restoration using SD955, a self-diagnostic error is detected. The error code is also stored in SD959 (Restoration error cause).

Precautions

The following describes the precautions for the restoration.

Prohibited operation during execution of the restoration processing

Do not perform the following operations during execution of the restoration processing.

- Removing/inserting an SD memory card (when "Backup Destination Specification Setting" is set to "SD Memory Card of CPU Module")
- Powering off or resetting the controller

The above mentioned operations leave the data in the controller in an incomplete state which is middle of the restoration processing. Do not run the controller with this incomplete state. Doing so may cause an unintended operation. Restore the data again or format each drive of the controller, and clear devices/labels before writing programs or parameters to the programmable controller.

Model name of the controller to which data is restored

Use the same model name as the backup source controller. If not, the data cannot be restored.

Functions that cannot be performed simultaneously with automatic restoration

Do not set both of the automatic restoration and boot operation at a time.

If the controller is powered off and on or is reset with both of the automatic restoration and boot operation set, the automatic restoration does not function.

The controller status differs from the one at the time of backup

If the controller status (program or parameter) of the restoration destination is different from the one at the time of backup, the restoration may be completed with an error (error code: 4C1BH).

When the items in "Restore Target Data Setting" differ from the items at the time of backup as follows, set "Restore Target Data Setting" to "All Target Data" (all bits of SD954 are off or all target bits are on), then execute the restoration.

"Restore Target Data Setting"*1	Item at the time of backup
"Device/Label Data with Latch Specified" in "Specify Data" (bit 0 of SD954 is on)	• Sequence program file • FB file • Label initial value setting • CPU parameter • Local label setting • Global label setting • Network label setting • File register file size
"Data Except for Followings" in "Specify Data" (bit 1 of SD954 is on)	• Sequence program file • FB file • Label initial value setting • Local label setting • Global label setting • Network label setting • File register file size

*1 This item is displayed in the "Automatic Restore Detailed Setting" window. (☞ Page 1644 Operating procedure)

When the same name folder or file exists in the restoration destination

If the name of a folder or file on the restoration destination controller is the same as one in the backup data, the folder or file on the controller will be overwritten by that in the backup data.

Backup data having a problem

If the backup data has a problem, which could be caused by operations such as intentionally deleting the backup data, and resetting the controller or turning off and on the power supply during the backup processing, the restoration will be completed with an error no matter how many times it is executed. Change the restoration target folder or avoid executing restoration for a folder having a problem.

Time required for completing the restoration processing

The restoration processing takes more time depending on the number of backup data (folders), file size, and number of files, and encryption settings.

Reflecting restored data

Some of the parameters are reflected only when the controller is powered off and on or is reset. Therefore, if the data is restored in STOP state and the status is switched from STOP to RUN, the controller may not operate with the backed-up data. In that case, power off and on or reset the controller. For device/label data, since device/label data except for latch-specified devices/labels is initialized when the controller is powered off and on or is reset, restore the device/label data again if required.

Abnormal completion of restoration

Since the restoration processing will be completed with an error, do not execute the restoration processing in the following cases.

- The name of a file in the restoration destination and the name of a file in backup data are identical, and a file password has been set.
- Data in a backup folder has been deleted. (Do not delete the data in backup folders that are likely to be used for restoration.)
- Backup data has problems. (Backup data has been changed, the controller was powered on and off during execution of the backup processing, or data that has been deleted exists.)

When the special relay and special register are restored

When a restoration is operated with the setting to restore the special relay and special register, the system will be operated with the values (time, day of the week, day, time, and the upper limit value of the number of backup data for the automatic backup set to the backup function setting) before restoration. (The backup function setting will not be re-set although the special register areas are overwritten by the restoration.)
To operate the system with the restored backup function setting, set the backup function setting again.

Operation of when the data logging function is used

If the backup is executed during the data logging function in progress and the logging start condition is set to "Auto start at initial completion" or "Auto start at transition to RUN", the data logging function is automatically executed at the initial completion or at the transition to RUN after the restoration execution.
To restart the data logging function after the restoration processing without the above setting, the start operation from CPU Module Logging Configuration Tool is required.
When the CPU built-in memory (function memory) is specified for the data storage destination memory, the function memory is not backed up. Therefore, when the data logging is restarted after the restoration processing, the logging files are deleted after the power supply is turned off or reset is cleared, and the logging file number starts from one at the storage file switching.

Size of backup data to be decrypted

If the size of the backup data to be decrypted is large, the file size may exceed the temporary area capacity of the controller and the restoration may fail.

Encryption settings

Settings of "Encryption Setting" for backup data are not restored. To encrypt the backup data after restoration, register "Encryption Setting" using the engineering tool again.

Add-on software

Software packages required to use add-ons are not restored. If the software package versions of the backup source controller and restoration destination controller differ, a stop error or unintended operation may occur while running.

User information of when user authentication function is enabled

If data backed up from a controller where the user authentication function is enabled is restored to a controller where the function is disabled, the user information for the function is changed to that of the backup data (where the user authentication function is enabled).

User information of when user authentication function is disabled

If data backed up from a controller where the user authentication function is disabled is restored to a controller where the function is enabled, the function is disabled. As a result, files to which access was limited will be allowed to be accessed.

If backup target drive does not have enough free space

If data is backed up to a backup target drive that does not have enough free space, and the backed-up data is used for restoration, the restoration may be completed with an error (error code: 3017H).

70 SOFTWARE UPDATE OF THE CONTROLLER

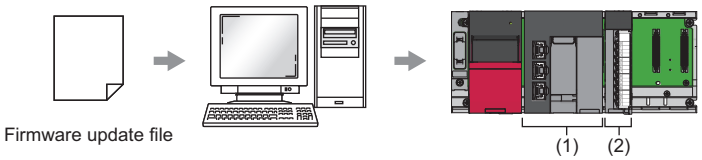
70.1 Firmware Update Function

This function updates firmware versions of controllers and MELSEC iQ-R series modules.
It enables users to update firmware versions of multiple modules at once by writing firmware update files to target modules using the engineering tool. (For firmware update files, please contact your local Mitsubishi representative.)

Point

When performing the firmware update (hereinafter abbreviated as update), check the safety of the system in advance. If the firmware version of the controller is updated while the controller is connected to the other system through a network, a system error (stop error) may occur.
During the execution of the update, communication with other modules, external devices, or the engineering tool is not possible.

The controller that writes the firmware update file is called an update writing controller. The firmware update file is written from the update writing controller to the module to be updated.



(1) Update writing controller
(2) Modules to be updated

Applicable models

The following shows the applicable models that can be used as an update writing controller and the models that can be updated by the firmware update function.

■Update writing controllers

The following is the models of controllers that can be used as an update writing controller.

- MXR500-256, MXR500-128
- MXR300-64, MXR300-32, MXR300-16

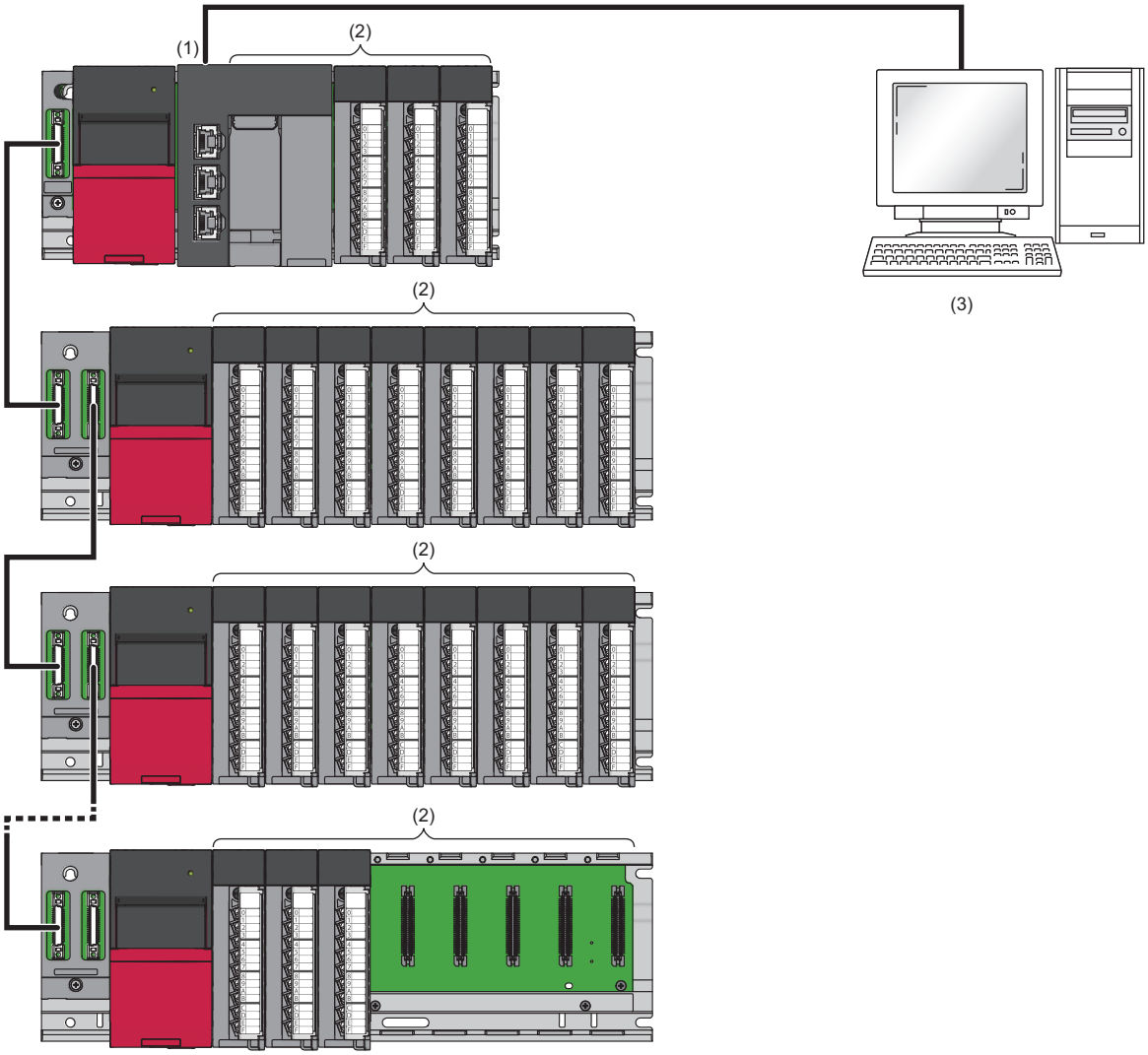
■Modules that can be updated

Modules that can be updated		
Product	**Model**	**Firmware version**
MELSEC MX Controller	MXR500-256, MXR500-128	"01" or later
	MXR300-64, MXR300-32, MXR300-16	
CC-Link IE Controller Network module	RJ71GP21-SX, RJ71GP21S-SX	"01" or later
CC-Link IE Field Network master/local module	RJ71GF11-T2	
Ethernet interface module with built-in CC-Link IE	RJ71EN71	
Serial communication module*2	RJ71C24, RJ71C24-R2, RJ71C24-R4	"01" or later
CC-Link IE TSN master/local module	RJ71GN11-T2*1	
	RJ71GN11-SX*1	
	RJ71GN11-EIP*4	
CC-Link system master/local module	RJ61BT11	
GP-IB interface module	RJ71GB91	
Analog-digital converter module	R60AD4, R60ADI8, R60ADV8	
Channel isolated analog-digital converter module (with signal conditioning function)	R60AD6-DG	
High speed analog-digital converter module	R60ADH4	
Digital-analog converter module	R60DA4, R60DAI8, R60DAV8	
High speed digital-analog converter module	R60DAH4	
Channel isolated RTD input module	R60RD8-G	
Channel isolated thermocouple input module	R60TD8-G	
Channel isolated pulse input module	RD60P8-G	
Flexible high-speed I/O control module	RD40PD01	
Positioning module*2	RD75P2, RD75P4, RD75D2, RD75D4	"06" or later*3

*1 The model with the main base unit can be updated.
*2 For the precautions of the modules used, refer to the User's Manual for each module.
*3 Modules whose 3rd and 4th digits from the left of the production information are "13" or earlier are excluded.
*4 Update the module while the configuration displayed in the "Update Firmware" window has been written to the update writing controller.

System configuration

The following figure shows a configuration example of the system.

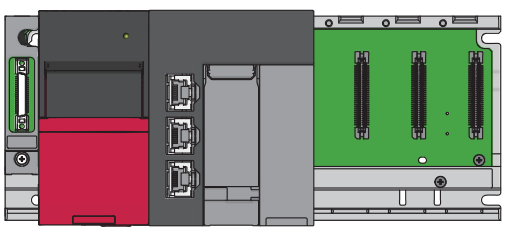


(1) Update writing controller
(2) Modules to be updated
(3) Engineering tool

- Mount the update writing controller on the CPU slot, and mount the modules to be updated on the slot of No.2 and later. (☞ Page 1651 Applicable models)
- The update of up to 62 modules is possible. The update of the update writing controller alone is also possible.
- Connect the engineering tool and update writing controller using a USB or Ethernet (Ethernet port direct connection/ connection via hub).

Ex.

System configuration to update the update writing controller alone



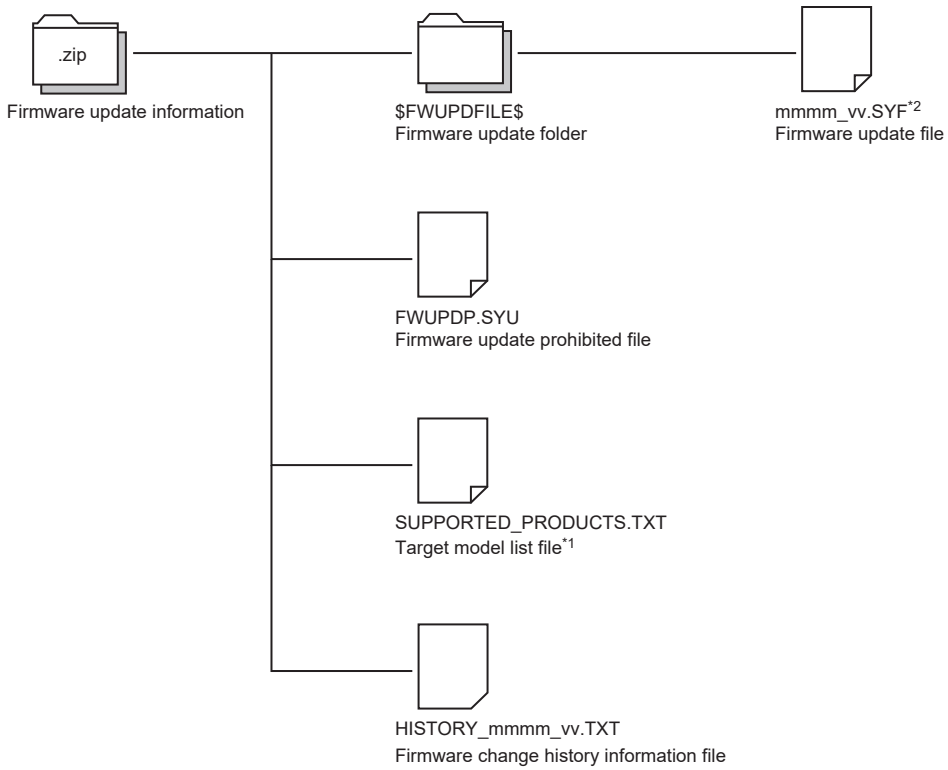
Update procedure

■Preparation

1. The firmware update information (.zip) for the model where the firmware update will be executed is stored in any folder on the personal computer. (For firmware update information, please contact your local Mitsubishi representative.)

- When the module to be updated is a controller: Decompressing the ZIP file is not required. (The motion control add-on is also included.)
- When the module to be updated is a MELSEC iQ-R series module: Decompressing the ZIP file is required. When decompressed, the folder structure is as follows.

Ex.



1 Update target models for the obtained firmware update information (.zip) are included.
*2 mmmm represents a model name and vv represents a firmware version.

2. Connect the engineering tool and update writing controller using a USB or Ethernet (Ethernet port direct connection/ connection via hub).

3. Check that the update writing controller and modules to be updated are stopped. (Power off the other systems and devices connecting the controller. If the systems or devices cannot be powered off, unplug the communication cable of them.)

4. Log on with user authentication as a user from the Administrators group. (Not required when user authentication is invalid or when logged on as a user from the Administrators group.)

5. Check whether the other functions of the controller are being executed.

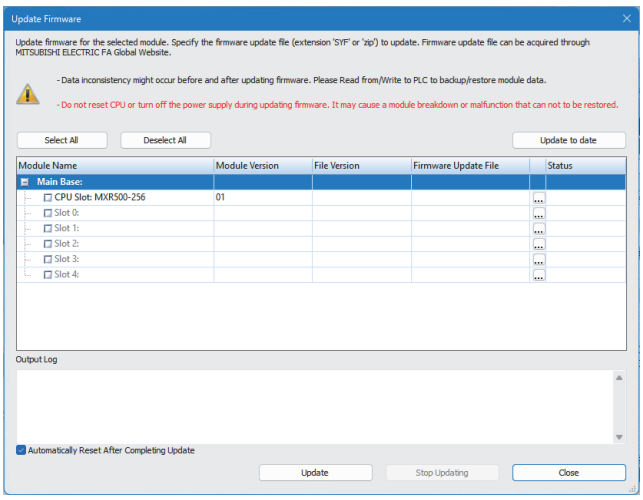
6. Check that the file operations (such as the write to programmable controller, online change, and file transfer function) are not executed on the modules to be updated and those not to be updated. (Starting the firmware update during file operations may result in corruption of the file.)

7. Clear the setting for firmware update prohibition if it has been set. (☞ Page 1657 Setting for firmware update prohibition)

8. Check that the stop error in the update writing controller or any error in the modules to be updated has not occurred.

9. Back up the data such as programs and parameters.

■Execution



1. Open the "Update Firmware" window from the engineering tool.

[Tool] ⇨ [Update Firmware]

2. Check the checkbox for the module to be updated. *1 Only the target module to be updated can be selected. (☞ Page 1651 Applicable models)
3. Click the [...] button for the module to be updated to select the firmware update file.

- When the update target module is a controller: *.SYF or *.zip*3
- When the module to be updated is a MELSEC iQ-R series module: *.SYF

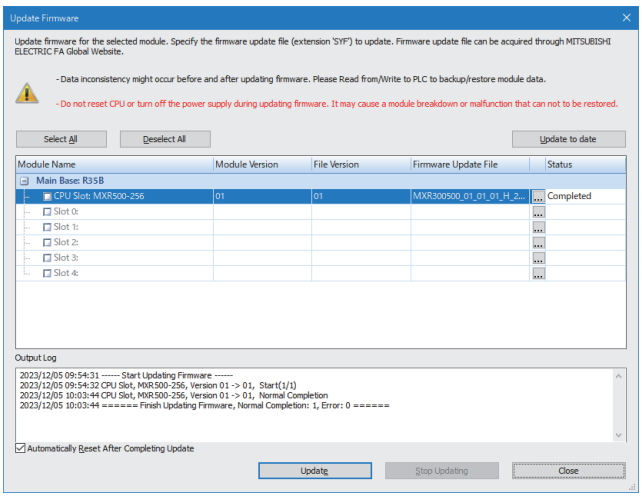
4. After the completion of firmware update, the controller is reset automatically. To avoid the automatic reset, deselect "Automatically Reset After Completing Update". *2
5. Clicking the [Update] button executes the update for all target modules to be updated regardless of whether the updates of the modules are completed successfully or with an error. (Modules will be reset while the update is being executed.)
6. During the update execution, the update status can be checked on the "Update Firmware" window in the engineering tool or by the LED indication on the update writing controller. (☞ Page 1655 Checking status and execution results with LEDs)

*1 If a module cannot be selected even though there is the firmware update information for it, update the engineering tool to the latest version and try again.

*2 To execute the remote RESET function, use the remote operation function of the engineering tool. In addition, set "Remote Reset Setting" to "Enable" in the "CPU Parameter" in advance.

*3 When the firmware update file (.zip) is specified, an error may occur depending on the number and size of the add-on files in the ZIP file, and the already installed add-ons.

■After execution



1. After the update is completed, the automatic reset or the manual reset window is displayed. Click the [OK] button. When the manual reset is selected, reset the module manually.
2. Check the result of firmware update in the "Status" column in the "Update Firmware" window. The detailed information including add-on installation can be checked on the event history. (☞ Page 1655 Checking execution results in event history)
3. When an error occurs, check the error code displayed on the event history.
4. Restore programs and parameters that were backed up in the step of Preparation.
5. Check the system operation.

■Checking status and execution results with LEDs

The status and execution result of an update can be checked with the controller LEDs.

Status and execution result of update		READY LED	PROGRAM RUN LED	FUNCTION LED	ERROR LED	USER LED / CARD LED
Updating	Pending or installing add-ons	On (red)	On (green)	Off	Off	Off
	Preparing					
	Transferring data					
	Writing data	On (red)	On (green)	On (green)	Off	Off
Update completed (all modules)*1		On (green)	Flashing (green)	Flashing (green)	Off	Off
Update completed with an error (controller only)*2		Flashing (red)	Off	Off	Flashing (red)	Off

*1 An LED indication that appears when the "Automatically Reset After Completing Update" checkbox is not selected.

*2 An LED indication that appears at power-on after the update has been completed with an error. Refer to the following to restore the controller.

☞ How to restore the controller after update failure

■Checking execution results in event history

After an update has been executed, perform a reset or turn off and on the power supply to check the execution result in the event history.

The following table lists the event codes and the timing of event history logging.

Event type	Module status	Event code	Timing of event history logging	Remarks
Update successful	Completed successfully	20414H	Upon completion of data writing	—
Update failed	Completed with an error	20415H	At the occurrence of an error	—
Add-on installation completed	Pending	20440H	Upon completion of installation	—
Interrupted by engineering tool	Transferring or writing	20414H	Upon completion of data writing	—
		20415H	At the occurrence of an error	—
Interrupted due to power-off	Pending or preparing	—	—	—
	Transferring	20415H	At next power-on	Error code 4D49H
	Writing	20415H	At next power-on	Error code 4D49H
Interrupted by engineering tool or due to communication error	Transferring	20415H	At next power-on	—
	Writing	20414H	Upon completion of data writing	—
		20415H	At the occurrence of an error	—

Restriction

Event codes other than the above and Add-on installation (event code 20440H) are not recorded in the event history of the update writing controller during the execution of the update or after the update is completed until a reset is performed or the power supply is turned off and on.

Update interruption

When the update is interrupted, the operation differs depending on the interruption timing as follows.
The event code is stored in the event history. (☞ Page 1655 Checking execution results in event history)

■Interrupted by the engineering tool

The following table lists the operation when the [Stop Updating] button in the "Update Firmware" window is clicked while the update is being executed.

Interruption timing	Controller operation	Firmware version of the module to be updated		Reset operation
Pending (interruption unavailable during add-on installation)	Immediate interruption	First module	Not updated	Not reset
		Second module and following ones		Operation according to the setting of "Automatically Reset After Completing Update"
Preparing	Immediate interruption	First module	Not updated	Not reset
		Second module and following ones		Operation according to the setting of "Automatically Reset After Completing Update"
During transferring or writing data	Interrupted after writing to the module being executed is completed when an interruption occurs	First module	Updated	Operation according to the setting of "Automatically Reset After Completing Update"
		Second module and following ones		

Reset is required to update again. If the reset does not occur automatically, reset the module manually. Remote reset using the engineering tool is also possible. In that case, change the setting of "Remote Reset Setting" in the CPU parameter as the default setting is "Disable".

■Interrupted due to power-off

Operation when the update writing controller is reset or powered off while the update is being executed.

Interruption timing	Status at next power-on for modules to be updated
Pending*1	Operation with the firmware version before the update
Preparing	
Transferring data	
Writing data	Malfunctions (operates as an unknown module)

*1 If a power failure occurs during the installation of an add-on, the add-on after the interruption is not updated, and an Add-on load error (error code 2880H) may occur after the power is turned on again.

■Interrupted by the engineering tool finished or due to communication error

Operation when the engineering tool is shut down, when the personal computer running the engineering tool is shut down, or when a communication error occurs during the firmware update.

Interruption timing	Controller operation	Firmware version of the module to be updated	Reset operation
Pending*1	Pending from the engineering tool	Not updated	Not reset
Preparing			
Transferring data			
Writing data	Pending from the engineering tool after writing data	Updated	

*1 If an interruption due to a communication error occurs during the installation of an add-on, the interrupted add-on is not updated, and an Add-on load error (error code 2880H) may occur after the power is turned on again.

How to restore the controller after update failure

When the update using the engineering tool fails and the update writing controller does not start up, update the firmware of the update writing controller by using the SD memory card. (☞ Page 1660 How to restore the controller after update failure)

Setting for firmware update prohibition

Storing the firmware update prohibition file to the controller prohibits update. (The add-on stored in the firmware update information (.zip) cannot be installed.)
Even if updates are prohibited, a firmware update can be executed during the restoration process after an update failure. (Installations of add-ons cannot be executed.)

1. Write the firmware update prohibition file (FWUPDP.SYU) to the "$MELPRJ$" folder in the data memory of the controller by using the engineering tool. The firmware update prohibition file (FWUPDP.SYU) is included in the firmware update information that was obtained in the step of Preparation. (☞ Page 1653 Preparation)

[Online] ⇨ [User Data] ⇨ [Write]

2. Power off and on or reset the controller.

■How to clear the setting for firmware update prohibition

To execute the firmware update, clear the setting for firmware update prohibition using an engineering tool.

1. Delete the file password set to the firmware update prohibition file.

[Project] ⇨ [Security] ⇨ [File Password Setting]

2. Delete the firmware update prohibition file in the "$MELPRJ$" folder in the data memory of the controller.

[Online] ⇨ [User Data] ⇨ [Delete]

For details on the operation method, refer to the following.
GX Works3 Operating Manual

Precautions

Point

For the precautions of the modules used, refer to the User's Manual for each module.

■Precautions on firmware update files

- Check the target model and use the firmware update file that matches with the target model. (For firmware update files, please contact your local Mitsubishi representative.) The firmware update is not executed if the firmware update file does not match with the target model.
- Do not modify the firmware update file (file name and data).

■Precautions for executing the firmware update

- Before starting the firmware update, check that the module to be updated has started up normally.
- Check the following before executing the firmware update: The controller has stopped; the system to be updated has stopped; and the communication cables and wires of the other systems, which are connected with the system to be updated via networks, have been disconnected.
- Starting the firmware update during the file operations may result in corruption of the file. Before starting the firmware update, check that all file operations are finished.
- Check that the file operations (such as the write to programmable controller, online change, and file transfer function) are not executed on the modules to be updated and those not to be updated. Starting the firmware update during file operations may result in corruption of the file.
- When executing the firmware update for multiple modules, it takes some time until update completion. The firmware update for one module takes approximately 13 minutes at the maximum.
- If the power is shut off during the update of the controller, the controller may fail. In this case, the controller can be recovered by executing the update using an SD memory card.
- Do not execute another update while a firmware update is being executed. A firmware update function error (via engineering tool) (error code: 4D47H) will occur when the [Update] button is clicked.
- Do not execute the other functions while the firmware update is being executed. If another function is executed, either a firmware update function error (via engineering tool) (error code: 4D4EH) occurs or the function cannot be executed successfully.
- Check the system operation before and after the firmware update. If an error occurs in the system after the firmware update, return the version to the previous one. When returning the version to the previous one, please contact your local Mitsubishi representative.
- When performing the firmware update with the checkbox of "Automatically Reset After Completing Update" deselected in the engineering tool, reset the controller manually after the firmware update is executed. To use the remote RESET function, set "Remote Reset Setting" to "Enable" in the "CPU Parameter" in advance. When "Remote Reset Setting" is set to "Disable", the remote RESET cannot be performed. Therefore, the controller needs to be reset at the site where the programmable controller is installed.
- The update writing controller registers the event occurrence time using the clock in the controller. The time displayed on "Output Log" of the "Update Firmware" window uses the clock of the personal computer. Therefore, to match the time of the event history and "Output Log", the clock in the controller is required to be matched with the clock of the personal computer in advance.

- When the following operations are executed during the firmware update, the firmware update may be completed with an error, resulting in failure of the module. In addition, the module may not start up or the firmware update may not restart. Execute the firmware update using an engineering tool carefully.
  - Powering off or resetting the controller.
  - Changing the operating status using the remote operation from the engineering tool or the switch of the controller
  - Operating from an external device
  - Connecting/disconnecting the communication cable between the update writing controller and engineering tool
  - Connecting/disconnecting the module to be updated
  - Starting the firmware update from the engineering tool
  - Finishing the engineering tool
- Do not insert/remove the SD memory card during the firmware update. Doing so may destroy the SD memory card data. The SD CARD OFF button is not available during the firmware update. Do not press the button to remove the SD memory card.

■Precautions of when the firmware update is completed

After the update is executed, power off and on or reset the update writing controller. To execute the remote RESET, use the remote operation function of the engineering tool. If other function is executed without the reset or powering off and on of the controller, the operation of all modules and the display on the engineering tool are not guaranteed.

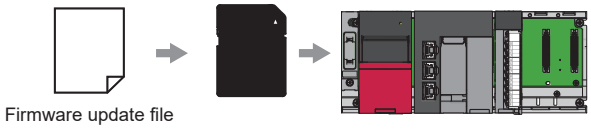
■Precautions of when the firmware update is suspended

During the firmware update, when the engineering tool is finished, when the personal computer running the engineering tool is shut down, or when a communication error occurs, the update is suspended. The reset using the automatic reset setting of the engineering tool is not executed. Therefore, check with the LED that the data is not being written, and reset the controller manually.

How to restore the controller after update failure

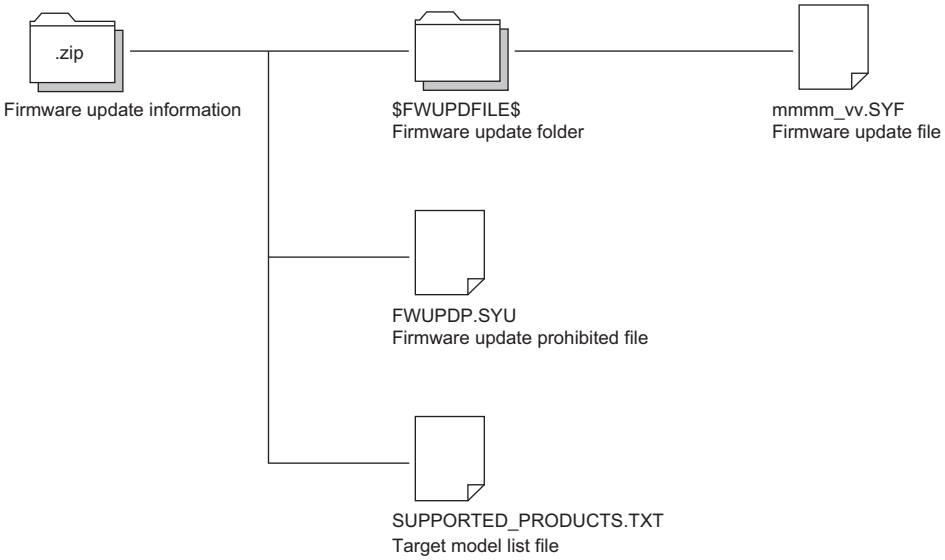
If a power shutoff occurs due to a reset or power-off or if a module is forcibly disconnected in the update writing controller or update target module during the execution of an update using the engineering tool, the update target module may malfunction (operates as an unknown module).

In that case, restore (update) it using an SD memory card. This procedure can only be performed when an update using the engineering tool fails. Even if an update is attempted using an SD memory card during normal operation, the operation to the controller is disabled.

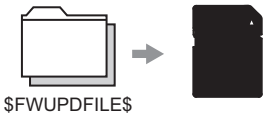


■Preparation

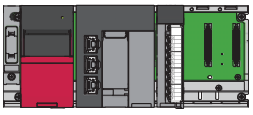
1. For the firmware update information for the model where the update will be executed, please contact your local Mitsubishi representative. The following figures show folder structures of the firmware update information. mmmm of the firmware update file represents a model name and vv of the firmware update file represents a firmware version.



2. Unzip the firmware update information (ZIP file).
3. Use a personal computer to save the "$FWUPDFILE$" folder in the root directory of an SD memory card. If the "$FWUPDFILE$" folder already exists in the SD memory card, delete the "$FWUPDFILE$" folder before saving the folder.



4. Mount the module on the base unit.



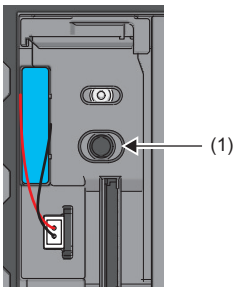
Restriction

Use a personal computer to save the "$FWUPDFILE$" folder in an SD memory card. The "$FWUPDFILE$" folder cannot be saved in an SD memory card using an engineering tool.

5. Before updating the firmware version, back up the data such as programs and parameters.

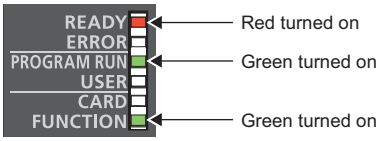
■Operation

1. Power off the controller and insert the SD memory card to it.
2. Reset or power on the controller while pressing the SD CARD OFF button (1). After pressing and holding the button for about 10 seconds, the flashing READY LED turns off and switches to a preparing-for-update LED indication.

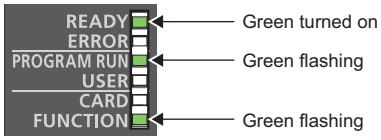


3. Release the SD CARD OFF button to start the update.

During the execution, the READY LED turns on in red, and the PROGRAM RUN LED and FUNCTION LED turn on in green.



4. When the update is completed successfully, the READY LED turns on in green, and the PROGRAM RUN LED and the FUNCTION LED flash in green. Any other LED indications mean the update is completed with an error. (☞ Page 1662 Checking status and execution results with LEDs)



5. After the update completion, power off the controller and remove the SD memory card. To execute the update again, return to the procedure of step 2 without removing the SD memory card.

■Checking the version after the update

1. Power on the controller and check that the firmware version has been updated. Although an error may occur at power-on, the error can be cleared by following the procedure of step 2 and later. (☞ Page 1662 Checking status and execution results with LEDs)
2. Initialize the controller whose firmware has been updated.

[Online] ⇨ [CPU Memory Operation]

3. Write the data backed up before the update to the controller, and power off and on the controller.

■Checking status and execution results with LEDs

The status and execution result of an update can be checked with the controller LEDs.

Status and execution result of update		READY LED	PROGRAM RUN LED	FUNCTION LED	ERROR LED	USER LED / CARD LED
Preparing for update		Off	Off	Off	Off	Off
Updating		On (red)	On (green)	On (green)	Off	Off
Completed successfully		On (green)	Flashing (green)	Flashing (green)	Off	Off
Completed with an error	FlashROM error	Off	Off	Off	Flashing (red)	Off
	Firmware update file error • Model mismatched • Invalid file • Combination invalid	On (red)	Off	Off	Flashing (red)	Off
	Firmware data error	Flashing (red)	Off	Off	Flashing (red)	Off

If the update is completed with an error even after the items above are checked, the possible cause is a hardware failure. Please contact your local Mitsubishi representative.

■Checking success in event history

The success can be checked with event code 20416H (Successful recovery of firmware via SD memory card).

■Precautions of when the firmware update is being executed

- Do not power off or reset the controller during the update execution. If the update is suspended, it automatically restarts by powering off and on or resetting the controller.
- Do not remove the SD memory card from the controller during the update execution. If the card is removed before the update completion, the update may fail.

■Precautions on the backup data writing

The free space in the program memory may become insufficient when data backed up is written to the controller. In this case, reduce the number of program steps and write the data again.

70.2 Add-on Function

This function expands the controller functions by installing the add-on software package to the controller.
For free add-ons from Mitsubishi Electric, please contact your local Mitsubishi representative.

Add-on type

The memory usage setting and the label (variable) operation are required according to the type of the add-on to be used.

Name	Add-on example
SQ	FFT instruction (sequence control instruction)
MT	Servo command direct control
GI	SECS/GEM (special predefined protocol), AI diagnostics

Memory specifications

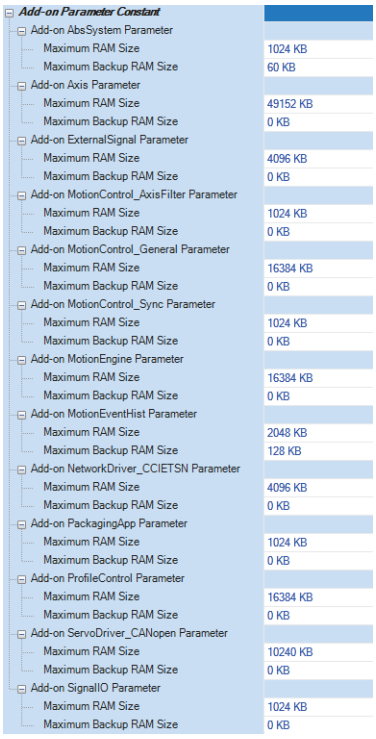
The following table lists the memory capacities of the controller where add-ons operate.

Item		Drive No.	Memory capacity	Application
System memory for add-ons (RAM)	SQ	—	64M bytes	Working area for sequence control add-ons
	MT		256M bytes	Working area for motion control add-ons
	GI		128M bytes	Working area for information processing add-ons
System memory for add-ons (backup RAM)	MT	Drive 6	• MXR500-☐: 512K bytes • MXR300-☐: 256K bytes	Latching area for motion control add-ons

Memory usage setting

For some add-ons, the maximum size of system memory for add-ons (RAM) and the maximum size of system memory for add-ons (backup RAM) can be changed for each add-on, in units of K bytes, by using the add-on parameters.
The total of the set maximum RAM size and the set maximum backup RAM size for each add-on must not exceed the size of the system memory (RAM) for add-ons and system memory (backup RAM) for add-ons.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Add-on Parameter]



Operating procedure

Operate an add-on by using the engineering tool.

[Tool] ⇨ [Add-on] ⇨ [CPU Module Add-on Management]

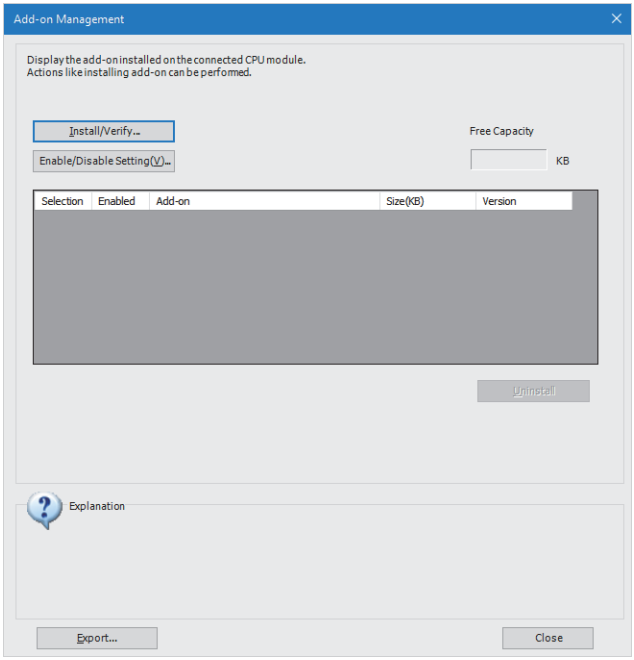
During a firmware update, an update file and add-on software packages can be installed at once. (☞ Page 1653 Update procedure)

Point

- To prevent unauthorized operation by an outsider, it is recommended to enable the user authentication function. Users are required to be authorized as Administrators when enabling the user authentication function.
- The installation/uninstallation and the enabling/disabling operations become effective by resetting or powering off and on the controller.

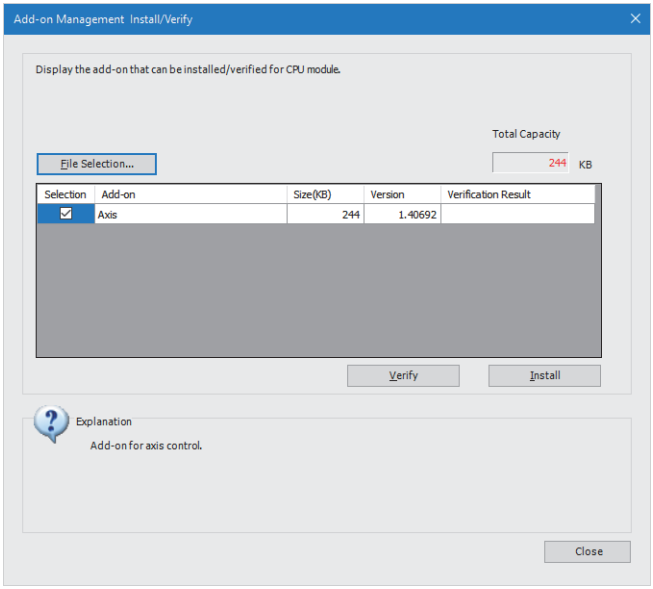
Installation

1. In the "Add-on Management" window, click the [Install/Verify] button.



2. Click the [File Selection] button to select a file to be installed.

3. After selecting the file, click the [Install] button.

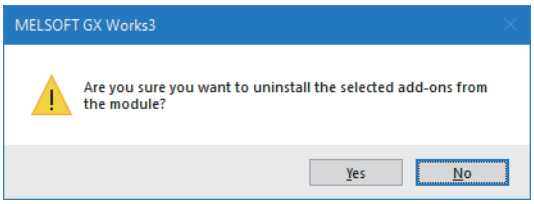


Point

The maximum number of add-ons that can be installed is 64. However, if the total size of the add-ons is 64M bytes or more, all of the add-ons cannot be installed.

Uninstallation

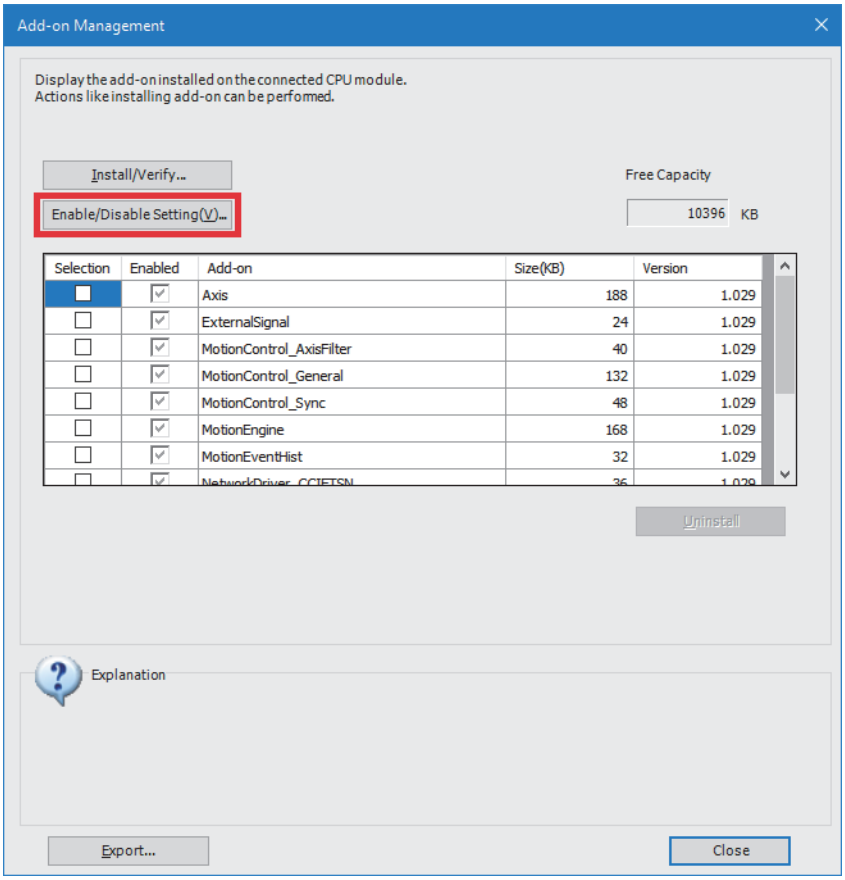
1. In the "Add-on Management" window, select a file to be uninstalled and click the [Uninstall] button.



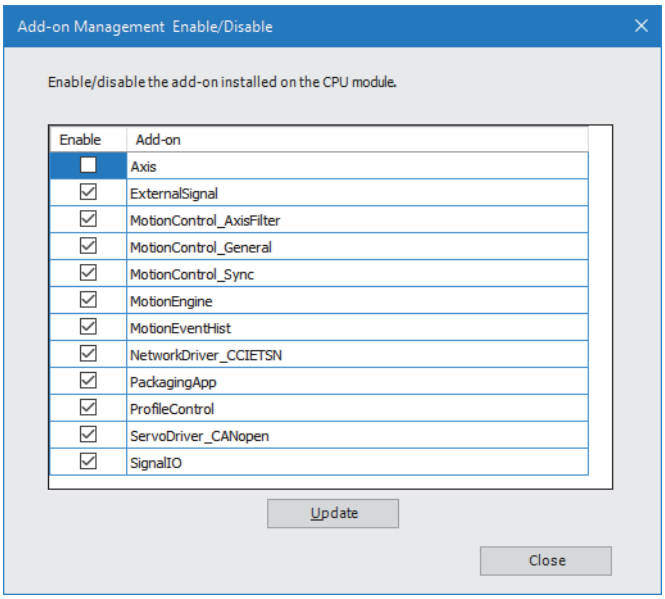
Enabling/Disabling

Functions that are not used frequently, such as functions used for starting up the system and the debug functions used only when an error occurs, can be disabled, and enabled when needed. However, unlike uninstallation, disabling functions does not reduce the occupied areas of the system drive.

1. In the "Add-on Management" window, click the [Enable/Disable Setting] button.



2. Select a file to be enabled or disabled and click the [Update] button.



Point

Enabled add-ons are loaded when the controller is initialized.
If the add-ons loading fails due to any of the following causes, an error occurs in the controller and the controller does not enter the RUN state.

- The add-on software package is broken.
- An unsupported add-on was loaded.
- The add-on on which the controller has dependencies (necessary add-on) has not been installed or enabled.
- An add-on that cannot be used with another add-on (exclusive add-on) has been installed or not been disabled.
- The versions between add-ons are inconsistent.
- The versions between add-ons and the operating system are inconsistent.
- An add-on of a node that does not exist in the setting was loaded.
- The add-on system memory size for a node of the loading destination is insufficient.

Safe mode

If an add-on parameter cannot be tolerated by the add-on (for example, if the maximum RAM size will be excessively reduced) or the add-on processing itself has a problem, the controller may not work properly and may be unable to connect with the engineering tool.
If connection is not possible, the parameter that caused the problem cannot be changed, and the concerned add-on cannot be uninstalled (nor disabled), preventing recovery.
This mode is intended for recovery from such a state by starting the controller without loading any add-ons.

Operating procedure

Use an SD memory card that contains a file with a certain name (add-on safe mode file) in the root path.

1. Store the SafeMode or SafeModeWithDelete file in the root path of the SD memory card and insert the card into the controller.
2. Power off the controller.
3. While pressing and holding the SD memory card forced disable button, power on the controller.

Check method

Use SM2392 (Addon Safe mode in progress) to check whether safe mode is active.

Precautions

When any function whose priority is higher than safe mode has satisfied the start condition at the same time, the controller will not proceed to safe mode.

Label list

The following table lists common labels (variables) provided with the add-on function.

Name[*1]		Description
AddonSystem.PrConst.Type_△☐_△_System.PrConst.AddonMemory	RamSizeMax	Specifies the size of system memory for add-ons (RAM) (in units of K bytes).[*2]
	BackupRamSizeMax	Specifies the size of system memory for add-ons (backup RAM) (in units of K bytes).[*2]
AddonSystem.Md.Type_△☐_△_System.Md.AddonMemory	RamUsage[*3]	Currently-used amount of system memory for add-ons (RAM) (in units of K bytes)
	RamMaxUsage[*3]	Maximum amount of system memory for add-ons (RAM) used (in units of K bytes)
	BackupRamUsage[*3]	Currently-used amount of system memory for add-ons (backup RAM) (in units of K bytes)
	BackupRamMaxUsage[*3]	Maximum amount of system memory for add-ons (backup RAM) used (in units of K bytes)
	AddonID	Add-on ID[*4]
	Version	Add-on version information (character string)[*5]
AddonSystem.Md.All_Type_MemoryUsage	RamUsage	Total of currently-used amount of system memory for add-ons (RAM) (in units of K bytes)
	RamMaxUsage	Total of maximum amount of system memory for add-ons (RAM) used (in units of K bytes)
	BackupRamUsage	Total of currently-used amount of system memory for add-ons (backup RAM) (in units of K bytes)
	BackupRamMaxUsage	Total of maximum amount of system memory for add-ons (backup RAM) used (in units of K bytes)

*1 Add-on type information (SQ, MT, GI) is to be entered in ☐ and an add-on name is to be entered in △. Their maximum number of characters are 60 including the termination character.

*2 A value exceeding each memory size cannot be set.

*3 When each add-on is loaded, the size set for each add-on will be reserved. As a result, the size may exceed the label values of RamSizeMax and BackupRamSizeMax.

*4 The value may change at each start-up of the controller because it is assigned at the start-up timing.

*5 It contains up to 24 characters including the termination character.

Precautions

- The add-ons are not initialized (deleted) even if 'all information initialization of controller' is executed.
- The initialization time of the controller (time required from reset or power-on to RUN) may vary depending on the size of enabled add-ons.
- After installing/uninstalling an add-on or enabling/disabling an add-on, check whether the operation was executed as intended by the add-on verification.
- Do not change the file name of the add-on software package.
- If the add-ons loading fails due to any of the following causes, an error occurs in the controller and the controller does not enter the RUN state.
    - The add-on software package is broken.
    - An unsupported add-on was loaded.
    - The add-on on which the controller has dependencies (necessary add-on) has not been installed or enabled.
    - An add-on that cannot be used with another add-on (exclusive add-on) has been installed or not been disabled.
    - The versions between add-ons are inconsistent.
    - The versions between add-ons and the operating system are inconsistent.
    - An add-on of a node that does not exist in the setting was loaded.
    - The add-on system memory size for a node of the loading destination is insufficient.

PART 17 TROUBLESHOOTING

This part consists of the following chapters.

71 TROUBLESHOOTING FUNCTION LIST

72 TROUBLESHOOTING PROCEDURE

73 TROUBLESHOOTING BY SYMPTOM

74 RAS FUNCTIONS RELATED TO TROUBLESHOOTING

75 ERROR CODES

76 EVENT LIST

77 RESPONSE CODE (SDO ABORT CODE)

78 FTP SERVER FUNCTION REPLY LIST

71 TROUBLESHOOTING FUNCTION LIST

The following table lists RAS functions related to troubleshooting.

Function		Description	Reference
Programmable controller RAS function	Self-diagnostic function	Checks if a problem exists in the controller.	Page 1745 Self-diagnostic function
	Event history function	Collects operations executed and errors occurred from the modules, and saves them in the controller. The saved logs can be checked in chronological order.	Page 1754 Event history function
	Scan monitoring function	Detects a hardware failure or program error by monitoring that the END processing is performed within the set scan time.	Page 1743 Scan monitoring function
	Error clear	Batch-clears all the continuation errors occurring.	Page 1751 Error clear
CC-Link IE TSN RAS function	CC-Link IE TSN/CC-Link IE Field diagnostics	Monitors the status of CC-Link IE TSN. The diagnostic items such as the network map, stations where data link is not operated, selected station communication status monitor are displayed on the engineering tool.	Page 1697 CC-Link IE TSN/CC-Link IE Field diagnostics
	Device station disconnection	Stops data link of the device station where an error occurred, and continues data link only for device stations that are operating normally.	Page 1767 Device station disconnection
	Automatic return	Restarts the data link automatically when the device station that was disconnected due to an error becomes normal again.	Page 1767 Automatic return
	Master station duplication detection	Detects duplication when one network has multiple master stations.	Page 1767 Master station duplication detection
	IP address duplication detection	Detects duplication when one network has stations with the same IP address.	Page 1768 IP address duplication detection
	Time synchronization	Synchronizes the time of device stations with the time synchronization source (controller of the master station).	Page 1257 Time Synchronization
	Module communication test	Checks whether no error occurs in the hardware of the module when the communication operation is unstable.	Page 1769 Module communication test
	LED display of data link faulty station	Sets display/hide of data link faulty stations during all station error detection.	Page 1770 LED display of data link faulty station
Ethernet RAS function	Ethernet diagnostics	Monitors communication status on the Ethernet-equipped module and external device.	Page 1707 Ethernet diagnostics
	Timer settings for data communication	Sets the timer used for data communication.	Page 1771 Timer settings for data communication
	Ethernet communication load monitor function	Visualizes the load status of Ethernet communication processing.	Page 1775 Ethernet communication load monitor function
	IP address duplication detection	Detects duplication when one network has stations with the same IP address.	Page 1775 IP address duplication detection

MEMO

72 TROUBLESHOOTING PROCEDURE

This chapter describes errors that may occur during system operation, error causes, and actions to be taken.
For the troubleshooting specific to each module, refer to the manual for the module used.

1. Check the LED status of the power supply module. For details, refer to the following.
📖MELSEC iQ-R Module Configuration Manual
2. Check the LED status of the controller. (☞ Page 50 CONTROLLER, ☞ Page 1674 Troubleshooting with LED Indicators)
3. Check the LED status of the module. (📖 User's manual for the module used)
4. Check the status of the module using the system monitor with an engineering tool. (☞ Page 1680 Checking the Module Status)
5. Check the network status by executing the CC-Link IE TSN diagnosis or communication test using an engineering tool. (☞ Page 1697 Checking the Network Status)
6. If the error cause cannot be identified in steps 1 to 5, perform troubleshooting by symptom. (☞ Page 1717 TROUBLESHOOTING BY SYMPTOM)

72.1 Troubleshooting with LED Indicators

This section describes troubleshooting with the LEDs of the controller.

When the READY LED or PROGRAM RUN LED turns off

When the READY LED or PROGRAM RUN LED turns off, check the following items.

Check item	Action
Is the controller mounted on the main base unit properly?	Re-mount the controller.
Check if the READY LED or PROGRAM RUN LED turns on when the power supply module is replaced and the power is restored to the system. (Check the LED status after the power supply module on the extension base unit is also replaced.)	If the READY LED or PROGRAM RUN LED turns on, an error has occurred in the power supply module before the replacement. Replace the power supply module.
Check if the READY LED or PROGRAM RUN LED does not turn on even after the power supply module is replaced and the power is restored to the system. (Check the LED status after the power supply module on the extension base unit is also replaced.)	If the READY LED or PROGRAM RUN LED does not turn on, an error has occurred in a module other than the power supply module. Repeatedly supply power to the system, returning the modules back to the system one by one. The last module mounted immediately before the READY LED or PROGRAM RUN LED turned off has failed. Replace the module.
Restart the system in safe mode.	• Disable or uninstall add-ons. • Check for problems in the add-on parameter settings.

For the CC-Link IE TSN function, if the problem cannot be solved by taking the above actions, perform a module communication test and check for any errors. (☞ Page 1769 Module communication test)
If the READY LED of the controller does not turn on even after the items above are checked and the actions are taken, the possible cause is a hardware failure. Please contact your local Mitsubishi representative.

When the ERROR LED turns on or is flashing

When the ERROR LED turns on or is flashing, check the following.

Check item	Action
Does any error occur in the module diagnostics?	Take the actions displayed on the window.
Is Network synchronous communication function transmission skip occurrence (error code 1860H) or Network synchronous communication function processing error (error code 2600H) registered in the module diagnostics?	Take corrective actions according to the error code.
Restart the system in safe mode.	• Disable or uninstall add-ons. • Check for problems in the add-on parameter settings.

When the D LINK LED turns off or is flashing

When the D LINK LED turns off or is flashing, check the following.

Check item	Action
Is the master station operating normally?	• If an error has occurred in the controller on the master station, eliminate the cause of the controller error. • If an error occurs in the master station, take action according to the module diagnosis procedure. (☞ Page 1680 Checking the Module Status)
Is the master station connected to the network?	Connect the master station to the network.
Does the IP address of each station match the "Network Configuration Settings" under "Basic Settings" of the master station?	Correct the setting of the IP address in "Network Configuration Settings" under "Basic Settings" of the master station. • Set IP addresses so that their third and fourth octets are unique for all stations. • Set the IP address and subnet mask to match the network addresses of all stations. • Set the third and fourth octets of the IP address to values other than all 0 or all 1. • Set the host address of the IP address to values other than all 0 or all 1. • Set an IP address other than a reserved address.
In the "Network Configuration Settings" under "Basic Settings", are the third and fourth octets of the IP address of the master station overlapped with those of any other stations?	
In the "Network Configuration Settings" under "Basic Settings", does the network address (subnet mask part) of the IP address of the master station match that of other stations?	
Are the third and fourth octets of the IP address set to all 0 or all 1?	
Is the host address of the IP address set to all 0 or all 1?	
Is a reserved address set to the IP address?	
Do the used Ethernet cables conform to the standard?	Replace the cables with Ethernet cables which conform to the standard. (☞ Page 62 Ethernet cable)
Is the industrial switch used operating normally?	• Use an industrial switch that conforms to the standard. (☞ Page 63 Industrial switch) • Power the industrial switch off and on.
Is the station-to-station distance 100m or less?	Set the station-to-station distance within 100m.
Does the cabling condition (bending radius) meet the specifications?	Refer to the manual for the Ethernet cable, and correct the bending radius.
Is any Ethernet cable disconnected?	Replace the Ethernet cable.
Is the connection different from the one set for "Network Topology" under "Basic Settings" of the master station?	Correct the wiring according to "Network Topology" under "Basic Settings" of the master station. (☞ Page 142 CC-Link IE TSN SYSTEM CONFIGURATION)
Has the time synchronization source station been reset?	• Since a station is temporarily disconnected after switching the time synchronization source, wait for it to return. • Avoid unnecessary disconnections or returns in a station that is the time synchronization source.
Is the time synchronization source station turned off?	
Is the time synchronization source station operating normally?	Check the manual of the module used for the time synchronization source station.
Has any other station been reset?	• Avoid unnecessary reset, since a station is disconnected while resetting. • Start other stations.
Are other stations turned off?	Power on other stations.
Are other connected stations operating normally?	• Check if the modules on the other stations are performing data link using the CC-Link IE TSN diagnostics. (☞ Page 1697 Checking the Network Status) • Check the operation status of modules on other stations. (📖 User's manual for the module used)
Is there any other station that has no IP address?	Set an IP address for the device station if applicable.
Is there any other station that is not set in "Network Configuration Settings" under "Basic Settings" of the master station?	Set the connected device station to "Network Configuration Settings" under "Basic Settings" of the master station.
Is a network topology with restrictions used for connection?	Correct the wiring. (☞ Page 142 CC-Link IE TSN SYSTEM CONFIGURATION)
Are station numbers unique?	Change the overlapped station number.
Is the IP address overlapped with another station?	Change the IP address of the overlapped station.
Are 254 or more device stations (257 modules or more) connected?	Change the connection of the device stations to 253 stations (256 modules) or less.

Check item	Action
If a CC-Link IE TSN device and an Ethernet compatible device coexist, are they connected correctly?	Correct the mixed structure of the CC-Link IE TSN device and the Ethernet compatible device. (☞ Page 142 CC-Link IE TSN SYSTEM CONFIGURATION)
Is the IP address of the device station blocked by the IP filter setting of the master station?	Correct the "IP Filter Settings" under "Application Settings".
Is the IP address of the master station blocked by the IP filter setting of the device station?	
Are time synchronization devices with time synchronization priority of 0 to 15 connected?	Remove time synchronization devices with time synchronization priority of 0 to 15, or change the priority setting to between 16 and 255. (📖 Manual for the time synchronization devices used)
Is the connected industrial switch (CC-Link IE TSN Class B certified) operating normally?	Power the industrial switch (CC-Link IE TSN Class B certified) off and on.
	Set the parameters of the industrial switch (CC-Link IE TSN Class B certified) as follows. • Enable each port of the industrial switch (CC-Link IE TSN Class B certified). • Set the communication speed and port type to Auto. • Check the time synchronization method of the master station. Match the settings of the time synchronization of the industrial switch (CC-Link IE TSN Class B certified) to those of the master station. • Match the settings of the time synchronization and communication cycle of the industrial switch (CC-Link IE TSN Class B certified) to those of the master station. • Match the VLAN setting of the master station to the VLAN setting of the device station. For the setting method, refer to the manual of the industrial switch (CC-Link IE TSN Class B certified) to be used.
Is the default open port used for communication closed?	Check "CC-Link IE TSN" in "Setting to Use or Not to Use Default Open Port" of "Security" under "Module Parameter (Common Setting)" and set the port to "Open" if necessary.
Are the usage purpose and the default open port used for communication appropriate?	Select an appropriate default open port according to the usage such as MELSOFT communication or SLMP communication. (☞ Page 1585 Default Open Port Usage Setting Function)
Is an error code registered in 'Buffer memory address' (Un\G3989847)?	If an error code is registered, take corrective actions according to the error code.
Is the network in the ring topology configured correctly?	Correct the wiring, such as loop wiring, to be proper ring topology.

When the L ER LED turns on

When the L ER LED turns on, check the following.

Check item	Action
Are the Ethernet cables used normally?	• Use an Ethernet cable that conforms to the standard. (☞ Page 62 Ethernet cable) • Set the station-to-station distance within 100m. • If the Ethernet cable is disconnected, reconnect it.
Is the industrial switch used operating normally?	• Use an industrial switch that conforms to the standard. (☞ Page 63 Industrial switch) • Power the industrial switch off and on.
Is there any source of noise near the module or cables?	Change the location of the module or cables.

When the LINK LED turns off

When the LINK LED turns off, check the following.

Check item	Action
Do the used Ethernet cables conform to the standard?	Use an Ethernet cable that conforms to the standard. (☞ Page 62 Ethernet cable)
Is the station-to-station distance 100m or less?	Set the station-to-station distance within 100m.
Does the cabling condition (bending radius) meet the specifications?	Refer to the manual for the Ethernet cable, and correct the bending radius.
Is any Ethernet cable disconnected?	Replace the Ethernet cable.
Is the industrial switch used operating normally?	• Use an industrial switch that conforms to the standard. (☞ Page 63 Industrial switch) • Power the industrial switch off and on.
Are other connected stations operating normally?	Check the manual of the module used for the other stations and take action accordingly. (📖 User's manual for the module used)
Does the communication speed of the connected device match the communication speed set in "Communication Speed" of the controller?	Connect the device with the communication speed set in "Communication Speed" in "Application Settings" of the master station.
If "Communication Speed" is set to 100Mbps for the controller to connect a device with a communication speed of 100Mbps, is the auto-negotiation of the device valid?	Enable the auto-negotiation of the connected device. Or, connect a device with auto-negotiation enabled.

If the problem cannot be solved by taking the above actions, perform a module communication test and check for any errors. (☞ Page 1769 Module communication test)

When the dot matrix LED is alternately repeating the station number display and ERR display

When the dot matrix LED alternately repeats the station number display and ERR display, check the following items.

Check item	Action
Is a disconnected station displayed in the CC-Link IE TSN diagnostics?	• Configure the network configuration settings and communication period setting according to the station actually connected. • Execute the following at the disconnected station. ☞ Page 1676 When the D LINK LED turns off or is flashing
Is event code 00C71H registered in the event history of the master station? (A mismatch of the synchronization setting may occur between the master station and device stations.)	Take the following actions for the device station with the IP address displayed in the detailed information of the event history. • Replace the device with a device supporting CC-Link IE TSN Class B network synchronous communication. • Match "Network Synchronous Communication" in "Network Configuration Settings" under "Basic Settings" of the master station to the synchronization setting of the device station.
Is event code 00C81H registered in the event history of the master station?	For the device station with the IP address displayed in the detailed information of the event history, match the CC-Link IE TSN Class of the device station to "CC-Link IE TSN Class Setting" in "Network Configuration Settings" of "Basic Settings" of the master station.
Is event code 00C72H registered in the event history of the master station?	• Update the engineering tool to the latest version. • Update the device station with the IP address displayed in the event history detailed information to the latest firmware version.
Is event code 00C80H registered in the event history of the master station when "Mixture of CC-Link IE TSN Class B/A" or "CC-Link IE TSN Class A Only" is set in the connection device information of the master station?	Take one of the following actions. • Check the CC-Link IE TSN protocol version 2.0 compatibility status (SW01A0-SW01AF) of each station, and update all device stations to the version compatible with CC-Link IE TSN Protocol version 2.0. Alternatively, replace the device stations with the stations that support protocol version 2.0. Set 'Protocol setting' (Un\G1326786) of the master station to the CC-Link IE TSN protocol version 1.0 fixed. After powering on the device stations and the devices on the communication path, power on the master station.
Is an error code registered in 'Buffer memory address' (Un\G3989847)?	If an error code is registered, take corrective actions according to the error code.
Is the network in the ring topology configured correctly?	Correct the wiring, such as loop wiring, to be proper ring topology.

If the problem cannot be solved by taking the above actions, perform a module communication test and check for any errors. (☞ Page 1769 Module communication test)

When S-ERR is displayed on the dot matrix LED

When S-ERR is displayed on the dot matrix LED, take measures to reduce noise, start the system in safe mode, or reset the controller to change its status to RUN.

If the dot matrix LED still displays S-ERR even after the items above are checked, the possible cause is an internal system error or hardware failure. Please contact your local Mitsubishi representative.

72.2 Checking the Module Status

Check the error or history using the engineering tool, and identify the error cause. More detailed information on the error as well as the error cause and action to be taken can be checked by using the engineering tool.
For details on each function of the engineering tool, refer to the following.
GX Works3 Operating Manual

System monitor

This function displays the module configuration, and detailed information and error status of each module.
For the error module identified, the module diagnostics function can be executed from this window.

[Diagnostics] ⇨ [System Monitor]

Module diagnostics

This function diagnoses the module. (The current error and its details can be checked.)
Information required for troubleshooting, such as the current error, details and cause of the error, and action to be taken, is displayed.
The incorrect parameter setting and program error location can also be identified by selecting the error and clicking the [Error Jump] button.
On the [Module Information] tab, the LED status and the switch status of the target module can be checked.

[Diagnostics] ⇨ [System Monitor] ⇨ Double-click the target module.

Module Information (Common)

The information of the controller is displayed in the [Module Information (Common)] tab.

Name	Name	Description
LED information	READY/ERROR	Indicates READY LED/ERROR LED status. • On/off: Normal operation • Off/on: Major error • Flashing/off: Executing all information initialization • Off/flashing: Major error • Flashing/flashing: Executing all information initialization • Slow flashing/off: Initial processing • On/flashing: Moderate error • Flashing/on: Executing all information initialization • On/on: Minor error
	PROGRAM RUN	Indicates the PROGRAM RUN LED status. • Off: Stopped (STOP state) or stop error • Flashing: Being suspended (PAUSE state) • On: Being executed (RUN state)
	USER	Indicates the USER LED status. • Off: - • On: Annunciator ON
	CARD	Indicates the CARD LED status. • Off: Card not inserted or can be removed • Flashing: Accessing the SD memory card • Slow flashing: SD memory card ready • On: SD memory card available
	FUNCTION	Indicates the FUNCTION LED status. • Off: - • Flashing: Debug function in use
Switch information	SD memory card access control switch	Indicates the status of the SD memory card access control switch. • Off: - • On: Stop instruction
	RUN/STOP/RESET switch	Indicates the status of the RUN/STOP/RESET switch. • RUN: RUN state • STOP: STOP state
Option mounting information	Memory card insertion status (option mounting information)	Indicates whether the SD memory card is inserted. • Inserted • Not inserted
Built-in motion function part information	Accessibility to labels for motion function	Indicates whether the label for the motion function can be accessed from the program. • Off: Inaccessible • On: Accessible

Module Information (P1, P2, P3)

The information of each port is displayed in the [Module Information (P1, P2, P3)] tab.

Name	Name	Description
LED information	STS GREEN[*2]	Indicates the STS LED status of each port. • Not used[*6]
	STS RED[*2]	
	D LINK[*2]	Indicates the D LINK LED status of each port. • Off: Disconnected • Flashing: Cyclic transmission stopped • On: Cyclic transmission being performed • Not used[*5]
	LINK	Indicates the LINK LED status of each port. • On: Link-up • Flashing: Data being sent or received • Off: Link-down • Not used[*3]
	L ER[*2]	Indicates the L ER LED status of each port. • On: Abnormal data received • Off: Normal data received
Soft LED information	RUN[*2]	Indicates the operating status of each port. • Off: During stop • On: During operation • Not used[*5]
	ERR[*2]	Indicates the error occurrence status of each port. • Off: Normal operation • On: Error or at error detection on all stations • Flashing: Error or a data link error station detected • Not used[*5]
	MST[*2]	Indicates the CC-Link IE TSN station type. • On: Operating as a master station • Not used[*5]
Port information	Network type	Indicates the network type. • Ethernet • CC-Link IE TSN • Not used[*5]
	Station type[*2]	Indicates the set station type. • Master station • Not used[*5]
	Network information setting status	Indicates the operating status of the network setting change function. • Operation according to the parameter settings • Operation according to the default value of the network setting change function • Operation according to the setting value of the network setting change function • Not used[*5]
	Network No.	Indicates the set network number. • 1 to 239 • Not used[*5]
	Station number	Indicates the set station number. • 0 • Not used[*5]
	Transient transmission group No.[*2]	Indicates the set transient transmission group number. • No group specification • Not used[*5]
	IP address	Indicates the set IP address for each octet. (In units of 8 bits)[*4]
	MAC address	Indicates the MAC address of the port for each octet. (In units of 8 bits)[*4]
	Communication speed setting	Indicates the set communication speed setting. • Automatic negotiation • 100Mbps[*1] • 1Gbps[*1] • Not connected

*1 These items are not displayed when the port setting (usage) is Ethernet (Port3).
*2 Indicates only P1 and P2.
*3 "Not used" is displayed when the port setting (usage) is Ethernet.
*4 If P1 and P2 are on the same network in CC-Link IE TSN, all 0 is displayed, indicating that the IP address and MAC address of P2 is the same as those of P1.
*5 "Not used" is displayed for P2 if P1 and P2 are on the same network in CC-Link IE TSN. In this case, the setting and operating status of P2 will be the same as those of P1.
*6 If P1 and P2 are on the same network in CC-Link IE TSN, P1 and P2 will be displayed.

■Troubleshooting when RUN for soft LED information is turned off

When RUN for soft LED information is turned off, check the following items.

Check item	Action
Does any error occur in the module diagnostics?	If an error occurs, follow the instructions to eliminate the cause of the error.

If RUN for soft LED information remains turned off despite checking the items above, refer to the following.

☞ Page 1674 When the READY LED or PROGRAM RUN LED turns off

■Troubleshooting when ERR for soft LED information is turned on or is flashing

When ERR for soft LED information is turned on or is flashing, check the following.

☞ Page 1679 When the dot matrix LED is alternately repeating the station number display and ERR display
☞ Page 1675 When the ERROR LED turns on or is flashing

Event history

This function displays the event information, such as errors occurred in the module(s) mounted, executed operations, and network errors.

Since information collected before the controller is powered off or reset can also be displayed, the error cause can be identified based on the past operations and errors.

The displayed information can also be saved in CSV file format.

[Diagnostics] ⇨ [System Monitor] ⇨ [Event History] button

Point

Use this function for the following purposes:

- To check the error status and identify the cause of error occurred in machinery or equipment
- To check when and how the program and parameters of the controller have been changed
- To check for unauthorized access

For details on this function and collected information, refer to the following.

☞ Page 1754 Event history function

72.3 Checking Status of Motion Function

Checking errors and warnings

Errors and warnings that occurred in the motion function can be checked by the following methods.

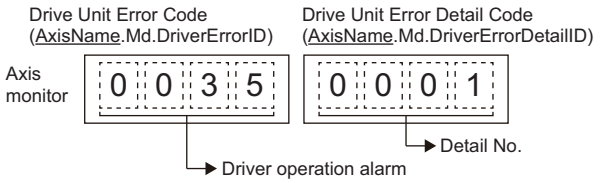
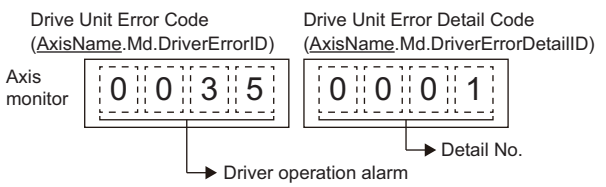
Method	Details
Event history of the engineering tool	The check can be performed in the event history window of the engineering tool. For details, refer to the following. GX Works3 Operating Manual
Module diagnostic of the engineering tool	The check can be performed in the module diagnostic window of the engineering tool. For details, refer to the following. GX Works3 Operating Manual
Monitor data (Label)	The detection flag of error/warning and the error code/warning code can be checked by the label of axis, axes group, and system. The controller can refer to these labels by the module label or the dedicated instruction.

Relevant variables

■System Monitor Data (MotionSystem.Md.)

Variable/structure name	Name	Details
Warning	Motion Area System Warning Detection	Becomes TRUE at warning occurrence.
Error	Motion Area System Error Detection	Becomes TRUE at error occurrence.
NetworkError	Network Area Error Detection	Becomes TRUE at network error occurrence.
WarningID	Latest Motion Area System Warning Code	Stores the latest warning code.
ErrorID	Latest Motion Area System Error Code	Stores the latest error code.
NetworkErrorID	Network Area Error Code	Stores the error code at network error occurrence.

■Axis monitor data (AxisName.Md.)

Variable/structure name	Name	Details
Warning	Axis Warning Detection	Becomes TRUE at axis warning occurrence.
Error	Axis Error Detection	Becomes TRUE at axis error occurrence.
DriverError	Drive Unit Error Detection	Becomes TRUE at drive unit error occurrence.
WarningID	Axis Warning Code	Stores the warning code at axis warning occurrence.
ErrorID	Axis Error Code	Stores the error code at axis error occurrence.
DriverErrorID	Drive Unit Error Code	Stores the upper 16 bits of the object data "Current alarm (2A41H)" at drive unit error occurrence. (Example) For the MR-J5(W)-G  • Stores [0035H] when servo alarm [AL.035.1_Command frequency error] occurs at drive unit.
DriverErrorDetailID	Drive Unit Error Detail Code	Stores the lower 16 bits of the object data "Current alarm (2A41H)" at drive unit error occurrence. (Example) For the MR-J5(W)-G  • Stores [0001H] when servo alarm [AL.035.1_Command frequency error] occurs at drive unit.

■Axes Group Monitor Data (AxesGroupName.Md.)

Variable/structure name	Name	Details
Warning	Axes Group Warning Detection	Becomes TRUE at axes group warning occurrence.
Error	Axes Group Error Detection	Becomes TRUE at axes group error occurrence.
WarningID	Axes Group Warning Code	Stores the warning code at axes group warning occurrence.
ErrorID	Axes Group Error Code	Stores the error code at axes group error occurrence.

■System Parameter Constant (MotionSystem.PrConst.)

Variable/structure name	Name	Details
ExcludeWarning	Excluded Warning	Sets the warning which is not to be detected. (Example) • "": Not set • "0x1000, 0x1001": The warnings of 0x1000 and 0x1001 are not detected. • "0x1000-0x1010": The warnings from 0x1000 to 0x1010 are not detected.

Control details

The latest error code occurred in motion is output in Latest Motion Area System Error Code (MotionSystem.Md.ErrorID). When multiple errors occur, follow the conditions below whether the error code output to Latest Motion Area System Error Code (MotionSystem.Md.ErrorID) is updated.

Occurring error	Occurred error					
Latest Motion Area System Error Code (MotionSystem.Md.ErrorID)	Axis Error Code (AxisName.Md.ErrorID) Axes Group Error Code (AxesGroupName.Md.ErrorID) Latest Motion Area System Error Code (MotionSystem.Md.ErrorID)			Network Area Error Code (System.Md.NetworkErrorID)		
	Minor error	Moderate error	Major error	Minor error	Moderate error	Major error
No error	Updating	Updating	Updating	Updating	Updating	Updating
Minor error	Updating	Updating	Updating	Not updating	Updating	Updating
Moderate error	Not updating	Updating	Updating	Not updating	Not updating	Updating
Major error	Not updating	Not updating	Updating	Not updating	Not updating	Not updating

■Excluded warning setting

- The specified warning can be ignored by setting Excluded Warning (MotionSystem.PrConst.ExcludeWarning).
- When the warning set to Excluded Warning (MotionSystem.PrConst.ExcludeWarning) has occurred, the relevant variables and various histories are not updated.
- Even if Excluded Warning (MotionSystem.PrConst.ExcludeWarning) is set, each checking process to detect warnings is not omitted, so that the processing time is not reduced.
- Even if the error code is set to Excluded Warning (MotionSystem.PrConst.ExcludeWarning), the error is not excluded.

Precautions

While the project data is being written to the controller, the label may become an undefined value. In such cases, the synchronization flag (X21) turns off, so do not refer to the label during that time. Check the error with the module diagnostics, special relay (SM0), or special register (SD0).

■Necessary objects

- PDO: CurrentAlarm (monitor of drive unit errors)
- SDO: None

■Relevant add-on

The following add-on is required to use this function.

- MotionControl_General

Error and warning reset

Errors and warnings that occurred in the motion function can be reset by the following methods.

Operation of this function for each system status

○: Available, △: Available (with restrictions), ×: Not available

System status	Operation availability
STOP	○
RUN	○
Moderate error	×
Major error	△ (only reset of axes or axes groups possible)

Data to be reset

■System Error Reset

• All errors/warnings

Error type	Description	Variable name
System	Motion Area System Error Detection	MotionSystem.Md.Error
	Latest Motion Area System Error Code	MotionSystem.Md.ErrorID
	Motion Area System Warning Detection	MotionSystem.Md.Warning
	Latest Motion Area System Warning Code	MotionSystem.Md.WarningID
	Network Area Error Detection	System.Md.NetworkError
	Network Area Error Code	System.Md.NetworkErrorID
Axis	Axis Warning Detection	AxisName.Md.Warning
	Axis Error Code	AxisName.Md.ErrorID
	Axis Error Detection	AxisName.Md.Error
	Axis Warning Code	AxisName.Md.WarningID
	Drive Unit Error Detection	AxisName.Md.DriverError
	Drive Unit Error Code	AxisName.Md.DriverErrorID
	Drive Unit Error Detail Code	AxisName.Md.DriverErrorDetailID
Axes group	Axes Group Warning Detection	AxesGroupName.Md.Warning
	Axes Group Warning Code	AxesGroupName.Md.WarningID
	Axes Group Error Detection	AxesGroupName.Md.Error
	Axes Group Error Code	AxesGroupName.Md.ErrorID

■Axis Error Reset

• Axis error/warning

Error type	Description	Variable name
Axis	Axis Warning Detection	AxisName.Md.Warning
	Axis Error Code	AxisName.Md.ErrorID
	Axis Error Detection	AxisName.Md.Error
	Axis Warning Code	AxisName.Md.WarningID
	Drive Unit Error Detection	AxisName.Md.DriverError
	Drive Unit Error Code	AxisName.Md.DriverErrorID
	Drive Unit Error Detail Code	AxisName.Md.DriverErrorDetailID

■Axes Group Error Reset

• Axes group error/warning

Error type	Description	Variable name
Axes group	Axes Group Warning Detection	AxesGroupName.Md.Warning
	Axes Group Warning Code	AxesGroupName.Md.WarningID
	Axes Group Error Detection	AxesGroupName.Md.Error
	Axes Group Error Code	AxesGroupName.Md.ErrorID
	Axis Warning Detection*1	AxisName.Md.Warning
	Axis Warning Code*1	AxisName.Md.WarningID
	Axis Error Detection*1	AxisName.Md.Error
	Axis Error Code*1	AxisName.Md.ErrorID
	Drive Unit Error Detection*1	AxisName.Md.DriverError
	Drive Unit Error Code*1	AxisName.Md.DriverErrorID
	Drive Unit Error Detail Code*1	AxisName.Md.DriverErrorDetailID

*1 Only axis which belongs to axes group

Relevant variables

■System Control Data (MotionSystem.Cd.)

Variable/structure name	Name	Details
ErrorReset	System Error Reset	Resets all errors and warnings.

■Axis Control Data (AxisName.Cd.)

Variable/structure name	Name	Details
ErrorReset	Axis Error Reset	Resets axis errors/warnings and drive unit errors.

■Axes Group Control Data (AxesGroupName.Cd.)

Variable/structure name	Name	Details
ErrorReset	Axes Group Error Reset	Resets axes group errors/warnings.

Relevant FBs

For details on motion control FBs, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Motion control FB	Name	Description
MCv_MotionErrorReset	Motion Error Reset	Resets all errors and warnings of the motion system.
MC_Reset	Axis Error Reset	Resets errors and warnings of the axis.
MC_GroupReset	Axes Group Error Reset	Resets errors and warnings of the axes group and each axis in the axes group.

System Error Reset

There are the following reset methods: System Error Reset (MotionSystem.Cd.ErrorReset), MCv_MotionErrorReset (Motion Error Reset), and reset by the error clear function.

Resetting errors/warnings by System Error Reset (MotionSystem.Cd.ErrorReset) and MCv_MotionErrorReset (Motion Error Reset) does not clear the special relay (SM0) or the special register (SD0), turn off the ERROR LED on modules, or reset errors in the system monitor and module diagnostics windows.

To clear the special relay (SM0) or the special register (SD0), turn off the ERROR LED on modules, or reset errors in the system monitor and module diagnostics windows, use the error clear function.

For the error clear function, refer to the following.

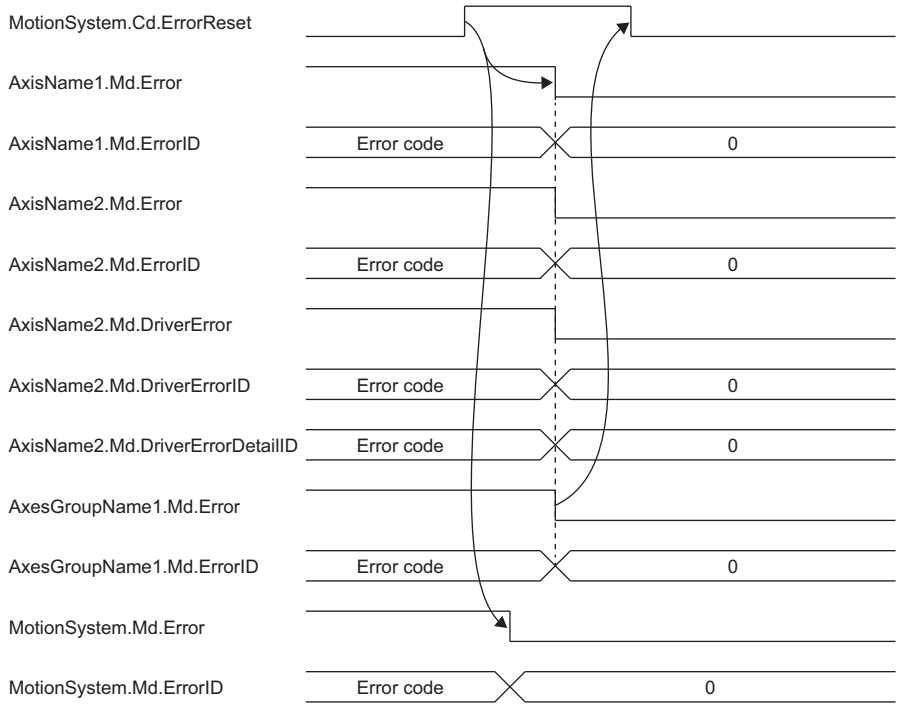
☞ Page 1751 Error clear

The System Error Reset (MotionSystem.Cd.ErrorReset) does not become TRUE when an error/warning is reset from the special relay or special register.

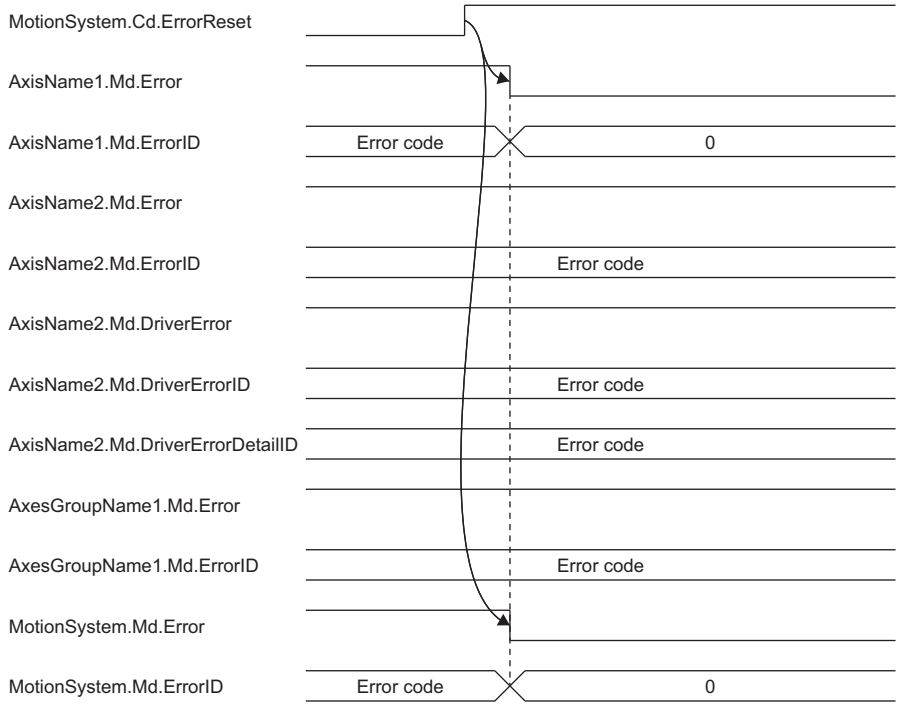
■System Error Reset (MotionSystem.Cd.ErrorReset)

- Reset is executed at the rising edge detection of System Error Reset (MotionSystem.Cd.ErrorReset).
- When the reset is completed, System Error Reset (MotionSystem.Cd.ErrorReset) becomes FALSE.
- If the error reset fails, System Error Reset (MotionSystem.Cd.ErrorReset) remains TRUE.
- The error reset is not executed if it is executed while an axis or an axes group is operating.

■When the operation is completed successfully (When the error reset succeeds)



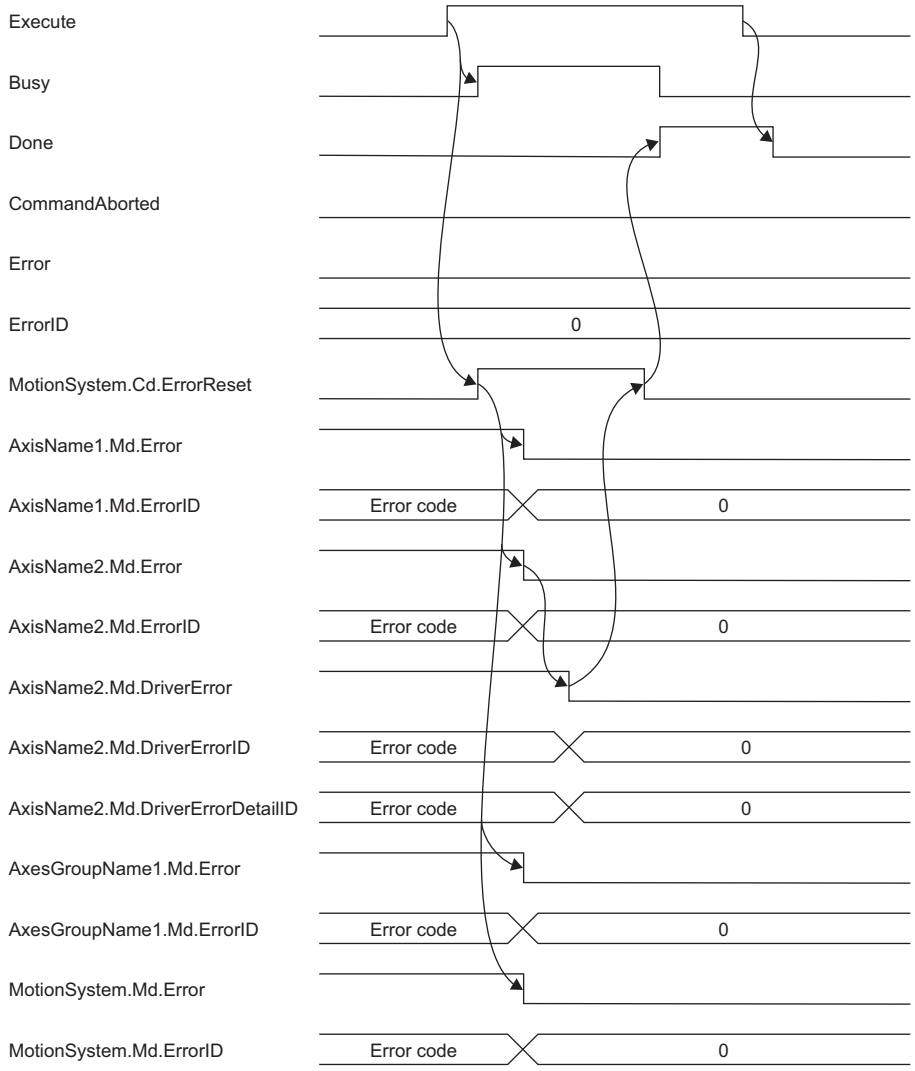
■When the operation is completed with an error (When the error reset fails)



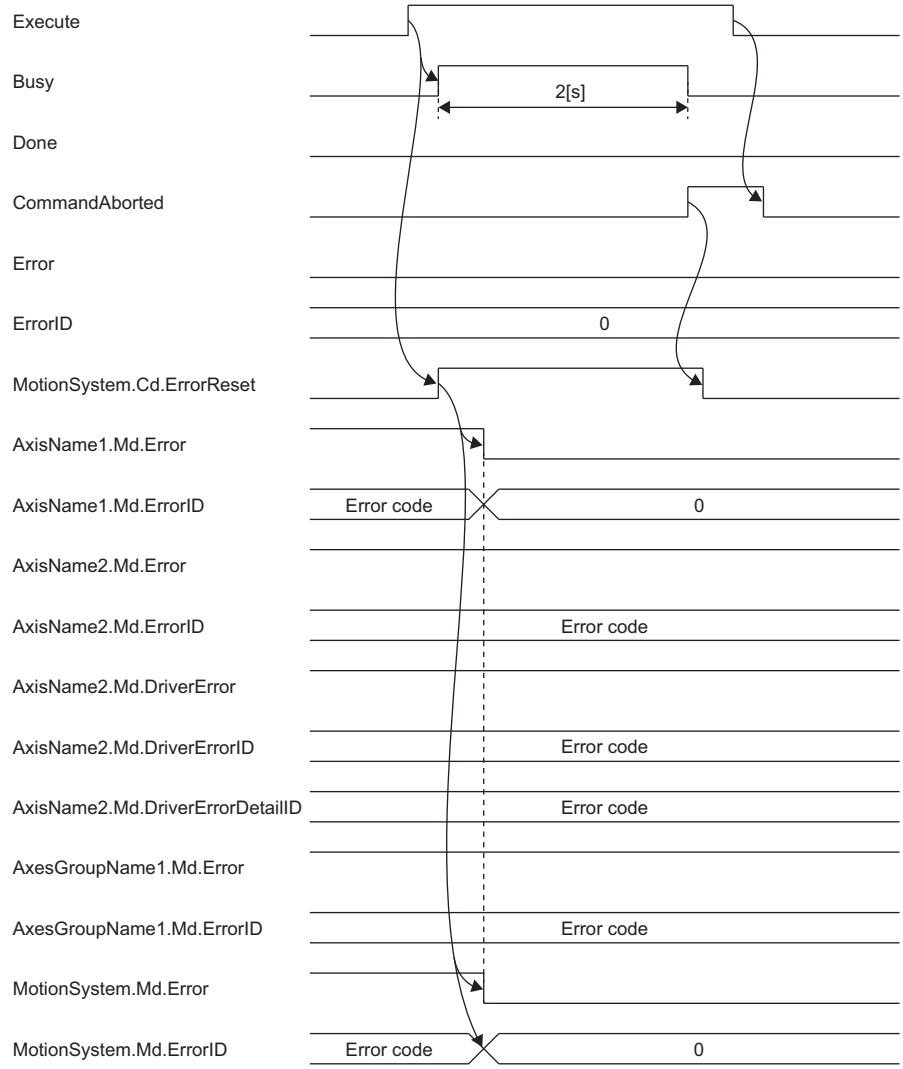
■MCv_MotionErrorReset (Motion Error Reset)

- The FB is executed with Execution command (Execute) = TRUE and Executing (Busy) becomes TRUE as the process starts, and then System Error Reset (MotionSystem.Cd.ErrorReset) is set to TRUE.
- Upon completion of clearing the errors/warnings of the motion function, Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE.
- The errors/warnings are not cleared if Execution command (Execute) becomes TRUE while the error/warning causes still remain. In this case, Abortion of execution (CommandAborted) becomes TRUE and System Error Reset (MotionSystem.Cd.ErrorReset) is set to FALSE if the errors are not cleared within 2 [s] after command is executed. Temporarily set Execution command (Execute) to FALSE, remove the causes of the errors/warnings, then set Execution command (Execute) to TRUE again.

■At normal completion



■At timeout



Precautions

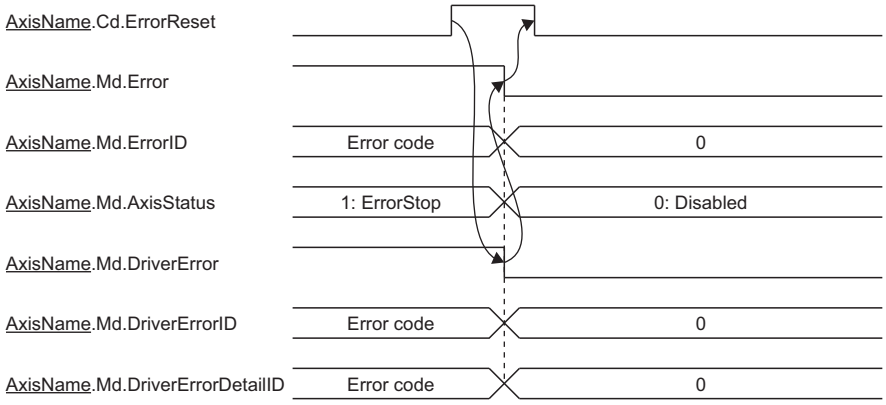
Do not directly operate System Error Reset (MotionSystem.Cd.ErrorReset) while MCv_MotionErrorReset (Motion Error Reset) is being executed.

Axis Error Reset

Reset the error/warning of a single axis and drive unit error by Axis Error Reset (AxisName.Cd.ErrorReset).

■Axis Error Reset (AxisName.Cd.ErrorReset)

- Reset is executed at the rising edge detection of Axis Error Reset (AxisName.Cd.ErrorReset).
- When the reset is completed, Axis Error Reset (AxisName.Cd.ErrorReset) becomes FALSE.
- The error reset is not executed if it is executed during axis operation. The error monitor is reset when the axis is stopped completely and Axis Error Reset (AxisName.Cd.ErrorReset) is TRUE.

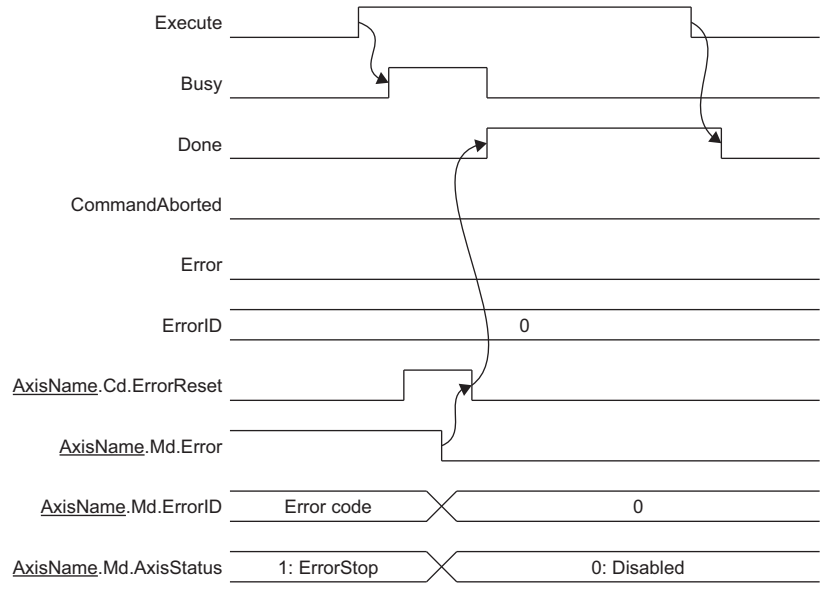


■MC_Reset (Axis Error Reset)

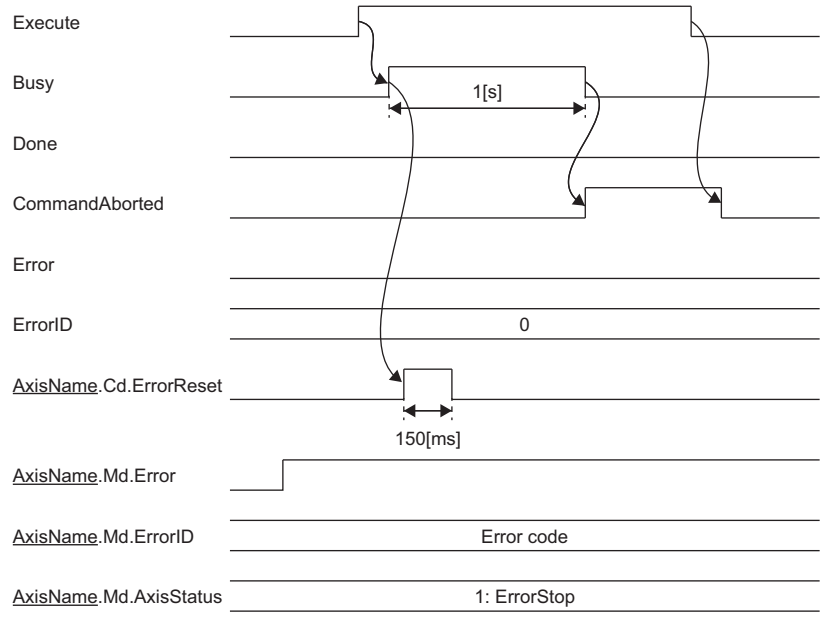
- The FB is executed with Execute command (Execute) = TRUE and Executing (Busy) becomes TRUE as the process starts, and then Axis Error Reset (AxisName.Cd.ErrorReset) of the target axis is set to TRUE.
- Upon completion of clearing the error/warning of the axis, Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE.
- If the execution is carried out when Axis Status (AxisName.Md.AxisStatus) is "1: Stopping on error (ErrorStop)", Executing (Busy) is set to FALSE and Execution completion (Done) becomes TRUE after the warning is cleared.
- The error/warning is not cleared even if Execution command (Execute) is set to TRUE while the axis error/warning cause still remains. If the error is not cleared within one second after the instruction is executed, Abortion of execution (CommandAborted) becomes TRUE. Temporarily set Execution command (Execute) to FALSE, remove the cause of the error/warning, then set Execution command (Execute) to TRUE again.
- If an error occurs in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

☞ Page 1776 ERROR CODES

■At normal completion



■At timeout



Precautions

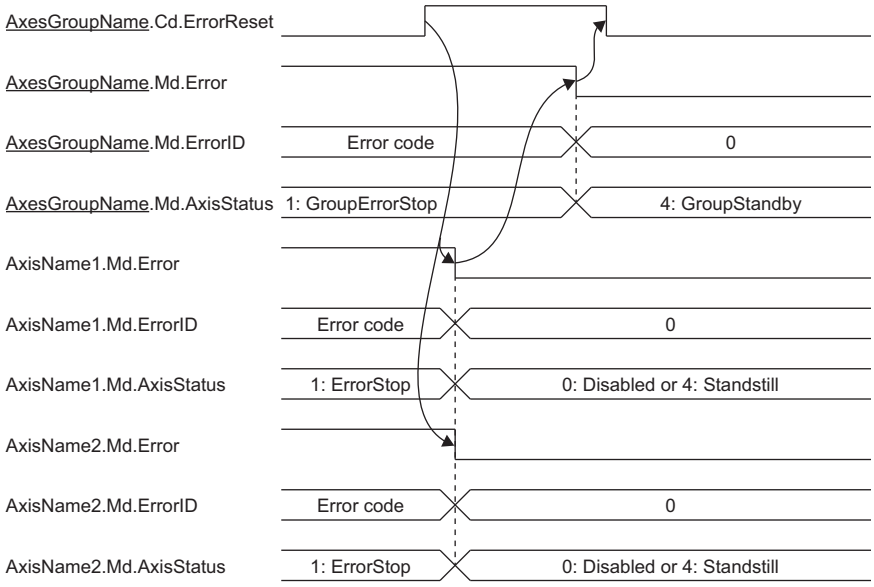
Do not operate Axis Error Reset (AxisName.Cd.ErrorReset) directly while executing MC_Reset (Axis Error Reset).

Axes Group Error Reset

Reset the error/warning of the axes group by Axes Group Error Reset (AxesGroupName.Cd.ErrorReset).
Reset the error of each axis which belongs to the axes group as well.

■Axes Group Error Reset (AxesGroupName.Cd.ErrorReset)

- Reset is executed at the rising edge detection of Axes Group Error Reset (AxesGroupName.Cd.ErrorReset).
- When the reset is completed, Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) becomes FALSE.
- When the error reset of the configuration axis is not completed, the error reset of the axes group is not completed.
- If the error reset fails, Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) remains TRUE.
- The error reset is not executed if it is executed during axes group operation. The error monitor is reset when the axes group is stopped completely and Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) is TRUE.
- The error reset can be canceled by changing Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) to FALSE.

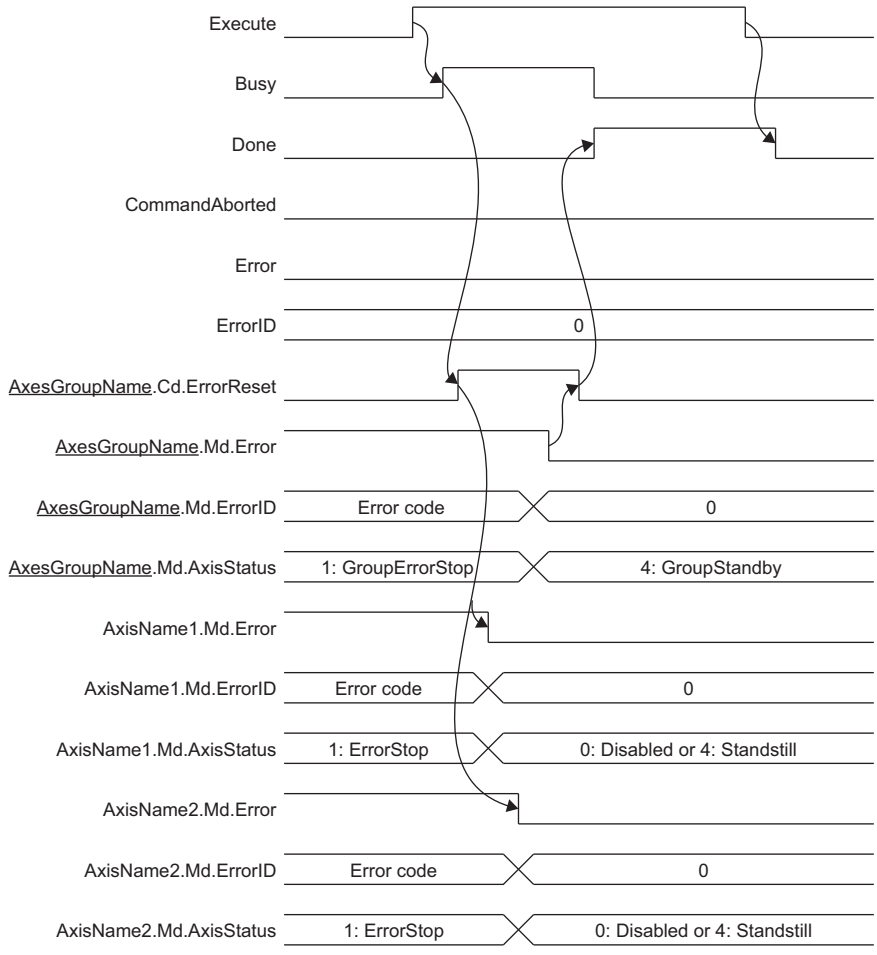


■MC_GroupReset (Axes Group Error Reset)

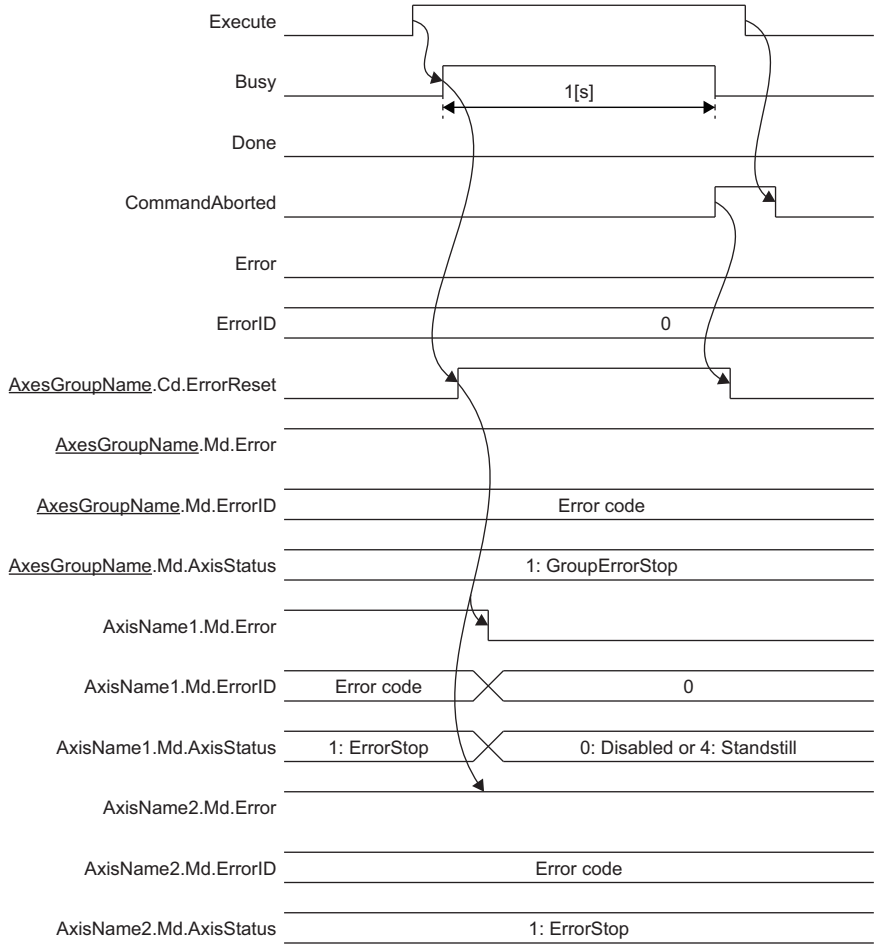
- This FB is executed upon detection of rising edge of Execution command (Execute). When the process starts, Executing (Busy) becomes TRUE, and then Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) of the target axes group is set to TRUE.
- Upon completion of clearing the errors/warnings of the axis and the axes group, Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE.
- If the execution is carried out when Axes Group Status (AxesGroupName.Md.GroupStatus) is not "1: Stopping on error (GroupErrorStop)", Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE after the warnings are cleared.
- The errors/warnings are not cleared even if Execution command (Execute) is set to TRUE while the axis error/warning causes still remain. In this case, Abortion of execution (CommandAborted) becomes TRUE and Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) of the target axes group becomes FALSE if the errors are not cleared within 1 [s] after command is executed. Temporarily set Execution command (Execute) to FALSE, remove the causes of the errors/ warnings, then set Execution command (Execute) to TRUE again.
- If an error occurs in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

☞ Page 1776 ERROR CODES

■At normal completion



■At timeout



Precautions

Do not operate Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) directly while executing MC_GroupReset (Axes Group Error Reset).

Precautions

■Necessary objects

- PDO: None
- SDO: Reset alarm (2A46H)*1

*1 For using the real drive axis or the real encoder axis

■Relevant add-ons

The following add-ons are required to use this function.

- AXIS
- MotionControl_General*1
- ServoDriver_CANopen*2

*1 For using the following FBs
· MCv_MotionErrorReset (Motion Error Reset)
· MC_Reset (Axis Error Reset)
· MC_GroupReset (Axes Group Error Reset)

*2 For using the real drive axis or the real encoder axis

72.4 Checking the Network Status

This section describes troubleshooting to check the status of the network by executing diagnostics and operation tests using the engineering tool.

CC-Link IE TSN/CC-Link IE Field diagnostics

For CC-Link IE TSN, perform status monitoring, operation tests, or others.

Precautions

In the following cases, the CC-Link IE TSN/CC-Link IE Field diagnostics cannot start.

- The controller specified on the "Specify Connection Destination Connection" window is not mounted.
- "Module Operation Mode" of "Application Settings" in "Module Parameter (Common Setting)" is not set to the online mode.
- The error code 20E0H occurs.
- The engineering tool is not connected to a station with the same communication speed as the master station.

Diagnostic items

When starting the CC-Link IE TSN/CC-Link IE Field diagnostics by specifying "No Specification" in "Other Station Setting" on the "Specify Connection Destination Connection" window, the following items can be used.

○: Diagnosed △: Diagnosed with restrictions ×: Not diagnosed

Item		Overview	Connection destination of engineering tool	Reference
			Master station	
Status monitor	Network map	Check if any errors are being caused by the devices and cables that configure the network. In addition, check the operating status of each station.	○	Page 1702 "CC-Link IE TSN/CC-Link IE Field Diagnostics" window
	Data Unlinked	Check that there is no station that is set on an actual network.	○	
	Selected Station Communication Status Monitor	Check details of, or actions for, errors that occurred in a selected station.	○	
Operation Test	Communication Test	Check whether outgoing/incoming paths of transient transmission between the own station and the communication target are correct.	○	Page 1713 Communication test
Information Confirmation/ Setting	Station Information List	Check information of the device stations which are performing data link in list form.	○	Page 1714 Station information list
Selected Station Operation	Remote Operation	Operate remotely from the engineering tool to device stations.	△*1	Page 1715 Remote operation

*1 If the setting on the "Specify Connection Destination Connection" window of the engineering tool is as follows, remote operation cannot be executed with "All Stations Specified".
Connection via Ethernet with the selections "Ethernet Board" for the personal computer-side I/F and "CC IE TSN/Field Module" for the programmable controller-side I/F

Restriction

When starting the CC-Link IE TSN/CC-Link IE Field diagnostics by specifying "Other Station (Single Network)" or "Other Station (Co-existence Network)" in "Other Station Setting" on the "Specify Connection Destination Connection" window, the following restrictions apply.

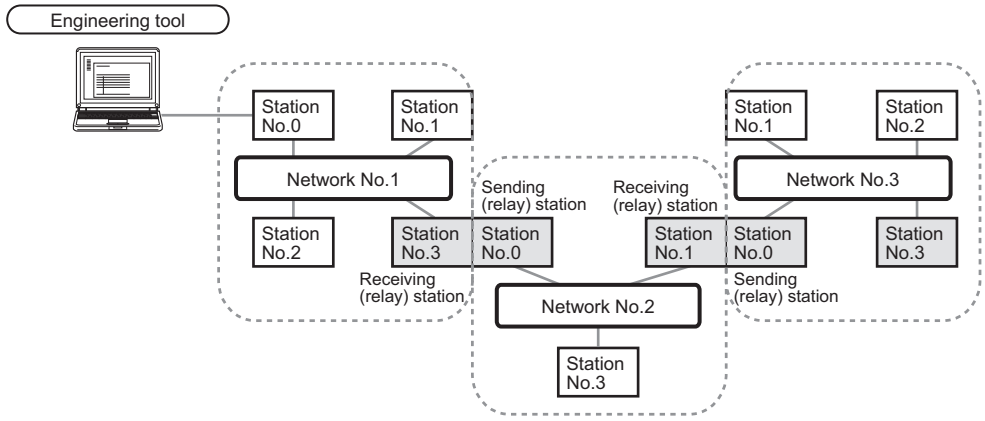
- A communication test cannot be used.
- A station information list cannot be used.
- If MELSECNET/H, multidrop connection of serial communication modules, an interface board for personal computer, a GOT (FA transparent function used), or network modules of the MELSEC-Q/L series are included in the communication path, diagnostics cannot start.

When "Other Station (Co-existence Network)" is specified in "Other Station Setting" on the "Specify Connection Destination Connection" window and "CC-Link" or "C24" is specified in "Co-existence Network Route", diagnostics cannot start.

Point

When starting the CC-Link IE TSN/CC-Link IE Field diagnostics by specifying "Other Station (Single Network)" or "Other Station (Co-existence Network)" in "Other Station Setting" on the "Specify Connection Destination Connection" window, specify the network number and station number of the relay receiving station or relay sending station for "Network No." and "Station No." in "Network Communication Route" on the "Specify Connection Destination Connection" window.

For example, to start the CC-Link IE TSN/CC-Link IE Field diagnostics of the network number 2, specify the network number 1 and station number 3, or the network number 2 and station number 0 in "Network No." and "Station No.".



- Although the CC-Link IE TSN/CC-Link IE Field diagnostics of the network to which the relay sending station belongs can be started, that of the network to which the relay receiving station belongs cannot be started.
- The CC-Link IE TSN/CC-Link IE Field diagnostics can be started for stations of up to eight networks ahead (number of relay stations: 7) including the station directly connected to the engineering tool.

Usage methods

The following describes how to use the CC-Link IE TSN/CC-Link IE Field diagnostics.

■When "No Specification" is specified in "Other Station Setting" on the "Specify Connection Destination Connection" window

1. Connect the engineering tool to the controller.

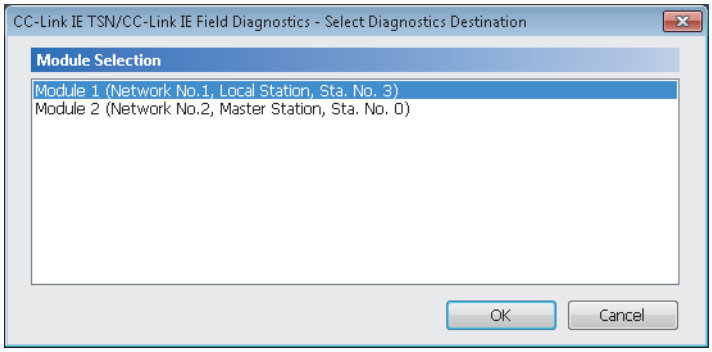
If a device station cannot be monitored due to an error such as cable disconnection, directly connect the engineering tool to the device station.

2. Start the CC-Link IE TSN/CC-Link IE Field diagnostics.

[Diagnostics] ⇨ [CC-Link IE TSN/CC-Link IE Field Diagnostics]

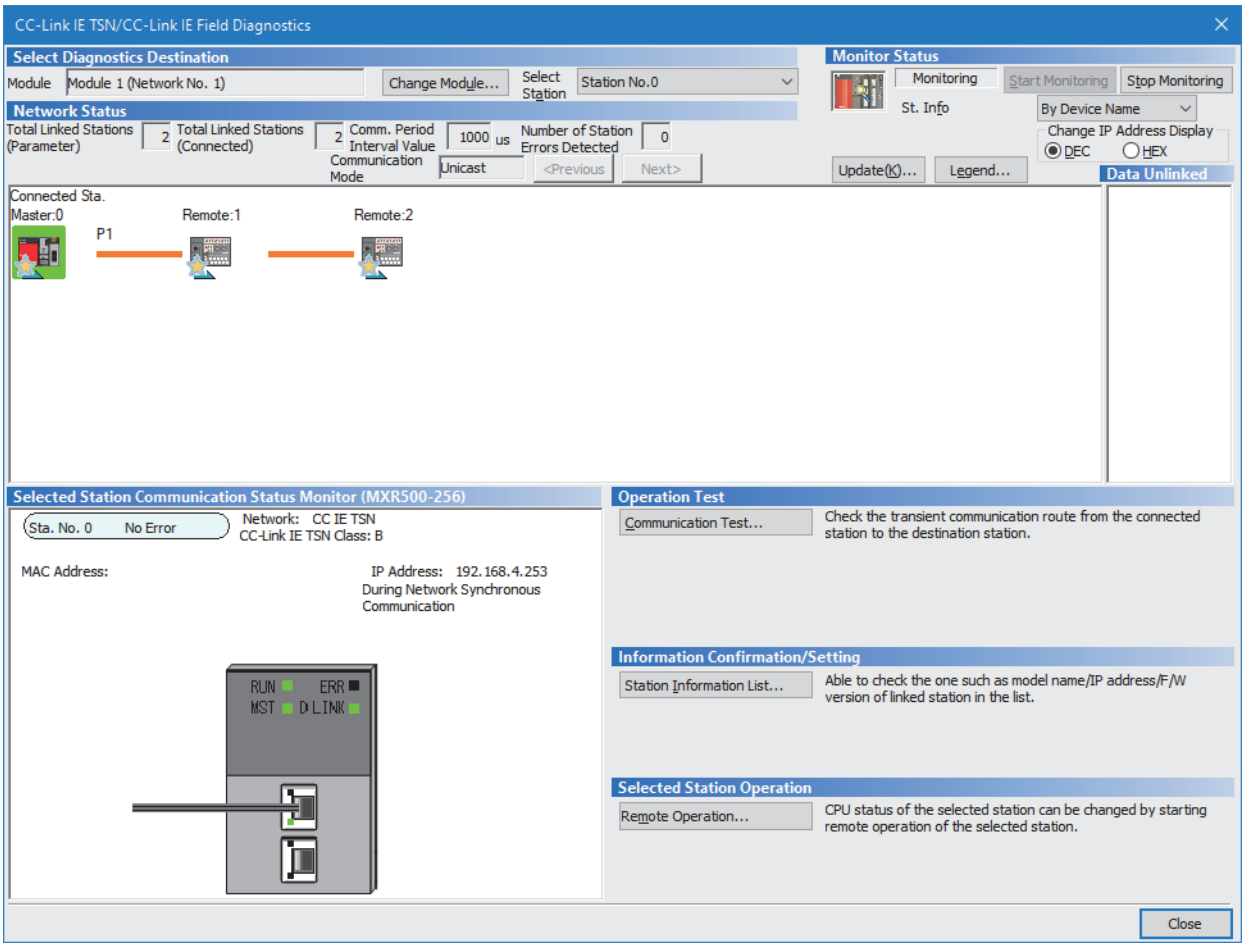
Point

When the controller and a CC-Link IE TSN-equipped module are mounted on the same base unit, the following "Select Diagnostics Destination" window appears. Select the module to be diagnosed.



However, if the controller and CC-Link IE TSN-equipped module have the same network number, CC-Link IE TSN/CC-Link IE Field diagnostics may not be executed properly when the CC-Link IE TSN-equipped module is selected.

3. Select the station to be diagnosed from "Select Station" or in the network map.



- An icon indicating an error is displayed on the module icon of the station where an error occurs.
- A disconnected station that has performed data link is indicated with the "Disconnected Station" icon in the network map. However, a disconnected station in following case is displayed on the right end of the area.

Stations displayed on the right end of the area.

- A station that was reconnected to a network after disconnecting/inserting the cable or powering off and on the system, and remains disconnected
- A disconnected station with the station icon deleted in the network map by clicking the [Update] button

- The "Error" icon is displayed on the icon of a cable where a communication error occurs. To check the details of the communication error, click the neighboring stations of the "Error" icon.

Point

When the station to be diagnosed cannot be selected, the status of network number mismatch or overlap of master stations cannot be checked using the CC-Link TSN/CC-Link IE Field diagnostics. Check the error details by directly connecting the engineering tool to the station where an error occurs, and opening the "System Monitor" window.

4. The status of a station selected in "Network Status" is displayed in "Selected Station Communication Status Monitor". (☞ Page 1702 "CC-Link IE TSN/CC-Link IE Field Diagnostics" window)

The station status is displayed on the top of "Selected Station Communication Status Monitor".

If an error occurs, a button indicating the error such as [PORT2 Communication Error] is displayed in "Selected Station Communication Status Monitor". Click the button to check the error details and actions.

5. Tests and operations can be performed by clicking "Operation Test" or "Selected Station Operation" in the bottom right of the window. (☞ Page 1713 Communication test, Page 1715 Remote operation)

■When a setting other than "No Specification" is specified in "Other Station Setting" on the "Specify Connection Destination Connection" window

1. Connect the engineering tool to the controller.
2. Start the CC-Link IE TSN/CC-Link IE Field diagnostics.

[Diagnostics] ⇨ [CC-Link IE TSN/CC-Link IE Field Diagnostics]

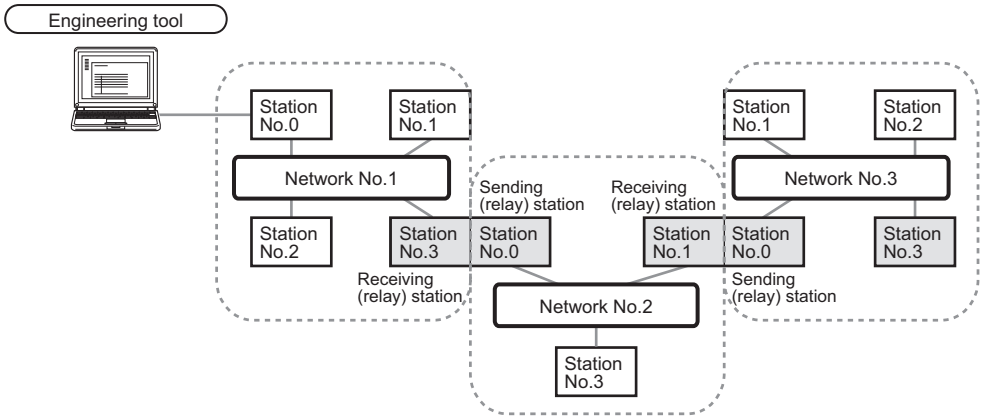
Point

The CC-Link IE TSN/CC-Link IE Field diagnostics cannot be started when "Other Station (Co-existence Network)" has been specified in "Other Station Setting" on the "Specify Connection Destination Connection" window and "CC-Link" or "C24" has been specified in "Co-existence Network Route".

3. Select the controller of the network number to be diagnosed and click the [OK] button to start the CC-Link IE TSN/CC-Link IE Field diagnostics.

Point

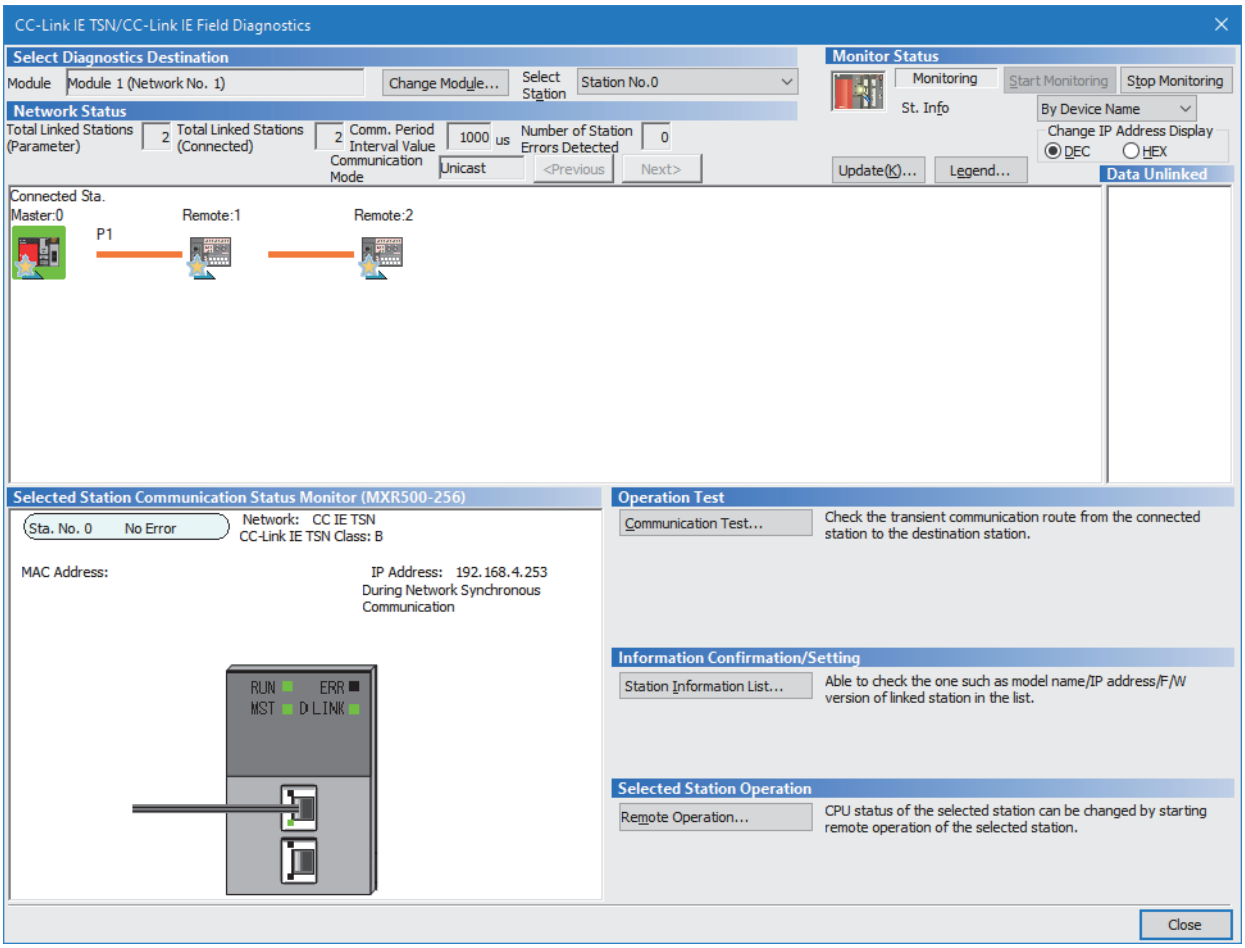
- Although the CC-Link IE TSN/CC-Link IE Field diagnostics of the network to which the relay sending station belongs can be started, that of the network to which the relay receiving station belongs cannot be started.
- To start the CC-Link IE TSN/CC-Link IE Field diagnostics, specify the network number and station number of the relay receiving station or relay sending station for "Network No." and "Station No." in "Network Communication Route" on the "Specify Connection Destination Connection" window. For example, to start the CC-Link IE TSN/CC-Link IE Field diagnostics of the network number 2, specify the network number 1 and station number 3, or the network number 2 and station number 0 in "Network No." and "Station No.".



- The CC-Link IE TSN/CC-Link IE Field diagnostics can be started for stations of up to eight networks ahead (number of relay stations: 7) including the station directly connected to the engineering tool.
- The selected station communication status monitor of the RJ72GF15-T2 cannot be executed in the CC-Link IE TSN/CC-Link IE Field diagnostics for the stations of five networks ahead (number of relay stations: 4) or later.

4. Step 4 and later is the same procedure as when "No Specification" is specified in "Other Station Setting" on the "Specify Connection Destination Connection" window. (☞ Page 1699 When "No Specification" is specified in "Other Station Setting" on the "Specify Connection Destination Connection" window)

"CC-Link IE TSN/CC-Link IE Field Diagnostics" window



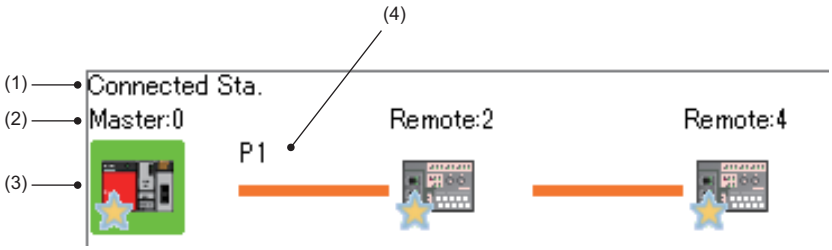
Item		Description
Select Diagnostics Destination	Module	Displays the controller being diagnosed.
	[Change Module] button	Allows to change the diagnostics destination when a CC-Link IE TSN-equipped module is mounted on the same base unit as the controller. However, when a CC-Link IE TSN-equipped module with the same network number is mounted on the same base unit, the controller will be diagnosed, regardless of which module is selected.
	Select Station	Selects the station number of the station to be diagnosed. A station to be diagnosed can also be selected by clicking the module icon displayed in the network map.
Monitor Status	[Start Monitoring] button	Starts monitoring the CC-Link IE TSN/CC-Link IE Field diagnostics.
	[Stop Monitoring] button	Stops monitoring the CC-Link IE TSN/CC-Link IE Field diagnostics.
[Update] button		If the actual network configuration and network map of the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window are inconsistent, match them by updating the network map. A data link error may momentarily occur in all the stations and outputs of the connected device stations may turn off since all stations on the network will be reconnected when executing the network map update. Configure the settings to hold outputs if needed.
[Legend] button		Displays the meaning of icons displayed in the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window.
St. Info		The display name of the device station can be selected from "By Device Name", "By Station Type", "By Model Name", or "By IP Address". "By Device Name" displays the information entered in "Alias" of "Network Configuration Settings" under "Basic Settings". The station type is displayed when the "Alias" is not entered.

Item		Description
Network Status	Total Linked Stations (Parameter)	Displays the total number of device stations set in "Network Configuration Settings" under "Basic Settings".
	Total Linked Stations (Connected)	Displays the total number of device stations that are actually performing data link in CC-Link IE TSN.
	Comm. Period Interval Value	Displays the communication cycle interval set in "Communication Period Setting" under "Basic Settings" of "Module Parameter (CC-Link IE TSN)" of the master station. (In units of μs)
	Number of Station Errors Detected	Indicates the number of error stations in the displayed network.
	Communication Mode	Displays the communication mode set in "Communication Mode" of "Application Settings" under "Module Parameter (CC-Link IE TSN)" of the master station.
	Change IP Address Display	Allows to select from "DEC" or "HEX" for IP address display on the selected station communication status monitor and network map. (Default: Decimal)
	Network map	Indicates the CC-Link IE TSN structure and the status of each station. (☞ Page 1704 Network map) If the status of each station is not displayed, check whether there are any overlaps of master stations.
	Data Unlinked	Displays a disconnected station that has been set in "Network Configuration Settings" under "Basic Settings" of "Module Parameter (CC-Link IE TSN)" but has not yet performed data link. Reserved stations or error invalid stations are also included. In the following cases, however, disconnected stations that have performed data link are displayed. • A station that was reconnected to a network after disconnecting/inserting the cable or powering off and on the system, and remains disconnected • A disconnected station with the station icon deleted in the network map by clicking the [Update] button Displays the station number on the station icon. The "Other Modules" icon indicates a station that has not yet performed data link. Icons other than the "Other Modules" icon indicate stations that have performed data link before disconnection. For details on the displayed icon, click the [Legend] button.
Selected Station Communication Status Monitor		Status of the station selected in "Network Status" is displayed. (☞ Page 1706 Selected Station Communication Status Monitor)
Operation Test	[Communication Test] button	Performs a communication test. (☞ Page 1713 Communication test)
Information Confirmation/ Setting	[Station Information List] button	Displays information of the device stations which are performing data link in list form. (☞ Page 1714 Station information list)
Selected Station Operation	[Remote Operation] button	Performs remote operation (such as RUN, STOP, or RESET operations) to the controller. (☞ Page 1715 Remote operation)

Network map

■Icon

The module type and station number are displayed with an icon.

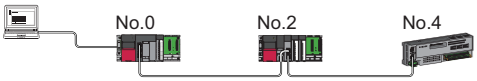
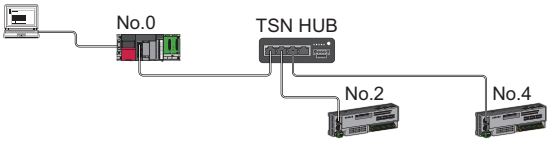
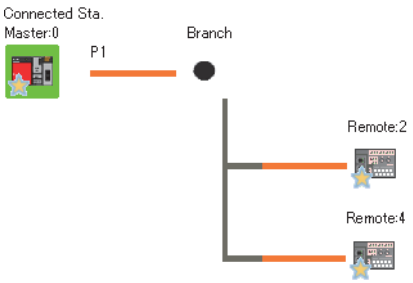
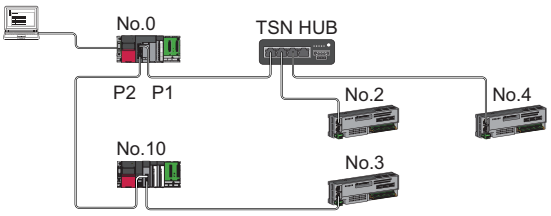
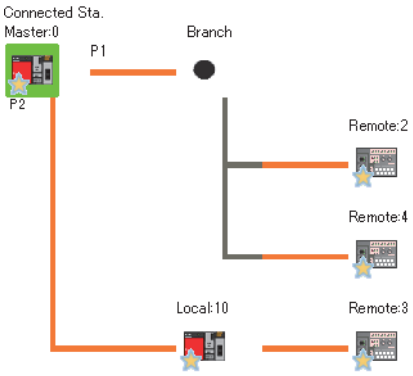


- Click: Selection
- Right-click: Executes tests or debugging.
- ↑ ↓ ← → keys on the keyboard: Move the focus to the module to be diagnosed, and determine it with the Space key.

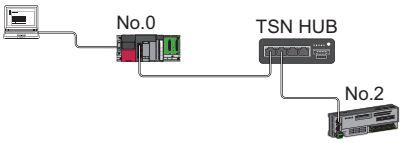
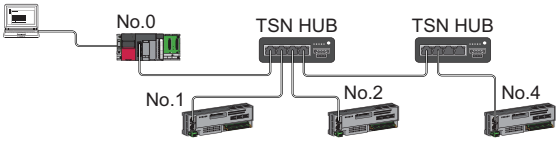
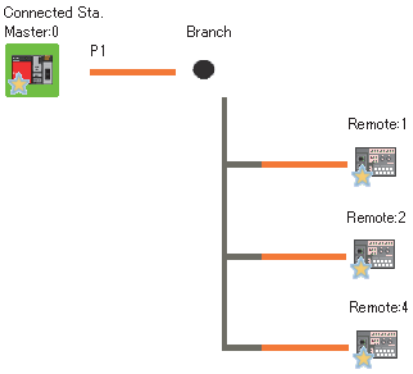
No.	Description
(1)	Displays the station (own station) where the engineering tool is connected.
(2)	Displays the station type and station number. "?" is displayed when a station number has not been set. Text with a colored background indicates that the relevant station is set as a reserved station or others. Click the [Legend] button to check the meaning of the background colors.
(3)	Module status is displayed. Click the [Legend] button to check the meaning of the icon. When the "Error (Illegal ring connection detected)" icon is displayed, take actions displayed in "Troubleshooting" of "Error details". (☞ Page 1706 Selected Station Communication Status Monitor)
(4)	P1 or P2 to which an Ethernet cable is connected is displayed.

■Network map

A network map is displayed according to the connection status.

Connection status	Display of the network map
Line topology 	
Star topology 	
Coexistence of line and star topologies 	

In the following cases, the network map is displayed differently from the actual connection status.

Connection status	Display of the network map
When two stations are connected to the industrial switch 	Branches are not displayed in the network map. 
When industrial switches are in cascade connection 	Only one branch is displayed. 

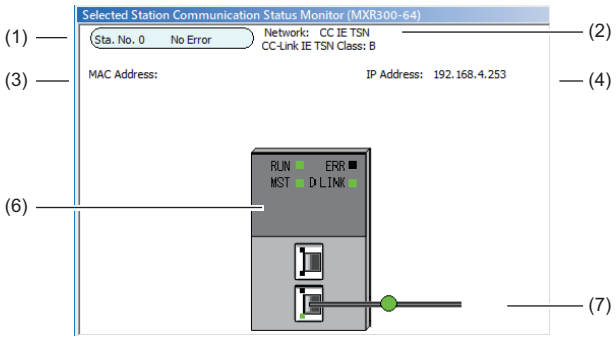
Precautions

- Stations in offline mode are not displayed in the network map. In line topology, stations connected after a station in offline mode are not displayed because they are disconnected.
- If a station whose connection information cannot be obtained exists in a line topology, the network map will be displayed as a star topology.

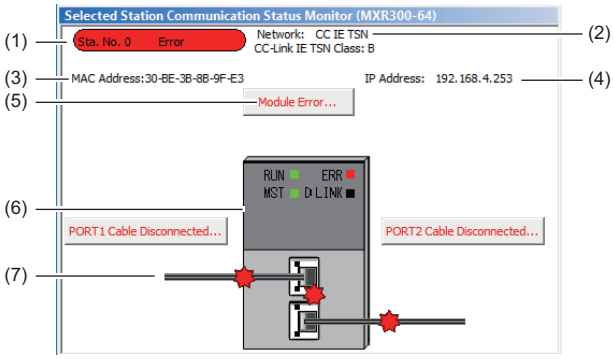
Selected Station Communication Status Monitor

Displays status of the station selected in "Network Status".

■Normal operation



■Error status



No.	Description
(1)	Indicates the station number and operating status. ■Normal operation • Station number No error (light blue): Normal operation ■Error status • Station number Error (yellow): Error (Data link is continued) • Station number Error (red): Error (Data link is stopped)
(2)	Displays the network type.
(3)	Displays a MAC address.*1
(4)	Displays an IP address.
(5)	Click this button to check error details. Take actions following the description displayed in "Error Factor" and "Troubleshooting".
(6)	The LED status of a module and communication status of P1 and P2 are displayed.
(7)	Status of the Ethernet cables connected to P1 and P2 is displayed.

*1 When 00-00-00-00-00-00 is displayed as a MAC address, the status of the selected station cannot be checked with the selected station communication status monitor. Check the error details by directly connecting the engineering tool to the station where an error occurs, and opening the "System Monitor" window.

*2 "During Network Synchronous Communication" displayed in "Selected Station Communications Status Monitor" indicates that the selected station is synchronizing through the network synchronous communications. When the master station does not perform the network synchronous communications, "During Network Synchronous Communication" is displayed in a device station while the device station is performing the network synchronous communications.

■When a selected station is not available for selected station communication status monitor

Information on the device is not displayed, but the "Error details" window (detailed information, error factor, troubleshooting) is displayed.

Ethernet diagnostics

The communication status of the controller and external device can be checked with Ethernet diagnostics.

[Diagnostics] ⇨ [Ethernet Diagnostics]

Set the controller to be diagnosed in "Target Module Specification".

Point

- The Ethernet diagnostics cannot be started when "Other Station (Co-existence Network)" has been specified in "Other Station Setting" on the "Specify Connection Destination Connection" window and "CC-Link" or "C24" has been specified in "Co-existence Network Route".
- When a setting other than "No Specification" has been specified in "Other Station Setting" of "Specify Connection Destination Connection", specify an Ethernet-equipped module to be diagnosed in "Other Station Setting" of "Specify Connection Destination Connection". If another Ethernet-equipped module is specified, Ethernet diagnostics cannot be started even if the Ethernet-equipped module is on the same base unit. The Ethernet diagnostics can be started for stations of up to eight networks ahead (number of relay stations: 7) including the network to which the station directly connected with the engineering tool belongs.

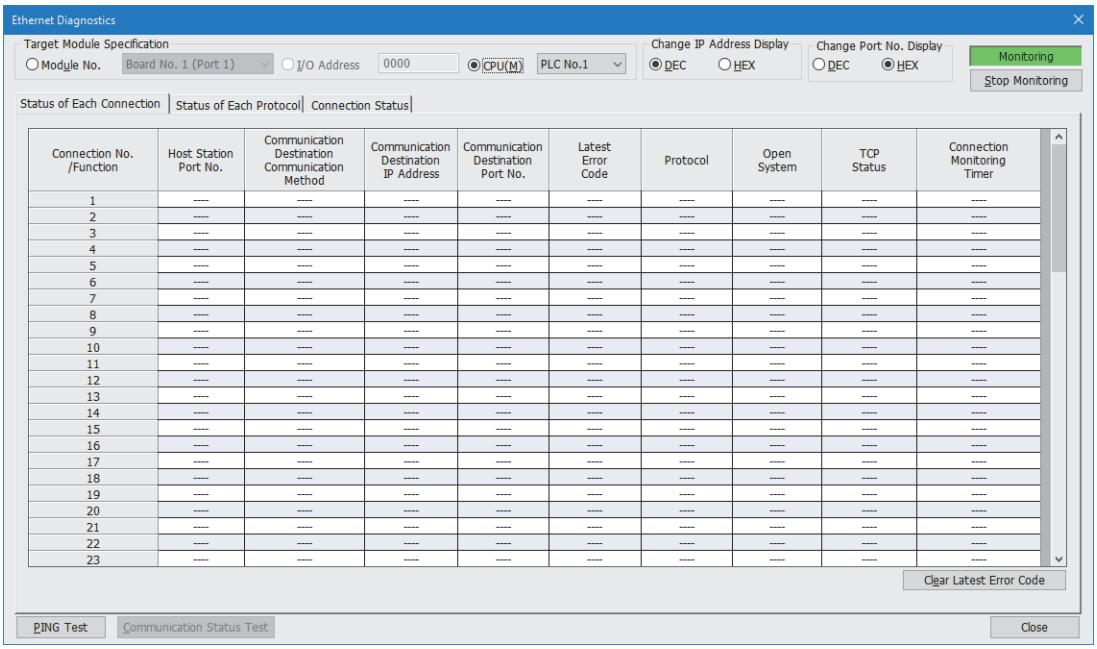
Precautions

If the communication path includes the following items, the Ethernet diagnostics cannot be started.

- MELSECNET/H
- Multidrop connection with a serial communication module
- Interface board for a personal computer
- GOT (when the transparent function is used)
- MELSEC-Q/L series network module

Status of each connection

The status of each connection of the selected controller can be checked.



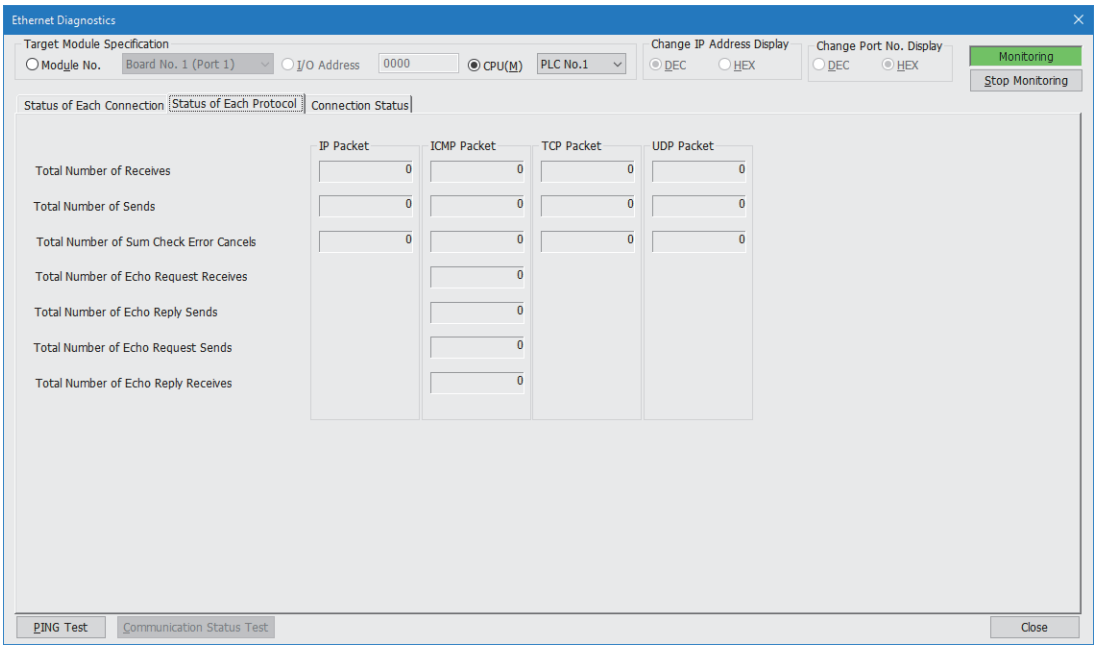
The following table lists the displayed items in "Status of Each Connection" tab.

Item	Description
Connection No./Function	Displays the connection number and functions (FTP server, FTP client, MELSOFT direct connection).
Host Station Port No.	Displays the own station port number used for the connection number.
Communication Destination Communication Method	Displays the communication method for the connection number.
Communication Destination IP Address	Displays the IP address of the sensor/device to be connected, which is set in the parameter settings of the connection number.
Communication Destination Port No.	Displays the port number of the sensor/device to be connected, which is set in the parameter settings of the connection number.
Latest Error Code	Displays the error code that indicates the definition of the latest error occurred in the connection number.
Protocol	Displays the protocol (TCP, UDP, TLS or DTLS) of the connection number.
Open System	Displays the open method (Active, Unpassive, or Fullpassive) when the protocol of the connection number is TCP or TLS.
TCP Status	Displays the status (open status) of connection with the sensor/device when the protocol of the connection number is TCP or TLS.
Connection Monitoring Timer	Displays the following information for the connection number: The time and unit of measurement set in the connection monitoring timer in the external device connection settings.

Click the [Clear Latest Error Code] button to clear all the errors displayed in "Latest Error Code" of each connection.

Status of each protocol

The total number of packets sent/received by each protocol of the selected controller can be checked.

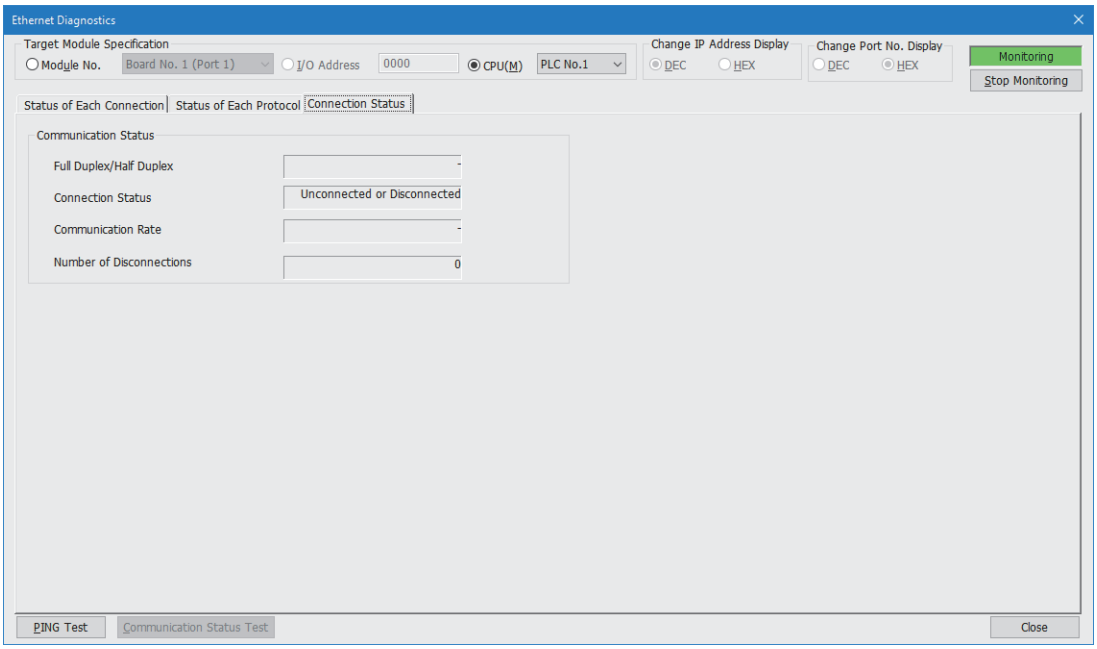


The following table lists the displayed items in "Status of Each Protocol" tab.

Item	Description	Display range
Total Number of Receives	Displays the total number of received packets.	0 to 4294967295
Total Number of Sends	Displays the total number of sent packets.	0 to 4294967295
Total Number of Sum Check Error Cancels	Displays the number of times the received packet was discarded due to checksum error.	0 to 4294967295
Total Number of Echo Request Receives	Displays the total number of received ICMP echo request packets.	0 to 4294967295
Total Number of Echo Reply Sends	Displays the total number of sent ICMP echo reply packets.	0 to 4294967295
Total Number of Echo Request Sends	Displays the total number of sent ICMP echo request packets.	0 to 4294967295
Total Number of Echo Reply Receives	Displays the total number of received ICMP echo reply packets.	0 to 4294967295

Connection status

The communication status of the controller line can be checked.



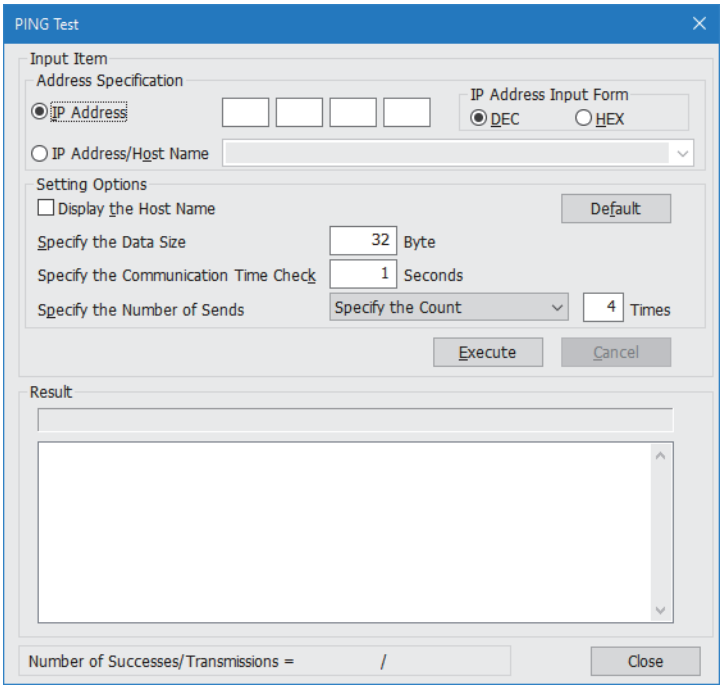
The following table lists the displayed items in "Connection Status" tab.

Item		Description	Display range
Communication Status	Full Duplex/Half Duplex	Displays whether the line is full-duplex or half-duplex.	—
	Connection Status	Displays the cable connection status.	—
	Communication Rate	Displays the communication speed.	—
	Number of Disconnections	Displays the number of times the line entered a state where communication cannot be performed.	0 to 65535

PING test

The PING test checks existence of an Ethernet device on the same Ethernet network.
This test is performed on the network of stations connected to the engineering tool by sending packets for check. If a response returns, the communication can be performed.

"Ethernet Diagnostics" window ⇨ [PING Test] button



■Procedure

Set the required items in "Input Item" and click the [Execute] button to execute the PING test. The test results are displayed in the "Result" box.

Point

- When the PING test is executed from the controller by connecting the engineering tool and controller with a USB cable, network number and station number settings are required to specify the PING executing station.
- When the Ethernet diagnostics are started with a setting other than "No Specification" in "Other Station Setting" on the "Specify Connection Destination Connection" window, the PING test cannot be used.

■Action for abnormal end

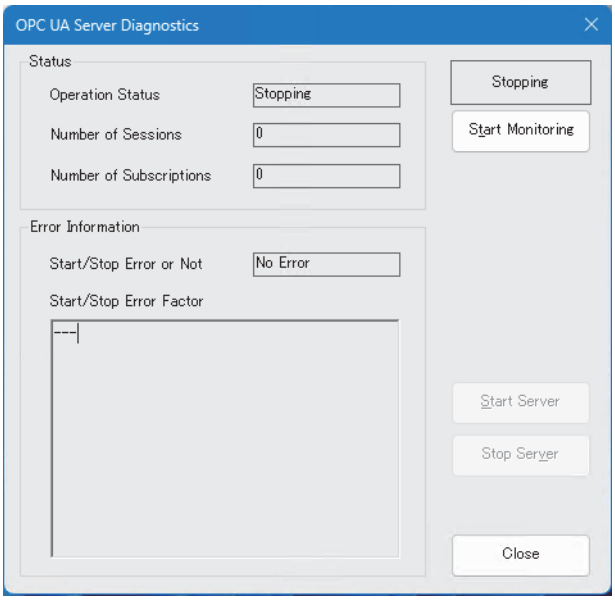
If the test fails, check the following and perform the test again.

- Mounting status of the controller to the base unit
- Connection to the Ethernet network
- Parameter settings written in the controller
- Operating status of the controller (whether or not an error has occurred)
- IP addresses set in the engineering tool and the PING test target station
- Whether the external device has been reset after the controller was replaced

OPC UA server diagnostics

The status of the OPC UA server can be checked with the OPC UA diagnostics.

[Diagnostics] ⇨ [OPC UA Server Diagnostics]

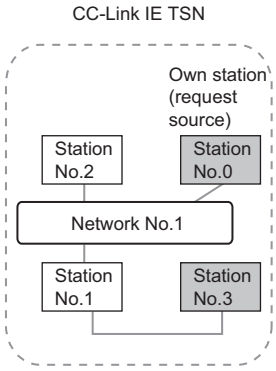


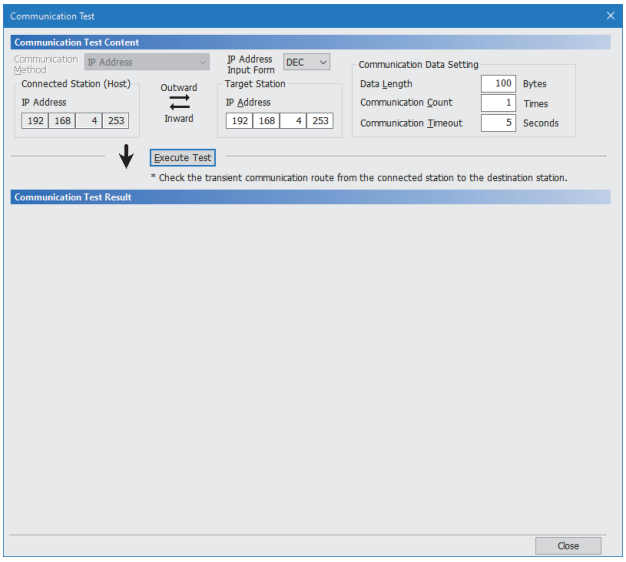
Item		Description
Status	Operation Status	Displays the current status of the OPC UA server. • During Start Processing • Starting • During Stop Processing • Stopping
	Number of Sessions	Displays the number of sessions of the clients connected to the OPC UA server.
	Number of Subscriptions	Displays the number of subscriptions created by the OPC UA server.
Error Information	Start/Stop Error or Not	Displays the presence or absence of an error.
	Start/Stop Error Factor	Displays details about the occurrence of the error.
Start Monitoring	Starts the OPC UA server monitor. When started, [Stop Monitoring] is displayed.	Displays the current monitoring status of the OPC UA server. • Monitoring • Stopping
Start Server	Starts up the OPC UA server. Valid only when the OPC UA server has stopped.	
Stop Server	Stops the OPC UA server. Valid only when the OPC UA server has started up.	

Communication test

Specify the IP address and check whether the transient transmission communication route from the own station to the communication destination (same network only) is correct.

The following system configuration is used to explain the procedure of the communication test.





1. Display "Communication Test" window and select "IP Address" from "Communication Method".

   [Diagnostics] ⇨ [CC-Link IE TSN/CC-Link IE Field Diagnostics] ⇨ [Communication Test] button

2. Enter values for "Target Station" and "Communication Data Setting".

3. Click the [Execute Test] button to execute the communication test. If an error occurs, take corrective actions according to the error message.

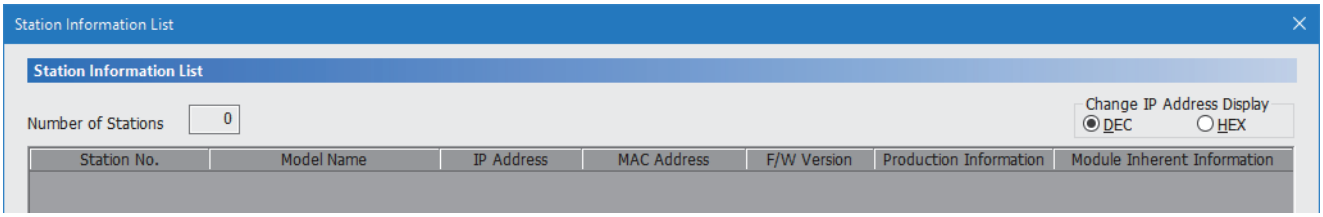
Precautions

- Since this function uses PING, a communication test target station communication error (error code D919H) occurs if the communication target does not respond to PING. When executing this function, check if the security setting (such as firewall) of the communication target is set to respond to PING. Moreover, if the target is set not to respond to PING in the security settings (such as a firewall), it may take some time until a timeout error occurs on the engineering tool. For details on when communication using the engineering tool is not allowed in the settings of Windows Firewall, refer to the following.

GX Works3 Operating Manual

Station information list

The station information list displays information of the device stations which are performing data link in list form.



Item	Description
Number of Stations	Displays the number of device stations to be displayed in the station information list.
Change IP Address Display	Select an IP address display format.
Station No.	Displays the station number of the device station.
Model Name	Displays the model name of the device station.
IP Address	Displays the IP address of the device station.
MAC Address	Displays the MAC address of the device station.
F/W Version	Displays the firmware version of the device station.
Production Information	Displays the production information of the device station.
Module Inherent Information	Displays the module-specific information of the device station.

Point

- The station information list displays only the device stations which are performing data link.
- If the engineering tool does not have information of the relevant device station, "—" is displayed for each item.
- If the relevant device station is an unsupported module, "Other Modules" is displayed.

Remote operation

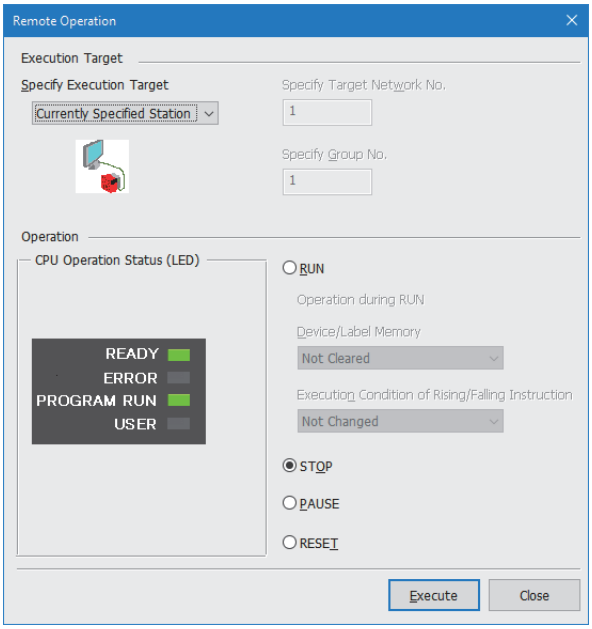
This function executes remote operations (such as RUN, STOP, and RESET operations) to the station selected on the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window, from the engineering tool. (Only RESET is available as remote operation for device stations.)

The displayed window varies depending on the station selected. For the operations with a module other than the controller selected, refer to the manual for the module used.

For details on remote operation, refer to the following.

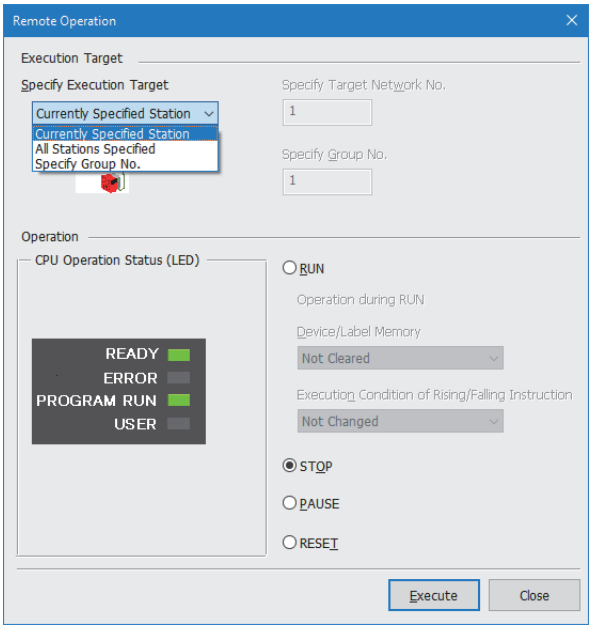
☞ Page 1606 REMOTE OPERATION

Procedure



1. In the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window, select a module intended to be operated remotely.
2. Click the [Remote Operation] button in the "CC-Link IE TSN/CC-Link IE Field Diagnostics" window, or right-click a module icon in the "Network Status" and click [Remote Operation].

The "Remote Operation" window is displayed.



3. Specify the target station in "Specify Execution Target".
   - "Currently Specified Station" performs remote operation only for the controller on the station selected in the CC-Link IE TSN/CC-Link IE Field diagnostics.
   - "All Stations Specified": Remote operations are performed on all stations under "Specify Target Network No.".
   - "Specify Group No.": Among the stations for which a transient transmission group number has been set, remote operations are performed only on the stations that are selected in "Specify Group No.".
4. Select the contents of remote operation (RUN, STOP, PAUSE, or RESET) for the controller in "Operation". (To perform remote RESET, set "Remote Reset Setting" under "Operation Related Setting" of "CPU Parameter" to "Enable" in advance.)
5. Click the [Execute] button to perform the remote operation.

Precautions

If remote STOP or remote PAUSE has been executed from the engineering tool to the CPU module on another station when the controller and engineering tool are connected with an Ethernet cable, perform remote RUN and remote RESET before resetting or turning the power off the controller.

Monitoring link special relay (SB) and link special register (SW)

The following table lists the link special relays (SB) and link special registers (SW) used for checking errors.

Check item	Action
Is SB0049 (Data link error status of own station) abnormal?	Execute troubleshooting if cyclic transmission cannot be performed at the own station. (☞ Page 1718 When cyclic transmission failed)
Are SW0290 to SW029F (each station's data link status) abnormal?	Execute troubleshooting when cyclic transmission cannot be performed at a station with a data link error. (☞ Page 1718 When cyclic transmission failed)
Is SB004A/SB004B (minor error status of own station controller or moderate/major error status of own station controller) abnormal?	Check the error code and take appropriate action. (☞ Page 1776 ERROR CODES)
Are SW0330 to SW033F/SW0350 to SW035F (moderate/major error status of each station CPU or minor error status of each station CPU) abnormal?	Check the error code and take appropriate action. (☞ Page 1776 ERROR CODES)
Is SW0049 (cause of data link stop) repeatedly updated?	Eliminate the illegal ring topology. (☞ Page 1727 When the network map or selected station communication status monitor is not displayed correctly)

73 TROUBLESHOOTING BY SYMPTOM

This chapter describes troubleshooting by symptom of the controller.

73.1 Programmable Controller Function Troubleshooting

This section describes troubleshooting by symptom related to the programmable controller function.

When data cannot be written to the controller

When data cannot be written to the controller, check the following items.

Check item	Action
Check if the SD memory card is write-protected while the SD memory card is being targeted for writing.	Clear the write-protect for the SD memory card.
When the target of the write is an SD memory card, check that the SD memory card has been formatted.	Carry out formatting for the SD memory card.
Does the data to be written exceed the capacity of the controller built-in memory or SD memory card?	Secure free space in the controller built-in memory or SD memory card. Organize the controller built-in memory or SD memory card which is the target for write.
Check if the user has logged on to the controller.	Log on to the controller from the engineering tool.
Does the user have the authority to write to the target file?	• Give authority to the user who is going to perform write. • Contact the administrator to change the user group or the operation authority.

If data cannot be written to the controller even after the items above are checked and the actions are taken, the possible cause is a hardware failure. Please contact your local Mitsubishi representative.

When data cannot be read from the controller

When data cannot be read from the controller, check the following items.

Check item	Action
Check if the target memory to be read is correctly specified.	Check the read target memory (controller built-in memory, SD memory card, or intelligent function module).
Check if the user has logged on to the controller.	Log on to the controller from the engineering tool.
Does the user have the authority to read from the target file?	• Give authority to the user who is going to perform read. • Contact the administrator to change the user group or the operation authority.

If data cannot be read from the controller even after the items above are checked and the actions are taken, the possible cause is a hardware failure. Please contact your local Mitsubishi representative.

When the operating status of the controller cannot be changed

When the operating status of the controller cannot be changed, check the following items.

Check item	Action
Check if a stop error has occurred.	Check the error cause using an engineering tool and eliminate the error cause.
Check if the online change processing is left suspended.	Execute the online change again.
If the operating status is to be changed by remote operation, is authority granted to the user to perform the remote operation?	• Give authority to the user who is going to perform the remote operation. • Contact the administrator to change the user group or the operation authority.

If the controller operating status cannot be changed even after the items above are checked and the actions are taken, the possible cause is a hardware failure. Please contact your local Mitsubishi representative.

73.2 CC-Link IE TSN Troubleshooting

This section describes troubleshooting by symptom related to CC-Link IE TSN.

When cyclic transmission failed

The following lists the actions to be taken if cyclic transmission cannot be performed.

Check item		Action
Is the D LINK LED on the controller turned on?		Perform troubleshooting for when the D LINK LED turns off or is flashing. (☞ Page 1676 When the D LINK LED turns off or is flashing)
Do the station types set in "Network Configuration Settings" under "Basic Settings" of the master station match those set for the connected device stations?		Check 'Station type match status of each station' (SB00E8) and 'Station type match status' (SW0300 to SW030F) to correct the station type of stations in which the station type does not match.
Is an industrial switch (CC-Link IE TSN Class B certified) being used?		• Of the troubleshooting items for when the D LINK LED turns off or is flashing, perform the one regarding industrial switches (CC-Link IE TSN Class B certified). (☞ Page 1676 When the D LINK LED turns off or is flashing) • Check the industrial switch to be used and the settings of the industrial switch. For the setting method, refer to the manual for the industrial switch to be used. • When using an industrial switch (CC-Link IE TSN Class B certified), check the precautions and restrictions for system configuration on the CC-Link Partner Association website (www.cc-link.org).
When "Communication Speed" under "Application Settings" of the master station is set to "100Mbps", is "System Reservation Time" in "Communication Period Setting" under "Basic Settings" of the master station set to 20μs?		Set "System Reservation Time" to 200μs.
Is "— — —" displayed on the dot matrix LED on the controller?		Set the module parameters.
When "Connection Device Information" under "Basic Settings" of the master station is set to "CC-Link IE TSN Class B Only"	Are CC-Link IE TSN Class A devices connected?	• Check the connected device and disconnect the CC-Link IE TSN Class A devices. • When connecting a CC-Link IE TSN Class A device, set "Connection Device Information" of the master station to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".
	Is an industrial switch (CC-Link IE TSN Class A certified) connected between CC-Link IE TSN Class B devices?	Check the connected devices and either remove the industrial switch (CC-Link IE TSN Class A certified) or replace it with an industrial switch (CC-Link IE TSN Class B certified).

Check item			Action
When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only"	Is a CC-Link IE TSN Class B device other than the master station connected with an industrial switch (CC-Link IE TSN Class A certified) in a star topology?		• In star topology, do not connect CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class A certified) other than the master station. • Connect CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class B certified).
	Are the master station and CC-Link IE TSN Class B device connected via an industrial switch (CC-Link IE TSN Class A certified)?		• Check the connected devices, and connect the master station and CC-Link IE TSN Class B devices in a line topology without connecting an industrial switch (CC-Link IE TSN Class A certified). • Check the connected devices, and connect the master station and CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class B certified).
	Is an Ethernet device connected to places other than the end of the network?		Check the connected device and connect the Ethernet device at the end of the network.
	Does the connected industrial switch support the CC-Link IE TSN Class used?		Use an industrial switch that supports "CC-Link IE TSN Class Setting" set to the master station. For the models and usage methods of industrial switches, refer to the CC-Link Partner Association website (www.cc-link.org).
	Is event code 00C81H registered in the event history?		Change "CC-Link IE TSN Class Setting" under "Network Configuration Settings" or "CC-Link IE TSN Class" on the device station side so that the CC-Link IE TSN Class settings for each station match.
	Is event code 00C80H registered in the event history?		Take one of the following actions. • Check 'Station protocol version 2.0 support status' (SW01A0 to SW01AF) and update the firmware of all device stations to support protocol version 2.0. Alternatively, replace with device stations that support protocol version 2.0. • Set 'Protocol setting' (Un\G1294018) of the master station to 1: Protocol version 1.0 fixed. (☞ Page 2131 Operating protocol setting) • After powering on the device stations and the devices on the communication path, power on the master station.
	Is '2: Operating with the protocol version 2.0' stored in 'Protocol operating status' (Un\G1294016)?	Are there any stations that do not support protocol version 2.0 stored in 'Station protocol version 2.0 support status' (SW01A0 to SW01AF)?	
When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only"	Is '1: Operating with the protocol version 1.0' stored in 'Protocol operating status' (Un\G1294016)?	Are there any stations that do not support protocol version 2.0 stored in 'Station protocol version 2.0 support status' (SW01A0 to SW01AF)?	Check 'Station protocol version 2.0 support status' (SW01A0 to SW01AF) and update the firmware of all device stations to support protocol version 2.0. Alternatively, replace with device stations that support protocol version 2.0.
		Are nine or more CC-Link IE TSN Class B devices and industrial switches (CC-Link IE TSN Class B certified) connected to the transmission path from the master station to the terminating CC-Link IE TSN Class B device at each port of the master station?	Check the connected devices, and limit the total number of CC-Link IE TSN Class B devices and industrial switches (CC-Link IE TSN Class B certified) on the transmission path from the master station to the terminating CC-Link IE TSN Class B device at each port of the master station to 8 or less.
		Has the cyclic data size exceeded 2K bytes in total for CC-Link IE TSN Class A devices connected to the CC-Link IE TSN Class B devices other than the master station? (Including when connecting to CC-Link IE TSN Class B devices via industrial switches (CC-Link IE TSN Class A certified))	• Connect to a CC-Link IE TSN Class B device via an industrial switch (CC-Link IE TSN Class B certified). (If connecting via an industrial switch, change the industrial switch to an industrial switch (CC-Link IE TSN Class B certified).) • Limit the number of connected stations so that the cyclic data size of the CC-Link IE TSN Class A devices does not exceed 2K bytes in total. • Connect the CC-Link IE TSN Class A device to the master station.
	Is there any difference between the CC-Link IE TSN Class B/A mixed system configuration and the "TSN HUB Setting" in "Connection Device Information" under "Basic Settings"?		For details, refer to the following. ☞ Page 1728 When CC-Link IE TSN Class A device does not perform data link
	Is event code 00C72H registered in the event history of the master station?		• Update the engineering tool to the latest version. • Update the device station firmware with the IP address displayed in the detailed information of the event history to the latest version.
If the stations are connected in a line topology, does "Communication Speed" for the stations match one another?			Correct "Communication Speed" under "Application Settings" for the stations so that the communication speeds match one another.
Is there any reason why cyclic transmission cannot be performed on the device station side?			• Check if an error has occurred on the device station. • Check if the device station settings and parameters are correct. • Refer to the manual of the device station for troubleshooting.
Is event code 00C44H registered in the event history?			Ensure that the communication speed of the master station and the communication speed of device station match.

Check item	Action
Is the cyclic transmission time set for a value smaller than the values shown in the following conditions? ■Conditions • 110% of 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273) • The value obtained by adding the following to 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273): When the communication speed of the master station is set to 1Gbps: Number of device stations × 2μs When the communication speed of the master station is set to 100Mbps: Number of device stations × 20μs	Set the cyclic transmission time for a value larger than the values shown in the conditions in the left column. If the setting causes the communication cycle interval to exceed the maximum value (10000.00μs), set the cyclic transmission time and communication cycle interval so that the communication cycle interval is within the limit by referring to the following. ☞ Page 2116 Shortening method of the communication cycle interval and cyclic transmission time Set the cyclic transmission time and communication cycle interval so that the transient transmission time does not fall below the lower limit value. The lower limit values of the transient transmission time are as follows: · A master station communication speed of 1Gbps: 14μs · A master station communication speed of 100Mbps: 140μs
When "Communication Speed" of the master station is 1Gbps, has the cyclic data size exceeded 2K bytes in total for all device stations on the device side with a communication speed of 100Mbps at the boundary between CC-Link IE TSN Class B devices (except for the master station) with a communication speed of 1Gbps and CC-Link IE TSN Class B devices with a communication speed of 100Mbps?	• Limit the number of connected stations so that the cyclic data size of the devices with a communication speed of 100Mbps does not exceed 2K bytes in total. • Connect the device with a communication speed of 100Mbps to the master station.
Is "Communication Period Setting" in "Basic Settings" of the module parameter set to the communication cycle that is not supported by the connected device station?	Set "Communication Period Setting" in "Basic Settings" of the module parameter to the communication cycle supported by the connected device station.
Is the CC-Link IE TSN-CC-Link IE Field Network bridge module, the CC-Link IE TSN-AnyWireASLINK bridge module, or the CC-Link IE TSN FPGA module connected?	Check the connected devices and disconnect the relevant modules.
Is SM973 (Communication cycle intervals measure setting status) set to on (Communication cycle interval measure enabled)?	Reset the controller by setting a value other than A501H (Communication cycle intervals measure disabled) to SD972 (Communication cycle intervals measure setting) and by disabling Communication cycle intervals measure by turning off SM972 (Communication cycle intervals measure setting request).

If the above actions do not solve the problem, perform the module communication test to check for hardware failure.
(☞ Page 1769 Module communication test)

When transient transmission failed

The following lists the actions to be taken if transient transmission cannot be performed with the target station, and the engineering tool cannot perform monitoring.

Check item		Action
Is the D LINK LED on the controller turned on?		Perform troubleshooting for when the D LINK LED turns off or is flashing. (☞ Page 1676 When the D LINK LED turns off or is flashing)
Is the data link status of the target station normal?		Use CC-Link IE TSN diagnostics to identify the cause of the error and take appropriate action. (☞ Page 1697 CC-Link IE TSN/CC-Link IE Field diagnostics)
Is "— — —" displayed on the dot matrix LED on the controller?		Set the module parameters.
When "Connection Device Information" under "Basic Settings" of the master station is set to "CC-Link IE TSN Class B Only"	Are CC-Link IE TSN Class A devices connected?	• Check the connected device and disconnect the CC-Link IE TSN Class A devices. • When connecting a CC-Link IE TSN Class A device, set "Connection Device Information" of the master station to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".
	Is an industrial switch (CC-Link IE TSN Class A certified) connected between CC-Link IE TSN Class B devices?	Check the connected devices and either remove the industrial switch (CC-Link IE TSN Class A certified) or replace it with an industrial switch (CC-Link IE TSN Class B certified).
When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only"	Is a CC-Link IE TSN Class B device other than the master station connected with an industrial switch (CC-Link IE TSN Class A certified) in a star topology?	• In star topology, do not connect CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class A certified) other than the master station. • Connect CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class B certified).
	Are the master station and CC-Link IE TSN Class B device connected via an industrial switch (CC-Link IE TSN Class A certified)?	• Check the connected devices, and connect the master station and CC-Link IE TSN Class B devices in a line topology without connecting an industrial switch (CC-Link IE TSN Class A certified). • Check the connected devices, and connect the master station and CC-Link IE TSN Class B devices to industrial switches (CC-Link IE TSN Class B certified).
	Is an Ethernet device connected to places other than the end of the network?	Check the connected device and connect the Ethernet device at the end of the network.
	Does the connected industrial switch support the CC-Link IE TSN Class used?	Use an industrial switch that supports "CC-Link IE TSN Class Setting" set to the master station. For the models and usage methods of industrial switches, refer to the CC-Link Partner Association website (www.cc-link.org).
	Is event code 00C81H registered in the event history?	Change "CC-Link IE TSN Class Setting" under "Network Configuration Settings" or "CC-Link IE TSN Class" on the device station side so that the CC-Link IE TSN Class settings for each station match.

<table>
<tr><th colspan="3">Check item</th><th>Action</th></tr>
<tr><td rowspan="7">When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only"</td><td colspan="2">Is event code 00C80H registered in the event history?</td><td rowspan="2">Take one of the following actions.
• Check 'Station protocol version 2.0 support status' (SW01A0 to SW01AF) and update the firmware of all device stations to support protocol version 2.0. Alternatively, replace with device stations that support protocol version 2.0.
• Set 'Protocol setting' (Un\G1294018) of the master station to 1: Protocol version 1.0 fixed. (☞ Page 2131 Operating protocol setting)
• After powering on the device stations and the devices on the communication path, power on the master station.</td></tr>
<tr><td>Is '2: Operating with the protocol version 2.0' stored in 'Protocol operating status' (Un\G1294016)?</td><td>Are there any stations that do not support protocol version 2.0 stored in 'Station protocol version 2.0 support status' (SW01A0 to SW01AF)?</td></tr>
<tr><td rowspan="3">Is '1: Operating with the protocol version 1.0' stored in 'Protocol operating status' (Un\G1294016)?</td><td>Are there any stations that do not support protocol version 2.0 stored in 'Station protocol version 2.0 support status' (SW01A0 to SW01AF)?</td><td>Check 'Station protocol version 2.0 support status' (SW01A0 to SW01AF) and update the firmware of all device stations to support protocol version 2.0. Alternatively, replace with device stations that support protocol version 2.0.</td></tr>
<tr><td>Are nine or more CC-Link IE TSN Class B devices and industrial switches (CC-Link IE TSN Class B certified) connected to the transmission path from the master station to the terminating CC-Link IE TSN Class B device at each port of the master station?</td><td>Check the connected devices, and limit the total number of CC-Link IE TSN Class B devices and industrial switches (CC-Link IE TSN Class B certified) on the transmission path from the master station to the terminating CC-Link IE TSN Class B device at each port of the master station to 8 or less.</td></tr>
<tr><td>Has the cyclic data size exceeded 2K bytes in total for CC-Link IE TSN Class A devices connected to the CC-Link IE TSN Class B devices other than the master station? (Including when connecting to CC-Link IE TSN Class B devices via industrial switches (CC-Link IE TSN Class A certified))</td><td>• Connect to a CC-Link IE TSN Class B device via an industrial switch (CC-Link IE TSN Class B certified). (If connecting via an industrial switch, change the industrial switch to an industrial switch (CC-Link IE TSN Class B certified).)
• Limit the number of connected stations so that the cyclic data size of the CC-Link IE TSN Class A devices does not exceed 2K bytes in total.
• Connect the CC-Link IE TSN Class A device to the master station.</td></tr>
<tr><td colspan="2">Is there any difference between the CC-Link IE TSN Class B/A mixed system configuration and the "TSN HUB Setting" in "Connection Device Information" under "Basic Settings"?</td><td>For details, refer to the following.
☞ Page 1728 When CC-Link IE TSN Class A device does not perform data link</td></tr>
<tr><td colspan="2">If the "CC-Link IE TSN Class Setting" of the general CC-Link IE TSN module added to the station list in the "CC-Link IE TSN Configuration" window is CC-Link IE TSN Class A, are the minimum values for communication cycle interval and cyclic transmission time set to "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings"?</td><td>Select the actual device to be used from "Module List" in the "CC-Link IE TSN Configuration" window and add it to the list of stations, or refer to the manual for the device to be connected to check the maximum response time for the time managed polling method and set the calculated values to "Communication Period Interval Setting" and "Cyclic Transmission Time".</td></tr>
<tr><td colspan="2">Is event code 00C72H registered in the event history of the master station?</td><td>• Update the engineering tool to the latest version.
• Update the device station firmware with the IP address displayed in the detailed information of the event history to the latest version.</td></tr>
<tr><td colspan="3">If the stations are connected in a line topology, does "Communication Speed" for the stations match one another?</td><td>Correct "Communication Speed" under "Application Settings" for the stations so that the communication speeds match one another.</td></tr>
<tr><td colspan="3">Is there any reason why cyclic transmission cannot be performed on the device station side?</td><td>• Check if an error has occurred on the device station.
• Check if the device station settings and parameters are correct.
• Refer to the manual of the device station for troubleshooting.</td></tr>
<tr><td colspan="3">Is event code 00C44H registered in the event history?</td><td>Ensure that the communication speed of the master station and the communication speed of device station match.</td></tr>
<tr><td colspan="3">Is the minimum value of the communication cycle interval set in the communication cycle interval setting in "Communication Period Setting" under "Basic Settings" of the module parameter?</td><td rowspan="2">Ensure that the largest value obtained from the following formulas is added to "Cyclic Transmission Time".
• 10% of the minimum value of the calculated cyclic transmission time
• When the communication speed of the master station is set to 1Gbps: Number of device stations × 2μs
• When the communication speed of the master station is set to 100Mbps: Number of device stations × 20μs</td></tr>
<tr><td colspan="3">Is the minimum value of the cyclic transmission time set in "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the module parameter?</td></tr>
<tr><td colspan="3">When "Communication Speed" of the master station is 1Gbps, has the cyclic data size exceeded 2K bytes in total for all device stations on the device side with a communication speed of 100Mbps at the boundary between CC-Link IE TSN Class B devices (except for the master station) with a communication speed of 1Gbps and CC-Link IE TSN Class B devices with a communication speed of 100Mbps?</td><td>• Limit the number of connected stations so that the cyclic data size of the devices with a communication speed of 100Mbps does not exceed 2K bytes in total.
• Connect the device with a communication speed of 100Mbps to the master station.</td></tr>
</table>

Check item	Action
Is "Communication Period Setting" in "Basic Settings" of the module parameter set to the communication cycle that is not supported by the connected device station?	Set "Communication Period Setting" in "Basic Settings" of the module parameter to the communication cycle supported by the connected device station.
Is the CC-Link IE TSN-CC-Link IE Field Network bridge module, the CC-Link IE TSN-AnyWireASLINK bridge module, or the CC-Link IE TSN FPGA module connected?	Check the connected devices and disconnect the relevant modules.
Has the communication path using dynamic routing been determined?	• Power on the system, and then start transient transmission after a while. • When "Dynamic Routing" is set to "Disable" for the stations on the communication path, change the settings to "Enable".
Do the relay stations on the communication path support dynamic routing?	If relay stations which do not support dynamic routing exist, set "Routing Setting" in "CPU parameter" to all stations on the communication path.
Is transient transmission performed with the send data size exceeding the maximum value?	Review the send data size and perform transient transmission again. (☞ Page 215 Performance specifications of CC-Link IE TSN)

If the above actions do not solve the problem, perform the following tests to check for an error.

- Module communication test (☞ Page 1769 Module communication test)
- Communication test (☞ Page 1713 Communication test)

When a station is disconnected from the network

The following is the action to be taken when a station in data link is disconnected.

Check item	Action
Is the ambient temperature for the module out of specification range?	Keep the ambient temperature within the specification range by taking actions such as removing heat source.

If the above action does not solve the problem, perform the module communication test to check for hardware failure. (☞ Page 1769 Module communication test)

When a station is repeatedly disconnected and reconnected

The following lists the actions to be taken when a station in data link is repeatedly disconnected and reconnected.

Check item		Action
Do the used Ethernet cables conform to the standard?		Replace the cables with Ethernet cables which conform to the standard. (☞ Page 62 Ethernet cable)
Is the station-to-station distance 100m or less?		Set the station-to-station distance within 100m.
Does the cabling condition (bending radius) meet the specifications?		Refer to the manual for the Ethernet cable, and if the bending radius is out of the specification range, correct the bending radius.
Is any Ethernet cable disconnected?		If an Ethernet cable is disconnected, replace the Ethernet cable.
Is the industrial switch used operating normally?		• Use an industrial switch that conforms to the standard. (☞ Page 63 Industrial switch) • Power the industrial switch off and on.
Is the station that is the time synchronization source normal?		Check the manual of the module used for the time synchronization source station.
Are resets of other stations repeated?		Avoid unnecessary reset since a station is disconnected while resetting.
Are other stations repeatedly powered on/off?		Avoid unnecessary power-off, since a station is disconnected while turned off.
When "Communication Speed" of the master station is set to 100Mbps, is "System Reservation Time" in "Communication Period Setting" under "Basic Settings" of the master station set to 20μs?		Set "System Reservation Time" to 200μs.
When "Communication Speed" of the master station is set to 1Gbps and a CC-Link IE TSN Class B/A device with a communication speed of 100Mbps is used, is "Communication Period Setting" set to "Basic Period" or "Normal-Speed"?		For a CC-Link IE TSN Class B/A device with a communication speed of 100Mbps, set "Communication Period Setting" to "Low-Speed".
Is '1: Operating with the protocol version 1.0' stored in 'Protocol operating status' (Un\G1294016)?	Has the cyclic data size exceeded 2K bytes in total for CC-Link IE TSN Class A devices connected to the CC-Link IE TSN Class B devices other than the master station? (Including when connecting to CC-Link IE TSN Class B devices via industrial switches (CC-Link IE TSN Class A certified))	Connect to a CC-Link IE TSN Class B device via an industrial switch (CC-Link IE TSN Class B certified). (When connecting via an industrial switch (CC-Link IE TSN Class A certified), change it to an industrial switch (CC-Link IE TSN Class B certified).)

Check item	Action
Is there any difference between the CC-Link IE TSN Class B/A mixed system configuration and the "TSN HUB Setting" in "Connection Device Information" under "Basic Settings"?	For details, refer to the following. ☞ Page 1728 When CC-Link IE TSN Class A device does not perform data link
Are the restrictions of industrial switches (CC-Link IE TSN Class B certified) violated?	Follow the restrictions for industrial switches (CC-Link IE TSN Class B certified). For details on the restrictions, refer to the manual for the industrial switch (CC-Link IE TSN Class B certified) used.
When "Communication Speed" of the master station is 1Gbps, has the cyclic data size exceeded 2K bytes in total for all device stations on the device side with a communication speed of 100Mbps at the boundary between CC-Link IE TSN Class B devices (except for the master station) with a communication speed of 1Gbps and CC-Link IE TSN Class B devices with a communication speed of 100Mbps?	• Limit the number of connected stations so that the cyclic data size of the devices with a communication speed of 100Mbps does not exceed 2K bytes in total. • Connect the device with a communication speed of 100Mbps to the master station.
In the connection, is there any device station that cannot configure a line topology with 121 or more stations on the trunk line of one port of the master station?	• Refer to '121 or more stations line topology non-support detection status' (SW0520 to SW052F) and check the device station products that do not support the line topology with 121 or more stations. • Device stations other than the ones manufactured by Mitsubishi Electric are recognized as the devices that do not support line topology with 121 or more stations. Also, for details on the device stations manufactured by Mitsubishi Electric, refer to the following technical bulletin. 📖Line Topology with 121 or More Device Stations (CC-Link IE TSN Products) • If the device station supports line topology with 121 or more stations, update the firmware to the supported version. • If the device station does not support line topology with 121 or more stations, correct the network configuration to the line topology configuration with 120 or less stations, or replace the device station to one that supports the line topology with 121 or more stations.
Is the cyclic transmission time set for a value smaller than the values shown in the following conditions? ■Conditions • 110% of 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273) • The value obtained by adding the following to 'Cyclic transmission time (calculation value)' (U3E0\G10272 to U3E0\G10273): When the communication speed of the master station is set to 1Gbps: Number of device stations × 2μs When the communication speed of the master station is set to 100Mbps: Number of device stations × 20μs	Set the cyclic transmission time for a value larger than the values shown in the conditions in the left column. If the setting causes the communication cycle interval to exceed the maximum value (10000.00μs), set the cyclic transmission time and communication cycle interval so that the communication cycle interval is within the limit by referring to the following. ☞ Page 2116 Shortening method of the communication cycle interval and cyclic transmission time
Is the CC-Link IE TSN-CC-Link IE Field Network bridge module, the CC-Link IE TSN-AnyWireASLINK bridge module, or the CC-Link IE TSN FPGA module connected?	Check the connected devices and disconnect the relevant modules.
Is SM973 (Communication cycle intervals measure setting status) set to on (Communication cycle interval measure enabled)?	Reset the controller by setting a value other than A501H (Communication cycle intervals measure disabled) to SD972 (Communication cycle intervals measure setting) and by disabling Communication cycle intervals measure by turning off SM972 (Communication cycle intervals measure setting). For details on SM972 and SM973, refer to the following. ☞ Page 1959 Latch area For details on SD972, refer to the following. ☞ Page 1996 Latch area
Is there any noise affecting the system?	Change the placement and/or wiring of the modules so that the system is not affected by noise.
Is a TSN hub installed at the end of line topology?	• Increase the number of Sync frame receive timeouts of the TSN hub. • If the number of Sync frame receive timeouts of the TSN hub cannot be increased or no improvement can be seen by increasing the number, review the network so that the TSN hub can be installed closer to the master station. Alternatively, connect the TSN hub and other stations after all the stations closer to the master station than the TSN hub establish data link. For the upper limit of the number of Sync frame receive timeouts and the setting method, refer to the TSN hub manual.

If the above actions do not solve the problem, perform the module communication test to check for hardware failure.
(☞ Page 1769 Module communication test)

When communications are unstable

When cyclic data transfer processing time or transmission delay time is long or when a transient transmission timeout occurs, check the following items.

Check item	Action
Is the L ER LED on the controller turned on?	If turned on, perform troubleshooting for a case when the L ER LED is turned on. (☞ Page 1677 When the L ER LED turns on)
Is the ambient temperature for the module out of specification range?	Keep the ambient temperature within the specification range by taking actions such as removing heat source.
Is any error shown in "Selected Station Communications Status Monitor" of CC-Link IE TSN diagnostics?	If an error is identified at P1 or P2, perform a module communication test.
Is there any noise affecting the system?	Change the placement and/or wiring of the modules so that the system is not affected by noise.
Is SM973 (Communication cycle intervals measure setting status) set to on (Communication cycle interval measure enabled)?	Reset the controller by setting a value other than A501H (Communication cycle intervals measure disabled) to SD972 (Communication cycle intervals measure setting) and by disabling Communication cycle intervals measure by turning off SM972 (Communication cycle intervals measure setting request).

If the above actions do not solve the problem, perform the module communication test to check for hardware failure.
(☞ Page 1769 Module communication test)

When communications using the SLMP cannot be performed

When communications using the SLMP cannot be performed, check the following items.

Check item	Action
Has the connection with the external device been opened?	• If the connection with the external device is not opened, perform the open processing.*1 • If an error occurs, check and eliminate the error cause.
Is the correct command format used for the command type, device specification, address specification, and others?	Correct the command format. (📖SLMP Reference Manual)
Does the external device send a command?	If the external device does not send a command, send a command to the controller.
Is a response returned to the device that sent the command?	• If no response is returned, check if the correct IP address is specified in the command. If not, correct the IP address and send the command again. • If a response is returned, check its end code to correct the faulty area. (📖Manual for the SLMP-compatible device)
Is the same communication speed set for the connected device and access destination?	Change the connection destination so that the connected device and access destination have the same communication speed.
Is the default open port used for communication closed?	Check "CC-Link IE TSN" in "Setting to Use or Not to Use Default Open Port" of "Security" under "Module Parameter (Common Setting)" and set the port to "Open" if necessary.
Are the usage purpose and the default open port used for communication appropriate?	Select an appropriate default open port according to the usage such as MELSOFT communication or SLMP communication. (☞ Page 1586 Setting to Use or Not to Use Default Open Port)
Is an error code registered in Buffer memory (Un\G3989847)?	If an error code is registered, take corrective actions according to the error code.

If the above actions do not solve the problem, perform the module communication test to check for hardware failure.
(☞ Page 1769 Module communication test)

*1 If the connection of only the external device is closed due to communication cable disconnection or personal computer restart, reopen the connection using the same port as that used before the error occurrence. The connection is not closed if another Active open request is received from the external device with a different IP address or port number.

When communications with Ethernet devices failed

When communications with Ethernet devices cannot be performed, check the following items.

Check item	Action
Is the firewall or proxy server setting enabled on the Ethernet device?	Check and correct the settings on the Ethernet device. (Such as: Is a response to the PING command (ICMP echo response) disabled?)
Is the antivirus software on the Ethernet device blocking the communication?	Check and correct the antivirus software settings on the Ethernet device. • Is the security setting level of the antivirus software low? • Is a response to the PING command (ICMP echo response) disabled in the firewall settings?
Is the default open port used for communication closed?	Check "CC-Link IE TSN" in "Setting to Use or Not to Use Default Open Port" of "Security" under "Module Parameter (Common Setting)" and set the port to "Open" if necessary.
Are the usage purpose and the default open port used for communication appropriate?	Select an appropriate default open port according to the usage such as MELSOFT communication or SLMP communication. (☞ Page 1586 Setting to Use or Not to Use Default Open Port)
Is an error code registered in Buffer memory (Un\G3989847)?	If an error code is registered, take corrective actions according to the error code.

For details on when communication using the engineering tool is not allowed in the settings of Windows Firewall, refer to the following.

📖GX Works3 Operating Manual

If the above actions do not solve the problem, perform the module communication test to check for hardware failure.

(☞ Page 1769 Module communication test)

When communications for the link device failed although the data link is normal

When the link device cannot communicate although the data link is normal (D LINK LED is on), check the following items.

Check item	Action
Is "Reserved/Error Invalid Station" of the device station set to "Reserved Station" in "Network Configuration Settings" of the master station?	Set "Reserved/Error Invalid Station" of the device station to "No Setting".
Is the input/output bit setting or input/output word setting of the device station set in "Network Configuration Settings" of the master station? (Simple display)	Set a link device used in the device station correctly.
Are "RX Setting", "RY Setting", "RWw Setting", and "RWr Setting" of the device station set in "Network Configuration Settings" of the master station? (Detailed display)	
Does the device station support the link devices set in "Network Configuration Settings" of the master station?	Correct the link devices to be assigned to the device station in "Network Configuration Settings" of the master station.
Is the link refresh setting range correct?	Correct the setting in "Refresh Settings" of "Basic Settings".
Is the refresh range of "CPU Side" in "Refresh Settings" overlapped with that of "CPU Side" of another network module?	
If PDO communication data is not transmitted when using the CANopen communication function, is CANopen initialization failure (event code: 00C70H) registered in the event history of the master station?	Check the contents displayed in the detailed information of the event, and take the appropriate action. For details, refer to the manual of the external device.

When the network map or selected station communication status monitor is not displayed correctly

If the network map of "CC-Link IE TSN/CC-Link IE Field Diagnostics" or the selected station communication status monitor is not displayed correctly, check the following.

Check item	Action
Is the network in the ring topology configured correctly?	• Match "Network Topology" under "Basic Settings" to the actual connection status.
Does the version of the engineering tool support the controller?	Use a version of the engineering tool that supports the controller.

When communications cannot be performed with the external device while the default open port is used

When the default open port is used, if communications cannot be performed with the external device, check the following.

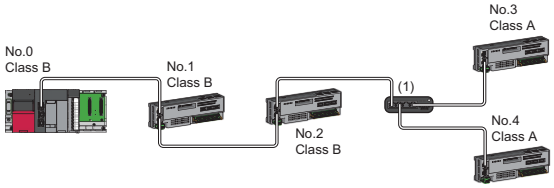
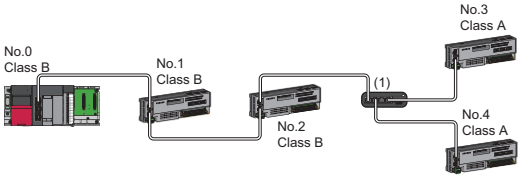
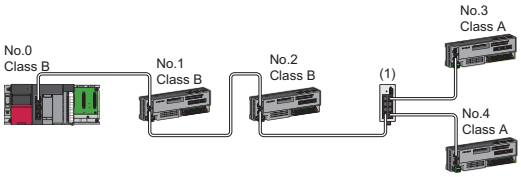
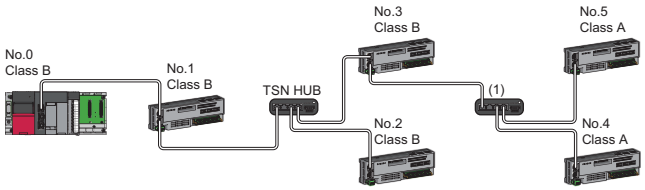
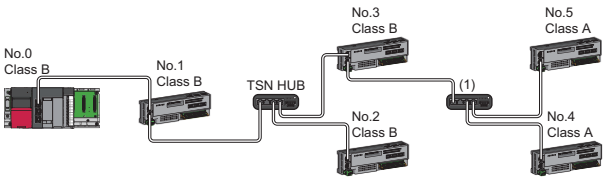
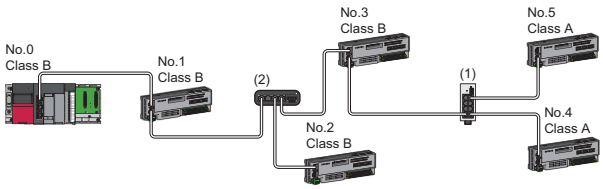
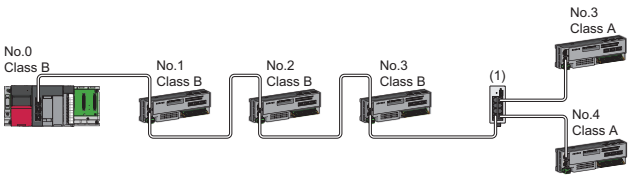
Check item	Action
Is the default open port used for communication closed?	Check "CC-Link IE TSN" in "Setting to Use or Not to Use Default Open Port" of "Security" in "Basic Settings" under "Module Parameter (Common Setting)" and set the port to "Open" if necessary.
Are the usage purpose and the default open port used for communication appropriate?	Select an appropriate default open port according to the usage, such as communication with a CC-Link IE TSN device, MELSOFT communication, search for the controller and CPU module on the network, or SLMP communication.

When CC-Link IE TSN Class A device does not perform data link

If there is a difference between the system configuration with mixed CC-Link IE TSN Class B/A and the "TSN HUB Setting", the CC-Link IE TSN Class A device may not perform a data link.

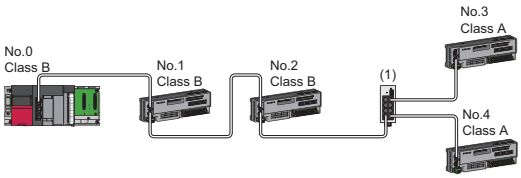
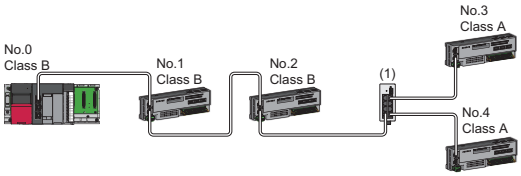
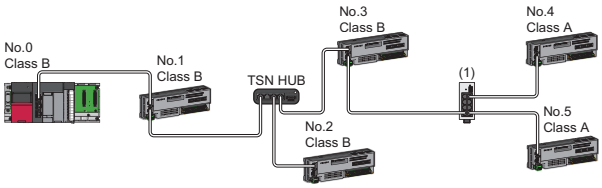
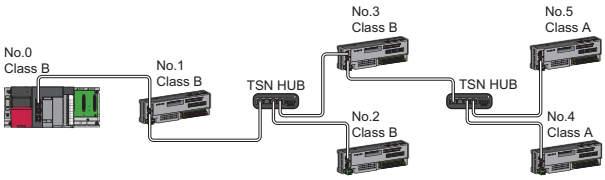
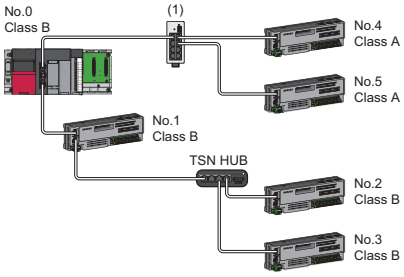
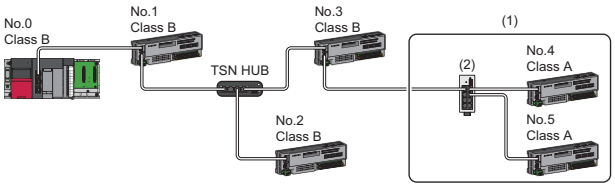
When set to "Not to Use TSN HUB"

If "TSN HUB Setting" in "Connection Device Information" under "Basic Settings" is set to "Not to Use TSN HUB", check the following.

Check item	Action
Are the CC-Link IE TSN Class B device and CC-Link IE TSN Class A device connected via (1) an industrial switch (CC-Link IE TSN Class B certified)? 	Set "TSN HUB Setting" in "Connection Device Information" under "Basic Settings" to "Use TSN HUB".  (1) Industrial switch (CC-Link IE TSN Class B certified)
	Connect the CC-Link IE TSN Class B device directly to the CC-Link IE TSN Class A device. Or, connect via (1) industrial switch (CC-Link IE TSN Class A certified). 
Is (1) an industrial switch (CC-Link IE TSN Class B certified) used in the connection between CC-Link IE TSN Class B devices? 	Set "TSN HUB Setting" in "Connection Device Information" under "Basic Settings" to "Use TSN HUB".  (1) Industrial switch (CC-Link IE TSN Class B certified)
Is (2) an industrial switch (CC-Link IE TSN Class B certified) used in the connection between CC-Link IE TSN Class B devices?  (1) Industrial switch (CC-Link IE TSN Class A certified)	Remove the industrial switch (CC-Link IE TSN Class B certified) used to connect CC-Link IE TSN Class B devices.  (1) Industrial switch (CC-Link IE TSN Class A certified)

When set to "Use TSN HUB"

If "TSN HUB Setting" in "Connection Device Information" under "Basic Settings" is set to "Use TSN HUB", check the following.

Check item	Action
Are the CC-Link IE TSN Class B device and CC-Link IE TSN Class A device directly connected or connected via (1) industrial switch (CC-Link IE TSN Class A certified)? 	Set "TSN HUB Setting" in "Connection Device Information" under "Basic Settings" to "Not to Use TSN HUB".  (1) Industrial switch (CC-Link IE TSN Class A certified)
Are the CC-Link IE TSN Class B device and CC-Link IE TSN Class A device directly connected or connected via (1) industrial switch (CC-Link IE TSN Class A certified)? 	Connect the CC-Link IE TSN Class B device and CC-Link IE TSN Class A device via an industrial switch (CC-Link IE TSN Class B certified) (TSN HUB). 
	Connect the CC-Link IE TSN Class A device directly to the master station. Or, connect via (1) industrial switch (CC-Link IE TSN Class A certified). 
	Limit the number of connected stations so that the cyclic data size does not exceed 2K bytes in total (1) for device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A.  (2) Industrial switch (CC-Link IE TSN Class A certified)
	Set "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" to "2K bytes". (☞ Page 313 Parameter settings)

When invalid information is displayed in the event history or detailed information of the module diagnostics window

When invalid information, such as the IP address of an unconnected device, is displayed in the event history or detailed information of the module diagnostics window, check the following items.

Check item	Action
Is the network in the ring topology configured correctly?	Correct the wiring, such as loop wiring, to be proper ring topology.

When a synchronous communication error is detected in a device station

When a synchronous communication error is detected in a device station, check the following items.

Check item	Action
Is the system used in an environment with large temperature changes?	Wire as follows to reduce the number of stations from the master station to the device station at the end side. • Equalize the number of device stations to be connected to each port. • Re-connect a device station where a synchronous communication error was detected and the subsequent device stations to other ports. • Re-connect a device station where a synchronous communication error was detected and the subsequent device stations using the TSN hub.
In the connection, is there any device station that cannot configure a line topology with 121 or more stations on the trunk line of one port of the master station?	• Refer to '121 or more stations line topology non-support detection status' (SW0520 to SW052F) and check the device station products that do not support the line topology with 121 or more stations. • Device stations other than the ones manufactured by Mitsubishi Electric are recognized as the devices that do not support line topology with 121 or more stations. Also, for details on the device stations manufactured by Mitsubishi Electric, refer to the following technical bulletin. 📖Line Topology with 121 or More Device Stations (CC-Link IE TSN Products) • If the device station supports line topology with 121 or more stations, update the firmware to the supported version. • If the device station does not support line topology with 121 or more stations, correct the network configuration to the line topology configuration with 120 or less stations, or replace the device station to one that supports the line topology with 121 or more stations.
In a line topology with 120 or less stations on the trunk line of one port of the master station, is there any device station among the connected ones whose number of connected stations exceeds its maximum number of connectable stations?	Use any of the following ways for wiring so as to reduce the number of stations from the master station to the device station at the end side. • Re-connect a device station where a synchronous communication error was detected and the subsequent device stations to other ports. • Re-connect a device station where a synchronous communication error was detected and the subsequent device stations using the TSN hub. For the maximum number of connectable stations, refer to the manuals for the device station used.
Is a TSN hub installed at the end of line topology?	• Increase the number of Sync frame receive timeouts of the TSN hub. • If the number of Sync frame receive timeouts of the TSN hub cannot be increased or no improvement can be seen by increasing the number, review the network so that the TSN hub can be installed closer to the master station. Alternatively, connect the TSN hub and other stations after all the stations closer to the master station than the TSN hub establish data link. For the upper limit of the number of Sync frame receive timeouts and the setting method, refer to the TSN hub manual.

73.3 Ethernet Troubleshooting

This section describes troubleshooting by symptom related to Ethernet.

When communications cannot be performed with the external device

The following lists the actions to be taken if communications cannot be performed with the external device.

Check item	Action
Is the Ethernet cable securely connected?	If the Ethernet cable is not securely connected, take the following actions. • Securely lock the cable. • Check the wiring. (☞ Page 62 Ethernet cable)
Does the external device conform to the Ethernet standard?	If the device does not conform to the Ethernet standard, replace it with one conforming to the standard. (☞ Page 216 Performance specifications of Ethernet)
Do the used Ethernet cables conform to the standard?	Replace the cables with Ethernet cables which conform to the standard. (☞ Page 62 Ethernet cable)
Is the external device powered on?	If the external device is not powered on, power it on.
Does any error occur in the external device, hub, router, or other devices?	If an error occurs, refer to the manual for each device and take action.
Is the access from the external device set to be denied in "IP Filter Settings" of "Security" under "Application Settings" of "Module Parameter (Ethernet)"?	If the access from the external device is denied in "IP Filter Settings", change the setting so that the access is allowed. (☞ Page 1583 IP Filter Settings)
Was a device on the line (such as an Ethernet-equipped module, external device, hub, and router) replaced with the one with the same IP address?	If a device was replaced, take any of the following actions. • Wait for update of the ARP cache (waiting time varies depending on the device) • Restart all the devices on the line*1
Is the IP address of the external device specified correctly?	Execute a PING test to the IP address of the external device. If the existence of the external device cannot be checked, network configuration is incorrect. Consult with the system or network manager.
Is "Module Operation Mode" in "Basic Settings" under "Module Parameter (Common Setting)" not set to "Online".	Set "Module Operation Mode" in "Basic Settings" under "Module Parameter (Common Setting)" to "Online". (☞ Page 1769 Module Operation Mode)
Has the initial processing been completed normally? (Check 'Initial status' (U3E0\G683).)	If the initial processing has not been completed successfully, correct the module parameters.
Is the access from the controller denied by the security setting of the external device?	Correct the security setting (such as firewall) of the external device.
Is the network setting change function being used?	Check "Network setting information" by executing module diagnostics using the engineering tool and correct the setting details.
Does a timeout occur when connecting to the engineering tool?	Increase the value for "Check at Communication Time" and "Retry Times" in the following windows in the "Specify Connection Destination Connection" window and connect again. • "Host Station Detailed Setting" window of "No Specification" • "Other Station Detailed Setting" window of "Other Station (Single Network)" or "Other Station (Co-existence Network)"
Is 'Receive abort count' (U3E0\G179) counting up?	Check 'Receive abort count' (U3E0\G179). If it is counting up, there may be a heavy load on the Ethernet line due to data sending and receiving between connected devices. To reduce the load on the Ethernet line, take measures such as separating the network or decreasing the number of times data is sent, or consult with the network manager and reduce the load on the Ethernet line.
When connecting to an engineering tool, use [Ethernet Diagnostics] ⇨ [TCP Status] to check if the connection to be established is "Connected".	Another user may be connected, so wait for the connection to be disconnected or try to connect using UDP. If there is no memory of such connection, it may be an illegal connection. Therefore, turn off the connection for 'Open request signal' (U3E0\G7873 to U3E0\G7876) to disconnect.
Is the connected network communication port correct?	Check whether the connected network communication port supports the corresponding communication function.

*1 A device on Ethernet has a table of IP addresses and their corresponding MAC address, called "ARP cache". When a device on the line is replaced by the one having the same IP address, the MAC address in the ARP cache is different from that of the replaced device; therefore, communications may not be normally performed. The "ARP cache" is updated by resetting the device or after a while. The time varies depending on the device.

When communications cannot be performed with the external device during encrypted communication

The following lists the actions to be taken if communications cannot be performed with the external device during encrypted communication.

Check item	Action
Is a connection with the external device established?	• If the connection with the external device is not opened, perform the open processing. • If an error occurs, check and eliminate the error cause.
Was a server certificate created or read, and then written to the client device?	Create and read the server certificate using the engineering tool, and then write the read server certificate to the client device. (☞ Page 1559 Digital certificate)
Does the protocol (TLS/DTLS) match with that of the external device?	If the protocol (TLS/DTLS) with the external device does not match, set the protocol to match in the "External Device Configuration" of "Basic Settings" under "Module Parameter (Ethernet)".
Are dedicated instructions compatible with an encrypted communication protocol used?	Use dedicated instructions compatible with an encrypted communication protocol.

When communications cannot be performed with the external device while the default open port is used

When the default open port is used, if communications cannot be performed with the external device, check the following.

Check item	Action
Is the default open port used for communication closed?	Check the "Setting to Use or Not to Use Default Open Port" in "Security" of "Basic Settings" under "Module Parameter (Common Setting)".
Are the usage purpose and the default open port used for communication appropriate?	Select an appropriate default open port according to the usage such as MELSOFT communication, SLMP communication, or CPU module search.

When a message sent from the external device cannot be received frequently

If the controller frequently cannot receive messages sent from the external device, check the following items.

Check item	Action
Is any system error stored in 'Connection status storage area' (U3E0\G130 to U3E0\G145) or 'Connection No.1 latest error code to Connection No.64 latest error code' (U3E0\G2080 to U3E0\G2143)?	If many errors are detected or a system error is stored, there may be a heavy load on the Ethernet line due to data sending and receiving between connected devices. • To reduce the load on the Ethernet line, take actions such as separating networks or decreasing the number of times data is sent. • Consult with the network manager and reduce the load on the Ethernet line.

When communications using the Ethernet port are slow

When communications using the Ethernet port are slow, check the following items and take action.

Check item	Action
Is the communication request load from the external device high?	Check 'Current number of received packets per unit time (1s)' (U3E0\G100) or 'Current size of receive data per unit time (1s) [Kbps]' (U3E0\G2032 to U3E0\G2033). If the value is significantly large compared to the normal communications, the following actions may improve the processing speed. • Review the communication request from the engineering tool and GOT. • Review the communication request from the transfer destination (execution source) of the simple CPU communications. • Review the file transfer function (FTP server). • Review the communications using the SLMP.
Is the communication request load from the controller high?	Check 'Current number of sent packets per unit time (1s)' (U3E0\G102) or 'Current size of send data per unit time (1s) [Kbps]' (U3E0\G2036 to U3E0\G2037). If the value is significantly large compared to the normal communications, the following actions may improve the processing speed. • Review the execution frequency of the instructions for the Ethernet function (socket communications instruction/predefined protocol support function instruction/SLMP frame send instruction/file transfer function instruction). • Review the settings (such as the execution interval and the number of points) of the simple CPU communications.

When direct connection to the engineering tool is not possible

When the direct connection to the engineering tool is not possible, check the following items.

Check item	Action
Is the controller directly connected to the engineering tool with a single Ethernet cable?	Directly connect the controller to the engineering tool with a single Ethernet cable.
Is "Disable Direct Connection with MELSOFT" in "Security" of "Basic Settings" under "Module Parameter (Common Setting)" set to "Close"?	If "Disable Direct Connection with MELSOFT" is set to "Close", change the setting to "Open".
Is the connection destination of the engineering tool correctly set?	If the setting is incorrect, check the following items. • Check that "Ethernet Board" is selected in "PC side I/F". • Check that "Ethernet Port Direct Connection" is selected in the "PLC side I/F Detailed Setting of PLC Module" window or "PLC side I/F Detailed Setting of Ethernet Module" window of "PLC side I/F".
Does a timeout occur when connecting to the engineering tool?	Increase the value for "Check at Communication Time" and "Retry Times" in the "Other Station Detailed Settings" window of "Other Station Setting" of the "Specify Connection Destination Connection" window and connect again.
Does the device (personal computer) to be connected support the direct connection?	If the device does not support the direct connection, connect a hub.

When the CPU module or CC-Link IE TSN-equipped module search on the network cannot be performed

When the CPU module or CC-Link IE TSN-equipped module search on the network cannot be performed, check the following items.

Check item	Action
Is "CPU Module Search" in "Security" of "Basic Settings" under "Module Parameter (Common Setting)" set to "Close"?	If "CPU Module Search" is set to "Close", change the setting to "Open".
Is the controller connected to a router?	The CPU module connected via a router cannot be searched. Modify the connection to search the CPU module.
Is the controller connected via wireless LAN?	Perform the search again. (The packet may be lost.)
Is the service processing (such as file read) load of the search target controller high?	• Increase the response waiting time and perform the search again. • Reduce the service processing load of the controller.
Does the network communication port connected to the controller match the "PLC side I/F" specified on the "Specify Connection Destination Connection" window of the engineering tool?	Match the connected network communication port with "PLC side I/F" specified on the "Specify Connection Destination Connection" window.

When communications using the SLMP cannot be performed

When communications using the SLMP cannot be performed, check the following items.

Check item	Action
Has the connection with the external device been opened? (Check 'Open completion signal' (U3E0\G7857 to U3E0\G7860).)*1	• If the connection with the external device is not opened, perform the open processing. • If an error occurs, check and eliminate the error cause.
Is the correct command format used for the command type, device specification, address specification, and others?	Correct the command format. (📖SLMP Reference Manual)
Did the external device send a command?	If the external device does not send a command, send a command to the controller.
Is a response returned to the device that sent the command?	• If no response is returned, check if the correct IP address is specified in the command. If not, correct the IP address and send the command again. • If a response is returned, check its end code to correct the faulty area. (📖Manual for the SLMP-compatible device)
Is the communication method of the connection used for communication with the external device set to an item other than "SLMP" in the "Ethernet Configuration" window?	Correct the communication method setting if an item other than "SLMP" is set. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

*1 If the connection of only the external device is closed due to communication cable disconnection, personal computer restart, or other reasons, reopen the connection using the same port used before the error occurred. The connection is not closed if another Active open request is received from the external device with a different IP address or port number.

When communications using the predefined protocol cannot be performed

When communications using the predefined protocol cannot be performed, check the following items and take action.

Check item	Action
Is the IP address setting of the external device correct?	Check and correct the IP address of the external device.
Has the connection with the external device been opened? (Check 'Open completion signal' (U3E0\G7857 to U3E0\G7860).)*1	• If the connection with the external device is not opened, perform the open processing. • If an error occurs, check and eliminate the error cause.
Has the send/receive processing (dedicated instruction) for the communications using the predefined protocol been executed properly?	• If the send/receive processing has not been executed, check and correct the execution condition of the send/receive processing. • If send/receive processing has completed with an error, check the error code in the completion status and eliminate the error cause.
When the send/receive processing (dedicated instruction) is executed for the communications using the predefined protocol, is the protocol execution status of the relevant connection 5H (execution completed)?	If the protocol execution status does not reach 5H (execution completed), set the protocol cancellation specification for the relevant connection to 1H and execute the send/receive processing (dedicated instruction) again.
Is the appropriate protocol used for the external device in the predefined protocol settings and program?	Correct the predefined protocol settings and program If inappropriate protocol is used. For appropriate protocol for the external device, refer to the manual for the device used.
Is the communication method of the connection used for communication with the external device set to an item other than "Predefined Protocol" in the "Ethernet Configuration" window?	Correct the communication method setting if an item other than "Predefined Protocol" is set. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))
Is 'Predefined protocol ready' (U3E0\G692) on?*2	If 'Predefined protocol ready' (U3E0\G692) is off, write the protocol setting data to the module.
Is the intended receive packet number 0H (verification matched) in the received data verification result for the relevant connection?	If a match is found with an unintended receive packet number, correct the protocol setting data.

*1 If the connection of only the external device is closed due to communication cable disconnection, personal computer restart, or other reasons, reopen the connection using the same port used before the error occurred. The connection is not closed if another Active open request is received from the external device with a different IP address or port number.

*2 Check this item during a RUN state because it is off when the controller is in a STOP state.

When socket communications cannot be performed

When socket communications cannot be performed, check the following items and take action.

Check item	Action
Has the connection with the external device been opened? (Check 'Open completion signal' (U3E0\G7857 to U3E0\G7860).)*1	• If the connection with the external device is not opened, perform the open processing. • If an error occurs, check and eliminate the error cause.
Has the send/receive processing been executed properly?	• If the send/receive processing has not been executed, check and correct the execution condition of the send/receive processing. • If send/receive processing has completed with an error, check the error code in the completion status and eliminate the error cause.
Does 'Socket communications reception status signal' (U3E0\G7889 to U3E0\G7892) turn on when receive processing is executed?	• Send data from the external device. • If data has been sent, check that the destination address (IP address and port number) is correctly set.
Is the communication method of the connection used for communication with the external device set to an item other than "Socket Communication" in the "Ethernet Configuration" window?	Correct the communication method setting if an item other than "Socket Communication" is set. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))
Is the communication method of the connection used for communication with the external device set to an item other than "Broadcast Send" or "Broadcast Receive" in the "Ethernet Configuration" window when broadcast communications are performed?	Correct the communication method setting if an item other than the one described in the left is set. (☞ Page 194 "Ethernet Configuration" Window (External Device Configuration Setting))

*1 If the connection of only the external device is closed due to communication cable disconnection, personal computer restart, or other reasons, reopen the connection using the same port used before the error occurred. The connection is not closed if another Active open request is received from the external device with a different IP address or port number.

When access using the file transfer function (FTP server) cannot be performed

When the controller cannot be accessed from the external device (FTP client) using the file transfer function (FTP server), check the following items and take action.

Check item	Action
Is the file transfer function (FTP server) for the controller enabled?	Set "FTP Server" in "FTP Server Settings" of "Application Settings" under "Module Parameter (Ethernet)" to "Use". (☞ Page 1347 FTP server settings)
Are the login name and password correct?	Check the login name and password set in the parameters, and log in again. (☞ Page 1347 FTP server settings)
Is the IP address entered at login correct?	Check the IP address of the Ethernet port set in the parameters, and log in again. (☞ Page 190 IP Address Setting)
Is executed command used properly?	Check the instructions of the command and use the command properly. (☞ Page 1353 FTP commands)
Is "Communication Mode" correctly set in "FTP Server Settings" of "Application Settings" under "Module Parameter (Ethernet)"?	Set "Communication Mode" correctly.
Is "Protocol" correctly set in "FTP Server Settings" of "Application Settings" under "Module Parameter (Ethernet)"?	Set "Protocol" correctly.

When access using the file transfer function (FTP client) cannot be performed

When the controller cannot access the external device (FTP server) during execution of the file transfer function (FTP client), check the following items and take action.

Check item	Action
Is a value other than 0000H stored in (s1)+1 (Completion status) of the GP.FTPCPUT or GP.FTPCGET instruction?	Take action for the error code stored in (s1)+1 (Completion status), and execute the instruction again. (☞ Page 1776 ERROR CODES)
If encrypted communication is being performed, is a value other than 0000H stored in (s1)+1 (Completion status) of the GP.FTPCPUT or GP.FTPCGET instruction?	• Check whether the "Version Setting for Encrypted Communication" in "Security" of "Application Settings" under "Module Parameter (Ethernet)" matches the security setting on the FTP server, and then execute the instruction again. Alternatively, select an FTP server that matches the security setting on the controller. • Check whether the cipher suite on the controller is included in the cipher suites that can be supported by the FTP server. If it is not included, set the compatible version again so that the cipher suite that can be used match, and then execute the instruction again. Alternatively, select an FTP server that matches the security setting on the controller. • Check whether the server certificate (self-certificate) issued by the FTP server has been written to the controller, and then execute the instruction again.
Is the IP address set as the DNS server address correct?	Correct "DNS Server 1 Address" or "DNS Server 2 Address" in "DNS Settings" of "Application Settings" under "Module Parameter (Ethernet)".
Is data communication with the set DNS server using the Ping command possible?	If the communication is not possible, check to see if the Ethernet cables are not disconnected.
Does the class match between the IP address of own station (CC-Link IE TSN port and Ethernet port) and the IP address of the DNS server?	If the classes are different, check the router setting.

When using the Web server function

If an abnormal operation occurs while the Web server function is used, refer to the following table and take actions.

Description	Cause	Action
The Web page is not displayed.	The combination of the system Web page, user Web page version, and the firmware version is inconsistent.	Update the version to the consistent one.
	The Web server function is disabled.	Enable the Web server function with parameter settings of the engineering tool and then write the parameters. Or, update the software version of the engineering tool to a version that supports the Web server function, enable the Web server function, and then write the parameters.
	The URL (IP address) is incorrect.	Check that the IP address in the URL matches the controller IP address.
	The port number specified in the URL is incorrect.	Check that the port number in the URL matches the own station port number of the controller.
	When "HTTPS" is selected as the protocol in the parameter settings, the URL is specified as "http://...". Or, when "HTTP" is selected as the protocol in the parameter setting, the URL is specified as "https://...".	Specify a URL that matches the protocol.
	After "HTTPS" or "HTTP/HTTPS" is selected as the protocol in the parameter setting, if the controller is started without creating a server certificate, the URL is specified as "https://...".	Check if a server certificate has been created.
	The Ethernet cable is disconnected.	Check that the Ethernet cable is correctly connected.
	The controller subnet mask is incorrect.	Check that the controller subnet mask is correctly set.
	The controller default gateway is incorrect.	Check the router on the controller side, and check that the controller default gateway is set.
	The LAN is set to use a proxy server.	Check the LAN settings, and disable the proxy server.
The following is displayed. 404 Not Found	The URL (folder path) is incorrect.	Check that the URL (folder path) is correct.
	An SD memory card is not installed.	To access the user Web page, check that an SD memory card containing index.html and Log-in_User.html is installed in the controller.
		To access the program monitor, check that an SD memory card containing a program monitor file is installed in the controller.
	The file name is 65 characters long or more.	Set the file name so that it is up to 64 characters long.
	The file name contains a two-byte character.	Set the file name with one-byte alphanumeric characters.
A message indicating that JavaScript is disabled is displayed.	JavaScript is disabled.	Enable JavaScript in the browser.
A message indicating that cookies are disabled is displayed.	Cookies are disabled.	Enable cookies in the browser.
The page is not displayed correctly, or the page layout is disrupted.	The Web browser does not support the HTML or CSS mounted with the Web server function.	Use a supported Web browser.
	The HTTP request received by the Web server includes no referer header field or the one which is illegal.	In the browser or firewall settings, check if the settings indicate that referer is not sent.
Characters are corrupted.	The Web browser character encoding setting is incorrect.	Check the Web browser character encoding setting.
A message indicating that the device name is incorrect is displayed.	The device name is incorrect.	Check that the device name is correct.
A message indicating that the device number is out of range is displayed.	The device number is out of range.	Check that the device number is within the specified range.
A message indicating that the setting value for the device is out of range is displayed.	The setting value for the device is out of range.	Check that the device setting value is within the specified range.

Description	Cause	Action
If the method of authentication to the web server is unique, a login is denied and the following message is displayed. The user name or password is incorrect.	The user name or password is incorrect.	Check the user name or password.
If the account of the user authentication function is used, a login is denied and the following message is displayed. Logon failed. Check the following, then retry the operation. • Check the registered user name and password. • If lockout, wait for the specified time. • Check if the password has expired.	The user name or password is incorrect.	Check the user name or password.
	Lockout is in progress.	Wait for the specified time.
	The password has expired.	Check if the password has expired.
The following message is displayed at logon. Logon failed. Check the following, then retry the operation. • A server certificate has been created. • The server certificate has not expired.	A server certificate has not been created or has expired.	Check the creation status of a server certificate or the expiration date.
Images or figure display objects are not displayed on the user Web page.	The file name written in the HTML file of the user Web page is incorrect.	Check that the file name written in the HTML file of the user Web page matches the name of the file stored in the SD memory card.
	An unsupported file format is used.	Check that the format of the image file is available.
	The file size is too large.	Check the file size.
	The description of HTML or JavaScript of the user Web page is incorrect.	Check the description of HTML and JavaScript of the user Web page.
	The parameter settings of the user Web page objects are incorrect.	Check the parameter settings of the user Web page objects.
The following is displayed. 403 Forbidden	The account that has logged on attempted to display a page for which the account does not have the display authority.	Check the display authority of the account, and log on with an account that has the display authority of the page.
	An attempt was made to refresh the system Web page after a communication timeout occurred.	Press "Execute" before a communication timeout occurs and refresh the system Web page.
The following is displayed. 400 Bad Request	The request path is longer than 256 characters. (Path length after http(s)://(IP address)/)	Check the request path length.
The following is displayed. 505 HTTP Version not supported	The HTTP version supported by the browser is earlier than 1.0.	Check if the recommended browser is used.
Items are not refreshed at "Display Update Interval".	The controller has a high communication load.	Reduce the communication load on the controller.
	The line status is unstable.	Check the line status (such as PING).
	The controller has been powered off.	Power on the controller.
A message indicating that an unpermitted operation was performed is displayed.	The account that has logged on does not have the operation authority.	Check the operation authority of the account, and log on with an account that has the operation authority.

When the simple CPU communication function is used

If faulty operation occurs while the simple CPU communication function is used, refer to the following table and take actions.

When communications cannot be performed with the communication destination

Description	Action
Does any error occur in the simple CPU communication diagnostics or simple CPU communication error code in the CPU buffer memory?	Eliminate the error cause. When communications can be performed by increasing the communication retry count and communication time-out period, review the communication retry count and communication time-out period, or check the line status of Ethernet communications with the external device, such as a cable, hub, and router, to check if the line is busy.
Is the communication status of the simple CPU communication diagnostics or the simple CPU communication status of the CPU buffer memory "preparing"?	Check the cable between the controller and hub, and check if the hub is operating normally.
During encrypted communication, does the protocol (DTLS) match with that of the external device?	If the protocol (DTLS) and that of the external device do not match, correct the parameters so that the protocol matches in the external device connection configuration setting of the communication destination.
During encrypted communication, is the certificate of the external device written?	If the certificate of the external device has not been written to the own station, read the server certificate created by the external device and write it to the own station.
During encrypted communication, check if the certificate of the external device has expired.	If the certificate of the external device has expired, create a certificate on the external device again and write it to the own station.

When communications with the communication destination are unstable

Description	Action
Does any error occur in the simple CPU communication diagnostics or simple CPU communication error code in the buffer memory?	Eliminate the error cause.
Is the retry of communications performed?	Check the line status of Ethernet communications with the external device, such as a cable, hub, and router, to check if the line is busy.

When communications cannot be performed at the set execution interval

Description	Action
Is another Ethernet function executed simultaneously in the controller/CPU module where the simple CPU communication function is set?	Review the Ethernet function executed simultaneously in the controller/CPU module where the simple CPU communication function is set.
Is the service processing load of the controller/CPU module of the communication destination high?	• When the communication destination is the model for which service processing setting is available, increase the number of times and the time of service processing of the communication destination. • If the communication destination supports the COM(P) and CCOM instructions, incorporate the COM instruction into the sequence program of the communication destination. • Review the execution interval.
Is the Ethernet communication load high? Or, is the communication quality low?	Check the line status of Ethernet communication with the external device, such as a cable, hub, and router, to reduce the load and improve the communication quality. (Check the number of receive packets per unit time (one second) or the number of send packets per unit time (one second) of the CPU buffer memory, and reduce the load and improve the communication quality.)
Is the response from the SLMP-compatible device delayed? (When the SLMP-compatible device (QnA-compatible 3E frame) is used)	• Check the function execution status of the communication destination (SLMP-compatible device). • Review the execution interval.

When the update by reading and writing device data is slow

Description	Action
The scan time of the controller/CPU module where the simple CPU communication function is set is long.	Incorporate the COM(P) instruction into the sequence program of the controller/CPU module where the simple CPU communication function is set.

When communications cannot be performed with the OPC UA server

When communications with the OPC UA server cannot be performed normally, check the following items and take action.

Symptom	Check item	Action
The OPC UA server cannot be accessed from an OPC UA client.	Is there an error with the OPC UA client?	If an error has occurred, check the details and take action.
	Is the destination OPC UA server correctly set for the OPC UA client?	Correct the destination OPC UA server setting for the OPC UA client.
	Is there a device set to the same IP address on the same network?	• Do not use devices with the same IP address on the same network. • Set the IP addresses of the devices so that they do not overlap.
	Are the security settings correctly set for the controller and OPC UA client?	Check the security settings for the controller and OPC UA client, and take action.
	Are the certificate expiration dates of the controller and OPC UA client correct?	Download the certificates of the controller and OPC UA client, check the expiration dates, and take action.
	Is the server certificate of the controller updated/deleted?	Reset the controller or turn the power off and on.
	Are the user name and password specified at connection correct?	Check and correct the specified user name and password.
	Has a lockout occurred with the user specified at connection?	Check that there is no lockout with the specified user, and take action. (☞ Page 1543 Lockout)
	Has the password of the user specified at connection expired?	Check that the password of the specified user has not expired, and take action. (☞ Page 1547 User status display)
	Is the user specified at connection from a user-defined group that does not have operation authority for device reading?	• Check if the specified user has the operation authority for device reading, and take action. (☞ Page 1539 User group) • Use a user that has the operation authority for device reading.
	Has the connection been attempted with "None" specified in "Security Policy" while "To Use or Not to Use User Authentication" is set to "Use"?	• Specify an item other than "None" in "Security Policy", then establish connection. • Set "To Use or Not to Use User Authentication" to "Not Use".
	Has the user management information or user group management information been changed since the OPC UA server startup?	Restart the OPC UA server.
	Is the operation status of the OPC UA server in the startup status?	When the operation status of the OPC UA server is in the startup processing status, wait until it becomes the startup status.
Node values of an address space are not updated.	Is the polling cycle correctly set?	Correct the polling cycle setting in OPC UA server settings.
Values of an OPC UA client are not reflected in nodes of an address space.	Are the corresponding label values modified inside the controller?	Do not modify the corresponding label values inside the controller while they are being modified by the OPC UA client.
	Is the access right of the corresponding label set to "Read"?	Set the access right of the corresponding label to "Read/Write".
Some nodes cannot be accessed from an OPC UA client.	Are the nodes to be accessed a structure?	Enable the setting that makes structure members public as components to access the nodes of the members.
	Are the nodes to be accessed an array of string [Unicode] or string?	Reduce the lengths of the labels made public to the address space or the number of elements.
At an attempt to connect from the OPC UA client, the client certificate is not displayed in the rejected certificate list and cannot be moved to the trusted list.	—	Acquire the client certificate from the OPC UA client, and write it to the controller.

When the time setting function (SNTP client) cannot be performed normally

When the time setting function (SNTP client) cannot be performed normally, check the following items and take action.

Check item	Action
Is the time setting function (SNTP client) enabled for the controller?	Set "Time Setting (SNTP Client)" in "Time Setting" of "Application Settings" under "Module Parameter (Ethernet)" to "Use". (☞ Page 1935 Time setting)
Are the SNTP server IP address and server name set correctly?	Correct "SNTP Server IP Address" or "SNTP Server Name" in "Time Setting" of "Application Settings" under "Module Parameter (Ethernet)". (☞ Page 1935 Time setting)

When the access cannot be allowed/denied correctly by the IP filter

When the access cannot be allowed/denied correctly by the IP filter, check the following items and take action.

Check item	Action
Is "Access from IP address below" correctly set in "IP Filter Settings" in "Security" of "Application Settings" under "Module Parameter (Ethernet)"?	Correct "Access from IP address below".
Is the IP address correctly set in "IP Address" in "IP Filter Settings" in "Security" of "Application Settings" under "Module Parameter (Ethernet)"?	Correct the IP addresses. When the IP addresses are specified by range, check also "IP Address Excluded from Range".
Is the IP address of the proxy server set to be allowed?	Set the IP address of the proxy server to be denied.

73.4 Motion Function Troubleshooting

This section describes troubleshooting by symptom related to the motion function.

When Servo ON failed

When Servo ON failed, check the following items.

Check item	Action
Are both MC_Power (Operation Available) and MCv_AllPower (All Axes Operation Available) being used?	For the axis set in Axis (axis information) of MC_Power (Operation Available), set MC_Power (Operation Available) to Enable and ServoON to TRUE. (For axes that use both MC_Power (Operation Available) and MCv_AllPower (All Axes Operation Available), the operation of MC_Power (Operation Available) takes precedence.)
Is the controller and servo amplifier not connected, or is the cable used for connection disconnected?	• Check the wiring of the controller and servo amplifier. • Replace the cable used in the connection.
Is the module operation mode set to "Online"?	Set the module operation mode setting to "Online". (☞ Page 1769 Module Operation Mode)
Is each-axis emergency stop or all-axis emergency stop input?	Check AxisName.Md.ForcedStop_Released and MotionSystem.Md.ForcedStop_Released. If they are in the emergency stop state (FALSE (0H)), cancel the emergency stop.
Is there an error occurring in the controller?	Refer to the error code and remove the error cause. (☞ Page 1776 ERROR CODES)
Is there an error occurring in the servo amplifier?	Refer to the servo amplifier manual and remove the error cause.
■Only for multi-axis servo amplifiers (MR-J5W-G) • Is the axis control disable switch of the servo amplifier turned on? • Is the axis emulation enabled for some axes of the multi-axis servo amplifier?	• When using the axis control disable switch, follow the instructions below to configure the settings. Servo amplifier: Set the control axis disable switch. For details, refer to the following. 📖MR-J5-G/MR-J5W-G User's Manual (Introduction) GX Works3: Delete the disabled axes from the network configuration settings. • To enable the axis emulation for some axes of the multi-axis servo amplifier, follow the instructions below to configure the settings. ☞ Page 1186 AXIS EMULATION

When a motor does not rotate

When a motor does not rotate, check the following items.

Check item		Action
Servo ON is TRUE	Is the driver unit conversion numerator/driver unit conversion denominator being set?	Convert the machine feed value to the driver command value by using the driver unit conversion function.
Acceleration/Deceleration method is set to Acceleration/Deceleration specification method (default)	Is Acceleration or Deceleration set as Acceleration (Acceleration)/Deceleration (Deceleration), not acceleration/deceleration time?	Correct the setting value of acceleration/deceleration.

When motion control cannot be used

If motion control cannot be used, check the following item.

Check item	Action
Is MotionSysm.Md.Ready FALSE?	When Programmable controller ready interlock selection (MotionSystem.PrConst.SequenceReadyInterlock) is TRUE: If MotionSystem.Cd.SequenceReady is FALSE, set it to TRUE. When Programmable controller ready interlock selection (MotionSystem.PrConst.SequenceReadyInterlock) is FALSE: If PLC READY (Y20) is FALSE, set it to TRUE.

74 RAS FUNCTIONS RELATED TO TROUBLESHOOTING

RAS stands for Reliability, Availability, and Serviceability. This function improves overall usability of automated equipment.

74.1 RAS Functions of Programmable Controller

Scan monitoring function

This function detects hardware and program errors of the controller by monitoring the scan time. The watchdog timer, an internal timer of the controller, is used to monitor the following scans.

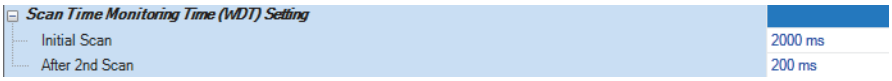
- Initial scan (first scan)
- Second and later scans

Scan Time Monitoring Time (WDT) Setting

Set the scan time monitoring time.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Scan Time Monitoring Time (WDT) Setting]

Window



Displayed items

Item	Description	Setting range	Default
Initial Scan	Sets the scan-time monitoring time (WDT) for the initial scan (first scan).	10 to 2000ms (in units of 10ms)	2000ms
After 2nd Scan	Sets the scan-time monitoring time (WDT) for the second and later scans.	10 to 2000ms (in units of 10ms)	200ms

Watchdog timer reset

The watchdog timer is reset when the END/FEND instruction is executed. While the controller is running correctly, if the END/FEND instruction is executed within the set time of the watchdog timer, the watchdog timer does not count up. If the END/FEND instruction cannot be executed within the set time of the watchdog timer due to a hardware error of the controller or increase in program execution time due to an interrupt or other causes, the watchdog timer counts up.

Precautions

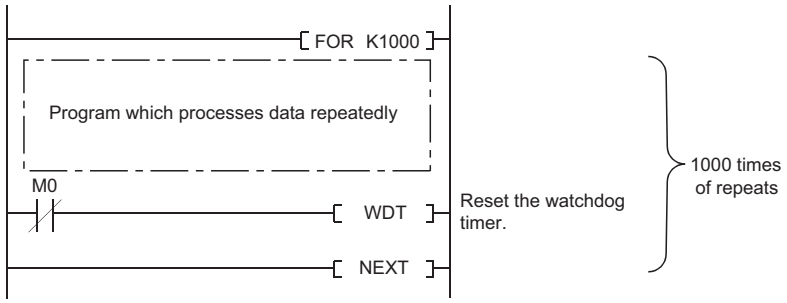
The following lists the precautions on the scan monitoring function.

■Measurement error of watchdog timer

Since the watchdog timer produces an error within the range of -1 to 10ms, take this into consideration when setting the scan time monitoring time. For example, if the scan time monitoring time is set to 100ms, an error will occur when the scan time falls within the range 99ms < t < 110ms.

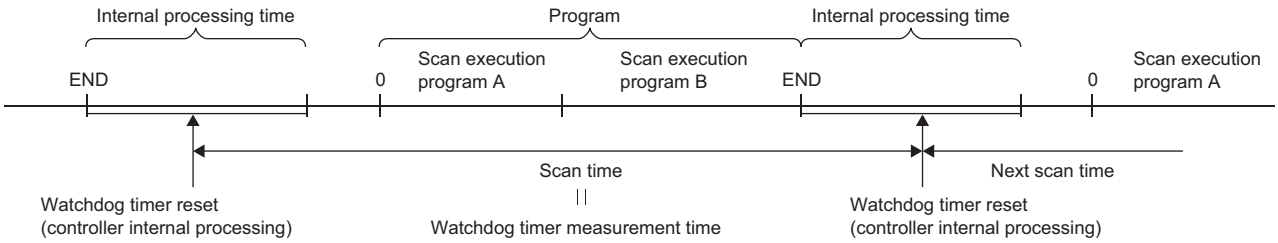
■Resetting the watchdog timer when repeatedly executing a program

The watchdog timer can be reset by executing the WDT reset instruction from the program. If the watchdog timer counts up while a program is being repeatedly executed by the FOR instruction and NEXT instruction, use the WDT reset instruction to reset the watchdog timer.



■Scan time when the WDT reset instruction is used

Even when the watchdog timer is reset by the WDT reset instruction, the scan time is not reset. The scan time is accumulated until the END instruction is executed.



Self-diagnostic function

The controller itself diagnoses whether or not there is an error, and if an error is detected, it sets the operation of the controller.

Self-diagnostics timing

If an error occurs when the controller is powered on or while it is in the RUN/STOP state, the controller detects and displays the error, and stops the operation.

However, depending on the error occurrence status or the instruction to execute, the controller may not be able to detect the error.

Configure safety circuits external to the programmable controller to ensure that the entire system operates safely even in such a case.

Check method of error

This section describes the check methods when error occurs.

■Check method using the special relay and special register

When the controller detects an error, it turns SM0 (Latest self-diagnostics error (including annunciator ON)) and SM1 (Latest self-diagnostics error (not including annunciator ON)) on and stores the error code corresponding to the error definition in SD0 (Latest self-diagnostics error code). If multiple errors are detected, the latest error code is stored in SD0.

Use SM0, SM1, and SD0 on the program for the controller or mechanical interlock.

Besides, up to 16 error codes corresponding to the errors being currently generated will be stored in SD10 to SD25 (Self-diagnostics error codes). (17th or later error codes corresponding to the errors will not be stored.)

■Check method using LED

The error occurrence status can be checked using methods such as the lighting status of the ERROR LED. (☞ Page 1675 When the ERROR LED turns on or is flashing)

■Check method using the engineering tool

The error status for the overall system, the currently generated error or event history can be checked in the module diagnostics window. (📖 GX Works3 Operating Manual)

Item	Description
Existing errors	Up to 16 errors (descriptions of errors) currently generated in the controller can be displayed.*1 However, even when an additional error occurs after a stop error, the error information is not updated.
Error history	The error history can be checked in the event history. The event history is updated only when a battery error occurs, independent of the operating status of the controller. Also, when a battery error is detected after the occurrence of a stop error, the information on existing errors is not refreshed, and only the event history is updated. ☞ Page 1754 Event history function

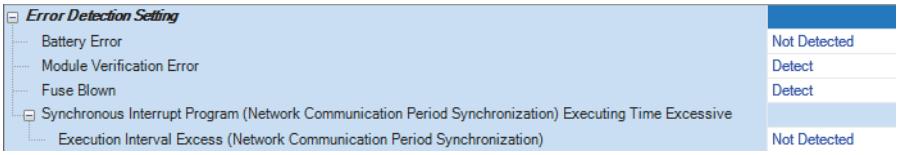
*1 The maximum number of displayable errors is 15 for continuation errors and 1 for stop errors. When 15 continuation errors are displayed and another one occurs, description of the new error is not displayed. Also, when an error with the same code has already been displayed, the date and time of occurrence and detailed information of the relevant error are not updated.

Error detection setting

Set whether or not to detect errors.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Error Detection Setting]

Window



Displayed items

Item		Description	Setting range	Default
Battery Error		Sets whether or not to detect the battery error.	• Detect • Not Detected	Not Detected*2
Module Verification Error*1		Sets whether or not to detect a module verification error.		Detect
Fuse Blown		Sets whether or not to detect a fuse blown of the controlled module.		
Synchronous Interrupt Program (Network Communication Period Synchronization) Executing Time Excessive	Execution Interval Excess (Network Communication Period Synchronization)	Sets whether to detect the excessive execution time for event execution type programs that are triggered by network communication cycle synchronization.		Not Detected

*1 When "Not Detected" is set and an operating module is removed, a module verification error is not detected, but a stop error may occur if a program tries to access the removed module. The removed module will not be accessible even when it is re-installed. Therefore, if an access to the re-installed module occurs by switching the operating status from STOP to RUN, a stop error may occur.

*2 When a battery is installed, change the setting to "Detect". Otherwise, the installation status and replacement period of the battery cannot be checked because the battery error cannot be detected.

■Applicable errors for the error detection settings

The following table lists errors for which whether or not to detect the errors can be set.

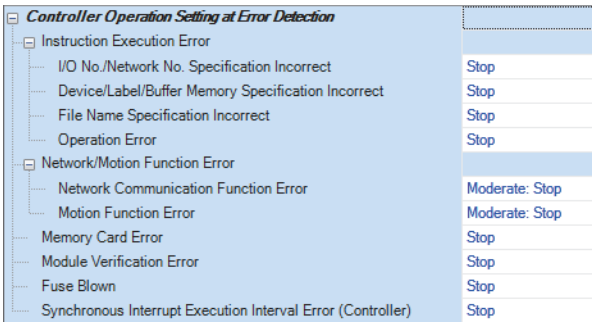
Error name	Error code
Battery error	1090H
Network communication cycle synchronization processing error	11F0H, 11F1H
Module verification error	2400H, 2401H
Fuse blown error	2420H

Controller Operation Setting at Error Detection

Set the controller operation when an error is detected.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Controller Operation Setting at Error Detection]

Window



Displayed items

Item		Description	Setting range	Default
Instruction Execution Error	I/O No./Network No. Specification Incorrect	Sets the controller operation when a specification error of I/O numbers or network numbers has been detected.	• Stop • Continue	Stop
	Device/Label/Buffer Memory Specification Incorrect	Sets the controller operation when a specification error of Device/Label/Buffer memory has been detected.		
	File Name Specification Incorrect	Sets the controller operation upon a file name specification error.		
	Operation Error	Sets the controller operation when an operation error is detected.		
Network/Motion Function Error	Network Communication Function Error	Sets the controller operation when an error occurs in the network communication function.	• Moderate: Continue • Moderate: Stop	Moderate: Stop
	Motion Function Error	Sets the controller operation when an error occurs in the motion function.		
Memory Card Error		Sets the controller operation when a memory card error occurs.	• Stop • Continue	Stop
Module Verification Error		Sets the controller operation upon a module verification error.		
Fuse Blown		Sets the controller operation when a blown fuse is detected.		
Synchronous Interrupt Execution Interval Error (Controller)		Sets the controller operation when the controller detects a synchronization signal error.		

■Applicable errors for the controller operation settings at error detection

The following table lists errors for which controller operation at error detection can be set.

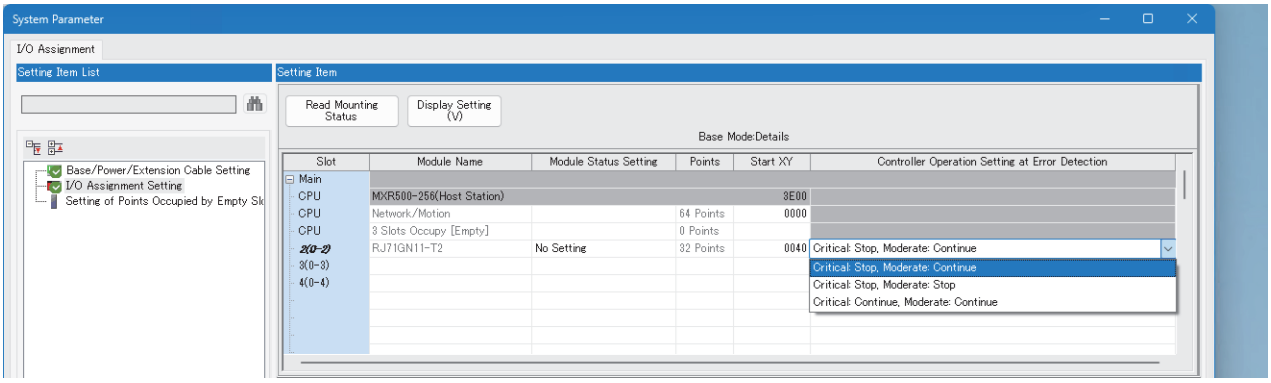
Error name	Error code
SD memory card error	2120H, 2121H
Module verification error	2400H, 2401H
Fuse blown error	2420H
I/O No./Network No. Specification Incorrect	2800H, 2801H, 2802H, 2803H, 2804H, 2805H, 2807H, 2810H
Device/Label/Buffer Memory Specification Incorrect	2820H, 2821H, 2822H, 2823H, 2824H
File Name Specification Incorrect	2840H, 2841H, 2842H
Operation error	3280H, 3281H, 3282H, 3283H, 3284H, 3285H, 3286H, 3290H, 3291H, 3292H, 3293H, 3295H, 3296H, 3297H, 329BH, 32A8H
Drive error	3401H
Cycle over	3402H
Base system error	3403H
Network driver error	3404H
Servo driver error	3405H
Synchronous setting combination error (at system start)	3407H
Master station duplication detection	3A0FH
IP address duplication error	3A91H
Grandmaster selection error	3AC0H
Drive unit version combination error	3AD4H
A servo amplifier with a firmware version that cannot perform positioning to the target position correctly is detected.	3AD7H

Each module operation setting at error detection

The operation when an error occurs in each module can be set in the controller operation setting at error detection.

Navigation window ⇨ [Parameter] ⇨ [System Parameter] ⇨ [I/O Assignment Setting]

Window



Displayed items

Item	Description	Setting range	Default
Controller operation setting at error detection	Set the controller operation upon the detection of major or moderate errors in the configured modules.	• Critical: Stop, Moderate: Continue • Critical: Stop, Moderate: Stop • Critical: Continue, Moderate: Continue	Critical: Stop, Moderate: Continue

■Applicable errors for the operation settings at each module error detection

The following table lists errors for which operation at each module error detection can be set.

Error name	Error code
Module moderate error	1200H
Module major error	2441H, 2442H, 2450H

■Controller operation

When the controller detects an error, it will perform the following operations according to the controller operation settings at error detection.

Controller operation setting at error detection	Controller operation	
	Output	Controller operation
Stop	Hold	When the controller detects an error, it will stop operations and hold the output at its last state before the operation is stopped.
Continue	—	The controller continues operations even if it detects an error.

■System operation

The system using the controller when an error is detected will perform the following operations according to the combination of the controller operation settings at error detection and the output mode at error in the module managed by the controller.

Setting item		System operation	
Controller operation setting at error detection	Error time output mode*1	Output	System operation
Stop	Clear	OFF	When the controller detects an error, it will stop operations, and the module managed by the controller turns off the output to external devices.
Stop	Hold	Hold	When the controller detects an error, it will stop operations, and the module managed by the controller holds the output to the external devices.
Continue	—	Continue	The controller continues operations even if it detects an error. The module managed by the controller continues to output the operation results to external devices.

*1 The output mode setting at error is valid only when the controller has stopped operations.
For the setting method of module parameter, refer to the manual for each module.

LED display setting

Set whether to display or hide the ERROR LED and USER LED.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [LED Display Setting]

Window



Displayed items

Item		Description	Setting range	Default
ERROR LED	Minor Error (Continue Error)	Set whether or not to display the ERROR LED when a minor error occurs.	• Display • Do Not Display	Display
USER LED	Annunciator ON	Set whether the USER LED is displayed or not when annunciator (F) ON is detected.		

■FUNCTION LED indication setting

The FUNCTION LED indication is for checking the program restoration information write status.

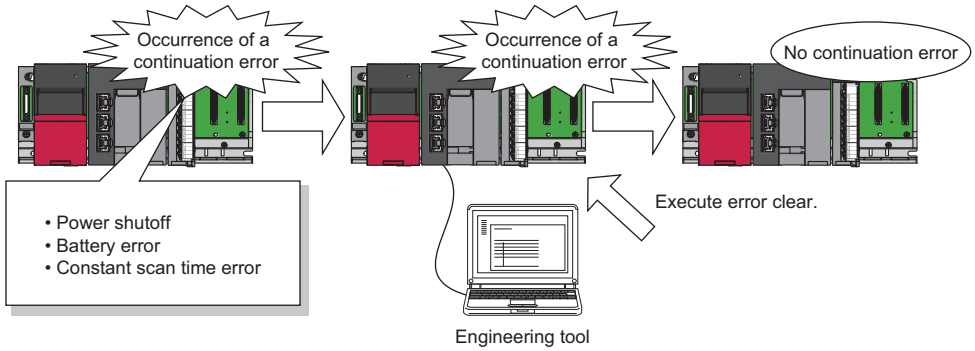
The indication is set with a bit pattern of 'FUNCTION LED indication setting' (SD1486) and is enabled when the controller is powered off and on or reset.

The setting details can be checked with 'FUNCTION LED indication setting status' (SD1487).

☞ Page 2007 FUNCTION LED indication function

Error clear

This function clears all the existing continuation errors at once.



Errors that can be cleared

This function can be used to clear only the continuation errors listed in the following table.

Error name	Error code
Power shutoff	1000H
ROM write count error	1080H
Battery error	1090H
SD memory card access error	1100H
SNTP clock setting error	1120H
Default gateway/gateway IP address error	1124H
Own node port number error	1128H
Open specification port number error	1129H
Specified IP address error	112DH
IP address error	1152H
Connection number acquisition error	1155H
Unsend data send error	1167H
PID operation error	11A0H to 11B8H
Module moderate error	1200H
Annunciator ON	1800H
Network configuration error	1803H
Connection configuration error	1804H
Send/receive data size error	1805H
Connection configuration error	1806H
Network configuration settings mismatch	1807H
Cyclic transmission distribution not possible	1808H
Constant scan time error	1818H
Receive queue full	1830H
Receive processing error	1831H
Transient data error	1832H
IP address duplication detection	1852H
Network synchronous communication function transmission omission	1860H
Synchronous watchdog counter error	1870H
Synchronous watchdog counter initialization error	1871H
System error	1A00H to 1A0BH
Network (motion)	1A40H to 1A49H
Parameter error	1A60H to 1A63H, 1A69H, 1A6AH
Axis relationship	1A80H to 1A9BH, 1A9EH to 1AA2H, 1AA4H to 1ADAH, 1ADEH to 1B03H, 1B05H to 1B08H, 1B0AH to 1B0CH, 1B0EH to 1B1CH, 1B29H, 1B2BH, 1B2DH to 1B30H

Error name	Error code
System error	1B80H to 1B95H, 1B9BH, 1B9CH, 1B9EH to 1BA1H, 1BA6H to 1BB0H, 1BB4H to 1BB9H, 1BBBH to 1BC8H, 1BCAH, 1BD0H, 1BD2H to 1BD4H
Memory card error	2120H, 2121H
Module verification error	2400H, 2401H
Fuse blown error	2420H
Module major error	2441H, 2442H, 2450H
I/O No./Network No. Specification Incorrect	2800H to 2805H, 2807H, 2810H
Device/Label/Buffer Memory Specification Incorrect	2820H to 2824H
File Name Specification Incorrect	2840H to 2842H
Operation error	3280H to 3286H, 3290H to 3293H, 3295H, 3297H, 329BH, 32A8H
File Access Error	3400H
Drive error	3401H
Cycle Over	3402H
Base System Error	3403H
Network Driver Error	3404H
Servo Driver Error	3405H
Synchronous setting combination error (at system start)	3407H
Master station duplication detection	3A0FH
Grandmaster selection error	3AC0H
Drive unit version combination error	3AD4H
A servo amplifier with a firmware version that cannot perform positioning to the target position correctly is detected.	3AD7H

Point

When the write protect switch of the SD memory card is enabled, an error of the memory card access error, which is generated when an event history is stored, can be cleared. After the error is cleared, even if the event history is stored due the occurrence of an event, the error will not be detected again.

How to clear errors

Errors can be cleared in the following ways:

■Using the engineering tool

Clear errors with the module diagnostics function of GX Works3. (GX Works3 Operating Manual)

Point

The event history of error clear using the engineering tool is stored in the controller connected.

■Using SM/SD

Clear errors by operating SM/SD.

1. Check SD0 (Latest self-diagnostics error code) to identify the detected continuation error.
2. Clear the cause of the currently detected continuation error.
3. Turn on SM50 (Error reset) to clear the error. When multiple continuation errors have occurred, all the errors are cleared at once.

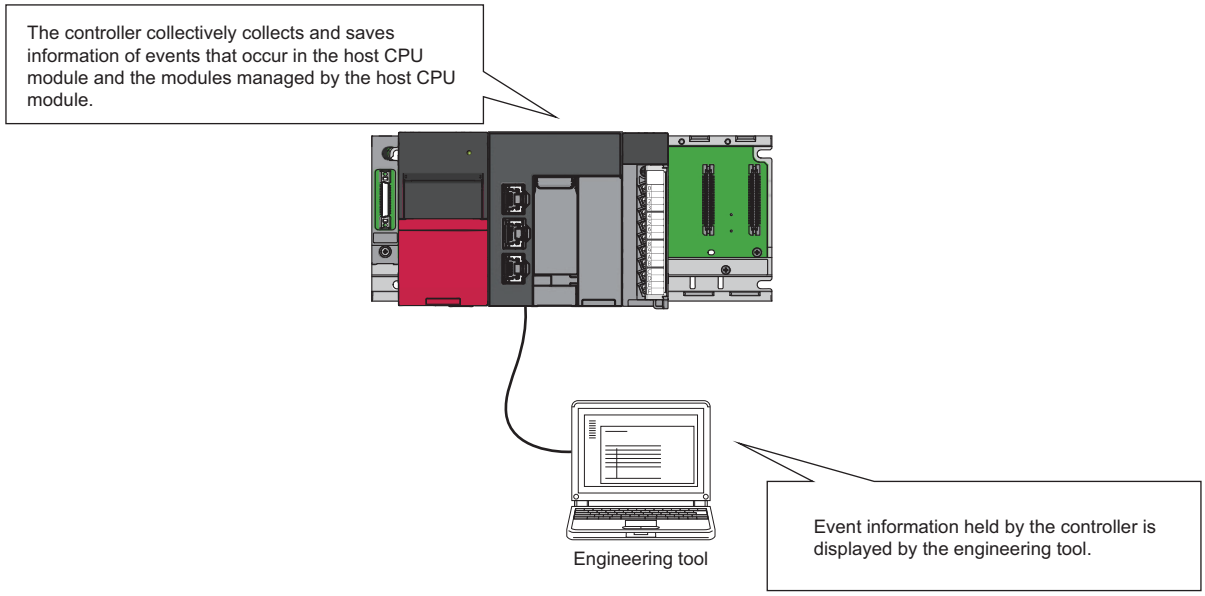
Precautions

This section describes some precautions to take when using the error clear function:

- Since the function clears all of the currently detected continuation errors at once, errors that should not yet be cleared may be cleared.
- Use the RST instruction to reset each annunciator individually.
- Running the error clear function does not remove the cleared errors from the event history.
- The cause of an error which occurred in a module other than the target controller for the error clear cannot be eliminated even though the error is cleared using this function. For example, when "Module verification error" (error code 2400H) or "Module major error" (error code 2450H) occurred, the error cause cannot be eliminated even though the error is cleared in the controller using this function. To eliminate the error cause, clear the error of the target module and reset the controller.
- Error clear (event code 20100H) registration is performed when error clear is requested. For this reason, the actual error clear time may differ.

Event history function

The controller collects and stores event information from each module, such as errors detected by the module, operations performed on the module, device/label data write operations[*1], and network errors. [*2]
Once errors and operations are stored, they can be checked chronologically. This function helps determine the causes of problems that have occurred in the equipment/devices, check the update status of the programmable controller control data, and detect unauthorized access.



*1 When "Save Device/Label Operations" is set in Event History Setting, device/label data write operations are saved. (☞ Page 1762 Device/label data write operation saving)
*2 If the controller is operated online using the engineering tool, there are times when processing performed automatically by the system is saved as an event.

Point

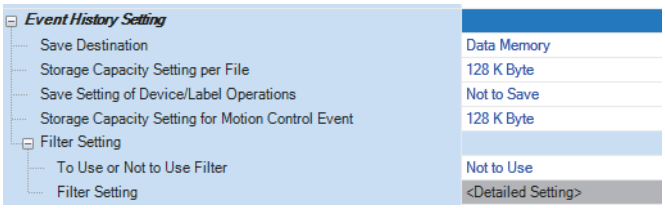
The event history information is constantly collected regardless of the operating state of the controller.
The maximum number of event history records that can be displayed and output to a file is 25000.
There are occasions, however, when the event history information cannot be collected due to a major error in a module, a base unit error, a cable failure, or some other cause.

Event history setting

Under normal circumstances, the event history function can be used with its default settings and need not be manually configured. The storage memory and size settings for event history files can be changed as needed. (☞ Page 1757 Logging of the event history)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [CPU Parameter] ⇨ [RAS Setting] ⇨ [Event History Setting]

Window



Displayed items

Item		Description	Setting range	Default
Save Destination		Specify the storage location of event history files. (☞ Page 1757 Storage memory)	• Data Memory • Memory Card	Data Memory
Storage Capacity Setting per File		Specify the storage capacity per event history file. (☞ Page 1758 File size)	1 to 2048 K bytes (in 1 K bytes)	128 K Byte
Save Setting of Device/Label Operations		Specify this item when saving device/label data write operations. (☞ Page 1762 Device/label data write operation saving)	• Not to Save • Save	Not to Save
Storage Capacity Setting for Motion Control Event		Set the size of the motion control event history file.	1 to 2048 K bytes (in 1 K bytes)	• MXR300-□: 63 K Byte • MXR500-□: 127 K Byte
Filter Setting	To Use or Not to Use Filter	Set whether to use filter setting.	• Not to Use • Use	Not to Use
	Filter Setting	Set the event code that is not saved in the event history file.	☞ Page 1756 Filter setting	
Check Falsification		Set whether to check for tampering with event history files.	• Do Not Check • Check	Do Not Check

Point

For use in any of the following environments, use of an SD memory card for the save destination memory is recommended because the number of events that occur becomes large.

- When file data write operations and device/label data write operations are performed frequently*1
- When the communication status changes frequently
- When device data write operations are periodically performed from a programmable controller of another station or from another CPU module*1

The number of writes to the data memory is limited to 50000 times. In any of the above cases, when data memory is used for the save destination memory, be careful about the number of writes to data memory.

*1 When "Save Device/Label Operations" is set in Event History Setting. Note that when device data write operations are performed periodically, the number of events registered in the history becomes large, and event history logging may be restricted. (☞ Page 1761 Event history logging restriction)

Precautions

If the destination memory is "Built-in Memory", set "Storage Capacity Setting for Motion Control Event" in "Event History Setting" in CPU parameters or set "Maximum Backup RAM Size" in "Add-on MotionEventHist Parameter" in "Add-on Parameter" to satisfy the following formula.

["Storage Capacity Setting for Motion Control Event" in "Event History Setting" in CPU parameters] ≤ ["Maximum Backup RAM Size" in "Add-on MotionEventHist Parameter" in add-on parameters] - 1*1

*1 The system uses 1KB of the memory capacity specified in "Maximum Backup RAM Size".

If the above formula is not satisfied, Event history parameter incorrect warning (event code 00F07H) is output at file creation, and the file size is clamped at ["Maximum Backup RAM Size" in "Add-on MotionEventHist Parameter" in add-on parameters] - 1.

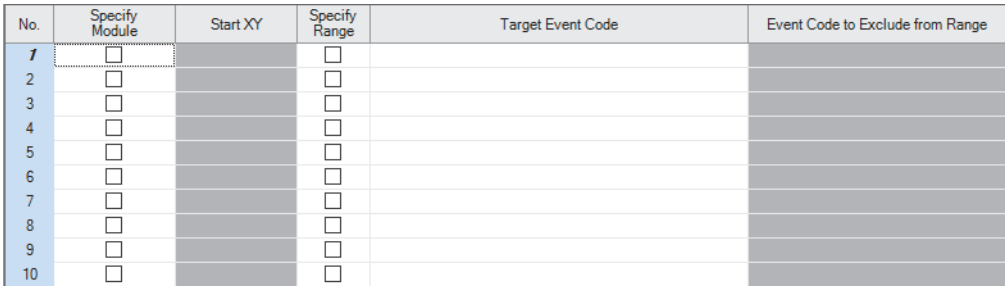
If the file size is less than 1KB, Event history file incorrect (error code 1A02H) is output and the file is not saved.

■Filter setting

Set the event code that is not saved in the event history file.

This function can prevent past event history from being overwritten due to unnecessary event history saving.

Window



Displayed items

Item	Description	Setting range
Specify Module	Select the check box when specifying the module that generated the events to be filtered. (If the check box is not selected, the events of all modules will be filtered)	—
Start XY	When specifying a module, specify the first XY of the module.	Controller: 3E00H Other than controller: 0000H to 0FF0H
Specify Range	Select the check box when specifying the range of event codes.	00000H to 2FFFFH
Target Event Code	Specify the event code that is not saved in the event history file. Up to 64 events can be set.	—
Event Code to Exclude from Range	When specifying the range, specify the event code that is not included in the range. Up to 32 events can be set for each target event code.	—

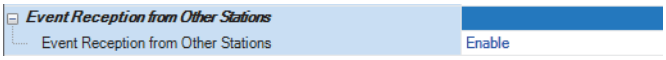
*1 To filter the motion control event history (EVENM.log), check "Specify Module" and set the I/O number of the motion function part in "Start XY". (☞ Page 133 I/O Numbers of Modules)

Event Reception from Other Stations

Select whether to obtain the events occurring in the other stations.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings]

Window



Displayed items

Item	Description	Setting range	Default
Event Reception from Other Stations	Select whether to obtain the events occurring in the other stations.	• Enable • Disable	Enable

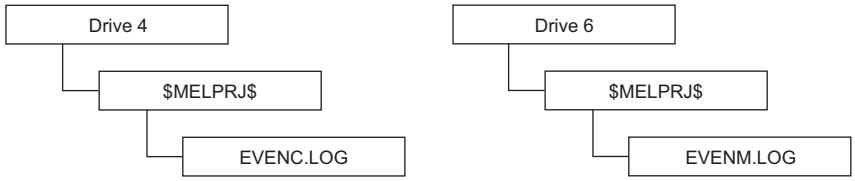
Logging of the event history

This section describes events saving for the event history.

■Event history file

The storage memory and file size for event history files can be changed in event history setting. (☞ Page 1755 Event history setting)

The event history file is saved in the system folder in the controller.



Name	Description
$MELPRJ$	This is the controller system folder.
EVENC.LOG	This is the storage folder for event history files.
EVENM.LOG	This is the storage folder for the motion control event history files.

Point

If no core is assigned to the motion operation execution, the read (display) and clear operations of the motion control event history will fail.

■Storage memory

Choose either the data memory or SD memory card.

If the storage memory is the SD memory card: when the write protect switch of the SD memory card is enabled, an event history will not be stored. (The engineering tool can read the event history file on the SD memory card.)

Therefore, if the write protect switch of the SD memory card is changed from Disabled to Enabled during operation, a write error to the SD memory card will occur in the following timing: At the occurrence of an event that is supposed to be stored in the event history (SD memory card available and event registration) after the write protect switch is enabled. (An error that has occurred can be checked by using the module diagnostics of the engineering tool immediately after its occurrence. However, the error is not stored in the event history after powering off and on or reset of the controller.)

■File size

The size for event history files can be changed in event history setting (☞ Page 1755 Event history function)

If the storage size exceeds the specified size, event history records are deleted in order from the oldest one, and the latest one is stored.

An event history file size is obtained from the following calculation formula.

Event history file size = File header size + Event history management information size + Signature size + (Number of records × Size per event history record)

Element	Size
File header	20 bytes
Event history management information	12 bytes
Event history	64 bytes per record at minimum (Because the contents of detailed information may differ depending on the event to be saved and the detailed information may include a variable-length file name, the size per event history record is variable.)
Signature	32 bytes (Added when the tamper check setting is set to "Check" in parameters.)

The number of events to be saved in the event history file differs depending on the event type to be saved. When the event history file size is 128K bytes (default), 1091 events can be registered if programs (whose program name is 8 characters (12 characters including a period and extension)) are written to the controller using the engineering tool.

[Calculation formula]

- 128 bytes × 1024 = 131072 bytes
- 131072 bytes - (20 bytes + 12 bytes + 32 bytes) = 131008 bytes
- 131008 bytes ÷ 120 bytes = 1091 events

Point

When the user authentication function is enabled, the logged-on user name is stored in the event history for operations subject to access control such as file writing, so the file size increases by the size of the logged-on user name.

Ex.

The table below shows the size of each element when 100 programs (whose program name is 8 characters (12 characters including a period and extension)) are written to the controller by the following operating procedure. Also, "Check Falsification" in "Event History Setting" is set to "Check".

Operating procedure

1. Turn on the power in the STOP state.
2. Write the system parameter, CPU parameter, module parameter, and 100 programs (whose program name is 8 characters (12 characters including a period and extension)) to the controller using the engineering tool.
3. Switch the controller to the RUN state.

Element		Size
File header		20 bytes
Event history management information		12 bytes
Signature		32 bytes
Event history	Power-on and reset	64 bytes
	Firmware diagnostics completed	64 bytes
	Operating status change (STOP)	64 bytes
	Program memory update start	88 bytes
	Writing files/folders (SYSTEM.PRM)	112 bytes
	Writing files/folders (CPU.PRM)	104 bytes
	Writing files/folders (UNIT.PRM)	104 bytes
	Writing files/folders (MAIN_001.PRG to MAIN_100.PRG)	12000 bytes
	Program memory update finish	88 bytes
	Operating status change (RUN)	64 bytes
Total		12784 bytes (without signature) 12816 bytes (with signature)

■When files are created

- When the power is off and on (when there is no event history file, or after the event history settings are changed)
- At reset (when there is no event history file, or after the event history settings are changed)
- Initialization of the data memory and SD memory card (when no event history file exists)*1
- When parameters are written to the built-in memory using the engineering tool (when no event history file exists, or after an event history setting is changed)

*1 When a parameter is stored in the program memory, the event history file is created on the SD memory card, according to the event history setting.

Point

When a new event history file is generated, "Event history file generation" (event code 00420H) is logged. When a new event history file is generated during the logging restriction of the event history, "Event history logging restriction" (event code 00421H) is also logged.

The following table shows how the event history is treated depending on operation.

Operation	Operation for the event history
Memory initialization	When this event occurs, the event history is stored into the internal memory. If the internal memory reaches the maximum number of event history records it can store, all subsequent events are lost. (☞ Page 1760 Logging of the event history)
Event history creation	The event history, which has been stored in the internal memory during absence of the event history file, is stored into the data memory or the SD memory card. (If any event was lost, it is logged as "*HST LOSS*").

The following table shows how the event history is treated at removal and installation of an SD memory card when the SD memory card is specified as the storage memory.

Operation	Operation for the event history
Removal of the SD memory card	When this event occurs, the event history is stored into the internal memory. If the internal memory reaches the maximum number of event history records it can store, all subsequent events are lost. (☞ Page 1760 Logging of the event history)
Installation of the SD memory card	The event history, which has been stored in the internal memory during absence of the SD memory card, is stored on the SD memory card. If the re-inserted SD memory card contains an event history file of the same file size, the controller continues to store the event history information. If the file size is different, a new event history file is created at the file creation timing such as when the power is turned on.

■When parameters take effect

Any changed parameters take effect when:

- The controller is powered on
- The controller is reset
- When parameters are written

Point

Any changed parameter written in the storage memory with the controller in the STOP state does not take effect when the controller operating state is changed from STOP to RUN. In this case, the changed parameters will take effect the next time the controller is powered off and on or is reset.

■Loss of event history information

If events are detected frequently, or the controller is powered off or reset immediately after the detection of events, some events may not be collected and lost. When event loss occurs, "*HST LOSS*" appears in the "Event Code" field of the engineering tool.

■Signature processing

When tamper check is performed for event history files, a signature is added using a secret key when writing is performed for an event history file. The signature will be verified when a reset is performed or when the power supply is turned off and on.
If tampering with the event history file is detected, an error code 1930H (Invalid file) occurs.
Whether to check for tampering with event history files is set with "Check Falsification" in CPU parameters.
However, tamper check for event history files can be performed only when the save destination is the data memory.

Point

Performing tamper check for an event history file adds signature at each event registration, which makes loss of event history information easier to happen. In that case, apply a filter to events that occur frequently but do not need to be registered in an event history file. (☞ Page 1756 Filter setting)

Event history logging restriction

When the number of minor events from the controller or intelligent function module such as link-up and link-down exceeds the upper limit value, event history logging is restricted (stopped).
When the number of events for which logging is restricted falls below the lower limit value, event history logging is restarted.
However, the error codes for moderate and major errors that occur in the controller are logged in the event history even when logging is restricted.

Item	Condition
Upper limit value	1500 events/minute
Lower limit value	750 events/minute

■Events not supported by the logging restriction

The following events are not subject to the logging restriction.

- Events of the self-diagnostics for major errors from the intelligent function module
- Events not registered due to the filter function
- Motion control event history

■How to check whether event history logging is restricted

When event history logging is restricted, SM1464 (Event history logging restriction status) turns on. SM1466 turns on when the event history logging of the controller is restricted and the event category is error (minor error), and SM1467 turns on when the event history logging of the controller is restricted and the event category is information or warning.
Modules on which event history logging is restricted can be identified in SD1464 to SD1467 (Module information on event history logging restriction).

Modules from which event history information is collected

Event history information is collected from the controller and other modules installed on the same base unit (i.e., the main base unit plus any additional extension base units). Event history information may or may not be collected from devices on the network depending on the specifications of the network modules used to connect to them. For more information including to what extent the event history information is collected regarding devices on the network, refer to the manuals for the respective modules.

Events stored by the controller

Information logged in the event history includes operation initiator and other detailed information for troubleshooting purposes.
For events that are logged in the event history on the controller, refer to the event list. (☞ Page 1887 EVENT LIST)

Device/label data write operation saving

When "Save Device/Label Operations" is enabled in Event History Setting, device/label data write operations are saved. (☞ Page 1755 Event history function)

Restriction

When devices and labels are written with multiple points specified, some device/label names and written values may not be shown.

■Target operations

The device/label data write operations of the following operations and functions are saved.

Operation and function		Remarks
Operation from the engineering tool Operation using SLMP	Changing current values of devices and labels from the watch window or with other methods	The written values are saved up to 128 words.
	Writing data to the device memory	
	Writing device/label data	
Operation using a GOT	Writing device/label data	
Other operations	Writing device data from a programmable controller of another station*1, reading device data from programmable controller of another station (with read notification)*2, and writing device data from another CPU module	
	Writing device data using the predefined protocol support function	

*1 When writing the data with write notification, the write notification device is also saved.

*2 The read notification device is saved.

• Applicable commands for writing device/label data through SLMP

The following table shows the applicable commands for writing device/label data through SLMP.

Type	Operation	Command	Subcommand	Remarks
Device	Write	1401	00□0 00□1	The written values are saved up to 128 words.
			00□2 00□3	
	Write Random	1402	00□0 00□1	The number of data sets to be saved varies depending on the device specified.
			00□2 00□3	
	Write Block	1406	00□0	The written values are saved up to 128 words per block. The number of data sets to be saved varies depending on the devices specified.
			00□2	
Label	Array Label Write	141A	0000	The written element data are saved up to 128 words. The number of data sets to be saved varies depending on the number of array points specified.
	Label Write Random	141B	0000	The number of data sets to be saved varies depending on the label assignment destination. The written strings are saved up to 128 words.
Memory	Write	1613	0000	The written values are saved up to 128 words.

• Applicable instructions for writing device data from a programmable controller of another station

The following table shows the applicable instructions for writing device data from a programmable controller of another station.

Major classification	Classification		Instruction name	Remarks
Writing device data from another station	Module dedicated instructions	Writing data to programmable controller of another station	JP.WRITE, GP.WRITE	The written values are saved up to 128 words.
		Writing data to program controller of another station (with write notification)	JP.SWRITE, GP.SWRITE	
		Reading data from programmable controller of another station (with read notification)	JP.SREAD, GP.SREAD	
		Writing data to target station	J(P).RIWT, G(P).RIWT	

For details on the module dedicated instruction, refer to the following.

MELSEC iQ-R Programming Manual (Module Dedicated Instructions)

■Target device

The following table shows the target devices. The write operations are also saved when writing data with index modification or indirect specification.

Type	Device
Bit device	X, DX, Y, DY, M, L, F, SM, V, B, SB, T (contact), T (coil), ST (contact), ST (coil), C (contact), C (coil), LT (contact), LT (coil), LST (contact), LST (coil), LC (contact), LC (coil), FX, FY, Jn\X, Jn\Y, Jn\SB, Jn\B
Word device	T (current value), ST (current value), C (current value), D, SD, W, SW, RD, R, ZR, Z, FD, Un\G, Jn\W, Jn\SW, U3En\G
Double-word device	LT (current value), LST (current value), LC (current value), LZ

Note that for write operation by specifying label names, label memory areas (such as GV, GLV, LV, LLV, and UV) may be displayed as device names. For details on the label memory, refer to the following.

GX Works3 Operating Manual

■Target label

The labels to be saved are all labels that can be specified by the engineering tool.

■Detailed information

The detailed information of an event history displays a device/label name, the number of write points, and written values.

(☞ Page 1887 Detailed information)

Item	Name displayed on window	Description
Device/Label	Device name information	A specified device name is displayed.
	Device name information (user-specified)	
	Device name information (target device)	The name and address of a device actually accessed is displayed. When a device is specified with index modification, if the accessed device is within the specified device range, the device name is displayed. If out of the specified device range, it is not accessed and the event is not logged. When a device is specified with indirect specification, the accessed address is displayed.
	Label name information	A specified label name is displayed.
	Label name information (user-specified)	
	Target bit No.	When a bit of a word device is specified with indirect specification, the accessed bit number is displayed. The same applies when a bit is specified with index modification and the accessed bit is out of the specified device range, it is not accessed and the event is not logged.
Number of write points	Number of points	The number of write points is displayed.
Written value	Written value	The written values for the number of write points are displayed.

Logging file operations

■Operation to be performed

The following file operations are performed by the engineering tool, SLMP and FTP server functions.

- New file creation
- File write (change)
- File name change
- File copy
- File deletion

Point

File operations by the controller (system), file operations by instruction execution, and file operations by the FTP client function are not logged as events.

■Applicable files

The files stored in the internal memory of the controller or SD memory card are appliable. (☞ Page 336 File types and storage memory)

Viewing the event history

The event history can be viewed using the menus of the engineering tool. For operating procedures and how to interpret the displayed information, refer to the following:

📖 GX Works3 Operating Manual

Clearing the event history

The event history can be cleared from the event history window. Once the event history is cleared, the controller deletes all the event history information stored in the specified storage memory. For operating procedures and other details, refer to the following:

📖 GX Works3 Operating Manual

Point

When the event history is cleared, "Event history clear" (event code 20200H) is logged. When the event history is cleared during the logging restriction of the event history, "Event history logging restriction" (event code 00421H) is also logged.

Precautions

■Clearing the event history during execution of another function

No event history can be cleared during execution of the following functions. Check that the following functions are not being executed, then clear the event history.

- Controller data backup/restoration function
- iQ Sensor Solution data backup/restoration function (only for the event history clear from the engineering tool)

■Reading the event history file during execution of another function

No event history files can be read during execution of the following functions. Check that the following functions are not being executed, then read the event history file.

- Controller backup (only for reading of the motion control event history file)
- Controller data restoration

■Logging of the event history

When event history logging is restricted, the relevant special relay (☞ Page 1761 How to check whether event history logging is restricted) turns on. Eliminate the event causes from the target module. The target module can be identified in SD1464 to SD1467 (Module information on event history logging restriction).

Whether event history logging is restricted or not can also be checked in "Event history logging restricted" (event code 00421H) in "Event Code" of the "Event History" window of the engineering tool.

■Execution of other functions while event history logging is restricted

When the controller is restored by turning on SM1354 while event history logging is restricted, event history logging is restarted after the completion of the restoration.

When event history logging is restarted and event history from a module is frequently logged again, logging the history of events occurring on the target module is stopped (restricted).

■Change of the event history setting

The following table shows the operation when the event history setting is changed after the controller starts, and written to the controller.

Changed item	Operation
Save Destination	With the original file left as is, an event history file is generated in the enabled save destination (drive).
Storage Capacity Setting per File	The event history file is discarded and regenerated.
Save Setting of Device/Label Operations	Added to the original file.
Filter Setting	Added to the original file.
Check Falsification	The event history file is discarded and regenerated.

Therefore, to save a past event history, before changing the event history setting, save data by using the [Create File] button in the event history window of the engineering tool.

[Diagnostics] ⇨ [System Monitor] ⇨ [Event History] button ⇨ [Create File] button

■Periodic device data write operation from a programmable controller of another station

When "Save Device/Label Operations" is set in Event History Setting, many event updates occur. Depending on the timing, events that occurred cannot be checked with the engineering tool.

■SD memory card

The following shows the operation when the write protect switch of an SD memory card is locked (write inhibited).

- Logging of the event history is not performed.
- If the power is turned off and on or reset is performed without an event history file saved on the SD memory card, File specification error (error code 21A1H) occurs.
- The event history window can be displayed.

■Operating event history files

After deleting or writing an event history file inside the controller through FTP, SLMP, or other operations, turn off and on the power supply or perform a reset and clear the reset. Without this step, the event history cannot be displayed properly.

■Display order of event history

In the event history window, events are displayed in the order in which they were registered in the event history file (sorted by number). To display them in the occurrence date and time order, sort them on the event history list by occurrence date and time.

■Assignment of event codes at occurrence of events related to the motion control

The event codes at occurrence of events related to the motion control are stored in the motion control event history file. (☞ Page 1755 Event history setting)

74.2 CC-Link IE TSN RAS Functions

Device station disconnection

Data link of the station where an error occurred is stopped, and the data link continues only for stations that are operating normally.

Automatic return

The data link is automatically restarted when the device station that was disconnected due to an error becomes normal again.

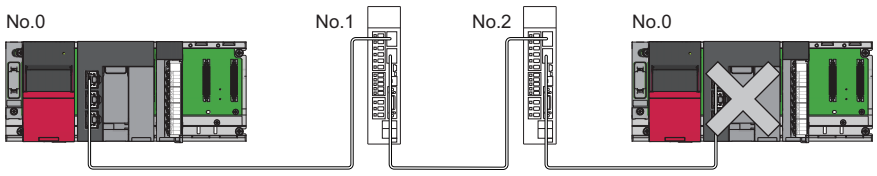
Precautions

- If a device station that differs from the parameter setting is connected, data link cannot be performed.
- When removing a device station while the system is operating, check that the device station is either performing cyclic transmission or is disconnected.

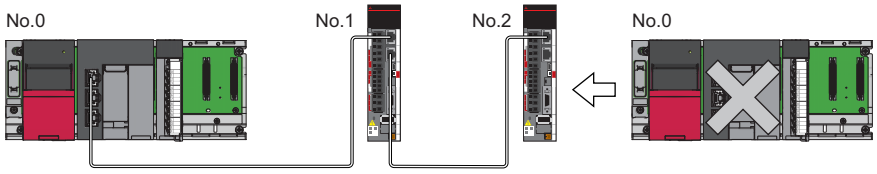
Master station duplication detection

If one network has multiple master stations, an overlap is detected.

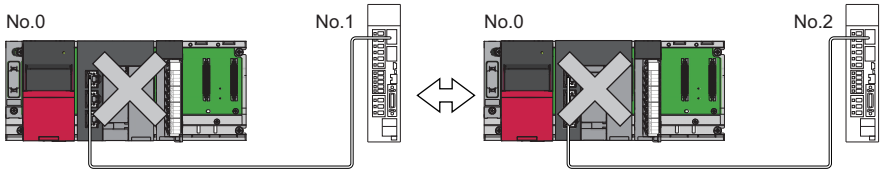
- When multiple master stations are simultaneously powered on, or when multiple master stations are simultaneously connected, Master station duplication detection (error code 3A0FH) is detected in all master stations and cyclic transmission cannot be performed in all stations. (Transient transmission available)



- If another master station is added to the network during data link, Master station duplication detection (error code 3A0FH) is detected in the added master station and cyclic transmission cannot be performed. (Transient transmission available) Other stations continue data link.



- If two networks are connected during data link, Master station duplication detection (error code 3A0FH) is detected in the master stations on both networks and cyclic transmission cannot be performed in all stations. (Transient transmission with IP address specification is available)

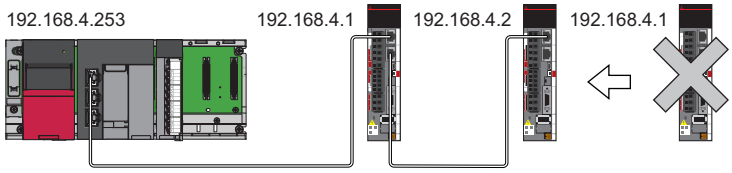


IP address duplication detection

If one network has stations with the same IP address, an overlap is detected.

IP address duplication detection at the device station

When adding a device station, if a station with the same IP address already exists, an IP address duplication detection error occurs in the station to be added and data link cannot be performed. (Other stations continue data link.)

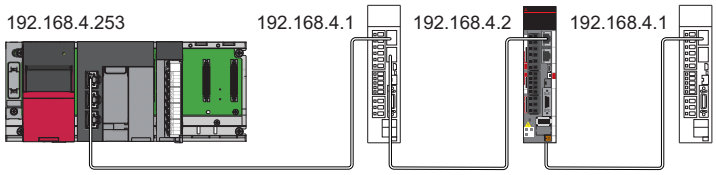


Precautions

When a device station already connected (linked up) with an industrial switch (CC-Link IE TSN Class B certified) is to be added including the industrial switch, an overlapping IP address is not detected in the station to be added. If IP address duplication detection (error code 1852H) is detected in the master station, disconnect the relevant device station from the network. Otherwise, multiple stations with the same IP address will exist on the same network, possibly leading to transient transmission being sent to an unintended station.

IP address duplication detection at the master station

If stations with the same IP address are found in the network when cyclic transmission is started (such as when the master station is powered off and on), Device station IP address duplication detection (error code 3A71H) occurs in the master station and data link cannot be performed with the relevant device stations.



Also, if stations with the same IP address are found by the periodic check of IP address duplication during cyclic transmission, IP address duplication detection (error code 1852H) occurs and cyclic transmission cannot be performed with the relevant device stations. (Data link with other stations continues.)

Restriction

- When cyclic transmission is started, an overlapping IP address between an Ethernet device and a CC-Link IE TSN device, and an overlapping IP address between Ethernet devices are not detected.
- Station number duplication is not detected.

■Methods of recovery from IP address duplication detection at the master station

When IP address duplication detection occurs in the master station, change the IP address of the corresponding station and take the following actions according to the detected error code.

- Error code 3A71H: Reset or power off and on the master station and device station.
- Error code 1852H: Clear the error in the master station, and reset or power off and on the device station.*1

*1 Device stations with overlapping IP addresses display the indicator according to the instruction from the master station. However, the way the indicator is displayed depends on the specifications of each device station.

Module communication test

If the communication of the controller is unstable, check for hardware errors.
In the module communication test, the result of the external self-loopback communication test (whether communication can be performed normally with an Ethernet cable connected between the two connectors of the controller) is checked.

Procedure

1. Set the module operation mode to "Self-communication Test Mode (P1/P2)".

Navigation window ⇨ [Parameter] ⇨ Target module ⇨ [Module Parameter (Common Setting)] ⇨ [Basic Settings] ⇨ [Module Operation Mode]

2. Connect the CC-Link IE TSN port of the controller with an Ethernet cable.
3. Write module parameters to the controller.
4. Reset or power off and on the controller to start the module communication test.

Point

Do not perform a module communication test while connected to another station. The operation of another station may be abnormal.

Check of status and result

Use the LED display of the controller to check the module communication test status and result.

Test status	LED display
Test in progress	The dot matrix LED displays "UCT".
Normal completion	The dot matrix LED displays "OK".
Abnormal end	The ERR LED (software LED) turns on and the dot matrix LED indicates "ERR" and error number alternately at intervals of one second.

■Error number when the test is completed with an error.

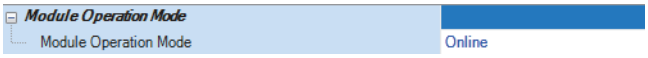
The dot matrix LED indicates an error with the form of "P1 or P2_Error number".
For example, "1_3" is displayed when error No.3 occurs in P1.
If the module communication test is completed with an error, check the following.

Error number	Description	Action
2	External self-loopback test connection error	Check the Ethernet cable connection or replace the Ethernet cable, and perform the test again. If the test fails again, contact your local Mitsubishi Electric representative.
3	External self-loopback test communication error	Replace the Ethernet cable and perform the test again. If the test fails again, contact your local Mitsubishi Electric representative.

Module Operation Mode

Set the module mode.

Window



Displayed items

Item	Description	Setting range
Module Operation Mode	• Online: Normal operation mode • Self-communication Test Mode (P1/P2): Mode for operating the module communication test	• Online • Self-communication Test Mode (P1/P2) (Default: Online)

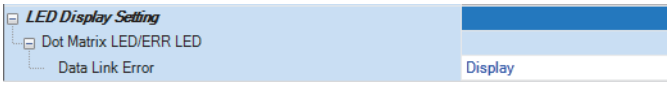
LED display of data link faulty station

This function sets display/hide of data link faulty stations during all station error detection.

LED display setting

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Application Settings]

Window



Displayed items

Item		Description	Setting range
Dot Matrix LED/ERR LED	Data Link Error	Sets whether to display/hide all station error detection and data link faulty station detection in dot matrix LED/ERR LED (software LED).	• Display • Do Not Display (Default: Display)

74.3 Ethernet RAS Functions

Timer settings for data communication

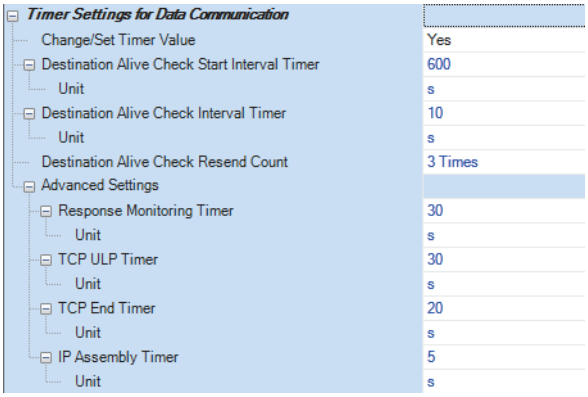
Set the timer used for the following communications.

- Connection with MELSOFT products and a GOT
- Communications using the SLMP
- Communications using the predefined protocol
- Socket communications
- File transfer function (FTP server)
- File transfer function (FTP client)

When changing the timer settings for data communication, refer to the precautions before setting. (☞ Page 1773 Precautions for settings)

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings]

Window



Displayed items

Each timer value has an error of 10% at maximum.

Item		Description	Setting range
Change/Set Timer Value		Select whether to change timer values from the default. The timer operates with its default value when "No" is selected.	• No • Yes (Default: No)
Destination Alive Check Start Interval Timer*1		Set the time interval between the reception of the last message from the external device and the start of an alive check.	Unit [s]: 1 to 3600 (Default: 600s)
Destination Alive Check Interval Timer*1		Set the time interval for performing an alive check again when no response is returned from the external device of alive check target. After data communication, an alive check is performed if data is not received from the external device by the time set with Destination Alive Check Start Interval Timer. If a response has still not been returned from the external device even after performing an alive check, another alive check is performed at the interval of this setting and in accordance with Destination Alive Check Resend Count.	Unit [s]: 1 to 3600 (Default: 10s)
Destination Alive Check Resend Count		Set the number of times to perform alive checks for the external device. (The number of times to perform alive checks including the first alive check) Valid only when the "TCP ULP Timer" is the default value (30s). • TCP/TLS connection: When no response is received even after repeating the alive check for the number of resends (the alive check failed), the controller closes the relevant connection and sends the RST packet to the external device. • UDP/DTLS connection: When no response is received even after repeating the alive check for the number of resends (the alive check failed), an error occurs for the relevant connection, and the alive check stops although the connection does not close. Then, the alive check restarts after communications with the external device restart.	1 to 255 (Default: 3 Times)
Advanced Settings	Response Monitoring Timer	Sets the time interval between the first message and last message when receiving the divided messages.	Unit [s]: 1 to 3600 (Default: 30s)
	TCP ULP Timer*1	Set the time-to-live of the send packet in TCP/IP communications. For example, when the TCP resend timer value is set to 10 seconds and the TCP ULP timer value is set to 30 seconds, data will be resent every 10 seconds if no response is returned from the external device after data sending, and a timeout error occurs if no response is returned within 30 seconds. Also, this setting is used as the timeout time that is applied when a session is established in TLS/DTLS encrypted communications. By default, there is an error of approximately five seconds at maximum.	Unit [s]: 1 to 3600 (Default: 30s)
	TCP End Timer	Sets the waiting time for checking before disconnecting from an encrypted communication session in TLS/DTLS encrypted communications. After sending a request of disconnection from encrypted communication session to an external device, if no disconnection request is received from the external device even after the specified period of time has elapsed, the connection is force terminated. Also, this setting is used as the timeout time that is applied when a session is disconnected in TLS/DTLS encrypted communications.	Unit [s]: 1 to 3600 (Default: 20s)
	IP Assembly Timer	The communication data may be divided at the IP level before being sent due to the buffer limitation of the sending station or the receiving station. Set the waiting time for the divided data in such a case.	Unit [s]: 1 to 3600 (Default: 5s)

*1 If no external device is on the network, request packets for destination alive check (Keepalive in TCP/TLS connections and Ping in UDP/DTLS connections) may not be sent. Even if no packet is sent, it acts as if packets were sent but no response was returned. A timeout error will occur after resending is repeated several times.

Precautions for settings

■Setting value of each timer on the controller side

Set the setting value of each timer on the controller side to a value that meets the following formulas.

(Response monitoring timer value) ≥ (TCP ULP timer value) ≥ (TCP end timer value) > (IP assembly timer value)

(TCP end timer value) ≥ (Minimum initial value of TCP resend timer (0.2 seconds))

For an Ethernet port, set the setting value of each timer for destination alive check to a value that meets the following formula.

(Destination alive check start interval timer) ≥ (Destination alive check interval timer)

When connecting Mitsubishi Electric products to the line, configure the same settings for both modules.

■Setting value of each timer on the external device side

Set the setting value of each timer on the external device side to a value that meets the following formulas. The frequency of a communication error, such as a transmission timeout, may be higher if the timer values do not meet the formulas.

(TCP ULP timer value on the external device side) > (Minimum initial value of TCP resend timer on the controller side (0.2 seconds))

(Monitoring timer value on the application software on the external device side) > {(TCP ULP timer value on the controller side) × n^{*1}}

*1 "n" is the number of TCP segment transmissions and is calculated by the following formula.

$$n = \left(\frac{\text{Size of message sent by the controller}}{\text{Maximum Segment size}} \right) \text{(with values after the decimal point rounded up)}$$

Ex.

The number of TCP segment transmissions when communications are performed on the same line

The Maximum Segment Size is 1460 bytes on the same line (without a router) and the number of TCP segment transmissions is as follows.

- n = 1 when the size of the message sent by the controller is 1460 bytes or less
- n = 2 when the size of the message sent by the controller is greater than 1460 bytes

Ex.

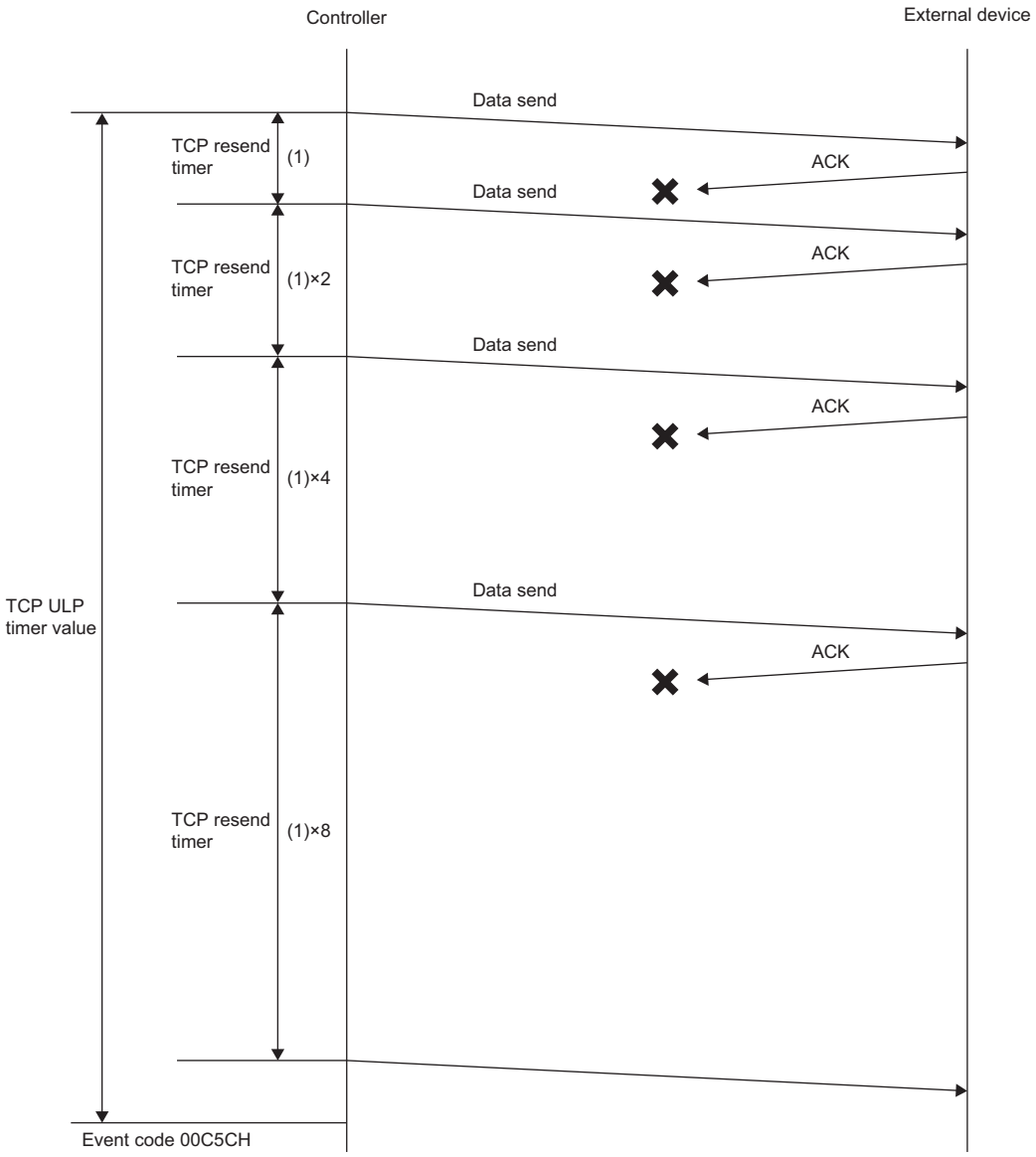
The number of TCP segment transmissions when communications are performed on a different line

The Maximum Segment Size is at least 536 bytes on another line (via a dial-up router or other communication device) and the number of TCP segment transmissions is as follows.

- n = 1 when the size of the message sent by the controller is 536 bytes or less
- n = 2 when the size of the message sent by the controller is greater than 536 bytes but equal to or less than 1072 bytes
- n = 3 when the size of the message sent by the controller is greater than 1072 bytes but equal to or less than 1608 bytes

■Number of retries

The TCP resend timer value is automatically calculated based on the TCP frame round-trip time measurement result.
Then, this automatically calculated TCP resend timer value is used as the initial value, and data is resent with the resend time interval doubled each time.
When determining the TCP resend timer initial value, the timer value is compared with the minimum value held by the system, and the larger value is used.
When doubling the resend time interval, processing is performed with the maximum value held by the system as the upper limit.
The controller operates with 0.2 seconds as the minimum value held by the system and 120 seconds as the maximum value.
TCP resend ends by the timeout of the TCP ULP timer. If no response was returned from the external device by that time, a TCP connection timeout (event code 00C5CH) occurs.



The TCP ULP timer also functions as the timeout time that is applied when a session is established in TLS/DTLS encrypted communications.

Ethernet communication load monitor function

This function visualizes the load status of Ethernet communication processing.
The number of packets sent/received per unit time (1 second) and the amount of sent/received data for the Ethernet port can be checked in the buffer memory. (☞ Page 2028 Buffer Memory)

Precautions

- Access from an IP address set to block by the IP filter function is also subject to communication load monitoring by this function.
- Communication data whose bandwidth is restricted by the bandwidth limitation function against DoS attacks is not subject to communication load monitoring by this function.

IP address duplication detection

If one network has stations with the same IP address, an IP address duplication error (error code 1900H) is detected.
The duplication status can be checked with the buffer memory areas. (☞ Page 2044 IP address duplication status storage area)

Detection timing

Duplicate IP addresses are detected at the following timing.

- Powered-on: When a power-off station is connected to a network in communication and its power is turned on
- Network connection: When a power-on station is connected to a network in communication

Methods of recovery from an overlapping IP address

Change the IP address of the relevant station, and power off and on or reset the master station.

75 ERROR CODES

The error details and cause can be identified by the error code. This chapter describes errors that may occur in the controller and actions to be taken.
The controller stores the corresponding error code in the special register (SD) upon detection of an error by the self-diagnostic function.
If an error occurs when the data communications are requested from the engineering tool, intelligent function module, or network system connected, the controller returns the corresponding error code to the request source.
The error code can be checked in either of the following ways:

- Module diagnostics of the engineering tool (GX Works3 Operating Manual)
- Special register (SD0 (Latest self-diagnostics error code), SD10 to SD25 (Self-diagnostic error code)) (☞ Page 1968 List of Special Register (SD) Areas)

75.1 Error Code System

Error codes are given in hexadecimal format (4 digits) (16-bit unsigned integer).
The type of error includes the error, which is detected through the self-diagnostic function of each module, and the common error, which is detected during data communications between modules.

Error detection type		Range
Errors detected by self-diagnostic function	Minor error	1000H to 1FFFH
	Moderate error	2000H to 3BFFH
	Major error	3C00H to 3FFFH
Errors detected by other than the self-diagnostic function	CPU function, motion function, security function	4000H to 4FFFH
	Ethernet function, CC-Link IE TSN function	C000H to CFFFH
	CC-Link IE TSN function	D000H to DFFFH

Detailed information

Upon detection of an error by the self-diagnostic function, the detailed information of the error cause is added with an error code. The detailed information can be checked using the engineering tool.

Detailed information for the latest error code can also be checked in the special register (SD). (☞ Page 1968 List of Special Register (SD) Areas)

Up to three types of detailed information are provided for each error code. The types differ depending on the error code. (Depending on the system status, some items are not displayed.)

Type	Item	Description
Detailed information 1	Error location information	Information on the location in a program Pou No./FB No. are numbers that are internally assigned during conversion by the engineering tool to identify each POU in a program file and FB file.
	Drive/file information	Information on the corresponding drive name and file name
	Parameter information	Information on the parameter, such as parameter storage location and parameter type
	System configuration information	Information on the system configuration, such as I/O numbers and power supply numbers
	Time information	Information on time
	Controller data backup/restoration folder information	Information on the backup destination/restore source folder for the controller data
	Operation source information	Information on the operation source such as connection port (USB, Ethernet)
	Program error information (FB)	Information on FB
	Label name information	Information on the label
	Own station information	Information on the own station such as network number and IP address
	Grandmaster MAC address information	Grandmaster MAC address
	Add-on name information	Add-on name
	Axis error	Information on the axis error
	Axis number information	Information on the axis such as axis type
	Cycle information	Information on the cycle such as cycle type
	Connection configuration error information	Information on the connection configuration
Detailed information 2	Drive/file information	Information on the corresponding drive name and file name
	Annunciator information	Information on the annunciator areas
	Parameter information	Information on the parameter, such as parameter storage location and parameter type
	System configuration information	Information on the system configuration, such as I/O numbers and power supply numbers
	Time information	Information on time
	Program error information (FB)	Information on the FB instance
	Device name information	Information on the device
	Label name information	Information on the label
	IP address duplication information	MAC address of the port where IP address duplication was detected
	Overlapped type information	Information on station type or station number duplication
	Target station information	Information on the target station such as network number and IP address
	Add-on name information	Add-on name
	Add-on version information	Information on the add-on version
	Detail code information	Detail code
	Axis error	Information on the axis error
Detailed information 3	Information on failures in the controller	Detail code of the error occurrence cause

75.2 How to Clear Errors

Continuation errors can be cleared. For the error clear method, refer to the following.

☞ Page 1751 Error clear

75.3 Codes of Errors Detected by Self-diagnostic Function (1000H to 3FFFH)

The following table lists error codes detected by the self-diagnostic function.

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1000H	Power shutoff	• A momentary power failure has occurred. • The power supply has been shut off. • The controller has been reset.	Continue	Check the power supply status.	—	Always
1080H	ROM write count error	The number of writes to the flash ROM (data memory, program memory, and system memory) exceeded 50000 times.	Continue	Replace the controller.	—	At power-on/ reset
1090H	Battery error	• The voltage of the battery built in the controller has dropped below the specified value. • The lead connector of the battery built in the controller is disconnected. • The lead connector of the battery built in the controller is not securely connected.	Continue	• Replace the battery. • Check the connection status of the battery lead connector in the controller. If it is loose, securely connect the lead connector.	—	Always
1100H	SD memory card access error	Data cannot be written to the SD memory card because the write protect switch is locked.	Continue	Unlock the write protect switch of the SD memory card.	—	Always
1101H	SD memory card access error	• The SD memory card is not inserted, and thus reading or writing cannot be executed. • An SD memory card is disabled by SM606 (SD memory card forced disable instruction), and thus reading or writing cannot be executed.	Continue	• Insert or re-insert an SD memory card. • If SM606 (SD memory card forced disable instruction) is on, turn it off to cancel the disabled state.	—	Always
1120H	SNTP clock setting error	Time setting has failed when the controller is powered on or reset.	Continue	• Check if the time is correctly set in the time setting function. • Check if the specified SNTP server is operating normally and there is no failure on the network accessing the SNTP server computer.	—	At power-on/ reset
1124H	Default gateway/ gateway IP address error	• The default gateway is not set correctly. • The gateway IP address is not set correctly. • The default gateway/gateway IP address (network address after the subnet mask) is different from that of the IP address of the own node.	Continue	• Correct the default gateway IP address. • Set the same network address as that of the IP address.	Parameter information	Always
1128H	Own node port number error	The port number is incorrect.	Continue	Correct the port number.	—	Always
1129H	Open specification port number error	The port number setting of the external device is incorrect.	Continue	Correct the port number of the external device.	—	Always
112DH	Specified IP address error	Request with all stations specification failed.	Continue	Execute request with the currently specified station.	—	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
112EH	Connection establishment failed	A connection could not be established in the open processing.	Continue	• Check the operation of the external device. • Check if the open processing has been performed in the external device. • Correct the port number of the Ethernet-equipped module, IP address/port number of the external device, and opening method. • When the firewall is set in the external device, check if the access is permitted. • Check that the Ethernet cable is not disconnected. • If the connection was closed immediately before the open processing, wait for 65 seconds and perform the open processing.	—	Always
1132H	Receive data buffer full detection	Receive data buffer full was detected, so the data was discarded.	Continue	Correct the function being executed and reduce the load on Ethernet communication.	—	Always
1155H	Connection number acquisition error	• The specified connection was already closed in TCP/IP communications. • Open processing is not performed.	Continue	• Perform the open processing for the specified connection. • Check if the open processing has been performed in the external device.	—	Always
1157H	Receive buffer securement error	• The specified connection was already closed in UDP/IP communications. • Open processing is not performed.	Continue	• Perform the open processing for the specified connection. • Check if the open processing has been performed in the external device.	—	Always
1167H	Unsent data send error	Unsent data found, but could not be sent.	Continue	• Check the settings for connection with the external device. • Check the operation of the external device or switching hub. • Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected. • Check that there is no connection failure with the switching hub. • Execute a communication test or PING test. If the test completes with an error, take an action to correct the error.	—	Always
1168H	Security function error (certificate expiration)	There is an expired certificate.	Continue	Check the certificates that have expired, and write the new certificates.	Drive/file information	• Always • At power-on/reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1169H	Security function error (TLS communication error)	Data was not sent correctly with TLS.	Continue	• Check the encrypted communication version setting (TLS or DTLS). • For the server device, check if the server certificate is created. • For the client device, check if the server certificate of the external device is stored in the trusted list. • Check if the server certificate has not expired and its digital signature is valid. • When the firewall is set in the external device, check if the access is permitted. • Check the settings for connection with the external device. • Check and correct the port number of the module, IP address/port number of the external device, opening method, and protocol. • Check the settings of the access restriction functions such as the IP filter and bandwidth limitation against DoS attacks on the external device.	—	Always
116AH	Security function error (DTLS communication error)	Data was not sent correctly with DTLS.	Continue	• Check the encrypted communication version setting (TLS or DTLS). • For the server device, check if the server certificate is created. • For the client device, check if the server certificate of the external device is stored in the trusted list. • Check if the server certificate has not expired and its digital signature is valid. • When the firewall is set in the external device, check if the access is permitted. • Check the settings for connection with the external device. • Check and correct the port number of the module, IP address/port number of the external device, opening method, and protocol. • Check the settings of the access restriction functions such as the IP filter and bandwidth limitation against DoS attacks on the external device. • In the simple CPU communication function, if DTLS is selected as the protocol in the communication destination settings, ensure that the external device has started up and connected normally.	—	Always
1192H	FTP server function error (user authentication disabled)	In the module parameters, "FTP Server Function" is set to "Use" in "To Use or Not to Use User Authentication Setting", but the user authentication function is disabled. Or, the user authentication function is enabled, but "Do not authenticate" is set for "Ethernet Port" in "Authentication Target Route Setting".	Continue	• Enable the user authentication function. • Set "Authenticate" for "Ethernet Port" in "Authentication Target Route Setting".	—	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1193H	SLMP error	The same own station port number was specified on a different channel with serial numbers added.	Continue	When executing the G(P).SLMPSNDC instruction, set the own station port number of each channel to which a serial number is assigned so that it does not overlap with each other.	—	At instruction execution
1194H	Web server function error (user authentication disabled)	In the module parameters, "Web Server Function" is set to "Use" in "To Use or Not to Use User Authentication", but the user authentication function is disabled. Or, the user authentication function is enabled, but "Do not authenticate" is set for "Ethernet Port" in "Authentication Target Route Setting".	Continue	• Enable the user authentication function. • Set "Authenticate" for "Ethernet Port" in "Authentication Target Route Setting".	—	At power-on/ reset
11A0H	PID operation error	A value outside the range (TS ≤ 0) was specified for the sampling time (TS).	Continue	Check and correct the sampling time (TS) value.	Error location information	At instruction execution
11A1H	PID operation error	A value outside the range (α < 0 or 100 ≤ α) was specified for the input filter constant (α).	Continue	Check and correct the input filter constant (α) value.	Error location information	At instruction execution
11A2H	PID operation error	A value outside the range (KP ≤ 0) was specified for the proportional gain (KP).	Continue	Check and correct the proportional gain (KP) value.	Error location information	At instruction execution
11A3H	PID operation error	A value outside the range (TI < 0) was specified for the integral time (TI).	Continue	Check and correct the integral time (TI) value.	Error location information	At instruction execution
11A4H	PID operation error	A value outside the range (KD < 0 or 201 ≤ KD) was specified for the derivative gain (KD).	Continue	Check and correct the derivative gain (KD) value.	Error location information	At instruction execution
11A5H	PID operation error	A value outside the range (TD < 0) was specified for the derivative time (TD).	Continue	Check and correct the derivative time (TD) value.	Error location information	At instruction execution
11A6H	PID operation error	A value less than or equal to the operation cycle was specified for the sampling time (TS).	Continue	Check and correct the sampling time (TS) value.	Error location information	At instruction execution
11A7H	PID operation error	A process value variation (ΔPV) overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11A8H	PID operation error	A deviation (EV) overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11A9H	PID operation error	An integral calculation value overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11AAH	PID operation error	A derivative gain (KD) value overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11ABH	PID operation error	A differential calculation value overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11ACH	PID operation error	A PID operation result overflow occurred.	Continue	Check and correct the control data setting values.	Error location information	At instruction execution
11ADH	PID operation error	A value smaller than the output lower limit setting value was specified for the output upper limit setting value.	Continue	Check and correct the output upper limit setting value or output lower limit setting value.	Error location information	At instruction execution
11AEH	PID operation error	A value smaller than 0 was specified for the input variation amount warning setting value or output variation amount warning setting value.	Continue	Change the input variation amount warning setting value or output variation amount warning setting value to a value greater than 0.	Error location information	At instruction execution
11AFH	PID operation error	• The deviation when starting auto tuning (step response method) became 150 or less. • The deviation when finishing auto tuning (step response method) was 1/3 or greater than the deviation when starting.	Continue	• Check and correct the control data. • If the deviation when starting auto tuning (step response method) is not 150 or more, specify a set value for auto tuning.	Error location information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
11B0H	PID operation error	The movement direction assumed from the relationship between the set value and process value when starting auto tuning (step response method) and the output value movement direction do not match.	Continue	• Perform auto tuning again after correcting the relationship among the set value, auto tuning (step response method) output value, and process value. • Check and correct the control data.	Error location information	At instruction execution
11B1H	PID operation error	The input value (PV) did not change correctly, and auto tuning (step response method) did not function normally.	Continue	• Set a long time for the sampling time (TS). • Set a larger value for the input filter constant (α). • Check the input value (PV).	Error location information	At instruction execution
11B2H	PID operation error	A value equal to or lower than the output lower limit (LLV) was specified for the auto tuning (limit cycle method) output upper limit (ULV).	Continue	Check and correct the output upper limit (ULV) and output lower limit (LLV) values.	Error location information	At instruction execution
11B3H	PID operation error	A value outside the range (SHPV < 0) was specified for the auto tuning (limit cycle method) process value threshold (hysteresis) width (SHPV).	Continue	Check and correct the process value threshold (hysteresis) width (SHPV) setting value.	Error location information	At instruction execution
11B4H	PID operation error	The system area used for auto tuning (limit cycle method) was rewritten.	Continue	Check whether the occupied system area has been rewritten with the PID instruction.	Error location information	At instruction execution
11B5H	PID operation error	As the auto tuning (limit cycle method) process time was exceeded, it was not possible to properly acquire the τ and τon time. (τon > τ, τon < 0, τ < 0)	Continue	Increase the difference (ULV-LLV) between the auto tuning output value upper and lower limits, or reduce the input filter constant (α) and auto tuning process value threshold (hysteresis) width (SHPV) values.	Error location information	At instruction execution
11B6H	PID operation error	An overflow occurred with the proportional gain (KP) calculated when performing auto tuning (limit cycle method).	Continue	• Ensure that the process value (PV) change increases. • Reduce the difference (ULV-LLV) between the auto tuning output value upper and lower limits.	Error location information	At instruction execution
11B7H	PID operation error	The integral time (TI) calculated when performing auto tuning (limit cycle method) was outside the 0 to 32767 range.	Continue	Increase the difference (ULV-LLV) between the auto tuning output value upper and lower limits, or reduce the input filter constant (α) and auto tuning process value threshold (hysteresis) width (SHPV) values.	Error location information	At instruction execution
11B8H	PID operation error	The derivative time (TD) calculated when performing auto tuning (limit cycle method) was outside the 0 to 32767 range.	Continue	Increase the difference (ULV-LLV) between the auto tuning output value upper and lower limits, or reduce the input filter constant (α) and auto tuning process value threshold (hysteresis) width (SHPV) values.	Error location information	At instruction execution
11D0H	Add-on individual warning	A warning occurred in the corresponding add-on.	Continue	Check the manual of the add-on for details about the detail code.	• Add-on name information • Detail code information	Depends on the add-on.
11D1H	Label instance error	An error occurred in the corresponding add-on for the label instances.	Continue	• Check the version of the corresponding add-on for the labels. • Increase the maximum RAM size of the corresponding add-on for the labels.	Parameter information	At power-on/ reset
11D2H	Add-on label setting error	• A device other than the D device was assigned to "Assign (Device/ Label)" for the add-on-related label. • Index modification was used for "Assign (Device/Label)" for the add-on-related label.	Continue	• Assign the D device to "Assign (Device/Label)" for the add-on-related label. • Do not use index modification for "Assign (Device/Label)" for the add-on-related label.	—	• At power-on/reset • At write

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
11F0H	Network communication cycle synchronization processing error	• The execution interval of a synchronous interrupt program has exceeded the set value. • The network communication cycle synchronous program has not been completed within the set communication cycle interval of the CC-Link IE TSN function.	Continue	Check the detailed information (time information), check its value (time), and take the following actions: • Check and correct the network communication cycle synchronous interrupt program so that the processing is to be completed within the period specified in the communication cycle interval setting for CC-Link IE TSN. • Set an appropriate value for the period specified in the communication cycle interval setting of CC-Link IE TSN.	• Error location information • Time information	At interrupt occurrence
11F1H	Network communication cycle synchronization processing error	• The execution interval of a synchronous interrupt program has exceeded the set value. • A cycle where the network communication cycle synchronous program was not executed has been detected.	Continue	• Check and correct the interrupt disable sections and the interrupt programs with a high priority so that the network communication cycle synchronous interrupt program can be executed. • Check and correct the communication cycle interval setting and refresh setting for the CC-Link IE TSN function. • Check and correct the motion operation processing.	Error location information	At interrupt occurrence
1200H	Module moderate error	• A moderate error has been notified from the intelligent function module connected. • A moderate error has been detected in the network communication function on the controller.	Stop/ continue	• Check the detailed information (system configuration information), identify the error module, and eliminate the error cause. • Eliminate the error that occurred in the network communication function on the controller.	System configuration information	Always
125AH	Synchronous watchdog counter error	The module cannot normally communicate with the device station on CC-Link IE TSN.	Continue	Set "Restart transfer" to 'Restart transfer of synchronous communication received data' (U3E0\G10708 to G10963) and check whether the data transfer to the device/label is restarted. If it does not restart, take the following actions and then turn off and on or reset the controller. (1) Increase the values for "Communication Period Interval Setting" and "Transient Transmission Time" in "Communication Period Setting" under "Basic Settings" of "CC-Link IE TSN". (2) Check if the switching hub and the cables are connected properly. (3) Take measures to reduce noise.	Target station information	Always
1800H	Annunciator ON	The annunciator (F) on status has been detected.	Continue	Check the detailed information (annunciator information) and correct the program corresponding to the displayed annunciator number.	• Error location information • Annunciator information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1803H	Network configuration error	The number of connected stations exceeds the limit.	Continue	• Set the number of CC-Link IE TSN Class B devices and TSN hubs to eight or less in total for each port of the master station in the transmission path from the master station to the CC-Link IE TSN Class B device of the end. • Update the firmware of the CC-Link IE TSN Class A device to the latest version, or replace it with a device that supports CC-Link IE TSN protocol version 2.0.	—	Always
1804H	Connection configuration error	During a data link, invalid connection structure has been detected. (1) A CC-Link IE TSN Class B station is connected further on the end side than a CC-Link IE TSN Class A station. (2) When the communication speed of the master station is 1Gbps, a station with 1Gbps is connected closer to the end side compared to a station with 100Mbps. (3) When the communication speed of the master station is 100Mbps, a station with a communication speed of 1Gbps is connected. (4) With the master station with a communication speed of 100Mbps, "Communication Period Setting" of the CC-Link IE TSN Class B station with a communication speed of 100Mbps is set to "Low-Speed". (5) When the communication speed of the master station is 1Gbps, the communication period setting of the station with 100Mbps is set to basic period or normal speed (four times).	Continue	Check the connection and setting on the end side of the station shown in detailed information 2 and take the following actions. (1) Connect the CC-Link IE TSN Class A station further on the end side than the CC-Link IE TSN Class B station. (2) If the master station has a communication speed of 1Gbps, connect the station with a communication speed of 1Gbps on the master station side rather than on the side where a station with a communication speed of 100Mbps is connected. (3) If the master station has a communication speed of 100Mbps, set the communication speed of the device station to 100Mbps. (4) If the master station has a communication speed of 100Mbps, set the communication period setting of the CC-Link IE TSN Class B station with a communication speed of 100Mbps to basic period or normal speed (four times). (5) If the master station has a communication speed of 1Gbps, set "Communication Period Setting" to "Low-Speed" for the station with a communication speed of 100Mbps.	• Own station information • Target station information	Always
1806H	Connection configuration error	• When "TSN HUB Setting" is set to "Not to Use TSN HUB", connection of the CC-Link IE TSN Class B devices in a star topology has been detected. • A CC-Link IE TSN Class B device is connected further on the end side than a CC-Link IE TSN Class A device.	Continue	• Disconnect the switching hub connected to the CC-Link IE TSN Class B device. • Set "TSN HUB Setting" to "Use TSN HUB". • Connect the CC-Link IE TSN Class A device further on the end side than the CC-Link IE TSN Class B device.	Own station information	Always
1807H	Network configuration settings mismatch	A mismatch has been detected between the device stations set in the network configuration settings and the connected device stations.	Continue	• Check the network configuration settings and connect the correct device station. Or, correct the network configuration settings. • Update the firmware or profile of the connected device station to the latest version.	• Own station information • Target station information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1808H	Cyclic transmission distribution error	When the communication speed of the master station is 1Gbps, "Cyclic Transmission Distribution Setting" for the station with 100Mbps is set to "Distribute".	Continue	• When the communication speed of the master station is 1Gbps, set "Cyclic Transmission Distribution Setting" of the station with 100Mbps to "Do not distribute", then power on the system again or reset the controller. • When the communication speed of the master station is 1Gbps, set 1Gbps for the communication speed of the station with 100Mbps in which "Cyclic Transmission Distribution Setting" is set to "Distribute".	• Own station information • Target station information	Always
1818H	Constant scan time error	The execution time until constant scan wait (the time period from the start of a scan to the completion of an END processing) exceeded the constant scan time set in the CPU parameters.	Continue	Check and correct the constant scan time setting.	Time information	At END instruction execution (for each program)
1852H	IP address duplication detection	During a data link, overlapping IP addresses have been detected.	Continue	Change the IP address of devices with an overlapped IP address.	• Operation source information • IP address duplication information	Always
1853H	Unsupported station detection (during control communication)	A line topology configuration with 121 or more stations was recognized on the trunk line of one port of the master station, and a device station that cannot be used in this configuration was detected in the connection.	Continue	• Refer to '121 or more stations line topology non-support detection status' (SW0520 to SW052F) and check the device station products that do not support the line topology with 121 or more stations. • Device stations other than the ones manufactured by Mitsubishi Electric are recognized as the devices that do not support line topology with 121 or more stations. Also, for details on the device stations manufactured by Mitsubishi Electric, refer to the following technical bulletin. Line Topology with 121 or More Device Stations (CC-Link IE TSN Products) • If the device station supports line topology with 121 or more stations, update the firmware to the supported version. • If the device station does not support line topology with 121 or more stations, correct the network configuration to the line topology configuration with 120 or less stations, or replace the device station to one that supports the line topology with 121 or more stations.	Target station information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1854H	Invalid communication cycle interval setting and low-speed multiplying factor	It is not possible to guarantee the send/receive of cyclic data of following device stations within the "Low-Speed" cycle: device stations set to "Low-Speed" in "Communication Period Setting" of "Network Configuration Settings" under "Basic Settings" of the master station.	Continue	• Set "Low-Speed" of "Multiple Period Setting" under "Basic Settings" of the master station to a value equal to or greater than the value stored in Multiple cycle setting (low speed) (Un\G1277442). • Set "Communication Period Interval Setting" under "Basic Settings" of the master station to a value equal to or greater than the value stored in Communication cycle interval (calculation value) (Un\G1277443).	Parameter information	Always
1855H	Cyclic transmission time error	The value set in "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station is smaller than the calculation value of cyclic transmission time.	Continue	• Set the value of "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station to a value equal to or greater than the value in the detailed information displayed by module diagnostics. • Check and correct the parameter settings and the network configuration so that a smaller value can be set for "Cyclic Transmission Time".	Communication period setting information	Always
1860H	Network synchronous communication function transmission omission	Cyclic transmission skip occurred due to one of the following causes. (1) Interrupts are disabled by executing the DI instruction. (2) The "Communication Period Interval Setting" value is small. (3) The "Cyclic Transmission Time" value is small.	Continue	(1) Enable the interrupt by the EI instruction within the communication cycle. (2) Enable the communication cycle interval measurement, and set "Communication Period Interval Setting" to a value larger than the value displayed in 'Communication cycle interval (actual measure value)' (U3E0\G10200 to U3E0\G10201). (3) Enable the communication cycle interval measurement, and set "Cyclic Transmission Time" to a value based on the value displayed in 'Cyclic transmission time (calculation result)' (U3E0\G10272 to U3E0\G10273). If the same error still occurs even after taking the above actions, set "Communication Period Interval Setting" to a sufficiently large value, and readjust the settings of "Communication Period Interval Setting" and "Cyclic Transmission Time" based on the manual.	—	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1863H	Network communication cycle over	Cyclic transmission skip occurred due to one of the following causes. (1) The "Communication Period Interval Setting" value is small. (2) The "Cyclic Transmission Time" value is small.	Continue	(1) Enable the communication cycle interval measurement, and set "Communication Period Interval Setting" to a value larger than the value displayed in 'Communication cycle interval (actual measure value)' (U3E0\G10200 to U3E0\G10201). (2) Enable the communication cycle interval measurement, and set "Cyclic Transmission Time" to a value based on the value displayed in 'Cyclic transmission time (calculation result)' (U3E0\G10272 to U3E0\G10273). If the same error still occurs even after taking the above actions, set "Communication Period Interval Setting" to a sufficiently large value, and readjust the settings of "Communication Period Interval Setting" and "Cyclic Transmission Time" based on the manual.	—	Always
1871H	Synchronous watchdog counter initialization error	Initialization processing with the device station on CC-Link IE TSN cannot be performed correctly.	Continue	• Update the version of the station shown in detailed information 2 to the one that supports the CC-Link IE TSN network synchronous communication function. • Take measures to reduce noise. • After taking the above corrective actions, turn off and on or reset the controller.	Target station information	Always
1900H	Overlapping IP addresses	Overlapping IP addresses have been detected.	Continue	Check and correct the IP addresses.	Operation source information	Always
1910H	OPC UA server function error (user authentication disabled state)	In the module parameters, "Use" is set in "To Use or Not to Use User Authentication" under "OPC UA Server Settings", but the user authentication function is disabled. Or, the user authentication function is enabled, but "Do not authenticate" is set for "Ethernet Port" in "Authentication Target Route Setting".	Continue	• Enable the user authentication function. • Set "Authenticate" for "Ethernet Port" in "Authentication Target Route Setting".	—	At power-on/ reset
1911H	OPC UA server function error (user authentication enabled state)	While the user authentication function was enabled, the OPC UA server function was started with "To Use or Not to Use User Authentication" set to "Not to Use" in the module parameters.	Continue	• Disable the user authentication function. • Set "To Use or Not to Use User Authentication" to "Use".	—	At power-on/ reset
1912H	OPC UA server function error (encrypted communication setting error)	A server certificate has not been created, and the security policy for the OPC UA server function is set to a value other than None.	Continue	• Check if the server certificate has been created. • Change the settings for the security policy.	—	At power-on/ reset
1913H	OPC UA server function error (label communication file error)	The label information is different between the global label assignment information and the OPC UA address space settings file.	Continue	After pressing the update button in the address space settings, write the OPC UA address space settings file and global label assignment information.	—	At power-on/ reset
1914H	OPC UA server function error (address space settings file error)	• The OPC UA address space settings file is not stored when the OPC UA server is started. • Analysis of the OPC UA address space settings file failed when the OPC UA server is started.	Continue	After pressing the update button in the address space settings, write the address space settings file.	Drive/file information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1915H	OPC UA server function error (address space error)	• The number of nodes in the address space settings file exceeded the maximum number of nodes. • The address space capacity exceeded the maximum capacity. • The Variable data size exceeded the maximum limit of the Variable data size.	Continue	Reduce the number of nodes in the address space and rewrite the address space settings file.	—	At power-on/ reset
1916H	OPC UA server function error (port number error)	Startup failed because the port number to be used by the OPC UA server was already in use.	Continue	Correct the port number.	—	At power-on/ reset
192AH	Invalid file	• A latch device/label file cannot be created. • A latch device/label file error has been detected.	Continue	• If the capacity of the SD memory card is not sufficient, secure free space. • Check the attribute of the latch device/label file, and make it ready for read/write. • Format the SD memory card, re-insert the SD memory card, or replace the SD memory card. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	Always
1930H	Invalid file	• An event history file created by another controller has been used. • The power or communication was interrupted during access to the event history file. • The event history file has been tampered with.	Continue	• Check whether an event history file created by another controller is used. • Check whether the power or communication was intentionally interrupted during access to the event history file. • If none of the above items are true, tampering is suspected. Take appropriate action.	Drive/file information	At power-on/ reset
1931H	Invalid file	An invalid system Web page file has been detected.	Continue	Please contact your local Mitsubishi representative.	Drive/file information	• At power-on/reset • At write
1A00H	Cycle over	Operation processing or other fixed scan processing is not completed within the set cycle.	Continue	• Change the value of the communication cycle interval setting to a larger value. • Change the axis control operation cycle to distribute the processing load. • For programs whose priority is higher than that of the network communication cycle synchronous interrupt program, change the priority or execution interval or check and correct the processing content.	Cycle information	Always
1A01H	Cycle assignment incorrect	The value is out of range for operation cycle setting or the value which cannot be set was specified.	Continue	Set the following within the range. (1) MotionSystem.PrConst.OperationCycle[1].Cycle (2) MotionSystem.PrConst.OperationCycle[2].Cycle (3) MotionSystem.PrConst.OperationCycle[3].Cycle	Cycle information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A02H	Event history file incorrect	• An error was detected in the motion control event history file. • The memory capacity of add-on MotionEventHist is insufficient. • The storage capacity for motion control events is insufficient. • The drive cannot be accessed.	Continue	• Delete unnecessary files to increase free space. • Delete the motion control event history file. • Check and correct the memory capacity of add-on MotionEventHist. • Check and correct the storage capacity settings for motion control events. • Power off and on the system or reset the controller.	Drive/file information	Always
1A03H	Out of cycle over error selection range	The value is out of range for cycle over error selection.	Continue	Set the following within the range. (1) MotionSystem.PrConst.OperationCycle[1].CycleOverErrorType (2) MotionSystem.PrConst.OperationCycle[2].CycleOverErrorType (3) MotionSystem.PrConst.OperationCycle[3].CycleOverErrorType	Cycle information	At power-on/ reset
1A04H	Invalid label (at system start)	Failed to import the label definition.	Continue	• Write the label settings. • If the device label import error occurs, refer to the corrective action for the device label import error.	—	At power-on/ reset
1A06H	Add-on SignalIO acquisition failure	Failed to acquire add-on SignalIO.	Continue	Install SignalIO.apk and enable it.	Parameter information	• At power-on/reset • At PLC READY ON
1A07H	Insufficient memory capacity of add-on SignalIO	A signal cannot be created because the memory capacity of the add-on SignalIO is insufficient.	Continue	• Increase the memory capacity of add-on SignalIO. • Increase the memory capacity of add-on ExternalSignal.	Parameter information	• At power-on/reset • At PLC READY ON
1A08H	Network driver memory size over	The memory size of the network driver exceeds the memory capacity set in the system.	Continue	• Increase the memory capacity set in the system. • Delete unnecessary stations and reduce the memory size.	Add-on name information	At power-on/ reset
1A09H	Absolute position control backup data saving failure	• Failed to save the backup data because of insufficient capacity. • The drive cannot be accessed.	Continue	• Check the usage rate of the event history file and delete unnecessary files. • Check and correct the system memory (backup RAM) size and storage capacity settings for the motion control event history file. • Power off and on the system or reset the controller.	Drive/file information	Always
1A0AH	Device label import error	• There are inconsistencies between the network configuration settings and the settings at device label creation. • Failed to import device labels.	Continue	Check the settings of network configuration and then create device labels again.	—	At power-on/ reset
1A0CH	Advanced synchronization control add-on memory shortage	System memory for the add-on AdvancedSync is insufficient. (1) Failed to generate input axis/ output axis data. (Detail code: 0001H) (2) Failed to generate backup data. (Detail code: 0002H)	Continue	• Increase the memory capacity of add-on AdvancedSync. • Delete unnecessary labels and reduce the memory usage.	Detail code information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A0DH	Advanced synchronization control smoothing memory shortage	• Failed to secure smoothing memory due to a shortage in add-on AdvancedSync system memory. • Failed to secure memory for the smoothing time constant corresponding to the following detail codes. (1) PrConst.SmoothingTime Constant (Detail code 0001H) (2) PrConst.MasterSpeedChange GearSmoothingTimeConstant (Detail code 0002H) (3) PrConst.MasterClutch SmoothingTimeConstant (Detail code 0003H) (4) PrConst.AuxSpeedChangeGear SmoothingTimeConstant (Detail code 0004H) (5) PrConst.AuxClutchSmoothing TimeConstant (Detail code 0005H) (6) PrConst.OutSpeedChangeGear SmoothingTimeConstant (Detail code 0006H)	Continue	• Increase the memory capacity of add-on AdvancedSync. • Check and adjust the setting value of the time constant to reduce the number of smoothing steps or increase the setting value of the operation cycle.	Axis error	• At power-on/reset • At PLC READY ON
1A0EH	Advanced synchronization control input axis invalid	A value that cannot be set as an input axis of the advanced synchronization control is set in the axis parameter. (For the error cause, refer to the detail codes of the event history.) (1) The input axis label ID of the advanced synchronization control is duplicated. (Detail code: 0001H) (2) The input axis number of the advanced synchronization control is duplicated. (Detail code: 0002H)	Continue	• Check and correct the settings so that the input axis label ID of the advanced synchronization control is not duplicated. • Check and correct the settings so that the input axis number of the advanced synchronization control is not duplicated.	Axis error	At power-on/ reset
1A0FH	Advanced synchronization control output axis invalid	A value that cannot be set as an output axis of the advanced synchronization control is set in the axis parameter. (For the error cause, refer to the detail codes of the event history.) (1) The output axis label ID of the advanced synchronization control is duplicated. (Detail code: 0001H) (2) The output axis number of the advanced synchronization control is duplicated. (Detail code: 0002H) (3) An axis type that cannot be set for the output axis of the advanced synchronization control (real encoder axis/virtual encoder axis) is set. (Detail code: 0003H)	Continue	• Check and correct the settings so that the output axis label ID of the advanced synchronization control is not duplicated. • Check and correct the settings so that the output axis number of the advanced synchronization control is not duplicated. • Set an axis type available for the output axis of the advanced synchronization control in the output axis information.	Axis error	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A40H	Watchdog counter error	A watchdog counter error of driver was detected.	Continue	• Set "Restart transfer" to 'Restart transfer of synchronous communication received data' (U3E0\G10708 to G10963) and check whether the data transfer to the device/label is restarted. If no data transfer is restarted, take the following actions. • If a stop error is detected, check the error details and take corrective action. • If an error is detected in the corresponding axis, check the axis error details and take corrective action. • Increase the values for "Communication Period Interval Setting" and "Transient Transmission Time" in "Communication Period Setting" under "Basic Settings" of "CC-Link IE TSN". • Check if the switching hub and the cables are connected properly. • Check errors such as noise in the environment and eliminate the error causes. • After taking the above corrective actions, turn off and on or reset the controller.	Axis number information	Always
1A41H	Unsupported driver connection	An unsupported driver was connected.	Continue	Connect a supported driver.	Axis number information	• Always • At power-on/reset
1A42H	SLMP communication error	An error occurred in SLMP communication.	Continue	• Check and correct the object data setting. • Check the manual of the driver.	• Axis number information • Parameter error contents	Always
1A43H	SLMP communication error (timeout)	Response timeout was detected in SLMP communication.	Continue	Check and correct the transient transmission time. It is derived by the following formula. Transient Transmission Time = Communication Cycle Interval Setting - Cyclic Transmission Time - System Reserved Time	—	Always
1A48H	SDO communication error	• An error occurred in the SDO communication. • Issued a large quantity of SLMP requests at a time.	Continue	• Remove the error cause according to the SDO error code. • Reduce the number of SLMPs to be issued, or modify the program to issue the next request after the response is received.	• Program error information (FB) • SLMP alarm information	At motion control FB execution
1A49H	Synchronization setting combination error (at parameter change)	A parameter change was performed to make a device station controlled by the motion system in a device station where the network synchronous communication setting is set to "Asynchronous".	Continue	• Set the network synchronous communication setting of the device station controlled by the motion system to "Synchronous". • Restart the system.	• CC-Link IE TSN device IP address information • Axis error	At PLC READY ON
1A4AH	Driver position unit invalid	A driver position unit that is not compatible with the motion system is detected.	Continue	Set the driver position unit of the drive unit for a value other than "degree".	Axis number information	Always
1A4BH	Driver speed unit invalid	A driver speed unit that is not compatible with the motion system is detected.	Continue	Set the driver speed unit of the drive unit for a value other than "r/min". Alternatively, use a drive unit where either of Encoder Increments or Motor revolutions is set to other than 0 pulse.	Axis number information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A60H	Out of parameter range (axis)	Parameter is specified out of the range. The description of each detail code differs depending on the parameters. For details, refer to the manual.	Continue	Change the specified value of the parameter in the detailed information within the range.	• Axis number information • Axis error • Parameter error contents	• At power-on/reset • At PLC READY ON • At motion control FB execution
1A61H	Out of parameter range (axes group)	Parameter is specified out of the range.	Continue	Change the specified value of the parameter in the detailed information within the range.	• Axis number information • Axis error • Parameter error contents	• At power-on/reset • At PLC READY ON • At motion control FB execution
1A62H	Out of parameter range (system)	Parameter is specified out of the range.	Continue	Change the specified value of the parameter in the detailed information within the range.	Parameter error contents	• At power-on/reset • At PLC READY ON • At motion control FB execution
1A65H	Out of parameter range (advanced synchronization control input axis)	The parameter is specified out of range.	Continue	Set the parameter within the range.	• Axis error • Parameter error contents	At power-on/ reset
1A66H	Out of parameter range (advanced synchronization control output axis)	The parameter is specified out of range.	Continue	Set the parameter within the range.	• Axis error • Parameter error contents	At power-on/ reset
1A80H	Software stroke limit over (target position)	A value out of the software stroke limit range was set for the target position.	Continue	Set the target position within the software stroke limit range.	Axis error	At axis start
1A81H	Software stroke limit over (start position)	• Started at a position out of the software stroke limit range. • Started at a position out of the software stroke limit range towards a direction other than the returning enable direction.	Continue	Set ONLY_INSIDE or DISABLE in AxisName.Cd.SwStrokeLimit_Override and move to the movable range.	Axis error	At axis start
1A83H	Software stroke limit over (forward direction)	The value specified for AxisName.Pr.SwStrokeLimit_Target during control to forward direction would result in a move outside the software stroke limit range.	Continue	Move to the software stroke limit range.	Axis error	Always
1A84H	Software stroke limit over (negative direction)	The value specified for AxisName.Pr.SwStrokeLimit_Target during control in the negative direction was about to result in a move outside the software stroke limit range.	Continue	Move to the software stroke limit range.	Axis error	Always
1A85H	Out of target position range	• The value is out of range for Position/Distance. • When the target position is specified beyond the ring counter, Direction was set to the shortest path and Position was set out of range.	Continue	• Set Position/Distance within the range. • Set Direction to a value other than the shortest path.	Axis error	At axis start
1A86H	Out of limit velocity range	The value is out of range for LimitVelocity.	Continue	Set LimitVelocity within the range.	Axis error	At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A87H	Velocity limit value over	The target velocity exceeded the following. ■Detail code • 0001H: AxisName.Pr.VelocityLimit_Positive • 0002H: AxisName.Pr.VelocityLimit_Negative • 0003H: AxesGroupName.Pr.VelocityLimit	Continue	Set target velocity so that it does not exceed the following. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative • AxesGroupName.Pr.VelocityLimit	Axis error	• At axis start • At multiple start
1A88H	Acceleration/ Deceleration 0 specified operation error at start	Started after setting AxisName(AxesGroupName).Pr.AccelerationZeroBehavior to "-1: Error (Not Started) (ACCError)" with Acceleration or Deceleration 0.	Continue	Adjust settings so that Acceleration and Deceleration do not become 0.	Axis error	At axis start
1A89H	Out of acceleration/ deceleration time range	Acceleration was out of range when using the acceleration/deceleration time-fixed method.	Continue	Set Acceleration within the range.	Axis error	At axis start
1A8AH	Acceleration/ deceleration method mismatched	The acceleration/deceleration method of the under-control FB is different from that of the multiply-started FB.	Continue	Set the same acceleration/ deceleration method for the under-control FB and the multiple-started FB.	Axis error	At multiple start
1A8BH	Acceleration time over at start	Acceleration time exceeded 8400 [s].	Continue	Set target velocity/target acceleration/ target deceleration/target jerk so that acceleration time does not exceed 8400 [s].	Axis error	At axis start
1A8CH	Deceleration time over at start	• Deceleration time exceeded 8400 [s]. • The deceleration time for automatically decelerating from the target velocity exceeded 8400 [s].	Continue	Set target velocity/target acceleration/ target deceleration/target jerk as follows. • Deceleration time: 8400 [s] or less • Deceleration time for automatically decelerating from the target velocity: 8400 [s] or less	Axis error	At axis start
1A8DH	Out of acceleration range	The value is out of range for Acceleration.	Continue	Set Acceleration within the range.	Axis error	At axis start
1A8EH	Out of deceleration range	The value is out of range for Deceleration.	Continue	Set Deceleration within the range.	Axis error	At axis start
1A8FH	Out of jerk range	The value is out of range for Jerk.	Continue	Set Jerk within the range.	Axis error	At axis start
1A90H	Command velocity after driver velocity unit conversion out of range	The command velocity after driver velocity unit conversion was out of the range from -2147483648 to 2147483647.	Continue	• Set the command velocity after driver velocity unit conversion within the setting range. • Driver velocity unit conversion is determined from the following equation: Driver velocity unit conversion = Velocity command unit × (driver unit conversion numerator/driver unit conversion denominator)	Axis error	At axis start
1A91H	Out of velocity initial value selection range	• The value is out of range for velocity initial value selection of Options. • The value is out of range for command limit velocity initial value selection of Options.	Continue	• Set the velocity initial value selection of Options within the range. • Set the command limit velocity initial value selection of Options within the range.	Axis error	At axis start
1A93H	csv unsupported driver	The driver does not support csv.	Continue	Execute the instruction in the driver supporting csv.	Axis error	At axis start
1A94H	cst unsupported driver	The driver does not support cst.	Continue	Execute the instruction in the driver supporting cst.	Axis error	At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1A95H	Control mode switching error	• Driver control mode switching did not complete within one [s] after a control mode switching command was issued. (Detail code: 0001H) • During communication initialization, driver control mode did not switch to csp. (Detail code: 0002H) • At a control mode switching request, a motion control FB that cannot be executed switched the mode to the control mode. (Detail code: 0003H)	Continue	• Check whether an error occurred in the driver or whether the setting is incorrect, and take necessary actions. (Detail code: 0001H) • When the MR-J5-G-LL is connected: Set the control switching method setting (PW13.4) to "0: Disabled". (Detail code: 0001H) • When the MR-J5(W)-G series is connected: When switching the driver control mode while the motor is operating, set ZSP disabled selection at control switching (PC76.1) to "1: Disabled". (Detail code: 0002H) • Use a motion control FB that can be executed to send a switch request. (Detail code: 0003H)	Axis error	• Always • At axis start
1A96H	Out of target torque range	The value is out of range for Torque.	Continue	Set Torque within the range.	Axis error	At axis start
1A97H	Out of torque positive direction ramp range	The value is out of range for TorquePositiveRamp.	Continue	Set TorquePositiveRamp within the range.	Axis error	At axis start
1A98H	Out of torque negative direction ramp range	The value is out of range for TorqueNegativeRamp.	Continue	Set TorqueNegativeRamp within the range.	Axis error	At axis start
1A99H	Start at homing incomplete	The positioning was started when homing request flag is on.	Continue	Start after executing homing.	Axis error	At axis start
1A9AH	Axis status incorrect start	The axis is started in the status except when AxisName.Md.AxisStatus is Standstill.	Continue	Start the axis in the status when AxisName.Md.AxisStatus is Standstill.	Axis error	At axis start
1A9BH	Axes group status incorrect start	• The axes group was started when AxesGroupName.Md.AxesGroupStatus was other than GroupStandby. • Unconnected real axes exist among the configuration axes.	Continue	• Start the axes group operation when AxesGroupName.Md.AxesGroupStatus is GroupStandby. • Connect the configuration axis before starting axis group operation.	Axis error	At axis start
1A9EH	FLS signal detection (at start)	The signal input from FLS signal at start was detected.	Continue	Set ONLY_INSIDE or DISABLE in AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.	Axis error	At axis start
1A9FH	RLS signal detection (at start)	The signal input from RLS signal at start was detected.	Continue	Set ONLY_INSIDE or DISABLE in AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.	Axis error	At axis start
1AA0H	FLS signal detection (controlling)	The signal input from FLS signal during controlling was detected.	Continue	Set ONLY_INSIDE or DISABLE in AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.	Axis error	Always
1AA1H	RLS signal detection (controlling)	The signal input from RLS signal during controlling was detected.	Continue	Set ONLY_INSIDE or DISABLE in AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.	Axis error	Always
1AA2H	Out of gear denominator range	The value is out of range for RatioDenominator.	Continue	Set a value within the range for RatioDenominator.	Axis error	At axis start
1AA4H	Velocity limit value over during controlling	The command velocity exceeded the following when AxisName.Pr.VelocityLimit_OverOperation is "3: Immediate Stop (ImmediateStop)". • AxisName.Pr.VelocityLimit_Positive (Detail code 0001H) • AxisName.Pr.VelocityLimit_Negative (Detail code 0002H)	Continue	Set the command velocity so that it does not exceed the following. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative	Axis error	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AA5H	Out of direction selection range	The value is out of range for Direction.	Continue	Set Direction within the range.	Axis error	• At axis start • At multiple start
1AA6H	Acceleration limit value over	Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit.	Continue	Set target acceleration so that it does not exceed AxisName(AxesGroupName).Pr.AccelerationLimit.	Axis error	• At axis start • At multiple start
1AA7H	Deceleration limit value over	Target deceleration exceeded AxisName(AxesGroupName).Pr.DecelerationLimit.	Continue	Set target deceleration so that it does not exceed AxisName(AxesGroupName).Pr.DecelerationLimit.	Axis error	• At axis start • At multiple start
1AA8H	Jerk limit value over	Target jerk exceeded AxisName(AxesGroupName).Pr.JerkLimit.	Continue	Set target jerk so that it does not exceed AxisName(AxesGroupName).Pr.JerkLimit.	Axis error	• At axis start • At multiple start
1AA9H	Deceleration stop by servo OFF during operation	"5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)" was selected for AxisName.Pr.StopMode_ServoOff, and FALSE was set to ServoOn in MC_Power(MCv_AllPower) during operation.	Continue	Set TRUE to ServoOn in MC_Power(MCv_AllPower).	Axis error	Always
1AAAH	Immediate stop by servo OFF during operation	• "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)" was selected for AxisName.Pr.StopMode_ServoOff, and FALSE was set to ServoOn in MC_Power(MCv_AllPower) during operation. • FALSE was set to Enable in MC_Power(MCv_AllPower) during operation.	Continue	Set TRUE to Enable and ServoOn in MC_Power(MCv_AllPower).	Axis error	Always
1AABH	Stop cause of axes group configuration axis	Error occurred in configuration axis.	Continue	Check the error details of configuration axis.	Axis error	• Always • At axis start
1AACH	Master axis and slave axis No. duplicated	• The same axis number has been set to the master axis and slave axis.	Continue	Set different axis numbers for the master axis and slave axis.	Axis error	• At motion control FB execution • At axis start
1AADH	Master axis and slave axis cyclic reference	• The master axis is set to the slave axis in the latter part of the FB. • The number of connected FBs for synchronization exceeds the upper limit.	Continue	• Do not set the master axis as the slave axis in the latter part of the FB. • Reduce the number of connected FBs for synchronization so that it does not exceed the upper limit.	Axis error	• At motion control FB execution • At axis start
1AAEH	Out of cam table ID range	The value is out of range for CamTableID.	Continue	Specify the value within the range for CamTableID.	Axis error	• At motion control FB execution • At axis start
1AAFH	Out of master axis offset range	The value is out of range for MasterOffset.	Continue	Set a value within the range for MasterOffset.	Axis error	• At motion control FB execution • At axis start
1AB0H	Out of slave axis range	The value is out of range for SlaveOffset.	Continue	Set a value within the range for SlaveOffset.	Axis error	• At motion control FB execution • At axis start
1AB1H	Out of master axis coefficient range	• The value is out of range for MasterScaling. • The result of multiplying MasterScaling and the length per cycle is set to a value out of the positioning range.	Continue	• Set a value within the range for MasterScaling. • Set a value so that the result of multiplying MasterScaling by the length per cycle is within the positioning range.	Axis error	• At motion control FB execution • At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AB2H	Out of slave axis coefficient range	• The value is out of range for SlaveScaling. • The result of multiplying SlaveScaling and the stroke amount is out of the positioning range.	Continue	• Set a value within the range for SlaveScaling. • Set a value that the result of multiplying SlaveScaling by the stroke amount is within the positioning range.	Axis error	• At motion control FB execution • At axis start
1AB3H	Out of master axis follow-up distance range	The value is out of range for MasterStartDistance.	Continue	Set a value within the range for MasterStartDistance.	Axis error	• At motion control FB execution • At axis start
1AB4H	Out of Master axis synchronization start position range	The value is out of range for MasterSyncPosition.	Continue	Set a value within the range for MasterSyncPosition.	Axis error	• At motion control FB execution • At axis start
1AB5H	Out of start mode range	The value is out of range for StartMode.	Continue	Set a value within the range for StartMode.	Axis error	• At motion control FB execution • At axis start
1AB6H	Out of master axis data source range	The value is out of range for MasterValueSource.	Continue	Set a value within the range for MasterValueSource.	Axis error	• At motion control FB execution • At axis start
1AB8H	Out of BufferMode range	The value is out of range for BufferMode.	Continue	Set BufferMode within the setting range.	Axis error	• At motion control FB execution • At axis start
1AB9H	No cam table	The cam table specified in CamTableID does not exist.	Continue	Open cam data to the open area with MC_CamTableSelect.	Axis error	• At motion control FB execution • At axis start
1ABAH	Out of velocity range	The value is out of range for Velocity.	Continue	Set Velocity within the range.	Axis error	• At motion control FB execution • At axis start
1ABBH	Out of options range	The value is out of range for Options.	Continue	Set Options within the setting range.	Axis error	• At motion control FB execution • At axis start
1ABCH	Same master axis 1 slave axis error	The same axis number was specified to Master1 and Slave.	Continue	Set different axis numbers for Master1 and Slave.	Axis error	• At motion control FB execution • At axis start
1ABDH	Same master axis 2 slave axis error	The same axis number was specified to Master2 and Slave.	Continue	Set different axis numbers for Master2 and Slave.	Axis error	• At motion control FB execution • At axis start
1ABEH	Out of master axis 1 gear denominator range	The value is out of range for GearRatioDenominatorM1.	Continue	Set a value within the range for GearRatioDenominatorM1.	Axis error	• At motion control FB execution • At axis start
1ABFH	Out of master axis 2 gear denominator range	The value is out of range for GearRatioDenominatorM2.	Continue	Set a value within the range for GearRatioDenominatorM2.	Axis error	• At motion control FB execution • At axis start
1AC0H	Configuration axis No. duplication error	The duplicated axis number of configuration axis was set.	Continue	Set the configuration axis so that the axis numbers do not overlap.	Axis error	• At power-on/reset • At write
1AC1H	Axes group No. setting duplication error	The axes group number was duplicated.	Continue	Change the axes group number of the axes group where the error was detected.	Axis error	• At power-on/reset • At write

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AC2H	Axes group configuration axis operation cycle incorrect	Operation cycles of configuration axes in axes group are different.	Continue	Set all the configuration axes to the same operation cycle.	Axis error	• At power-on/reset • At write
1AC4H	Forced stop status	Forced stop signal was detected during operating.	Continue	Cancel the forced stop signal.	Axis error	• Always • At axis start
1AC5H	Axis data memory size over	The memory size of the data used for the axis exceeds the memory capacity set in the system.	Continue	• Increase the memory capacity set in AddonSystem.PrConst.MT_Axis.RamSizeMax, AddonSystem.PrConst.MT_MotionEngine.RamSizeMax. • Delete unnecessary axes and reduce the memory size of axis data.	• Axis number information • Axis error • Add-on name information	At power-on/ reset
1AC7H	Mapping communication error	• An object that cannot be mapped was mapped. • An object that does not exist on the object data setting was mapped.	Continue	Check and correct the mapping object.	Axis number information	Always
1AC8H	Maximum number of registrations for axes group over	The memory size of axes group data exceeds the memory capacity set in the system.	Continue	Increase the memory capacity set in the system. Or, delete unnecessary axes and keep the memory size of axis data within the memory capacity.	• Axis error • Add-on name information	• At power-on/reset • At PLC READY ON
1AC9H	Out of velocity mode range	The value is out of range for velocity mode.	Continue	Correct the velocity mode so that it is within the range.	Axis error	• At axis start • At multiple start
1ACAH	Circular interpolation axes unset	• A configuration axis not set up was set in CircAxes. • The same index No. was set in CircAxes in duplicate.	Continue	• Set as a configuration axis the axis that has been set in CircAxes. • Set the index numbers of configuration axes in CircAxes while avoiding duplication.	Axis error	• At axis start • At multiple start
1ACBH	Out of circular interpolation mode range	The value is out of range for CircMode.	Continue	Set CircMode within the range.	Axis error	• At axis start • At multiple start
1ACCH	Out of boundary point address range	The value is out of range for boundary point (AuxPoint) at circular interpolation.	Continue	Set the boundary point (AuxPoint) within the range.	Axis error	• At axis start • At multiple start
1ACDH	Start point - center point address same value	Start point is equal to center point at circular interpolation of center point specification.	Continue	Set the center point (AuxPoint) so that the start point is not equal to the center point.	Axis error	• At axis start • At multiple start
1ACEH	Start point - end point address same value	Start point is equal to end point at circular interpolation.	Continue	Set the end point (EndPoint) so that the start point is not equal to the end point.	Axis error	• At axis start • At multiple start
1ACFH	End point - center point address same value	End point is equal to center point at circular interpolation of center point specification.	Continue	Set the center point (AuxPoint) or end point (EndPoint) so that the end point is not equal to the center point.	Axis error	• At axis start • At multiple start
1AD0H	Start point - boundary point address same value	Start point is equal to boundary point at circular interpolation of boundary point specification.	Continue	Set the boundary point (AuxPoint) so that the end point is not equal to the boundary point.	Axis error	• At axis start • At multiple start
1AD1H	End point - boundary point address same value	End point is equal to boundary point at circular interpolation of boundary point specification.	Continue	Set the boundary point (AuxPoint) so that the end point is not equal to the boundary point.	Axis error	• At axis start • At multiple start
1AD2H	Start point - boundary point - end point address same straight line	Start point, end point and boundary point are on the same straight line at circular interpolation of boundary point specification.	Continue	Set the boundary point (AuxPoint) so that it is not on the same straight line with the start point and the end point.	Axis error	• At axis start • At multiple start
1AD3H	Out of center point address range	The value is out of range for center point (AuxPoint) at circular interpolation.	Continue	Set the center point (AuxPoint) within the range.	Axis error	• At axis start • At multiple start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AD4H	Out of radius range	The radius is out of range at circular interpolation.	Continue	Set the end point (EndPoint) or the auxiliary point (AuxPoint) so that its radius is within the range.	Axis error	• At axis start • At multiple start
1AD5H	Out of end point address range	The value is out of range for end point (EndPoint) at circular interpolation.	Continue	Set the end point (EndPoint) within the range.	Axis error	• At axis start • At multiple start
1AD6H	Radius setting error	End point (EndPoint) and radius (AuxPoint) which were not able to form an arc were set at circular interpolation of radius specification.	Continue	Set values so that the distance between the start point and the end point (EndPoint) ≤ the radius (AuxPoint) × 2.	Axis error	• At axis start • At multiple start
1AD7H	Out of path selection range	The value is out of range for PathChoice.	Continue	Set PathChoice within the range.	Axis error	• At axis start • At multiple start
1AD8H	Out of circular interpolation error allowable value range	The value is out of range for CircularErrorTolerance.	Continue	Set CircularErrorTolerance within the range.	Axis error	• At axis start • At multiple start
1AD9H	Circular interpolation error allowable value over	The difference between radius of start point - center point and radius of end point - center point exceeds CircularErrorTolerance at circular interpolation of center point specification.	Continue	Set end point (EndPoint), center point (AuxPoint), and CircularErrorTolerance so that CircularErrorTolerance is not exceeded.	Axis error	• At axis start • At multiple start
1ADAH	Software stroke limit invalid at circular interpolation	Circular interpolation including an axis where software stroke limit is set to invalid was executed.	Continue	Enable software stroke limit for the axis to execute circular interpolation.	Axis error	• At axis start • At multiple start
1ADEH	Out of signal selection range	■Detail code • 0002H: The value is out of range for Detection. • 0003H: The value is out of range for CompensationTime. • 0004H: The value is out of range for FilterTime.	Continue	■Detail code • 0002H: Set Detection within the range. • 0003H: Set CompensationTime within the range. • 0004H: Set FilterTime within the range.	Axis error	• At axis start • At multiple start
1ADFH	Out of forward direction torque limit initial value specification range	A value larger than AxisName.PrConst.TorqueLimit_Max was set to AxisName.PrConst.TorqueLimit_PositiveInitial.	Continue	Set AxisName.TorqueLimit_PositiveInitial within the range of 0 to AxisName.PrConst.TorqueLimit_Max.	Axis number information	At power-on/ reset
1AE0H	Out of reverse direction torque limit initial value specification range	A value larger than AxisName.PrConst.TorqueLimit_Max was set to AxisName.PrConst.TorqueLimit_NegativeInitial.	Continue	Set AxisName.PrConst.TorqueLimit_NegativeInitial within the range of 0 to AxisName.PrConst.TorqueLimit_Max.	Axis number information	At power-on/ reset
1AE2H	Motion FB issue error to the axis during axes group operating	An attempt to stop an operating axis in the axes group was made by executing multiple start of the single axis control FB.	Continue	Stop an axis of an operating axes group by executing multiple start of multiple axes control FB.	Axis error	At axis start
1AE3H	Overrun error	• Overrun occurred since the deceleration distance for the output velocity was not satisfied after the last positioning address was detected. • As the operation was switched to the subsequent buffering FB during axis operation, the positioning direction was inverted. • Positioning direction was inverted when changing target position.	Continue	Set Velocity, Position/Distance, and Deceleration so that an overrun will not occur.	Axis error	• At axis start • At control change
1AE5H	BufferMode specification disabled	Multiple start was executed in combination disable BufferMode.	Continue	Specify a combinatorial BufferMode.	Axis error	At multiple start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AE6H	Out of frequency specification range	The value is out of range for Frequency.	Continue	Set Frequency within the range.	Axis error	At axis start
1AE7H	Out of filter operation specification range	The value is out of range for Filter.	Continue	Set Filter within the range.	Axis error	At axis start
1AE8H	Out of direction limit value specification range	The value is out of range for PositiveLimit and NegativeLimit.	Continue	Set PositiveLimit and NegativeLimit within the range.	Axis error	At axis start
1AEAH	Synchronous encoder via drive unit setting incorrect	• The real drive axis with the same station address as the real encoder axis via drive unit is not set. (Detail code: 0001H) • The scale measurement function of the connected driver is disabled. (Detail code: 0002H) • The object data required to be set for the real encoder axis via drive unit does not exist. (Detail code: 0003H) • Scale measurement encoder Resolution is 0. (Detail code: 0004H) • The object data required to be set for the real encoder axis via drive unit is not mapped to the real drive axis with the same station address. (Detail code: 0005H) • Absolute position control settings do not match. (Detail code: 0006H)	Continue	• Set the real drive axis with the same station address as the real encoder axis via drive unit. • Enable scale measurement function of the connected driver. • Check if the object data required to be set for the real encoder axis via drive unit exists. • Connect the encoder whose Scale measurement encoder Resolution is not 0. • Map the object data required to be set for the real encoder axis via drive unit to the real drive axis with the same station address. • Match the absolute position control settings of the real encoder axis and the connected device.	Axis error	• Always • At power-on/reset
1AEBH	Axis No. setting duplication error	The same axis number has been set.	Continue	Set a different axis number.	Axis error	At power-on/ reset
1AECH	Station address duplication error	The set of IP address and multiple axes ID of a real drive axis overlaps with that of another.	Continue	Set real drive axes and sets of IP address and multiple axes ID to 1:1.	Axis error	At power-on/ reset
1AEDH	Station address setting incorrect	There are no specified station address or connection devices in the real axis that does not use the axis emulation function.	Continue	Specify the station address where a device is connected, when the axis emulation function is not used.	Axis number information	At power-on/ reset
1AEEH	Object data setting incorrect	• The data type is incorrect. • The data type is set to [OBJ], and a size other than 8 bits, 16 bits, or 32 bits is set for the size. • The requirement conditions for the object data are not satisfied.	Continue	• Set [OBJ] or [CONST] for the data type. • Set [OBJ] for the data type, and set the sizes of 8 bits, 16 bits, or 32 bits for the size. • Set a value other than "".	• Axis number information • Parameter error contents	At power-on/ reset
1AEFH	Axes group status incorrect (when axes group is disabled)	MC_GroupDisable was executed when AxesGroupName.Md.GroupStatus was other than GroupStandby or GroupErrorStop.	Continue	Execute MC_GroupDisable when AxesGroupName.Md.GroupStatus is GroupStandby or GroupErrorStop.	Axis error	At motion control FB execution
1AF0H	No configuration axis	Configuration axis is not set in axes group.	Continue	Set the configuration axes in the axes group.	Axis error	• At power-on/reset • At write
1AF1H	No axis	A non-existent axis was set in the configuration axis.	Continue	Set an existing axis in the configuration axis.	Axis error	• At power-on/reset • At write
1AF2H	Absolute position control setting mismatch	The ENCODER_ABS_STATUS object setting in connection devices is not match.	Continue	Correct the axis and absolute position control setting of connection device.	Axis error	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AF3H	Out of ring counter range	• The settings of ring counter upper limit value and lower limit value exceeded the positioning range. • Ring counter lower limit value > Ring counter upper limit value • 0 < (Ring counter upper limit value - Ring counter lower limit value) < 2.0	Continue	• Set the ring counter upper limit value and lower limit value within the positioning range. • Set the values so that they meet the following condition: Ring counter lower limit value < Ring counter upper limit value. • Set the values so that they meet the following condition: 2.0 < (Ring counter upper limit value - Ring counter lower limit value).	Axis error	At power-on/ reset
1AF4H	Driver unit conversion magnification upper over	The magnification that exceeded upper limit in the driver unit conversion numerator/denominator is set.	Continue	Set values so that the calculation result of driver unit conversion numerator/denominator does not exceed 400000000.	Axis error	At PLC READY ON
1AF5H	Driver unit conversion numerator/ denominator change timing incorrect	The driver unit conversion numerator/ denominator setting was changed when follow-up processing cannot be executed.	Continue	• Restore the driver unit conversion numerator/denominator setting to the previous state and set it to Ready ON. • Set it to Ready ON in a state where both of the following are satisfied (in a state where follow-up is possible). (1) AxisName.Md.AxisStatus is Disabled. (2) AxisName.Md.FollowupDisable is FALSE.	Axis error	At PLC READY ON
1AF6H	Add-on acquisition failure	Failed to acquire the add-on SignalIO when set the "Counter Disabling Signal".	Continue	Install the add-on SignalIO and enable it.	Parameter name	At power-on/ reset
1AF7H	Required object data unset	• Necessary object data for motion control FB execution does not exist in the axis (configuration axis for an axes group). • The object required for the real drive axis connection does not exist.	Continue	• Check that the object data exists in the axis to be controlled. • Map the object required for the real drive axis connection.	Axis error	• At axis start • At multiple start
1AF8H	Out of acceleration/ deceleration method range	The value is out of range for acceleration/deceleration method of Options.	Continue	Set the acceleration/deceleration method according to the executed control instruction.	Axis error	• At axis start • At multiple start
1AF9H	ABS reference point read error	Failed to acquire the data from drive unit normally for homing.	Continue	• Execute homing again. • When reading or writing parameters of a device station while executing homing, reduce the number of simultaneous executions.	Axis error	At axis start
1AFAH	Reference axis movement amount 0	The movement amount of the reference axis was 0 during a linear interpolation with reference axis specified.	Continue	Set the axis of which the movement amount is not 0 to a reference axis.	Axis error	• At axis start • At multiple start
1AFBH	Out of torque ramp function selection range	The torque ramp function selection of Options was set out of range.	Continue	Set the torque ramp function selection of Options within the range.	Axis error	• At axis start • At multiple start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1AFCH	Start not possible	Positioning start not possible. • Moderate error detection (Detail code 0001H) • MotionSystem.Cd.SequenceReady OFF (Detail code 0002H) • Forced stop signal ON (Detail code 0003H) • Axis stop signal ON (Detail code 0004H) • Hardware stroke limit override incorrect at homing start (Detail code 0005H) • Axis/axes group status incorrect (Detail code 0100H) • Axes group operating (Detail code 0101H) • Configuration axis status incorrect (Detail code 0102H)	Continue	• Start positioning after clearing the moderate error. (Detail code: 0001H) • Start positioning while PLC READY and READY are on. (Detail code: 0002H) • Check and correct the program which turns on or off PLC READY. (Detail code: 0002H) • Start positioning while Forced Stop Cancelling is on. (Detail code 0003H) • Start positioning after checking that Stop Status is off. (Detail code: 0004H) • Do not set Hardware Stroke Limit Override to ONLY_INSIDE at homing start. (Detail code: 0005H) • Check the status of the drive unit power supply, the wiring with the drive unit, and connector status. (Detail code: 0100H, 0102H) • Start positioning after the axis status changes to Standstill. (Detail code: 0100H, 0102H) • Start positioning after the axes group status changes to GroupStandby. (Detail code: 0100H) • For the axes where Using Axes Group is on, disable their axes group. (Detail code: 0101H)	Axis error	At axis start
1AFDH	Driver error	An error occurred in the driver.	Continue	Check the error details and take corrective actions according to AxisName.Md.DriverErrorID. (For details on AxisName.Md.DriverErrorID, refer to the manual for the driver used.)	Axis error	Always
1AFEH	Driver ready OFF	• Servo OFF is executed during control. • A driver error occurred during controlling.	Continue	• Execute servo ON. • Check the error details and take corrective actions according to AxisName.Md.DriverErrorID. (For details on AxisName.Md.DriverErrorID, refer to the manual for the driver used.)	Axis error	Always
1AFFH	PLC READY OFF during operation	• The status of the motion function part was changed to STOP during operation. • MotionSystem.Cd.SequenceReady was turned off.	Continue	• Check the cause why the status of the motion function part was changed to STOP using the event history or the program, and take action. • Check and correct the sequence program that turns MotionSystem.Cd.SequenceReady on/off.	Axis error	Always
1B00H	Module error during operation	Moderate error or major error was detected in the motion function part during operation.	Continue	Power on the module again.	Axis error	Always
1B01H	Driver network disconnection	Driver network disconnection was detected during operation.	Continue	Check the connection cable of the driver.	Axis error	Always
1B02H	Executing FB analysis disabled	An error was detected in executing FB analysis at target position changing. • Position/Distance after change is out of range. • Target position after change is out of range of software stroke limit.	Continue	Set Position/Distance within the range when changing the target position.	Axis error	At control change

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B03H	Buffering FB analysis disabled	• An error was detected in the buffering FB analysis. • The number of multiple start-ups of the operation FBs for the same axis/axes group has exceeded the maximum number that can be processed simultaneously.	Continue	• Set the buffering FB analysis so that it will not result in an error. • When multiple FBs are started for the same axis/axes group, set the number of FBs to be started simultaneously to three or less.	Axis error	At motion control FB execution
1B05H	External signal selection string incorrect	• Incorrect string was set in the string of the external signal selection. • A signal that does not exist or is incorrect was set.	Continue	• Set a valid string in the external signal. (Detail code: 0001H) • Set an available data type. (Detail code: 0002H) • Set an available type. (Detail code: 0003H) • Set a signal name that exists. (Detail code: 0004H) • Set a label where "Access from External Device" is available. (Detail code: 0004H) • Check and correct the number of characters. (Detail code: 0005H)	Axis error	At axis start
1B06H	Path choice setting incorrect	Incorrect value was set in PathChoice.	Continue	Set the value that supports CircMode in PathChoice.	—	• At axis start • At multiple start
1B07H	Total movement angle 0	The angle between start point - end point became 0 at circular interpolation of boundary point specification or radius specification.	Continue	Set EndPoint or PathChoice so that the angle of start point - end point will not be 0.	Axis error	• At axis start • At multiple start
1B08H	Linear interpolation axes setting incorrect	• A configuration axis not set up was set in LinearAxes. • 0 was set in the first element of LinearAxes. • Same index number was set in LinearAxes in duplicate. • The number of axes set for LinearAxes exceeded the maximum number of interpolation axes.	Continue	• Set as a configuration axis the axis that has been set in LinearAxes. • Set a configuration axis in the first element of LinearAxes. • Set the index numbers of configuration axes in LinearAxes while avoiding duplication. • Set the number of axes in the LinearAxes settings so that it is equal to or less than the maximum number of interpolation axes.	Axis error	• At axis start • At multiple start
1B0BH	Out of master axis No. range	The value is out of range for Master.AxisNo.	Continue	• Set a value within the range for Master.AxisNo. • Set the axis number in which the instance is created.	Axis error	• At motion control FB execution • At axis start
1B0CH	Out of slave axis No. range	The value is out of range for Slave.AxisNo.	Continue	• Set a value within the range for Slave.AxisNo. • Set the axis number in which the instance is created.	Axis error	• At motion control FB execution • At axis start
1B0EH	Command filter add-on system memory shortage	System memory for the add-on is insufficient.	Continue	Check and correct AddonSystem.PrConst.MT_MotionControl_AxisFilter.RamSizeMax.	Axis error	• At axis start • At multiple start
1B0FH	Add-on memory shortage	System memory for add-ons related to operation is insufficient.	Continue	Check and correct AddonSystem.PrConst.MT_*.RamSizeMax for the related add-ons.	• Axis error • Add-on name information	• At axis start • At multiple start
1B10H	Out of linear movement amount range	An interpolation axis for which the movement amount exceeds "4,294,967,296.0 (= 2^32)" exists during a linear interpolation with vector speed specified.	Continue	Set the value of Position or Distance so that the movement amount of each interpolation axis does not exceed "4,294,967,296.0 (= 2^32)".	Axis error	• At axis start • At multiple start
1B11H	Insufficient current position backup capacity	The necessary memory capacity in backup was not secured when restoring current position.	Continue	Check and correct AddonSystem.PrConst.MT_AbsSystem.BackupRamSizeMax, then reboot the software.	Axis error	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B12H	Driver restoration data incorrect	The data of the connected driver device was incorrect when the current position was restored. (1) The parameter of the connected driver device was incorrect. (Detail code: 0001H) (2) The restored data of the connected driver device was incorrect. (Detail code: 0002H)	Continue	• Change the electronic gear to nth power of two at the connected driver side. (Detail code: 0001H) • Change the electronic gear to 1:1 at the driver side, if the connected encoder resolution is not nth power of two. (Detail code: 0001H) • Check the motor and encoder cables. (Detail code: 0002H)	Axis error	Always
1B13H	Out of encoder ring counter setting range	Encoder Ring counter lower limit value > Encoder Ring counter upper limit value.	Continue	Set the values so that they meet the following condition: Encoder Ring counter lower limit value < Encoder Ring counter upper limit value.	Axis error	At power-on/ reset
1B14H	Out of addition and subtraction selection range	The value is out of range for CombineMode.	Continue	Set CombineMode within the setting range.	Axis error	At axis start
1B15H	csp unsupported driver	The driver does not support csp.	Continue	Connect a driver that supports csp.	Axis number information	Always
1B16H	Out of operation cycle converted velocity range	The velocity converted from Velocity by operation cycle is out of the range.	Continue	Set Velocity so that the velocity converted by operation cycle is within the range.	Axis error	At axis start
1B17H	Communication error of connected encoder	A communication error occurred between the driver and encoder.	Continue	Check the motor and encoder cables.	Axis error	Always
1B18H	Driver command discard detection	Statusword bit12 OFF was received from the drive unit during axis operation. (In the drive unit, Statusword bit12 is turned off when a motion system command is discarded, such as stopping the motor by detecting a limit signal or forced stop.)	Continue	Before and after this error, a drive unit alarm that causes Statusword bit12 to turn off may occur. If the alarm occurs, refer to the manual for the drive unit for troubleshooting.	Axis error	Always
1B19H	Driver execution control mode incorrect	The control mode of the connected driver device switched to an unsupported mode for the built-in function during operation.	Continue	Switch the driver control mode to the control mode that is supported by the built-in function.	Axis error	Always
1B1AH	Velocity range over during controlling	Set velocity exceeded the velocity command range.	Continue	Adjust settings so that the set velocity does not exceed the velocity command range.	Axis error	Always
1B1BH	Driver control mode unsupported	The driver was switched to an unsupported driver control mode. (1) ct: Continuous operation to torque control (Detail code 0001H) (2) cspr: Cyclic synchronous pressure mode (Detail code 0002H)	Continue	Connect a driver that supports the driver control mode to be switched to.	Axis error	At axis start
1B1CH	Servo driver memory size over	The memory size of the servo driver exceeds the memory capacity set in the system.	Continue	• Increase the memory capacity set in the system. • Delete unnecessary axes and reduce the memory size.	Add-on name information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B22H	Advanced synchronization control axis unset	An axis where the advanced input axis settings or advanced output axis settings are not set or disabled is specified for any of the master axis, auxiliary axis, sub input axis, or slave axis of the advanced synchronization control. (1) Master axis (Detail code 0001H) (2) Main axis sub (Detail code 0002H) (3) Auxiliary axis (Detail code 0003H) (4) Slave axis (Detail code 0004H)	Continue	Check and correct the axis corresponding to the detail code as follows. (1) Specify an axis where the advanced synchronization control input axis settings and advanced synchronization control output axis settings are set for the master axis, auxiliary axis, sub input axis, and slave axis of the advanced synchronization control. (2) Check and correct the setting values if a parameter is out of range in the advanced synchronization control input axis or the advanced synchronization control output axis.	• Axis error • Parameter name	At motion control FB execution
1B23H	Advanced synchronization control operation overflow	Overflow occurred in a module of the synchronization control output axis. (1) Composite main shaft gear (Detail code 0001H), main shaft gear (Detail code 0002H), main shaft clutch (Detail code 0003H), main shaft module speed change gear (Detail code 0004H) (2) Auxiliary shaft (Detail code 0005H), auxiliary shaft gear (Detail code 0006H), auxiliary shaft clutch (Detail code 0007H), auxiliary shaft module speed change gear (Detail code 0008H), composite auxiliary shaft gear (Detail code 0009H) (3) Output axis speed change gear (Detail code 000AH), output axis phase compensation (Detail code 000BH), output axis smoothing (Detail code 000CH), output axis synchronization control change (Detail code 000DH), output axis cam operation (Detail code 000EH)	Continue	Check and correct the module corresponding to the detail code as follows. (1) Common: Lower the input axis speed of the error module. (2) Main shaft gear/auxiliary shaft gear: Reduce the gear ratio (gear numerator/gear denominator) of the error module. (3) Output axis smoothing: Check and adjust the setting value of the time constant to reduce the number of smoothing steps. Alternatively, increase the setting value of the operation cycle. (4) Composite main shaft gear/ auxiliary shaft gear: Decrease the input values of the main shaft main input axis and main shaft sub input axis. Alternatively, decrease the input values of the main shaft and auxiliary shaft. (5) Output axis phase compensation: Decrease the value of the phase compensation advance time. Alternatively, increase the phase compensation time constant. (6) Output axis synchronization control change: Decrease the synchronization control change value. Alternatively, increase the synchronization control change reflection time. (7) Output axis cam operation: Check and correct the cam waveform so that the stroke does not change rapidly.	Axis error	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B24H	Advanced synchronization control restoration disabled	■For current position per cycle restoration When the cam axis position restoration object was set to "0: Current position per cycle restoration", restoration failed for the current position per cycle corresponding to the output value at the start of the advanced synchronization control. (This occurred in a two-way cam pattern.) ■For cam set position restoration When the cam axis position restoration object was set to "2: Cam set position restoration", restoration failed because the difference between the restored output value and the set position of the slave axis at the start of the advanced synchronization control was larger than the cam set position restoration allowable movement setting value.	Continue	■For current position per cycle restoration (1) Move the slave axis so that it remains within the stroke of the two-way cam pattern, then start the advanced synchronization control. (2) Set the cam reference position so that the operation remains within the stroke of the two-way cam pattern. ■For cam set position restoration (1) Calculate the output value to be restored using the cam position calculation function, and move the slave axis. Then, start the advanced synchronization control. (2) If the cam set position restoration allowable movement setting value is extremely small, such as 0, increase the setting value.	Program error information (FB)	At motion control FB execution
1B25H	Out of parameter range (advanced synchronization control output axis)	The parameter is out of range.	Continue	Set the parameter within the range.	• Axis error • Parameter error contents	• At motion control FB execution • At multiple start
1B26H	Out of advanced synchronization control output axis ring counter range	In an axis where the ring counter is enabled, the ring counter setting value is invalid.	Continue	Set the ring counter upper limit value and lower limit value for either of the following combinations. (1) Ring counter upper limit = 10000000000.0, ring counter lower limit = -10000000000.0 (2) 0.0 < Ring counter upper limit ≤ 2147483647.0, ring counter lower limit = 0.0	Axis error	At power-on/ reset
1B27H	FB input variables abnormal	An error occurred at the start of FB due to any of the following causes. (1) The FB input variable is out of range. (Detail code 0001H) (2) PositioningData.ProfileID.Number is out of range (Detail code 0003H) (3) StartDataNo is out of range (Detail code 0004H) (4) StepMode is out of range (Detail code 0005H)	Continue	• Check detailed information (data error information), and set the variable that is displayed in the data name within the range. (Detail code 0001H) • Specify the value within the range for PositioningData.ProfileID.Number. (Detail code: 0003H) • Set StartDataNo within the range. (Detail code: 0004H) • Set StepMode within the range. (Detail code: 0005H)	Axis error	• Always • At axis start • At multiple start
1B28H	Add-on acquisition failure	Acquisition of the add-on necessary for axis generation and operation failed.	Continue	Check the detailed information, and install and enable apk of an add-on displayed.	• Axis error • Add-on name information	• Always • At axis start • At multiple start
1B29H	Operation cycle mismatch	The control cycle settings or the communication period settings do not match between the input and output. (1) The operation cycles of the master axis and the slave axis are different (Detail code 0001H) (2) The refresh cycle of the external signal and the operation cycle of the motion control FB are different (Detail code 0002H)	Continue	• Match the control cycle settings or the communication period settings between the input and output. • Synchronize the control cycle of the input or the communication cycle with the control cycle of the output using MCv_SyncOperationCycles. (Take this action for a single axis synchronous control FB where MCv_SyncOperationCycles is enabled.)	Axis error	• At motion control FB execution • At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B2AH	Operation profile data settings incorrect under advanced synchronization control	Any of the following operation profile data settings is set to a value that cannot be used in the advanced synchronization control. (1) Profile data type incorrect (Detail code 0001H) (2) Operation profile data format incorrect (Detail code 0002H) (3) Not periodic (Detail code: 0003H) (4) The master axis (input) absolute coordinate is not set for the relative coordinate. (Detail code: 0004H) (5) The slave axis (output) absolute coordinate is not set for the relative coordinate. (Detail code: 0005H) (6) The start position is set to a value other than 0. (Detail code: 0006H) (7) The initial stroke is set to a value other than 0. (Detail code: 0007H) (8) The value set for the cam starting point (AdvOutputName.Pr.Cam.StartingPoint) is larger than or equal to the resolution. (Detail code: 0008H) (9) The target operation profile data is being operated by another FB. (Detail code: 0009H) (10)A value exceeding 32 bits is set for the output coordinates. (Detail code: 000AH) (11)The output value calculated by extending the line segment between two coordinates exceeded 32 bits. (Detail code: 000BH)	Continue	• Set the profile data type to "1: Cam data". (Detail code: 0001H) • Set the operation profile data format to any of "0: Linear Interpolation", "1: Section Interpolation", or "2: Spline Interpolation". (Detail code: 0002H) • Set the periodic operation to "1: Periodic". (Detail code: 0003H) • Set the master axis (input) absolute coordinate to "0: Relative coordinate". (Detail code: 0004H) • Set the slave axis (output) absolute coordinate to "0: Relative coordinate". (Detail code: 0005H) • Set "0" for the start position. (Detail code: 0006H) • Set "0" for the initial stroke. (Detail code: 0007H) • Set the cam starting point (AdvOutputName.Pr.Cam.StartingPoint) to a value smaller than the resolution. (Detail code: 0008H) • End the FB that is operating the target operation profile data. (Detail code: 0009H) • If the operation profile data format is set to "0: Linear Interpolation", correct the cam data so that an output value exceeding 32 bits is not included. (Detail code: 000AH) • Adjust the slope between the coordinates so that the output value calculated by extending the line segment between two coordinates does not exceed 32 bits in the length per cycle. (Detail code: 000BH)	Axis error	• At motion control FB execution • At multiple start
1B2BH	Cycle assignment incorrect (axis)	• "Communication Period Setting" of "Module Parameter (CC-Link IE TSN)" was set to a cycle that cannot be used for an axis control cycle. • The real axis control cycle and the communication cycle of the devices do not match.	Continue	• When "Control Cycle Setting" of the axis is set to "1: Operate in the first operation cycle", set the communication period interval of the basic period to 8ms or less. • When "Control Cycle Setting" of the axis is set to "2: Operate in the second operation cycle", set the communication period interval of the normal-speed period to 8ms or less. • When "Control Cycle Setting" of the axis is set to "3: Operate in the third operation cycle", set the communication period interval of the low-speed period to 8ms or less. • In "Basic Period Setting" of "Module Parameter (CC-Link IE TSN)", set "Setting in Units of 1μs" to "Not Set". • Set "Control Cycle Setting" of the real axis to "0: Automatic setting", or match the control cycle of the real axis and the communication cycle of devices.	Axis error	• At power-on/reset • At PLC READY ON

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B2CH	Operation profile data control specification profile incorrect	• The profile data is not expanded to the open area specified by the PROFILE_ID type data. (Detail code: 0001H) • The type in the open area specified by the PROFILE_ID type data is incorrect. (Detail code: 0002H) • The target operation profile data is being operated by another FB. (Detail code: 0003H)	Continue	• Expand the operation profile data to the open area specified by the PROFILE_ID type data. (Detail code: 0001H) • Specify the open area of an available data type by each operation profile data control. (Detail code: 0002H) • End the FB that is operating the target operation profile data. (Detail code: 0003H)	Axis error	• At axis start • At multiple start
1B31H	External signal selection incorrect	• "Asynchronous" was set in the network synchronous communication setting of the device station being referred to. • An unconnected station or non-existent station was set. • A signal which is not compatible with the external signal high-accuracy I/O was set. • A non-existent object in TPDO/ RPDO was set. • An incorrect type was set.	Continue	• Set "Synchronous" in the network synchronous communication setting of the device station being referred to. (Detail code: 0001H) • Connect the target station. (Detail code: 0002H) • Check and correct the station address. (Detail code: 0003H) • Set a signal which is compatible with the external signal high-accuracy I/O. (Detail code: 0004H) • Set a correct object for TPDO/ RPDO. (Detail code: 0005H) • Check and correct the specified type. (Detail code: 0006H)	Axis error	At axis start
1B32H	External signal selection incorrect	• "Asynchronous" was set in the network synchronous communication setting of the device station being referred to. • An incorrect device was set. • An incorrect label was set. • An incorrect axis data was set. • An incorrect constant was set.	Continue	• Set "Synchronous" in the network synchronous communication setting of the device station being referred to. (Detail code: 0001H) • Check and correct the specified type. (Detail code: 0002H) • Set a supported device. (Detail code: 0003H) • Set a device number within the range. (Detail code: 0004H) • Set an available global label with "Access from External Device" enabled. (Detail code: 0005H) • Check and correct the target modification. (Detail code: 0006H) • Set an available axis to the target data. (Detail code: 0007H) • Correct the data name. (Detail code: 0008H) • Check and correct the number of characters. (Detail code: 0009H)	Axis error	At axis start
1B33H	Add-on SignalIO internal error	An error has occurred in add-on SignalIO.	Continue	Install the software again, and rewrite the program. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Axis error	At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B34H	Control method incorrect after skipping	• During skipping, ControlMethod of the following positioning data is set to CircularAbsolute. (Detail code: 0001H) • During skipping, the positioning data for CircularAbsolute was read in advance when only one of the positioning data with ControlMethod set to LinearRelative or CircularRelative has been passed through. Or, although the positioning data for LinearAbsolute has been passed through, the positioning data of a different interpolation axis, CircularAbsolute, was read in advance. (Detail code: 0001H) • During skipping, the positioning data whose ControlMethod was LinearAbsolute and also VelocityMode was LongAxisSpeed was read in advance. (Detail code: 0002H) • After skipping, the positioning data for CircularAbsolute was read in advance when only one of the positioning data with ControlMethod set to LinearRelative or CircularRelative has been passed through. Or, although the positioning data for LinearAbsolute has been passed through, the positioning data of a different interpolation axis, CircularAbsolute, was read in advance. (Detail code: 0003H)	Continue	• Execute positioning based on the positioning data for LinearAbsolute between the positioning data to be skipped and the positioning data whose ControlMethod is CircularAbsolute. In addition, configure the settings so that the interpolation axes of the LinearAbsolute positioning data include the interpolation axis of CircularAbsolute. (Detail code: 0001H, 0003H) • For the positioning data to be executed after skipping, set VelocityMode to a value other than LongAxisSpeed. (Detail code: 0002H)	Axis error	Always
1B35H	Out of setting range of operation profile data in multi-axis positioning data format	• The value out of the setting range was set for OperationPattern. (Detail code: 1001H) • The value out of the setting range was set for ControlMethod. (Detail code: 1002H) • The value out of the setting range was set for DwellTime. (Detail code: 1003H) • The value out of the setting range was set for McodeOutput_Override. (Detail code: 1004H) • The value out of the setting range was set for JumpDestinationDataNo. (Detail code: 1005H) • The value out of the setting range was set for LoopCount. (Detail code: 1006H) • The value out of the setting range was set for ConditionSignalNo. Or, the signal setting has not been configured for the number specified by ConditionSignalNo. (Detail code: 1007H) • The value out of the setting range was set for SkipSignalNo. Or, the signal setting has not been configured for the number specified by SkipSignalNo. (Detail code: 1008H)	Continue	Set values of corresponding positioning data items within the range. (Detail code: 1001H to 1008H)	Axis error	• Always • At axis start • At multiple start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B36H	Multiple axes positioning data control method incorrect	• For positioning data where the control method is JUMP, the positioning data number where the control method is JUMP in JumpDestinationDataNo has been set. (Detail code: 1101H) • The positioning data where the control method is set to others was continuously executed exceeding the upper limit value. (Detail code: 1102H)	Continue	• Set the positioning data number where the control method is a value other than JUMP for JumpDestinationDataNo. (Detail code: 1101H) • Set the number of continuous executions for positioning data, where the control method is set to others, so that the number of times of the executions does not exceed the upper limit. (Detail code: 1102H)	Axis error	• Always • At axis start • At multiple start
1B37H	Condition signal setting incorrect	• Incorrect string was set for any one of ConditionSignal1 to ConditionSignal10.Target. (Detail code: 1211H to 121AH) • The value out of the setting range was set for any one of ConditionSignal1 to ConditionSignal10.Detection. (Detail code: 1221H to 122AH) • The value out of the setting range was set for any one of ConditionSignal1 to ConditionSignal10.CompensationTime. (Detail code: 1231H to 123AH) • The value out of the setting range was set for any one of ConditionSignal1 to ConditionSignal10.FilterTime. (Detail code: 1241H to 124AH)	Continue	Set values of the corresponding condition signal items within the range. (Detail code: 1211H to 124AH)	Axis error	• At axis start • At multiple start
1B38H	Skip signal setting incorrect	• Incorrect string was set for any one of SkipSignal1 to SkipSignal10.Target. (Detail code: 1311H to 131AH) • The value out of the setting range was set for any one of SkipSignal1 to SkipSignal10.Detection. (Detail code: 1321H to 132AH) • The value out of the setting range was set for any one of SkipSignal1 to SkipSignal10.CompensationTime. (Detail code: 1331H to 133AH) • The value out of the setting range was set for any one of SkipSignal1 to SkipSignal10.FilterTime. (Detail code: 1341H to 134AH)	Continue	Set values of the corresponding skip signal items within the range. (Detail code: 1311H to 134AH)	Axis error	• At axis start • At multiple start
1B39H	Velocity limit value over in speed bias value	The speed bias value (AxisName(AxisGroupName).Pr.VelocityBias) was set to a value larger than Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive), Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), or Velocity Limit Value (AxisGroupName.Pr.VelocityLimit).	Continue	Set the speed bias value (AxisName(AxisGroupName).Pr.VelocityBias) to a value smaller or equal to Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive), Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), or Velocity Limit Value (AxisGroupName.Pr.VelocityLimit).	Axis error	At PLC READY ON

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B3AH	Less than speed bias value error	When the axis was started, the target speed was other than 0.0, and also a value less than the speed bias value set in any of the following parameters was set. (1) In single axis operation: The axis parameter of the specified axis (2) In linear interpolation operation (vector velocity): The axes group parameter of the specified axes group (3) In linear interpolation operation (reference axis velocity): The axis parameter of the reference axis (4) In linear interpolation operation (long axis velocity): The axis parameter of the long axis (5) In circular interpolation operation: The axes group parameter of the specified axes group	Continue	Check and correct the velocity override factor and the commanded velocity so that the target speed is greater than or equal to the speed bias value.	Axis error	Always
1B3BH	Connection setting incorrect for drive unit other than MELSERVO	• The operation processing high speed mode was enabled on the axis to which a drive unit other than MELSERVO was assigned. • A parameter that assigned a drive unit other than MELSERVO to the real drive axis was set using an engineering tool that does not support connections with drive units other than MELSERVO.	Continue	Update the engineering tool to a version that supports connections with drive units other than MELSERVO, then set the parameter.	Axis error	Always
1B3CH	Out of the movement amount range after driver position unit conversion	The movement amount per operation cycle after the driver position unit conversion exceeded the range of 31 bits.	Continue	Set the movement amount per operation cycle after the driver position unit conversion within the range of 31 bits.	Axis error	At control change
1B3DH	Start when software stroke limit is invalid	The software stroke limit was set to invalid, and start or multiple start was performed.	Continue	Enable the software stroke limit.	Axis error	• At axis start • At multiple start
1B3EH	Forward-side position incorrect	• ForwardSidePosition is set outside the software stroke limit range. (Detail code 0001H) • The absolute value of the difference between ForwardSidePosition and the reference position exceeded the upper limit assuming that the reference position is the set position (AxisName.Md.SetPosition) at the time of request to switch the control mode to cspr. (Detail code 0002H)	Continue	• Set ForwardSidePosition within the software stroke limit range. (Detail code 0001H) • Set ForwardSidePosition so that the absolute value of the difference with the reference position does not exceed "(2147483648 - 10 × Encoder resolution/Electronic gear) × Driver Unit Conversion Denominator/Numerator". (Detail code 0002H)	Axis error	• At axis start • At multiple start
1B3FH	Ramp time over	The pressure ramp time has exceeded 8400 [s].	Continue	Set Pressure/PressureRamp for MCv_PressureControl so that the pressure ramp time does not exceed 8400 [s].	Axis error	• At axis start • At multiple start
1B40H	Forward-side position exceeded	The absolute value of the difference between the set position (AxisName.Md.SetPosition) and the forward-side position at cspr (AxisName.Md.Cspr_ForwardSidePosition) exceeded the upper limit.	Continue	Review the settings for operation so that the absolute value of the difference does not exceed "(2147483648 - 10 × Encoder resolution/Electronic gear) × Driver Unit Conversion Denominator/Numerator".	Axis error	At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B80H	MCFB specification incorrect	Undefined MCFB exists.	Continue	• Check if the add-on required for running MCFB is installed. • Write the program again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	At PLC READY ON
1B81H	MCFB execution error	Unable to execute MCFB.	Continue	• Check that the label area outside the range is not written. • Write the program again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At motion control FB execution
1B82H	Out of axis No. range	• The value is out of range for axis number. • Invalid axis No. has been set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis number in which the instance is created.	Program error information (FB)	• At motion control FB execution • At axis start
1B84H	Out of axes group No. range	• The value is out of range for axes group number. • Invalid axes group has been set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis group number where the instance is created.	Program error information (FB)	At motion control FB execution
1B85H	Out of master axis No. range	• The value is out of range for master axis number. • An unavailable axis number is set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis number in which the instance is created.	Program error information (FB)	• At motion control FB execution • At axis start
1B86H	Out of slave axis No. range	• The value is out of range for slave axis number. • An unavailable axis number is set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis number in which the instance is created.	Program error information (FB)	• At motion control FB execution • At axis start
1B87H	Out of master axis 1 No. range	• The value is out of range for axis number of master axis 1. • An unavailable axis number is set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis number in which the instance is created.	Program error information (FB)	• At motion control FB execution • At axis start
1B88H	Out of master axis 2 No. range	• The value is out of range for axis number of master axis 2. • Invalid axis number has been set.	Continue	• Set the value within the range of 1 to 10000. • Set the axis number in which the instance is created.	Program error information (FB)	• At motion control FB execution • At axis start
1B8AH	Latch count incorrect	RecordCount has been set outside the range when RecordMode = RecordCount, RingBuffer.	Continue	Set RecordCount.	Program error information (FB)	At motion control FB execution
1B8BH	Out of touch probe ID range	A probe ID of a touch probe that does not exist in TouchProbeID was set.	Continue	Set a probe ID of a touch probe that exists to TouchProbeID.	Program error information (FB)	At motion control FB execution
1B8CH	Out of compensation time range	The value is out of range for CompensationTime.	Continue	Set the value within the range of -5.0 to 5.0 [s].	Program error information (FB)	At motion control FB execution
1B8DH	Out of latch mode range	The value is out of range for RecordMode.	Continue	Set the value within the range for MC_RECORD_MODE.	Program error information (FB)	At motion control FB execution
1B8EH	No operation profile data	• PROFILE_DATA.Location has not been set. • No operation profile data exists in PROFILE_DATA.Location. • Operation profile data of an available data type is not opened to the open area specified by PROFILE_ID.	Continue	• Set a storage location of operation profile data for PROFILE_DATA.Location. • Open the operation profile data of an available data type to the open area specified by PROFILE_ID.	• Program error information (FB) • Drive/file information	• At power-on/reset • At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B8FH	Operation profile data incorrect	• Reading has failed because the file format of the operation profile data (file) has an error. (Detail code 1001H) • Writing of the operation profile data (file) has failed. (Detail code 1002H) • The operation profile data format or interpolation method specification has an error. (Detail code 1003H) • The operation profile data is set out of range. (Detail code 1004H) • The current value per cycle is not aligned in the ascending order. (Detail code 1005H)	Continue	• Set a value within the range for the operation profile data (file) in accordance with the file format. (Detail code: 1001H) • Set a value within the range in accordance with the file format. (Detail code: 1002H) • Set a value within the range for the operation profile data type or interpolation method specification. (Detail code: 1003H) • Set a value within the range. (Detail code: 1004H) • Align the current value per cycle in the ascending order. (Detail code: 1005H)	• Program error information (FB) • Data error Information	• At power-on/reset • At motion control FB execution
1B90H	Operation profile data being operated	The other FBs performed operation for the operation profile data being operated.	Continue	When the other FBs finish operation (Busy = FALSE), execute the FB again.	Program error information (FB)	• At motion control FB execution
1B91H	Operation profile data error	The operation profile data is broken, or the format is incorrect.	Continue	Set the operation profile data in a correct format.	• Program error information (FB) • Drive/file information	• At power-on/reset • At motion control FB execution
1B92H	Out of offset range	Offset exceeds the number of elements of operation profile data (file or open area).	Continue	Set a value which does not exceed the number of elements of operation profile data (file or open area) in Offset.	Program error information (FB)	• At power-on/reset • At motion control FB execution
1B93H	Out of operation profile data ID range	The value is out of range for ProfileData.ID.Number or ProfileID.Number.	Continue	Set a value within the range for ProfileData.ID.Number or ProfileID.Number.	Program error information (FB)	• At motion control FB execution • At control change
1B94H	Out of MasterAbsolute range	The value is out of range for MasterAbsolute.	Continue	Set a value within the range.	Program error information (FB)	At motion control FB execution
1B9BH	Out of backlash amount range	The value is out of range for BacklashAmount.	Continue	Set a value within the range.	Program error information (FB)	At motion control FB execution
1B9CH	MC_SetPosition instruction error	An error occurred during executing MC_SetPosition for the following causes. • Position is out of range. (Detail code 0001H) • ExecutionMode is out of range. (Detail code 0002H) • The current position after changing is out of range of software stroke limit. (Detail code 0003H) • Axis status at execution is incorrect. (Detail code 0004H) • Another MC_SetPosition was executed in the specified axis. (Detail code 0008H) • Options is out of range. (Detail code 0009H)	Continue	• Set Position within the range. • Set ExecutionMode within the range. • Set the values so that the current position after change is within the software stroke limit range. • Execute it when the axis status is Standstill. • Execute another MC_SetPosition after the current one is completed. • Set Options within the range.	Program error information (FB)	• At motion control FB execution • At axis start

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1B9EH	MCv_SetTorque Limit instruction error	An error occurred during executing MCv_SetTorqueLimit for the following causes. • PositiveValue is out of range. (Detail code 0001H) • NegativeValue is out of range. (Detail code 0002H) • ExecutionMode is out of range. (Detail code 0003H) • Axis type is incorrect. (Detail code 0004H) • Axis status at execution is incorrect. (Detail code 0005H) • Another MCv_SetTorqueLimit was executed in the specified axis. (Detail code 0006H) • Options is out of range. (Detail code 0007H)	Continue	• Set PositiveValue within the range. • Set NegativeValue within the range. • Set ExecutionMode within the range. • Execute it for an axis whose axis type is real drive axis. • Execute it when the axis status is Standstill. • Execute another MCv_SetTorqueLimit after the current one is completed. • Set Options within the range.	Program error information (FB)	• At motion control FB execution • At axis start
1B9FH	Out of start mode range	The value is out of range for ExecutionMode.	Continue	Set a value within the range for ExecutionMode.	Program error information (FB)	At axis start
1BA0H	Insufficient operation profile data ID	The profile ID to be assigned automatically is insufficient.	Continue	Specify and open the unused profile ID.	Program error information (FB)	Always
1BA1H	Operation profile data control unsupported	Control FB was executed for the unsupported operation profile data.	Continue	Open the operation profile data which supports the operation profile data control FB in the open area.	Program error information (FB)	At axis start
1BA7H	Out of read target/write target range	The value is out of range for Target.	Continue	Set a value within the range for Target.	Program error information (FB)	At motion control FB execution
1BA8H	Read/Write data data type incorrect	The incorrect data type is set in Data1 or Data2.	Continue	Set a normal data type in Data1 and Data2.	Program error information (FB)	At motion control FB execution
1BA9H	Read/Write data data name specification method incorrect	The incorrect data name specification method is set in Data1 or Data2.	Continue	Set a normal data name specification method in Data1 and Data2.	Program error information (FB)	At motion control FB execution
1BAAH	Read/Write data type incorrect	• An incorrect type is set in Data1 or Data2. • Add-on that supports the operation profile data format has not been installed.	Continue	• Set a normal type in Data1 and Data2. • Install and enable the add-on that supports the operation profile data format.	Program error information (FB)	At motion control FB execution
1BABH	Read/Write data target modification incorrect	The incorrect target modification is set in Data1 or Data2.	Continue	Set normal target modification in Data1 and Data2.	Program error information (FB)	At motion control FB execution
1BACH	Number of read/ write data mismatch	Points do not match the number of elements of read/write structured data type.	Continue	Set values so that the number of elements in Points and the read/write structure match.	Program error information (FB)	At motion control FB execution
1BADH	Number of offset/read/write data incorrect	• When the read/write destination is a file, Offset and Points were set to values other than 0. • When the write destination is an open area and Offset was set to a value other than 0, Points was set to 0. • When multiple axes positioning data is to be written to an open area, DataNo of the write source value is other than 0 and different from that of the write destination.	Continue	• When the read/write destination is a file, set both Offset and Points to 0. • When the write destination is an open area and Offset is set to a value other than 0, set Points to a value other than 0. • When multiple axes positioning data is to be written to an open area, set DataNo of the write source to 0 or the same value as DataNo of the write destination.	Program error information (FB)	At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1BAFH	Current value per cycle change unsupported	FB which does not support the current value per cycle change is set.	Continue	Set FB which supports the current value per cycle change.	Program error information (FB)	At motion control FB execution
1BB0H	No instance ID	The set instance ID does not exist.	Continue	Set an existing instance ID.	Program error information (FB)	At motion control FB execution
1BB4H	Operation profile data add-on system memory shortage	System memory for the add-on is insufficient.	Continue	• Check and correct AddonSystem.PrConst.MT_ProfileControl.RamSizeMax. • Check and correct the setting to reduce the usage of the open area. • Reduce the number of FBs to be executed simultaneously.	Program error information (FB)	At PLC READY ON
1BB5H	Operation profile data add-on internal error	An error occurred in internal of operation profile data add-on.	Continue	Install the software again, and rewrite the program. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Program error information (FB)	At PLC READY ON
1BB6H	Axis status incorrect (when axes group is enabled)	MC_GroupEnable was executed when AxisName.Md.AxisStatus of configuration axis was other than Standstill or Disabled.	Continue	Execute MC_GroupEnable after setting Standstill or Disabled in AxisName.Md.AxisStatus of all configuration axes.	Program error information (FB)	At motion control FB execution
1BB8H	Axes group configuration axis is in use	MC_GroupEnable was executed for an axes group in which the AxisName.Md.UseInGroup of a configuration axis was TRUE (the configuration axis was in use in another axes group).	Continue	Disable the axes group in use and execute MC_GroupEnable.	Program error information (FB)	At motion control FB execution
1BB9H	MCv_ChangeCycle instruction error	An error occurred during executing MCv_ChangeCycle for the following causes. (1) Cycle is out of range. (Detail code 0001H) (2) ExecutionMode is out of range. (Detail code 0002H) (3) MCv_ChangeCycle was executed when the axis status was SyncronizedMotion. (Detail code 0004H) (4) Another MCv_ChangeCycle was executed with the specified instance ID. (Detail code 0008H) (5) Options is out of range. (Detail code 0009H) (6) MCv_ChangeCycle was executed when the axis status was Standstill. (Detail code 000AH)	Continue	• Set Cycle within the range. (Detail code: 0001H) • Set ExecutionMode within the range. (Detail code: 0002H) • Execute another MCv_ChangeCycle after the current one is completed. (Detail code: 0008H) • Set Options within the range. (Detail code: 0009H) • Execute the instruction when the axis status is SynchronizedMotion. (Detail code: 000AH)	Program error information (FB)	At motion control FB execution
1BBBH	Add-on memory shortage	System memory for the related add-ons is insufficient.	Continue	Increase AddonSystem.PrConst.MT_*.RamSizeMax for related add-ons.	• Add-on name information • Program error information (FB)	• At power-on/reset • At PLC READY ON • At motion control FB execution
1BBCH	Out of velocity override factor (VelFactor) range	The value is out of range for VelFactor.	Continue	Set VelFactor within the range.	Program error information (FB)	At control change
1BBDH	Out of acceleration override factor (AccFactor) range	The value is out of range for AccFactor.	Continue	Set AccFactor within the range.	Program error information (FB)	At control change

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1BBEH	Out of jerk override factor (JerkFactor) range	The value is out of range for JerkFactor.	Continue	Set JerkFactor within the range.	Program error information (FB)	At control change
1BBFH	Latch data storage shortage	• The number of elements specified for OutputBuffer is less than RecordCount. • Access to the outside of device or label range was made.	Continue	• Set the number of elements specified for OutputBuffer to be more than RecordCount. • Adjust settings to avoid an access to the outside of the range.	Program error information (FB)	• At motion control FB execution • At control change
1BC0H	Out of backlash compensation direction range	The value is out of range for BacklashDirection.	Continue	Set a value within the range.	Program error information (FB)	At motion control FB execution
1BC1H	Parameter reading and writing FB execution disabled error	• Unable to execute the parameter reading FB or the parameter writing FB. • An unconnected station or non-existent station was set. • PLC READY was turned off before the SLMP request was issued.	Continue	• Correct the setting data. • Correct the number of transient transmission executions. • Check and correct the sequence program which turns PLC READY on/off.	Program error information (FB)	At motion control FB execution
1BC2H	Out of parameter No. range	The value is out of range for ParameterNumber.	Continue	Set a value within the range.	Program error information (FB)	At motion control FB execution
1BC3H	Out of option range	The value is out of range for Options.	Continue	Set a value within the range.	Program error information (FB)	At motion control FB execution
1BC4H	MC_AbortTrigger unsupported	FB which does not support MC_AbortTrigger (Touch Probe Disabled) is set.	Continue	Set FB which supports MC_AbortTrigger (Touch Probe Disabled).	Program error information (FB)	At motion control FB execution
1BC5H	External signal selection string incorrect	• Incorrect string was set in the string of the external signal selection. • A signal that does not exist or is incorrect was set.	Continue	• Set a valid string in the external signal. (Detail code: 0001H) • Set an available data type. (Detail code: 0002H) • Set an available type. (Detail code: 0003H) • Set a signal name that exists. (Detail code: 0004H) • Set a label where "Access from External Device" is available. (Detail code: 0004H) • Check and correct the number of characters. (Detail code: 0005H)	• Program error information (FB) • Parameter error contents	At motion control FB execution
1BC6H	Out of detection setting range of signal	The value is out of range for Detection.	Continue	Set a value within the range for Detection.	• Program error information (FB) • Parameter name	At motion control FB execution
1BC7H	Out of compensation time setting range of signal	The value is out of range for CompensationTime.	Continue	Set a value within the range for CompensationTime.	• Program error information (FB) • Parameter name	At motion control FB execution
1BC8H	Out of filter time setting range of signal	The value is out of range for FilterTime.	Continue	Set a value within the range for FilterTime.	• Program error information (FB) • Parameter name	At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1BCAH	MC_DigitalCamSwitch instruction error	An error occurred due to the following causes during executing MC_DigitalCamSwitch. (1) OnCompensation or OffCompensation is out of range. (Detail code 0001H) (2) Hysteresis is out of range. (Detail code 0002H) (3) RingCount_LowerValue is greater than or equal to RingCount_UpperValue. (Detail code 0003H) (4) |RingCount_UpperValue-RingCount_LowerValue| is greater than 0 and smaller than 2.0. (Detail code 0004H) (5) RingCount_LowerValue or RingCount_UpperValue is out of range. (Detail code 0005H) (6) SpeedAverageNum is out of range. (Detail code 0006H) (7) The refresh cycle does not match between ValueSource and Output. (Detail code 0007H) (8) Options is out of range. (Detail code 0008H) (9) The number of switches is different from the previous time. (Detail code 0009H)	Continue	• Set OnCompensation or OffCompensation within the range. • Set Hysteresis within the range. • Set a value so that RingCount_LowerValue is less than RingCount_UpperValue. • Set a value so that |RingCount_UpperValue-RingCount_LowerValue| is greater than 2.0. • Set RingCount_LowerValue or RingCount_UpperValue within the range. • Set SpeedAverageNum within the range. • Specify the signals of the same refresh cycle for ValueSource and Output. • Set Options within the range. • Set Switches so that the number of switches does not change.	Program error information (FB)	At motion control FB execution
1BCBH	Add-on acquisition failure	Acquisition of the add-on necessary for FB execution failed.	Continue	Check the detailed information, and install and enable apk of an add-on displayed.	• Add-on name information • Program error information (FB)	At motion control FB execution
1BCCH	MCv_AdvCamPositionPerCycleCalc instruction error	An error occurred during executing MCv_AdvPositionPerCycleCalc for the following causes. (1) RingCountUpperValue is out of range. (Detail code 0001H) (2) LengthPerCycle is out of range. (Detail code 0002H) (3) StrokeAmount is out of range (Detail code 0003H) (4) PositionPerCycle is out of range. (Detail code 0004H) (5) ReferenceSetPosition is out of range. (Detail code 0005H) (6) SetPosition is out of range. (Detail code 0006H) (7) StartingPoint is out of range (Detail code 0007H)	Continue	• Set RingCountUpperValue within the range. (Detail code: 0001H) • Set LengthPerCycle within the range. (Detail code: 0002H) • Set StrokeAmount within the range. (Detail code: 0003H) • Set PositionPerCycle within the range. (Detail code 0004H) • Set ReferenceSetPosition within the range. (Detail code: 0005H) • Set SetPosition within the range. (Detail code: 0006H) • Set StartingPoint within the range. (Detail code: 0007H)	Program error information (FB)	At motion control FB execution
1BCDH	MCv_AdvCamSetPositionCalc instruction error	An error occurred during executing MCv_AdvCamSetPositionCalc for the following causes. (1) RingCountUpperValue is out of range. (Detail code 0001H) (2) LengthPerCycle is out of range. (Detail code 0002H) (3) StrokeAmount is out of range (Detail code 0003H) (4) PositionPerCycle is out of range. (Detail code 0004H) (5) ReferenceSetPosition is out of range. (Detail code 0005H) (6) StartingPoint is out of range (Detail code 0007H)	Continue	• Set RingCountUpperValue within the range. (Detail code: 0001H) • Set LengthPerCycle within the range. (Detail code: 0002H) • Set StrokeAmount within the range. (Detail code: 0003H) • Set PositionPerCycle to be less than LengthPerCycle. (Detail code: 0004H) • Set ReferenceSetPosition within the range. (Detail code: 0005H) • Set StartingPoint within the range. (Detail code: 0007H)	Program error information (FB)	At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1BCEH	Cam position calculation disabled for advanced synchronization control	During current position per cycle calculation, calculation of the target current position per cycle failed. (This occurred in a two-way cam pattern.)	Continue	Set "StrokeAmount", "ReferenceSetPosition", and "SetPosition" so that they are within the stroke of the two-way cam pattern.	Program error information (FB)	At motion control FB execution
1BCFH	Cam position operation profile data setting disabled for advanced synchronization control	The following settings for the operation profile data are set to values unavailable for cam position calculation. • Profile data type incorrect (Detail code 0001H) • Operation profile data format incorrect (Detail code 0002H) • Not periodic. (Detail code: 0003H) • The master axis (input) absolute coordinate is not set for the relative coordinate. (Detail code: 0004H) • The slave axis (output) absolute coordinate is not set for the relative coordinate. (Detail code: 0005H) • The start position is set to other than 0. (Detail code: 0006H) • The initial stroke is set to other than 0. (Detail code: 0007H) • The value set for the cam position calculation cam starting point (StartingPoint) is larger than or equal to the resolution. (Detail code: 0008H) • The target operation profile data is being operated by another FB. (Detail code: 0009H) • A value exceeding 32 bits is set for the output coordinates. (Detail code: 000AH) • The output value calculated by extending the line segment between two coordinates exceeded 32 bits. (Detail code: 000BH)	Continue	• Set the profile data type to "1: Cam data". (Detail code: 0001H) • Set the operation profile data format to any of "0: Linear Interpolation", "1: Section Interpolation", or "2: Spline Interpolation". (Detail code: 0002H) • Set to "1: Periodic". (Detail code: 0003H) • Set the master axis (input) absolute coordinate to "0: Relative coordinate". (Detail code: 0004H) • Set the slave axis (output) absolute coordinate to "0: Relative coordinate". (Detail code: 0005H) • Set "0" for the start position. (Detail code: 0006H) • Set "0" for the initial stroke. (Detail code: 0007H) • Set the cam position calculation cam starting point (StartingPoint) to a value smaller than the resolution. (Detail code: 0008H) • End the FB that is operating the target operation profile data. (Detail code: 0009H) • If the operation profile data format is set to "0: Linear Interpolation", correct the cam data so that an output value exceeding 32 bits is not included. (Detail code: 000AH) • Adjust the slope between the coordinates so that the output value calculated by extending the line segment between two coordinates does not exceed 32 bits in the length per cycle. (Detail code: 000BH)	Program error information (FB)	At motion control FB execution
1BD0H	MCv_SyncOperationCycles instruction error	An error occurred when executing MCv_SyncOperationCycles for the following causes. • OperationCycle is out of range. (Detail code 0001H) • Options is out of range. (Detail code 0002H) • Data of the control operation cycle being synchronized was specified. (Detail code: 0003)	Continue	• Set OperationCycle within the range. • Set Options within the range. • Specify data other than that of a control operation cycle being synchronized.	Program error information (FB)	At motion control FB execution
1BD1H	MCv_MovePositioningData instruction error	An error occurred when MCv_MovePositioningData was executed or in progress. The detected positioning data No. (data No.) and the related error code (related event code) are stored in the detailed information (operation profile data control information).	Continue	• Check and correct the settings of the error positioning data No. • Check the corrective actions of the related error code.	• Program error information (FB) • Operation profile data control information	• Always • At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
1BD5H	Motion label instance error	• An error occurred in the corresponding add-on for the label instances. • An error occurred when the label instances are generated.	Continue	• Check the version of the corresponding add-on for the labels. • Increase the maximum RAM size of the corresponding add-on for the labels. • Check if the add-on required for running MCFB is installed. • Reduce MCFB labels.	Program error information (FB)	• At power-on/reset • At write
1BD6H	External signal selection incorrect	• "Asynchronous" was set in the network synchronous communication setting of the device station being referred to. • An unconnected station or non-existent station was set. • A signal which is not compatible with the external signal high-accuracy I/O was set. • A non-existent object in TPDO/ RPDO was set. • An incorrect type was set.	Continue	• Set "Synchronous" in the network synchronous communication setting of the device station being referred to. (Detail code: 0001H) • Connect the target station. (Detail code: 0002H) • Check and correct the station address. (Detail code: 0003H) • Set a signal which is compatible with the external signal high-accuracy I/O. (Detail code: 0004H) • Set a correct object for TPDO/ RPDO. (Detail code: 0005H) • Check and correct the specified type. (Detail code: 0006H)	• Program error information (FB) • Parameter error contents	At motion control FB execution
1BD7H	External signal selection incorrect	• "Asynchronous" was set in the network synchronous communication setting of the device station being referred to. • An incorrect device was set. • An incorrect label was set. • An incorrect axis data was set. • An incorrect constant was set.	Continue	• Set "Synchronous" in the network synchronous communication setting of the device station being referred to. (Detail code: 0001H) • Check and correct the specified type. (Detail code: 0002H) • Set a supported device. (Detail code: 0003H) • Set a device number within the range. (Detail code: 0004H) • Set an available global label with "Access from External Device" enabled. (Detail code: 0005H) • Check and correct the target modification. (Detail code: 0006H) • Set an available axis to the target data. (Detail code: 0007H) • Correct the data name. (Detail code: 0008H) • Check and correct the number of characters. (Detail code: 0009H)	• Program error information (FB) • Parameter error contents	At motion control FB execution
1BD8H	Add-on SignalIO internal error	An error has occurred in add-on SignalIO.	Continue	Install the software again, and rewrite the program. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	• Program error information (FB) • Parameter error contents	At motion control FB execution
1BD9H	External signal access error	The external signal cannot be accessed.	Continue	Check the external signal settings and wiring.	• Program error information (FB) • Parameter error contents	At motion control FB execution
2000H	Module configuration error	The module type set in the system parameters ("I/O Assignment Setting") differs from that of the module actually mounted.	Stop	Re-set the I/O assignment setting of the system parameters in accordance with the intelligent function module and controller actually mounted.	System configuration information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2001H	Module configuration error	The I/O numbers set in the system parameters ("I/O Assignment Setting") are overlapping between modules.	Stop	Re-set the I/O numbers in the system parameters ("I/O Assignment Setting") in accordance with the intelligent function module or I/O module actually mounted.	System configuration information	At power-on/ reset
2002H	Module configuration error	The number of points assigned to the intelligent function module in the system parameters ("I/O Assignment Setting") is smaller than that of the module actually mounted.	Stop	Re-set the number of points in the system parameters ("I/O Assignment Setting") in accordance with the intelligent function module actually mounted.	System configuration information	At power-on/ reset
2004H	Module configuration error	Nine or more CC-Link IE Controller Network modules are mounted in the entire system. (Including when CC-Link IE Controller Network is used for a CC-Link IE built-in Ethernet interface module)	Stop	Reduce the number of CC-Link IE Controller Network modules to eight or less in the entire system. (Including when CC-Link IE Controller Network is used for a CC-Link IE built-in Ethernet interface module)	System configuration information	At power-on/ reset
2005H	Module configuration error	• Two or more interrupt modules (QI60) with no interrupt pointer setting are mounted. • The interrupt pointer numbers are overlapping in the interrupt module (QI60) with no interrupt pointer setting and a module with an interrupt pointer setting.	Stop	• Mount only one QI60 in the entire system. • Configure the interrupt pointer setting for the QI60. • Correct the interrupt pointer setting.	System configuration information	At power-on/ reset, at STOP → RUN
2006H	Module configuration error	A module is mounted on the 65th slot or later.	Stop	Remove the module mounted on the 65th slot or later.	System configuration information	At power-on/ reset
2007H	Module configuration error	A module is mounted on the slot whose number is later than that specified in the system parameters ("I/O Assignment Setting").	Stop	Remove the module mounted on the slot whose number is later than that specified in the I/O assignment setting.	System configuration information	At power-on/ reset
2008H	Module configuration error	• A module is mounted over or across the maximum number of I/O points (4096).	Stop	• Remove the module mounted over or across the maximum number of I/O points (4096). • Replace the module mounted on the last slot with the one that does not exceed the maximum number of I/O points (4096).	System configuration information	At power-on/ reset
2009H	Module configuration error	• There is no response from the I/O module or intelligent function module accessed. • An error has been detected in the network communication function on the controller.	Stop	• Check and correct the I/O assignment setting in the system parameters. • Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller, the I/O module, or intelligent function module. Please contact your local Mitsubishi representative.	System configuration information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2020H	Module configuration error	• There is a mounted module that is not supported, or there is a mounted module that is not supported by the network type (module model name) set in the system parameters ("I/O Assignment Setting"). • The firmware version of the corresponding module is not supported.	Stop	• Remove the unsupported module if any. • Check whether modules are supported by the network type (module model name) set in the system parameters. • Check the firmware version of the controller and the corresponding module to use a supported product or update them to supported versions. • If the corresponding module or network type (module model name) is supported, the possible cause is a hardware failure of the controller, base unit, I/O module, or intelligent function module. Please contact your local Mitsubishi representative.	System configuration information	At power-on/ reset
2043H	CPU module configuration error	The CPU module/controller is mounted on the inapplicable slot.	Stop	• Mount the CPU module/controller on the applicable slot (CPU slot or I/O slot 0 to 6). • Remove the CPU module/controller from the inapplicable slot.	System configuration information	At power-on/ reset
2052H	CPU module configuration error	A multiple CPU system was configured with CPU modules/ controllers incompatible with multiple CPU systems.	Stop	Check and correct the system configuration.	System configuration information	At power-on/ reset
2060H	Base unit configuration error	The number of connected extension base units exceeds seven.	Stop	Reduce the number of extension base units to seven or less.	System configuration information	At power-on/ reset
2070H	Base unit configuration error	An unsupported base unit is connected.	Stop	Disconnect the unsupported base unit. If all the base units are supported, the possible cause is a hardware failure of the controller or base unit. Please contact your local Mitsubishi representative.	System configuration information	At power-on/ reset
20E0H	Invalid module	A module that cannot be recognized is mounted.	Stop	• Mount only applicable modules. • The possible cause is a hardware failure of the I/O module or intelligent function module. Please contact your local Mitsubishi representative.	System configuration information	Always
2120H	SD memory card error	The SD memory card was removed without being disabled.	Stop/ continue	Disable the SD memory card, and then remove it.	Drive/file information	Always
2121H	SD memory card error	An error has been detected in the SD memory card.	Stop/ continue	Format the SD memory card, re-insert the SD memory card, or replace the SD memory card. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	Always
2122H	SD memory card error	The controller did not start because restoring the SD memory card takes time.	Stop	Reset the controller. If the same error code is displayed again, the possible cause is a hardware failure of the SD memory card. Replace the SD memory card.	Drive/file information	At power-on/ reset
2162H	FTP server encrypted communication setting error	Encrypted communication start failed on the FTP server.	Stop	Check if the server certificate has been created on the controller at the FTP server side.	—	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2163H	Web server encrypted communication setting error	Encrypted communication start failed on the web server.	Stop	Check if the server certificate has been created.	—	At power-on/ reset
2180H	Invalid file	An invalid file has been detected.	Stop	Refer to the detailed information (drive/file information) to check the file name, and write the specified file. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	• At power-on/reset, at STOP → RUN • At END instruction execution (for each program)
2181H	Invalid file	Due to firmware update or restoration of the controller, a program file whose file structure is not supported by the new firmware version of the controller has been written.	Stop	After reading program files from the programmable controller, format the memory. Then, write to the programmable controller, reset the controller, and run it again.	Drive/file information	At power-on/ reset
2182H	Invalid file	• An invalid file has been detected. • The file has not been written correctly.	Stop	Refer to the detailed information (drive/file information) to check the drive number, and write the file in the corresponding drive again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	At power-on/ reset
2183H	Invalid file	An invalid file has been detected.	Stop	Refer to the detailed information (drive/file information) to check the file name, and write the specified file. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	At power-on/ reset
2184H	Invalid file	An error in user management information, user group management information, or user authentication setting information has been detected.	Stop	After initializing all corresponding information by using the all information initialization function of the controller, write the user management information again to enable the user authentication function.	—	At power-on/ reset
21A0H	File specification error	• The file specified in the CPU parameters does not exist. • When using a file in the SD memory card, the SD memory card is disabled by turning on SM606 (SD memory card forced disable instruction). • In the file setting of the CPU parameters, the file register is set to "Use Common File Register in All Programs" and the capacity for the file register is not set. • The file specified in the memory card parameters ("Boot Setting") does not exist in the SD memory card.	Stop	• If SM606 is on, turn it off to cancel the disabled state. • Set the capacity for the file register in the file setting of the CPU parameters. If the same error is displayed again, the possible cause is a hardware failure of the device/label memory in the controller or the SD memory card. Please contact your local Mitsubishi representative.	• Drive/file information • Parameter information	• At instruction execution • At interrupt occurrence • At power-on/reset, at STOP → RUN • At END instruction execution (for each program)

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
21A1H	File specification error	The file specified in the parameter cannot be created.	Stop	• Check the detailed information (parameter information), and correct the name and size of the file corresponding to the displayed value (parameter number). • Check the detailed information (drive/file information) and take the following actions. (1) Format the corresponding drive. (2) Delete unnecessary files on the corresponding drive to increase free space. (3) Unlock the corresponding drive if it is locked. (4) Check that the controller recognizes the corresponding drive correctly.	• Drive/file information • Parameter information	• At write • At power-on/reset, at STOP → RUN
21A2H	File specification error	The model (controller model name) set to the file differs from the model name of the controller actually mounted.	Stop	Check the detailed information (drive/file information), and match the project file corresponding to the displayed value (file name) with the model name of the controller actually mounted.	Drive/file information	• At write • At power-on/reset, at STOP → RUN
2200H	Parameter error	• The system parameter and CPU parameter/module parameter do not exist. • The memory card parameter or module extension parameter stored in the SD memory card cannot be accessed because the SD memory card is disabled by turning on SM606 (SD memory card forced disable instruction).	Stop	• Write the system parameter and CPU parameter/module parameter to the controller. • If SM606 is on, turn it off to cancel the disabled state.	Parameter information	At power-on/ reset, at STOP → RUN
2220H	Parameter error	• The parameter setting is corrupted. • Parameters that the firmware version of the controller does not support were written.	Stop	• Check the detailed information (parameter information), and write the displayed parameters. If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller, SD memory card, I/O module, or intelligent function module. Please contact your local Mitsubishi representative. • Check the firmware version of the controller and use a supported product. Then, write parameters again.	Parameter information	At power-on/ reset, at STOP → RUN
2221H	Network parameter error	• The set value is out of range. • An unsupported parameter exists.	Stop	• Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number). If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller, SD memory card, I/O module, or intelligent function module. Please contact your local Mitsubishi representative. • Check the firmware version of the controller and use a supported product.	Parameter information	• At power-on/reset, at STOP → RUN • At END instruction execution (for each program) • At instruction execution • At module access

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2222H	Parameter error	• Use of the function that is not supported by the module is enabled. • The module is non-operational. • Parameters that the firmware version of the module does not support were written.	Stop	• Remove the unsupported module if any. • Use functions supported by the module. • Check the status of the module. • Check the firmware version of the module and use a supported product. • Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number). If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller, SD memory card, I/O module, or intelligent function module. Please contact your local Mitsubishi representative.	Parameter information	At power-on/ reset, at STOP → RUN
2223H	Parameter error	The parameter that needs a reset of the controller after modification was rewritten.	Stop	• Reset the controller, and run it again. • When the latch range setting or the device/label latch interval setting of the CPU parameter is changed, check that SM4098 (latch save completion flag after latch setting change) is on, and then reset the controller.	Parameter information	Always
2224H	Parameter error	• A memory area cannot be ensured. • A global label setting file exists when the label assignment area set in the CPU parameters is 0K words.	Stop	• Check the detailed information (parameter information), display the error-detected area by clicking the [Error Jump] button, and increase the capacity of the area. (If the capacity of the area cannot be increased, decrease the capacity of other areas.) • Reduce the number of labels or local devices used. • If no global label is used, delete the global label setting file.	Parameter information	• At write • At power-on/reset, at STOP → RUN
2225H	Parameter error	• The set model (controller model name) differs from the model name of the controller actually mounted. • The operation set in the memory card parameters cannot be performed. (The boot function cannot be executed.)	Stop	• Match the model (controller model name) set in the project with the model name of the controller actually mounted. • Delete the memory card parameter settings. • Remove the SD memory card so that the operation set in the memory card parameters will not be performed. (Do not execute the boot operation.)	Parameter information	• At write • At power-on/reset, at STOP → RUN
2228H	Parameter error	The memory area set by the parameter cannot be secured.	Stop	Check the firmware version of the controller and use a supported product. Then, write parameters again.	Parameter information	At power-on/ reset, at STOP → RUN
2229H	Parameter error	The sum of the number of latch points of devices and the latch label area capacity is larger than the latch capacity.	Stop	• Change the device/label memory area setting so that the sum of the number of latch points of devices and the latch label area capacity does not exceed the latch capacity. • Change the save destination memory setting from the built-in memory to the SD memory card.	Parameter information	At power-on/ reset, at STOP → RUN

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2241H	Parameter error (module)	• The I/O numbers set in the system parameters differ from those of the module actually mounted. • The target module is not mounted on the slot where the system parameters and module parameters are set. • The module type set in parameter differs from that of the module actually mounted.	Stop	• Check if the system configuration displayed on the system monitor window matches the actual system configuration. • Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number). If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller, I/O module, or intelligent function module. Please contact your local Mitsubishi representative.	Parameter information	• At power-on/reset, at STOP → RUN • At END instruction execution (for each program) • At instruction execution • At module access
2242H	Parameter error (module)	• The intelligent function module has detected a module parameter error. • The controller has detected a module parameter error.	Stop	Check the detailed information (system configuration information), and check the module corresponding to the displayed value (I/O number). If the same error code is displayed again, the possible cause is a hardware failure of the controller or the intelligent function module. Please contact your local Mitsubishi representative.	System configuration information	At power-on/ reset, at STOP → RUN
2260H	Parameter error (network)	Network numbers are overlapping.	Stop	Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number). If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller or intelligent function module. Please contact your local Mitsubishi representative.	Parameter information	At power-on/ reset
2262H	Parameter error (network)	• The station type set in the module parameters differs from that of the module actually mounted. • Parameters that the firmware version of the CC-Link IE TSN master/local module does not support are written.	Stop	• Check the detailed information (parameter information) by executing module diagnostics using the engineering tool and correct the parameter setting corresponding to the displayed value (parameter number). If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller or intelligent function module. Please contact your local Mitsubishi representative. • Check the firmware version of the CC-Link IE TSN master/local module and use a supported product. Then, write parameters again.	Parameter information	At power-on/ reset, at STOP → RUN
2263H	Parameter error (network)	Even though the CC-Link IE module is mounted, a CC-Link IE module is not set in the system parameters ("I/O Assignment Setting"), or CC-Link IE module parameters have not been set.	Stop	Set the system parameters and module parameters. If the same error code is displayed again, the possible cause is a hardware failure of the data memory in the controller or intelligent function module. Please contact your local Mitsubishi representative.	Parameter information	At power-on/ reset, at STOP → RUN

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2280H	Parameter error (refresh)	The refresh setting is not set correctly. (Data were refreshed exceeding the file register capacity.)	Stop	Check the detailed information (parameter information), and correct the parameter setting corresponding to the displayed value (parameter number) so that the data are refreshed within the specified device range. (Take the following actions: increase the number of file register points (capacity), set a file register file having a capacity for all of the target data to be refreshed, or reduce the refresh device range.)	Parameter information	• At power-on/reset, at STOP → RUN • At END instruction execution (for each program) • At instruction execution • At module access
2281H	Parameter error (refresh)	A device that cannot be used as a refresh device is specified.	Stop	Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number).	Parameter information	At power-on/ reset, at STOP → RUN
2282H	Parameter error (refresh)	The number of specified refresh points is invalid.	Stop	Check the detailed information (parameter information) and correct the parameter setting corresponding to the displayed value (parameter number).	Parameter information	At power-on/ reset, at STOP → RUN
2400H	Module verification error	• The module information at power-on differs from the information of modules actually mounted. • The I/O module or intelligent function module is not mounted properly or was removed during operation.	Stop/ continue	• Check the detailed information (system configuration information), and check the module corresponding to the displayed value (slot number). • Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the error module. Please contact your local Mitsubishi representative.	System configuration information	Always
2401H	Module verification error	A controller, I/O module, or intelligent function module was mounted on the base unit during operation.	Stop/ continue	• Check the detailed information (system configuration information), and check the module corresponding to the displayed value (slot number). • Do not mount a controller, I/O module, nor intelligent function module during operation. • Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the error module. Please contact your local Mitsubishi representative.	System configuration information	Always
2420H	Fuse blown error	The output module with a blown fuse has been detected.	Stop/ continue	• Check the FUSE LED of each output module, and replace the one with the FUSE LED on. • Check the detailed information (system configuration information), and replace the output module corresponding to the displayed value (slot number).	System configuration information	Always
2440H	Module major error	An error has been detected in the I/O module or intelligent function module during the initial processing.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the error module. Please contact your local Mitsubishi representative.	System configuration information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2441H	Module major error	• An error has been detected in the I/O module or intelligent function module when the instruction was executed. • An error has been detected in the controller when the instruction was executed.	Stop/ continue	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or the module. Please contact your local Mitsubishi representative.	• Error location information • System configuration information	At instruction execution
2442H	Module major error	• An error has been detected in the I/O module or intelligent function module during the END processing. • An error has been detected in the controller during the END processing.	Stop/ continue	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or the module. Please contact your local Mitsubishi representative.	System configuration information	At module access
2443H	Module major error	• An error has been detected in the I/O module or intelligent function module. • An error has been detected in the network communication function on the controller.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or the module. Please contact your local Mitsubishi representative.	System configuration information	At module access
2450H	Module major error	• A major error has been notified from the intelligent function module connected. • The I/O module or intelligent function module is not mounted properly or was removed during operation. • An error has been detected in the network communication function on the controller.	Stop/ continue	• Take measures to reduce noise. • Check the connection status of the extension cable. • Check the detailed information (system configuration information), and check the module corresponding to the displayed value (slot number). • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or the module. Please contact your local Mitsubishi representative.	System configuration information	Always
24C0H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error is displayed again, the possible cause is a hardware failure of the controller, I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	At module access
24C1H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error is displayed again, the possible cause is a hardware failure of the controller, I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	At module access

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
24C2H	System bus error	• The I/O module or intelligent function module is not mounted properly or was removed during operation. • An error was detected on the system bus.	Stop	• Check the detailed information (system configuration information), and check the module corresponding to the displayed value (slot number). • Check the connection status of the extension cable. • Take measures to reduce noise. • Reset the controller, and run it again. If the same error is displayed again, the possible cause is a hardware failure of the controller, I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	Always
24C3H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error is displayed again, the possible cause is a hardware failure of the controller, I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	At module access
24C4H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	At module access
24C5H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the I/O module, intelligent function module, base unit, or extension cable. Please contact your local Mitsubishi representative.	—	At module access
24C6H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or extension cable. Please contact your local Mitsubishi representative.	—	At module access
24C8H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the I/O module, intelligent function module, or extension cable. Please contact your local Mitsubishi representative.	—	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
24D0H	System bus error	• An unsupported base unit is connected. • An error was detected on the system bus.	Stop	• Check the connection status of the extension cable. • Check that the 10m mark is printed on the base unit connected when using the ten-meter extended cables (RC100B). (📖 MELSEC iQ-R Module Configuration Manual) • Disconnect the unsupported base unit. • Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller, base unit, or extension cable. Please contact your local Mitsubishi representative.	System configuration information	Always
24E0H	System bus error	An error was detected on the system bus.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller or the base unit. Please contact your local Mitsubishi representative.	System configuration information	Always
2500H	WDT error	• The scan time exceeded the execution monitoring time setting value • The initial (1st) scan time exceeded the execution monitoring time set in the CPU parameter. • The execution time of the fixed scan interrupt program exceeded the interrupt execution interval.	Stop	• Check the detailed information (time information), check its value (time), and take the following actions: (1) Check and correct the program so that it can be executed within the monitoring time setting value. (2) Set the monitoring time to an appropriate value. • Check and correct the fixed scan interrupt program so that the processing completes within the interrupt execution interval. • If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Time information	Always
2501H	WDT error	• The scan time exceeded the execution monitoring time setting value. • The 2nd or later scan time exceeded the execution monitoring time set in the CPU parameter. • The execution time of the fixed scan interrupt program exceeded the interrupt execution interval.	Stop	• Check the detailed information (time information), check its value (time), and take the following actions: (1) Check and correct the program so that it can be executed within the monitoring time setting value. (2) Set the monitoring time to an appropriate value. • Check and correct the fixed scan interrupt program so that the processing completes within the interrupt execution interval. • If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Time information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2520H	Invalid interrupt	Even though an interrupt was requested, there is no interrupt factor.	Stop	• Take measures to reduce noise. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller, I/O module, intelligent function module, or base unit. Please contact your local Mitsubishi representative.	System configuration information	At interrupt occurrence
2521H	Invalid interrupt	Even though an interrupt was requested, there is no interrupt factor.	Stop		—	At interrupt occurrence
2522H	Invalid interrupt	An interrupt was requested from the module with no interrupt setting in the module parameter.	Stop	• Check and correct the interrupt setting in the module parameter. • Take measures so that no interrupt is requested from the module with no interrupt setting. • Check and correct the interrupt setting in the buffer memory of the intelligent function module.	System configuration information	At interrupt occurrence
2600H	Network synchronous communication function processing error	The cyclic processing has not been completed by the start timing for the next network communication cycle due to one of the following causes. (1) The network communication cycle synchronization program whose communication cycle setting matches the "Communication Period Setting" of the device station where "Network Synchronous Communication" of "Network Configuration Settings" is set to "Synchronous" is not written. (2) Interrupts are disabled by executing the DI instruction. (3) The "Communication Period Interval Setting" value is small. (4) The "Cyclic Transmission Time" value is small.	Stop	(1) Check whether the relevant network communication cycle synchronization program has been written to the controller. (2) Enable the interrupt by the EI instruction within the communication cycle. (3) Enable the communication cycle interval measurement, and set "Communication Period Interval Setting" to a value larger than the value displayed in 'Communication cycle interval (actual measure value)' (U3E0\G10200 to U3E0\G10201). (4) Enable the communication cycle interval measurement, and set "Cyclic Transmission Time" to a value based on the value displayed in 'Cyclic transmission time (calculation result)' (U3E0\G10272 to U3E0\G10273). If the same error still occurs even after taking the above actions, set "Communication Period Interval Setting" to a sufficiently large value, and readjust the settings of "Communication Period Interval Setting" and "Cyclic Transmission Time" based on the manual.	—	Always
2800H	I/O number or network number specification error	The specified I/O number is out of range (other than 0 to FFH, 3E0H).	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2801H	I/O number or network number specification error	The I/O number of the module that does not exist was specified.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	• Error location information • System configuration information	At instruction execution
2802H	I/O number or network number specification error	• The I/O number of the module that does not support the instruction was specified. • The dedicated instruction specified in the program cannot be executed in the specified module or mode.	Stop/ continue	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Check the execution propriety (including support status and execution mode) of the dedicated instruction, referring to the manual for the target module.	• Error location information • System configuration information	• At instruction execution • At motion control FB execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2803H	I/O number or network number specification error	The I/O number of the module that cannot be specified in the instruction was specified.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	• Error location information • System configuration information	At instruction execution
2804H	I/O number or network number specification error	The specified network number is out of range (other than 1 to 239).	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2805H	I/O number or network number specification error	The network number that does not exist was specified.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2807H	I/O number or network number specification error	• The target module cannot be identified in the instruction that requires a specification of the I/O module or intelligent function module. (There is a mistake in the string specifying the module.) • There is a mistake in the string of the instruction that executes the network communication function for the target.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2810H	I/O number or network number specification error	• The I/O module or intelligent function module specified in the instruction is in a status where the instruction cannot be executed for it. • The instruction of the network communication function executed by the controller failed.	Stop/ continue	The possible cause is a hardware failure of the controller, or the I/O module or intelligent function module specified in the instruction. Please contact your local Mitsubishi representative.	• Error location information • System configuration information	At instruction execution
2820H	Device, label, or buffer memory specification error	• The device or label area specified in the instruction exceeded the s available range. • The file register was accessed when the settings of the file register were not configured in the file setting of the CPU parameter.	Stop/ continue	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Set the file register, and access the file.	Error location information	• At instruction execution • At END instruction execution (for each program)
2821H	Device, label, or buffer memory specification error	The device or label areas used in the instruction to store data are overlapping.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2822H	Device, label, or buffer memory specification error	The device or label that cannot be used in the instruction was specified.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2823H	Device, label, or buffer memory specification error	• The buffer memory area of the module specified in the instruction exceeded the specified range. • The module specified in the instruction does not have a buffer memory area.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
2824H	Device, label, or buffer memory specification error	The access prohibited area in the buffer memory was accessed.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
2840H	File name specification error	The file specified in the instruction does not exist.	Stop/ continue	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Check the detailed information (drive/file information), create the specified file, and write it to the controller. Or, set all the required files in the CPU parameters (file setting).	• Error location information • Drive/file information	At instruction execution
2841H	File name specification error	The program file specified by the instruction is not set in the CPU parameters (program setting).	Stop/ continue	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Check the detailed information (drive/file information) and register the specified program file in the program setting.	• Error location information • Drive/file information	At instruction execution
2842H	File name specification error	A file that cannot be specified with the instruction was specified.	Stop/ continue	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Check the detailed information (drive/file information) and check the specified file.	• Error location information • Drive/file information	At instruction execution
2880H	Add-on load error	• The add-on file is broken or incorrect. (Detail code: 0001, 0005) • The add-on on which it is dependent has not been installed or enabled. (Detail code: 0002) • An add-on that cannot be combined has been installed or enabled. (Detail code: 0003) • Add-ons with the same name have been installed or enabled. (Detail code: 0004) • An error occurred in an add-on initialization process after loading. (Detail code: 0006) • An error occurred in the system during loading. (Detail code: 0007) • There is an inconsistency in the versions. (Detail code: 0008)	Stop	Check the error cause from the detail code and correct the add-ons installed or enabled. If this error still occurs, update the controller firmware to the latest version.	• Add-on name information • Add-on version information	At power-on/ reset
2881H	Insufficient Total System Memory (RAM)	The total number of AddonSystem.PrConst.Type_AddonLibraryName.RamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.RamSizeMax of all add-ons exceeds the total size of the system memory (RAM).	Stop	Set the total number of AddonSystem.PrConst.Type_AddonLibraryName.RamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.RamSizeMax of all add-ons within the total size of the system memory (RAM).	—	At power-on/ reset
2882H	Insufficient Add-on System Memory (RAM)	Memory that exceeded AddonSystem.PrConst.Type_AddonLibraryName.RamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.RamSizeMax has been used.	Stop	Increase AddonSystem.PrConst.Type_AddonLibraryName.RamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.RamSizeMax.	Add-on name information	• Always • At power-on/reset
2883H	Insufficient Total System Memory (Backup RAM)	The total number of AddonSystem.PrConst.Type_AddonLibraryName.BackupRamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.BackupRamSizeMax of all add-ons exceeds the total size of the system memory (backup RAM).	Stop	Set the total number of AddonSystem.PrConst.Type_AddonLibraryName.BackupRamSizeMax or Type_AddonLibraryName_System.PrConst.AddonMemory.BackupRamSizeMax of all add-ons within the total size of the system memory (backup RAM).	—	At power-on/ reset
2885H	Add-on individual error	An add-on error occurred.	Stop	Check the manual of the add-on for details about the detail code.	• Add-on name information • Detail code information	Depends on the add-on.

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3000H	Boot function execution error	The boot setting in the memory card parameters is incorrect.	Stop	Check and correct the boot setting in the memory card parameters.	Drive/file information	At power-on/ reset
3001H	Boot function execution error	When the boot function was executed, the file format processing failed.	Stop	• Reset the controller and execute the boot function again. • The possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Drive/file information	At power-on/ reset
3004H	Boot function execution error	When the boot function was executed, the CPU built-in memory capacity was exceeded.	Stop	• Check and correct the boot setting. • Delete unnecessary files in the CPU built-in memory. • Clear the CPU built-in memory by selecting "Clear" to "Operation Setting at CPU Built-in Memory Boot" and execute the boot function.	Drive/file information	At power-on/ reset
3006H	Boot function execution error	The boot function cannot be executed because the user authentication function is enabled.	Stop	Disable the user authentication function.	—	At power-on/ reset
3010H	Data restoration function execution error	The model of the restoration destination controller differs from the model of the backup source controller.	Stop	• Execute restoration with the same controller model as the backed up source controller. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3011H	Data restoration function execution error	Reading of backup data from the backup target drive completed with an error.	Stop	• Replace the SD memory card, and execute the function again. • The backup data may have been corrupted. Execute the data restoration of the controller using another backup data. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	• Controller data backup/ restoration folder information • Drive/file information	At power-on/ reset
3012H	Data restoration function execution error	Writing of backup data completed with an error.	Stop	• The possible cause is a hardware failure of the restoration target controller. Execute the data restoration of the controller to another controller. • Replace the SD memory card, and execute the function again. • Unlock the write protect switch of the SD memory card.	• Controller data backup/ restoration folder information • Drive/file information	At power-on/ reset
3013H	Data restoration function execution error	• The system file does not exist in the backup data to be restored. • File(s) in the system file information does not exist in the folder of the backed up data.	Stop	• The backup data may have been corrupted. Execute the data restoration function using another backup data. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3015H	Data restoration function execution error	• A folder with a value that matches the restoration source specification setting value, restoration target date folder setting value, or restoration target number folder setting value does not exist. • The restoration target data setting value is out of range. • The restoration source specification setting value, restoration target date folder setting value, or restoration target number folder setting value is out of range.	Stop	• Check and correct the restoration source specification setting value, restoration target date folder setting value, or restoration target number folder setting value, and execute the function again. • Check and correct the restoration target data setting value, and execute the function again. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3016H	Data restoration function execution error	Automatic restoration was executed without an SD memory card.	Stop	• Insert or re-insert an SD memory card, and execute the function again. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3017H	Data restoration function execution error	• Automatic restoration was executed exceeding the maximum memory capacity of the controller. • Automatic restoration was executed exceeding the maximum number of files that can be stored in the controller. • Automatic restoration was executed exceeding the maximum memory capacity of the SD memory card.	Stop	• Execute the function so that the maximum memory capacity will not be exceeded. • Execute the function so that the maximum number of storable files will not be exceeded. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration. • If the capacity of the SD memory card is not sufficient, secure free space.	Controller data backup/ restoration folder information	At power-on/ reset
3018H	Data restoration function execution error	The condition (such as programs, parameters, and file structure) of the controller differs from that of when the restoration destination controller was backed up.	Stop	• Match the controller status to the one at the time of backup, and execute the function again. • Set all data as the backup/ restoration target data, and execute the data restoration function. • Turn off the automatic restoration setting (bit 0 of SD955) to disable the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3030H	Data restoration function execution error	• The decryption password is different. • Integrity verification failed. (Tampering or overwriting of backup data was detected.)	Stop	• Enter the decryption password, and then retry the operation. • The backup data may contain an error, so execute the function using other backup data. • Turn off the automatic restoration setting to clear the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3033H	Data restoration function execution error	The data specified with the restoration target data setting does not exist in the folder with a value that matches the restoration source specification setting value, restoration target date folder setting value, or restoration target number folder setting value.	Stop	• Check and correct the restoration target data setting value, and execute the function again. • Turn off the automatic restoration setting to clear the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3034H	Data restoration function execution error	The controller cannot be restored because the controller backup system file cannot be recognized. (The controller cannot be restored because the file version of the backup system file is different.)	Stop	• Execute restoration using a controller that can recognize the backup system file. (Execute restoration using a controller that can recognize the file version of the backup system file.) • Turn off the automatic restoration setting to clear the automatic restoration.	Controller data backup/ restoration folder information	At power-on/ reset
3035H	Data restoration function execution error	The specified operation cannot be performed.	Stop	Retry the operation after a while. If the same error is displayed again, please contact your local Mitsubishi representative.	Controller data backup/ restoration folder information	At power-on/ reset
3040H	Network label setting error	• The total number of stations using the network labels exceeds the maximum limit. • The total number of the points of the network labels exceeds the maximum limit.	Stop	• Check and correct the "Network label" setting under the "Network Configuration Settings". • Reduce the number of the network labels used.	Drive/file information	At power-on/ reset, at STOP → RUN

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3041H	Network label setting error	The network labels were used for stations with station types that cannot use network labels.	Stop	• Check and correct the "Network label" setting under the "Network Configuration Settings". • Check the firmware version of the controller to use an applicable product.	Drive/file information	At power-on/ reset, at STOP → RUN
3044H	Parameter error	• The interrupt priority value of the network communication cycle synchronization interrupt is not set as "basic cycle < normal-speed cycle < low-speed cycle". • The interrupt priority value of the network communication cycle synchronization interrupt overlaps with the interrupt priority of other interrupts.	Stop	• Set the interrupt priority value for the network communication cycle synchronous interrupt as "basic cycle < normal-speed cycle < low-speed cycle". • Set the different interrupt priority between the network communication cycle synchronous interrupt and the other interrupts.	Parameter information	At power-on/ reset, or write
3100H	Program error	The program includes any instruction that cannot be used or decoded in the controller.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Take measures to reduce noise. • Write the program again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative. • Update the controller firmware to the latest version.	Error location information	• At instruction execution • At power-on/reset, or write
3110H	Program error	The controller does not support the dedicated instruction executed.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Check the firmware version of the controller, use an applicable product, and then try again.	Error location information	• At instruction execution • At power-on/reset, at STOP → RUN
3111H	Program error	The number of devices used in the dedicated instruction specified in the program is incorrect.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	—	At instruction execution
3112H	Program error	The function block or function specified in the program does not exist.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Please check if the add-on files required for execution have been installed. • Take measures to reduce noise. • Write the sequence program(s) and FB program(s) again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At instruction execution
3118H	Program error	The link direct device specified in the instruction cannot be executed.	Stop	Check and correct the link direct device setting of the CPU parameter.	Error location information	At instruction execution
3119H	Program error	A program block that starts from a subroutine program or an interrupt program was executed when the main routine program was in progress.	Stop	Check the error program (step) displayed by using the error jump function, and move the program block that starts from the subroutine program or interrupt program to a position after the main routine program.	Error location information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3120H	END instruction error	The END (FEND) instruction does not exist in the program.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Take measures to reduce noise. • Write the sequence program(s) and FB program(s) again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At power-on/ reset, at STOP → RUN
3121H	FB/FUN program error	The structure of FB/FUN program is incorrect.	Stop	• Take measures to reduce noise. • Write the sequence program(s) and FB program(s) again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At instruction execution
3122H	Temporary area error	The temporary area was used incorrectly.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button. • Take measures to reduce noise. • Write the sequence program(s) and FB program(s) again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At instruction execution
3200H	Program execution error	Memory/Device Setting and File Register Setting in the CPU parameters do not match the device/ label assignments in the sequence program, FB program, and global label setting file. (After Memory/ Device Setting and File Register Setting were changed, only the CPU parameters were written to the controller.)	Stop	• If Memory/Device Setting and File Register Setting in the CPU parameters have been changed, write the sequence program, FB file, and global label setting file as well as the CPU parameters to the controller. • If no global label is used, delete the global label setting file.	Drive/file information	At power-on/ reset, at STOP → RUN
3201H	Program execution error	Even though no program is set in the CPU parameters, multiple program files exist.	Stop	• Set a program in the CPU parameter (program setting). • Delete unnecessary program files.	Drive/file information	At power-on/ reset, at STOP → RUN
3202H	Program execution error	• The program file is incorrect. Or, the program file is not correctly written. • For the subroutine type FB, "Use MC/MCR to Control EN" of "Inherent Property" is set to "Yes". • The program includes an instruction that cannot be used or decoded.	Stop	• Write the program file to the CPU built-in memory again. • Set "Use MC/MCR to EN Control" in "Inherent Property" of subroutine-type FB to "No" and write the program file to the CPU built-in memory again. • Replace the controller with the one that supports the use of the subroutine-type FB for which "Use MC/MCR to EN Control" of "Inherent Property" is set to "Yes". • Update the controller firmware to the latest version.	Drive/file information	At power-on/ reset, at STOP → RUN
3203H	Program execution error	No program file exists.	Stop	• Check if the system parameter file, CPU parameter file, and program file exist. • Write the system parameter file, CPU parameter file, and program file to the CPU built-in memory.	Drive/file information	At power-on/ reset, at STOP → RUN

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3205H	Program execution error	• After the global label setting file was modified, only the modified file was written to the controller. Or, without writing the modified global label setting file, only the sequence program file(s) and FB file(s) were written to the programmable controller. (The global label setting file was not written to the controller.) • After an FB file was modified, only the modified file was written to the controller. Or, without writing the modified FB file, only the sequence program file(s) and global label setting file were written to the controller. (The modified FB file was not written to the programmable controller.) • After the "Access from External Device" setting of the global label setting was changed, only the global label assignment information was written to the controller. Or, after the "Access from External Device" setting was changed, only the sequence program file(s) and FB file(s) were written to the controller. • When the "Access from External Device" setting is not selected, the sequence program file(s), FB file(s), and global label setting file are written to the controller without initializing the memory where the global label assignment information file is stored.	Stop	• Write all the sequence program file(s), FB file(s), global label setting file, and global label assignment information file to the controller. • If no global label is used, delete the global label setting file. • When the "Access from External Device" setting is not selected, initialize the memory where the global label assignment information is written, then write the sequence program(s), FB file(s), and global label setting file to the controller.	Drive/file information	At power-on/ reset, at STOP → RUN
3206H	Program execution error	• After the sequence program was modified, only the modified sequence program file was written to the programmable controller. Or, without writing the modified sequence program file, only the initial local label value file was written to the programmable controller. • After the global label setting file was modified, only the modified file was written to the programmable controller. Or, without writing the modified global label setting file, only the initial global label value file was written.	Stop	• Write both the sequence program file(s) and initial local label value file to the programmable controller. • Write both the global label setting file and initial global label value file to the programmable controller. • If no initial global label value is used, delete the initial global label value file. • If no initial local label value is used, delete the initial local label value file.	Drive/file information	At power-on/ reset, at STOP → RUN
3207H	Program execution error	The signal flow area to be used in the FB program cannot be secured.	Stop	Check the detailed information (drive/ file information). Then, reduce the number of instructions that use the signal flow area of the FB program used in the sequence program file.	Drive/file information	At power-on/ reset, at STOP → RUN
3209H	Program execution error	The program cache memory capacity has been exceeded.	Stop	Reduce the size of a sequence program and an FB file program.	—	At power-on/ reset
320AH	Program execution error	The maximum capacity of the label assignment information management area has been exceeded.	Stop	• Reduce the number of labels with "Access from External Device" checkbox selected in the specified label settings, and write the data again. • Reduce the number of MCFBs to be used.	—	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
320BH	Program execution error	• A device is assigned to a global label for which device assignment is prohibited. • A label for which latch setting is prohibited was set to be latched.	Stop	Check and correct the label settings displayed in the detailed information.	Label name information	At power-on/ reset
320CH	Program execution error	• After the global label setting file was modified, only the modified file was written to the programmable controller. Or, after the global label setting file was changed, only the network label setting file was written to the programmable controller. (The global label setting file was not written to the programmable controller.) • After the network label setting file was changed, only the changed file was written to the programmable controller. Or, after the network label setting file was changed, only the global label setting file was written to the programmable controller. (The network label setting file was not written to the programmable controller.)	Stop	• Write the global label setting file and the network label setting file to the programmable controller. • If no global label is used, delete the global label setting file.	Drive/file information	At power-on/ reset, at STOP → RUN
3280H	Operation error	Division where the divisor is zero was performed.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3281H	Operation error	Data that cannot be converted by using the data conversion instruction was input.	Stop/ continue		Error location information	At instruction execution
3282H	Operation error	The operation was performed with the invalid data (-0, denormalized number, NaN (not a number), or ±∞).	Stop/ continue		Error location information	At instruction execution
3283H	Operation error	An overflow has occurred during the operation.	Stop/ continue		Error location information	At instruction execution
3284H	Operation error	A string that is not supported in the instruction was specified.	Stop/ continue		Error location information	At instruction execution
3285H	Operation error	The input data was out of range.	Stop/ continue		Error location information	At instruction execution
3286H	Operation error	• The device or label area specified in the instruction exceeded the s available range. • The operation result is out of the output range. (The operation result of the instruction that concatenate character strings exceeded the allowable number of characters.)	Stop/ continue		Error location information	At instruction execution
3290H	Operation error	The link direct device, module access device, or CPU buffer memory access device is specified for both (s) and (d) used in the BMOV instruction.	Stop/ continue		Error location information	At instruction execution
3291H	Operation error	• When writing data to the data memory by using the SP.DEVST instruction, the number of writes per day exceeded the number set in SD771. • The value set in SD771 is out of range.	Stop/ continue	• Check the program (step) displayed by clicking the [Error Jump] button and check if the number of SP.DEVST instruction executions is appropriate. • Execute the SP.DEVST instruction again on another day, or change the value in SD771. • Set the value in SD771 within the settable range.	Error location information	At instruction execution
3292H	Operation error	The structure of the PID control instruction is incorrect.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, and correct the configuration of the PID control instruction.	Error location information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3293H	Operation error	The size of data to be sent/received by the socket communications instruction exceeds the allowable range.	Stop/ continue	• Check and change the send data size of the controller or the external device. • If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At instruction execution
3295H	Operation error	The clock data specified with the DATEWR(P) instruction is less than 1 hour from the daylight saving time starting time.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button, and correct the clock data specified with the instruction or the daylight saving time setting starting time.	Error location information	At instruction execution
3296H	Operation error	• The specified file name (before a period) or extension includes two or more "*". • The specified file name (before a period) or extension includes "*" and "?". • A wild card ("*", "?") is used in a location where it cannot be used. • A file that cannot be transferred has been specified. • A file name is not specified. • A delimiter for a drive number has been specified with characters other than ":\" or ":/".	Stop/ continue	• Check the usage of wild card characters. • Use a file that can be transferred. • Specify a file name. • Specify a delimiter for a drive number with ":\" or ":/".	Error location information	At instruction execution
3297H	Operation error	The control data (d1) of the SP.FREAD and SP.FWRITE instructions are specified with an invalid combination between the execution/completion type and the data type specification.	Stop/ continue	Check the error program (step) displayed by clicking the [Error Jump] button and correct it to a specifiable combination.	Error location information	At instruction execution
3298H	Operation error	The display format was used for (s1) of the SPF instruction in a format that is not specified. (1) An unavailable specifier was used. (2) The display format was used in an alignment other than the specified format. (3) [Accuracy] and [Acquired data size] were used multiple times in one display format.	Stop/ continue	Check the program (step) displayed with the error jump, and use the display format in a format that can be specified.	Error location information	At instruction execution
3299H	Operation error	The display format is not specified for (s1) of the SPF instruction.	Stop/ continue	Check the program (step) displayed with the error jump, and specify the display format.	Error location information	At instruction execution
329AH	Operation error	When "s" was specified for [Conversion specifier] of the SPF instruction, the string specified for (s2) exceeded the specifiable range.	Stop/ continue	Check the program (step) displayed with the error jump, and correct the character string so that it fits within the specifiable range.	Error location information	At instruction execution
329BH	Operation error	An instruction has been executed without setting parameters which are required when the instruction is executed.	Stop/ continue	Set parameters required to execute the instruction.	Error location information	At instruction execution
329CH	Operation error	The value specified for [Minimum field width] or [Accuracy] of the SPF instruction exceeded the specifiable range.	Stop/ continue	Check the program (step) displayed with the error jump, and correct the numerical value so that it fits within the specifiable range.	Error location information	At instruction execution
3300H	Pointer setting error	The total number of points of local or global pointers used in the program exceeded the points set in the pointer setting of the CPU parameters.	Stop	• Reduce the number of points of local or global pointers used in the program. • Check and correct the pointer setting of the CPU parameters.	Error location information	At power-on/ reset, at STOP → RUN

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3301H	Pointer setting error	The total number of pointer-type labels used in the program exceeded the points set in the pointer setting of the CPU parameters.	Stop	• Reduce the number of points of pointer-type labels used in the program. • Check and correct the pointer setting of the CPU parameters.	Error location information	At power-on/ reset, at STOP → RUN
3302H	Pointer setting error	Multiple global pointers with the same number or pointer-type global labels are used in the program. (The pointer numbers or the labels are overlapping.)	Stop	Check the detailed information (device name information or label name information). Then, correct the program so that the pointer numbers or the pointer-type global labels of the global pointer do not overlap with each other.	• Error location information • Device name or label name information	At power-on/ reset, at STOP → RUN
3303H	Pointer setting error	Multiple local pointers with the same number or pointer-type local labels are used in the program. (The pointer numbers or the labels are overlapping.)	Stop	Check the detailed information (device name information or label name information). Then, correct the program so that the pointer numbers or the pointer-type local labels of the local pointer do not overlap with each other.	• Error location information • Device name or label name information	At power-on/ reset, at STOP → RUN
3310H	Interrupt pointer setting error	The interrupt pointer numbers used in the files are overlapping.	Stop	Check the detailed information (device name information). Then, correct the program so that the pointer numbers of the interrupt pointer do not overlap with each other.	• Error location information • Device name information	At power-on/ reset, at STOP → RUN
3321H	FOR-NEXT instruction error	The NEXT instruction was executed even though the FOR instruction was not executed. Or, there are more NEXT instructions than FOR instructions.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3322H	FOR-NEXT instruction error	The BREAK instruction was executed even though the FOR instruction was not executed.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3330H	Nesting depth error	The number of nesting levels in the subroutine program exceeded its limit (16).	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct the number of nesting levels to 16 or less.	Error location information	At instruction execution
3332H	Nesting depth error	The number of nesting levels in the DI instruction exceeded its limit (16).	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct the number of nesting levels to 16 or less.	Error location information	At instruction execution
3333H	Nesting depth error	The number of nesting levels in the function block or function exceeded its limit (32).	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct the number of nesting levels to 32 or less.	Error location information	At instruction execution
3340H	Pointer execution error	• The pointer specified in the instruction does not exist. • The pointer that exists between FOR and NEXT is specified.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3341H	Pointer execution error	The RET instruction does not exist in the executed subroutine program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At END instruction execution (for each program)
3342H	Pointer execution error	The RET instruction exists before the FEND instruction in the main program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3350H	Interrupt pointer execution error	The interrupt pointer corresponding to the interrupt input does not exist.	Stop	Check if the program corresponding to the interrupt pointer number set in the module parameters exists.	—	At instruction execution
3351H	Interrupt pointer execution error	• The IRET instruction does not exist in the executed interrupt program. • The STOP instruction has been executed in an interrupt program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3352H	Interrupt pointer execution error	The IRET instruction was executed in the main routine program or subroutine program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3353H	Interrupt pointer execution error	The IRET instruction or STOP instruction was executed in the fixed scan execution type program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3354H	Interrupt pointer execution error	The IRET instruction or STOP instruction has been executed in an event execution type program.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, then correct it.	Error location information	At instruction execution
3360H	FB/FUN execution error	Before the FB/FUN program ends, the call source program ended.	Stop	• Check the error program (step) displayed by clicking the [Error Jump] button, then correct it. • Take measures to reduce noise. • Write the program again. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	Error location information	At instruction execution
3368H	Temporary area exceeded	The secured temporary area size exceeded its limit.	Stop	Check the error program (step) displayed by clicking the [Error Jump] button, and correct the number of nesting levels in the function (FUN).	Error location information	At instruction execution
3401H	Drive error	A verification error of plane management target memory occurred.	Stop/ continue	• Format the target drive. • For Drive 6 (motion data memory), check and correct the system memory (backup RAM) size and storage capacity settings for motion control events.	Drive/file information	At power-on/ reset
3402H	Cycle over	Operation processing or other fixed scan processing is not completed within the set cycle.	Stop/ continue	• Change the value of the communication cycle interval setting to a larger value. • Change the axis control operation cycle to distribute the processing load. • For programs whose priority is higher than that of the network communication cycle synchronous interrupt program, change the priority or execution interval or check and correct the processing content.	Cycle information	Always
3403H	Base system error	• Label configuration has failed. • The initial processing has failed. • The global label has not been written.	Stop/ continue	• Write the global label. • Install the software again, and rewrite the program. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3404H	Network driver error	Failed in communication between motion area and network area.	Stop/ continue	Install the software again, and rewrite the program. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	• Always • At power-on/reset
3405H	Servo Driver Error	Failed to initialize the servo driver.	Stop/ continue	Install the software again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	• Always • At power-on/reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3407H	Synchronous setting combination error (at system start)	The network synchronous communication setting of the device station controlled by the motion system is set to "Asynchronous".	Stop/ continue	Set the network synchronous communication setting of the device station controlled by the motion system to "Synchronous".	• CC-Link IE TSN device IP address information • Axis error	At power-on/ reset
3408H	Invalid write to the controller	• Writing to the controller (including online program change) was performed after labels that cannot be changed or deleted was edited. • Writing to the controller (including online program change) was performed after "Access from External Device" in the label was switched from enabled to disabled.	Stop	Power off and on the system or reset the controller.	—	At write
3409H	Invalid label (invalid write to the controller)	An operation was executed and it may cause the label to be set to an undefined value.	Stop	Power off and on the system or reset the controller.	—	At write
340AH	Link device size over	The size of the link device is out of range.	Continue	Set the CANopen-compatible device stations assigned to the axis as follows. • In "Network Configuration Settings" of the module parameter (network), set the number of points of both the RWr setting and RWw setting to values within 40.	Target station information	At power-on/ reset
340BH	Absolute position control backup data saving stop	Backup data saving stopped because a drive initialization was executed.	Stop/ continue	Power off and on the system or reset the controller.	—	Always
340CH	Add-on memory insufficient	System memory for the related add-ons is insufficient.	Stop	Increase AddonSystem.PrConst.MT_*.RamSizeMax for related add-ons.	Add-on name information	At power-on/ reset
3A00H	Network synchronous communication function parameter mismatch	Although a device station where "Network Synchronous Communication" is set to "Synchronous" and "Communication Period Setting" is set to "Normal-Speed" or "Low-Speed" in "Network Configuration Settings" under "Basic Settings" of "CC-Link IE TSN" exists, a device station where "Network Synchronous Communication" is set to "Synchronous" and Communication Period Setting" is set to "Basic Period" does not exist.	Stop	Check and correct the parameters shown in cause.	Parameter information	Always
3A0BH	Communication cycle error	The Announce frame send cycle parameter error was detected.	Stop	• Check the Announce frame send cycle parameter setting value of the device operating as the grandmaster. • When the CC-Link IE TSN function is operating as the grandmaster, reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3A0CH	Communication cycle error	A propagation delay send cycle parameter error was detected.	Stop	• Check the propagation delay send cycle parameter setting value of the device operating as the grandmaster. • When the CC-Link IE TSN function is operating as the grandmaster, reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3A0DH	Communication cycle error	The Sync frame send cycle parameter error was detected.	Stop	• Check the Sync frame send cycle parameter setting value of the device operating as the grandmaster. • When the CC-Link IE TSN function is operating as the grandmaster, reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3A0FH	Master station duplication detection	Multiple master stations were detected in the network.	Stop/ continue	• Connect only one master station on the same network. • After taking the above action, power off and on or reset all stations where the error was detected.	• Parameter information • Overlapped type information	Always
3A11H	Cyclic transmission time error	The value set in "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station is smaller than the cyclic transmission time calculated by the number of device stations and number of points set in "Network Configuration Settings" under "Basic Settings".	Stop	• Set the value of "Cyclic Transmission Time" over the value in the detailed information displayed by module diagnostics using "Communication Period Setting" under "Basic Settings" of the master station. • If the detailed information value exceeds the upper limit of "Cyclic Transmission Time" that can be set in the master station, reduce the number of modules connected to the master station and the number of link devices assigned to each module in "Network Configuration Settings", so that the upper limit of "Cyclic Transmission Time" is not exceeded.	Communication period setting information	At power-on/ reset
3A18H	Cyclic transmission time error	The value set in "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station is smaller than the calculation value of cyclic transmission time.	Stop	• For "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station, set a value equal to or larger than the value of the detailed information displayed by module diagnostics. • Check and correct the parameter settings and the network configuration so that a smaller value can be set for "Cyclic Transmission Time".	Communication period setting information	Always
3A32H	Ring topology parameter error	"Network Topology" under "Basic Settings" of the master station is set to "Ring".	Stop	Set "Network Topology" of "Basic Settings" of the master station to "Line/Star".	Parameter information	At power-on/ reset
3A4CH	High-speed communication cycle mode setting error	"Parameter Name" in "Application Settings" of "CC-Link IE TSN" is set to a string that operates as the high-speed communication cycle mode.	Stop	Set a blank in "Parameter Name" in "Application Settings" of "CC-Link IE TSN". Or change the string in "Parameter Name".	Parameter information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3A60H	Invalid communication cycle interval setting and low-speed multiplying factor	It is not possible to guarantee the send/receive of cyclic data of following device stations within the "Low-Speed" cycle: device stations set to "Low-Speed" in "Communication Period Setting" of "Network Configuration Settings" under "Basic Settings" of the master station.	Stop	• Set "Low-Speed" of "Multiple Period Setting" under "Basic Settings" of the master station to a value equal to or larger than the value displayed in "Multiple cycle setting (low speed) (Un\G1277442)". • Set "Communication Period Interval Setting" under "Basic Settings" of the master station to a value equal to or greater than the value displayed in the communication cycle interval (calculation value) (Un\G1277443).	Parameter type	Always
3A61H	CC-Link IE TSN Class setting values mismatch	The settings of "CC-Link IE TSN Class" for the device stations set in "Network Configuration Settings" under "Basic Settings" of the master station do not match "CC-Link IE TSN Class Setting" of "Connection Device Information" under "Basic Settings".	Stop	Set "CC-Link IE TSN Class" of the device stations specified in "Network Configuration Settings" under "Basic Settings" of the master station to "CC-Link IE TSN Class B". Alternatively, set "CC-Link IE TSN Class Setting" in "Connection Device Information" under "Basic Settings" to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".	Parameter information	At power-on/ reset
3A69H	Cyclic transmission distribution setting mismatch	For device stations where either of the settings shown below is configured in "Network Configuration Settings" under "Basic Settings" of the master station, "Cyclic Transmission Distribution Setting" is set to "Distribute". • "Communication Period Setting" is set to "Basic Period". • "CC-Link IE TSN Class" is set to "CC-Link IE TSN Class A".	Stop	For device stations where either of the settings shown below is configured in "Network Configuration Settings" under "Basic Settings" of the master station, set "Cyclic Transmission Distribution Setting" to "Do not distribute". • Set "Communication Period Setting" to "Basic Period". • Set "CC-Link IE TSN Class" to "CC-Link IE TSN Class A".	Parameter information	At power-on/ reset
3A6DH	CC-Link IE TSN communication disabled	When the device station is set in "Network Configuration Settings" under "Basic Settings" of the master station, "CC-Link IE TSN Connection" in "To Use or Not to Use Default Open Port Setting" of "Module Parameter (Common Setting)" is set to "Close".	Stop	In "To Use or Not to Use Default Open Port Setting" of "Module Parameter (Common Setting)", set "CC-Link IE TSN Connection" to "Open". Or, delete the device station set in "Network Configuration Settings" under "Basic Settings" of the master station.	Parameter information	At power-on/ reset
3A6EH	Parameter error (network)	• In "Network Configuration Settings" under "Basic Settings" of "CC-Link IE TSN", device stations whose "Station Type" is "Local Station" have been set. • In "Network Configuration Settings" under "Basic Settings" of "CC-Link IE TSN", the number of points has been set in "LB Setting" and "LW Setting". • "Transient Transmission Group No." in "Application Settings" of "CC-Link IE TSN" is set to a value of "1" to "32". • "Communication Mode" in "Application Settings" of "CC-Link IE TSN" is set to "Multicast".	Stop	• Delete the device stations whose "Station Type" is "Local Station" in "Network Configuration Settings" under "Basic Settings" of "CC-Link IE TSN". • Delete the number of points set in "LB Setting" and "LW Setting" in "Network Configuration Settings" under "Basic Settings" of "CC-Link IE TSN". • Set "Transient Transmission Group No." in "Application Settings" of "CC-Link IE TSN" to "0". • Set "Communication Mode" in "Application Settings" of "CC-Link IE TSN" to "Unicast".	Parameter information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3A6FH	Network communication cycle over	The cyclic processing has not been completed by the start timing for the next network communication cycle due to one of the following causes. (1) The "Communication Period Interval Setting" value is small. (2) The "Cyclic Transmission Time" value is small.	Stop	(1) Enable the communication cycle interval measurement, and set "Communication Period Interval Setting" to a value larger than the value displayed in 'Communication cycle interval (actual measure value)' (U3E0\G10200 to U3E0\G10201). (2) Enable the communication cycle interval measurement, and set "Cyclic Transmission Time" to a value based on the value displayed in 'Cyclic transmission time (calculation result)' (U3E0\G10272 to U3E0\G10273). If the same error still occurs even after taking the above actions, set "Communication Period Interval Setting" to a sufficiently large value, and readjust the settings of "Communication Period Interval Setting" and "Cyclic Transmission Time" based on the manual.	—	Always
3A70H	Transient transmission time error	The value in "Transient Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station is smaller than the settable lower limit value.	Stop	Set "Communication Period Interval Setting" and "Cyclic Transmission Time" so that the value of "Transient Transmission Time" in "Communication Period Setting" under "Basic Settings" of the master station is equal to or larger than the value shown in the detailed information of module diagnostics.	Communication period setting information	At power-on/ reset
3A71H	Device station IP address duplication detection	At startup of data link, an overlapping IP address among device stations has been detected.	Stop	Correct the IP addresses of the device stations.	Operation source information IP address duplication information	Always
3A80H	Failed to create response data	Response data of the dedicated instruction cannot be created.	Stop	• Increase the request interval. • Decrease the number of request nodes. • Wait for a response to the previous request before sending the next request. • Correct the timeout value.	—	Always
3A90H	Send/receive data size error	The send/receive data size exceeds the allowable range.	Stop	• Check and change the send data size of the controller or the external device. • If the same error code is displayed again even with the changed data size, the possible cause is a hardware failure of the error module or controller. Please contact your local Mitsubishi representative.	—	Always
3A91H	IP address duplication error	Overlapping IP addresses have been detected.	Stop/ continue	Check and correct the IP addresses.	—	Always
3AC0H	Grandmaster selection error	Devices with time synchronization priority of 0 to 15 have been connected.	Stop/ continue	Remove devices with time synchronization priority of 0 to 15, or change the priority to between 16 and 255.	Grandmaster MAC address information	Always
3AD4H	Drive unit version combination error	The MR-J5-G-LL whose version is earlier than F0 was connected.	Stop/ continue	Check the version of the MR-J5-G-LL and apply the latest version.	Target station information	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3AD7H	A servo amplifier with a firmware version that cannot perform positioning at the target position correctly was detected.	When positioning operation was performed in profile position mode or point table mode, a servo amplifier with a firmware version that cannot perform positioning at the target position correctly was detected.	Stop/ continue	Update the servo amplifier firmware to B9 or later.	Target station information *For TSN	Always
3AD8H	Link device number of points error	The number of points of link devices of the device stations set to "CC-Link IE TSN Class A" in "CC-Link IE TSN Class" of "Network Configuration Settings" under "Basic Settings" exceeds the number of points that can be assigned.	Stop	In "Network Configuration Settings" under "Basic Settings", review the device assignment settings so that the number of points of link devices of the stations with detailed information 2 does not exceed the number of points assigned to stations with CC-Link IE TSN Class A.	• Parameter information • Target station information	At power-on/ reset
3AD9H	Parameter error (module)	The set value is out of the range.	Stop	• Write again from the buffer memory, and reset the controller or turn the power off and on. • If the same error occurs again even after writing again, the possible cause is a hardware failure of the error module. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3ADAH	Parameter error (module)	• Parameter was not written correctly. • Turned off during parameter writing.	Stop	• Write again from the buffer memory, and reset the controller or turn the power off and on. • If the same error occurs again even after writing again, the possible cause is a hardware failure of the error module. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3ADBH	Unsupported station detection (at startup)	A line topology configuration with 121 or more stations was recognized on the trunk line of one port of the master station, and a device station that cannot be used in this configuration was detected in the connection.	Stop	• Refer to '121 or more stations line topology non-support detection status' (SW0520 to SW052F) and check the device station products that do not support the line topology with 121 or more stations. • Device stations other than the ones manufactured by Mitsubishi Electric are recognized as the devices that do not support line topology with 121 or more stations. Also, for details on the device stations manufactured by Mitsubishi Electric, refer to the following technical bulletin. Line Topology with 121 or More Device Stations (CC-Link IE TSN Products) • If the device station supports line topology with 121 or more stations, update the firmware to the supported version. • If the device station does not support line topology with 121 or more stations, correct the network configuration to the line topology configuration with 120 or less stations, or replace the device station to one that supports the line topology with 121 or more stations.	Target station information	At power-on/ reset

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3ADCH	Parameter error	• The parameter setting is corrupted. • Parameters that the firmware version of the controller does not support were written.	Stop	• Check the detailed information (parameter information), and write the displayed parameters. If the same error is displayed again, the possible cause is a hardware failure of the data memory in the controller or the SD memory card. Please contact your local Mitsubishi representative. • Check the firmware version of the controller to use an applicable product.	Parameter information	At power-on/ reset, at STOP → RUN
3ADDH	Parameter error	• The set value is out of range. • An unsupported parameter exists.	Stop	• Check the detailed information (parameter information) of the error and correct the parameter setting corresponding to the displayed number. If the same error is displayed again, the possible cause is a hardware failure of the data memory in the controller or the SD memory card. Please contact your local Mitsubishi representative. • Check the firmware version of the controller to use an applicable product.	Parameter information	• At power-on/reset, at STOP → RUN • At END instruction execution (for each program) • At instruction execution • At module access
3ADEH	PDO mapping setting error	In "PDO Mapping Setting" of "Network Configuration Settings" under "Basic Settings" of the master station, an object of the watchdog counter is set for only one of TPDO or RPDO.	Stop	In "PDO Mapping Setting" of "Network Configuration Settings" under "Basic Settings" of the master station, set as either of the following. (1) Set an object of the watchdog counter for both TPDO and RPDO. (2) Delete any object of the watchdog counter from both TPDO or RPDO.	• Parameter information • Target station information	At power-on/ reset
3AF0H	Network synchronous communication function error	Cyclic processing performed in a medium speed cycle cannot be completed by the start timing of the next network communication cycle.	Stop	Set a value larger than the current setting for "Communication Period Interval Setting".	—	Always
3AF1H	Network synchronous communication function error	Cyclic processing performed in a low speed cycle cannot be completed by the start timing of the next network communication cycle.	Stop	Set a value larger than the current setting for "Communication Period Interval Setting".	—	Always
3C00H	Controller failure	A controller error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	CPU internal error information	Always
3C01H	Hardware failure	A hardware failure has been detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	Always
3C02H	Hardware failure	A hardware failure has been detected.	Stop		—	• At power-on/reset • At END instruction execution (for each program) • At interrupt occurrence
3C03H	Hardware failure	A hardware failure has been detected.	Stop		—	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3C0FH	Controller failure	A controller error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always
3C10H	Controller failure	A controller error was detected.	Stop		—	At power-on/ reset
3C11H	Hardware failure	A hardware failure has been detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	Always
3C12H	Hardware failure	• The waveform of the voltage out of the specified range has been detected in the power supply module. • A hardware failure has been detected in the power supply module, controller, base unit, or extension cable.	Stop	• Check the waveform of the voltage applied to the power supply module. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the power supply module, controller, base unit, or extension cable. Please contact your local Mitsubishi representative.	—	Always
3C13H	Hardware failure	A hardware failure has been detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	Always
3C14H	Controller failure	A controller error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3C20H	Memory error	An error has been detected in the memory.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	• At power-on/reset • At END instruction execution (for each program)
3C21H	Memory error	An error has been detected in the memory.	Stop		—	
3C22H	Memory error	An error has been detected in the memory.	Stop		—	
3C23H	Memory error	An error has been detected in the production information.	Stop		—	• At power-on/reset • At END instruction execution (for each program)
3C24H	Memory error	An error has been detected in the memory.	Stop		—	• At power-on/reset • At END instruction execution (for each program)
3C2FH	Memory error	An error has been detected in the memory.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always
3C30H	Memory error	An error has been detected in the memory.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Format the memory. Write all files. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At instruction execution
3C31H	Memory error	An error has been detected in the memory.	Stop		—	Always
3C32H	Memory error	An error has been detected in the memory.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	Always
3C40H	Hardware failure	A hardware failure has been detected.	Stop		—	At power-on/ reset
3C41H						
3C42H						
3C43H						
3C44H						
3C45H						
3C46H						
3C47H						
3C48H						
3C49H						
3C4AH						
3C4BH						
3C4CH						

Error code (Hex)	Error name	Error details and cause	Stop/ continue	Action	Detailed information	Diagnostic timing
3E00H	Operation circuit error	A controller error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Format the memory. Write all files. Then, reset the controller and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3E61H	Add-on load error	An add-on load error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	At power-on/ reset
3EC1H	Own station network type error	Network type of the own station is unexpected setting.	Stop	Rewrite the module parameter using the engineering tool. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always
3EC2H	Time synchronization error	A time synchronization error was detected.	Stop	Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always
3EC3H	Memory error	An error was detected in the memory.	Stop		—	At power-on/ reset
3EC4H	Controller failure	A controller error was detected.	Stop		—	Always
3EC5H	Controller failure	A controller error was detected.	Stop		—	Always
3EC6H	Controller failure	A controller error was detected.	Stop	• Take measures to reduce noise. • Check the mounting status of the controller. • Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a controller failure. Please contact your local Mitsubishi representative.	—	Always
3EC7H	Controller failure	A controller error was detected.	Stop		—	Always
3ED0H	Controller failure	A controller error was detected.	Stop		—	At power-on/ reset
3ED1H	Controller failure	A controller error was detected.	Stop		—	Always
3ED2H	Hardware failure	A hardware failure has been detected.	Stop	Reset the controller, and run it again. If the same error code is displayed again, the possible cause is a hardware failure of the controller. Please contact your local Mitsubishi representative.	—	Always

75.4 Error Codes Returned to Request Source During Communications (4000H to 4FFFH)

This section shows error codes returned to the request source during communications with the controller.

- Errors generated when the data communications are requested from the engineering tool, intelligent function module, or network system connected
- Errors generated with the data logging function

These error codes are not stored in SD0 because they are not detected by the self-diagnostic function.

Error code (Hex)	Error name	Error details and cause	Action
4000H	Common error	Serial communication sum check error	• Connect the serial communication cable correctly. • Take measures to reduce noise.
4001H	Common error	• An unsupported request was executed. (The request was executed to the controller that does not support the request.) • The controller is in initial processing.	• Check the command data of the SLMP/MC protocol. • Check the CPU module/controller model name selected in the engineering tool. • Check the model name of the target CPU module/controller. • Check that the target network number is not duplicated. • Perform operations to the controller again after the initial processing of the controller ends.
4002H	Common error	An unsupported request was executed.	• Check the command data of the SLMP/MC protocol. • Check the CPU module/controller model name selected in the engineering tool. • Retry the operation. • If the same error code is displayed again, the possible cause is a hardware failure of the CPU module/controller. Please contact your local Mitsubishi representative.
4003H	Common error	Command for which a global request cannot be performed was executed.	Check the command data of the SLMP/MC protocol.
4004H	Common error	All the operations to the CPU module/controller are disabled because of the following reason: • The CPU module/controller is starting up.	Perform operations to the CPU module/controller again after the start-up processing ends.
4005H	Common error	The amount of data handled according to a specified request is out of range.	Check the command data of the SLMP/MC protocol.
4006H	Common error	Initial communication has failed.	• When using serial communication, inquire of the external device manufacturer for support conditions. • During serial communication, check the CPU module/controller model name selected in the engineering tool. • When using Ethernet communication, shift the communication start timing. • When executing the simple CPU communication function, check that the communication status or CPU module of the communication destination matches the device type of the communication destination set with the engineering tool.
4008H	Common error	The CPU module/controller is BUSY. (The buffer is not vacant.)	Execute the request again after a certain period of time has elapsed.
4010H	CPU module operation error	The request cannot be executed because the CPU module/controller is running.	Set the operating status of the CPU module/controller to STOP, and then execute the request.
4013H	CPU module operation error	The request cannot be executed because the CPU module/controller is not in the STOP state.	Set the operating status of the CPU module/controller to STOP, and then execute the request.
4021H	File related error	The specified drive (memory) does not exist or there is an error.	• Check the specified drive (memory) status. • After backing up the data inside the CPU module/controller, initialize the memory.
4022H	File related error	• The file with the specified file name or file No. does not exist. • The specified program block does not exist.	• Check the specified file name and file number. • Check the specified program block name.
4023H	File related error	The file name and file No. of the specified file do not match.	Delete the file and then recreate the file.
4024H	File related error	The specified file cannot be handled by a user.	Do not access the specified file.
4025H	File related error	The specified file is processing the request from another engineering tool.	Forcibly execute the request. Or, execute the request again after the processing being performed ends.
4027H	File related error	The specified range is larger than the file size.	Check the specified range and access within the range.

Error code (Hex)	Error name	Error details and cause	Action
4028H	File related error	The same file already exists.	Forcibly execute the request. Or, change the file name and execute the request again.
4029H	File related error	The specified file capacity cannot be obtained.	Check and correct the specified file capacity, and then retry the operation.
402AH	File related error	The specified file is abnormal.	After backing up the data inside the CPU module/controller, initialize the memory.
402BH	File related error	The request cannot be executed in the specified drive (memory).	Set the operating status of the CPU module/controller to STOP, and then execute the request.
402CH	File related error	The request cannot be executed currently.	Retry the operation after a while.
402FH	File related error	Writing of a file did not complete.	• After backing up the data inside the CPU module/controller, delete the file where the error occurred. Alternatively, initialize the drive 4, then write the file again. • Write the program restoration information. Then, read the program files from the programmable controller again.
4030H	Device specification error	The specified device is not supported.	Check the specified device name.
4031H	Device specification error	• The specified device number is out of range. • The controller does not support the specified device.	• Check the specified device number. • Check the device assignment of the CPU module/controller. • Check the specified device name.
4032H	Device specification error	The device modification was incorrectly specified. Or, the unusable device (TS, TC, SS, SC, CS, or CC) was specified in any of the following SLMP/MC protocol commands; Read random, Write random (in units of words), Entry monitor device, or Execute monitor.	• Check the specified device modification method. • Check the specified device name.
4033H	Device specification error	Writing cannot be done because the specified device is for system use.	Do not write the data in the specified device. Or, do not turn it on or off.
4034H	Device specification error	The dedicated instruction cannot be executed since the completion device for the dedicated instruction does not turn on.	Since the completion device for the SREAD or SWRITE instruction cannot turn on in the CPU module/controller on the target station, execute the instruction again after setting the operating status of the CPU module/controller on the target station to RUN.
403FH	Device specification error	The link direct device specified cannot be executed.	Set the link direct device setting of the CPU parameter to the "Extended Mode (iQ-R Series Mode)".
4040H	Intelligent function module specification error	The request cannot be executed to the specified intelligent function module.	Check whether the specified module is the intelligent function module having the buffer memory.
4041H	Intelligent function module specification error	The access range exceeds the buffer memory range of the specified intelligent function module.	Check the start address and access number of points and access using a range that exists in the intelligent function module.
4042H	Intelligent function module specification error	The specified intelligent function module cannot be accessed.	• Check that the specified intelligent function module is operating normally. • Check the specified module for a hardware failure.
4043H	Intelligent function module specification error	The intelligent function module does not exist in the specified position.	Check the I/O number of the specified intelligent function module.
4044H	Intelligent function module specification error	A control bus error occurred during access to the intelligent function module.	Check the specified intelligent function module and other modules and base units for a hardware failure.
4049H	Intelligent function module specification error	A request cannot be processed because the module extension parameter of the positioning module is being used for the positioning control.	Turn off module ready (Yn+0) of the positioning module or execute the processing again after removing the extension parameter of the positioning module from the target data.
4050H	Protect error	The request cannot be executed because the write protect switch of the SD memory card is on.	Turn off the write protect switch.

Error code (Hex)	Error name	Error details and cause	Action
4051H	Protect error	The specified drive (memory) cannot be accessed.	Check the following and take corrective action. • Is the drive (memory) the one that can be used? • Is the specified drive (memory) correctly installed?
4052H	Protect error	The specified file attribute is read only, so the data cannot be written.	Do not write data in the specified file. Or, change the file attribute.
4053H	Protect error	An error occurred when writing data to the specified drive (memory).	Check the specified drive (memory). Or, write data again after changing the corresponding drive (memory).
4054H	Protect error	An error occurred when deleting the data in the specified drive (memory).	Check the specified drive (memory). Or, delete data again after changing the corresponding drive (memory).
4060H	Online registration error	• The online debug function (such as online change) and the data logging function are being executed with another engineering tool. • Data is being written to the flash ROM (data memory, program memory, and system memory) and the SD memory card. • The global label assignment information is being written to the programmable controller (data memory).	• Execute the function again after the processing of the function executed from another engineering tool ends. • If the operation of another engineering tool is on hold, resume and finish the operation of another engineering tool, and then execute the function again. • Execute the function again after the completion of writing to the flash ROM and the SD memory card. If the same error code is displayed again, reset the controller.
4061H	Online registration error	• Settings for the online debug function (such as online change) are incorrect. • The CPU module/controller is powered off or reset during the monitoring.	• Register an online debug function (such as online change and external input/output forced on/off), and then execute the function. • Check the communication route including communication cables, and then retry the operation. • Power on or reset the CPU module/controller and execute the monitoring again.
4063H	Online registration error	The registered number of locked files exceeded the maximum value.	Execute the request again after the file access from another engineering tool ends.
4064H	Online registration error	The specified contents of the online debug function (such as the online program change), data logging function, and real-time monitor function are incorrect.	• Check the set data of the online debug function (such as the online program change), data logging function, and real-time monitor function. • Check the communication route including communication cables, and then retry the operation.
4065H	Online registration error	The device assignment information differs from the parameter.	Check the device assignment of the CPU module/controller or the device assignment of the request data.
4067H	Online registration error	Monitor communication has failed.	Check the communication route including communication cables, and then retry the operation.
4068H	Online registration error	Operation is disabled because it is being performed with another engineering tool.	After the process executed from another engineering tool ends, retry the operation.
406AH	Online registration error	The drive (memory) number other than 0 to 6 was specified.	Check the drive and specify the drive number correctly.
406BH	Online registration error	Online operation was interrupted due to a CPU module/ controller error.	Check the status of the CPU module/controller using module diagnostics. Identify the error, and take a corrective action referring to the troubleshooting section.
406CH	Online registration error	The number of functions that can be executed simultaneously exceeds the limit.	Execute again after stopping the functions that are executed in another engineering tool.
406DH	Online registration error	The operation cannot be performed because the operation is performed from the same activation source.	Execute again after the operation from the same activation source has completed.
406EH	Online registration error	The specified operation cannot be maintained.	Check and correct the operation.
4070H	Verification error	• The program not yet corrected and the one corrected by online program change are different. • The execution program that was written to the programmable controller (including online change) or the execution program that was written by using online change operation differs from the program restoration information to be written.	• Read the program from the programmable controller to match the program of the engineering tool with that of the CPU module/controller, then execute online change again. • Write the program including the program restoration information to the programmable controller (including online change), or execute online change.
4071H	Verification error	The CPU parameter is different from when the specified operation was performed, or has been deleted.	• Execute the specified operation again. • Write the CPU parameter of the specified operation.
4072H	Verification error	The global label setting file or the program file with the target program name is different from when the specified operation was performed, or the file has been deleted.	• Write the global label setting file or the program file with the target program name of the specified operation. • Execute the specified operation again. • Check and correct the setting of Stop direction at file change on label specification (SD940), and execute the function again.

Error code (Hex)	Error name	Error details and cause	Action
4073H	Verification error	The program written to the controller and the program written during online change have different internal information.	Read the program from the controller to match it with that of the engineering tool, and then execute online change again.
4080H	Any other error	Request data error	Check the request data that has been specified.
4081H	Any other error	The search target data cannot be detected.	Check the data to be searched.
4082H	Any other error	The specified command cannot be executed because it is being executed.	Execute the command again after the processing of the request from another engineering tool is completed.
4083H	Any other error	An attempt was made to perform operation to the program not registered in parameter.	Register the program in parameter.
4084H	Any other error	The specified pointer (P or I) does not exist.	Check if the pointer (P or I) exist in the data.
4085H	Any other error	The pointer (P or I) cannot be specified because the program is not specified in parameter.	Register the program to be executed in parameter first, and specify the pointer (P or I).
4086H	Any other error	The specified pointer (P or I) has already been added.	Check and correct the pointer number to be added.
4087H	Any other error	The number of pointers (P or I) exceeds its limit.	Check and correct the pointer (P or I) to be specified.
4089H	Any other error	An attempt was made to insert/delete the END instruction by online program change.	• Check the specified program file contents. • Set the operating status of the CPU module/controller to STOP, and write the program.
408AH	Any other error	The file capacity exceeded after the online change was executed.	• Check the capacity of the specified program file. • Set the operating status of the CPU module/controller to STOP, and write the program.
408BH	Any other error	The remote request cannot be executed.	• Change the status of the CPU module/controller so that the remote request can be executed, and execute the request again. • For the remote reset operation, set the parameter to "Enable remote reset".
408DH	Any other error	The instruction code that cannot be handled exists.	• Check whether the model of the CPU module/controller being used is correct or not. • The program where online change was attempted includes the instruction that cannot be handled by the CPU module/controller specified for the project. Check the program and delete the instruction.
408EH	Any other error	• The write step is illegal. • The program differs from that stored in the CPU module/controller.	• Set the operating status of the CPU module/controller to STOP, and write the program. • The starting position of online program change is not specified with the correct program step number. Check whether the engineering tool supports the model and version of the CPU module/controller that is specified for the project. • Read the program from the programmable controller to match the program of the engineering tool with that of the CPU module/controller, then execute online change again.
40C0H	Label communication error	• The specified label name does not exist. • An attempt was made to access a label that cannot be accessed with a label name.	• Check the label setting of the specified CPU module/controller. If the "Access from External Device" checkbox is not selected, select it. • Change the data type of the specified label to the one other than the macro type function block or pointer. • Change the class of the specified label to the one other than "VAR_GLOBAL_CONSTANT".
40C1H	Label communication error	Label access with a label name has failed because the specified array element number is outside the range.	Reduce the number of array values and specify values so that they can fit into the array size.
40C2H	Label communication error	Label access with a label name has failed because the bit array type label is not specified by bit specification.	Specify the label by bit specification, and access again.
40C3H	Label communication error	Label access with a label name has failed because the word array type label is not specified by word specification.	Specify the label by word specification, and access again.
40C4H	Label communication error	Label access with a label name has failed because the number of labels used in the program exceeded its limit.	Reduce the number of labels in the program, and access the labels multiple times.

Error code (Hex)	Error name	Error details and cause	Action
40C5H	Label communication error	• Label access with a label name has failed because the global label setting file and global label assignment information do not match. • The request execution has failed because the global label is being modified by the specified CPU module/controller.	• Check the access from an external device of the specified global label setting, and write the global label setting file and the global label assignment information to the programmable controller together. • Execute the label access again after a while.
40C6H	Label communication error	The request execution has failed because the global label is being modified by the specified CPU module/controller.	After a while, write the data to the programmable controller/ execute online change again. Or, execute the label access again.
40C7H	Label communication error	• Although changes of the global label were written to the programmable controller, the reflection operation (STOP → RUN or power-on/reset) of the global label setting file is not performed. • The request cannot be executed because the data in the global label setting file being processed and the specified consistency check data are not the same.	• Perform the reflection operation (STOP → RUN or Power-on/reset) of the global label setting file. • Correct the details of the global label setting, and write the file to the programmable controller again.
40CBH	Label communication error	Data are not written to the controller because the data type of the specified label does not match the size of the write data.	Change the size of data written from the external device (SLMP/MC protocol device) so that it matches the data type of the label in the specified CPU module/controller.
40CCH	Label communication error	Online program change has failed because the global label setting file before modification and the global label assignment information do not match.	Write the global label setting file and the global label assignment information to the programmable controller together after modification.
40CEH	Label communication error	An attempt was made to access a label that cannot be accessed with a label name.	• Change the data type of the specified label to the one other than the macro type function block or pointer. • Change the class of the specified label to the one other than "VAR_GLOBAL_CONSTANT". • Change the assignment (device specification) of the specified label to a device that is not being modified. (Bit-specified word devices and digit-specified bit devices can be specified.) • Change the data type of the specified label to the one other than "Bit and two-dimensional array" or "Bit and three-dimensional array".
40D0H	Label communication error	The target CPU module/controller does not support "Access from External Device" of "Global Label Setting".	Disable "Access from External Device", and then write the data to the programmable controller again.
40D1H	Label communication error	When the byte is specified for the unit for reading/writing data, an odd-numbered value is specified for the read/write array data length.	Specify an even-numbered value for the read/write array data length.
40D2H	Label communication error	The label was accessed during label communication preparation.	Execute the label access again after a while.
40D3H	Label communication error	After the "Access from External Device" setting of the global label setting was changed, only the global label setting file was written to the controller.	Write global label setting file and global label assignment information to the controller.
40D4H	Label communication error	The maximum capacity of the label assignment information management area has been exceeded.	• Reduce the number of labels with the "Access from External Device" checkbox selected in the specified label settings, and write the data again. • Reduce the number of MCFBs to be used.
40D5H	Label communication error	Label assignment information write failed.	Check the event history for details on the cause of failure.
40D6H	Label communication error	An attempt was made to access a label that cannot be accessed with a label name using a device/label specified as an array index.	• Change the data type of the label specified as the array index to word [unsigned]/bit string [16 bits], double word [unsigned]/bit string [32 bits], word [signed], or double word [signed]. • Change the data type of the specified label to the one other than string or string [Unicode]. • Change the number of nesting levels of the specified label to 5 or less.
4100H	Any other error	Hardware failure of the CPU module/controller	Replace the CPU module/controller.
4101H	Any other error	Serial communication connection was executed for a different CPU module/controller series.	Check the series of the CPU module/controller.

Error code (Hex)	Error name	Error details and cause	Action
4103H	Any other error	The instruction written by online program change is incorrect or invalid.	Execute online program change again. Or, set the operating status of the CPU module/controller to STOP, and write the program.
4108H	Any other error	The device monitor/test cannot be performed normally.	Execute the function again. Check that the access prohibited area is not accessed, and then retry the operation.
410AH	Any other error	The specified command cannot be executed because the online program change is being executed.	Execute the request again after the online program change.
410BH	Any other error	The monitor condition registration was cleared after the online program change was executed.	Execute the registration of monitoring condition again after the online program change.
410CH	Any other error	Writing to the specified data is not supported.	• Check that the version of the engineering tool used is correct. • Check and correct the settings.
410EH	Any other error	When the execution status of the online program change is in error, the online program change command was issued.	Issue the online program change cancel command, and execute the function again.
410FH	Any other error	During the execution of the online program change function, the cancel command was issued by the same request source.	Issue the command again after the currently-performed processing ends.
4110H	CPU module error	• The request cannot be executed because the CPU module/controller is in a stop error state. • The online module was replaced when the CPU module/controller was in a stop error state.	• Reset the CPU module/controller and execute the request again. • To replace the online module, turn off the power of the programmable controller.
4112H	Any other error	• A label that cannot be changed or deleted during online change was changed or deleted. • The reserved area capacity of the FB instance containing labels that cannot be changed or deleted during online change was exceeded.	Set the operating status of the controller to STOP, and write data to the controller.
4113H	Any other error	The system area capacity used for online change was exceeded.	Power off and on or reset the controller, and execute online change again. Or, set the operating status of the controller to STOP, and write data to the controller.
4114H	Any other error	The amount of label changes that can be changed at one time was exceeded during online change.	Set the operating status of the controller to STOP, and write data to the controller.
4115H	Any other error	The request cannot be executed because the conditions required to write or delete during PAUSE are not satisfied.	Change the state to RUN or STOP, then execute writing or deleting again.
4116H	Any other error	Data was written from more than 17 startup sources simultaneously.	Write data from 16 or fewer startup sources.
4118H	Performance monitor function error	The upper limit for simultaneous monitoring has been exceeded.	Execute again after stopping the performance monitor functions that are executed in another engineering tool.
4119H	Performance monitor function error	The specified operation cannot be maintained.	Execute again after stopping the performance monitor functions that are executed in another engineering tool.
411DH	Performance monitor function error	The request cannot be executed because the operation is not supported by the controller.	Check if the model and version of the controller being used support the executed operation.
4121H	File related error	The specified drive (memory) or file does not exist.	Check the specified drive (memory) or file, and then retry the operation.
4122H	File related error	The specified drive (memory) or file does not exist.	Check the specified drive (memory) or file, and then retry the operation.
4123H	File related error	The specified drive (memory) is abnormal.	Initialize the memory, and restore the drive (memory) to its normal state.
4124H	File related error	The specified drive (memory) is abnormal.	Initialize the memory, and restore the drive (memory) to its normal state.
4125H	File related error	The specified drive (memory) or file is performing processing.	Retry the operation after a while.
4126H	File related error	The specified drive (memory) or file is performing processing.	Retry the operation after a while.
4129H	File related error	The request cannot be executed since the specified drive (memory) is ROM.	Change the target drive (memory), and then retry the operation.
412AH	File related error	The request cannot be executed since the specified drive (memory) is ROM.	Change the target drive (memory), and then retry the operation.
412BH	File related error	The specified drive (memory) is write-inhibited.	Change the write-protect condition or drive (memory), and then retry the operation.

Error code (Hex)	Error name	Error details and cause	Action
412CH	File related error	The specified drive (memory) is write-inhibited.	Change the write-protect condition or drive (memory), and then retry the operation.
412DH	File related error	The specified drive (memory) does not have enough free space.	Increase the free space of the drive (memory), and then retry the operation.
412EH	File related error	The specified drive (memory) does not have enough free space.	Increase the free space of the drive (memory), and then retry the operation.
412FH	File related error	The drive (memory) capacity differs between the drive (memory) copy destination and copy source.	Check the drive (memory) copy destination and copy source, and then retry the operation.
4130H	File related error	The drive (memory) type differs between the drive (memory) copy destination and copy source.	Check the drive (memory) copy destination and copy source, and then retry the operation.
4131H	File related error	The file name of the file copy destination is the same as that of the copy source.	Check the file name, and then retry the operation.
4132H	File related error	The specified number of files does not exist.	Check the specified content and then retry the operation.
4133H	File related error	The specified drive (memory) has no free space.	Increase the free space of the drive (memory), and then retry the operation.
4134H	File related error	The attribute specification data of the file is wrong.	Check the specified content and then retry the operation.
4135H	File related error	The date/time data of the engineering tool (personal computer) is out of range.	Check the clock setting of the engineering tool (personal computer), and then retry the operation.
4136H	File related error	The specified file already exists.	Check the specified file name, and then retry the operation.
4137H	File related error	The specified file is read-only.	Change the condition of the specified file, and then retry the operation.
4138H	File related error	Simultaneously accessible files exceeded the maximum.	Reduce the file operations, and then retry the operation.
4139H	File related error	The size of the specified file has exceeded that of the existing file.	Check the size of the specified file, and then retry the operation.
413AH	File related error	The specified file has exceeded the already existing file size.	Check the size of the specified file, and then retry the operation.
413BH	File related error	The same file was simultaneously accessed from different engineering tools.	Retry the operation after a while.
413CH	File related error	The specified file is write-inhibited.	Change the conditions of the file, and then retry the operation.
413DH	File related error	The specified file capacity cannot be secured.	Increase the free space of the specified drive (memory), and then retry the operation.
413EH	File related error	Operation is disabled for the specified drive (memory).	Change the target drive (memory), and then retry the operation.
413FH	File related error	The file is inhibited to be written to the file storage area.	Change the specified drive (memory), and then retry the operation.
414CH	Intelligent function module specification error	The specified buffer memory address cannot be accessed.	Execute again after checking the buffer memory address.
4150H	File related error	An attempt was made to initialize the drive (memory) protected by the system.	Do not initialize the target drive (memory) as it cannot be initialized.
4151H	File related error	An attempt was made to delete the file/folder protected by the system.	Do not delete the target file/folder as it cannot be deleted.
41C1H	File related error	The format information data of the specified drive (memory) is abnormal.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.
41C2H	File related error	File open specification data for file access is wrong.	Check the specified data and execute again.
41C3H	File related error	Simultaneously accessible files exceeded the maximum.	Reduce the file operations, and then retry the operation.
41C4H	File related error	Simultaneously accessible files exceeded the maximum.	Reduce the file operations, and then retry the operation.
41C5H	File related error	The specified file does not exist.	Check the file, and then retry the operation.
41C7H	File related error	The specified file/folder or drive (memory) does not exist.	Check the file/folder or drive (memory), and then retry the operation.
41C8H	File related error	The size of the specified file has exceeded that of the existing file.	• Check the size of the specified file, and then retry the operation. • If the error recurs after re-execution, the file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.

Error code (Hex)	Error name	Error details and cause	Action
41C9H	File related error	• Access to the file sector has failed. • The format information data of the target drive (memory) is abnormal.	After backing up the data inside the CPU module/controller, initialize the memory.
41CAH	File related error	• Access to the file sector has failed. • The format information data of the target drive (memory) is abnormal.	After backing up the data inside the CPU module/controller, initialize the memory.
41CBH	File related error	The file name is specified in a wrong method.	Check the file name, and then retry the operation.
41CCH	File related error	The specified file does not exist. Or, the specified subdirectory does not exist.	Check the file name and subdirectory name. Then, retry the operation.
41CDH	File related error	An access to the file is prohibited in the system.	• Do not access the specified file or subdirectory. • Check the file name and subdirectory name. Then, retry the operation. • Check the file open mode, and then retry the operation.
41CEH	File related error	The file cannot be written because the specified file is read-only.	Check the attributes of the specified file, and then retry the operation.
41CFH	File related error	• The specified drive (memory) has been used exceeding the capacity. • The specified number of files exceeds the number that can be handled by this controller.	• Check the free space of the drive (memory), and then retry the operation. • Check the specified number of files, and then retry the operation.
41D0H	File related error	The specified drive (memory) has no free space. Or, the number of files in the directory of the specified drive (memory) has exceeded the maximum.	• Increase the free space of the drive (memory), and then retry the operation. • Delete files in the drive (memory), and then retry the operation.
41D1H	File related error	• The file name is specified in a wrong method. • The SD memory card is being disabled by SM606 (SD memory card forced disable instruction).	• Check the file name, and then retry the operation. • If the error recurs after re-execution, the file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory. • Cancel the SD memory card forced disable instruction.
41D5H	File related error	The file of the same name exists.	Forcibly execute the request, or execute after changing the file name.
41D6H	File related error	The format information data of the specified drive (memory) is abnormal.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.
41D7H	File related error	The format information data of the specified drive (memory) is abnormal.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.
41D8H	File related error	The specified file is being accessed.	Retry the operation after a while.
41D9H	File related error	The program cache memory capacity has been exceeded.	Reduce the size of a sequence program and an FB file program.
41DAH	File related error	The program file is incorrect. Or, the program file is not written properly.	Write the program file to the CPU/controller built-in memory again.
41DBH	File related error	A file was written to module parameter/address space settings when the OPC UA server was started.	Stop the OPC UA server.
41DFH	File related error	The specified drive (memory) is write-protected.	Cancel the write protection of the specified drive (memory), and then retry the operation.
41E0H	File related error	The specified drive (memory) is abnormal or does not exist.	• Check that the SD memory card has been inserted, and then retry the operation. • After backing up the data, initialize the memory.
41E1H	File related error	Access to the SD memory card has failed.	Back up data, and then execute writing to the data memory.
41E4H	File related error	Access to the SD memory card has failed.	• Execute the operation again after checking that the SD memory card has been inserted. • Execute the operation again after replacing the SD memory card. • Back up data, and then initialize the memory.
41E7H	File related error	The format information data of the specified drive (memory) is abnormal.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.
41E8H	File related error	The format information data of the specified drive (memory) is abnormal.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.

Error code (Hex)	Error name	Error details and cause	Action
41E9H	File related error	The specified file is being accessed.	Retry the operation after a while.
41EBH	File related error	The file name is specified in a wrong method.	Check the file name, and then retry the operation.
41ECH	File related error	The file system of the specified drive (memory) is logically corrupted.	• The file information data may be corrupted. • After backing up the data inside the CPU module/controller, initialize the memory.
41EDH	File related error	The specified drive (memory) does not have continuous free space. (The free space for file is sufficient but the continuous free space is insufficient.)	Delete unnecessary files, and then retry the operation.
41EFH	File related error	Creation of the power failure backup data in the specified drive (memory) has failed.	Check that the SD memory card has been inserted, and then retry the operation.
41F0H	File related error	The power failure backup data of the specified drive (memory) are corrupted.	Check that the SD memory card has been inserted, and then retry the operation.
41F3H	File related error	The file size is larger than the following: • the value to be acquired when 2 bytes are subtracted from 4G bytes.	Specify a smaller value for the file size when creating a file or changing the file size. Alternatively, divide the files so that each file size is smaller.
41F4H	File related error	The request cannot be executed because the operation is prohibited by the system.	Do not request the file operation because it is prohibited by the system.
41F5H	File related error	The command for the (split storage) program was executed to the file other than the (split storage) program file. Or, the command not for the (split storage) program was executed to the (split storage) program file.	Check the command, and execute the command applicable to the target file.
41F8H	File related error	The data is being accessed from another engineering tool.	After checking that the following functions are completed, retry the operation. • Data are being written to the program memory or being transferred to the backup memory.
41FAH	File related error	Program was written beyond the area where the program can be executed.	Execute again after reducing either the already written program or newly written program.
41FBH	File related error	The specified file is already being manipulated from the engineering tool.	After the currently performed operation is completed, retry the operation.
41FCH	File related error	An attempt was made to initialize the drive (memory) being used.	Stop all accesses to the specified drive (memory), and execute the request again.
41FDH	File related error	There are no data written to the data memory.	Write all the required files to the programmable controller.
41FEH	File related error	• The SD memory card has not been inserted. • The SD memory card is being disabled. • The SD memory card is being disabled by SM606 (SD memory card forced disable instruction).	• Insert the SD memory card. • Remove the SD memory card, and insert it again. • Cancel the SD memory card forced disable instruction.
41FFH	File related error	The type of the SD memory card differs.	Check the type of the SD memory card.
4269H	Any other error	The remote RUN (function) cannot be executed.	After waiting for a while, execute the remote RUN operation again.
426AH	Any other error	The date and time data specified by an engineering tool (personal computer) are less than one hour from the start time of daylight saving time.	• Specify the time to other than one less than one hour from the start time of daylight saving time using an engineering tool (personal computer). Then, execute the function again. • Check and Correct the start time of the daylight saving time setting.
4270H	Debug related function error	Data logging is being performed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data) to another memory.	Register data logging to the memory where the data logging is being performed. Or, stop the data logging being performed and register again.
4271H	Debug related function error	The specified data logging is already being performed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data).	Stop data logging. Or, write, delete, or register data logging to the setting number where no data logging is being performed.
4272H	Debug related function error	The trigger logging specifying the device and label as trigger conditions is being performed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data).	Change the trigger condition and then register. Or, stop the trigger logging being performed with the trigger conditions = "Device" and "Label" (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data), and register another trigger logging.

Error code (Hex)	Error name	Error details and cause	Action
4273H	Debug related function error	A program name whose execution type is Event (network communication cycle synchronization) was specified for the collection start condition.	• Change the collection start condition to a program whose execution type is other than Event (network communication cycle synchronization). • Change the collection start condition to network communication cycle synchronization.
4275H	Debug related function error	Auto logging is being performed.	After the auto logging, replace the SD memory card and execute again.
4276H	Debug related function error	The function that cannot be executed during the data logging (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data) was executed.	Stop the data logging, and then execute the function.
4277H	Debug related function error	The number of saved files exceeded the specified number.	The number of files saved in the storage destination memory has exceeded the setting value. Delete files, or change the storage destination and then register.
4278H	Debug related function error	An attempt was made to register data logging in a state where the saved file number has reached its maximum, FFFFFFFF. Or, the number reached to the maximum during the execution.	The saved file number in the storage target memory has reached its maximum, FFFFFFFF. Delete files, or change the storage destination and then register.
427AH	Debug related function error	The auto logging setting file is corrupted.	Write the auto logging setting file to the target memory again.
427BH	Debug related function error	The data logging with the same file storage destination is being performed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data).	Stop the data logging being performed with the same file storage destination, then register. Or, change the storage destination of the file, and then register.
4282H	Debug related function error	The registration was performed with the internal buffer capacity set to 0.	Check and correct the internal buffer capacity setting.
4283H	Debug related function error	An attempt was made to register trigger logging in a state that the specified number of records before trigger has exceeded the number of records that can be collected within the internal buffer capacity.	• Check and correct the internal buffer capacity setting. • Reduce the number of records before trigger.
428CH	Debug related function error	Execution fails because any of the following files does not exist. • CPU parameter file • Global label setting file • Program file with the target program name	Write the following files to the CPU module/controller. • CPU parameter file • Global label setting file • Program file with the target program name
4290H	Debug related function error	The program file or global label setting file was changed during the realtime monitor where a label (global label or local label) is specified as a monitor target, timing condition, or trigger condition.	• Do not change the program file or global label setting file during the realtime monitor where a label (global label or local label) is specified. • Stop the realtime monitor where a label (global label or local label) is specified. • Check and correct the setting of the special register (SD940), and execute the function again.
4292H	Debug related function error	Real-time monitor does not begin during the execution of real-time monitor.	Start real-time monitor after the stop of the real-time monitor being executed.
4293H	Debug related function error	Execution fails because the internal buffer exceeds its maximum capacity.	Check and correct the settings of internal buffer capacity, and then try again.
4294H	Debug related function error	Execution fails because the settings of internal buffer capacity has been changed during the execution of functions that consume the internal buffer.	Deactivate the functions that consume the internal buffer, and then try again. Or, restore the internal buffer capacity to the previous state, and then try again.
4300H	Security function error (user authentication)	• An operation requiring authentication was executed when no authentication was received from the CPU module/controller. • An operation requiring authentication was executed from a startup source or function that does not support user authentication.	• Check if the user has logged on to the CPU module/controller. • Perform operation from a device which supports the user authentication function. • Disable the user authentication function.
4302H	Security function error (user authentication)	The request data for user management information registration is incorrect. • An unsupported setting was written. • The specified access level is incorrect. • The number of registered items exceeds the maximum number that can be registered at one time. • The specified user management information initialization option is incorrect.	• Write (register) the user management information again. • Enable the operation or write (register) the user management information again. • Update the firmware to one that supports the setting.

Error code (Hex)	Error name	Error details and cause	Action
4310H	Security function error (user authentication)	Logon failed.	• Log on with a registered user name/password. • If the password authentication is disabled (lockout), wait for the specified time and try again.
4314H	Security function error (user authentication)	A user authentication operation was performed with the user authentication function disabled.	Perform the operation after enabling the user authentication function.
431CH	Security function error (user authentication)	The number of simultaneously logged on users exceeds the maximum value, and therefore the system is unable to authenticate the applicable user.	• Unnecessary logged on users should log off. • Adjust the number of log ons to within the maximum value.
433CH	Maintenance and inspection error	The error was not cleared. (Error clear was performed during execution of error clear.)	Retry the operation after a while. If the same error code is displayed again, the possible cause is a hardware failure of the target module. Please contact your local Mitsubishi representative.
433DH	Maintenance and inspection error	The target module cannot handle the error clear.	Check the target module (the module in which the error occurred).
4427H	Security function error	Password lockout occurred because incorrect passwords were entered multiple times.	Set a correct password and perform password authentication again after a certain period of time.
4431H	Security function error (encrypted communication)	Creation of a server certificate failed.	• Execute again after checking the drive (memory) capacity. • Try again. If the same error is displayed again, there is a hardware failure of the controller, please contact your local Mitsubishi representative.
4470H	Security function error (all information initialization of controllers)	• An attempt was made to initialize all information of the controller without logging on with user authentication and without turning the RUN/STOP/RESET switch of the controller to the STOP side. • An attempt was made to initialize all controller information (operation that disables the user authentication function) with a user logged on to the FTP server.	• Log on with user authentication. • If user authentication is not used when logging on, change the RUN/STOP/RESET switch to the STOP position. • Perform the operation after logging off the user currently logged on to the FTP server.
4471H	Security function error (OPC UA server function)	An attempt was made to execute an unavailable operation of another function during OPC UA server startup processing.	Retry the operation after a while.
4491H	Security function error (controller user authentication)	An operation has been attempted by a user in a user group not authorized for the operation.	• Perform the operation as a user who belongs to a user group authorized for the operation. • Request the administrator of the target controller to perform the relevant operation.
4494H	Security function error (controller user authentication)	• The request data for user group management information registration is incorrect. • The specified operation authority is incorrect. • The number of registered items exceeds the maximum number that can be registered at one time. • The specified user group management information initialization option is incorrect.	• Write (register) the user group management information again. • Update the firmware to one that supports the setting.
4498H	Security function error (controller user authentication)	The request data for user authentication setting information registration is incorrect. • The specified authentication setting value is incorrect. • The specified user authentication setting initialization option is incorrect.	Set "Authentication Target Route Setting" to "Authenticate" or set "Communication Enabled Setting with Intelligent Function Module Without Logging on" to "Disable".
449AH	Security function error (controller user authentication)	Lockout release failure	Check whether the specified user is registered in the controller.
449BH	Security function error (controller user authentication)	Password expiration date initialization failure	Check whether the specified user is registered in the controller.
449DH	Security function error (controller user authentication)	The password cannot be changed because its strength does not meet the password strength setting criteria.	Change the password to one that meets the password strength setting criteria of the controller.
449EH	Security function error (user authentication)	The password of the logged on user has expired.	Change the controller password.

Error code (Hex)	Error name	Error details and cause	Action
44A0H	Security function error (user authentication)	• An attempt was made to change the user management information of the logged on user. • An attempt was made to change the user management information while the FTP server was logged on by a user. • An attempt was made to change the user management information while the web server was logged on by a user. • An attempt was made to change the user management information while the number of sessions of the OPC UA server was 1 or more.	The operation should be performed after the other user logs off.
44A1H	Security function error (user authentication)	Logon failed.	Wait for a while and try again.
44A2H	Security function error (user authentication)	Characters that cannot be used in the user name or user group name are used.	Change the user name and user group name so that they do not use characters that cannot be used.
44A3H	Security function error (all information initialization of controllers)	The operation could not be executed because all information in the controller was initialized.	Power off and on or change from reset to reset release, and execute the operation.
44A4H	Security function error (user authentication)	Writing of the previous user management information and user group management information has not completed properly.	• Power off and on or change from reset to reset release, and execute the operation. • Wait for a while and try again.
44A5H	Security function error (user authentication)	An attempt was made to change the user management information while the OPC UA server was started.	Stop the OPC UA server.
4800H	iQ Sensor Solution related error	The specified command cannot be executed because the iQ Sensor Solution data backup/restoration function is being executed.	Execute the command again after the processing of the iQ Sensor Solution data backup/restoration function ends.
4801H	iQ Sensor Solution related error	• When the iQ Sensor Solution data backup/restoration is requested, the target module does not exist. • When the iQ Sensor Solution data restoration is requested, the specified backup folder does not exist. • The value in the special register (SD) related to the iQ Sensor Solution data backup/restoration is out of range.	• Check and correct the value in the special register, and execute the function again. • Check that the backup data created by the MELSEC iQ-R series module is specified.
4802H	iQ Sensor Solution related error	The number of backup folders used by the iQ Sensor Solution data backup/restoration function has reached to its limit.	• Delete an existing backup folder(s), and execute the function again. • Set "Automatic specification (Folder deletion supported)" in the special register for setting a backup target folder number.
4803H	iQ Sensor Solution related error	The system file does not exist in the specified backup data, or the system file is corrupted.	Specify another backup data.
4804H	iQ Sensor Solution related error	The backup file does not exist in the specified backup data, or the backup file is corrupted.	Specify another backup data.
4805H	iQ Sensor Solution related error	• When the iQ Sensor Solution data backup function is executed, no backup target device exists. • The data backup function was executed to a device which does not support the function. • The number of modules to be backed up has exceeded the number of connectable modules.	• Check and correct the value in the special register, and execute the function again. • Execute the function to a device supporting iQSS which supports the function. • Check and correct the number of modules to be backed up, and execute the function again.
4806H	iQ Sensor Solution related error	An SD memory card is in the following state while the function is being executed. • An SD memory card is not inserted. • An SD memory card is disabled by SM606 (SD memory card forced disable instruction).	• Insert or re-insert an SD memory card, and execute the function again. • Enable the SD memory card operation, and execute the function again.
4807H	iQ Sensor Solution related error	Data communications cannot be performed with a target device of the iQ Sensor Solution data backup/restoration function.	• Check the operation of the target device. • Check the network status between the target device, such as cables, hubs, and routers. • The line may be busy. Perform a retry after a while. • Check and correct the communication timeout time of data backup/restoration specified in the special register.

Error code (Hex)	Error name	Error details and cause	Action
4808H	iQ Sensor Solution related error	• When the backup data is restored to the device supporting iQ Sensor Solution, data communications cannot be performed with the restoration target device. • When backup data is restored to the device supporting iQ Sensor Solution, the device of the specified backup data and the restoration target device do not match.	• Check the operation of the target device. • Check the connections and network status with the target devices, such as cables, hubs, and routers. • The line may be busy. Perform a retry after a while. • Check and correct the specified backup data and the device supporting iQ Sensor Solution (manufacturer, model name, version) specified as the restoration target device.
4809H	iQ Sensor Solution related error	The data backup/restoration function of iQ Sensor Solution was executed to the module which does not support the function.	• Replace the module with the one which supports the function. • Execute the function to the module which supports the function.
480AH	iQ Sensor Solution related error	The function was executed to the CC-Link module whose operation had been switched from the standby master station to master station.	After powering off and on the master station and standby master station, execute the function again.
480CH	iQ Sensor Solution related error	The specified command cannot be executed because the automatic detection of the connected device function of iQ Sensor Solution is being executed.	Execute the command again after the automatic detection processing ends.
480DH	iQ Sensor Solution related error	• The specified command cannot be executed because the reflection of the communication setting of iQ Sensor Solution is being executed. • A communication timeout occurred in a command of a device supporting iQ Sensor Solution.	• Execute the command again after the reflection of the communication setting processing ends. • Check and correct the communication time check setting value using the engineering tool.
480EH	iQ Sensor Solution related error	• The specified command cannot be executed because the monitor function of iQ Sensor Solution is being executed. • The specified command cannot be executed because the sensor parameter read/write function of iQ Sensor Solution is being executed. • A communication timeout occurred in a command of a device supporting iQ Sensor Solution.	• Execute the function again after a while. • Execute the command again after the sensor parameter read/write processing ends. • Check and correct the communication time check setting value using the engineering tool.
4810H	iQ Sensor Solution related error	The series of the CPU module where the iQ Sensor Solution data restoration function is to be executed differs from the series of the CPU module where the iQ Sensor Solution data backup function was executed. Or the restoration target module differs from the backup target module.	Check the series of the CPU module where the data backup function was executed and the backup target module.
4811H	iQ Sensor Solution related error	The series of the CPU module where the iQ Sensor Solution data backup function is to be executed differs from the series of the CPU module where last time the function was executed. Or the last backup target module differs from the current backup target module.	• Execute the data backup function to the module where the data backup function was executed last time. • Set a different folder number.
4812H	iQ Sensor Solution related error	The functions that cannot be executed simultaneously, such as the file transfer function (FTP server/client), are being executed.	Retry the operation after a while.
4902H	Any other error	The communications have stopped because an error occurred in another simple CPU communication function setting No. for which the same communication destination is specified in the simple CPU communication function.	Eliminate the error cause of the simple CPU communication setting No. with an error.
4905H	Any other error	• The capacity of label area to be used exceeded its limit. • The size of the global label or the local label to be used in each program is smaller than that of the write-destination controller.	• Check the program, delete the unused local and global label definitions, rebuild all data, and then write the program to the programmable controller. • Change the label area size in the parameter, rebuild all data, and then write the program to the programmable controller. • Set the operating status of the CPU module/controller to STOP, and then write the program.

Error code (Hex)	Error name	Error details and cause	Action
4A00H	Network error	• Access to the specified station cannot be made because the routing parameters, network number/station number, or network station number ⇔ IP-related information setting are not set to the start source CPU module/controller and/or relay CPU module/controller. • For routing via a multiple CPU system, the control CPU module/controller of the network module for data routing or the CPU module/controller for data routing has not started. • The third byte of the IP address (network number) specified for the IP communication test is the same as that of the CPU module/controller where the test is executed. • The CPU module/controller that performs IP packet transfer is not the control CPU module/controller of the CC-Link IE module, which is on the path that IP packets travel.	• Set the routing parameters, network number/station number, or network station number ⇔ IP-related information setting, each of which is for accessing the specified station, to the related stations. • Retry the operation after a while. Or, start communication after checking that the system for data routing has started. • Ensure that the third byte (network number) of the IP address specified for the IP communication test and the third byte (network number) of the IP address of the CPU module/controller where the test is executed do not overlap. • Set the CPU module/controller that performs IP packet transfer as the control CPU module/controller of the CC-Link IE module, which is on the path that IP packets travel.
4A01H	Network error	• The network of the number set to the routing settings does not exist. • The specified CPU module/controller cannot be communicated through the network that is not supported by the CPU module/controller.	• Check and correct the routing settings set to the related stations. • Set communication through the network that is supported by the specified CPU module/controller.
4A02H	Network error	Access to the specified station cannot be made.	• Check the network module for error, or check that the modules are not offline. • Check that the network number and PC number are correctly set.
4A03H	Network error	A request for network test was issued.	Check the request data of the SLMP/MC protocol.
4A05H	Link related error (file related error)	121 stations or more are specified to the station number.	Check station numbers.
4A20H	IP communication test error	• The upper 2 bytes of the IP addresses do not match between the CPU module/controller and the request destination device on the same path that IP packets travel. • The upper 2 bytes of the IP addresses do not match between the CPU module/controller and the CC-Link IE module on the same path that IP packets travel. • The upper 2 bytes of the IP addresses do not match between the CC-Link IE modules on the same path that IP packets travel. • The upper 2 bytes of the IP addresses do not match between the request source device and the CPU module/controller connected to the request destination device by Ethernet.	• Check and correct the IP address settings of the CPU module/controller. • Check and correct the IP address of the request destination device. • Check and correct the IP address of the CC-Link IE module. • Check and correct the IP address of the request source device.
4A21H	IP communication test error	• The 3rd byte (Network No.) or 4th byte (Station No.) of the IP address of the CPU module/controller is the number that is not available for CC-Link IE. • The 3rd byte (Network No.) or 4th byte (Station No.) of the IP address of the request destination device is the number that is not available for CC-Link IE.	• Check and correct the IP address settings of the CPU module/controller. • Check and correct the IP address of the request destination device.
4A22H	IP communication test error	The IP address is not set to the CC-Link IE module on the path that IP packets travel.	• Set the IP address to the CC-Link IE module used as a master station. • Check the communication status with the master station when the CC-Link IE module is used as a local station. • Replace the CC-Link IE module (master station) with the one that supports the IP packet transfer function. • Conduct the IP communication test again after the CC-Link IE module is started up. • Check and correct the IP address of the request destination device.
4A23H	IP communication test error	• The CPU module/controller on the path that IP packets travel does not support the IP packet transfer function. • Routing parameters are set so that IP packets are routed to the CPU module/controller that is incompatible with IP packet transfer.	• Replace the CPU module/controller with the one supporting the IP packet transfer function. • Check and correct the routing parameter so that IP packets are routed to the CPU module/controller that supports the IP packet transfer function. • Check and correct the IP address of the request destination device.

Error code (Hex)	Error name	Error details and cause	Action
4A24H	IP communication test error	• The CC-Link IE module on the path that IP packets travel does not support the IP packet transfer function. • Routing parameters are set so that IP packets are routed to the network module that does not support the IP packet transfer function. • The 3rd byte (Network No.) of the IP address of the device on the path that IP packets travel is overlapping with the network No. of the module (not supporting the IP packet transfer function) connected to the CPU module/controller. • The 3rd byte (Network No.) of the IP address of the request destination device is overlapping with the network No. of the module (not supporting the IP packet transfer function) connected to the CPU module/controller.	• Replace the CC-Link IE module with the one supporting the IP packet transfer function. • Check and correct the routing parameters so that IP packets are routed to the CC-Link IE module that supports the IP packet transfer function. • Ensure that the 3rd byte (Network No.) of the IP address of the device on the path that IP packets travel is not overlapping with the network No. of the module (not supporting the IP packet transfer function) connected to the CPU module/controller. • Check and correct the setting so that the 3rd byte (Network No.) of the IP address of the request destination device does not overlap with the network No. of the module (not supporting the IP packet transfer function) connected to the CPU module/controller. • Check and correct the IP address of the request destination device.
4A25H	IP communication test error	• The IP packet transfer setting is not set. • Routing parameters are set so that IP packets are routed to the CPU module/controller where IP packet transfer setting is not set.	• Select "Use" for the IP packet transfer function setting in the CPU parameters. • Check and correct the routing parameters so that IP packets are routed to the CPU module/controller where IP packet transfer setting is set. • Check and correct the IP address of the request destination device.
4A27H	IP communication test error	The CPU module/controller that performs IP packet transfer is not the control CPU module of the CC-Link IE module, which is on the path that IP packets travel.	Set the CPU module/controller that performs IP packet transfer as the control CPU module of the CC-Link IE module, which is on the path that IP packets travel.
4A28H	IP communication test error	• In the system where the CPU module/controller is connected to the request destination device over Ethernet, the request path and the response path of IP packets differ. • When multiple CC-Link IE modules with the same network number are connected in a multiple CPU system, the CC-Link IE module mounted on the lowest number slot is not set as a controlled module of the CPU module that transfers IP packets. • When multiple CC-Link IE modules with the same network number are connected in a single or multiple CPU system, the station number of the CC-Link IE module mounted on the lowest number slot is not set as a relay station number in routing parameter.	• Check and correct the routing parameter setting so that IP packets travel the same path for both request and response transmission. • When multiple CC-Link IE modules with the same network number are connected in a multiple CPU system, set the module mounted on the lowest number slot as a controlled module that transfers IP packets. • When multiple CC-Link IE modules with the same network number are connected in a single or multiple CPU system, set the station number of the module mounted on the lowest number slot as a station number in routing parameter.
4A29H	IP communication test error	The 3rd byte (network No.) of the IP address of the request destination device is overlapping with the 3rd byte of the IP address of the CPU module/controller connected to the request source device over Ethernet.	• Check and correct the IP address settings of the CPU module/controller. • Check and correct the IP address of the request destination device.
4A2AH	IP communication test error	An IP address of a device on CC-Link IE network or the CPU module/controller is not specified.	Specify an IP address of a device on CC-Link IE network or the CPU module/controller.
4A30H	OPC UA server function error	The OPC UA server cannot be started because the operating status change of the server is in progress.	Retry the operation after a while.
4A31H	OPC UA server function error	The OPC UA server cannot be stopped because the operating status change of the server is in progress.	Retry the operation after a while.
4A32H	OPC UA server function error	The OPC UA server function in the OPC UA server setting was set to "Not to Use".	Check and correct the OPC UA server setting again.
4A33H	OPC UA server function error	The OPC UA server was started or stopped when any of the following functions was in progress. • Writing data to the programmable controller program memory • All controller information initialization • User management information operation in the user authentication function	Retry the operation after a while.
4A34H	OPC UA server function error	In the module parameters, "OPC UA Server Settings" is set to "Use" in "To Use or Not to Use User Authentication", but the user authentication function is disabled. Or, the user authentication function is enabled, but "Do not authenticate" is set for "Ethernet Port" in "Authentication Target Route Setting".	• Enable the user authentication function. • Set "Authenticate" for "Ethernet Port" in "Authentication Target Route Setting".

Error code (Hex)	Error name	Error details and cause	Action
4A35H	OPC UA server function error	While the user authentication function was enabled, the OPC UA server function was started with "To Use or Not to Use User Authentication" set to "Not to Use" in the module parameters.	• Disable the user authentication function. • Set "To Use or Not to Use User Authentication" to "Use".
4A36H	OPC UA server function error	A server certificate has not been created, and the security policy for the OPC UA server function is set to an option other than None.	• Check if the server certificate has been created. • Change the settings for the security policy.
4A37H	OPC UA server function error	The label information is different between the global label assignment information and the OPC UA address space settings file.	After pressing the update button in the address space settings, write the OPC UA address space settings file.
4A38H	OPC UA server function error	• The OPC UA address space settings file is not stored when the OPC UA server is started. • Analysis of the OPC UA address space settings file failed when the OPC UA server is started.	After pressing the update button in the address space settings, write the address space settings file.
4A39H	OPC UA server function error	• The number of nodes in the address space settings file exceeded the maximum number of nodes. • The address space capacity exceeded the maximum capacity.	Reduce the number of nodes in the address space and rewrite the address space settings file.
4A3AH	OPC UA server function error	Startup failed because the port number to be used by the OPC UA server was already in use.	Correct the port number.
4B00H	Target module error	• An error occurred in the access destination or the relay station. • The specified connection destination (request destination module I/O number) is incorrect. • The access destination CPU module/controller has not started up. • The specified target CPU module/controller No. does not exist.	• Check the error that occurred in the specified access destination or the relay station to the station to be accessed, and take corrective action. • Check the connection destination (request destination module I/O number or PC number) in the request data of SLMP/MC protocol. • Check the stop error, and take corrective action. • Check and correct the target CPU module/controller No.
4B02H	Target module error	The request is not addressed to the CPU module/controller.	Perform operation for the module that can execute the specified function.
4B03H	Target module error	• The specified route is not supported by the specified CPU module/controller version. • The communication target CPU module/controller is not mounted. • A device mounted on the specified route does not support communications.	• Check whether the specified route is supported or not. • Check the mounting status of the CPU module/controller. • Check the stop error, and take corrective action.
4B04H	Target module error	The specified connection destination (request destination module I/O number) is not supported.	An invalid value is set as the start I/O number of the connection target module. Set the start I/O number of the existing module correctly, and retry data communications.
4C00H	Data logging function error	There is not enough free space for storing the result file in the target memory.	Increase the free space in the target memory and create the result file again.
4C01H	Data logging function error	• Writing of the result file to the target memory has not completed successfully because the SD memory card is write-protected. • Writing of the result file to the target memory has not completed successfully because the folder/file structure is incorrect.	• Unlock the write protect switch of the SD memory card, and write the result file again. • Check that the target memory is broken. • Check that the folder or file to be used in the target memory is deleted.
4C02H	Data logging function error	The SD memory card was removed while the data logging function was being executed (data logging status: Waiting RUN Not collected, Waiting to establish collection conditions Not collected, Waiting start Not collected, Pause, Collecting, Waiting trigger Collecting before trigger, Collecting after trigger, or Saving in progress). Or, writing to the SD memory card has not completed successfully.	• Insert the SD memory card and execute the function again. • Replace the SD memory card and execute the function again.
4C03H	Data logging function error	The number of files in the root directory and subdirectory in the target memory exceeded the limit.	• Increase the free space of the drive (memory), and execute the function again. • Delete files in the drive (memory), and execute the function again.
4C04H	Data logging function error	During auto logging, a data logging was not registered due to a registration failure of the data logging with another setting number.	Clear the error, and start auto logging.
4C06H	Data logging function error	System error	Check the specified data, and write it to the controller again.

Error code (Hex)	Error name	Error details and cause	Action
4C07H	Data logging function error	A data logging is attempted to start with a data storage memory that is different from the one for the data logging already registered.	Check and correct the setting for the data logging to be started.
4C09H	Data logging function error	Free space in the target memory (data memory) is not enough.	Increase the free space in the target memory (data memory) and execute the function again.
4C0AH	Data logging function error	The target drive (data memory) is abnormal	Initialize the memory to bring the drive (data memory) back to normal state.
4C0BH	Data logging function error	• A data logging file that is being transferred is deleted. • Reading from (an access to) a data logging file is failed. • The specified file does not exist. Or, the specified subdirectory does not exist.	• Check and correct the number of files to be saved in the file switching setting. • Check that the data logging file is not deleted. • Check that an SD memory card is inserted. • Check the file name and subdirectory name. Then, execute the function again.
4C0DH	Data logging function error	A data logging is attempted to start during a transfer of a result file.	Restart the data logging after the completion of the data logging file transfer.
4C0FH	Data logging function error	The program file or global label setting file was changed while the data logging function specifying the label (global label or local label) as the collection start condition, data collection target, or trigger condition was being executed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data).	• Do not change the program file or global label setting file while the data logging function specifying the label (global label or local label) is being executed (data logging status: RUN waiting (no collection), Condition waiting (no collection), Start waiting (no collection), Pause, Collecting, Trigger waiting (collecting before trigger), Collecting after trigger, or Saving the logging data). • Stop the data logging specifying the label (global label or local label). • Check and correct the setting of SD940 (Stop direction at file change on label specification), and execute the function again.
4C10H	CPU module/ controller data backup/ restoration function error	• The maximum allowable capacity is exceeded. • The maximum allowable number of files is exceeded. • The upper limit of the backup folder number is exceeded. • The maximum length (255 characters) of the file path is exceeded.	• Increase the free space of the SD memory card and CPU module/controller, and execute the function again. • Delete files in the SD memory card and CPU module/ controller, and execute the function again. • Delete the backup data in the SD memory card and CPU module/controller, and execute the function again. • Check and correct the folder structure or folder/file names of backup target data, and execute the data backup function again.
4C11H	CPU module/ controller data backup/ restoration function error	An SD memory card is not inserted.	• Insert or re-insert an SD memory card, and execute the function again. • Enable the SD memory card operation, and execute the function again.
4C12H	CPU module/ controller data backup/ restoration function error	Reading/writing of data from/to the drive specified by the customer has not completed successfully.	• Check that the SD memory card has been inserted, and then retry the operation. • Replace the SD memory card, and execute the function again. • The backup data may have been corrupted. Execute the data restoration function using another backup data.
4C13H	CPU module/ controller data backup/ restoration function error	Reading/writing of data from/to the CPU module/controller built-in memory completed with an error.	• Back up data in the CPU module/controller built-in memory, initialize the memory, and write the data back to the original memory. Then, execute the data backup/restoration function of the CPU module/controller. • The possible cause is a hardware failure of the restoration target CPU module/controller. Execute the data restoration function to another CPU module/controller.
4C15H	CPU module/ controller data backup/ restoration function error	A function that cannot be executed simultaneously, such as the file transfer function (FTP server/FTP client), iQ Sensor Solution data backup/restoration function, and network setting change function, is in progress.	Execute the intended function again after the completion of the function that cannot be executed simultaneously, such as the file transfer function (FTP server/FTP client), iQ Sensor Solution data backup/restoration function, and network setting change function.

Error code (Hex)	Error name	Error details and cause	Action
4C16H	CPU module/ controller data backup/ restoration function error	• The automatic backup setting by specifying the day and time was turned on when the setting value for the automatic backup day and time setting exceeded the specifiable range. • The automatic backup setting based on the time and day of the week was turned on when the setting value for the automatic backup time and day of the week setting exceeded the specifiable range.	• Correct the setting value for the automatic backup date and time setting, and turn on automatic backup setting by specifying the date and time. • Correct the setting value for the automatic backup time and day of the week setting, and turn on automatic backup setting by specifying the time and day of the week.
4C17H	CPU module/ controller data backup/ restoration function error	The model of the restoration target CPU module/controller differs from the model of the backup source CPU module/ controller.	Execute restoration again with the same CPU module/ controller model as the backed up CPU module/controller.
4C1AH	CPU module/ controller data backup/ restoration function error	• The value set in the backup destination specification setting (SD963, SD964) is out of range. • The value set in the backup target data setting (SD966, SD967) is out of range. • The value set in the restoration source specification setting (SD965) is out of range. • The value set in the restoration target date folder setting (SD956, SD957) or restoration target number folder setting (SD958) is out of range. • The value set in the restoration target data setting (SD954) is out of range. • A folder with a value that matches the value of the restoration source specification setting (SD965), restoration target date folder setting (SD956, SD957), or restoration target number folder setting (SD958) does not exist in the customer-specified drive.	• Check and correct the backup destination specification setting value (SD963, SD964), and execute the function again. • Check and correct the backup target data setting value (SD966, SD967), and execute the function again. • Check and correct the restoration source specification setting value (SD965), and execute the function again. • Check and correct the restoration target date folder setting value (SD956, SD957) or restoration target number folder setting value (SD958), and execute the function again. • Check and correct the restoration target data setting value (SD954), and execute the function again.
4C1BH	CPU module/ controller data backup/ restoration function error	The data restoration function was executed to the CPU module/controller whose status (such as programs, parameters, and file structure) differs from that of when the data backup function was executed.	• Match the CPU module/controller status to the one at the time of backup, and execute restoration again. • Change the target restoration data to all data for backup/ restoration target, and execute automatic restoration.
4C1CH	CPU module/ controller data backup/ restoration function error	• The SD memory card has not been inserted. • The SD memory card is write-protected.	• Insert the SD memory card. Or, re-insert the SD memory card, and execute the function again. • Cancel the write protection of the SD memory card, and execute the function again.
4C21H	CPU module/ controller data backup/ restoration function error	The amount of backup data stored on the SD memory card exceeded the upper limit.	• Check and correct the backup data upper limit setting, and execute the function again. • Delete the backup data in the SD memory card, and execute the function again.
4C22H	CPU module/ controller data backup/ restoration function error	The backup data upper limit enable setting (bit 5 of SD944) was turned on while the setting value of the backup data upper limit setting (SD1353) exceeded the specifiable range.	Check and correct the setting value of the backup data upper limit (SD1353), and turn on the backup data upper limit enable setting (bit 5 of SD944).
4C23H	CPU module/ controller data backup/ restoration function error	Because a CPU data folder already exists on the SD memory card, the upper limit of the amount of backup data cannot be changed.	Delete the CPU data folder on the SD memory card, turn off the backup data upper limit enable setting (bit 5 of SD944), and then turn on the backup data upper limit enable setting again.
4C24H	CPU module/ controller data backup/ restoration function error	Backup cannot be executed because the amount of backup data on the SD memory card exceeds the value of the upper limit.	• Delete any backup data that exceeds the upper limit, and execute the function again. • Check and correct the backup data upper limit setting, and execute the function again.

Error code (Hex)	Error name	Error details and cause	Action
4C40H	File transfer function (FTP client) error	• When files are specified by using wild card characters for the file transfer function instruction, the number of files matched exceeds the upper limit of the transferable number of files. • When files are specified by using wild card characters for the file transfer function instruction, no files are matched. • When files are specified by using wild card characters for the file transfer function instruction, no files satisfy the conditions of the wild card specification.	• Check and correct the wild card specification. • Check if the specified folder path exists. • Check that the number of characters of the path is 255 or less including the extension and the file name that satisfy the conditions of the wild card specification. • Check that the number of characters of the file name (including the extension) that satisfy the conditions of the wild card specification is 64 or less. • Check if a file satisfying the conditions of the wild card specification exists.
4C43H	File transfer function (FTP client) error	The number of processing completed files for sending or acquiring FTP client file is mismatched with the total number of processing files.	Retry the operation.
4C44H	File transfer function (FTP client) error	The file transfer function (FTP client) is executed while the following functions are being executed. • Controller data backup/restoration function • iQ Sensor Solution data backup/restoration function	After the corresponding function is completed, retry the operation.
4D40H	Firmware update function error (Via engineering tool)	Access to the flash ROM of the module to be updated has failed.	Perform the firmware update to the target module again.
4D41H	Firmware update function error (Via engineering tool)	• Access to the module to be updated has failed. • The module is unable to perform the firmware update. • An incorrect firmware update file (a firmware update file not for the module to be updated) has been used. • An invalid firmware update file has been used.	Check the following and perform the firmware update again. • No hardware failure occurs in the base unit or the module. • The module started up normally. • The module is able to perform the firmware update. • The correct firmware update file for the module is set in the engineering tool. • The name or contents of the firmware update file are not changed from their original state.
4D44H	Firmware update function error (Via engineering tool)	• A firmware update file of the version that cannot be installed on the module used has been used. • The module does not support the firmware update. • The module information cannot be read from the module to be updated.	• Use the module with a firmware version that supports the firmware update using the engineering tool. • Check if the module supports the firmware update. • Check that the module is mounted properly, reset the controller, and perform the firmware update again.
4D45H	Firmware update function error (Via engineering tool)	The firmware update is disabled.	Enable the firmware update and perform the operation again.
4D46H	Firmware update function error (Via engineering tool)	The engineering tool and the CPU module/controller are connected incorrectly.	• Check that the CPU module/controller No.1 is connected with a USB or built-in Ethernet ("Ethernet Port Direct Connection"/"Connection via HUB"). • Check that the "Target PLC" is set to "Not Specified" in the "Specify Connection Destination" window of the engineering tool. • Set the redundant CPU setting to "Not Specified".
4D47H	Firmware update function error (Via engineering tool)	• The operation cannot be performed because the firmware update is being performed from another engineering tool. • The operation cannot be performed because the CPU module/controller No.1 was not reset after the last firmware update. • A communication error occurred in the last firmware update.	• Perform the firmware update to the module again after the completion of the update from the other engineering tool. • Manually reset the controller and perform the firmware update again.
4D48H	Firmware update function error (Via engineering tool)	• The firmware update cannot be performed due to a CPU module/controller stop error. • The update cannot be started because a parameter does not exist. • The module may be faulty.	• Check the parameters. • Check whether the module is mounted correctly. • If the same error code is displayed again, please contact your local Mitsubishi representative.
4D49H	Firmware update function error (Via engineering tool)	• The CPU module/controller No.1 has been powered off or reset during the firmware update processing. • The engineering tool has been exited or a communication error has occurred during the firmware update processing.	Update the firmware again.

Error code (Hex)	Error name	Error details and cause	Action
4D4AH	Firmware update function error (Via engineering tool)	• The firmware update has been performed to the module that the CPU module/controller No.1 does not support. • The firmware update has been performed using the firmware update file that the CPU module/controller No.1 does not support. • An invalid firmware update file has been used.	• Update the CPU module/controller No.1 to the latest firmware version and perform the firmware update again. • Do not modify the file name or contents of the firmware update file from its original state.
4D4CH	Firmware update function error (Via engineering tool)	• The module to be updated cannot be updated on the extension base unit. • The firmware update file set in the engineering tool cannot be used for the module on the engineering tool.	• Mount the module to be updated to the main base unit and perform the firmware update again. • Set the correct firmware update file for the module to be updated in the engineering tool, and perform the firmware update again.
4D4DH	Firmware update function error (Via engineering tool)	A firmware data error has been detected during the firmware update processing.	Update the firmware again.
4D4EH	Firmware update function error (Via engineering tool)	• The specified operation cannot be performed because the firmware update is being performed. • The specified operation cannot be performed because the CPU module/controller No.1 was not reset after the firmware update.	After the completion of the firmware update, reset the controller and perform the operation again.
4D53H	Firmware update function error (Via engineering tool)	An update was performed to a module managed by a CPU module/controller executing another function.	Check that the control CPU module/controller is not executing another function, and perform the firmware update again.
4D70H	Web server function error	Event history cannot be displayed because event history is being updated on the target module.	Check for repeated event detection on the target module.
4D80H	CPU module/ controller data backup/ restoration function error	• The password contains characters that cannot be used. • The password exceeds the maximum number of characters that can be set. • The password strength does not meet the criteria.	Check the character string and number of characters in the password, and then retry the operation.
4D81H	CPU module/ controller data backup/ restoration function error	Encryption failed because a file exceeding 60M bytes existed.	If there is a sequence program file or FB file exceeding 60M bytes, reduce the size to less than or equal to 60M bytes and retry the encryption. If there is a file exceeding 60M bytes except for the files mentioned above, contact your local Mitsubishi representative.
4D82H	CPU module/ controller data backup/ restoration function error	Decryption failed.	• The decryption password may have been incorrect. Enter the correct password and retry the operation. • The backup data may contain an error, so execute using other backup data.
4D85H	CPU module/ controller data backup/ restoration function error	Backup execution request (SM1351) was turned on with the special relay/special register when backup was in progress.	After the backup in progress finishes, execute the request again.
4D86H	CPU module/ controller data backup/ restoration function error	Backup execution request was executed with the engineering tool when backup was in progress.	After the backup in progress finishes, execute the request again.
4D88H	CPU module/ controller data backup/ restoration function error	Data specified in the restoration target data setting (SD954) cannot be restored because the folders that match the restoration source specification setting value (SD965), restoration target date folder setting value (SD956, SD957), and restoration target number folder setting value (SD958) have not been backed up for all target data.	Check and correct the restoration source specification setting value (SD965), restoration target date folder setting value (SD956, SD957), restoration target number folder setting value (SD958), and restoration target data setting value (SD954), and execute the function again.
4D8BH	CPU module/ controller data backup/ restoration function error	The key cannot be created currently.	Retry the operation after a few seconds.

Error code (Hex)	Error name	Error details and cause	Action
4D8CH	CPU module/ controller data backup/ restoration function error	The specified operation cannot be performed.	Retry the operation. If the same error is displayed again, please contact your local Mitsubishi representative.
4D8DH	CPU module/ controller data backup/ restoration function error	A backup was attempted without the specification of encryption when the user authentication function was enabled.	Specify encryption and execute backup.

75.5 Codes of Errors Detected by Other Than the Self-diagnostic Function (C000H to DFFFH)

The following table lists the codes of errors related to Ethernet and CC-Link IE TSN.

These error codes are not stored in SD0 because they are not detected by the self-diagnostic function.

Error code (Hex)	Error details and cause	Action
C001H	The IP address is not set correctly.	Correct the IP address.
C005H	• The default gateway is not set correctly. • The default gateway network address (network address after the subnet mask) is different from that of the IP address of the own node.	• Correct the default gateway IP address. • Set the same network address as that of the IP address.
C011H	The port number of the external device is not set correctly.	Correct the port number of the external device.
C012H	The port number used in an already opened connection is set. (For TCP/IP)	Check and correct the port number of the controller and the external device.
C013H	The port number used in an already opened connection is set. (For UDP/IP)	Check and correct the port number of the controller and the external device.
C015H	• The specified IP address of the external device for the open processing is incorrect. • The specified IP address of the external device of the dedicated instruction is incorrect. • The data was sent to the connected device while the IP address setting of the device set in the network configuration setting was incorrect.	• Correct the value specified for the external device IP address in the SOCOPEN instruction. Set the class to A/B/C. • Execute the dedicated instruction again after correcting the specified IP address of the external device. • Correct the IP address of the connected device in the network configuration setting. • Check that the IP address class of the connected device is set to A, B, or C in the network configuration setting.
C017H	A connection could not be established in the open processing.	• Check the operation of the external device. • Check if the open processing has been performed in the external device. • When a firewall is set in the external device, check if access is permitted. • Check if the Ethernet cable is disconnected. • If the connection was closed immediately before the open processing, wait for 65 seconds and perform the open processing.
C018H	The specified IP address of the external device is incorrect.	Correct the specified IP address of the external device.
C020H	The send/receive data length exceeds the allowable range.	• Correct the data length to be sent. • When the amount of data to be sent exceeds the limit, divide the data into smaller chunks to send it.
C025H	• There is an error in the usage setting area when starting the open processing by the CONOPEN/OPEN/SOCOPEN instruction or I/O signals. • There is an error in the usage setting area when starting the open processing by the SOCOPEN instruction.	• When starting the open by using the CONOPEN/OPEN/SOCOPEN instruction, correct the setting value in the usage setting area of the control data. • When starting the open by I/O signals, correct the connection usage setting area of the buffer memory. • When starting the open by using the SOCOPEN instruction, correct the setting value in the usage setting area of the control data.
C027H	Message send of the socket communications has failed.	• Check the operation of the external device or switching hub. • Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected. • Check that there is no connection failure with the switching hub. • Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module. • Check the IP address specified as the destination.
C029H	• Description of control data is not correct. • Open instruction was executed through open settings parameter even though parameters are not set.	• Correct the descriptions of the control data. • Set the open settings parameters. Execute the OPEN instruction through control data.

Error code (Hex)	Error details and cause	Action
C031H	A send error has occurred.	• Check the operation of the external device or switching hub. • Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected. • Check that there is no connection failure with the switching hub. • Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module. • Check the IP address specified as the destination.
C032H	The external device does not send an ACK response in the TCP/IP communications.	• Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected.
C035H	• The existence of the external device could not be checked within the response monitoring timer value. • The alive status of an external device could not be checked.	• Check the operation of the external device. • Check and correct the data communication timer setting of the controller. • Check if the connection cable is disconnected.
C037H	• The receive buffer or send buffer is not sufficient. • The window size of the external device is not sufficient.	• Check the operation of the external device or switching hub. • When the value of the 'Receive buffer status storage area' (Un\G6291486) is 0001H, reduce the frequency of data received from the external device.
C038H	Data was not sent correctly with UDP/IP.	• Check that the external device (including a switching hub) has no error in the connection setting, operation (an error and being in a reset state, or others), and connection (error such as a connection cable being disconnected). • Since there may be congestion of packets on the line, send data after a certain period of time. • Execute the PING test and communication status test, and if the test was completed with an error, take the corrective action. • Correct the network number and station number or IP address of the target station of the dedicated instruction.
C039H	Data was not sent correctly via TCP/IP.	• Check that the external device (including a switching hub) has no error in the connection setting, operation (an error and being in a reset state, or others), and connection (error such as a connection cable being disconnected). • Since there may be congestion of packets on the line, send data after a certain period of time. • Execute the PING test and communication status test, and if the test was completed with an error, take the corrective action.
C03AH	An attempt was made to send data using a port that was closed in "Setting to Use or Not to Use Default Open Port" of the controller.	Set the port in use to "Open" in "Setting to Use or Not to Use Default Open Port" of the controller, write to the controller again, and then turn the power back on.
C03BH	The specified connection was already closed in TCP/IP communications.	Execute the TCP/IP communications again.
C040H	• Not all the data could be received within the response monitoring timer value. • Sufficient data for the data length could not be received. • The remaining part of the message divided at the TCP/IP level could not be received within the response monitoring timer value.	• Correct the data length of the communication data. • The packets may be crowded in the line, so send the data again from the external device after a random time has passed.
C050H	• When the communication data code of the Ethernet-equipped module is set to "ASCII", ASCII code data which cannot be converted into binary is received. • A request message in an incorrect format was received.	• Check if ASCII code data which cannot be converted into binary code data has been sent from the external device. • Check that the format of the request message from the external device is correct.
	An ASCII code data that cannot be converted into binary code is received.	Check if ASCII code data which cannot be converted into binary code data has been sent from the external device.
C051H	• The number of read/write points from/to the device of SLMP message is out of the allowable range in the controller (in units of words). • The number of write points for the long counter of SLMP message is not in two-word units.	Correct the number of read/write points and send the SLMP message to the controller again.
C052H	The number of read/write points from/to the device of SLMP message is out of the allowable range in the controller (in units of bits).	Correct the number of read/write points and send the SLMP message to the controller again.

Error code (Hex)	Error details and cause	Action
C053H	The number of read/write points from/to the random device of SLMP message is out of the allowable range in the controller (in units of bits).	Correct the number of read/write points and send the SLMP message to the controller again.
C054H	The number of read/write points from/to the random device of SLMP message is out of the allowable range in the controller (in units of words or double words).	Correct the number of read/write points and send the SLMP message to the controller again.
C055H	The read/write size from/to the file data of SLMP message is out of the allowable range.	Correct the number of read/write points and send the SLMP message to the controller again.
C056H	The read/write request exceeds the largest address.	• Correct the start address or the number of read/write points so that the request does not exceed the largest address and send the data to the controller again. • If the access destination is a MELSEC MX Controller or MELSEC iQ-R series module, send the SLMP message again to the controller using 00□3 and 00□2 of subcommands.
C057H	The request data length of the SLMP message does not match with the number of data in the character (a part of text).	Check and correct the text or request data length, and send the SLMP message to the controller again.
C058H	The request data length of the SLMP message after the ASCII-to-binary conversion does not match with the number of data in the character (a part of text).	Check and correct the text or request data length, and send the SLMP message to the controller again.
C059H	• The specified command and subcommand of the SLMP message are incorrect. • The function which is not supported by the target device was executed.	• Check that there is no error in the specification of the command and subcommand of the SLMP message. • Check whether the function executed is supported by the target device. • Check the version of the target device.
C05AH	The controller cannot read/write data from/to the device specified by the SLMP message.	Correct the specification of the device to be read/written and send the SLMP message to the controller again.
C05BH	The controller cannot read/write data from/to the device specified by the SLMP message.	Correct the specification of the device to be read/written and send the SLMP message to the controller again.
C05CH	• The received request data of the SLMP message is incorrect. • The setting value of the communication setting when the iQSS function is executed is out of range. • When the iQSS function is executed, the items of communication setting which cannot be set on the target device are set. • When the iQSS function is executed, the required setting items have not been set to the target device. • The received request data of the SLMP message is incorrect.	• Correct the request data and send the SLMP message to the Ethernet-equipped module again. • Correct the setting details of when the iQSS function is executed, and retry the operation. • Check and correct the request data, and send the SLMP message to the controller again.
C05DH	The "Monitor Request" command is received before the monitor registration is performed by "Monitor Registration/Clear" command of the SLMP message.	Register the monitoring data using "Monitor Registration/Clear" command and perform monitoring.
C05EH	• The time between the controller receiving the SLMP message and the access destination returning a response exceeded the monitoring timer value set in the SLMP command. • An unresponsive command was sent to another network station as the access destination.	• Increase the monitoring timer value. • Check if the access destination is operating normally. • Correct the network number or request destination station number. • If the access destination is a module with a different network number, correct the routing parameter setting. • If the access destination is a module with a different network number, check if the network number is not in use.
C05FH	This request cannot be executed to the access destination specified by the SLMP message.	Correct the access destination.
C060H	The request details for bit devices of the SLMP message is incorrect.	Correct the request and send the SLMP message to the controller again.
C061H	• The request data length of the SLMP message does not match with the number of data in the character (a part of text). • The write data length specified by the label write command is not even byte.	• Check and correct the text or request data length, and send the SLMP message to the controller again. • Add the dummy data for one byte, and specify the length by even byte.
C06EH	The network number of request destination specified by the SLMP request message is not available for communications with the station number 254 or larger.	Check that the request destination network number and station number are correct.

Error code (Hex)	Error details and cause	Action
C06FH	The network number of request destination specified by the SLMP request message is not available for communications with the station number 121 or larger. Or, the SLMP request message frame in use does not support station number 121 or higher.	• If the 3E or 4E frame is used at SLMP, check that there is no error for the network number of the request destination and station number. • If the SLMP station number extension frame is used, check that there is no error for the network number of the request destination and station number.
C070H	The device memory cannot be extended for the access destination specified by the SLMP message.	• Correct the SLMP message to read/write data without the device memory set for extension. • Specify the extension of the device memory only for connected stations or R/Q/L/QnACPUs or controllers via the network.
C071H	The number of read/write points for devices other than the controller or R/Q/QnACPU in the SLMP message is out of range.	Correct the number of read/write points and send the SLMP message to the controller again.
C072H	The request details of the SLMP message is incorrect. (For example, a request for data read/write in bit units has been issued to a word device.)	• Check if the data can be requested to the access destination. • Correct the request and send the SLMP message to the controller again.
C073H	The access destination of the SLMP message cannot issue this request. (For example, the number of double word access points cannot be specified for modules other than controllers and R/Q/QnACPUs.)	Correct the request details of the SLMP message.
C075H	The request data length for the label access is out of range.	• Correct the number of array points or read/write points and send the SLMP message to the controller again. • Correct the number of abbreviated points and send the SLMP message to the controller again. • Correct the label name length and send the SLMP message to the controller again. • Correct the label to shorten the label name and send the SLMP message to the controller again. • Correct the read/write data length and send the SLMP message to the controller again.
C087H	IP address of the target external device cannot be acquired.	• Check and correct the IP address in the network station number <-> IP-related information setting. • Check if the network station number of the external device is correctly specified by using control data of the dedicated instruction. • Check if the connection cable is disconnected. • Increase the request interval (execution interval) and execute the operation. • Do not concentrate access through own station using the MELSOFT connection or SLMP. • Wait for a response to the previous request before sending the next request.
C0B2H	There is insufficient space in the receive buffer or the send buffer of the relay station or external station for the MELSOFT connection or SLMP. (Send · receive buffer full error)	Increase the request interval (execution interval) and execute the operation. • Do not concentrate access through one station using the MELSOFT connection or SLMP. • Wait for a response to the previous request before sending the next request. • Check and correct the value set for the data communication timer setting of the controller.
C0B3H	A request that cannot be processed was issued from the CPU function.	• Correct the request details. • Correct the network number or request destination station number.
C0B6H	• The channel specified by the dedicated instruction is out of the range. • The channel specified by the SLMPSND/SLMPSNDC instruction is out of the range. Or, the SLMPSND/SLMPSNDC instruction was executed to the channel where the same instruction was already in progress.	Correct the channel to a value within the allowable range of each dedicated instruction.
C0BAH	• Since the close processing is in execution using the CONCLOSE/CLOSE/SOCCLOSE instruction, a send request cannot be accepted. • Since the close processing is in execution using the SOCCLOSE instruction, a send request cannot be accepted.	Do no perform the send processing during the close processing.
C0D4H	The number of relay stations to communicate with other networks exceeds the allowable range.	• Check if the specification (network number/station number) for the communication destination is correct. • Check that number of relay stations accessing to the communication destination is 7 or less. • Correct the settings in the Network station number <-> IP information for the stations between the own station and the communication destination.
C0D8H	The number of specified blocks exceeded the range.	Correct the number of blocks.

Error code (Hex)	Error details and cause	Action
C0D9H	The specified subcommand of the SLMP message is incorrect.	Correct the subcommand.
C1A2H	A response to the request could not be received.	• Check and correct the response waiting time. • Check the operation of the external device. • Check if the external device supports the executed function. • Execute the dedicated instruction again after correcting the specified IP address of the external device. • For hubs with the automatic negotiation function, check whether the communication mode is in automatic negotiation. • For hubs without the automatic negotiation function, check whether the half-duplex communication mode is enabled.
C1A4H	• Any of the specified command, subcommand, or request destination module I/O number specified with the SLMP message is incorrect. • The function which is not supported by the target device was executed.	• Correct the command, subcommand, or request destination module I/O number specified by SLMP message. • Check the version of the target device.
C1A6H	The specified connection number is incorrect.	Correct the setting value of the connection number.
C1A7H	The specified network number is incorrect.	Correct the specified network number.
C1A9H	The specified device number is incorrect.	Correct the specified device number.
C1ACH	The specified number of resends is incorrect.	Correct the specified number of resends.
C1ADH	The specified data length is incorrect.	Correct the specified data length.
C1AFH	The specified port number is incorrect.	Correct the specified port number
C1B0H	The open processing of the specified connection has been already completed.	• Do not perform the open processing to a connection already opened. • When communications with the external device cannot be performed, perform the close processing before the open processing.
C1B1H	The open processing of the specified connection has not been completed.	After completion of the open processing, perform the communication.
C1B2H	• The connection for which the open or close processing using the CONOPEN/CONCLOSE/OPEN/CLOSE/SOCOPEN/SOCCLOSE instruction was being executed was specified and the processing was performed. • The SOCOPEN/SOCCLOSE/SOCSND/SOCRCV instruction was specified for a connection where these instruction was already in progress and the processing was executed.	• Execute the processing again after ensuring that the CONOPEN/CONCLOSE/OPEN/CLOSE/SOCOPEN/SOCCLOSE instruction is completed. • Execute the processing again after ensuring that the SOCOPEN/SOCCLOSE/SOCSND/SOCRCV instruction is completed.
C1B3H	• The other send/receive instruction is in progress for the specified channel. • The other SLMP frame send instruction is in progress for the specified channel.	• Change the channel number. • Execute the instruction after completion of the send/receive instruction. • Execute the instruction after completion of the SLMP frame send instruction.
C1B4H	The specified arrival time is incorrect.	Set the arrival monitoring time within the range.
C1B9H	• The CONOPEN/OPEN/SOCOPEN instruction cannot be executed for the specified connection. • The SOCOPEN instruction cannot be executed for the specified connection.	• Correct the specified connection. • Check if the specified connection setting exists.
C1BAH	The dedicated instruction was executed when the initial processing was not completed.	Execute the dedicated instruction after completion of the initial processing.
C1BFH	The channel used for the dedicated instruction is incorrect.	• Execute again after correcting the used channel within the allowable range at the request source. • If the request source is on another network, check if the routing setting is set correctly, and correct the settings. • Change the channel number to be within the range.
C1C6H	The execution or error completion type of the dedicated instruction is incorrect.	• Execute again after correcting the execution/error completion type in the control data. • If the problem cannot be resolved with the above actions, the possible cause is a hardware failure of the module. Please contact your local Mitsubishi representative.
C1CCH	A response of the data length that exceeds the allowable range was received by the SLMPSND instruction.	• Execute again after correcting the request data to be within the range. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
C1CDH	Message send of the SLMPSND instruction has failed.	• Check the operation of the external device or switching hub. • Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected. • Check that there is no connection failure with the switching hub. • Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module. • Check the IP address specified as the destination. • Set "Use" in "To Use or Not to Use SLMPSND Instruction" under "Application settings" of the module for which the SLMPSND instruction was executed, and retry the operation.
C1D0H	The requested module I/O No. of the dedicated instruction is incorrect.	• Execute again after correcting the requested module I/O No. at the request source of the dedicated instruction. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
C1D3H	The dedicated instruction not supported by the communication method of the connection was executed.	• Check that the dedicated instruction can be executed by the specified communication method. Correct the program when the instruction cannot be executed. • Check that there is no error in the connection specification of the dedicated instruction.
C207H	The file name has too many characters.	Name the file with 255 characters or less.
C208H	The password length is out of range.	Set the password within 6 to 32 characters.
C400H	The ECPRTCL instruction was executed when Predefined protocol ready is not completed.	• Execute the ECPRTCL instruction after Predefined protocol ready has turned on. • Execute the ECPRTCL instruction after rewriting the protocol setting data to the Ethernet-equipped module. • If the error occurs again even after taking the above, the possible cause is a hardware failure of the module. Please contact your local Mitsubishi representative.
C401H	The protocol number specified by the ECPRTCL instruction is not registered in the Ethernet-equipped module.	• Correct the specified protocol number and execute the instruction again. • Register the protocol specified protocol number to the Ethernet-equipped module.
C402H	An error has occurred in the protocol setting data registered in the Ethernet-equipped module and the ECPRTCL instruction cannot be executed.	Correct the protocol setting data and register it again.
C403H	Multiple dedicated instructions was executed simultaneously.	• Do not execute the dedicated instructions which do not support simultaneous execution. • Correct the specified connection number and execute the dedicated instruction again.
C404H	The protocol being executed by the ECPRTCL instruction was canceled.	Check the canceled protocol in the control data of the ECPRTCL instruction (execution count result) and eliminate the cause of the cancellation.
C405H	The protocol number specified by the ECPRTCL instruction is incorrect.	Correct the specified protocol number.
C406H	The continuous protocol execution count of the ECPRTCL instruction is incorrect.	Correct the continuous protocol execution count.
C407H	The connection number specified by the ECPRTCL instruction is incorrect.	• Correct the specified connection number and execute the protocol again. • Correct the specified connection number in "External Device Configuration" under "Basic Settings" of the Ethernet-equipped module and execute the protocol again.
C408H	An error has occurred when the send processing of the predefined protocol using the ECPRTCL instruction was performed.	• Check the operation of the external device or switching hub. • Since there may be congestion of packets on the line, send data after a certain period of time. • Check if the connection cable is disconnected. • Check that there is no connection failure with the switching hub. • Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module.
C410H	Receive waiting time of the ECPRTCL instruction timed out.	• Check if the cable is disconnected. • Correct the specified connection number in "External Device Configuration" under "Basic Settings" of the Ethernet-equipped module and execute the protocol again. • Check that there is no error in the external device. • Check that the sending from the external device is not interrupted. • Check that there is no data lost due to a receive error. • Check that there is no error in the data (packet) sent by the external device.

Error code (Hex)	Error details and cause	Action
C417H	The data length or data quantity of the received data using the predefined protocol is out of range.	• Check the maximum allowable data length and specify the maximum length or less in the data length storage area. • Check the maximum allowable data quantity, and specify the maximum quantity or less in the data quantity storage area.
C430H	Protocol setting data was written during the ECPRTCL instruction execution.	Do not write the protocol setting data during the ECPRTCL instruction execution.
C431H	Close processing of the connection was performed during the ECPRTCL instruction execution.	• Check the operation of the external device. • Check the connection open status with the external device. • Open the connection with the external device again and execute the instruction.
C612H C613H	The module processing was completed with an error.	• Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module.
C615H	The module processing was completed with an error.	• Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module.
C624H	An error occurred during transfer processing of the FTP client.	• Check and correct the FTP server settings (login user name, login password, folder path, and connection method). • Check that the user has a right to access (read/write) the transmission destination FTP server or the specified file. • Check that the folder and file specified in the settings exist in the transmission destination FTP server. • Delete unnecessary files on the FTP server and secure free space. • Check that the FTP server name is registered in the DNS. • Delete the FTP server name, change to IP address setting, and check the operation. • Check that the data communications with the FTP server is possible by using the Ping command. • The specified file may be used in the other process. Wait for a while and perform the operation again. • The communication line may be congested. Wait for a while and perform the operation again. • If a firewall or proxy server exists on the connection path, consult a network administrator about the settings. • Check the data communication history of the FTP server software. • Correct the TCP ULP timeout value because connecting to the FTP server may require a longer time. • Check that the replacement for renaming is permitted in the FTP server settings. • When the SD memory card is set for the transfer source or transfer destination, check if the SD memory card is available. • Correct the encrypted communication settings for FTP clients and FTP servers. • Correct the encrypted communication version setting.
C625H	The file size limit was exceeded in the transfer process of the FTP client (TLS1.3 communication).	• Check that the size of the file to be transferred is 14000 [Byte] or less. • Correct the encrypted communication version setting.
C626H	Relative path specification was detected in the transfer process of the FTP client.	Check if the folder path on the FTP client side (transfer destination/transfer source) contains a relative path.
C627H	An error related to encrypted communication was detected during transfer processing of the FTP client.	• Correct the encrypted communication settings for FTP clients and FTP servers. • Correct the encrypted communication version setting.
C628H	Connection establishment of the data transfer port to the FTP server failed.	• Check connection with the FTP server. • Correct the FTP server setting (connection method). • If a firewall is active or the proxy server is on the connection path, consult a network administrator about the settings. • Disconnect the user session on the FTP server. • Data communications may not be ready. Wait for a while and perform the operation again.
C700H	• The module processing was completed with an error. • The IP packet transfer function was completed with an error.	• Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module. • Check and correct the data size to be used for the connections in the IP packet transfer function.
C701H	The IP address (network number) setting is incorrect in the communications using the IP packet transfer function.	Check the IP address (network number) setting.
C702H	The IP address (station number) setting is incorrect in the communications using the IP packet transfer function.	Check the IP address (station number) setting.

Error code (Hex)	Error details and cause	Action
C703H	The destination IP address (upper) is incorrect in the communications using the IP packet transfer function.	Check the destination IP addresses setting.
C704H	The destination IP address (lower) is incorrect in the communications using the IP packet transfer function.	Check the destination IP addresses setting.
C705H	• The module processing was completed with an error. • The own station IP address setting is incorrect in the communications using the IP packet transfer function.	• Execute the communication status test, and if the test was completed with an error, take the corrective action. • Execute the module communication test, and check that there is no failure in the module. • Check the own station IP address setting.
C709H	A communication error has occurred with MELSOFT direct connection.	• Do no execute the specification of the direct connection when direct connection is not used. • Do not power off or reset the controller, or remove the cable during the communications when direct connection is used.
C842H	The routing setting is not set to reach to the destination network number.	• Execute the link dedicated instruction again after correcting the target network number and station number. • When the dynamic routing is used, check that communication path to the destination network number is set. • When the dynamic routing is not used, or a module in the series other than MELSEC iQ-R is included, retry the operation after correcting the settings in "Routing Setting" of "CPU Parameter".
C844H	Incorrect frame is received. • Unsupported command	• Replace the network module with a module of the version supporting the function that has been executed. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
C900H	Communication failed.	Do not execute communication from multiple engineering tools to the same master station simultaneously.
C901H	The size of the request data to the external device or response data from the external device exceeds the range supported for communications.	Correct the size of the request data or response data to within 1500 bytes.
C902H	Communication was interrupted because no response was returned from the external device.	Execute the communication test, and if the test was completed with an error, take corrective action.
C903H	Failed to send request to the external device.	• Correct the IP address of the external device. • Check if the subnet mask of the external device matches the master station. • Check if the communication speed matches the communication speed of the external device. • Check if the cables are properly connected and that there is no error.
CF40H	Incorrect frame was received.	• Check the operating status and connection status of the target device. • Check the connection of an Ethernet cable and a hub. • Check the line status of Ethernet. • Reset the controller and target device, and retry the operation. If the above actions do not solve the problem, contact the manufacturer of the target device.
CF41H	Incorrect frame was received.	• Check the operating status and connection status of the target device. • Check the connection of an Ethernet cable and a hub. • Check the line status of Ethernet. • Reset the controller and target device, and retry the operation. If the above actions do not solve the problem, contact the manufacturer of the target device.
CF42H	Incorrect frame was received.	• Check the operating status and connection status of the target device. • Check the connection of an Ethernet cable and a hub. • Check the line status of Ethernet. • Reset the controller and target device, and retry the operation. If the above actions do not solve the problem, contact the manufacturer of the target device.
CF43H	An error has occurred.	• Check the operating status of the external device. • Check if there is any error in the line status. If the above actions do not solve the problem, contact the manufacturer of the target device.
CF44H	Incorrect frame was received.	• Check the operating status and connection status of the target device. • Check the connection of an Ethernet cable and a hub. • Check the line status of Ethernet. • Reset the controller and target device, and retry the operation. If the above actions do not solve the problem, contact the manufacturer of the target device.

Error code (Hex)	Error details and cause	Action
CFB0H	Sending data failed due to a resend timeout.	• Check the operation of the external device. • Check the line status with the external device such as a cable, hub, and router. • Check and correct the latency time. • Correct the IP address and Ethernet address of the external device. • Check if the external device has the ARP function, and perform communications with an external device that has the ARP function. • When the communication destination is a MODBUS/TCP-compatible device and the communication pattern is write, do not specify Input or Input Register for the transmission destination. • If the number of connections exceeds the upper limit in the external device, reduce the number of used connections by sharing a TCP connection with multiple communication settings, or through other means. Setting the own station port numbers to the same value allows for the sharing of one TCP connection. • The type of the external device depends on the firmware version of the network module. Check the firmware version of the network module. • When using the encrypted communication, check the settings related to encryption, such as whether the certificate of the external device is stored in the trusted list, whether the certificate is valid, and whether the port of the external device is open.
CFB1H	The external device cannot be connected. Or the external device is disconnected.	• Check if the connection cable is disconnected. • Check the line status with the external device such as a cable, hub, and router. • Correct the IP address and Ethernet address of the external device. • Check if the external device has the ARP function, and perform communications with an external device that has the ARP function. • The type of the external device depends on the firmware version of the network module. Check the firmware version of the network module.
CFB2H	The same specified own station port number is already used.	• Correct the specified port number so that it is not duplicate. • It depends on the firmware version whether the network module can make multiple settings for the same communication destination. Check the firmware version of the network module.
CFB4H	An abnormal response was received from the external device.	Check the abnormal response code in the buffer memory.
D203H	The read data or write address of the transient transmission is incorrect.	Execute the instruction again after correcting the read data or write address at the transient request source.
D205H	The target station number of transient transmission is incorrect.	Execute the instruction again after correcting the target station number at the transient request source.
D20AH	The target station number of transient transmission is incorrect.	Execute the instruction again after correcting the target station number at the transient request source.
D20BH	There was no master station when the specified master station was specified for transient transmission.	Execute the instruction again after correcting the target station number at the transient request source.
D20DH	Transmission completion wait timeout has occurred in transient data transmission.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. • When the own station, target station, or relay station detected an error, identify the cause of the error and take action. • Execute the instruction again after lower the transient transmission usage frequency. • Check if the switching hub and the Ethernet cables at the request source are connected properly.
D20EH	The header information of transient transmission is incorrect.	Execute the instruction again after correcting the header information at the transient request source, and retry the operation.
D20FH	In transient transmission, the command which cannot be requested to all or a group of stations was executed with all stations specification or group specification.	Execute the instruction again after checking that the command can be requested to all or a group of stations at the transient request source.
D213H	• The command of transient transmission is incorrect. • The CC-Link IE TSN/CC-Link IE Field diagnostics was used for the network to which the relay receiving station belongs. • The module at the connection destination does not support this function.	• Execute the instruction again after correcting the request command at the transient request source, and retry the operation. • Review the connection destination so that the CC-Link IE TSN/CC-Link IE Field diagnostics is used for the network to which the relay sending station belongs. • Check the manual for the module at the connection destination and check the status of support for this function. If not supported, update the firmware version to the one that supports this function.
D214H	The data length of transient transmission is incorrect.	Execute the instruction again after correcting the data length at the transient request source, and retry the operation.
D239H	SLMP transmission failed.	• Retry the operation after a while. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D240H	The network number specification of the dedicated instruction is incorrect.	• Execute the instruction again after correcting the network number at the request source of the dedicated instruction. • If the request source is on another network, check if "Routing Settings" of CPU parameters are set correctly, and take action.
D241H	The target station number of the dedicated instruction is incorrect.	• Execute the instruction again after correcting the target station number at the request source of the dedicated instruction. • If the request source is on another network, check if "Routing Settings" of CPU parameters are set correctly, and take action.
D242H	The command code of the dedicated instruction is incorrect.	• Execute again after correcting the command code at the request source. • If the request source is on another network, check if "Routing Settings" of CPU parameters are set correctly, and take action.
D243H	The channel specified in the dedicated instruction is incorrect.	• Execute again after correcting the used channel within the allowable range at the request source. • If the request source is on another network, check if "Routing Settings" of CPU parameters are set correctly, and take action.
D244H	The transient data is incorrect.	• Execute the instruction again after correcting the transient data at the transient request source. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D247H	When the dedicated instruction was executed, response from the target station was received twice.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. • Check if the switching hub and the cables at the request source are connected properly. • If the request source is on another network, check if "Routing Settings" of CPU parameters are set correctly, and take action.
D24AH	The arrival monitoring time specification of the dedicated instruction is incorrect.	• Execute the instruction again after correcting the arrival monitoring time at the request source of the dedicated instruction. • When the own station, target station, or relay station detected an error, identify the cause of the error and take action. • Execute the instruction again after lower the transient transmission usage frequency. • Check if the switching hub and the cables at the request source are connected properly.
D24BH	The number of resends specified in the dedicated instruction is incorrect.	• Execute the instruction again after correcting the number of resends at the request source of the dedicated instruction. • When the own station, target station, or relay station detected an error, identify the cause of the error and take action. • Execute the instruction again after lower the transient transmission usage frequency. • Check if the switching hub and the cables at the request source are connected properly.
D24DH	The channel specified in the dedicated instruction is incorrect.	Execute the instruction again after correcting the channel number used by own station in the control data.
D253H	A response timeout has occurred when the dedicated instruction was executed.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. • For IP address specification, it is not possible to target stations beyond a relay station. Execute the dedicated instruction by specifying the network number/station number. • Execute the instruction again after increasing the number of resends at the request source of the dedicated instruction. • Execute the instruction again after lower the transient transmission usage frequency. • When "Dynamic Routing" in "Application Settings" is set to "Enable", check the 'Communication path determination status' (Un\G1260544 to Un\G1260559) and check if communication to the target network number is possible. • Execute the dedicated instruction for a target station that supports the executed dedicated instruction. • For the SLMPSND instruction, execute it again after checking if the destination port number set in the control data is the available port number using the manual of the external device. • Correct the network number and station number/IP address of the target station of the dedicated instruction. • Check if the connection cable is disconnected. • If the request destination is on another network, check if the controller working as the relay station supports the routing settings, and take action. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D255H	The target station number of the dedicated instruction is incorrect.	• Execute the instruction again after correcting the target station number in the control data. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D256H	The execution or error completion type of the dedicated instruction is incorrect.	• Execute the instruction again after correcting the execution or error completion type in the control data. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D258H	The control station does not exist when the dedicated instruction was executed to the specified control station or current control station.	• Execute the instruction again after correcting the target station number in the control data. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D25AH	The dedicated instruction was executed specifying the channel in use.	• Retry the operation after a while. • Change the channels used by own station or the target station storage channel in the control data.
D25BH	The dedicated instruction was executed specifying the channel in use.	Change the channels used by own station or the target station storage channel in the control data.
D25DH	The transient data is incorrect.	• Execute the instruction again after correcting the transient data at the transient request source. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D273H	The request data size of transient transmission is incorrect.	• Correct the request command at the transient request source, and retry the operation. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D275H	Other dedicated instructions are in execution, and the executed instruction cannot be processed.	• Execute the instruction again after a while. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D2D2H	The IP address/port number of the target station is incorrect.	• Execute again after correcting the port number of the target station in the setting data. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D2D3H	Send processing of the transient transmission has failed.	• Check the network status using the CC-Link IE Field Network diagnostics of the engineering tool, and take action. • When the own station, target station, or relay station detected an error, identify the cause of the error and take action. • Execute the instruction again after correcting the target IP address of transient data. • If the access destination is a module with a different network number, correct the routing parameter setting.
D602H	Parameter error	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D605H	Parameter error	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D611H	Parameter error (each station device range assignment error (RWw))	• Write the module parameter to the controller again. • Execute the operation again after correcting the size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D612H	Parameter error (each station device range assignment error (RWw))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D613H	Parameter error (each station device range assignment error (RWr))	• Write the module parameter to the controller again. • Execute the operation again after correcting the size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D614H	Parameter error (each station device range assignment error (RWr))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D615H	Parameter error (each station device range assignment error (RY))	• Write the module parameter to the controller again. • Execute the operation again after correcting the size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D616H	Parameter error (each station device range assignment error (RY))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D617H	Parameter error (each station device range assignment error (RX))	• Write the module parameter to the controller again. • Execute the operation again after correcting the size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D618H	Parameter error (each station device range assignment error (RX))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D61BH	Parameter error (device overlap error (RWw))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset or size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D61CH	Parameter error (device overlap error (RWr))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset or size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D61DH	Parameter error (device overlap error (RY))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset or size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D61EH	Parameter error (device overlap error (RX))	• Write the module parameter to the controller again. • Execute the operation again after correcting the offset or size of the link device of the device station in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D621H	Parameter error	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D622H	Parameter error (error in the total number of device stations)	• Write the module parameter to the controller again. • Execute the operation again after correcting the total number of device stations. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D625H	Parameter error (station-based block data assurance setting error)	• Write the module parameter to the controller again. • Execute the operation again after correcting the station-based block data assurance setting. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D628H	Parameter error (station type error)	• Write the module parameter to the controller again. • Execute the operation again after correcting the station type in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D629H	Parameter error (station number range error)	• Write the module parameter to the controller again. • Execute the operation again after correcting the station number in the module parameter (CC-Link IE TSN) to be within the range of 1 to 253. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D62AH	Parameter error (data link faulty station setting error)	• Write the module parameter to the controller again. • Execute the operation again after correcting the data link faulty station setting. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D62BH	Parameter error (output hold/clear setting error during controller STOP)	• Write the module parameter to the controller again. • Execute the operation again after correcting the output hold/clear setting during controller STOP. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D641H	Parameter error (IP address error)	• Write the module parameter to the controller again. • Execute the operation again after correcting the IP address in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D642H	Parameter error (gateway address setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the gateway address setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D643H	Parameter error (communication cycle setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the communication period setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D644H	Parameter error (cyclic transmission time setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the cyclic transmission time in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D645H	Parameter error (transient transmission time setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the communication period setting or cyclic transmission time in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D646H	Parameter error (transmission path setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the transmission path setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D647H	Parameter error (time synchronization setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the time synchronization setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D649H	Parameter error (send timeslot setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the send timeslot setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D64AH	Parameter error (number of data link error detection)	• Write the module parameter to the controller again. • Execute the operation again after correcting the number of data link errors detected in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D64BH	Parameter error (number of occupied stations)	• Write the module parameter to the controller again. • Execute the operation again after correcting the number of occupied stations in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D64DH	Parameter error (parameter automatic setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the parameter automatic setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D64FH	Parameter error (cyclic frame cycle setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the cyclic frame cycle setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D651H	Parameter error (number of modules)	• Write the module parameter to the controller again. • Execute the operation again after correcting the number of modules in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D652H	Parameter error (communication mode setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the communication mode setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D653H	Parameter error (transient transmission group setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the transient transmission group setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D654H	Parameter error (dynamic routing setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the dynamic routing setting in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D655H	Network addresses of the master station and device stations are incorrect.	Correct the IP address settings of the master station or device stations.
D657H	Parameter error (station sub-ID)	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D658H	Parameter error (multidrop number)	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D65AH	Parameter error (maximum number of connectable stations)	• Parameters are set over the maximum number of connectable stations. Check and correct the module parameter so that the number of device stations is 253 (256) or less, then write parameters to the controller again. Note that extension modules whose station number is not set (for example, multi-axis servo amplifier extension modules) are not counted as one station, but are counted as one module. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D65BH	Parameter error (CC-Link IE TSN Class setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting "CC-Link IE TSN Class Setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D65CH	Parameter error (TSN hub setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting "TSN HUB Setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D65DH	Parameter error (multiple period setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting "Multiple Period Setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D660H	Parameter error (CC-Link IE TSN Class A Group Send Upper Limit Size Setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.

Error code (Hex)	Error details and cause	Action
D661H	Parameter error (PDO Mapping Setting)	• Write the module parameter to the controller again. • Execute the operation again after correcting the "PDO mapping setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D664H	Parameter error (setting method of basic/application settings)	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D665H	Parameter error (Station No./IP Address Setting Method)	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D666H	Parameter error	• Write the module parameter to the controller again. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D667H	Parameter error (station-specific mode)	• Write the module parameter to the controller again. • Execute the operation again after correcting "Station-specific mode setting" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D668H	Parameter error (device name/comment)	• Write the module parameter to the controller again. • Execute the operation again after correcting "Alias" or "Comment" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D669H	Parameter error (Event Reception from Other Stations)	• Write the module parameter to the controller again. • Execute the operation again after correcting "Event Reception from Other Stations" in the module parameter (CC-Link IE TSN). • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D840H	Number of transient request exceeded the upper limit of simultaneously processable requests.	• Pause the transient transmission temporarily, and retry the operation. • Lower the transient transmission usage frequency, and then perform again.
D841H	The request data size of memory read/write command is out of range.	Execute the operation again after correcting the read or write size specification at the transient request source.
D842H	• Routing information to the destination network number is not registered. • In transient transmission, the number of relays to other networks exceeded seven. • The communication path is being updated.	• Execute the operation again after correcting the target network number at the transient request source. • Execute the operation again after correcting the communication path from the transient request source to the destination. • When dynamic routing is not used, or the module of the series other than MELSEC iQ-R is included, retry the operation after correcting the routing parameter (routing settings). • Change the system configuration so that the number of relay stations is seven or less. • Transient transmission cannot be performed while the communication path is being updated. Retry the operation.
D843H	The module operation mode is set to a mode in which transient transmission cannot be executed.	After completion of the module communication test, retry the transient transmission.
D844H	Incorrect frame was received. • Unsupported pre-conversion protocol • Unsupported frame type • Application header variable part • Application header HDS • Application header RTP • Read command not requiring response	Execute the operation again after correcting the request data at the transient request source.
D902H	The online test data is incorrect.	• Correct the data at the station that started the online test, and retry the operation. • If the error occurs again even after taking the above, please contact your local Mitsubishi representative.
D903H	During execution of the communication test, the test was retried.	After completion of the communication test, retry the operation.
D905H	A communication monitoring timeout has occurred in communication test.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. Then, retry the operation. • Execute the operation again after lowering the transient transmission usage frequency.

Error code (Hex)	Error details and cause	Action
D906H	Transmission completion wait timeout has occurred in communication test.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. Then, retry the operation. • Execute the operation again after lowering the transient transmission usage frequency.
D909H	The header information of transient transmission is incorrect.	Execute the operation again after correcting the header information at the transient request source.
D90AH	During execution of the communication test, the test was retried.	Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. Then, retry the operation.
D90BH	The number of stations that communicate in the network is out of the specification range.	• Check the network status using the CC-Link IE TSN/CC-Link IE Field diagnostics of the engineering tool, and take action. • If the number of device stations per network is more than 253, reduce it to 253 or less.
D90CH	The communication destination specified for the communication test is incorrect.	• Correct "Target Station" of communication test, and retry the operation. • Do not perform "Communication Test" on the own station. Set "Target Station" to a station other than own station.
D912H	Transient transmission sending failed.	• Execute the operation again after lowering the transient transmission usage frequency. • Check if the switching hub and the cables are connected properly.
D913H	An error was detected in the network module.	Please contact your local Mitsubishi representative.
D914H		
D915H		
D916H		
D919H	No response from the target station of the communication test.	• Check and correct the IP address for the target station of the communication test. • Check if the network configuration setting is correctly set in the master station within the same network as the target station of the communication test. • When "IP Address" is selected for "Communication Method", "Communication Test" cannot be executed for stations on networks different from that of the connected station (own station). Execute "Communication Test" from the "Specify Connection Destination Connection" window.
DA00H	An error was detected in the network module.	Please contact your local Mitsubishi representative.
DA10H	An error was detected in the network module.	Please contact your local Mitsubishi representative.
DA11H		
DA12H		
DA13H		
DA14H		
DA15H		
DA16H		
DA17H		
DA19H	An error was detected in the network module.	Please contact your local Mitsubishi representative.
DB00H	The station numbers of 121 stations or more are specified.	Check station numbers.
DC00H	The setting value is incorrect.	Execute the write instruction again after correcting the setting value.
DC01H	The setting value was not written correctly.	Execute the write instruction again. Please contact your local Mitsubishi representative.
DD00H	A request was received from an engineering tool that does not support station numbers 121 or higher.	Update the engineering tool to the latest version.

76 EVENT LIST

The controller collects information, such as errors detected by the module; operations performed for the module; and network errors, from modules, and stores the collected data into the data memory or an SD memory card. (☞ Page 1754 Event history function)
When an event occurs, its event code and details can be read by using an engineering tool.

Point

For details on events occurred in each module, refer to the manual for the module used.

76.1 How to Read the Event List

The event list contains the following information.

Item	Description
Event code	ID number assigned to an event
Event type	Type of an event
Event category	Category of an event
Detected event	Description of a detected event
Detailed information 1 to 5	Details of a detected event

Detailed information

The following table lists the details of information displayed in the detailed information 1 to 5.

Detailed information	Item	Description
Detailed information 1	Operation source information	Information on the operation source • Connection port (such as Ethernet and USB) • I/O number • CPU number (a number assigned to CPU modules in a multiple CPU system) • Network number • Station number • IP address • User name
	Time synchronization information	Information on the time synchronization
	Communication status	Information on the connection with connection monitoring timer excess
	Time synchronization/grandmaster information	Information on the time synchronization with the grandmaster
	Own station information	Information on the own station network
	Event history file information	Information on the event history file
	Module information	Information on the target module (I/O number)
	Daylight saving time status	Information on the daylight saving time status (start/end)
	Add-on name information	Information on the add-on
	MCFB start/stop information	Information on MCFB
	Drive/file information	Information on the corresponding drive name and file name
	Drive unit position information	Information on the drive unit position
	Current position restoration information	Information on the current position restoration
	SLMP request destination information	Information on the SLMP request destination when the SLMP response frame is discarded
	Axis error	Information on the axis error
	Parameter information	Information on the parameter
	Cycle information	Information on the cycle
	Detail code information	Information on the servo system recorder or add-on
	CPU internal error information	Information on the firmware integrity check function at startup
	Firmware update information at recovery	Information on the firmware recovery via the SD memory card

Detailed information	Item	Description
Detailed information 1	Controller data backup/restoration information	Information on the controller data backup/restoration function (operation, result, error, data specification, initialization, latest data, special relay, special register, operation mode)
	Controller data backup information	Information on the controller backup setting (backup function setting, error codes)
	Data backup/restoration information of iQ Sensor Solution	Information on the data backup/restoration function of iQ Sensor Solution (operation, target device, execution unit, target module, folder number setting method, total number of executions, number of successful executions, number of executions completed with an error, folder number)
	Information on the execution status of the data backup/restoration function of iQ Sensor Solution	Information on the execution status of the data backup/restoration function of iQ Sensor Solution (result, error category, error code)
	Information on the right to use the data backup/restoration function of iQ Sensor Solution	Information on the right to use the data backup/restoration function of iQ Sensor Solution (right-to-use number, operation)
	Network setting change information	Information on the network setting change

Detailed information	Item	Description
Detailed information 2	Communication speed and communication mode	Information on the communication speed and the communication mode
	Grandmaster MAC address information	Information on the grandmaster MAC address
	Restricted event category	Information on the category targeted for the event history logging restriction
	Target station information	Information on the target station
	CC-Link IE TSN device IP address information	Information on the CC-Link IE TSN devices (connected/disconnected)
	Parameter error contents	Information on the received parameter
	Cause of data link stop	Information on the cause of data link stop
	Loopback occurrence	Information on the loopback
	Device station parameter automatic setting information	Information on the device station parameter automatic setting
	Error frame information	Information on the error frame
	Target station MAC address information	Information on the target station MAC address
	Blocked IP address information	Information on the blocked IP address
	Restricted IP address information	Information on the IP address specified as the restriction target by the band restriction setting
	Disconnected system connection	Information on the system connection monitoring timer
	User authentication information	Information on the user authentication
	Login/logout information	Information on login/logout
	User name	Information on the user name used for the user authentication
	Operation target information	Information on the operation target: I/O number
	Firmware update information	Information on the firmware update that is performed via the engineering tool (firmware versions before and after update, modules whose firmware versions are updated)
	Controller data backup/restoration folder information	Information on the controller data backup/restoration folder (folder specification, date, number)
	Target device information of the data backup/restoration function of iQ Sensor Solution	Information (station number, station sub-ID number, IP address) on the iQ Sensor Solution compatible target device for data backup/restoration
	Clock information (before change)	Clock information before change
	Remote operation type information	Information on the remote operation type
	Copy source drive/file information	Information on the corresponding drive name and file name
	Setting/change information	Information on the network setting change
	Device name information	Information on the device name
	Device name information (user-specified)	Information on the device name
	Label name information	Information on the label name
	Label name information (user-specified)	Information on the label name
	Parameter change occurrence cause	Information on the parameter change occurrence cause
	Operating status of CPU module on another station	Information on the operating status of the CPU module on another station
	Device/label clearing information	Information on device/label clearing
	Add-on information	Information on the add-on
	Firmware update execution information	Information on the file used for firmware update via the engineering tool and detailed information on the cause of error
	Program monitor file write information	Information on writing program monitor files
	Web server logon/logoff information	Information on logging on to and logging off from the web server
	System Web page information	Information on the system Web page used by the web server
Detailed information 3	Clock information (after change)	Clock information after change
	Copy destination drive/file information	Information on the corresponding drive name and file name
	Written value	Information on the written value
	Number of points	Information on the number of points
	Types of PTP frames that failed to be received	Information on the time synchronization
Detailed information 4	Device name information (target device)	Information (device name, address) on the device actually accessed
Detailed information 5	Target bit No.	Information on the target bit number

76.2 System (00000H to 03FFFH)

Event code (Hex)	Event category	Detected event	Description	Detailed information
00100H	Information	Link-up	Link-up has occurred when the network cable connected to the external device was connected.	Operation source information Communication speed and communication mode (only for modules that can be set)
00110H		Communication start/end (TCP)	Data communications with an external device through TCP connection started, or data communications with an external device through TCP connection ended.	Operation source information Communication status
00120H		FTP connection start/end	FTP connection with an external device started, or FTP connection with an external device ended.	
00140H		SNTP server time synchronization failure	Time setting by the time synchronization function failed because there was no response from the SNTP server.	Operation source information
00400H		Power-on/reset	The controller has been powered on or reset.	—
00406H		Device station time synchronization completion	The device station time synchronization has completed.	Own station information CC-Link IE TSN device IP address information
00407H		Grandmaster selection (CC-Link IE TSN device)	The CC-Link IE TSN device was selected as the grandmaster.	Own station information Grandmaster MAC address information
00408H		Grandmaster selection (general-purpose device)	The general-purpose device was selected as the grandmaster.	
00409H		Own station time synchronization completion	The own station time synchronization has completed.	
00410H		Boot operation	Boot operation was performed using the boot function.	—
00412H		Firmware diagnostics completed	Firmware diagnostics have been completed.	
00413H		Firmware diagnostics completed with an error	Firmware diagnostics have been completed with an error.	CPU internal error information
00420H		Event history file generation	An event history file was generated.	Event history file information
00421H		Event history logging restricted	Event history logging from the module was restricted.	Module information Restricted event category (Detailed information 2 is stored only when detailed information 1 is the controller (3E00H).)
00450H		Daylight saving time start/end	Daylight saving time started, or daylight saving time ended.	Daylight saving time status
00460H		Device/label initialization	The following operation was performed when the system was powered off and on or the status was changed from STOP (PAUSE) to RUN. • After conversion of all: The label values were cleared to 0 and initial values of the devices and labels were set. • After clearing of devices/labels: Initial values of devices/labels were set.	—
00461H		Label assignment information write failure	Label assignment information write failed due to either of the following causes. • A device is assigned to a global label for which device assignment is prohibited. • A label for which latch setting is prohibited was set to be latched.	Label name information
00470H		Execution program change with online program change	The execution program was changed with the online program change.	Operation source information
00480H		Starting/disconnecting the connection with the OPC UA client	A connection with the OPC UA client has started. Or, the connection from the OPC UA client has been disconnected.	Operation source information Communication status
00500H		(Own station) Network entry	Own station enters the network.	Own station information
00501H		(Another station) Network entry	Another station enters the network.	Target station information
00502H		Network entry in all stations	All stations enter the network.	—
00510H		(Own station) Data link restart (cyclic transmission start)	Own station data link restarted.	—

Event code (Hex)	Event category	Detected event	Description	Detailed information
00511H	Information	(Another station) Data link restart (cyclic transmission start)	Data link of another station restarted.	Target station information
00512H		All stations data link normalization (all-station cyclic transmission start)	Data link returned to normal status at all stations.	—
00535H		(Another station) Reserved station enable setting instruction execution	Reserved station enable setting was executed at another station.	Target station information
00610H		Web server logon succeeded	Logging on to the Web server has succeeded.	Operation source information - Web server logon/logoff information
00611H		Web server logon failed	Logging on to the Web server has failed.	
00612H		Web server logoff	Logged off from the Web server.	
00613H		System Web page update succeeded	The system Web page was successfully updated.	Operation source information - System Web page information
00614H		System Web page update failed	The update of the system Web page has failed.	
006FBH		Device station parameter automatic setting completed	Device station parameters were automatically set from the master station.	Own station information Target station information
006FCH		Device station parameter backup completed	Device station parameters were backed up in the master station.	
006FFH		Add-on individual event	An add-on event occurred.	Add-on name information Detail code information Optional information depending on the add-on
007EAH		Event history clear	The event history was cleared.	—
007EDH		Velocity override "0"	"0" was set to velocity override.	Axis number information
007EFH		Follow-up temporarily invalid cancellation	Follow-up invalid has been temporarily canceled.	
007F0H		MCFB start (administrative)	MCFB was started.	MCFB start/stop information
007F1H		MCFB start (motion)	MCFB start or continuous start was executed.	
007F2H		MCFB start (general FB)	MCFB start or continuous start was executed.	
007F3H		MCFB stop	MCFB was stopped by stop cause.	
007F5H		Start when SW stroke limit is disabled	Started when software stroke limit was disabled by AxisName.Cd.SwStrokeLimit_Override.	Axis number information
007F6H		Start when HW stroke limit is disabled	Started when hardware stroke limit was disabled by AxisName.Cd.HwStrokeLimit_Override.	
007F7H		Forced stop detection	Forced stop signal is detection status.	
007F8H		Event history file generation	An event history file was generated.	—
007F9H		Homing request clear	Homing request clear is on.	Axis number information
007FAH		Current position change	Current position change was executed.	
007FBH		Follow-up temporarily invalid	Follow-up was switched to invalid temporarily.	
007FCH		Servo ON when follow-up is invalid	Changed it to servo ON in follow-up invalid status during servo OFF.	Drive unit position information
007FDH		Current position restoration completion	Current position restoration was completed.	Current position restoration information

Event code (Hex)	Event category	Detected event	Description	Detailed information
007FEH	Information	Homing Request off to on	Homing request is on. • Absolute position erased on driver side was detected. [Only for real drive axes] (Detail code: 0000H) • An absolute position data error in the controller was detected. (Detail code: 0001H) • The axis type was changed. (Detail code: 0002H) • Polarity (607EH) b7: position polarity of the object data was changed. (Detail code: 0003H) • A change of the driver or motor encoder was detected. (Detail code: 0004H) • Machine homing was started. (Detail code: 0005H) • The driver unit conversion (numerator/denominator) of the axis was changed. (Detail code: 0006H) • Machine homing has never been executed after the system started. (Detail code: 0007H) • Current position restoration was executed. (Detail code: 0007H) • A driver other than the one used at last home position establishment was connected for a virtual axis. (Detail code: 0008H) • The upper/lower limit value of the encoder ring counter (encoder resolution) was changed. (Detail code: 0009H) • Home offset (607CH) of the object data was changed. (Detail code: 000AH) • When using a drive unit other than the MELSERVO, Absolute Position Erased and Current Position Restore Request was set to "2: Current Position Restore Execute in Absolute Position Erased". (Detail code: 000BH)	Axis number information
007FFH		Add-on individual event	An add-on event occurred.	Add-on name information Detail code information Optional information depending on the add-on

Event code (Hex)	Event category	Detected event	Description	Detailed information
00800H	Warning	Link-down	Link-down has occurred when network cable connected to the external device was disconnected.	Operation source information Communication speed and communication mode
00901H		Data length error	The send/receive data length exceeds the allowable range.	Operation source information
00902H		Initial processing error	Socket communications or communications using a fixed buffer were performed without the initial processing completed.	
00903H		Specified IP address error	A broadcast address was specified for the external device IP address using a module other than an Unpassive connection module.	
00904H		Socket communication send error	Message send of the socket communications has failed.	
00905H		Open not executed	• The open processing of the connection with the external device has not been completed. • The connection with the external device has been closed.	
00906H		Alive check error	The existence of the external device could not be checked within the response monitoring timer value.	
00907H		Divided message receive timeout error	• Not all the data could be received within the response monitoring timer value. • Sufficient data for the data length could not be received. • The remaining part of the message divided at the TCP/IP level could not be received within the response monitoring timer value.	
00908H		IP composition timeout error	An IP assembly timeout error has occurred since the transient transmission load is high or transient transmission time is not enough. (The remaining part of the divided data could not be received and a timeout has occurred.)	
00909H		TCP-specified port number error	The port number used in a connection already opened is set. (For TCP/IP)	
0090AH		UDP-specified port number error	The port number used in a connection already opened is set. (For UDP/IP)	
00C00H		Disconnection from network (Own station)	Own station was disconnected from the network.	Own station information
00C01H		Disconnection from network (Another station)	Another station was disconnected from the network.	Target station information
00C02H		Abnormal access response of another station	• Abnormal response was returned from another station when accessing another station. • Abnormal response was returned to another station when accessed from another station.	
00C10H		Data link stop (cyclic transmission stop) (Own station)	Own station data link was stopped.	Own station information Cause of data link stop
00C11H		Data link stop (cyclic transmission stop) (Another station)	Data link of another station was stopped.	Target station information
00C21H		Error occurrence (Another station)	An error has occurred in another station.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00C40H	Warning	Device station parameter automatic setting: Interruption	An abnormal response was received from the device station, and device station parameter automatic setting processing was interrupted. For details on device station response codes, refer to the manual for the device station used.	Device station parameter automatic setting information
00C41H		Device station parameter automatic setting: Parameter update interruption	An abnormal response was received from the device station, and parameter update processing of device station parameter automatic setting was interrupted. For details on device station response codes, refer to the manual for the device station used.	
00C42H		Device station parameter automatic setting: System error	An error occurred while the device station parameter automatic setting was executing.	Own station information
00C43H		Device station parameter automatic setting: Transmission timeout	Transmission timed out while communicating with the device station parameter automatic setting.	
00C44H		Device station parameter automatic setting: Receive timeout	The specified period of time expired without receiving while communicating with the device station parameter automatic setting.	
00C46H		Device station parameter automatic setting SLMP send error	An error occurred while transmitting SLMP for the device station parameter automatic setting.	
00C47H		Device station parameter automatic setting Access error	Access to the programmable controller function part failed at device station parameter automatic setting.	
00C48H		Device station parameter automatic setting: No target station parameter	The device station parameter file targeted during device station parameter automatic setting was not stored in the controller. Or, the writing destination of the device station parameter is different from the setting of the memory card parameter.	Device station parameter automatic setting information
00C54H		Initialization failure	A communication error occurred in the initialization processing when control communications started.	Operation source information Error frame information
00C55H		Request discard	The request was discarded because there were many requests to be processed.	Operation source information Target station information
00C56H		Response timeout	There was no response from the external device and timeout occurred.	
00C57H		Response discard	After response timeout, the response data from the external device was received.	
00C58H		SLMP response frame discard	The received SLMP response frame was disposed of due to any of the following causes. • The request source of the received SLMP response frame is not clear. • The received SLMP response frame has already returned an error response according to the monitoring timeout. • The SLMP communication load is high so that the received SLMP response frame cannot be transferred.	SLMP request destination information

Event code (Hex)	Event category	Detected event	Description	Detailed information
00C59H	Warning	Specified port number error	There was a request for a port number not open from the external device.	Operation source information Target station information
00C5AH		Specified IP address error	Data was sent to a device whose "IP Address" setting of the device station is set incorrectly in "Network Configuration Settings" under "Basic Settings" of the master station.	
00C5BH		Connection establishment failed	A connection could not be established in the open processing.	
00C5CH		TCP connection timeout	The external device does not send an ACK response in the TCP/IP communications.	
00C5DH		Send processing execution disabled	• The receive buffer or send buffer is not sufficient. The window size of the external device is not sufficient. • The window size of the external device is not sufficient.	
00C5EH		UDP/IP send failed	Data was not sent correctly with UDP/IP due to either of the following causes. • An error has occurred in the external device. • An error has occurred in the switching hub or cable. • Congestion of packets on the line	
00C5FH		TCP/IP send failed	Data was not sent correctly via TCP/IP due to either of the following causes. • An error has occurred in the external device. • An error has occurred in the switching hub or cable. • Congestion of packets on the line	
00C60H		IP address of the external device acquisition error	Target IP address could not be acquired from the network number and station number.	
00C63H		Grandmaster switching (CC-Link IE TSN device)	The device acting as the grandmaster station was disconnected, and then the CC-Link IE TSN device was newly selected as the grandmaster.	Own station information Grandmaster MAC address information
00C64H		Grandmaster switching (general-purpose device)	The device acting as the grandmaster was disconnected, and then the general-purpose device was newly selected as the grandmaster.	
00C65H		Time synchronization receive processing failure	The receive processing for time synchronization failed.	Target station MAC address information Types of PTP frames that failed to be received
00C70H		CANopen initialization failure	A communication error occurs in CANopen initialization processing.	Operation source information Error frame information
00C71H		Initialization failure (parameter mismatch between master and device stations)	During initialization processing at the start of control communication, a parameter mismatch was detected between the master station and device stations.	Operation source information Error frame information
00C72H		Maximum response time mismatch during time-managed polling	A mismatch was detected in the maximum response time during time-managed polling. Update the version of the engineering tool and the device stations to the latest version, and then retry the operation.	CC-Link IE TSN device IP address information
00C80H		A device station that does not support CC-Link IE TSN Protocol version 2.0 detected	A device station that does not support CC-Link IE TSN Protocol version 2.0 was detected.	Own station information
00C81H		CC-Link IE TSN Class settings mismatch	A mismatch was detected between the parameter of the master station and the CC-Link IE TSN Class of the device stations.	CC-Link IE TSN device IP address information

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D00H	Warning	Absolute Position Data Incorrect Warning	The absolute position data became invalid at current position restoration due to the following reasons. • The axis type was changed. • The absolute position data was erased. • The homing request was TRUE at backup. • Driver unit conversion of the axis (numerator/denominator) was changed. • Machine homing was started, but not completed properly. • Absolute position erased was detected in the scale measurement encoder for the driver side of the actual drive axis or the actual encoder axis (via the drive unit). • The driver device connected as the actual drive axis has been changed. Or the encoder resolution of the connected driver device has been changed. • The encoder resolution of the scale measurement encoder has been changed on the actual encoder axis (via the drive unit). • When using a drive unit other than the MELSERVO on the actual drive axis, Absolute Position Erased and Current Position Restore Request (AxisName.Cd.PosRestoration_Request_EraseAbsPos) was set to "2: Current Position Restore Execute in Absolute Position Erased". ■Action Execute homing.	Axis error
00D01H		Start during operation warning	An instruction that cannot start during operation was executed. ■Action Start when axis is Standstill.	
00D02H		JOG command input at both directions warning	JogForward and JogBackward became TRUE at the same time. ■Action Adjust settings so that JogForward and JogBackward do not become TRUE at the same time.	
00D03H		Velocity limit value over warning	The target velocity exceeded the following when changing velocity/velocity override factor, or velocity exceeded the following during control. • AxisName.Pr.VelocityLimit_Positive (Detail code: 0001H) • AxisName.Pr.VelocityLimit_Negative (Detail code: 0002H) • AxesGroupName.Pr.VelocityLimit (Detail code: 0003H) ■Action Set the velocity within the following. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative • AxesGroupName.Pr.VelocityLimit	
00D04H		Acceleration time limit over warning	Acceleration time exceeded 8400 [s] when changing velocity/acceleration (acceleration/deceleration time)/ velocity override factor/acceleration override factor. ■Action Set the velocity, acceleration (acceleration/deceleration time), velocity override factor, and acceleration override factor so that the acceleration time does not exceed 8400 [s].	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D05H	Warning	Deceleration time limit over warning	The following occurred when changing velocity/deceleration (acceleration/deceleration time)/velocity override factor/acceleration override factor. • Deceleration time exceeded 8400 [s]. • The deceleration time for automatically decelerating from the target velocity exceeded 8400 [s]. ■Action Set velocity/deceleration (acceleration/deceleration time)/velocity override factor/acceleration override factor as follows. • Adjust settings so that the deceleration time does not exceed 8400 [s]. • Adjust settings so that the deceleration time for automatically decelerating from the target velocity does not exceed 8400 [s].	Axis error
00D06H		Acceleration limit value over warning	Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing acceleration/acceleration override factor. ■Action Set target acceleration so that it does not exceed AxisName (AxesGroupName).Pr.AccelerationLimit.	
00D07H		Deceleration limit value over warning	Target deceleration exceeded AxisName(AxesGroupName).Pr.DecelerationLimit when changing deceleration/acceleration override factor or when a stop cause occurred. ■Action Set target deceleration so that it does not exceed AxisName(AxesGroupName).Pr.DecelerationLimit.	
00D08H		Position command unit mismatch warning	Different values have been set to AxisName(AxesGroupName).Pr.Unit_Position for the axes group and for interpolation axes. ■Action Set the same value to AxisName(AxesGroupName).Pr.Unit_Position for the axes group and interpolation axes.	
00D09H		Out of forward direction torque limit value specification range warning	The value is out of range for AxisName.Cd.TorqueLimit_Positive. ■Action Set AxisName.Cd.TorqueLimit_Positive within the range.	
00D0AH		Out of reverse direction torque limit value specification range warning	The value is out of range for AxisName.Cd.TorqueLimit_Negative. ■Action Set AxisName.Cd.TorqueLimit_Negative within the range.	
00D0BH		Out of velocity override factor range warning	The value is out of range for AxisName(AxesGroupName).Cd.VelocityOverride. ■Action Set AxisName(AxesGroupName).Cd.VelocityOverride within the range.	
00D0CH		Out of acceleration override factor range warning	The value is out of range for AxisName(AxesGroupName).Cd.AccelerationOverride. ■Action Set AxisName(AxesGroupName).Cd.AccelerationOverride within the range.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D0DH	Warning	Out of Position/Distance setting range warning	The value is out of range for Position/Distance. ■Action Set Position/Distance within the range.	Axis error
00D0FH		Out of velocity range warning	The value is out of range for Velocity. ■Action Set Velocity within the range.	
00D10H		Overrun warning	Target position turned overrun because the deceleration distance for command output velocity was not reached according to either of the following settings. • Target position change during control • Acceleration/deceleration, acceleration/deceleration time change during control • Switching based on multiple start ■Action Set Velocity, Position/Distance, and Deceleration so that an overrun will not occur.	
00D11H		Multiple start velocity mode specified mismatch warning	The VelocityMode of the under-control FB is different from that of the multiply-started FB. ■Action Set the same VelocityMode for the under-control FB and the multiply-started FB.	
00D12H		Torque limit value over warning	• Torque was changed to a larger value than AxisName.Md.TorqueLimit_Positive. (Detail code: 0001H) • Torque was changed to a larger value than AxisName.Md.TorqueLimit_Negative. (Detail code: 0002H) ■Action Set Torque within the following. • AxisName.Md.TorqueLimit_Positive • AxisName.Md.TorqueLimit_Negative	
00D13H		Filter cumulated value over warning	Filter cumulated value exceeded the positioning range. ■Action Reduce the velocity of Master.	
00D15H		Current position change execution disabled warning	An error occurred when changing the current position. ■Action • Check and correct the settings for MC_SetPosition. • Execute it when the axis status is Standstill.	
00D16H		Out of torque setting range warning	The value is out of range for Torque. ■Action Set Torque within the range.	
00D17H		Out of acceleration range warning	The value is out of range for Acceleration. ■Action Set Acceleration within the range.	
00D18H		Out of deceleration range warning	The value is out of range for Deceleration. ■Action Set Deceleration within the range.	
00D19H		Out of acceleration/deceleration time range warning	The value is out of range for Acceleration. ■Action Set Acceleration within the range.	
00D1BH		Out of limit velocity range warning	The value is out of range for LimitVelocity. ■Action Set LimitVelocity within the range.	
00D1CH		Out of torque forward direction ramp range warning	The value is out of range for TorquePositiveRamp. ■Action Set TorquePositiveRamp within the range.	
00D1DH		Out of torque reverse direction ramp range warning	The value is out of range for TorqueNegativeRamp. ■Action Set TorqueNegativeRamp within the range.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D1EH	Warning	Velocity command unit mismatch warning	The velocity command unit is different from that of the under-control FB. ■Action Set the same value to AxisName(AxesGroupName).Pr.Unit_Velocity for the axes group and interpolation axes.	Axis error
00D1FH		Driver warning	Warning occurred in the driver. ■Action Check the error details and take corrective actions according to AxisName.Md.DriverErrorID. (For details on AxisName.Md.DriverErrorID, refer to the manual for the driver used.)	
00D20H		Velocity limit value over warning on direction change	Target velocity exceeded the velocity limit value on that direction when accelerating again from velocity 0 on direction change. ❶ AxisName.Pr.VelocityLimit_Positive (Detail code: 0001H) ❷ AxisName.Pr.VelocityLimit_Negative (Detail code: 0002H) ■Action Adjust the settings so that the target velocity after direction change does not exceed the following. ❶ AxisName.Pr.VelocityLimit_Positive ❷ AxisName.Pr.VelocityLimit_Negative	
00D22H		Warning starting over number of buffering FBs	The maximum number of FBs which can be buffered has been exceeded with multiple start. ■Action Multiple start is executed so that the maximum number of FBs which can be buffered has not been exceeded.	
00D23H		Torque limit value change warning for axis not connected	The torque limit value change request was sent to the axis that has not been connected. ■Action Send the torque limit value change request to the connected axis.	
00D24H		Out of filter time setting range of each axis signal warning	The value is out of range for FilterTime. ■Action Set FilterTime within the range.	Axis number information Parameter error contents
00D2DH		Out of position command unit range warning	The value is out of range for AxisName(AxesGroupName).Pr.Unit_Position. ■Action Set AxisName(AxesGroupName).Pr.Unit_Position within the range.	Axis error
00D2EH		Out of velocity command unit range warning	The value is out of range for AxisName(AxesGroupName).Pr.Unit_Velocity. ■Action Set AxisName(AxesGroupName).Pr.Unit_Velocity within the range.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D2FH	Warning	Out of operation cycle converted velocity range warning	The velocity converted from Velocity by operation cycle is out of the range. ■Action Set Velocity so that the velocity converted by operation cycle is within the range.	Axis error
00D30H		Out of deceleration range at stop warning	The value was out of range for Axis Name(AxesGroupName).Pr.StopMode_Deceleration or MotionSystem.Pr.StopMode_AllDeceleration when factors that cause a stop occurred. ■Action Set AxisName(AxesGroupName).Pr.StopMode_Deceleration or MotionSystem.Pr.StopMode_AllDeceleration within the range.	
00D31H		Control mode switching disabled warning	Control mode switching is requested during a switching disabled controlling. ■Action Request for switching when control mode is switchable.	
00D32H		Acceleration time exceeded during direction change warning	Acceleration time exceeded 8400 [s] when accelerating again from velocity 0 on direction change. ■Action Adjust settings so that the acceleration time after direction change does not exceed 8400 [s].	
00D33H		Deceleration time over warning on FB switching	Deceleration time exceeded 8400 [s] on FB switching. ■Action Set velocity, deceleration, and jerk so that deceleration time does not exceed 8400 [s].	
00D34H		Out of velocity range clamping warning	The velocity after velocity override was below the velocity lower limit value. ■Action Adjust settings so that the velocity after velocity override is within the range.	
00D35H		Out of acceleration range clamping warning	• The acceleration after acceleration override was out of range. • The acceleration calculated from Acceleration was out of range when the acceleration/deceleration time-fixed method was specified. ■Action • Adjust settings so that the acceleration after acceleration override is within the range. • Adjust settings so that the acceleration or deceleration calculated from Acceleration is within the range when the acceleration/deceleration time-fixed method is specified.	
00D36H		Out of deceleration range clamping warning	The deceleration after acceleration override was out of range. ■Action Adjust settings so that the deceleration after acceleration override is within the range.	
00D37H		Out of acceleration/deceleration time range clamping warning	The acceleration/deceleration time after acceleration override time was out of range. ■Action Adjust settings so that the acceleration/deceleration time after acceleration override is within the range.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D38H	Warning	Out of operation cycle converted acceleration range warning	Because the acceleration converted from Acceleration by operation cycle is low, there is a possibility that the error of set velocity is large. ■Action • Set Acceleration so that the acceleration converted by operation cycle becomes larger. • Increase the operation cycle.	Axis error
00D39H		Out of operation cycle converted deceleration range warning	Because the deceleration converted from Deceleration by operation cycle is low, there is a possibility that the error of set velocity is large. ■Action • Set Deceleration so that the deceleration converted by operation cycle becomes larger. • Increase the operation cycle.	
00D3AH		Out of operation cycle converted jerk range warning	Because the jerk converted from Jerk by operation cycle is low, there is a possibility that the error of set velocity or set acceleration is large. ■Action • Set Jerk so that the jerk converted by operation cycle becomes larger. • Increase the operation cycle.	
00D3BH		Jerk acceleration/deceleration disabled warning	Because the jerk converted from Jerk by operation cycle is 0, it does not operate as a jerk acceleration/deceleration. ■Action • Set Jerk so that the jerk converted by operation cycle becomes larger. • Increase the operation cycle.	
00D3EH		Advanced synchronization control operation overflow warning	An overflow has occurred during the operation of a module used in the advanced synchronization control. [Input axis] • An overflow has occurred in the movement amount of the data source. (Detail code: 0001H) • An overflow has occurred in the movement amount during the smoothing compensation. (Detail code: 0002H) • An overflow has occurred in the movement amount during the phase compensation amount. (Detail code: 0003H) • A phase compensation amount overflow has occurred. (Detail code: 0004H) • An overflow has occurred in the accumulated value of the movement direction restriction amount. (Detail code: 0005H) [Output axis] An overflow has occurred in the movement amount of the output axis during the phase compensation. (Detail code: 0100H) ■Action • Reduce the velocity of the input axis. • Check and adjust the setting value of the time constant to reduce the number of smoothing steps or increase the setting value of the operation cycle. • Decrease the phase compensation advance time. • Check the allowed direction of the movement direction restriction setting. (The setting may have been the opposite.) • Check for an operation where the input axis moves by a large amount in the opposite direction to the allowed direction.	
00D3FH		Advanced synchronization control variable out-of-range warning	The parameter or control data became out of range during the advanced synchronization control. ■Action Set a value within the range for the target variable.	Axis error Parameter error contents

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D40H	Warning	Advanced synchronization control restoration invalid warning	The absolute position data became invalid at current position restoration due to the following reasons. • The target axis of the input axis or output axis in the advanced synchronization control is different before and after connecting the axis. (Detail code: 0001H) • The file version of the backup data is different. (Detail code: 0002H) ■Action Set the same value for the target axis and axis label ID of the input axis or output axis before and after connecting the axis.	Axis error
00D44H		No cam table warning	The cam table specified in CamTableID does not exist. ■Action Open cam data to the open area with MC_CamTableSelect.	
00D45H		Cam length per cycle change invalid warning for advanced synchronization control	In advanced synchronization control, "Length per cycle" for the cam data of the stroke ratio data was changed when an operation profile data with a cam data starting position other than 0 was used. ■Action Set 0 for the cam starting point (AdvOutputName.Pr.Cam.StartingPoint).	
00D46H		Operation profile data setting disabled warning for advanced synchronization control	Any of the following operation profile data settings is set to a value that cannot be used in the advanced synchronization control. • Profile data type incorrect (Detail code: 0001H) • Operation profile data format incorrect (Detail code: 0002H) • Not periodic. (Detail code: 0003H) • The master axis (input) absolute coordinate is not set for the relative coordinate. (Detail code: 0004H) • The slave axis (output) absolute coordinate is not set for the relative coordinate. (Detail code: 0005H) • The start position is set to other than 0. (Detail code: 0006H) • The initial stroke is set to other than 0. (Detail code: 0007H) • The value set for the cam starting point (AdvOutputName.Pr.Cam.StartingPoint) is larger than or equal to the resolution. (Detail code: 0008H) • The target operation profile data is being operated by another FB. (Detail code: 0009H) ■Action • Set the profile data type to "1: Cam data". (Detail code: 0001H) • Set the operation profile data format to any of "0: Linear Interpolation", "1: Section Interpolation", or "2: Spline Interpolation". (Detail code: 0002H) • Set the periodic operation to "1: Periodic". (Detail code: 0003H) • Set the master axis (input) absolute coordinate to "0: Relative coordinate". (Detail code: 0004H) • Set the slave axis (output) absolute coordinate to "0: Relative coordinate". (Detail code: 0005H) • Set "0" for the start position. (Detail code: 0006H) • Set "0" for the initial stroke. (Detail code: 0007H) • Set the cam starting point (AdvOutputName.Pr.Cam.StartingPoint) to a value smaller than the resolution. (Detail code: 0008H) • End the FB that is operating the target operation profile data. (Detail code: 0009H)	
00D47H		Add-on acquisition failure warning	Acquisition of the add-on necessary for operation failed. ■Action Check the detailed information, and install and enable apk of an add-on displayed.	Axis error Add-on name information

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D48H	Warning	Operation profile data control profile ID setting incorrect warning	During the control of multiple axes positioning data operation, the operation pattern was switched from the positioning data of the continuous path to the following positioning data in the M code output status. ■Action Do not set an M code for the positioning data whose operation pattern is the continuous path. Alternatively, reset the M code before switching the operation pattern.	Axis error
00D49H		Synchronous control variable out-of-range warning	A value out of range was set for the parameter or control data during synchronous control. • Out of master axis offset range (Detail code: 0001H) • Out of slave axis offset range (Detail code: 0002H) • Out of master axis coefficient range (Detail code: 0003H) • Out of slave axis coefficient range (Detail code: 0004H) • Out of cam table ID range (Detail code: 0005H) ■Action Set the target variable to a value within the range.	
00D4AH		Speed bias function combination incompatible warning	An operation where the jerk was set to a value other than 0.0 was started for an axis whose speed bias value was other than 0.0. ■Action Set the jerk to 0.0.	
00D4BH		Less than speed bias value warning	When the commanded velocity or velocity override factor was changed, the target speed was set to other than 0.0, and a value less than the speed bias value set in any of the following parameters was set. • In single axis operation: The axis parameter of the specified axis • In linear interpolation operation (vector velocity): The axes group parameter of the specified axes group • In linear interpolation operation (reference axis velocity): The axis parameter of the reference axis • In linear interpolation operation (long axis velocity): The axis parameter of the long axis • In circular interpolation operation: The axes group parameter of the specified axes group ■Action Check and correct the velocity override factor and the commanded velocity so that the target speed is greater than or equal to the speed bias value.	
00D4CH		Connection setting incorrect warning for drive unit other than MELSERVO	"-1: Automatic Setting (Acquire from Connected Device)" was set for Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) of an axis to which a drive unit other than MELSERVO was assigned. ■Action Set "0: Disable Absolute Position System" or "1: Enable Absolute Position System" for Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) according to the settings of the drive unit.	
00D4DH		Out of direction selection range warning	Direction was set to a value out of range during control. ■Action Set the value of Direction within the range.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
00D4FH	Warning	Out of pressure range warning	The value is out of range for Pressure. ■Action Set Pressure within the range.	Axis error
00D50H		Out of pressure ramp range warning	The value is out of range for PressureRamp. ■Action Set PressureRamp within the range.	
00D51H		Forward-side position incorrect warning	• The value is out of range for ForwardSidePosition. (Detail code 0001H) • ForwardSidePosition is set outside the software stroke limit range. (Detail code 0002H) • The absolute value of the difference between ForwardSidePosition and the reference position exceeded the upper limit assuming that the reference position is the set position (AxisName.Md.SetPosition) at the time of request to switch the control mode to cspr. (Detail code 0003H) • The absolute value of the difference between ForwardSidePosition and the reference position exceeded the upper limit assuming that the reference position is the forward-side position at cspr (AxisName.Md.Cspr_ForwardSidePosition). (Detail code 0004H) ■Action • Set ForwardSidePosition within the range. (Detail code 0001H) • Set ForwardSidePosition within the software stroke limit range. (Detail code 0002H) • Set ForwardSidePosition so that the absolute value of the difference with the reference position does not exceed "(2147483648 - 10 × Encoder resolution/ Electronic gear) × Driver Unit Conversion Denominator/ Numerator". (Detail codes 0003H, 0004H)	
00D52H		Process incorrect warning	The value is out of range for Process. ■Action Set Process within the range.	
00D53H		Ramp time over warning	The pressure ramp time has exceeded 8400 [s]. ■Action Set Pressure/PressureRamp for MCv_PressureControl so that the pressure ramp time does not exceed 8400 [s].	
00EFEH		Position data history update disabled warning	• An error was detected when updating position data history. • The memory capacity of add-on MotionEventHist is insufficient. ■Action • Delete unnecessary files and secure free capacity. • Format the target drive. • Delete position data history files. • Check and correct the memory capacity of add-on MotionEventHist.	Drive/file information
00F05H		Event filter setting failed warning	The memory capacity of add-on MotionEventHist is insufficient. ■Action Check and correct the memory capacity of add-on MotionEventHist.	Drive/file information

Event code (Hex)	Event category	Detected event	Description	Detailed information
00F07H	Warning	Event History parameter incorrect warning	The value is out of range for Storage Capacity Setting for Motion Control Event History. ■Action • Set a value within the range for the storage capacity setting in the motion control event history file. • When the event history save destination is set to data memory, set the storage capacity for motion control events to a value smaller than AddonSystem.PrConst.MT_MotionEventHist.BackupRamSizeMax.	Parameter information
00F08H		Cycle over warning	Operation processing or other fixed scan processing is not completed within the set cycle. ■Action • Change the value of the communication cycle interval setting to a larger value. • Change the axis control operation cycle to distribute the processing load. • Assign the motion operation processing to a larger number of expansion cores. • For programs whose priority is higher than that of the network communication cycle synchronous interrupt program, change the priority or execution interval or check and correct the processing content.	Cycle information
00F0BH		Maximum setting axis number over warning	Axis setting that exceeded the maximum control axis number exists. ■Action Set the number of setting axis within the maximum number of control axis.	Axis number information
00F0FH		Out of filter time setting range of system signal warning	The value is out of range for FilterTime. ■Action Set FilterTime within the range.	Parameter error contents
00F18H		Advanced synchronization control backup memory shortage warning	The capacity required for backup of the backup target input axis or output axis exceeds MotionControl_AdvancedSync_System.PrConst.AddonMemory. ■Action Check and correct the setting of MotionControl_AdvancedSync_System.PrConst.AddonMemory.	—
00F19H		Program warning	An error occurred during executing an FB for the following causes. • TrackOptions.OnCompensation is out of range. (Detail code 0001H) • TrackOptions.OffCompensation is out of range. (Detail code 0002H) • TrackOptions.Hysteresis is out of range. (Detail code 0003H) • Switches is out of range. (Detail code 0004H) ■Action • Set TrackOptions.OnCompensation within the range. • Set TrackOptions.OffCompensation within the range. • Set TrackOptions.Hysteresis within the range. • Set Switches within the range.	Detail code information
00F2FH		Add-on individual warning	An add-on warning occurred. ■Action Check the manual of the add-on for details about the detail code.	Add-on name information Detail code information Depends on the add-on.

76.3 Security (10000H to 1FFFFH)

Event code (Hex)	Event category	Detected event	Description	Detailed information
10300H	Information	Access from an IP address blocked by the IP filter setting	An access from an IP address blocked by the IP filer setting was accepted.	Operation source information Blocked IP address information
10301H		Access limitation (bandwidth excess)	Access is limited because access from an IP address targeted by the bandwidth limitation setting exceeded the bandwidth.	Operation source information Restricted IP address information
10310H		Connection close (connection monitoring timer excess)	Connection is closed because no communication was performed for a period exceeding the set value of the connection monitoring timer.	Communication status
10311H		System connection close (connection monitoring timer excess)	System connection is closed because no communication was performed for a period exceeding the set value of the system connection monitoring timer.	Communication status Disconnected system connection
10600H		User authentication function enabled/disabled	The user authentication function was enabled or disabled.	Operation source information User authentication information
10601H		Login succeeded	The login processing of the user authentication function completed successfully.	Operation source information Login/logout information
10602H		Login failed	The login processing of the user authentication function failed.	
10603H		Log off successful	The log off processing of the user authentication function completed successfully.	
10604H		Log off failed	The log off processing of the user authentication function failed.	
10605H		Auto logout	The system automatically logged out the user by executing the user authentication function.	
10606H		User management information update	The user management information was updated. (The information was added, changed, or deleted.)	Operation source information
10607H		User management information registration (Administrators)	An operator (Administrators) was registered to the user management information.	
1060BH		Password changed	The password for the user authentication function was changed.	
10611H		User group management information update	The user group management information was updated. (The information was added, changed, or deleted.)	
10711H		Access from an unauthorized user group	An operation from a user group that is not authorized by the user authentication function was received.	Operation source information
10720H		Lockout	Lockout was performed by the user authentication function.	Operation source information User name
10721H		Lockout release	Lockout release of the user authentication function was performed.	
10722H		Initialization of password expiration date	Password expiration date was initialized by the user authentication function.	
10730H		User authentication setting update	The user authentication setting is updated.	Operation source information
10800H		Communication start/end (TLS)	Data communications with an external device through TLS connection started, or data communications with an external device through TLS connection ended.	Operation source information Communication status
10801H		Communication start/end (DTLS)	Data communications with an external device through DTLS connection started, or data communications with an external device through DTLS connection ended.	
10802H		Certificate creation	A certificate to be used for encrypted communication was created.	Operation source information Drive/file information
10803H		Certificate expiration within 90 days	The certificate expires within 90 days.	Drive/file information
10804H		Registration upper limit for the number of denied certificates	Because the number of the denied client certificates has reached the registration upper limit, the certificate file with the most recent update has been deleted.	—
18200H	Warning	All controller information initialization	All information in the controller was initialized.	Operation source information Erasing method

76.4 Operation (20000H to 2FFFFH)

Event code (Hex)	Event category	Detected event	Description	Detailed information
20100H	Information	Error clear	The error was cleared.	Operation source information Operation target information
20200H		Event history clear	The event history was cleared.	Operation source information Drive/file information
20210H		Scan time clear	The scan time was cleared.	Operation source information
20300H		SD memory card enabled	The SD memory card was enabled.	—
20301H		SD memory card forcibly disabled	The SD memory card forced disable function was executed and the SD memory card became ready to be removed.	
20414H		Firmware update successful via engineering tool	Firmware update using the engineering tool was performed and completed successfully.	Operation source information Firmware update information Firmware update execution information
20415H		Firmware update failed via engineering tool	Firmware update using the engineering tool was performed and was not completed successfully.	
20416H		Successful recovery of firmware via SD memory card	Firmware was recovered successfully via SD memory card.	Firmware update information at recovery
20440H		Add-on installation	Add-on was installed using the engineering tool.	Operation source information Add-on name information
20441H		Add-on uninstallation	Add-on was uninstalled using the engineering tool.	
20442H		Add-on enabled	Add-on was enabled using the engineering tool.	
20443H		Add-on disabled	Add-on was disabled using the engineering tool.	
20445H		Add-on individual event	An add-on event occurred.	Add-on name information Detail code information
20500H		Controller data backup succeeded	Data in the controller were successfully backed up.	Controller data backup/ restoration information Controller data backup/ restoration folder information Operation source information
20501H		Controller data backup failed	Backup of data in the controller failed.	
20502H		Controller data restoration succeeded	Data in the controller were successfully restored.	Controller data backup/ restoration information Controller data backup/ restoration folder information
20510H		Controller data backup setting disabled	Backup function cannot be set.	Controller data backup information
20511H		Controller data backup setting succeeded	The backup function was set successfully.	Controller data backup/ restoration information Controller data backup/ restoration folder information Operation source information
20512H		Controller data restoration setting succeeded	The restoration function was set successfully.	Controller data backup/ restoration information Controller data backup/ restoration folder information Operation source information
20520H		Controller data backup request disabled	The execution request for the backup function was not received because the function was already being executed.	Controller data backup/ restoration information
20522H		Restore settings lockout	Lockout occurred because an incorrect password was entered consecutively more than the specified number of times during the restore settings.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
20600H	Information	iQ Sensor Solution data backup succeeded	Data in the target device supporting iQ Sensor Solution were successfully backed up.	Information on the execution status of the data backup/ restoration function of iQ Sensor Solution Target device information of the data backup/restoration function of iQ Sensor Solution
20601H		iQ Sensor Solution data backup failed	Backup of data in the target device supporting iQ Sensor Solution failed.	
20602H		iQ Sensor Solution data restoration succeeded	Data were successfully restored to the target device supporting iQ Sensor Solution.	
20603H		iQ Sensor Solution data restoration failed	Restoration of data to the target device supporting iQ Sensor Solution failed.	
20610H		iQ Sensor Solution data backup start/cancel/end	The data backup processing of the target device supporting iQ Sensor Solution started, canceled, or ended.	Data backup/restoration information of iQ Sensor Solution
20611H		iQ Sensor Solution data restoration start/cancel/end	The data restoration processing of the target device supporting iQ Sensor Solution started, canceled, or ended.	
20620H		Right-to-use acquisition/release	The right to use the data backup/restoration function of iQ Sensor Solution was acquired or released.	Information on the right to use the data backup/restoration function of iQ Sensor Solution
20630H		Network setting written successfully	Writing an IP address, a subnet mask, and a default gateway into the network setting storage area was attempted using the network setting change function and the writing succeeded.	Network setting change information
20631H		Network setting write failure	Writing an IP address, a subnet mask, and a default gateway into the network setting storage area was attempted using the network setting change function and the writing failed.	
20632H		Network setting cleared successfully	Clearing an IP address, a subnet mask, and a default gateway in the network setting storage area was attempted using the network setting change function and the clearing succeeded.	
20633H		Network setting clear failure	Clearing an IP address, a subnet mask, and a default gateway in the network setting storage area was attempted using the network setting change function and the clearing failed.	
24000H		Clock setting	The clock data was set.	Operation source information Clock information (before change) Clock information (after change)
24001H		Remote operation request accepted	A remote operation request (RUN, STOP, or PAUSE) was accepted.	Operation source information Remote operation type information
24010H		Clearing of maximum value of performance monitor function	The maximum value of the performance monitor function was cleared.	Operation source information
24020H		OPC UA server startup successful	The OPC UA server was successfully started.	Operation source information
24021H		OPC UA server startup failure	An attempt to start up the OPC UA server failed.	
24022H		OPC UA server stop successful	The OPC UA server was successfully stopped.	
24023H		OPC UA server stop failure	An attempt to stop the OPC UA server failed.	
24100H		Operating status change (RUN)	The operating status of the controller was changed to RUN.	—
24101H		Operating status change (STOP)	The operating status of the controller was changed to STOP.	
24102H		Operating status change (PAUSE)	The operating status of the controller was changed to PAUSE.	
24200H		Creation of new folders/files, and write to files[*1]	• A new folder was created. • A new file was created or data was written to a file.	Operation source information Drive/file information
24201H		File copy[*1]	A file was copied.	Operation source information Copy source drive/file information
24202H		Folder/file rename[*1]	A folder name or file name was changed.	
24203H		Program memory update start	A program memory update started.	Operation source information Drive/file information
24204H		Program memory update end	A program memory update ended.	
24205H		Program memory update failure	A program memory update failed.	

Event code (Hex)	Event category	Detected event	Description	Detailed information
24A00H	Information	Write device in word units (1 point)	Data was written to the device in word units.	Operation source information Device name information Written value
24A01H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24A10H		Write device in bit units (1 point)	Data was written to the device in bit units.	Operation source information Device name information Written value
24A11H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24A20H		Write device in double-word units (1 point)	Data was written to the device in double-word units.	Operation source information Device name information Written value
24A21H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24A40H		Write device in word units (n points)	Data was written to the device in word units.	Operation source information Device name information Number of points Written value
24A50H		Write device in bit units (n points)	Data was written to the device in bit units.	Operation source information Device name information Number of points Written value
24B00H		Write device in word units (1 point)	Data was written to the device in word units.	Operation source information Device name information Written value
24B01H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24B10H		Write device in bit units (1 point)	Data was written to the device in bit units.	Operation source information Device name information Written value
24B11H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24B20H		Write device in double-word units (1 point)	Data was written to the device in double-word units.	Operation source information Device name information Written value
24B21H				Operation source information Device name information (user-specified) Written value Device name information (target device)

Event code (Hex)	Event category	Detected event	Description	Detailed information
24B30H	Information	Write device in quad-word units (1 point)	Data was written to the device in quad-word units.	Operation source information Device name information Written value
24B31H				Operation source information Device name information (user-specified) Written value Device name information (target device)
24B40H		Write device in word units (n points)	Data was written to the device in word units.	Operation source information Device name information Number of points Written value
24B50H		Write device in bit units (n points)	Data was written to the device in bit units.	
24B60H		Write device in double-word units (n points)	Data was written to the device in double-word units.	
24B70H		Write device in quad-word units (n points)	Data was written to the device in quad-word units.	
24C00H		Write label in word units (1 point)	Data was written to the label in word units.	Operation source information Label name information Written value
24C01H				Operation source information Label name information (user-specified) Written value Device name information (target device)
24C10H		Write label in bit units (1 point)	Data was written to the label in bit units.	Operation source information Label name information Written value
24C11H				Operation source information Label name information (user-specified) Written value Device name information (target device)
24C20H		Write label in double-word units (1 point)	Data was written to the label in double-word units.	Operation source information Label name information Written value
24C21H				Operation source information Label name information (user-specified) Written value Device name information (target device)
24C30H		Write label in quad-word units (1 point)	Data was written to the label in quad-word units.	Operation source information Label name information Written value
24C31H				Operation source information Label name information (user-specified) Written value Device name information (target device)
24C40H		Write label in word units (n points)	Data was written to the label in word units.	Operation source information Label name information Number of points Written value
24C41H				Operation source information Label name information (user-specified) Number of points Written value Device name information (target device)

Event code (Hex)	Event category	Detected event	Description	Detailed information
24F10H	Information	Program monitor file write	Writing of the program monitor file was performed.	Operation source information Program monitor file write information
2A200H	Warning	Memory initialization*1	The memory was initialized.	Operation source information Drive/file information
2A201H		Device/label zero clear	Values in a device or label were cleared to zero.	Operation source information Device/label clearing information
2A202H		Folder/file deletion*1	A folder or file was deleted.	Operation source information Drive/file information

*1 As for target files for file-related events such as writing and deleting a file, refer to the following.
☞ Page 1764 Logging file operations

77 RESPONSE CODE (SDO ABORT CODE)

The following table lists response codes to be issued when an error occurs in sending or receiving object data using PDO mapping or the transient transmission function.

SDO Abort Code	Description	Action to be taken
0601 0000h	An unsupported object was accessed.	Check and correct Index and Sub Index.
0601 0001h	A read access was made to a write-only object.	
0601 0002h	A write access was made to a read-only object.	
0602 0000h	An object not defined in the object dictionary was accessed.	
0604 0041h	An object not allowed for PDO mapping was mapped.	Check and correct the data for PDO mapping.
0604 0042h	The total number of the PDO mapping target data and data length exceeded the value defined by the application or other tools.	
0607 0010h	The data size of the accessed object and the data size specified at the time of the request do not match.	Check and correct the value specified for object size.
0607 0012h		
0607 0013h		
0609 0011h	Sub Index that does not exist was specified.	Check and correct Index and Sub Index.
0609 0030h	An invalid parameter value was set.	Check and correct the data value.
0609 0031h	A value larger than the parameter range was set.	
0609 0032h	A value smaller than the parameter range was set.	
0800 0020h	The application cannot transfer or store data.	Check the status of the target device.

MEMO

78 FTP SERVER FUNCTION REPLY LIST

The following table describes the list of replies that the FTP server function sends to the FTP client.

Code	Message	Action to be taken
150	Accepted data connection	—
150	Connecting to port [value]	—
200	PORT command successful	—
200	Idle time set to [value] seconds	—
200	XDBG command succeeded, debug level is now [value]	—
200	Zzz···	—
200	TYPE is now 8-bit binary	—
200	TYPE is now ASCII	—
200	Data protection level set to "[String]"	—
200	Protection level [string] not understood. Fallback to "[String]"	—
200	Ready to proceed	—
200	Command successful.	—
200	200 Path-delimiter is OFF / 200 Path-delimiter is ON	—
200	S OK	—
200	F OK	—
200	OK, UTF-8 enabled	—
202	Please tell me who you are	—
211	End.	—
213	End.	—
213	Command execution failure.	• Check the command and enter the supported parameter. • Check the directory name and enter the correct directory name.
214	[String] is an alias for [string].	—
214	The following aliases are available :	—
214	The following commands are recognized. (* =>'s not implemented)	—
214	Help End.	—
214	HELP command reply result (The message differs depending on the command.)	—
220	This server supports FXP transfers	—
220	Local time is now [value]: [value]. Server port: [value].	—
220	Only anonymous FTP is allowed here	—
220	You will be disconnected after [value] mseconds of inactivity.	—
220	This is a private system - No anonymous login	Correct the user name.
220	Active mode is disabled	—
221	Goodbye. You uploaded [value] and downloaded [value] kbytes.	—
221	Logout.	—
226	Since you see this ABOR must've succeeded	—
226	Out of memory during globbing of [string]	—
226	Read error during globbing of [string]	—
226	Nothing left to download	—
226	Transfer aborted	—
226	Output truncated to [value] matches	—
226	[Value] matches total	—
226	File successfully transferred	—
226	Transfer complete.	—
226	Options: [string]	—
226	Command execution failure.	• Check the command and enter the supported parameter. • Check the directory name and enter the correct directory name.
227	Entering Passive Mode ([value], [value], [value], [value], [value], [value])	—

Code	Message	Action to be taken
229	Extended Passive mode OK (|||[value]|)	—
230	Anonymous user logged in	Correct the user name.
230	Any password will work	—
230	OK. Current directory is [string]	—
230	OK. Current restricted directory is [string]	—
234	AUTH TLS OK.	—
250	OK. Current directory is [string]	—
250	Deleted [string]	—
250	End.	—
250	The directory was successfully removed	—
250	File successfully renamed or moved	—
250	Changed attribute is [string].	—
250	Current attribute is [string].	—
257	[String] is your current location	—
257	The directory was successfully created	—
331	Any password will work	—
331	Password required.	—
331	Any password will work	—
350	Restarting at [value]. But we're in ASCII mode	—
350	Restarting at [value]	—
350	RNFR accepted - file exists, ready for destination	—
400	Logout.	—
421	Timeout	• Execute the command again after a while. • Correct the FTP server setting again.
421	Timeout - try typing a little faster next time	• Log in again and then retry executing the command again. • Correct the FTP server setting again.
421	Line too long	• Check the command and enter the supported command. • Correct the FTP server setting again.
421	Timeout (no operation for [value] seconds)	• Check and correct the command input monitoring timer setting. • Log in again and execute the command.
421	Timeout (no new data for [value] seconds)	• Check and correct the command input monitoring timer setting. • Log in again and execute the command.
421	We can't do that in the current session	Correct the FTP server setting again.
421	Unable to set up secure anonymous FTP	Correct the FTP server setting again.
421	Sorry, but I can't trust you	Correct the FTP server setting again.
421	Home directory not available - aborting	Correct the FTP server setting again.
421	Unable to set up a secure chroot() jail	Correct the FTP server setting again.
421	Can't change directory to [string]	Correct the FTP server setting again.
421	Path too long	Correct the FTP server setting again.
421	Unable to identify the local socket	Correct the FTP server setting again.
421	The connection couldn't be accepted	Correct the FTP server setting again.
421	Sorry, but that file doesn't exist	Correct the FTP server setting again.
421	Please run pure-ftpd within a super-server (like tcpserver)	Correct the FTP server setting again.
421	Configuration error	Correct the FTP server setting again.
421	Missing virtual users file name	Correct the FTP server setting again.
421	Illegal value for throttling	Correct the FTP server setting again.
421	Illegal trusted gid for chroot	Correct the FTP server setting again.
421	Illegal user limit	Correct the FTP server setting again.
421	Invalid LDAP configuration file	Correct the FTP server setting again.
421	Illegal load limit	Correct the FTP server setting again.
421	Illegal ports range	Correct the FTP server setting again.
421	Illegal 'ls' limits	Correct the FTP server setting again.
421	Illegal forced IP for passive connections	Correct the FTP server setting again.
421	Illegal upload/download ratio	Correct the FTP server setting again.

Code	Message	Action to be taken
421	Illegal uid limit	Correct the FTP server setting again.
421	Unknown run-time option	Correct the FTP server setting again.
421	Missing LDAPBaseDN in the LDAP configuration file	Correct the FTP server setting again.
421	[Value] users (the maximum) are already logged in, sorry	Check whether other FTP clients are already connected.
421	Invalid umask	Correct the FTP server setting again.
421	Too many connections ([value]) from this IP	Check whether other FTP clients are already connected.
421	Out of memory	Correct the FTP server setting again.
421	Illegal trusted IP address	Correct the FTP server setting again.
421	Unknown logging format	Correct the FTP server setting again.
421	Invalid SQL configuration file	Correct the FTP server setting again.
421	Missing server in the SQL configuration file	Correct the FTP server setting again.
421	Invalid quota	Correct the FTP server setting again.
421	Unknown authentication method	Correct the FTP server setting again.
421	Unable to read the indexed puredb file (or old format detected) - Try pure-pw mkdb	Correct the FTP server setting again.
421	I can't accept more than [value] connections as the same user	Correct the FTP server setting again.
421	Sorry, cleartext sessions and weak ciphers are not accepted on this server. [line break] Please reconnect using TLS security mechanisms.	Correct the encrypted communication setting of the FTP client.
421	Invalid LDAPAuthMethod in the configuration file. Should be 'bind' or 'password'.	Correct the FTP server setting again.
421	Invalid argument: "[String]"	Correct the FTP server setting again.
421	Interprocess communication transmission error.	• Check and correct the response monitoring timer setting. • Log in again and execute the command.
421	setsockopt	Correct the FTP server setting again.
421	chdir [string]	Correct the FTP server setting again.
421	Unable to switch capabilities	Correct the FTP server setting again.
421	Accepted data connection	—
421	Could not open data connection to port [value]	• Correct the data connection port on the FTP client side. • Correct the network environment and execute the target command again.
421	Connecting to port [value]	—
421	Timeout (no new data for [value] mseconds)	• Check and correct the command input monitoring timer setting. • Log in again and execute the command.
425	Can't create the data socket	Correct the data connection port on the FTP client side.
425	You cannot use PASV on IPv6 connections. Use EPSV instead.	Set the IP address of the FTP client to IPv4.
425	Unable to open a passive connection	Close all other connections except for the Ethernet function.
425	All reserved TCP ports are busy	Close all other connections except for the Ethernet function.
425	Unable to identify the local data socket	Close all other connections except for the Ethernet function.
425	Sorry, invalid address given	Check and correct the IP address of the FTP client.
425	Please use an IPv6-conformant client with EPSV support	Set the IP address of the FTP client to IPv4.
425	No data connection	Correct the data connection port on the FTP client side.
425	Could not open data connection to port [value]	• Correct the data connection port on the FTP client side. • Correct the network environment and execute the target command again.
426	ABORT	• Correct the data connection port on the FTP client side. • Check that the target file is correct. • Correct the network environment and execute the target command again.
426	Transfer aborted	Check the command and enter the supported parameter.
427	[String] Command Error.	Check the command and enter the supported parameter.
427	427 [String] Command Error	Check the command and enter the supported parameter.

Code	Message	Action to be taken
428	[String] The specified file cannot be operated.	• Check that the specified file or directory name does not contain any invalid characters. • Check that the file extension can be operated for the destination drive. • Set the status to STOP. • Correct the length of file and folder names. • Correct the length of the file path. • Correct the file path name. • Check that the file can be operated by currently logged-in users when the user authentication function is used. • Check that the drive can be operated using the FTP server function. • Check if the system folder is not specified.
429	[String] File Locked.	Check that the specified file is not opened by an engineering tool or external device such as SLMP.
451	Can't find file size	• Specify the file that exists. • Execute the command again after a while.
451	Transfer aborted	• Check the command and enter the supported parameter. • Check the free space of the drive. • Check that the file attribute is not read-only.
451	Error during read from data connection	Correct the data connection port on the FTP client side.
451	Couldn't get the local time	Specify the file that exists.
451	Rename/move failure	• Check that the storage source file exists. • Check the name of the storage source/location file.
451	System protected.	• Set the status to STOP. • Allow the online change. • Check the command to see if it is compatible with the user authentication function. • Check the operating procedure on the FTP client side.
451	remap	Check the command and enter the supported parameter.
451	seek	• Check the command and enter the supported parameter. • Correct the FTP server setting again.
451	ftruncate	• Check the command and enter the supported parameter. • Correct the FTP server setting again.
451	Error during write to file	• Check the free space of the write destination. If there is not enough free space, delete unnecessary files to create free space on the media. • Correct the network environment and execute the target command again. • Correct the FTP server setting again.
451	fcntl(F_SETFL, O_NONBLOCK)	Correct the FTP server setting again.
451	gettimeofday()	Correct the FTP server setting again.
452	Error during write to file	• Check the free space of the write destination. If there is not enough free space, delete unnecessary files to create free space on the media. • Correct the network environment and execute the target command again. • Correct the FTP server setting again.
500	This security scheme is not implemented	Check the command and enter the supported command.
500	[String] Missing argument (Including cases where no characters are input in [string])	Check the command and enter the supported parameter.
500	is an unknown extension	Check the command and enter the supported command.
500	Unknown command	• Check the command and enter the supported command. • If a file is being transferred, wait until the transfer is complete before executing the command again.
500	I won't open a connection to [string] (only to [string])	Correct the data connection port on the FTP client side.
500	Command not understood.	Check the command and enter the supported command.
501	Syntax error in IP address	Correct the network settings on the FTP client side.
501	No file name	Check the command and enter the supported parameter.
501	No directory name	Check the command and enter the supported parameter.
501	No restart point	Check the command and enter the supported parameter.
501	[String] Missing argument (Including cases where no characters are input in [string])	Check the command and enter the supported parameter.
501	Garbage found after value	Check the command and enter the supported parameter.
501	Value too large	Check the command and enter the supported parameter.

Code	Message	Action to be taken
501	Invalid permissions	Check the command and enter the supported parameter.
501	Sorry, but I won't connect to ports < 1024	Correct the data connection port on the FTP client side.
501	Can't find file size	• Check the command and enter the supported parameter. • Execute the command again after a while.
501	Can't get a time stamp	• Check the command and enter the supported parameter. • Check and correct the specified file name.
501	Active mode is disabled	Check the command and enter the supported parameter.
501	501 File, directory not present or syntax error.	Check the command and enter the supported parameter.
501	TYPE is now 8-bit binary	—
501	TYPE is now ASCII	—
502	Unknown command	• Check the command and enter the supported command. • If a file is being transferred, wait until the transfer is complete before executing the command again.
502	Configuration error	Check the FTP server setting parameter.
502	Unknown alias [string].	Check the command and enter the supported command.
502	Unknown command [string].	Check the command and enter the supported command.
503	[String] Missing argument (Including cases where no characters are input in [string])	Check the command and enter the supported parameter.
503	Need RNFR before RNTO	Check the order in which the commands are sent on the FTP client side.
503	ASCII resume is unsafe, please delete the file first	• Check the command and enter the supported parameter. • Delete the existing file and execute the command again.
503	PROT must be preceded by a successful PBSZ command	Check the command and enter the supported parameter.
504	Unknown command	• Check the command and enter the supported command. • If a file is being transferred, wait until the transfer is complete before executing the command again.
504	Reply marker must be 0 in ASCII mode	Check the command and enter the supported command.
504	Only 8-bit bytes are supported, we're not 10 years ago	Check the command and enter the supported parameter.
504	Unknown TYPE	Check the command and enter the supported parameter.
504	Only F(ile) is supported	Check the command and enter the supported parameter.
504	Please use S(tream) mode	Check the command and enter the supported parameter.
504	Parameter not accepted, not implemented.	Check the command and enter the supported parameter.
504	Parameter not accepted, not implemented.	Check the command and enter the supported parameter.
504	TYPE is now 8-bit binary	—
504	TYPE is now ASCII	—
520	Unable to open a passive connection	Check whether the control port of the FTP server is restricted by the firewall.
520	Active mode is disabled	Correct the FTP server setting again.
521	Data connection cannot be opened with this PROT setting.	Correct the FTP client encrypted communication setting and the command name.
522	Only IPv4 and IPv6 are supported (1,2)	Correct the network settings on the FTP client side.
522	Only IPv4 is supported (1)	Correct the network settings on the FTP client side.
530	Line too long	Check the password and enter the correct password.
530	You aren't logged in	Log in and execute the command again.
530	You're already logged in	Log in again and execute the command.
530	We can't do that in the current session	Log in again and execute the command.
530	Sorry, but I can't trust you	Log in again and execute the command.
530	Please tell me who you are	Log in again and execute the command.
530	Please tell me who you are	Log in again and execute the command.
530	This is a private system - No anonymous login	Correct the user name.

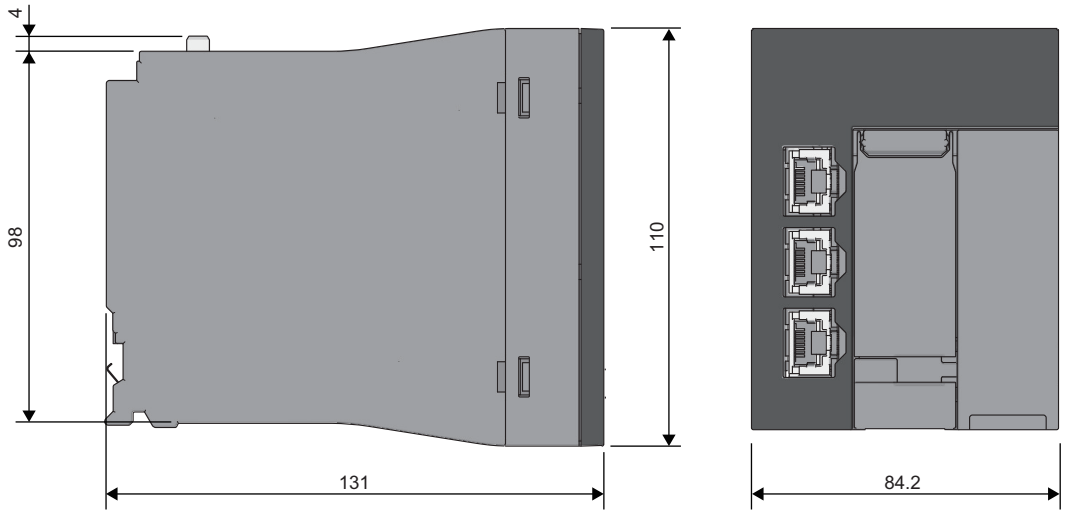
Code	Message	Action to be taken
530	Login authentication failed	• Correct the user name and password. • When the user authentication function is enabled, check that the parameter setting of the FTP server (To Use or Not to Use User Authentication) is set to "Use". • When the user authentication function is disabled, check that the parameter setting of the FTP server (To Use or Not to Use User Authentication) is set to "Not Use". • When the user authentication function is enabled, check that the password of the specified user has not expired and that the user account is not locked out. • When the user authentication function is enabled, check that the Ethernet port is set to "Authenticate" in the user authentication function setting item (Authentication Target Route Setting). • Check that the iQ Sensor Solution data backup/restoration function is not being executed. • If all information is initialized when the user authentication function is enabled, retry the operation after re-setting the user authentication function and the FTP server function and restarting the controller. • If attempting to write user information when the user authentication function is enabled, retry the operation after the writing process is completed.
530	Not logged in.	• Log in and retry the operation. • Check the operating procedure on the FTP client side.
530	This is a private system - No anonymous login	Log in again and execute the command.
534	TLS: Cipher too weak	Correct the encrypted communication setting of the FTP client.
534	Fallback to [C]	Check the command and enter the supported parameter.
535	The server certificate has expired or error detected.\n Please confirm server certificate.	• Check if the controller server certificate has not expired. • Generate the controller server certificate again, then restart the controller and retry the operation.
550	No file name	Check the command and enter the supported parameter.
550	No directory name	Check the command and enter the supported parameter.
550	You must respect a [value]:[value] (UL/DL) ratio	• Execute the command again after a while. • Check that the specified file exists.
550	Can't change directory to [string]	Check that the specified directory exists.
550	Anonymous users are not allowed to move/rename files	• Execute the command again after a while. • Check that the specified file exists.
550	Anonymous users can not change perms	• Execute the command again after a while. • Check that the specified file exists.
550	Could not change perms on [string]	• Execute the command again after a while. • Check that the specified file exists.
550	Anonymous users may not overwrite existing files	• Execute the command again after a while. • Check that the specified file exists.
550	Could not delete [string]	• Execute the command again after a while. • Check that the specified file exists. • Check that the file attribute is not read-only.
550	The load was [value] when you connected. We do not allow downloads [line break] by anonymous users when the load is that high. Uploads are always [line break] allowed.	• Execute the command again after a while. • Check that the specified file exists.
550	Can't open [string]	• Specify the file that exists. • Execute the command again after a while.
550	Can't check for file existence	• Execute the command again after a while. • Check that the specified file exists.
550	I can only retrieve regular files	• Execute the command again after a while. • Check that the specified file exists.
550	This file has been uploaded by an anonymous user. It has not [line break] yet been approved for downloading by the site administrators.	• Execute the command again after a while. • Check that the specified file exists.
550	Sorry, but the upload/download ratio is [value]:[value].[line break] You currently uploaded [value] Kb and downloaded [value] Kb. [line break] Please upload some goodies and try leeching later.	• Execute the command again after a while. • Check that the specified file exists.

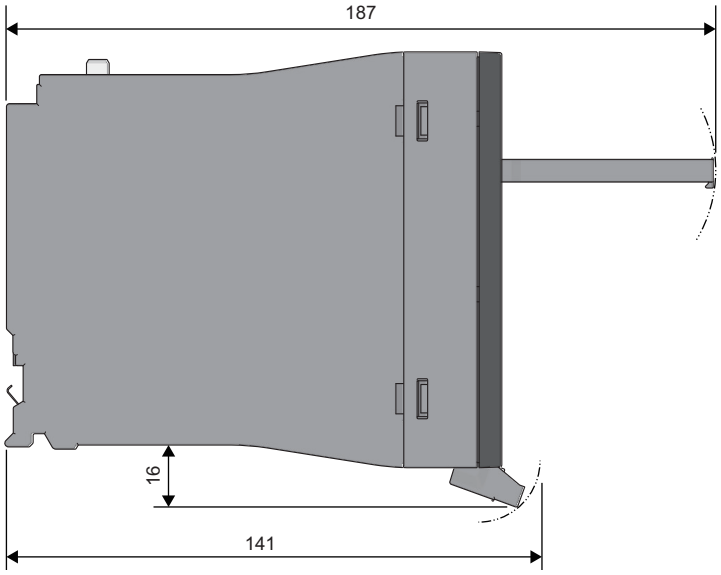
Code	Message	Action to be taken
550	Can't create directory	• Check that the folder with the same name does not already exist in the storage destination. • Check the space of the storage destination drive. • Check the path to the directory creation destination.
550	Can't remove directory	• Execute the command again after a while. • Check that the specified folder exists. • Check that there are no files in the folder. • Check that the specified drive can be operated through access to its directory. • Check the free space of the write destination. If there is not enough free space, delete unnecessary files to create free space on the media. • Correct the FTP server setting again. • Correct the specified by the path details. (Check that the target path is a directory.)
550	Sorry, but that file doesn't exist	• Execute the command again after a while. • Check that the specified file exists.
550	Rename/move failure	• Check that the storage source file exists. • Check the name of the storage source/location file.
550	Command execution failure.	• Check the command and enter the supported parameter. • Check the directory name and enter the correct directory name.
550	Can't change directory to [string]	Check that the specified directory exists.
550	550 File not found.	Check and correct the specified file name.
550	SD card not present error.	• Check that the SD memory card is inserted. • Check that the SD memory card is not damaged. • Check the command and enter the supported parameter.
550	Options: [string]	—
550	Is Directory.	Check that the path specified is not a directory.
552	Transfer aborted	Check the command and enter the supported parameter.
552	Disk full - please upload later	Check the free space of the write destination. If there is not enough free space, delete unnecessary files to create free space on the media.
553	Can't open that file	Specify the file that exists.
553	Can't check for file existence	Specify the file that exists.
553	Prohibited file name: [string]	Check and correct the specified file name.
553	Can't get a time stamp	• Check the command and enter the supported parameter. • Check and correct the specified file name.
553	Rename/move failure	• Check that the storage source file exists. • Check the name of the storage source/location file.
553	Invalid Delimiter Detected.	Check that a path delimiter ("\" or "/") in the specified path string is the delimiter specified by using the FTP operation command, or with the special relay or special register.
553	Can't open that file: Permission denied	Check that the file attribute is not read-only.
554	Restart offset [value] is too large for file size [value].	• Execute the command again after a while. • Check that the specified file exists.
554	Restart offset reset to 0	• Execute the command again after a while. • Check that the specified file exists.
554	REST needs a numeric parameter	• Execute the command again after a while. • Check that the specified file exists.
Undefined	Your bandwidth usage is restricted	Correct the FTP server setting again.
Undefined	This server supports FXP transfers	—
Undefined	You must respect a [value]:[value] (UL/DL) ratio	—
Undefined	FXP transfer: from [string] to [string]	—
Undefined	(This probably means "Permission denied")	—
Undefined	The computer is your friend. Trust the computer	—
Undefined	[Value] kbytes to download	—
Undefined	[Value] seconds (measured here), [value] Mbytes per second	—
Undefined	[Value] seconds (measured here), [value] Kbytes per second	—
Undefined	[Value] seconds (measured here), [value] bytes per second	—
Undefined	[Value] Mbytes free disk space	—
Undefined	[Value] Kbytes free disk space	—

Code	Message	Action to be taken
Undefined	Aborting previous rename operation	Check the command and enter the supported parameter.
Undefined	Welcome to	—
Undefined	You are user number [value] of [value] allowed.	—
Undefined	RATIOS ARE ENABLED FOR EVERYONE:	—
Undefined	ANONYMOUS USERS ARE SUBJECT TO AN UL/DL RATIO:	—
Undefined	to download [value] Mb, uploading [value] Mb of goodies is mandatory.	—
Undefined	[Value] files used ([value]%) - authorized: [value] files	—
Undefined	[Value] Kbytes used ([value]%) - authorized: [value] Kb	—
Undefined	Quota exceeded: [[string]] won't be saved	Correct the FTP server setting again.
Undefined	IPv6 connections are also welcome on this server.	—
Undefined	Warning: client is in ASCII mode - Assuming data is plain text	—
Undefined	[String] Missing argument (Including cases where no characters are input in [string])	Check the command and enter the supported parameter.

APPENDICES

Appendix 1 External Dimensions





(Unit: mm)

Appendix 2 EMC and Low Voltage Directives

In each country, laws and regulations concerning electromagnetic compatibility (EMC) and electrical safety are enacted.
For the products sold in the European countries, compliance with the EU's EMC Directive has been a legal obligation as EMC regulation since 1996, as well as the EU's Low Voltage Directive as electrical safety regulation since 1997.
Manufacturers who recognize their products are compliant with the EMC and Low Voltage Directives are required to attach a "CE marking" on their products in European countries.
In some other countries and regions, manufacturers are required to make their products compliant with applicable laws or regulations and attach a certification mark on the products as well (such as UK Conformity Assessed (UKCA) marking in the UK, and Korea Certification (KC) marking in South Korea).
Each country works to make their regulatory requirements consistent across countries based on international standards. When the requirements are consistent, measures to comply with the EMC and electrical safety regulations become common across countries.
The UK and South Korea have enacted EMC regulations whose requirements are consistent with those of the EMC Directive. The UK has also enacted electrical safety regulations whose requirements are consistent with those of the Low Voltage Directive. In this section, the requirements of the EMC and Low Voltage Directives are described as examples of those of the EMC and electrical safety regulations.

Measures to comply with the EMC Directive

The EMC Directive sets requirements for emission (conducted and radiated electromagnetic interference emitted by a product) and immunity (the ability of a product not to be influenced by externally generated electromagnetic interference).
This section describes the precautions for machinery constructed with the controller to comply with the EMC Directive.
These precautions are based on the requirements of the EMC Directive and the harmonized standards. However, they do not guarantee that the entire machinery constructed according to the descriptions complies with the EMC Directive.
The manufacturer of the machinery must determine the testing method for compliance and declare conformity to the EMC Directive.

EMC Directive related standards

■Emission requirements

Standard: EN 61131-2: 2007

Test item	Test description	Value specified in standard
CISPR16-2-3 Radiated emission*2	The electromagnetic wave emitted by the product to the external space is measured.	• 30 to 230MHz, QP: 40dBμV/m (measured at 10m distance)*1 • 230 to 1000MHz, QP: 47dBμV/m (measured at 10m distance)
CISPR16-2-1, CISPR16-1-2 Conducted emission*2	The noise level which the product emits to the power line is measured.	• 0.15 to 0.5MHz, QP: 79dB, Mean: 66dB*1 • 0.5 to 30MHz, QP: 73dB, Mean: 60dB

*1 QP: Quasi-Peak value, Mean: Average value
*2 The controller is an open-type device and must be placed in a conductive control panel or similar type of enclosure. The tests were conducted with the controller installed in a control panel, applying the maximum rated input voltage of the power supply module.

■Immunity requirements

Standard: EN 61131-2: 2007

Test item	Test description	Value specified in standard
EN 61000-4-2 Electrostatic discharge immunity*1	An electrostatic discharge is applied to the enclosure of the equipment.	• 8kV: Air discharge • 4kV: Contact discharge
EN 61000-4-3 Radiated, radio-frequency, electromagnetic field immunity*1	An electric field is radiated to the product.	80% AM modulation @1kHz • 80 to 1000MHz: 10V/m • 1.4 to 2.0GHz: 3V/m • 2.0 to 2.7GHz: 1V/m
EN 61000-4-4 Fast transient burst immunity*1	Burst noise is applied to power lines and signal lines.	• AC/DC power, I/O power, and AC I/O (unshielded) lines: 2kV • DC I/O, analog, and communication lines: 1kV
EN 61000-4-5 Surge immunity*1	Lightning surge is applied to power lines and signal lines.	• AC power, AC I/O power, and AC I/O (unshielded) lines: 2kV CM, 1kV DM • DC power and DC I/O power lines: 0.5kV CM, 0.5kV DM • DC I/O, AC I/O (shielded), analog*2, and communication lines: 1kV CM
EN 61000-4-6 Conducted RF immunity*1	High-frequency noise is applied to power lines and signal lines.	0.15 to 80MHz, 80% AM modulation @1kHz, 10Vrms
EN 61000-4-8 Power-frequency magnetic field immunity*1	The product is immersed in the magnetic field of an induction coil.	50/60Hz, 30A/m
EN 61000-4-11 Voltage dips and interruptions immunity*1	Power voltage is momentarily interrupted.	• 0%, 0.5 periods, starting at zerocrossing • 0%, 250/300 periods (50/60Hz) • 40%, 10/12 periods (50/60Hz) • 70%, 25/30 periods (50/60Hz)

*1 The controller is an open-type device and must be placed in a conductive control panel or similar type of enclosure. The tests were conducted with the controller installed in a control panel.

*2 The accuracy of an analog-digital converter module may temporarily vary within ±10%.

Installation in a control panel

The controller is an open-type device intended to be placed in a conductive control panel or similar type of enclosure. Remote modules on each network must be also installed inside the control panel. Waterproof type remote modules can be installed outside the control panel.
Installing the controller inside the control panel ensures safety and provides effective shielding from electromagnetic noise emitted by the controller.

■Control panel

- Use a conductive control panel.
- Mask off an area used for grounding when securing the top or bottom plate to the control panel using bolts.
- To ensure electrical contact between inner plates and the control panel, mask off the bolt installation areas of each inner plate so that conductivity can be ensured in the largest area.
- Ground the control panel with a thick ground cable so that low impedance can be ensured even at high frequencies.
- Keep the diameter of the holes on the control panel to 10cm or less. If the diameter is larger than 10cm, electromagnetic wave may leak. In addition, because electromagnetic wave leaks through a clearance between the control panel and its door, reduce the clearance as much as possible. Use of EMI gaskets (sealing the clearance) can suppress undesired radiated emissions.

The tests were conducted by Mitsubishi Electric Corporation using a control panel having damping characteristics of 37dB (maximum) and 30dB (average) (measured at 3m distance, 30 to 300MHz).

■Power cable and ground cable

- Provide a ground point to the control panel near the power supply module. Ground the LG and FG terminals of the power supply module to the ground point with the shortest and thickest ground cable possible (30cm or shorter, 2mm^2).
- Twist the ground cable extended from the ground point with the power cable so that larger amount of noise generated from the power cable is absorbed to the ground. Note that if a noise filter is attached to the power cable, twisting may not be required.

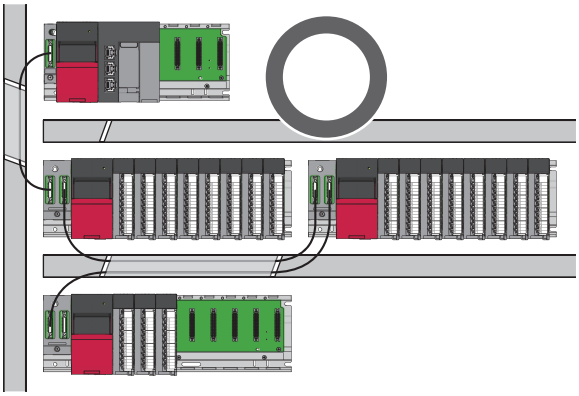
■DIN rails

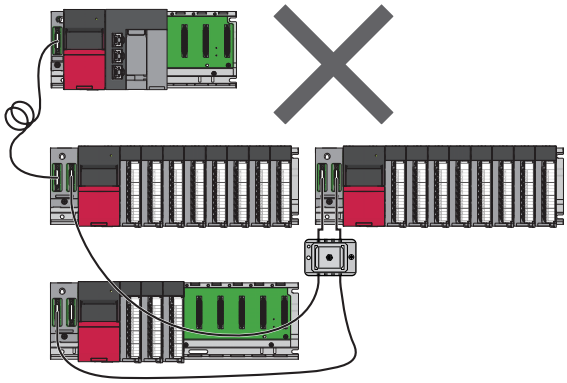
Aluminum DIN rails may have insulation films. If an electrical contact cannot be secured between a DIN rail and the controller, take measures to obtain conductivity. The following methods can be used to obtain conductivity.

- Secure the controller to the control panel with screws (instead of using a DIN rail).
- Use iron DIN rails, such as TH35-7.5Fe and TH35-15Fe.

■Extension cables

- Wire cables with extension cables placed in ducts. If not, dangling cable may swing or inadvertently be pulled, resulting in damage to the module or cables or malfunction due to poor contact.
- Do not clamp the extension cables with the jacket stripped.
- Use the shortest extension cable according to the distance between the base units connected.



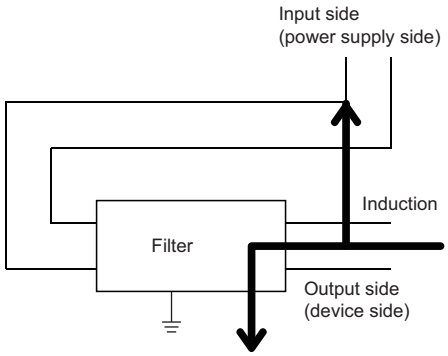


■Noise filter (power supply line filter)

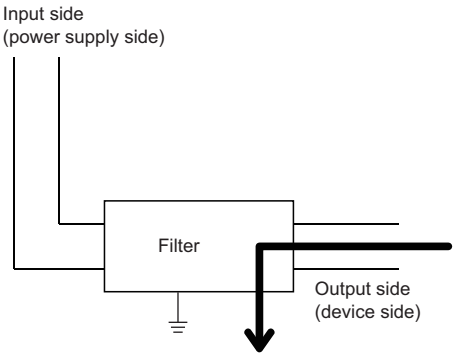
A noise filter is effective for reducing conducted noise in the 10MHz or less frequency band. (Use of a noise filter can suppress noise.)

The following are the installation precautions.

- Do not bundle the cables on the input side and output side of the noise filter. If bundled, the noise on the output side is induced into the filtered cable on the input side.



• Problematic example
Noise is induced when the input and output cables are bundled.

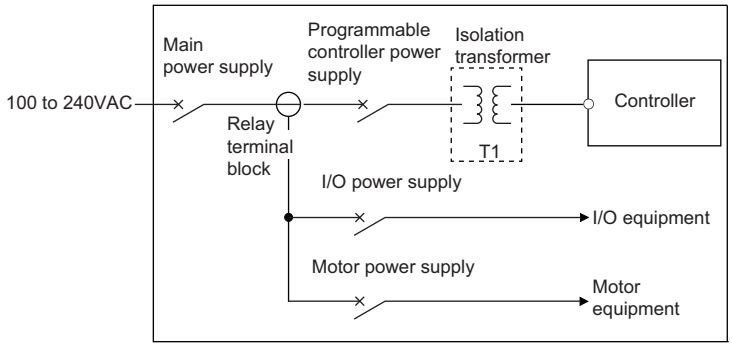


• Modification example
Install the input and output cables separately.

- Ground the ground terminal of the noise filter to the ground point of the control panel with the shortest cable possible (approximately 10cm).

■Isolation transformer

An isolation transformer is effective for reducing conducted noise (especially for lightning surge noise). Lightning surge noise may cause malfunction of the controller. As measures against lightning surge noise, connect an isolation transformer as shown below. Use of an isolation transformer can reduce a lightning effect.



Use the isolation transformer according to its usage environment and storage environment. The following table lists the performance specifications of the recommended isolation transformer.

Item	Specifications
Number of phase	Single phase
Frequency	50/60Hz
Rated capacity	*1
Secondary voltage*2	200V/100V
Rating	Continuous
Heat resistance class (insulation class)	H
Electrostatic shield	Provided
Isolation resistance and withstand voltage*3	4200V/1 minute, 5MΩ or more between P and S
	2500V/1 minute, 7MΩ or more between P and iron core
	2500V/1 minute, 7MΩ or more between S and iron core
Standard*4	UL 506, UL 5085
	EN 61558-1
	EN 61558-2-4

*1 Select an isolation transformer considering the power capacity of equipment to be used.
*2 Select the secondary voltage so that the input voltage specifications of the power supply module are met.
*3 Among required voltage values specified in UL and EN standards, stricter values are listed here.
*4 Use an isolation transformer in the conditions that satisfy the requirements of standards.

External power supply

Use a reinforced or double insulated CE-marked external power supply, and ground the FG terminal.

- External power supply used for the tests conducted by Mitsubishi Electric: PS5R-SF24 (manufactured by IDEC Corporation)

Each module

■Power supply module

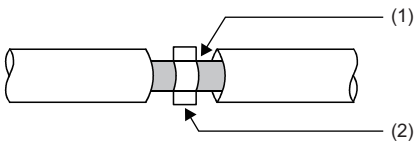
- Ground the LG and FG terminals after short-circuiting them.
- Keep the power cable length for the external power supply to 30m or less.

■Controller

When inserted into the controller, the SD memory card (NZ1MEM-□GBSD) manufactured by Mitsubishi Electric complies with EN 61131-2.

■Ethernet cable used for the CC-Link IE TSN port (P1, P2)

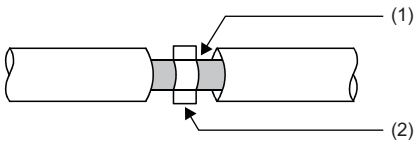
- Use an Ethernet cable recommended by CC-Link Partner Association.
- Ethernet cable is a shielded cable. Strip a part of the jacket as shown below and ground the exposed shield to the largest area.



(1) Shield
(2) Clamp

■Ethernet cable used for the Ethernet port (P3)

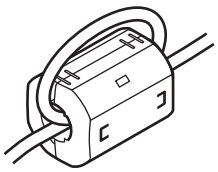
- Use a duplex shield type cable.
- Ethernet cable is a shielded cable. Strip a part of the jacket as shown below and ground the exposed shield to the largest area.



(1) Shield
(2) Clamp

■USB cable used for the USB port

- The cable length must be 3m or shorter.
- Attach a ferrite core to the cable by wrapping the cable around the ferrite core once as shown below. Ferrite core used for the tests conducted by Mitsubishi Electric: ZCAT2132-1130 (manufactured by TDK Corporation)



Measures to comply with the Low Voltage Directive

The Low Voltage Directive requires electrical equipment that is designed or adapted for use between 50 to 1000VAC or 75 to 1500VDC to satisfy the safety requirements.
This section describes the precautions for use of the controller to comply with the Low Voltage Directive.
These precautions are based on the requirements of the Low Voltage Directive and the harmonized standards. However, they do not guarantee that the entire machinery constructed according to the descriptions complies with the Low Voltage Directive. The manufacturer of the machinery must determine the testing method for compliance and declare conformity to the Low Voltage Directive.

Standard that applies to the controller

• EN61131-2 "Safety requirements for electrical equipment for measurement, control and laboratory use"

For products used with the controller, modules that operate at a rated voltage of 50VAC/75VDC or higher have also been developed in accordance with the above standard.
However, the modules that operate at a rated voltage of less than 50VAC/75VDC are not subject to the Low Voltage Directive compliance.

Scope of the standard

■Power supply module

Power supply modules for the AC power supply have hazardous voltage (peak voltage higher than or equal to 42.4V) internally. Therefore, for the CE-marked power supply modules, insulation between the primary and secondary circuits is reinforced.

■Base unit, controller, SD memory card

These products are not subject to the Low Voltage Directive compliance because the circuits in the products operate at the rated voltage of 24VDC or less.

Power supply

The insulation specifications of the power supply modules are determined based on the assumption that the overvoltage category Ⅱ is applied. Therefore, select the power supply to the controller so that the overvoltage category Ⅱ is met.
Supply the power to this device from the SELV (Safety Extra-Low Voltage) power supply that meets LIM or UL 1310 Class 2.

External wiring

■24VDC external power supply

For 24VDC I/O modules or intelligent function modules requiring an external power supply, connect an external power supply where the 24VDC circuit section is separated from the hazardous voltage circuit section with reinforced insulation.

■External devices

When connecting the controller to an external device that has the hazardous voltage circuit internally, use the device whose interface circuit section to the controller is separated from the hazardous voltage circuit using reinforced insulation.

■Reinforced insulation

Reinforced insulation means insulation having the following withstand voltage.

Rated voltage of hazardous voltage	Surge withstand voltage (1.2/50μs)
150VAC or less	2500V
300VAC or less	4000V

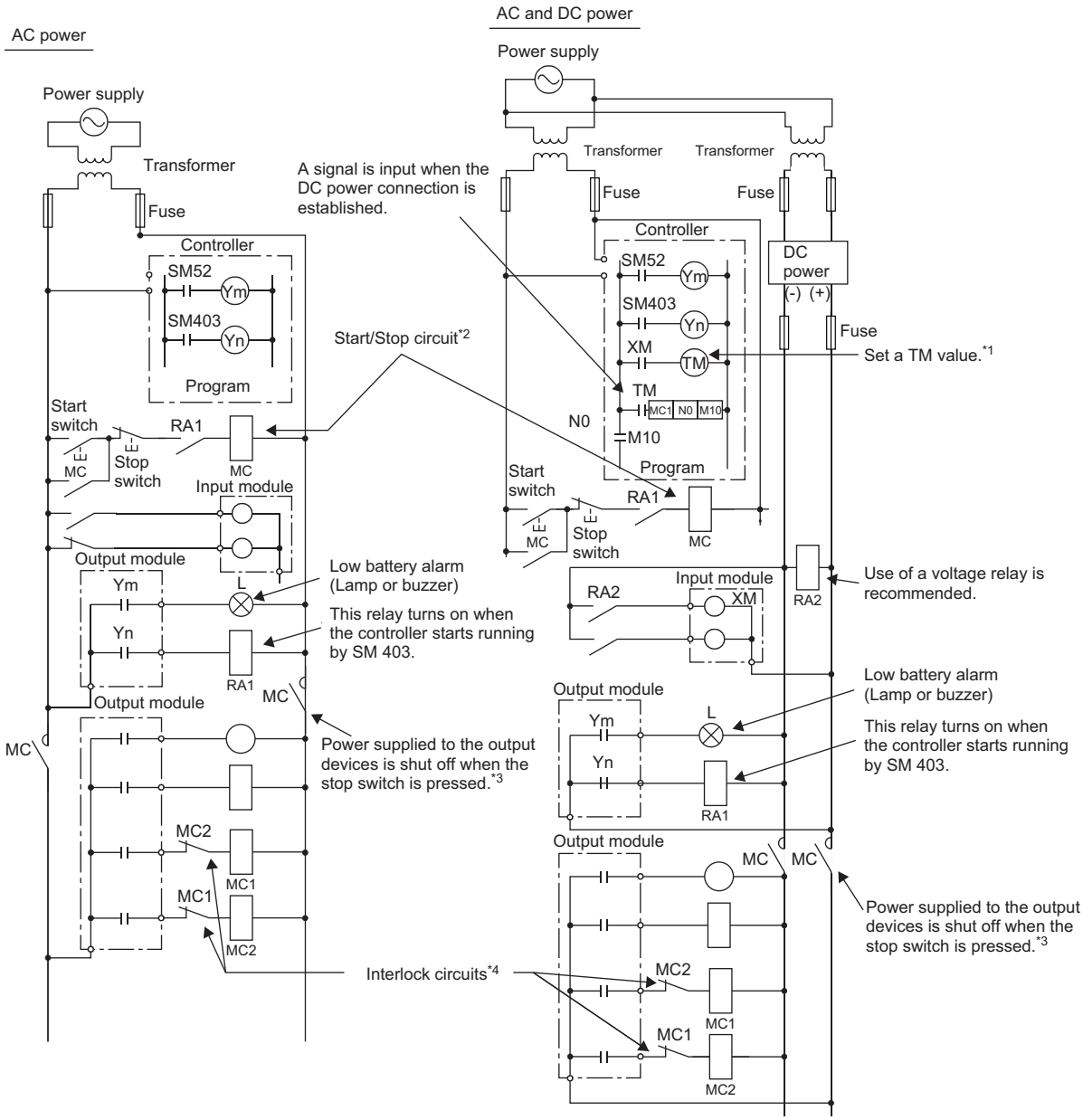
(Overvoltage category Ⅱ, source: IEC 60664-1)

Appendix 3 General Safety Requirements

When a controller is powered on or off, the control target module may temporarily fail to correctly output signals due to differences in the delay and startup times between the controller's power supply and the external power supply (especially, DC power) for the control target module.
In addition, the signals may not be output correctly when the external power supply or the controller fails.
In terms of fail-safe measures and to prevent any incorrect output signals from causing the entire system failure, configure safety circuits (such as emergency stop circuits, protection circuits, and interlock circuits) external to the controller for the parts where the incorrect output may cause damage to the machines or accidents.
This section shows system design circuit examples, considering the points described above.

System design circuit examples

When the $\overline{\text{ERR}}$ contact of the power supply module is not used



*1 Set a time required for DC input signal to be established.
*2 It can start when RA1 (controller RUN output) turns on.
*3 The output devices are turned off at an emergency stop or a stop caused by a limit switch.
*4 Configure external interlock circuits for conflicting operations such as forward/reverse rotations and the parts where the incorrect output may cause damage to the machines or accidents.

The power-on procedure is described below.

■For AC power

1. Power on the controller.
2. Set the controller to RUN.
3. Turn on the start switch.
4. The output devices will be activated by the program when the electromagnetic contactor (MC) turns on.

■For AC and DC power

1. Power on the controller.
2. Set the controller to RUN.
3. RA2 turns on when DC power is established.
4. The timer (TM) turns on when DC power is fully established.

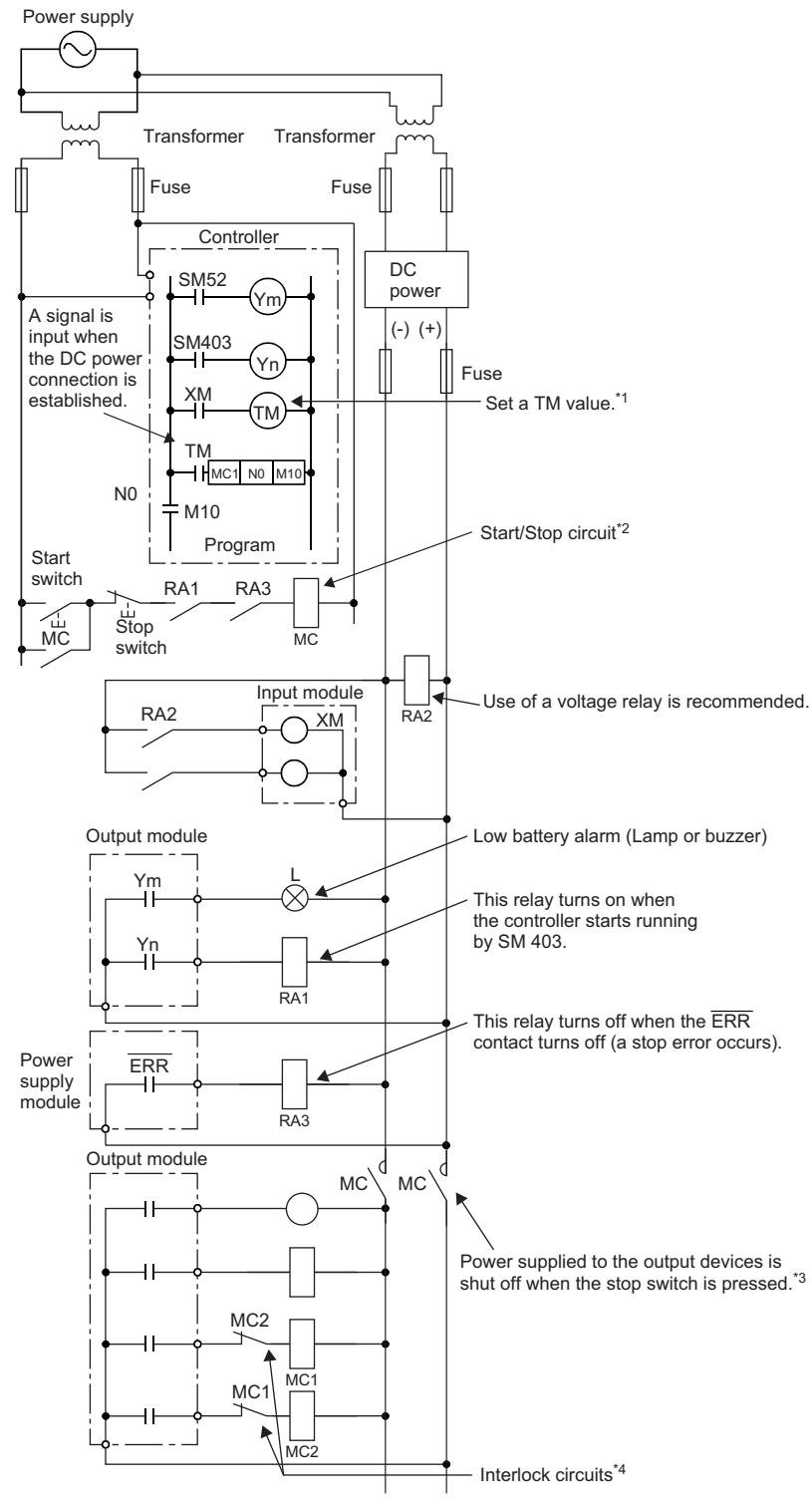
(The TM value shall be the time required from when RA2 turns on to when DC voltage is fully established. Set this value to 0.5 seconds.)

5. Turn on the start switch.
6. The output devices will be activated by the program when the electromagnetic contactor (MC) turns on.

(If a voltage relay is used for RA2, the timer (TM) on the program is not required.)

When the $\overline{\text{ERR}}$ contact of the power supply module is used

AC and DC power



*1 Set a time required for DC input signal to be established.

*2 It can start when RA1 (controller RUN output) turns on.

*3 The output devices are turned off at a stop caused by a stop switch (an emergency stop switch or a limit switch) or $\overline{\text{ERR}}$ contact OFF.

*4 Configure external interlock circuits for conflicting operations such as forward/reverse rotations and the parts where the incorrect output may cause damage to the machines or accidents.

The power-on procedure is described below.

■For AC and DC power

1. Power on the controller.

2. Set the controller to RUN.

3. RA2 turns on when DC power is established.

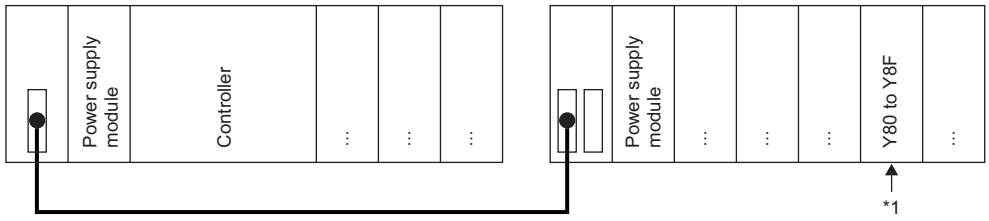
4. The timer (TM) turns on when DC power is fully established.
(The TM value shall be the time required from when RA2 turns on to when DC voltage is fully established. Set this value to 0.5 seconds.)

5. Turn on the start switch.

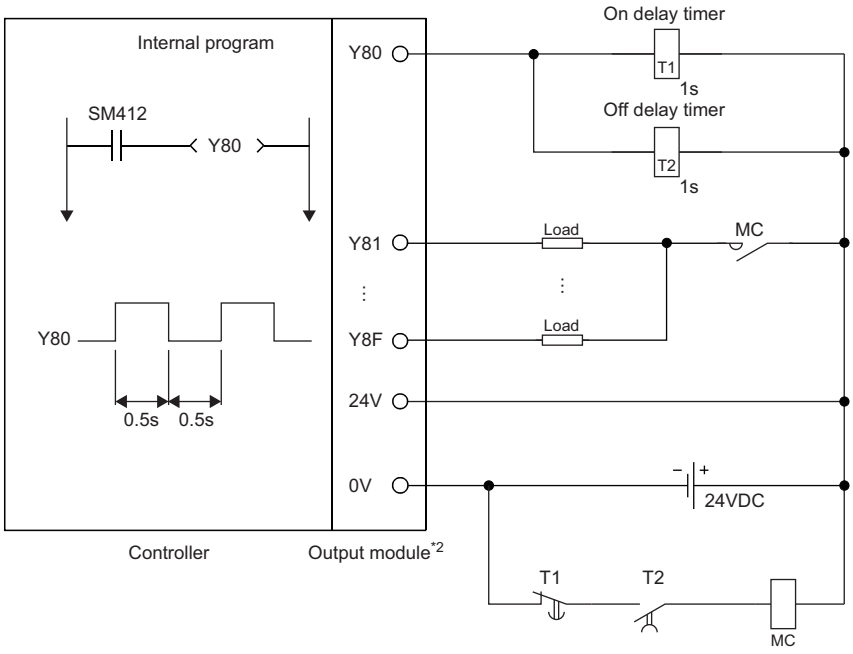
6. The output devices will be activated by the program when the electromagnetic contactor (MC) turns on.
(If a voltage relay is used for RA2, the timer (TM) on the program is not required.)

Fail-safe measures for controller failure

A controller can detect hardware failures of itself and its memory by the self-diagnostic function. However, failures which occur in a part, such as an I/O control part, may not be detected by the controller.
In this case, depending on the failure, all input or output points may turn on or off, or normal operation and safety of the control-target device may not be ensured.
Although Mitsubishi Electric controllers are manufactured under strict quality control, they may still fail for some reason.
Therefore, provide fail-safe circuits external to the controller to prevent machine damage and accidents.
A system example and its fail-safe circuit example are shown below.



*1 Mount an output module for fail-safe purpose in the last slot of the system.
In the example above, Y80 to Y8F are assigned to the output module.



*2 Since Y80 turns on and off at 0.5 second intervals, use a contactless output module. (In the example above, a transistor output module is used.)

Appendix 4 Clock Data

The controller internally maintains clock data and uses it to manage time for the system functions such as time stamp for the event history and the data logging function.

Time setting

The clock continues operating with the internal battery of the controller while the controller is powered off or during power failure longer than the allowable momentary power failure time.

Clock data

The following table lists the details of clock data in the controller.

Data name	Description
Year	Four digits (from 1980 to 2079)
Month	1 to 12
Day	1 to 31 (Automatic leap year detection)
Hour	0 to 23 (24 hours)
Minute	0 to 59
Second	0 to 59
Day of Week	0: Sunday, 1: Monday, 2: Tuesday, 3: Wednesday, 4: Thursday, 5: Friday, 6: Saturday
1/1000 seconds*1	0 to 999

*1 Data can be read from the S(P).DATERD instruction. (MELSEC MX Controller MX-R Model Programming Manual)

Changing the clock data

The clock data can be changed in one of the following methods:

- Using the engineering tool
- Using the SM/SD/label
- Using the instruction
- Automatic change using the SNTP server (☞ Page 1937 SNTP client)

Point

When the clock data is changed, the following operation is performed:

- Clock setting (Event code: 24000H) is logged in the event history.

■Using the engineering tool

Choose "Set Clock" from the menu. (GX Works3 Operating Manual)

■Using the SM/SD/label

After SM210 (clock data set request) is tuned off and on, values stored in SD210 (Clock data) to SD216 (Clock data) are written to the controller. Once the write operation is finished, SM210 is turned on and off. If values in SD210 to SD216 are out of the effective range, SM211 (Clock data set error) turns on and the values in SD210 to SD216 are not written to the controller.

■Using the instruction

Use the DATEWR instruction to write the clock data to the controller. (MELSEC MX Controller MX-R Model Programming Manual)

■Automatic change using the SNTP server

The time of the controller is automatically set by collecting clock data from the time information server (SNTP server) connected to the network at the specified timing.

Reading the clock data

The clock data can be read in one of the following methods:

- Using the SM/SD/label
- Using the instruction

■Using the SM/SD/label

When SM213 (Clock data read request) is turned on, the clock data is read to SD210 to SD216.

■Using the instruction

Use the DATERD(P)/S(P).DATERD instructions to read the clock data from the controller. (📖MELSEC MX Controller MX-R Model Programming Manual)

Operation of clock data

The clock data can be read and then operated by the sequence program.

For details on clock instructions, refer to the following.

📖MELSEC MX Controller MX-R Model Programming Manual

Precautions on the clock data

The following lists the precautions on the clock data.

■When using the product for the first time

Since the clock data is not set at the factory, be sure to set the correct data.

■Modifying the clock data

Even if a portion of the clock data is changed, write all the data to the controller again.

■Range of the clock data

The clock data must be written within the following range.

☞ Page 1935 Time setting

Even within the range, the clock function does not operate normally if data outside the clock range is written to the controller.

Ex.

Operating status of the controller when impossible date is set

Date	Write operation to the controller	Operating status of the controller
February 30	Executed	An error is not detected.
32th of month 13	Not executed	• When the DATEWR instruction is executed: Operation error (error code: 3285H) • When SM210 is turned off and on, SM211 turns on.

■Clock data setting during momentary power failure

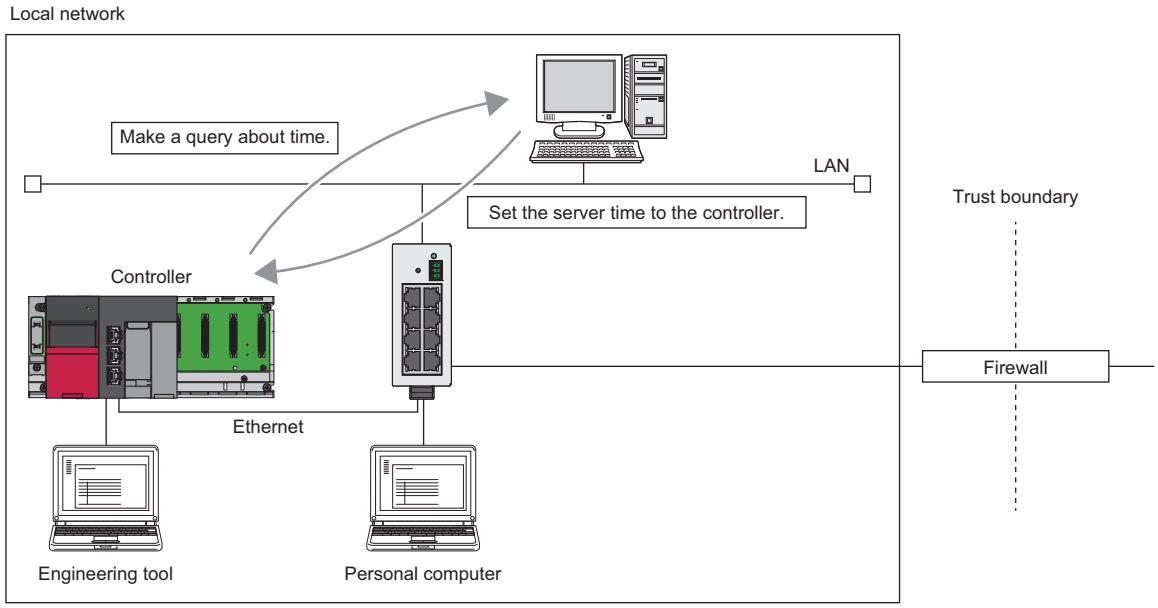
If clock data is set during a momentary power failure, the clock data may not be set.

SNTP client

The time of the controller is automatically set by collecting clock data from the time information server (SNTP server) connected to the network at the specified timing.

This setting can be used only for Ethernet ports. For port assignment, refer to the following.

☞ Page 50 MX-R Model



Point

An SNTP server (time information server) must be provided on the LAN line to use this function.
Locate the SNTP server (time information server) inside the trust boundary.

Time setting execution timing

Time setting is executed in the following timing.

- When the controller is powered off and on or reset
- At each set time (execution at set cycle interval)
- At set time (execution at set time)
- At programmed arbitrary timing*1

*1 The time is set when 'Time setting execution (U3E0\G299)' is turned on.

Point

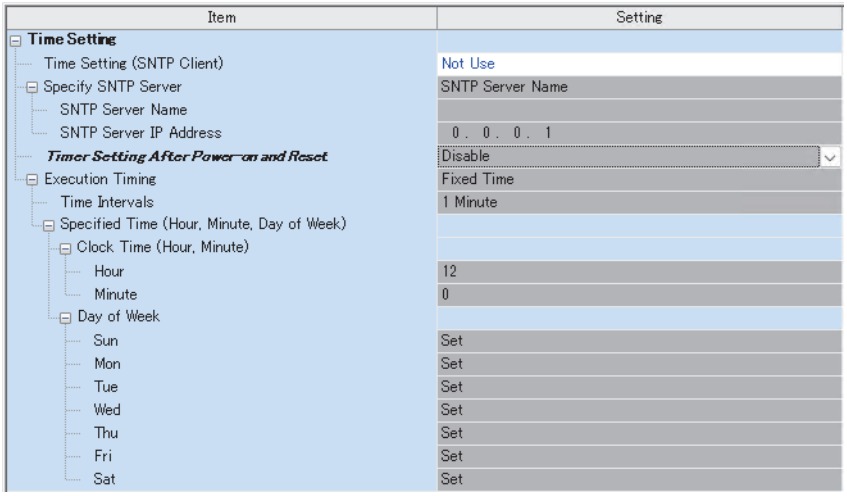
When setting the time at the controller power-on or reset, check the industrial switch or external device connection before setting.

Time Setting (SNTP Client)

Set the time setting function (SNTP client).

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 3: Ethernet)] ⇨ [Module Parameter (Ethernet)] ⇨ [Application Settings]

Window



Displayed items

Item		Description	Setting range
Time Setting (SNTP Client)		Select whether to use the time setting function (SNTP client).	• Not Use • Use (Default: Not Use)
Specify SNTP Server		Set the specification method of the SNTP server.	• SNTP Server Name • SNTP Server IP Address (Default: SNTP Server Name)
SNTP Server Name		Set the SNTP server name.	1 to 256 one-byte characters Alphanumeric characters, symbols (except \/:;*? <>|+=",) (Default: Empty)
SNTP Server IP Address		Set the IP address of the SNTP server.	0.0.0.1 to 223.255.255.254 (Default: 0.0.0.1)
Timer Setting After Power-on and Reset		Select whether to execute the time setting function upon power-on or reset.	• Disable • Enable (Default: Disable)
Execution Timing	—	Select the execution timing of the time setting.	• Fixed Time • Fixed Scan Interval (Default: Fixed Time)
	Time Intervals	When "Execution Timing" is set to "Fixed Scan Interval", set the time interval (minute) of time setting executions.	1 to 1440 (Default: 1 Minute)
	Specified Time (Hour, Minute, Day of Week)	When "Execution Timing" is set to "Fixed Time", set the day of the week and the clock time (hour and minute) of time setting executions. (☞ Page 1939 Specified Time (Hour, Minute, Day of Week))	—

Point

The SNTP server must be only one in a network. The time to be output is the same even though multiple modules in the same system retrieve time from the same SNTP server.

■Specified Time (Hour, Minute, Day of Week)

Set an execution time value within the following range in "Clock Time (Hour, Minute)".

Item	Setting range
Hour	0 to 23 (Default: 12)
Minute	0 to 59 (Default: 0)

To specify the day of the week when time setting is executed, set "Not Set" in the day when time setting is not executed under "Day of Week". (Time setting is set to be executed every day (all the days are set to "Set") by default.)
When specifying the day of the week, set at least one day of the week to "Set". An error occurs when all the days are set to "Not Set".

Confirming the execution results

The time setting execution results can be checked with the following buffer memory areas of the CPU function part.

- 'Operation result' (U3E0\G290)
- 'Execution time' (U3E0\G291 to U3E0\G297)
- 'Required response time' (U3E0\G298)

Precautions

■Time to be set

The time to be set in the controller is a time that is obtained by adjusting the time information (UTC) retrieved from the SNTP server (time information server) based on the time zone set in "Clock Related Setting" under "Operation Related Setting" of "CPU Parameter".

■Communication timeout

If a response is not received from the SNTP server (time information sever) 20 seconds after the time setting is executed, the communication times out. An error does not occur when the communication times out. Instead, the timeout occurrence appears in the event history.

■Delay by communication time

The time set in the controller may be delayed by the time required to communicate with the SNTP server personal computer. To reduce this delay, specify an SNTP server personal computer on the network that is as close to the controller as possible.

■Setting the execution time

The execution time can be set in the range of 1980 to 2079.
When the SNTP server time is out of the range, the correct time is not set.

■Time synchronization function

When this function is enabled, the time synchronization function of CC-Link IE TSN cannot be used.

■Clock function

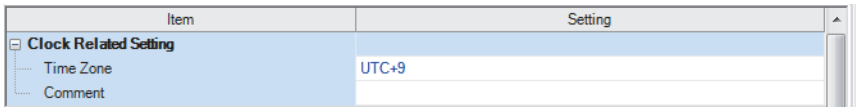
Even when this function is enabled, the time can be set by the clock function. However, the time obtained from the SNTP server will be set at the execution timing.

Setting time zone

Specify the time zone to be used for the controller. Specifying the time zone enables the clock of the programmable controller to work in the local time zone.

[CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Clock Related Setting]

Window



Displayed items

Item	Description	Setting range	Default
Time Zone	Sets the time zone used for the controller.	• UTC+13 • UTC+12 • UTC+11 • UTC+10 • UTC+9:30 • UTC+9 • UTC+8 • UTC+7 • UTC+6:30 • UTC+6 • UTC+5:45 • UTC+5:30 • UTC+5 • UTC+4:30 • UTC+4 • UTC+3:30 • UTC+3 • UTC+2 • UTC+1 • UTC • UTC-1 • UTC-2 • UTC-3 • UTC-3:30 • UTC-4 • UTC-4:30 • UTC-5 • UTC-6 • UTC-7 • UTC-8 • UTC-9 • UTC-10 • UTC-11 • UTC-12	UTC+9
Comment	Enters a comment for a time zone (e.g., name of the city).	32 characters or less	—

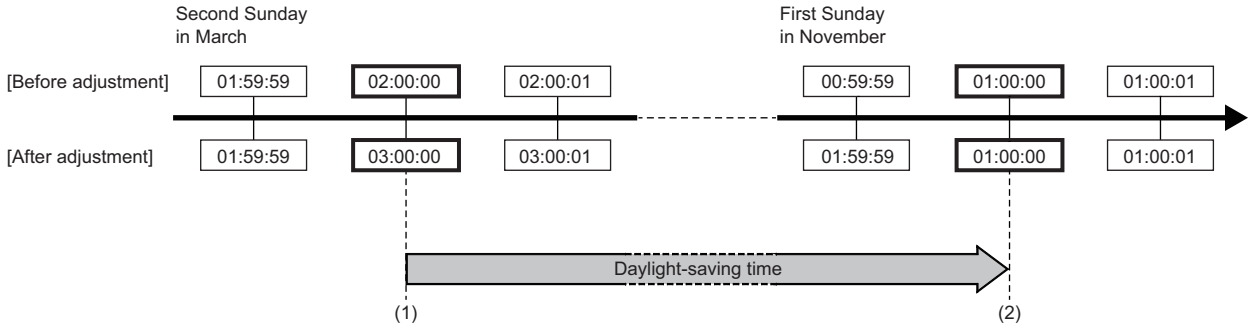
Point

To reflect the time zone setting on the controller, the controller must be restarted. If no parameter is set for the controller, it operates with "UTC+9".

Daylight saving time function

The daylight saving time function is used to adjust the controller time to daylight saving time.
This function advances the controller time by one hour on the starting date of daylight saving time, and reverses the time by one hour on the ending date.

Ex.
When daylight saving time starts from 2:00 on the second Sunday in March, and ends at 2:00 on the first Sunday in November



Setting to Adjust Clock for Daylight Saving Time

Set the starting date and ending date for daylight saving time.

[CPU Parameter] ⇨ [Operation Related Setting] ⇨ [Clock Related Setting] ⇨ [Setting to Adjust Clock for Daylight Saving Time]

Window

Item	Setting
Setting to Adjust Clock for Daylight Saving Time	
Adjust Clock for Daylight Saving Time	Disable
Start/End Time Specification Method	Week
Week	
Start	
Month	3
Week	2nd Week
Day of Week	Sunday
Time	2:00
End	
Month	11
Week	1st Week
Day of Week	Sunday
Time	2:00
Date	
Start	
Month	3
Day	1
Time	2:00
End	
Month	11
Day	1
Time	2:00

Displayed items

Item			Description	Setting range	Default
Adjust Clock for Daylight Saving Time			Sets whether to enable the daylight saving time setting.	• Enable • Disable	Disable
Start/End Time Specification Method			Sets the timing of the switch to daylight saving time to specified week or specified date.	• Week • Date	Week
Week	Start	Month	Sets the daylight saving time starting date.	1 to 12	3
		Week		• 1st Week • 2nd Week • 3rd Week • 4th Week • The Last Week	2nd Week
		Day of Week		• Sunday • Monday • Tuesday • Wednesday • Thursday • Friday • Saturday	Sunday
		Time		0:00 to 23:00	2:00
	End	Month	Sets the daylight saving time ending date.	1 to 12	11
		Week		• 1st Week • 2nd Week • 3rd Week • 4th Week • The Last Week	1st Week
		Day of Week		• Sunday • Monday • Tuesday • Wednesday • Thursday • Friday • Saturday	Sunday
		Time		0:00 to 23:00	2:00
Date	Start	Month	Sets the daylight saving time starting date.	1 to 12	3
		Day		1 to 31, The Last Date	1
		Time		0:00 to 23:00	2:00
	End	Month	Sets the daylight saving time ending date.	1 to 12	11
		Day		1 to 31, The Last Date	1
		Time		0:00 to 23:00	2:00

Restriction

- The same month cannot be specified for the start and end of the timing of the switch.
- February 29 cannot be specified directly. If specifying February 29, the date can be substituted by entering "Last Date in February".

Timing of daylight saving time adjustment

Daylight saving time is adjusted at the following times.

- On the starting date and ending date of daylight saving time
- When the controller is powered off and on
- When the controller is reset

Daylight saving time function operation check

The daylight saving time function operation can be checked as follows.

■Special relay

SM217 (Daylight saving time status flag) can be used to check whether the date lies inside or outside the daylight saving time period. (☞ Page 1949 List of Special Relay (SM) Areas)

■Event history

The history for the start and end of daylight saving time can be checked in the event history for the date set in "Setting to Adjust Clock for Daylight Saving Time". (☞ Page 1754 Event history function)

Operation of other functions using clock data during daylight saving time

Functions using controller clock data operate as follows during the daylight saving time period.

Item	Description
Clock data reading	Reads clock data following adjustment for daylight saving time.
Clock data writing	Writes as clock data following adjustment for daylight saving time.

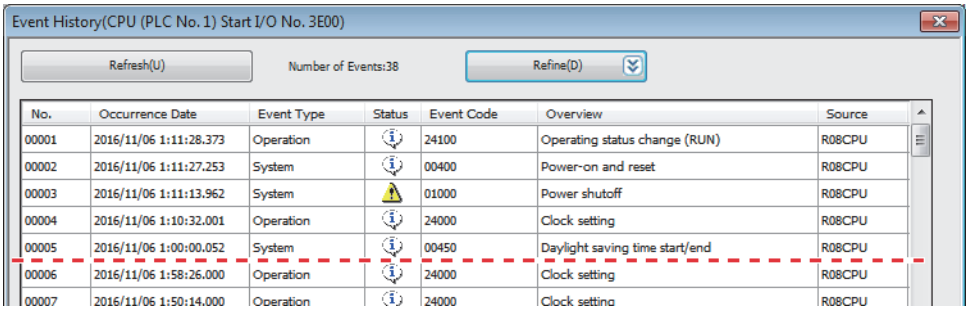
Precautions

This section describes precautions on the daylight saving time function.

- The clock data cannot be changed to data less than one hour from the starting time of the daylight saving time.
- For the period less than one hour from the starting time or less than one hour until the ending time of daylight saving time, the function that is triggered by time may not work or may work twice.
- When "Setting to Adjust Clock for Daylight Saving Time" is enabled, functions operate based on date and time information adjusted for daylight saving time. As a result, the timestamps output from functions that use clock data are recorded in non-chronological order, where a time adjusted for daylight saving time can be equal to or later than a time during standard time. This may cause the sequence of occurrence numbers (No.) to differ from the order of their timestamps. Consequently, when checking the output results in chronological order, sort by occurrence number (No.) rather than by timestamp.

Ex.

Event history



Since the time goes back one hour at No.00005 where the daylight saving time ends, the dates and times on which events occurred are reversed at the upper and lower side of the broken line ((time of new event history) < (time of old event history)).

System clock

The system clock is turned on/off by the system or turns on/off automatically at the interval specified by the user.

Special relay used for system clock

Special relay used for system clock are as follows. (☞ Page 1953 System clock)

SM number	Name
SM400	Always On
SM401	Always Off
SM402	After RUN, ON for 1 scan only
SM403	After RUN, OFF for 1 scan only
SM409	0.01 second clock
SM410	0.1 second clock
SM411	0.2 second clock
SM412	1 second clock
SM413	2 second clock
SM414	2n second clock
SM415	2n millisecond clock
SM420	User timing clock No.0
SM421	User timing clock No.1
SM422	User timing clock No.2
SM423	User timing clock No.3
SM424	User timing clock No.4

■Precautions

- SM409 to SM415 (System clock) start to measure the time before the controller is switched to RUN. Therefore, the time from the first scan after the controller has been switched to RUN until switching of the on/off state of the system clock may not match the measurement time of the system clock.
- The on/off status of SM409 to SM415 (System clock) changes even during execution of a program. For this reason, when one program has multiple processes that are performed based on the on/off status of the system clock, these processes are not performed in the execution order of the program. If these processes are required to be performed in the execution order of the program, write a program such that the on/off status of the system clock is transferred to an internal relay at the start of every scan and each processing is performed based on the status in the internal relay.

Special register used for system clock

Special register used for system clock are as follows. (☞ Page 1989 System clock)

SD number	Name
SD412	One second counter
SD414	2n second clock setting
SD415	2n ms clock setting
SD420	Scan counter

Appendix 5 I/O Signals

This section describes I/O signals.

The I/O signal assignment for when the start I/O number of the CC-Link IE TSN function part is "0" is listed below.

Point

- Do not use (turn on) any "use prohibited" signals as an input or output signal to the controller. Doing so may cause malfunction of the system.

List of input signals

CC-Link IE TSN function part

Device No.	Signal name
X0	Controller failure
X1*1	Own station data link status
X2	Use prohibited
X3*2	Other stations data link status
X4 to XE	Use prohibited
XF*3	CC-Link IE TSN function READY
X10 to X1F	Use prohibited

*1 When SB0049 is normal (OFF), X1 is in data link (ON), but when not even one device station is set in the network configuration settings, both are turned off.

*2 The specifications are the same as that of SB00B0.

*3 When X0 is turned on, XF is turned off.

Motion function part

Device No.	Signal name
X20	Built-in motion ready
X21	Synchronization flag
X22 to X3F	Use prohibited

List of output signals

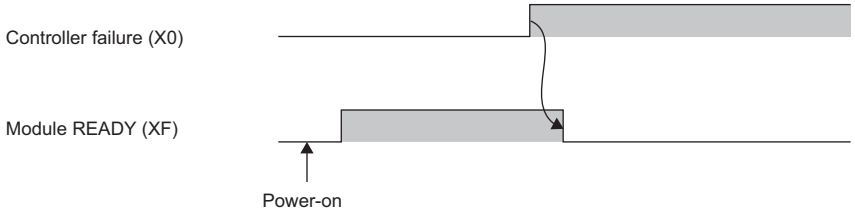
Device No.	Signal name
Y0 to Y1F	Use prohibited
Y20	PLC READY
Y21 to Y3F	Use prohibited

Details of input signals

Controller failure (X0)

This signal is used to check the status of the CC-Link IE TSN function.

- Off: Normal
- On: Error



Own station data link status (X1)

This signal is used to check the data link status of the own station.

- Off: Data link stop
- On: Data link in progress

'Data link error status of own station' (SB0049) has the same signal, but when using it in a program, use either Own station data link status (X1) or 'Data link error status of own station' (SB0049) only. Also note that the on/off conditions for Own station data link status (X1) and SB0049 are reversed.

If an error occurs, the cause of the fault can be checked by CC-Link IE TSN/CC-Link IE Field diagnostics or 'Cause of data link stop' (SW0049).

Other stations data link status (X3)

This signal is used to check the data link status of other stations.

- Off: All stations normal
- On: Faulty station exists

'Data link error status of each station' (SB00B0) has the same signal, but when using it in a program, use either Other stations data link status (X3) or 'Data link error status of each station' (SB00B0) only.

If an error occurs, the faulty station can be checked by CC-Link IE TSN/CC-Link IE Field diagnostics or with 'Data link status of each station' (SW00B0 to SW00B7).

CC-Link IE TSN function READY (XF)

This signal is used to check the status of CC-Link IE TSN function operation preparation.

- Off: Not available for operation
- On: Available for operation

For the CC-Link IE TSN function READY timing chart, refer to Controller failure (X0). (☞ Page 1946 Controller failure (X0))

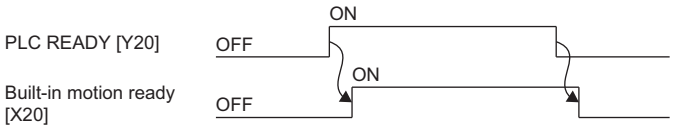
Built-in motion ready (X20)

When a moderate error or a major error occurs, this signal turns off. This signal is used for interlock or others in a program. This signal is the same as MotionSysm.Md.Ready.

- Off: Not ready
- On: Ready

When MotionSystem.Cd.SequenceReady turns on, a parameter setting range check is performed and this signal turns on if there are no errors.

When MotionSystem.Cd.SequenceReady turns off, this signal turns off.



Synchronization flag (X21)

This signal indicates that the motion function part can be accessed from the program. It is used to determine whether a label can be accessed.

- Off: Motion function part cannot be accessed.
- On: Motion function part can be accessed.

When this signal is on, the label of the motion function part is enabled. When this signal is off, the motion function part may not refresh the label.

Details of output signals

PLC READY (Y20)

This function is used when PLC READY is FALSE. This signal notifies the motion function part that the CPU function part is normal.

- Off: PLC READY (MotionSystem.Cd.SequenceReady) is turned off.
- On: PLC READY (MotionSystem.Cd.SequenceReady) is turned on.

It is turned on/off in the sequence program.

When a stop error occurs in the CPU function part, the signal is treated as off.

When the data (parameter) is changed, the PLC READY signal is turned off depending on the parameter.

☞ Page 544 System control data (MotionSystem.Cd.)

Appendix 6 List of Special Relay (SM) Areas

The following table lists items in the list.

Item	Description
No.	Special relay number
Name	Special relay name
Data stored	Data stored in the special relay and its meaning
Details	Detailed description of the data stored
Set by (setting timing)	Set side of data (system or user) and timing when data is set by the system <Set by> • S: System • U: User (program, engineering tool, GOT, or other testing operations from external device) • S/U: Both the system and user <Set timing> • Every END: Data is set every time END processing is performed. • Initial: Data is set when initial processing is performed (e.g. powering on the system, changing the operating status from STOP to RUN). • Status change: Data is set when the status is changed. • Error: Data is set when an error occurs. • Instruction execution: Data is set when an instruction is executed. • Request: Data is set when requested by a user (using the special relay). • Writing: Data is set when a user performs a writing operation. • END processing: Data is set when the operating status changes from power-on to RUN or from STOP to RUN.

Point

Do not change the data set by the system in a program or by a device test. Doing so may result in system down or communication failure.

Diagnostic information

The following is the list of special rely areas relating to the diagnostic information.

No.	Name	Data stored	Details	Set by (setting timing)
SM0	Latest self-diagnostic error (including annunciator ON)	Off: No error On: Error	• This relay turns on when the self-diagnostics returns an error (including the case when an error is detected by turning the annunciator ON). • The ON state is maintained even after the error has been later cleared.	S (Error)
SM1	Latest self-diagnostic error (not including annunciator ON)	Off: No self-diagnostic error On: Self-diagnostic error exists	• This relay turns on when the self-diagnostics returns an error (not including the case when an error is detected by turning the annunciator ON). • The ON state is maintained even after the error has been later cleared.	S (Error)
SM2	Latest self-diagnostic error (not including annunciator ON, network and motion function error)	Off: No self-diagnostic error On: Self-diagnostic error exists	• This relay turns on when the self-diagnostics returns an error (not including the case when an error is detected by turning the annunciator ON or by the network and motion function). • The ON state is maintained even after the error has been later cleared.	S (Error)
SM50	Error reset	Off → On:Error reset request On → Off:Error reset complete	• This relay clears the error state when the mode transfers from off to on. • This relay switches from on to off when the error reset has been completed.	U/S (Status change)
SM51	Battery low latch	Off: Normal On: Battery low	• This relay switches to on when the battery voltage of the controller drops below the specified value. • The ON state is maintained even after the battery voltage has been later recovered to the normal value.	S (Error)
SM52	Battery low	Off: Normal On: Battery low	This relay has the same function as SM51 except for switching to off after the battery voltage has been recovered to a normal value.	S (Error)
SM53	AC/DC DOWN	Off: No AC/DC DOWN detection On: AC/DC DOWN is detected	• This relay switches to on when a momentary power failure within 20ms is detected while the AC power supply module is in use. This relay can be reset when power is turned off and on. • This relay switches to on when a momentary power failure within 10ms is detected while the DC power supply module is in use. This relay can be reset when power is turned off and on.	S (Error)
SM56	Instruction execution fault	Off: Normal On: Instruction execution fault state	• This relay switches to on when an error which can be classified as instruction execution fault is returned. • The ON state is maintained even after the error has been later cleared.	S (Error)
SM60	Fuse Blown	Off: Normal On: Fuse blown is detected	• This relay is on when at least one output module is in fuse blown state and the ON state is maintained even after later recovering to the normal state. • The fuse blown state check is also done for output modules on the remote I/O station.	S (Error)
SM61	I/O module verification error	Off: Normal On: Error	• This relay switches to on when the state of the I/O module is different from one registered during power-on, and the ON state is maintained even after later recovering to the normal state. • I/O module verification is also done for modules on the remote I/O station.	S (Error)
SM62	Annunciator	Off: Not detected On: Detected	• This relay switches to on when at least one annunciator is turned on. • This relay returns to off when all the annunciators are turned off.	S (Instruction execution)

No.	Name	Data stored	Details	Set by (setting timing)
SM80	Detailed information 1: Flag in use	Off: Not used On: In use	This relay switches to on if the detailed information n exists when SM0 switched to on.	S (Status change)
SM112	Detailed information 2: Flag in use			
SM2400	AC/DC DOWN flag	AC/DC DOWN flag	This flag indicates that a momentary power failure has occurred. It remains on after a momentary power failure occurs until the momentary power failure is cleared.	S (Error occurrence)

System information

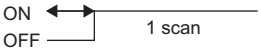
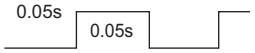
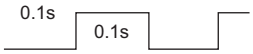
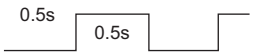
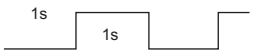
The following is the list of special relay areas relating to the system information.

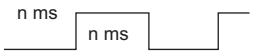
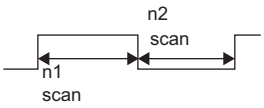
No.	Name	Data stored	Details	Set by (setting timing)
SM203	STOP contact	Off: Other than STOP state On: STOP state	This relay is on in STOP state.	S (Status change)
SM204	PAUSE contact	Off: Other than PAUSE state On: PAUSE state	This relay is on in PAUSE state. Note that this relay is on during the END processing of the scan which the specified PAUSE contact turns on if PAUSE state is generated at the PAUSE contact of the RUN-PAUSE contact.	S (Status change)
SM210	Clock data set request	Off → On:Setting requested On → Off:Setting is completed	• Clock data stored in SD210 to SD216 is written into the clock element when this relay is switched from off to on. • This relay switches from on to off when writing of clock data stored in SD210 to SD216 into the clock element is completed.	U/S (Status change)
SM211	Clock data set error	Off: No error On: Error	This relay switches to on when an error is generated in clock data (SD210 to SD216) values, and to off when no errors are generated.	S (Request)
SM213	Clock data read request	Off: Non-processing On: Reading request	Clock data is loaded into SD210 to SD216 when this relay is in the ON state.	U
SM217	Daylight saving time status flag	Off: Not during daylight saving time On: During daylight saving time	Turns on if during daylight saving time with daylight saving time function. Turns off if not during daylight saving time.	S (Status change)
SM220	CPU No.1 preparation completed	Off: CPU No.1 preparation not completed On: CPU No.1 preparation completed	• This relay switches to on at the time when access from other CPUs to CPU No.1 is enabled during power-on or resetting.	S (Status change)
SM230	CPU No.1 error flag	Off: CPU No.1 normal On: CPU No.1 stop error state	• This relay is off when CPU No.1 is normal (including a continuation error period). • This relay is on when CPU No.1 is in a stop error state.	S (Status change)
SM240*1	CPU No.1 reset flag	Off: CPU No.1 not being reset On: CPU No.1 in reset mode	• This relay switches to off when CPU No.1 is not being reset. • This relay is on while CPU No.1 is being reset (including the case when the controller is removed from the base unit). Other CPUs also enter into reset mode.	S (Status change)
SM387	Program restoration information write status	Off: All written On: Not all written	• This relay indicates the write status of program restoration information in the controller. • This relay turns off when all program restoration information is written. • This relay turns on if there is any program whose program restoration information is not in the controller.	S (Status change)

*1 As the purpose of SM240 (CPU No.1 reset flag) is to display the operating status in the engineering tool, use SM220 (CPU No.1 preparation completed) to ensure the synchronization among multiple CPUs.

System clock

The following is the list of special relay areas relating to the system clock.

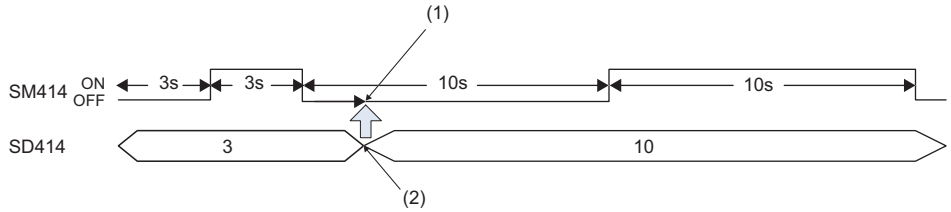
No.	Name	Data stored	Details	Set by (setting timing)
SM400	Always On		Always On	S (Every END)
SM401	Always Off		Always Off	S (Every END)
SM402	After RUN, ON for 1 scan only		• This relay is on during only one scan after RUN mode starts. • This relay is enabled only for the scan execution type program.	S (Every END)
SM403	After RUN, OFF for 1 scan only		• This relay is off during only one scan after RUN mode starts. • This relay is enabled only for the scan execution type program.	S (Every END)
SM409	0.01 second clock		• This relay repeats on/off at 5ms intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM410	0.1 second clock		• This relay repeats on/off at certain intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM411	0.2 second clock		• This relay repeats on/off at certain intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM412	1 second clock		• This relay repeats on/off at certain intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM413	2 second clock		• This relay repeats on/off at certain intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM414	2n second clock		• This relay repeats on/off at regular intervals specified in SD414 (in units of seconds). (When the value in SD414 is changed, the elapsed time count that has started when the on/off state of SM414 last changed continues, and the on/off state changes when the new specified time is elapsed.[*1]) • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)

No.	Name	Data stored	Details	Set by (setting timing)
SM415	2n millisecond clock		• This relay repeats on/off at regular intervals specified in units of milliseconds on the SD415. (When the value in SD415 is changed, the elapsed time count that has started when the on/off state of SM415 last changed continues, and the on/off state changes when the new specified time is elapsed.*1) • The initial state is off when the programmable controller is powered on or the controller is reset. • Note that this relay switches to on or off after a specified time is elapsed even when the program execution is in progress.	S (Status change)
SM420	User timing clock No.0		• This relay repeats on/off at specified scan intervals. • The initial state is off when the programmable controller is powered on or the controller is reset. • The on/off scan interval is set using the DUTY instruction. (n1: ON scan interval, n2: OFF scan interval)	S (Every END)
SM421	User timing clock No.1			
SM422	User timing clock No.2			
SM423	User timing clock No.3			
SM424	User timing clock No.4			

*1 The following figures show operation examples of SM414/SM415 when a value in SD414/SD415 is changed.

Ex.

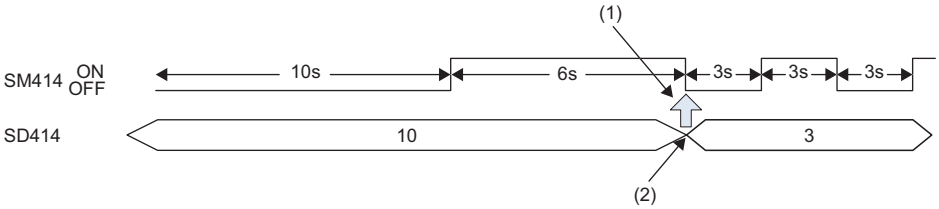
When a value in SD414 is changed from 3 to 10:



(1) The elapsed time after the on/off state of SM414 changes remains.
(2) Value change

Ex.

When a value in SD414 is changed from 10 to 3:



(1) If the new interval in SD414 has already elapsed after the last change of the on/off state of SM414, the on/off state changes as soon as a value in SD414 is changed.
(2) Value change

Fixed scan function information

The following is the list of special relay areas relating to the fixed scan function information.

No.	Name	Data stored	Details	Set by (setting timing)
SM489	Network communication period synchronization error	Off: No error On: Error	This relay switches to on when an error has occurred in the network communication period synchronization.	S (Status change)
SM492	Network communication period synchronization cycle error occurrence flag (basic period)	Off: No error On: Error	When the network communication period synchronization program cannot be executed because an interrupt factor has occurred while interrupt is disabled (DI), an interrupt factor with the same or a lower priority has occurred while the interrupt program is being executed, or the same interrupt factor has occurred while the interrupt program is being executed, the error occurrence flag (SM492) is turned on and the number of error occurrences (SD492) is counted up.	S (Status change)
SM493	Network communication period synchronization cycle error occurrence flag (medium-speed period)	Off: No error On: Error	When the network communication period synchronization program cannot be executed because an interrupt factor has occurred while interrupt is disabled (DI), an interrupt factor with the same or a lower priority has occurred while the interrupt program is being executed, or the same interrupt factor has occurred while the interrupt program is being executed, the error occurrence flag (SM493) is turned on and the number of error occurrences (SD493) is counted up.	S (Status change)
SM494	Network communication period synchronization cycle error occurrence flag (low-speed period)	Off: No error On: Error	When the network communication period synchronization program cannot be executed because an interrupt factor has occurred while interrupt is disabled (DI), an interrupt factor with the same or a lower priority has occurred while the interrupt program is being executed, or the same interrupt factor has occurred while the interrupt program is being executed, the error occurrence flag (SM494) is turned on and the number of error occurrences (SD494) is counted up.	S (Status change)
SM522	Scan time clear request	Off: Do not clear On: Clear	This relay clears the maximum/minimum scan time. Turning off and on this relay clears the scan time. This relay automatically turns off when the scan time has been cleared.	U/S (Status change)

Drive information

The following is the list of special relay areas relating to the drive information.

No.	Name	Data stored	Details	Set by (setting timing)
SM600	Memory card usable flags	Off: Disabled On: Enabled	This relay is on when an SD memory card is enabled (this relay switches to on when a valid SD memory card is inserted and prepared for use).	S (Status change)
SM601	Memory card protect flag	Off: Not protected On: Protected	This relay is on when the protect switch of the SD memory card is set to on.	S (Status change)
SM603	Memory card (drive 2) flag	Off: No SD memory card inserted On: SD memory card inserted	This relay is on when an SD memory card is inserted. (this relay switches to on when an SD memory card is inserted regardless of its state (enabled/disabled) and type).	S (Status change)
SM604	Memory card in-use flag	Off: Not used On: In use	This relay is on when the SD memory card is being used.	S (Status change)
SM605	Memory card remove/insert prohibit flag	Off: Allowed to remove/insert On: Not allowed to remove/insert	Turn on this relay to prohibit the SD memory card from being removed/inserted. When this relay is on, if SM607 is set to on, the system switches it to off.	U/S (Status change)
SM606	SD memory card forced disable instruction	Off: SD memory card forced disable cancel instruction On: SD memory card forced disable instruction	• This relay can be switched to on to issue the instruction that forces the SD memory card to be disabled. However, whenever any function accesses the SD memory card, the disabling process does not start until the access is completed. • This relay can be switched to off to cancel the instruction that forces the SD memory card to be disabled.	U/S (Status change)
SM607	SD memory card forced disable status flag	Off: Not disabled On: Disabled	• This relay switches to on when the SD memory card is disabled by switching SM606 to on. • This relay switches to off when the forcibly-disabled SD memory card is enabled by switching SM606 to off.	S (Status change)
SM628	Program memory write error	Off: No write operation/normal On: Write error	This relay switches to on when a write error is detected during write operation to the program memory (Flash ROM). This relay switches to off when the write instruction is issued.	S (Writing)
SM629	Program memory write flag	Off: No write operation On: Executing write operation	This relay switches to on when the write process to the program memory (Flash ROM) is in progress, and switches to off when the write process is complete.	S (Writing)
SM632	Data memory write error	Off: No write operation/normal On: Write error	This relay switches to on when a write error is detected during write operation to the data memory (Flash ROM). This relay switches to off when the write instruction is issued.	S (Writing)
SM633	Data memory write flag	Off: No write operation On: Executing write operation	This relay switches to on when the write process to the data memory (Flash ROM) is in progress, and switches to off when the write process is complete.	S (Writing)
SM4124	Built-in memory rewrite count error flag	Off: The number of rewrite operations is less than 50000 On: The number of rewrite operations reaches 50000	This relay switches to on when the number of rewrite operations to the program memory and data memory (Flash ROM) reaches 50000. (The controller must be replaced.)	S (Writing)

Instruction related

The following is the list of special relay areas relating to the instruction-related items.

No.	Name	Data stored	Details	Set by (setting timing)
SM699	Dedicated instruction skip flag	Off: Instruction being executed or completed On: There is a core for which instruction has been skipped.	• This relay indicates whether there is a core for which the built-in Ethernet function instruction*1 or intelligent function module dedicated instruction has been skipped. Off: The instruction has not been skipped for any of the cores. (The instruction is being executed or completed.) On: There is a core for which the process was completed without the instruction being executed. • Whether there is a core for which an instruction has been skipped can be checked by using SD699. • This relay saves/returns while the interrupt program is being executed.	S (Status change)
SM700	Carry flag	Off: Carry off On: Carry on	• This relay is a carry flag used while the application instruction is executing. • This relay saves/returns while the interrupt program is being executed.	S (Instruction execution)
SM701	Number of output characters selection	Off: Outputs until reaching NULL code On: Outputs 16 characters	• ASCII codes are output until reaching NULL (00H) code, when SM701 is off. • 16 characters of ASCII codes are output, when SM701 is on. • This relay saves/returns while the interrupt program is being executed.	U
SM702	Search method	Off: Sequential search On: Dichotomizing search	• The search method in the search instruction can be specified by using this relay. • To use the dichotomizing search, data must be sorted. • This relay saves/returns while the interrupt program is being executed.	U
SM703	Data sort instruction sort order	Off: Ascending On: Descending	• This relay can be used to specify how to arrange data in the data sort instruction: ascending or descending. • This relay saves/returns while the interrupt program is being executed.	U
SM704	Block comparison	Off: Mismatch is detected On: Completely match	• This relay switches to on when all the data conditions are met in the BKCMP instruction. • This relay saves/returns while the interrupt program is being executed.	S (Instruction execution)
SM705	Number of conversion digits selection	Off: Fixed number of digits On: Desired number of digits	• When SM705 is off, the conversion data is specified and output with the fixed number of digits. • When SM705 is on, the conversion data is specified and output with the desired number of digits. • This relay saves/returns while the interrupt program is being executed.	U
SM709	DT/TM instruction improper data detection flag	Off: No improper data On: Improper data is detected	• This relay switches to on when the comparison target data is date data or cannot be recognized as clock data, or the comparison target device (three words) exceeds the specified device range in the DT/TM instruction. • This relay saves/returns while the interrupt program is being executed.	S (Instruction execution)/ U

No.	Name	Data stored	Details	Set by (setting timing)
SM752	Dedicated instruction End bit control flag	Off: Automatically controlled On: Not automatically controlled	This relay can be used to set whether the system automatically controls the on/off operation of End bit being used for the dedicated instruction and other (control of End bit which is registered in the End processing of the instruction completion and turned on for only the next one scan (Off: turned on for only one scan after the instruction is completed as well as normal/error End bit, On: turned on when the instruction is completed and the On status is maintained after that)).	U
SM753	File being accessed	Off: Not in progress On: In progress	• This relay is on during access to the file by the COMRD or SP.DEVST instruction. • This relay is on during access to the SD memory card and data memory. • This relay is on when the S(P).SFCSCOMR or S(P).SFCTCOMR instruction is being executed. • This relay is on when the GP.FTPCPUT or GP.FTPCGET instruction is being executed. • This relay is on when the SP.FTPPUT or SP.FTPGET instruction is being executed. • This relay is on when a database access instruction is being executed. • This relay is on when a file operation instruction is being executed.	S (Status change)
SM754	BIN/DBIN instruction error control flag	Off: Executes error detection On: Not execute error detection	This relay can be switched to on when the error detection is not desirable in the BIN/DBIN instruction.	U
SM755	Scaling instruction search method setting	Off: Sequential search On: Dichotomizing search	This relay can be used to determine the search method when the scaling instruction is executed.	U
SM756	Module access completion wait control flag	Off: Not wait the completion On: Waits the completion	This relay can be used to determine whether the system must wait until the access is completed before starting the next instruction when the write access instruction to the buffer memory or Y output of another module is being executed.	U
SM772	CRC instruction conversion mode (16-bit/8-bit) selection	Off: 16-bit conversion mode On: 8-bit conversion mode	This relay can be used to select 16-bit conversion mode or 8-bit conversion mode with the CRC instruction.	U
SM775	Selection of refresh processing during the COM instruction execution	Off: Executes all the refresh processings On: Executes the refresh processing specified in SD775	This relay can be used to select the refresh processing target when the COM instruction is executed from two options: all refresh processing or only refresh processing specified in SD775.	U
SM776	Local device setting at CALL	Off: Disables local devices On: Enables local devices	This relay can be used to determine whether the local devices on the subroutine program called when the CALL instruction is being executed are enabled or not.	U
SM792	PID bumpless processing (for the complete differentiation PIDCONT instruction)	Off: Matching On: Not matching	This relay can be used to specify whether to match SV to PV in manual mode.	U
SM794	PID bumpless processing (for the inexact differential S.PIDCONT instruction)	Off: Matching On: Not matching	This relay can be used to specify whether to match SV to PV in manual mode.	U

*1 The built-in Ethernet function instruction applies to GP.SOCOPEN, GP.SOCCLOSE, GP.SOCRCV, G.SOCRCVS, GP.SOCSND, GP.ECPRTCL, G(P).SLMPSND, J(P).SLMPSND, G(P).SLMPSNDC, GP.FTPCPUT, GP.FTPCGET, SP.SOCOPEN, SP.SOCCLOSE, SP.SOCRCV, S.SOCRCVS, SP.SOCSND, SP.ECPRTCL, SP.SLMPSND, SP.FTPPUT, and SP.FTPGET.

Latch area

The following is the list of special relay areas relating to the latch area.

No.	Name	Data stored	Details	Set by (setting timing)
SM953	Controller data backup error check flag	Off: No error On: Error	• This relay turns on if an error occurs at the execution of the controller data backup. • This relay turns off when the backup data upper limit enable setting is changed at the start of the controller data backup.	S (Status change)
SM959	Controller data restoration error check flag	Off: No error On: Error	• This relay turns on if an error occurs at the execution of the controller data restoration. • This relay turns off at the start of the controller data restoration.	S (Status change)
SM960	Upper limit setting flag for the number of controller backup data	Off: Backup continued On: Backup stopped	This relay specifies the operation of backup when the number of backup data of the controller reaches the upper limit. (This relay is valid only when bit 5 of SD944 (controller backup data upper limit enable setting) is on.) Off: After deleting the oldest date stamp folder, the backup is continued. On: The backup is not continued if the upper limit of the number of backup data is exceeded. (In this case, the backup is completed with an error.)	U
SM961	Automatic backup retry failure flag	Off: Retry not executed/ Retry being executed On: Retry failed	This relay turns on when the retry of the automatic backup of the controller is failed even after the specified number of retries are attempted. This relay turns off at the start of the automatic backup. (This relay does not turn off when SM1351 (controller data backup execution request) is on.)	S (Status change)
SM968	Duplicated backup request error check flag	Off: No duplicated backup request error On: Duplicated backup requested	This relay turns on when any of the following operation is performed during execution of the data backup/restoration function of the controller. • SM1351 (backup execution request) is turned on. • Backup execution was requested using the engineering tool. If the execution timing of the automatic backup coincides with the execution of the controller data backup/restoration function, causing the automatic backup to fail, this relay does not turn on. Instead, backup request disabled (event code 20520H) is stored in the event history. This relay turns off when the backup data upper limit enable setting is changed at the start of the controller data backup.	S (END processing)
SM972	Communication cycle intervals measure setting request	Off: Disabled On: Enabled	• This relay indicates communication cycle intervals measure setting request (enabled/disabled). • If this relay is on when the power is turned off and on or when a reset is cleared, the communication cycle intervals measure is enabled/disabled in accordance with the setting value for SD972 (communication cycle intervals measure setting). (Communication cycle intervals measure is disabled when this relay is off when the power is turned off and on or a reset is cleared.)	U
SM973	Communication cycle intervals measure setting status	Off: Communication cycle intervals measure disabled On: Communication cycle intervals measure enabled	• This relay indicates if communication cycle intervals measure is enabled or disabled. • When this relay is on (Communication cycle interval measure enabled), U3E0\G10200 to U3E0\G10269 and U3E0\G10272 to U3E0\G102723 are enabled.	S (Initial)
SM4098	Latch save completion flag after latch setting change	Off: Latch save not completed On: Latch save completed	• This relay is turned off after the CPU parameter latch range setting or device/label latch interval setting is changed. • When the latch save is completed with the changed latch range setting and device/label latch interval setting, the relay is turned on. Subsequently, power off/reset the controller.	S (Status change)

No.	Name	Data stored	Details	Set by (setting timing)
SM4102	Max latch interval time clear request	Off → On:Clear requested On → Off:Cleared	• When this relay is changed from off to on, the max latch interval time (SD1402/1403) is cleared. The system turns on and off when the time has been cleared. • The time is cleared when the operating status is RUN state.	U/S (Status change)

Data logging function

The following is the list of special relay areas relating to the data logging function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1200	Auto logging setting file and registration status	Off: Mismatch On: Matching	• This relay is on when the auto logging setting executed (registered) matches with the content of the configuration file stored in the target memory. This relay is off when the setting does not match with the content.	S (Status change)
SM1201	SD memory card setting file in use flag	Off: Not used On: In use	• This relay switches to on when the data logging configuration file stored in an SD memory card is being used. This relay switches to on when one or more data logging of the settings No.1 to 10 is registered. • The ON state is maintained even when the data logging later enters into suspend/waiting for start without collection/waiting for RUN without collection mode. However, the relay switches to off when all the data logging stops.	S (Status change)
SM1202	Data memory setting file in use flag	Off: Not used On: In use	• This relay switches to on when the data logging configuration file stored in the data memory is being used. This relay switches to on when one or more data logging of the settings No.1 to 10 is registered. • The ON state is maintained even when the data logging later enters into suspend/waiting for start without collection/waiting for RUN without collection mode. However, the relay switches to off when all the data logging stops.	S (Status change)
SM1210	Data logging setting No.1 Data logging preparation	Off: Not prepared On: Prepared	• This relay switches to on when the data logging preparation is completed. • The ON state is maintained even when the data logging later enters into suspend/waiting for start without collection/waiting for RUN without collection mode. This relay switches to off when the data logging stops.	S (Status change)
SM1211	Data logging setting No.1 Data logging start	Off: Suspended/waiting for start On: Start	• This relay switches to on when the data logging starts. The relay turns off when the data logging is in suspend/waiting for start without collection mode. Associated special relay, such as Data logging collection, Data logging end, Data logging trigger, and After data logging trigger, switches to off simultaneously. • This relay also switches to off when the controller is changed from RUN to STOP mode and therefore the data collection is halted.	S (Status change)
SM1212	Data logging setting No.1 Data logging collection	Off: Not in progress On: In progress	This relay switches to on when the data logging starts data collection.	S (Status change)
SM1213	Data logging setting No.1 Data logging end	Off: Not completed On: Completed	This relay switches to on when the data logging is completed. Continuous logging: The corresponding bit switches to on when writing reaches the maximum number of storage files and data logging is completed (with "Stop" set for the operation at the time when the number of save files exceeds the limit). Trigger logging: The corresponding bit switches to on when data collection for the specified number of records has been completed followed by writing into the SD memory card or function memory after the trigger condition was satisfied. The bit also switches to on when an error is generated (except for data logging error caused by online program change) during the data logging execution.	S (Status change)
SM1214	Data logging setting No.1 Data logging trigger	Off → On:Triggered	The system switches this relay to on when the specified trigger condition is satisfied.	S (Status change)

No.	Name	Data stored	Details	Set by (setting timing)
SM1215	Data logging setting No.1 After data logging trigger	Off: Not post triggering On: Post triggering	• This relay switches to on once data logging triggering occurs. The ON state is maintained even when the data logging is completed. However, this relay is off when the data logging is in suspend/waiting for start without collection/stop mode • This relay also switches to off when the controller is changed from RUN to STOP mode and therefore the data collection is halted.	S (Status change)
SM1216	Data logging setting No.1 Data logging error	Off: No error On: Error	• This relay switches to on when a data logging function error is generated. • This relay switches to off when the setting is registered or by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SM1217	Data logging setting No.1 Data logging data saving in progress	Off: Not in progress On: In progress	This relay turns on when data in the internal buffer is being saved in the SD memory card or function memory with the data logging.	S (Status change)
SM1218	Data logging setting No.1 Logging data storage file switching in progress	Off: Storage file switching not in progress On: Storage file switching in progress	This relay switches to on when storage file switching is in progress.	S (Status change)
SM1219	Data logging setting No.1 Data logging file transfer execution status flag	Off: Not executed On: Being executed	• This relay turns on when the transfer of a data logging file to data memory starts. • It turns off at the completion of data logging file transfer to data memory.	S (Status change)
SM1220 to SM1229	Data logging setting No.2	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1230 to SM1239	Data logging setting No.3	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1240 to SM1249	Data logging setting No.4	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1250 to SM1259	Data logging setting No.5	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1260 to SM1269	Data logging setting No.6	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1270 to SM1279	Data logging setting No.7	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1280 to SM1289	Data logging setting No.8	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1290 to SM1299	Data logging setting No.9	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1300 to SM1309	Data logging setting No.10	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SM1210 to SM1219).	Same configuration as the setting No.1
SM1312 to SM1321	Data logging setting No.1 to 10 Data logging suspend/ resume flag	Off → On:Suspend On → Off:Resume	• When this relay changes from off to on, the data logging function is suspended. In an off state of the data logging start SM, no processing is performed. • When this relay changes from on to off, the data logging function resumes. In an ON state of the data logging start SM, no processing is performed.	U

Controller data backup/restoration function

The following is the list of special relay areas relating to the controller data backup/restoration function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1350	Controller data backup in-execution flag	Off: Not being executed On: Being executed	This relay turns on when the controller data backup is being executed.	S (Status change)
SM1351	Controller data backup execution request	Off → On:Backup requested On → Off:Backup completed	At the timing when this relay turns from off to on, the controller data backup is executed.	S (Status change)/U
SM1356	Controller data automatic backup retry in-execution flag	Off: Not being executed On: Error	This relay turns on during the retry of the controller data automatic backup.	S (Status change)
SM1357	Backup suspension request	Off → On:Backup suspension requested On → Off:Backup suspension completed	This relay suspends backup when the backup suspension request is turned on during backup execution. The relay turns off after the backup suspension process is completed. "Failure by backup/restoration suspension request" is displayed in the detailed information 1 of event code 20501H.	S (Status change)/U

iQ Sensor Solution data backup/restoration function

The following is the list of special relay areas relating to the iQ Sensor Solution data backup/restoration function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1360	Right-to-use request for iQ Sensor Solution data backup	Off → On: Right to use requested On → Off: Right to use acquired/released	• This relay requests acquiring or releasing the right to use of the data backup/restoration of iQ Sensor Solution. • At the timing when this relay turns from off to on, the relay requests the right to use with the specified value. • This relay turns off when the right to use has been acquired or released.	S (Status change)/U
SM1361	iQ Sensor Solution backup request	Off → On: Backup requested On → Off: Backup completed	• This relay requests the data backup of iQ Sensor Solution. • At the timing when this relay turns from off to on, the backup of the set device(s) is executed. • This relay turns off at the completion of the data backup of iQ Sensor Solution. • This relay turns from on to off when the right to use is acquired.	S (Status change)/U
SM1362	iQ Sensor Solution backup normal completion	Off: Other than normal completion On: Completed normally	• This relay turns on when the iQ Sensor Solution data backup is completed normally. • When the iQ Sensor Solution data backup is completed with an error, SM1363 turns on and this relay remains off. • This relay turns from on to off when the right to use is acquired or the backup is requested.	S (Status change)
SM1363	iQ Sensor Solution backup error completion	Off: Other than error completion On: Completed with an error	• This relay turns on when the iQ Sensor Solution data backup is competed with an error. The error code is stored into SD1376 or SD1377. • When the iQ Sensor Solution data backup is competed normally, SM1362 turns on and this relay remains off. • This relay turns from on to off when the right to use is acquired or the backup is requested.	S (Status change)
SM1364	iQ Sensor Solution restoration request	Off → On: Restoration requested On → Off: Restoration completed	• This relay requests the iQ Sensor Solution data restoration. • At the timing when this relay turns from off to on, the restoration of the set device(s) is executed. • This relay turns off at the completion of the iQ Sensor Solution data restoration. • This relay turns from on to off when the right to use is acquired.	S (Status change)/U
SM1365	iQ Sensor Solution restoration normal completion	Off: Other than normal completion On: Completed normally	• This relay turns on when the iQ Sensor Solution data restoration is completed normally. • When the iQ Sensor Solution data restoration is completed with an error, SM1366 turns on and this relay remains off. • This relay turns from on to off when the right to use is acquired or the restoration is requested.	S (Status change)
SM1366	iQ Sensor Solution restoration error completion	Off: Other than error completion On: Completed with an error	• This relay turns on when the iQ Sensor Solution data restoration is completed with an error. The error code is stored into SD1376 or SD1377. • When the iQ Sensor Solution data restoration is completed normally, SM1365 turns on and this relay remains off. • This relay turns from on to off when the right to use is acquired or the restoration is requested.	S (Status change)

No.	Name	Data stored	Details	Set by (setting timing)
SM1367	iQ Sensor Solution backup/ restoration suspend request	Off → On: Suspension requested On → Off: Suspension completed	• This relay requests the suspension of the iQ Sensor Solution data backup/restoration. • At the timing when this relay turns from off to on, the iQ Sensor Solution data backup/restoration is suspended. • This relay turns off at the suspension completion of the iQ Sensor Solution data backup/restoration. • This relay turns from on to off when the right to use is acquired or the backup/restoration is requested.	S (Status change)/U

File transfer function (FTP client)

The following is the list of special relay areas relating to the file transfer function (FTP client).

No.	Name	Data stored	Details	Set by (setting timing)
SM1392	FTP client connection status	Off: Not connected (disconnected) On: Connected	The update timing of FTP client connection status is as follows. • Off → On: At instruction start for file transfer function (FTP client) • On → Off: At instruction end for file transfer function (FTP client) (including an abnormal end of file transfer processing)	S (Status change, END processing)

Event history function

The following is the list of special relay areas relating to the event history function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1464	Event history logging restriction status	Off: Not restricted On: Restricted	Turns on when the event history logging has been restricted. The relay remains on even after the restriction is lifted. Restricted modules can be identified in SD1464 to SD1467. If the controller event history logging is restricted and a minor error occurs in the restricted controller, SM1466 turns on. If the event history logging of the information or warning is restricted, SM1467 turns on.	S (Status change)
SM1466	Event history logging restriction status of controller (minor error)	Off: Not restricted On: Restricted	The relay turns on when controller event history logging whose event category is error (minor error) was restricted. The relay remains on even after the restriction is lifted.	S (Status change)
SM1467	Event history logging restriction status of controller (information, warning)	Off: Not restricted On: Restricted	The relay turns on when controller event history logging whose event category is information or warning was restricted. The relay remains on even after the restriction is lifted.	S (Status change)
SM2376	Event history clear execution request	Off → On:Execution requested	Requests execution to clear the event history specified in the event history clear target specification (SD2376).	U

User authentication function

The following is the list of special relay areas relating to the user authentication function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1469	User authentication inapplicable operation enable setting	Off: Log-on required On: Log-on not required	When this relay is turned on, the operations set as excluded in the Operation settings not subject to user authentication will be available without log-on. When this relay is turned off, the operations set as excluded will require log-on.	U

Ethernet function

The following is the list of special relay areas relating to the Ethernet function.

No.	Name	Data stored	Details	Set by (setting timing)
SM1512	FTP server function file path name switching setting Enable	Off → On:Enable	• Switches the path delimiter to "/".	S (Status change)/U
		On → Off:Disable	• Returns the path delimiter to "\".	
SM1520	Network setting write request	Off → On:Write requested On → Off:Writing completed	• When this relay is changed from off to on, IP address settings stored in SD1518 to SD1525 are written to the network setting storage area (system memory*1) of the controller. • Once write to the network setting storage area (system memory*1) is completed (regardless of whether it was successful or not), this relay is turned off.	S (Status change)/U
SM1521	Network setting write error	Off: No error On: Error	This relay turns on when write to the network setting storage area (system memory*1) failed, and off when it was successful.	S (Status change)
SM1522	Network setting clear request	Off → On:Clear requested On → Off:Cleared	• When this relay is changed from off to on, the network setting storage area (system memory*1) is cleared. • Once clearing the network setting storage area (system memory*1) is completed (regardless of whether it was successful or not), this relay is turned off.	S (Status change)/U
SM1523	Network setting clear error	Off: No error On: Error	This relay turns on when clearing the network setting storage area (system memory*1) failed, and off when it was successful.	S (Status change)
SM1524	Initial processing successful completion state	Off: Completed with an error On: Completed normally	• This relay turns on when the initial processing for the Ethernet function is completed successfully. • When the initial processing was completed with an error, SM1525 is turned on and SM1524 stays off.	S (Status change)
SM1525	Initial processing error completion state	Off: Completed normally On: Completed with an error	• This relay turns on when the initial processing for the Ethernet function is completed with an error. • When the initial processing was completed successfully, SM1524 is turned on and SM1525 stays off.	S (Status change)

*1 This is the memory used by the system when the controller is executing functions.

Add-on function

The following is the list of special relay areas relating to the add-on function.

No.	Name	Data stored	Details	Set by (setting timing)
SM2392	Add-on Safe mode in progress	Off: Disabled On: Enabled (Safe mode in progress)	Enabled status of the add-on Safe mode	S (Initial)

Appendix 7 List of Special Register (SD) Areas

The following table lists items in the list.

Item	Description
No.	Special register number
Name	Special register name
Data stored	Data stored in the special register
Details	Detailed description of the data stored
Set by (setting timing)	Set side of data (system or user) and timing when data is set by the system <Set by> • S: System • U: User (program, engineering tool, GOT, or other testing operations from external device) • S/U: Both the system and user <Set timing> • Every END: Data is set every time END processing is performed. • Initial: Data is set when initial processing is performed (e.g. powering on the system, changing the operating status from STOP to RUN). • Status change: Data is set when the status is changed. • Error: Data is set when an error occurs. • Instruction execution: Data is set when an instruction is executed. • Request: Data is set when requested by a user (using the special relay). • Switch change: Data is set when the switch of the controller is changed. • Card insertion/removal: Data is set when an SD memory card is inserted or removed. • Writing: Data is set when a user performs a writing operation. • During END: Data is set when END processing is performed.

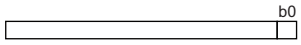
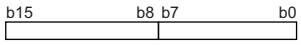
Point

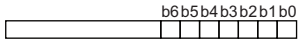
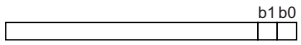
Do not change the data set by the system in a program or by a device test. Doing so may result in system down or communication failure.

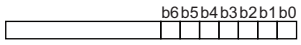
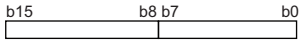
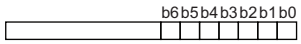
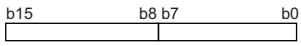
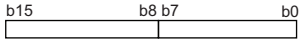
Diagnostic information

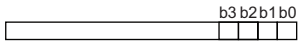
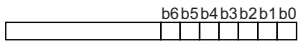
The following is the list of special register areas relating to the diagnostic information.

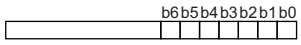
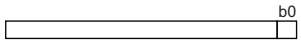
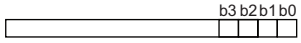
No.	Name	Data stored	Details	Set by (setting timing)
SD0	Latest self diagnostics error code	Latest self diagnostics error code	Error codes are stored in a hexadecimal value when the diagnostics detects an error.	S (Error)
SD1	Latest self-diagnostics error time	Latest self-diagnostics error time	The year value (four digits) of the date/time when SD0 data was updated is stored as a BIN code.	S (Error)
SD2			The month value of the date/time when SD0 data was updated is stored as a BIN code.	
SD3			The day value of the date/time when SD0 data was updated is stored as a BIN code.	
SD4			The hour value of the date/time when SD0 data was updated is stored as a BIN code.	
SD5			The minute value of the date/time when SD0 data was updated is stored as a BIN code.	
SD6			The second value of the date/time when SD0 data was updated is stored as a BIN code.	
SD7			The day of the week value of the date/time when SD0 data was updated is stored as a BIN code. (0: Sun, 1: Mon, 2: Tue, 3: Wed, 4: Thu, 5: Fri, 6: Sat)	
SD10	Self-diagnostic error number	Self-diagnostic error number 1	The maximum of 16 types of error codes (maximum of 16 errors, which are 15 continuation errors and 1 stop error) are stored into SD10 onwards when the diagnostics detects an error (the same error code as one already stored in SD10 onwards is not stored). The 17th error code onwards are not stored. Also error codes are not stored when 16 types of error codes have already been stored into SD10 to SD25.	S (Error)
SD11		Self-diagnostic error number 2		
SD12		Self-diagnostic error number 3		
SD13		Self-diagnostic error number 4		
SD14		Self-diagnostic error number 5		
SD15		Self-diagnostic error number 6		
SD16		Self-diagnostic error number 7		
SD17		Self-diagnostic error number 8		
SD18		Self-diagnostic error number 9		
SD19		Self-diagnostic error number 10		
SD20		Self-diagnostic error number 11		
SD21		Self-diagnostic error number 12		
SD22		Self-diagnostic error number 13		
SD23		Self-diagnostic error number 14		
SD24		Self-diagnostic error number 15		
SD25		Self-diagnostic error number 16		

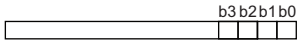
No.	Name	Data stored	Details	Set by (setting timing)
SD49	Error detection disable setting	Error detection disable setting	• Specify the function by which to disable the continuation error detection.  b0: Built-in Ethernet port communication (for details on the faulty operation, refer to the self-diagnostics function.) (☞ Page 1745 Self-diagnostic function)) b1 to b15: Not used • Specify the value of each bit as follows. Off: Not disabled (Errors will be detected.) On: Disabled (Errors will not be detected.)	U
SD53	AC/DC DOWN	The number of AC/DC DOWN detections	The value of this register increments by one and stored as a BIN code, each time input voltage drops to 85% (AC power)/65% (DC power) or less of the nominal value while the controller is carrying out an operation. A counting cycle from 0 to 65535 to 0 is repeated.	S (Error)
SD60	Number of module with blown fuse	Number of module with blown fuse	• The lowest I/O number of module in which a fuse blew is stored.	S (Error)
SD61	I/O module verify error module number	I/O module verify error module number	• The lowest I/O number of the module which has an error detected by the I/O module verification is stored.	S (Error)
SD62	Annunciator number	Annunciator number	The annunciator number which is detected first is stored.	S (Instruction execution)
SD63	Number of annunciators	Number of annunciators	The number of detected annunciator is stored.	S (Instruction execution)
SD64 to SD79	Table of detected annunciator numbers	Detected annunciator number	• Numbers of activated annunciators are sequentially registered into SD64 to SD79, each time an annunciator (F) is turned on by the SET F instruction. • Number of the annunciator deactivated by the RST F instruction is removed from register areas SD64 to SD79, and the numbers of annunciators which were lined up behind the removed one move forward one by one. When the number of detected annunciators has already reached 16, the number of a newly detected annunciator is not stored into SD64 to SD79. For details on the annunciator, refer to the annunciator (F). (☞ Page 351 Annunciator (F))	S (Instruction execution)
SD80	Detailed information 1 information category	Detailed information 1 information category code	• Detailed information 1 information category code is stored.  b0 to b7: Information category code b8 to b15: Not used • The following codes are stored into the information category code. 0: N/A 1: Error location information 2: Drive/file information 4: Parameter information 5: System configuration information 7: Time information 9: Operation source information 10: Operation source information 11: Operation source information 35: Program error information (FB) 47: Controller data backup/restoration folder information 61: Label name information 87: Own station information 98: Grandmaster MAC address information 106: Add-on name information 129: Axis error 134: Axis number information 135: Cycle information 146: Connection structure error information	S (Error)

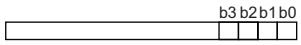
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	• Detailed information 1 corresponding to the error code (SD0) is stored. • The type of the detailed information 1 can be checked in SD80 (The value of the "Detailed information 1 information category code" stored in SD80 corresponds to the following figures (1), (2), (4) to (7), (9), (10), (11), (24), (35), (46), (61), (87), (98), (106), (129), (134), (135), and (146).)	S (Error)
			(1) Error location information ■SD81: With or without specification  b0: Argument number b1 to b3: Not used b4 to b5: Step information b6: File name b7 to b15: Not used ■SD82: Argument number (stored in the range from 1) ■SD83 to SD87: Not used ■SD88 to SD89: Step information (sequence step number) ■SD90: Step information (Not used) ■SD91: Step information (Pou No./FB No.) (Pou No./FB No. are numbers that are internally assigned during conversion by the engineering tool to identify each POU in a program file and FB file.) ■SD92 to SD99: File name (first eight characters of Unicode string)	
			(2) Drive/file information ■SD81: With or without specification  b0: Drive number b1: Folder name/file name b2 to b15: Not used ■SD82: Drive number ■SD83 to SD90: Folder name/file name (first eight characters of Unicode string)	

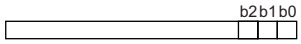
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(4) Parameter information ■SD81: With or without specification  b0: Parameter type b1: Parameter storage location b2: I/O number b3: Parameter number b4: Network number b5: Station number b6: System information b7 to b15: Not used ■SD82  • b0 to b7: Parameter type (stored in the following value) 1: System parameter 2: CPU parameter 3: Module parameter 4: Module extension parameter 5: Memory card parameter • b8 to b15: Parameter storage location (0: Program memory, 2: SD memory card, 4: Data memory) ■SD83: I/O number If the I/O number is not assigned and the parameter type is "3: Module parameter" or "4: Module extension parameter", 0xFFFFH is stored. ■SD84: Parameter number ■SD85: Network number ■SD86: Station number 0 to 254 (0 is stored for the master station.) ■SD87 to SD97: System information	S (Error)
			(5) System configuration information ■SD81: With or without specification  b0: I/O number b1: Slot number b2: Base number b3: Power supply number b4: CPU number b5: Network number b6: Station number b7 to b15: Not used ■SD82: I/O number ■SD83  • b0 to b7: Slot number (0 to 11) • b8 to b15: Base number (0: Main base unit, 1 to 7: Extension base unit level 1 to level 7, 8: Higher than level 7) ■SD84  • b0 to b7: Power supply number (1: Power supply 1) • b8 to b15: CPU number (1: CPU No.1) ■SD85: Network number ■SD86: Station number 0 to 254 (0 is stored for the master station.)	

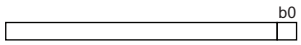
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(7) Time information When there is no specification, 0 is set to each SD. ■SD81: With or without specification  b0: Time (value set) (ms) b1: Time (value set) (μs) b2: Time (actual measurement value) (ms) b3: Time (actual measurement value) (μs) b4 to b15: Not used ■SD82: Time (value set) (ms) ■SD83: Time (value set) (μs) ■SD84: Time (actual measurement value) (ms) ■SD85: Time (actual measurement value) (μs)	S (Error)
			(9) Operation source information ■SD81: With or without specification  b0: Connection port b1: I/O number b2: CPU No. b3: Network number b4: Station number b5: IP address (IPv4) b6: User name b7 to b15: Not used ■SD82: Connection port 0: USB 1: Ethernet ■SD83: I/O number ■SD84: CPU No. 1: CPU No.1 ■SD85: Network number ■SD86: Station number 0: Master station 1 to 254: Device station ■SD87 to SD88: IP address (IPv4) b15 b8 b7 b0 SD87: 2nd byte | 1st byte SD88: 4th byte | 3rd byte ■SD89 to SD109: User name (Unicode string)	

No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(10) Operation source information ■SD81: With or without specification  b0: Connection port b1: I/O number b2: CPU No. b3: Network number b4: Station number b5: IP address (IPv4) b6: User name b7 to b15: Not used ■SD82: Connection port 1: IN 2: OUT 3: PORT1 4: PORT2 ■SD83: I/O number ■SD84: CPU No. 1: CPU No.1 ■SD85: Network number 1 to 239: 1 to 239 255: No setting ■SD86: Station number 0: Master station 1 to 253: Device station 255: No setting ■SD87 to SD88: IP address (IPv4) b15 b8 b7 b0 SD87: 2nd byte | 1st byte SD88: 4th byte | 3rd byte	S (Error)
			(11) Operation source information ■SD81: With or without specification  b0: IP address (IPv4) b1 to b15: Not used ■SD82 to SD83: IP address (IPv4) b15 b8 b7 b0 SD82: 2nd byte | 1st byte SD83: 4th byte | 3rd byte	
			(35) Program error information (FB) ■SD81: With or without specification  b0: Detail code b1: FB type b2: FB instance ID b3: Instance name b4 to b15: Not used ■SD82: Detail code ■SD83 to SD84: FB type ■SD85 to SD86: FB instance ID ■SD87 to SD111: Instance name (first 25 characters of Unicode string)	

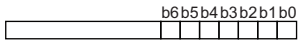
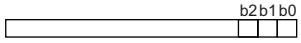
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(47) Controller data backup/restoration folder information ■SD81: With or without specification  b0: Folder specification b1: Date folder b2: Number folder b3: Data backup destination/restoration source specification b4 to b15: Not used ■SD82: Folder specification 0: Specification allowed 1: Specification not allowed ■SD83 to SD84: Date folder (yyyymmdd) Date of the folder is stored in BCD code. (yyyy: 0 to 9999, mm: 1 to 12, dd: 1 to 31) FFFFFFFFH is stored when a folder cannot be specified. • SD83: Lower digit of the date folder (yyyymmdd) • SD84: Upper digit of the date folder (yyyymmdd) ■SD85: Number folder 0 to 32767 (FFFFH is stored when a folder cannot be specified.) ■SD86: Data backup destination/restoration source specification 2: SD memory card	S (Error)

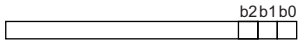
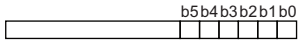
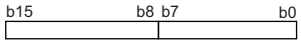
<table>
<tr><th>No.</th><th>Name</th><th>Data stored</th><th>Details</th><th>Set by (setting timing)</th></tr>
<tr><td>SD81 to SD111</td><td>Detailed information 1</td><td>Detailed information 1</td><td>(61) Label name information
Label name information is system information.</td><td>S (Error)</td></tr>
<tr><td></td><td></td><td></td><td>(87) Own station information
■SD81: With or without specification
 

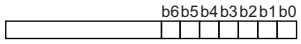
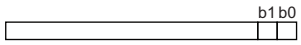
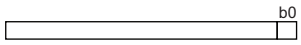
b0: I/O number
b1: Network number
b2: Station number
b3: IP address
b4 to b15: Not used
■SD82: I/O number
■SD83: Network number
1 to 239: 1 to 239
255: No setting
■SD84: Station number
0: Master station
1 to 253: Device station
255: No setting
■SD85 to SD86: IP address (IPv4)
<table><tr><th></th><th>b15 b8</th><th>b7 b0</th></tr><tr><td>SD85</td><td>2nd byte</td><td>1st byte</td></tr><tr><td>SD86</td><td>4th byte</td><td>3rd byte</td></tr></table></td><td></td></tr>
<tr><td></td><td></td><td></td><td>(98) Grandmaster MAC address information
■SD81: With or without specification
 

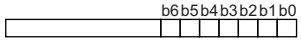
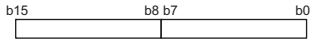
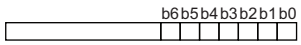
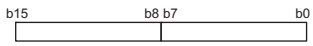
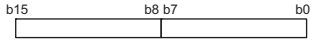
b0: MAC address (1st octet and 2nd octet)
b1: MAC address (3rd octet and 4th octet)
b2: MAC address (5th octet and 6th octet)
b3 to b15: Not used
■SD82: MAC address (1st octet and 2nd octet)
■SD83: MAC address (3rd octet and 4th octet)
■SD84: MAC address (5th octet and 6th octet)
If the MAC address is 123456789ABC, the following is an example.
<table><tr><th></th><th>b15 b8</th><th>b7 b0</th></tr><tr><td>SD82</td><td>12H</td><td>34H</td></tr><tr><td>SD83</td><td>56H</td><td>78H</td></tr><tr><td>SD84</td><td>9AH</td><td>BCH</td></tr></table></td><td></td></tr>
<tr><td></td><td></td><td></td><td>(106) Add-on name information
■SD81: With or without specification
 

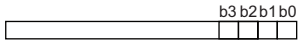
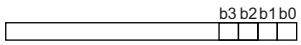
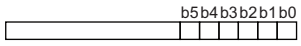
b0: Add-on name
b1 to b15: Not used
■SD82 to SD111: Add-on name (first 30 characters of Unicode string)</td><td></td></tr>
</table>

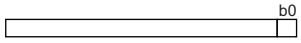
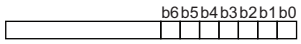
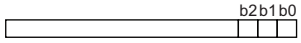
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(129) Axis error ■SD81: With or without specification  b0: Type b1: Axis/axes group where an event has occurred b2: Axis/axes group status b3: Detail code b4: FB type b5: FB instance ID b6: Instance name b7 to b15: Not used ■SD82: Type 0: Real drive axis 1: Real general-purpose output axis 2: Real encoder axis 3: Virtual drive axis 4: Virtual encoder axis 5: Virtual linked axis 100: Axis group ■SD83: Axis/axes group where an event has occurred ■SD84: Axis/axes group status -1: Invalid 0: Disabled 1: Errorstop 2: Stopping 3: Homing 4: Standstill 5: DiscreteMotion 6: ContinuousMotion 7: SyncronizedMotion 100: GroupDisabled 101: GroupErrorStop 102: GroupStopping 103: GroupHoming 104: GroupStandby 105: GroupMoving ■SD85: Detail code ■SD86 to SD87: FB type ■SD88 to SD89: FB instance ID ■SD90 to SD111: Instance name (first 22 characters of Unicode string)	S (Error)
			(134) Axis number information ■SD81: With or without specification  b0: Type b1: Detail code b2: Axis/axes group where an event has occurred b3 to b15: Not used ■SD82: Type 0: Real drive axis 1: Real general-purpose output axis 2: Real encoder axis 3: Virtual drive axis 4: Virtual encoder axis 5: Virtual linked axis 100: Axis group ■SD83: Detail code ■SD84 to SD85: Axis/axes group where an event has occurred	

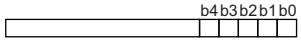
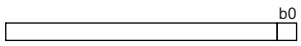
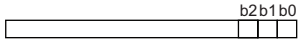
No.	Name	Data stored	Details	Set by (setting timing)
SD81 to SD111	Detailed information 1	Detailed information 1	(135) Cycle information ■SD81: With or without specification  b0: Cycle type b1: Core number b2: Detail code b3 to b15: Not used ■SD82: Cycle type 0: System basic cycle 1: Buffer memory refresh cycle 2: First operation cycle 3: Second operation cycle 4: Third operation cycle ■SD83: Core number 0: Main core 1 to 3: Extended core 1 to 3 ■SD84: Detail code	S (Error)
			(146) Connection structure error information ■SD81: With or without specification  b0: Vendor code of normal device b1: Not used b2: Model code of normal device b3: Vendor code of connected device b4: Not used b5: Model code of connected device b6 to b15: Not used ■SD82: Vendor code of normal device ■SD83: Not used ■SD84 to 85: Model code of normal device ■SD86: Vendor code of connected device ■SD87: Not used ■SD88 to 89: Model code of connected device	
SD112	Detailed information 2 information category	Detailed information 2 information category code	Detailed information 2 information category code is stored.  • b0 to b7: Information category code • b8 to b15: Not used The following codes are stored into the information category code. • 0: N/A • 1: Error location information • 2: Drive/file information • 3: Annunciator number • 4: Parameter information • 5: System configuration information • 7: Time information • 35: Program error information (FB) • 56: Device name information • 61: Label name information • 68: IP address duplication information • 81: Overlapped type information • 88: Target station information • 96: Communication period setting information • 99: Target station information • 106: Add-on name information • 107: Add-on version information • 108: Detail code information • 118: Target station information • 129: Axis error	S (Error)

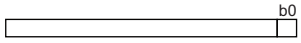
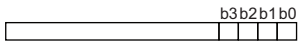
No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	• Detailed information 2 corresponding to the error code (SD0) is stored. • The type of the detailed information 2 can be checked in SD112. (The value of the "Detailed information 2 information category code" stored in SD112 corresponds to the following figures (1) to (5), (7), (35), (56), (61), (68), (81), (88), (99), (106), (107), (108), and (129).)	S (Error)
			(1) Error location information ■SD113: With or without specification  b0: Argument number b1 to b3: Not used b4 to b5: Step information b6: File name b7 to b15: Not used ■SD114: Argument number ■SD115: SFC block number ■SD116 to SD117: SFC step number ■SD118 to SD119: SFC transition number ■SD120 to SD121: Step information (sequence step number) ■SD122: Step information (Not used) ■SD123: Step information (Pou No./FB No.) (Pou No./FB No. are numbers that are internally assigned during conversion by the engineering tool to identify each POU in a program file and FB file.) ■SD124 to SD131: File name (first eight characters of Unicode string)	
			(2) Drive number and file name ■SD113: With or without specification  b0: Drive number b1: File name b2 to b15: Not used ■SD114: Drive number ■SD115 to SD122: File name (first eight characters of Unicode string)	
			(3) Annunciator number ■SD113: With or without specification  b0: Annunciator number b1 to b15: Not used ■SD114: Annunciator number	

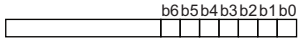
No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(4) Parameter information ■SD113: With or without specification  b0: Parameter type b1: Parameter storage location b2: I/O number b3: Parameter number b4: Network number b5: Station number b6: System information b7 to b15: Not used ■SD114  • b0 to b7: Parameter type (stored in the following value) 1: System parameter 2: CPU parameter 3: Module parameter 4: Module extension parameter 5: Memory card parameter • b8 to b15: Parameter storage location (0: Program memory, 2: SD memory card, 4: Data memory) ■SD115: I/O number 0xFFFFH is stored when no I/O number is assigned. ■SD116: Parameter number ■SD117: Network number ■SD118: Station number 0 to 254 (0 is stored for the master station.) ■SD119 to SD129: System information	S (Error)
			(5) System configuration information ■SD113: With or without specification  b0: I/O number b1: Slot number b2: Base number b3: Power supply number b4: CPU number b5: Network number b6: Station number b7 to b15: Not used ■SD114: I/O number ■SD115  • b0 to b7: Slot number (0 to 11) • b8 to b15: Base number (0: Main base unit, 1 to 7: Extension base unit level 1 to level 7, 8: Higher than level 7) ■SD116  • b0 to b7: Power supply number (1: Power supply 1) • b8 to b15: CPU number (1: CPU No.1) ■SD117: Network number ■SD118: Station number 0 to 254 (0 is stored for the master station.)	

No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(7) Time information ■SD113: With or without specification  b0: Time (value set) (ms) b1: Time (value set) (μs) b2: Time (actual measurement value) (ms) b3: Time (actual measurement value) (μs) b4 to b15: Not used ■SD114: Time (value set) (ms) ■SD115: Time (value set) (μs) ■SD116: Time (actual measurement value) (ms) ■SD117: Time (actual measurement value) (μs)	S (Error)
			(35) Program error information (FB) ■SD113: With or without specification  b0: Detail code b1: FB type b2: FB instance ID b3: Instance name b4 to b15: Not used ■SD114: Detail code ■SD115 to SD116: FB type ■SD117 to SD118: FB instance ID ■SD119 to SD143: Instance name (first 25 characters of Unicode string)	
			(56) Device name information (system information)	
			(61) Label name information (system information)	
			(68) IP address duplication information ■SD113: With or without specification  b0: Duplication station 1 MAC address (1st octet and 2nd octet) b1: Duplication station 1 MAC address (3rd octet and 4th octet) b2: Duplication station 1 MAC address (5th octet and 6th octet) b3: Duplication station 2 MAC address (1st octet and 2nd octet) b4: Duplication station 2 MAC address (3rd octet and 4th octet) b5: Duplication station 2 MAC address (5th octet and 6th octet) b6 to b15: Not used ■SD114: Duplication station 1 MAC address (1st octet and 2nd octet) ■SD115: Duplication station 1 MAC address (3rd octet and 4th octet) ■SD116: Duplication station 1 MAC address (5th octet and 6th octet) ■SD117: Duplication station 2 MAC address (1st octet and 2nd octet) ■SD118: Duplication station 2 MAC address (3rd octet and 4th octet) ■SD119: Duplication station 2 MAC address (5th octet and 6th octet) If the MAC address of the duplication station is 123456789ABC, the following is an example. b15 b8 b7 b0 SD114: 12H | 34H SD115: 56H | 78H SD116: 9AH | BCH	

No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(81) Overlapped type information ■SD113: With or without specification  b0: Overlapped type information b1 to b15: Not used ■SD114: Overlapped type information 0: Station number duplication 3: Master station duplication 4: Submaster station duplication 5: Master station/submaster station duplication	S (Error)
			(88) Target station information ■SD113: With or without specification  b0: Network number b1: Station number b2: IP address b3: Port with an error b4: Error details b5: Parameter error information b6: Error information b7 to b15: Not used ■SD114: Network number 1 to 239: 1 to 239 255: No setting ■SD115: Station number 0: Master station 1 to 253: Device station 255: No setting ■SD116 to SD117: IP address b15 b8 b7 b0 SD116: 2nd byte | 1st byte SD117: 4th byte | 3rd byte ■SD118: Port with an error 3: PORT1 4: PORT2 ■SD119 to SD120: Error details ■SD121: Parameter error information 1: Parameter error occurrence 2: Parameter error clear ■SD122: Error information 1: Major/moderate error occurrence 2: Major/moderate error clear 3: Minor error occurrence 4. Minor error clear	
			(96) Communication period setting information ■SD113: With or without specification  b0: Communication cycle interval (calculation) b1: Cyclic transmission time (calculation) b2: Transient transmission time (calculation) ■SD114: Communication cycle interval (calculation) ■SD115: Cyclic transmission time (calculation) ■SD116: Transient transmission time (calculation)	

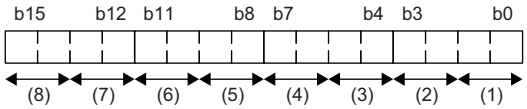
No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(99) Target station information ■SD113: With or without specification  b0: Network number b1: Station number b2: IP address b3: Port with an error b4: Error details b5 to b15: Not used ■SD114: Network number 1 to 239: 1 to 239 255: No setting ■SD115: Station number 0: Master station 1 to 253: Device station 255: No setting ■SD116 to SD117: IP address b15 b8 b7 b0 SD116: 2nd byte | 1st byte SD117: 4th byte | 3rd byte ■SD118: Port with an error 3: PORT1 4: PORT2 ■SD119 to SD120: Error details	S (Error)
			(106) Add-on name information ■SD113: With or without specification  b0: Add-on name b1 to b15: Not used ■SD114: Add-on name (first 30 characters of Unicode string)	
			(107) Add-on version information ■SD113: With or without specification  b0: Detail code b1: Not used b2: Add-on version b3 to b15: Not used ■SD114: Detail code ■SD115: Not used ■SD116 to SD143: Add-on version (first 28 characters of Unicode string)	

No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(108) Detail code information ■SD113: With or without specification  b0: Detail code b1 to b15: Not used ■SD114: Detail code	S (Error)
			(118) Target station information ■SD113: With or without specification  b0: Network number b1: Station number b2: IP address b3: Multidrop number b4 to b15: Not used ■SD114: Network number 1 to 239: 1 to 239 255: No setting ■SD115: Station number 0: Master station 1 to 253: Device station 255: No setting ■SD116 to 117: IP address (IPv4) b15 b8 b7 b0 SD116: 2nd byte | 1st byte SD117: 4th byte | 3rd byte ■SD118: Multidrop number	

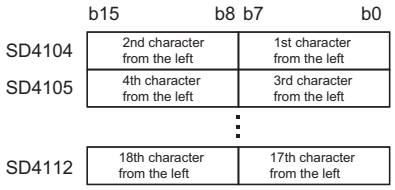
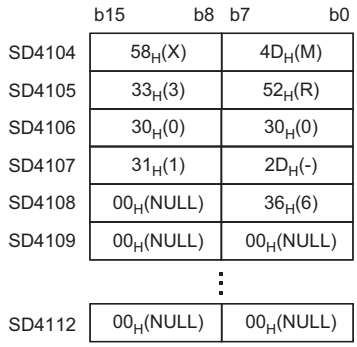
No.	Name	Data stored	Details	Set by (setting timing)
SD113 to SD143	Detailed information 2	Detailed information 2	(129) Axis error ■SD113: With or without specification  b0: Type b1: Axis/axes group where an event has occurred b2: Axis/axes group status b3: Detail code b4: FB type b5: FB instance ID b6: Instance name b7 to b15: Not used ■SD114: Type 0: Real drive axis 1: Real general-purpose output axis 2: Real encoder axis 3: Virtual drive axis 4: Virtual encoder axis 5: Virtual linked axis 100: Axis group ■SD115: Axis/axes group where an event has occurred ■SD116: Axis/axes group status -1: Invalid 0: Disabled 1: Errorstop 2: Stopping 3: Homing 4: Standstill 5: DiscreteMotion 6: ContinuousMotion 7: SyncronizedMotion 100: GroupDisabled 101: GroupErrorStop 102: GroupStopping 103: GroupHoming 104: GroupStandby 105: GroupMoving ■SD117: Detail code ■SD118 to SD119: FB type ■SD120 to SD121: FB instance ID ■SD122 to SD143: Instance name (first 22 characters of Unicode string)	S (Error)

System information

The following is the list of special register areas relating to the system information.

No.	Name	Data stored	Details	Set by (setting timing)
SD160	Firmware version	Firmware version	The firmware version is stored.	S (Initial)
SD200	Status of switch	Status of switch	The switch status of the controller is stored as follows: 0: RUN, 1: STOP	S (Switch change)
SD201	LED status	CPU-LED state	This register stores the information that indicates LED status (0: off, 1: on, 2: flashing (fast/slow)) of the controller in the following bit patterns.  (1) READY (2) ERROR (3) PROGRAM RUN (4) USER (5) Not used (6) CARD (7) Not used (8) FUNCTION	S (Status change)
SD203	Operating status of CPU	Operating status of CPU	The operation status of the controller is stored as follows: 0: RUN, 2: STOP, 3: PAUSE	S (Every END)
SD210	Clock data	Clock data (year)	The year value (four digits) of the clock data is stored as a BIN code.	S/U (Request)
SD211		Clock data (month)	The month value of the clock data is stored as a BIN code.	S/U (Request)
SD212		Clock data (day)	The day value of the clock data is stored as a BIN code.	S/U (Request)
SD213		Clock data (hour)	The hour value of the clock data is stored as a BIN code.	S/U (Request)
SD214		Clock data (minute)	The minute value of the clock data is stored as a BIN code.	S/U (Request)
SD215		Clock data (second)	The second value of the clock data is stored as a BIN code.	S/U (Request)
SD216		Clock data (day of the week)	The day of the week value of the clock data is stored as a BIN code. (0: Sun, 1: Mon, 2: Tue, 3: Wed, 4: Thu, 5: Fri, 6: Sat)	S/U (Request)
SD218	Time zone setting value	Time zone (in minutes)	The time zone setting value specified in the parameter is stored in increments of minutes. (Example 1) SD218 = 540 540 ÷ 60 minutes = 9 hours The time zone value set by the parameter is "UTC+9 (+9 hours)". (Example 2) SD218 = -720 -720 ÷ 60 minutes = -12 hours The time zone value set by the parameter is "UTC-12 (-12 hours)".	S (Initial)
SD243 SD244	Number of base slots	Number of base slots	The number of slots of the base unit, which is specified in the Base / power supply / extension cable setting of system parameters, is stored. When the number of slots of the base unit is not specified by the system parameter, that of the mounted base unit is stored. b15 b12 b11 b8 b7 b4 b3 b0 SD243: 3 2 1 0 SD244: 7 6 5 4 0: Main 1 to 7: Extension 1 to 7	S (Initial)
SD250	Loaded maximum I/O	Loaded maximum I/O number	The value obtained by dividing the last I/O number for an implemented unit plus one by 16 is stored. Example 1: Last I/O number 010F • SD250 = 0011H Example 2: Last I/O number 0FFF • SD250 = 0100H	S (Initial)

No.	Name	Data stored	Details	Set by (setting timing)
SD260	Number of points assigned to bit devices	X (L)	The number of points assigned to the X device is stored in 32 bits.	S (Initial)
SD261		X (H)		
SD262		Y (L)	The number of points assigned to the Y device is stored in 32 bits.	S (Initial)
SD263		Y (H)		
SD264		M (L)	• The number of points assigned to the M device is stored in 32 bits. • The number of points is stored even when the number of points assigned to M is 32K or less.	S (Initial)
SD265		M (H)		
SD266		B (L)	• The number of points assigned to the B device is stored in 32 bits. • The number of points is stored even when the number of points assigned to B is 32K or less.	S (Initial)
SD267		B (H)		
SD268		SB (L)	• The number of points assigned to the SB device is stored in 32 bits. • The number of points is stored even when the number of points assigned to SB is 32K or less.	S (Initial)
SD269		SB (H)		
SD270		F (L)	The number of points assigned to the F device is stored in 32 bits.	S (Initial)
SD271		F (H)		
SD272		V (L)	The number of points assigned to the V device is stored in 32 bits.	S (Initial)
SD273		V (H)		
SD274		L (L)	The number of points assigned to the L device is stored in 32 bits.	S (Initial)
SD275		L (H)		
SD280	Number of points assigned to word devices	D (L)	• The number of points assigned to the D device is stored in 32 bits. • The number of points is stored even when the number of points assigned to D is 32K or less.	S (Initial)
SD281		D (H)		
SD282		W (L)	• The number of points assigned to the W device is stored in 32 bits. • The number of points is stored even when the number of points assigned to W is 32K or less.	S (Initial)
SD283		W (H)		
SD284		SW (L)	• The number of points assigned to the SW device is stored in 32 bits. • The number of points is stored even when the number of points assigned to SW is 32K or less.	S (Initial)
SD285		SW (H)		
SD288	Number of points assigned to timer/ counter devices	T (L)	• The number of points assigned to the T device is stored in 32 bits. • The number of points is stored even when the number of points assigned to T is 32K or less.	S (Initial)
SD289		T (H)		
SD290		ST (L)	• The number of points assigned to the ST device is stored in 32 bits. • The number of points is stored even when the number of points assigned to ST is 32K or less.	S (Initial)
SD291		ST (H)		
SD292		C (L)	• The number of points assigned to the C device is stored in 32 bits. • The number of points is stored even when the number of points assigned to C is 32K or less.	S (Initial)
SD293		C (H)		
SD294		LT (L)	• The number of points assigned to the LT device is stored in 32 bits. • The number of points is stored even when the number of points assigned to LT is 32K or less.	S (Initial)
SD295		LT (H)		
SD296		LST (L)	• The number of points assigned to the LST device is stored in 32 bits. • The number of points is stored even when the number of points assigned to LST is 32K or less.	S (Initial)
SD297		LST (H)		
SD298		LC (L)	• The number of points assigned to the LC device is stored in 32 bits. • The number of points is stored even when the number of points assigned to LC is 32K or less.	S (Initial)
SD299		LC (H)		
SD300	Number of points assigned to the index register	Z	The number of points assigned to the Z device is stored.	S (Initial)
SD302	Number of points assigned to the long index register	LZ	The number of points assigned to the LZ device is stored.	S (Initial)
SD306	Number of points assigned to the file register	ZR (L)	• The number of points assigned to the ZR device is stored in 32 bits. • The number of points is stored even when the number of points assigned to ZR is 32K or less.	S (Initial)
SD307		ZR (H)		
SD308	Number of points assigned to refresh devices	RD (L)	• The number of points assigned to the RD device is stored in 32 bits. • The number of points is stored even when the number of points assigned to RD is 32K or less.	S (Initial)
SD309		RD (H)		
SD312	File register block number	File register block number	The block number of the file register currently selected is stored.	S (Status change)

No.	Name	Data stored	Details	Set by (setting timing)
SD4104 to SD4112	Model	Module model (string)	The model name string of this module is stored. The string to be stored is as follows. • Characters are stored as ASCII characters. 00H is stored as the 18th character. When a model name is less than 17 characters, 00H is stored for any other characters as well.  If the module model name is MXR300-16 (9 characters) 	S (Initial)
SD4114	Model code	Module model name (numerical value)	The numerical value that is paired with the module model of this module is stored. • 48E9H: MXR300-16 • 48EAH: MXR300-32 • 48EBH: MXR300-64 • 48EEH: MXR500-128 • 48EFH: MXR500-256	S (Initial)
SD4115	Number of axes	Number of axes of the module	The numerical value that expresses the maximum number of axes of this module is stored.	S (Initial)

System clock

The following is the list of special register areas relating to the system clock.

No.	Name	Data stored	Details	Set by (setting timing)
SD412	One second counter	The number of counts that is counted once per second.	• The value in this register increments by one for each second after the controller enters RUN mode. • A counting cycle from 0 to 65535 to 0 is repeated.	S (Status change)
SD414	2n second clock setting	Unit setting for 2n second clock	• The n value of the 2n second clock is stored (Default: 30). • Configurable range is -32768 to 32767 (0 to FFFFH).	U
SD415	2n ms clock setting	Unit setting for 2n ms clock	• The n value for the 2n ms clock is stored. (Default: 30). • Configurable range is -32768 to 32767 (0 to FFFFH).	U
SD420	Scan counter	The number of counts that is counted once for each scan.	• The value in this register increments by one for each scan after the controller enters RUN mode. (however, the count is skipped for scans by the initial execution type program). • A counting cycle from 0 to 65535 to 0 is repeated.	S (Every END)

Fixed scan function information

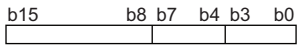
The following is the list of special register areas relating to the fixed scan function information.

No.	Name	Data stored	Details	Set by (setting timing)
SD492	Network communication period synchronization cycle error count (basic period)	Network communication period synchronization cycle error count (basic period)	The number of network communication period synchronization cycle (basic period) errors that have occurred is counted. (0 to 65535) When the count exceeds 65535, it returns to 0 and starts a new cycle. Note that the number of error occurrences is counted regardless of the controller operation setting for error detection within the RAS setting of the CPU parameter.	S (Status change)
SD493	Network communication period synchronization cycle error count (medium-speed period)	Network communication period synchronization cycle error count (medium-speed period)	The number of network communication period synchronization cycle (medium-speed period) errors that have occurred is counted. (0 to 65535) When the count exceeds 65535, it returns to 0 and starts a new cycle. Note that the number of error occurrences is counted regardless of the controller operation setting for error detection within the RAS setting of the CPU parameter.	S (Status change)
SD494	Network communication period synchronization cycle error count (low-speed period)	Network communication period synchronization cycle error count (low-speed period)	The number of network communication period synchronization cycle (low-speed period) errors that have occurred is counted. (0 to 65535) When the count exceeds 65535, it returns to 0 and starts a new cycle. Note that the number of error occurrences is counted regardless of the controller operation setting for error detection within the RAS setting of the CPU parameter.	S (Status change)
SD500	Execution program number	Execution program number	The program number (1 to 380) which is currently executed is stored as a BIN value.	S (Status change)
SD518	Initial scan time	Initial scan time (unit: ms)	• The initial scan time is stored into SD518 and SD519 (it is measured in increments of μs). SD518: The ms part is stored. (Storage range: 0 to 65535) SD519: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD519		Initial scan time (unit: μs)		
SD520	Current scan time	Current scan time (unit: ms)	• The current scan time is stored into SD520 and SD521 (it is measured in increments of μs). SD520: The ms part is stored. (Storage range: 0 to 65535) SD521: The μs part is stored. (Storage range: 0 to 999) (Example) If the current scan time is 23.6ms, the following values are stored: SD520 = 23 SD521 = 600 • These areas are cleared to 0 when the operating status of the controller is switched to STOP.	S (Every END)
SD521		Current scan time (unit: μs)		
SD522	Minimum scan time	Minimum scan time (unit: ms)	• The minimum value of the scan time other than one for the initial execution program is stored into SD522 and SD523 (it is measured in increments of μs). SD522: The ms part is stored. (Storage range: 0 to 65535) SD523: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD523		Minimum scan time (unit: μs)		
SD524	Maximum scan time	Maximum scan time (unit: ms)	• The maximum value of the scan time other than one for the initial execution program is stored into SD524 and SD525 (it is measured in increments of μs). SD524: The ms part is stored. (Storage range: 0 to 65535) SD525: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD525		Maximum scan time (unit: μs)		
SD526	END processing time	END processing time (unit: ms)	• The time period from completion of a scan program until start of the next scan is stored into SD526 to SD527 (it is measured in increments of μs). SD526: The ms part is stored. (Storage range: 0 to 65535) SD527: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD527		END processing time (unit: μs)		

No.	Name	Data stored	Details	Set by (setting timing)
SD528	Constant scan wait time	Constant scan wait time (unit: ms)	• The waiting time specified in the constant scan setting process is stored into SD528 and SD529 (it is measured in increments of μs). SD528: The ms part is stored. (Storage range: 0 to 65535) SD529: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD529		Constant scan wait time (unit: μs)		
SD530	Scan program execution time	Scan program execution time (unit: ms)	• The execution time of the scan program for one scan is stored into SD530 and SD531 (it is measured in increments of μs). SD530: The ms part is stored. (Storage range: 0 to 65535) SD531: The μs part is stored. (Storage range: 0 to 999) • These areas are cleared to 0 when the operating status of the controller is switched from STOP to RUN.	S (Every END)
SD531		Scan program execution time (unit: μs)		

Drive information

The following is the list of special register areas relating to the drive information.

No.	Name	Data stored	Details	Set by (setting timing)
SD600	Memory card mounting status	SD memory card type	This register indicates the type of mounted SD memory cards.  b0 to b3: Not used b4 to b7: Drive 2 (SD) type • 0: Does not exist • 4: SD memory card b8 to b15: Not used	S (Initial, card insertion/ removal)
SD604	SD memory card (drive 2) usage status	SD memory card (drive 2) usage status	Usage status of the SD memory card is stored using the following bit pattern. (On indicates being used.) b0: Event history b1: Module extension parameter*1 b2: Label communication data b3 to b15: Not used	S (Status change)
SD606	SD memory card (drive 2) capacity	SD memory card (drive 2) capacity: the lower digits (unit: K bytes)	The capacity of the SD memory card is stored in increments of 1K byte	S (Initial, card insertion/ removal)
SD607		SD memory card (drive 2) capacity: the higher digits (unit: K bytes)	The capacity of the SD memory card is stored in increments of 1K byte	S (Initial, card insertion/ removal)
SD610	SD memory card free space (drive 2 free space)	Memory card free space (drive 2): the lower digits (unit: K bytes)	The amount of free space of the SD memory card is stored in increments of 1K byte.	S (at change)
SD611		Memory card free space (drive 2): the higher digits (unit: K bytes)	The amount of free space of the SD memory card is stored in increments of 1K byte.	S (at change)
SD612	Device/label memory (file storage area) free space (drive 3 free space)	Device/label memory (file storage area) free space (drive 3): the lower digits (unit: K bytes)	The free space of the device/label memory (file storage area) is stored in increments of 1K bytes.	S (at change)
SD613		Device/label memory (file storage area) free space (drive 3): the higher digits (unit: K bytes)	The free space of the device/label memory (file storage area) is stored in increments of 1K bytes.	S (at change)
SD614	Device/label memory (file storage area) use condition (drive 3 use condition)	Device/label memory (file storage area) use condition (drive 3)	Usage status of the device/label memory is stored using the following bit pattern. (On indicates being used.) b0: File register b1 to b15: Not used	S (Status change)
SD616	Device/label memory capacity	Device/label memory capacity: the lower digits (unit: K bytes)	The capacity of the device/label memory is stored in increments of 1K byte.	S (Initial)
SD617		Device/label memory capacity: the higher digits (unit: K bytes)	The capacity of the device/label memory is stored in increments of 1K byte.	S (Initial)
SD618	Device/label memory (file storage area) capacity (drive 3 capacity)	Device/label memory (file storage area) capacity (drive 3): the lower digits (unit: K bytes)	The capacity of the device/label memory (file storage area) is stored in increments of 1K byte	S (Initial)
SD619		Device/label memory (file storage area) capacity (drive 3): the higher digits (unit: K bytes)	The capacity of the device/label memory (file storage area) is stored in increments of 1K byte	S (Initial)
SD620	Data memory usage status (drive 4 usage status)	Data memory usage status (drive 4)	Usage status of the data memory is stored using the following bit pattern. (On indicates being used.) b0: Event history b1: Module extension parameter*1 b2 to b15: Not used	S (Status change)
SD622	Data memory capacity (drive 4 capacity)	Data memory capacity (drive 4): the lower digits (unit: K bytes)	The capacity of the data memory is stored in increments of 1K byte	S (Initial)
SD623		Data memory capacity (drive 4): the higher digits (unit: K bytes)	The capacity of the data memory is stored in increments of 1K byte	S (Initial)
SD629	Program memory write (transfer) status	Write (transfer) status display (percent)	This register displays write (transfer) status to the program memory (Flash ROM) in percentage (0 to 100%). The initial value is 0. Upon completion of writing, this register is set to 100. It is set to 0 at the time when the write command is issued.	S (Writing)

No.	Name	Data stored	Details	Set by (setting timing)
SD633	Data memory write (transfer) status	Write (transfer) status display (percent)	This register displays write (transfer) status to the data memory (Flash ROM) in percentage (0 to 100%). The initial value is 0. Upon completion of writing, this register is set to 100. It is set to 0 at the time when the write command is issued.*2	S (Writing)
SD648	Function memory capacity	Function memory capacity Low-order (in K bytes)	The capacity of the function memory is stored in K bytes.	S (Initial)
SD649		Function memory capacity High-order (in K bytes)	The capacity of the function memory is stored in K bytes.	S (Initial)
SD650	Function memory free space capacity	Function memory free space capacity Low-order (in K bytes)	The amount of free space of the function memory is stored in K bytes.	S (Status change)
SD651		Function memory free space capacity High-order (in K bytes)	The amount of free space of the function memory is stored in K bytes.	S (Status change)
SD660	Motion data memory (drive 6) capacity	Motion data memory (drive 6) capacity lower digits (unit: K bytes)	The capacity of the motion data memory (drive 6) is stored in increments of 1K byte.	S (Initial)
SD661		Motion data memory (drive 6) capacity higher digits (unit: K bytes)	The capacity of the motion data memory (drive 6) is stored in increments of 1K byte.	S (Initial)
SD662	Motion data memory (drive 6) free space	Motion data memory (drive 6) free space lower digits (unit: K bytes)	Free space of the motion data memory (drive 6) is stored in increments of 1K byte.	S (Status change)
SD663		Motion data memory (drive 6) free space higher digits (unit: K bytes)	Free space of the motion data memory (drive 6) is stored in increments of 1K byte.	S (Status change)
SD664	Motion Data memory (drive 6) usage status	Motion Data memory (drive 6) usage status	Usage status of the motion data memory is stored using the following bit pattern. (On indicates being used.) b0: Motion data memory usage status event log history (drive 6) b1 to b15: Not used	S (Status change)
SD666	Program cache memory capacity	Program cache memory capacity lower digits (unit: K bytes)	The capacity of the program cache memory is stored in increments of 1K byte.	S (Initial)
SD667		Program cache memory capacity higher digits (unit: K bytes)	The capacity of the program cache memory is stored in increments of 1K byte.	S (Initial)
SD668	Program cache memory free space	Program cache memory free space lower digits (unit: K bytes)	The free space of the program cache memory is stored in increments of 1K byte.	S (Status change)
SD669		Program cache memory free space higher digits (unit: K bytes)	The free space of the program cache memory is stored in increments of 1K byte.	S (Status change)
SD4124	Built-in memory write count index*3	Index of the number of write operations to the built-in memory up to now (lower)	• This register indicates the index value for the number of write operations to the program memory and data memory (Flash ROM) up to now. (Stored as a 32-bit BIN value) • When the index value exceeds 50000, "FLASH ROM ERROR" (error code: 1080H) is generated (the index value is continued to be counted even when it exceeds 50000).	S (Initial)
SD4125		Index of the number of right operations to the built-in memory up to now (higher)		

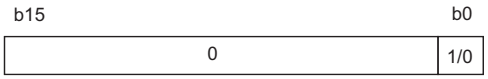
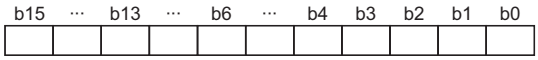
*1 It is stored when used for the Ethernet function of the controller.

*2 When the save destination for the event history is the data memory: the event history will be stored at the timing of powering off and on and resetting the controller. Accordingly, since the data will be written into the data memory, 100 is stored. (When the save destination for the event history is the SD memory, the initial value remains 0.)

*3 If the number of write operations exceeds 50000, the controller must be replaced.
The number of write operations may not be equal to the index value.

Instruction related

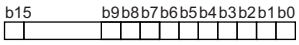
The following is the list of special register areas relating to the instruction-related items.

No.	Name	Data stored	Details	Set by (setting timing)
SD699	Dedicated instruction skip flag	Dedicated instruction skip flag	This register indicates whether the built-in Ethernet function instruction or intelligent function module dedicated instruction has been skipped. This register saves/returns when the interrupt program is being executed.  Off: The instruction has not been skipped. (The instruction is being executed or completed.) On: The process was completed without the instruction being executed. The built-in Ethernet function instruction applies to GP.SOCOPEN, GP.SOCCLOSE, GP.SOCRCV, G.SOCRCVS, GP.SOCSND, GP.ECPRTCL, G(P).SLMPSND, J(P).SLMPSND, G(P).SLMPSNDC, GP.FTPCPUT, GP.FTPCGET, SP.SOCOPEN, SP.SOCCLOSE, SP.SOCRCV, S.SOCRCVS, SP.SOCSND, SP.ECPRTCL, SP.SLMPSND, SP.FTPPUT, and SP.FTPGET.	S (Status change)
SD757	Current interrupt priority	Current interrupt priority	The priority for the interrupt of the interrupt program currently executed is stored. 1 to 32: Priority for the interrupt pointer of the interrupt program currently being executed 0: No interrupt operation (default)	S (Status change)
SD758	Interrupt disabling for each priority setting value	Interrupt disabling for each priority setting value	The interrupt priority of the interrupt program in which the interrupt is disabled by using the DI instructions (Disabling interrupt programs/ Disabling interrupt programs with specified priority or lower) and the EI instruction (Enabling interrupt programs) is stored in this register. 1: Interrupt programs with priority 1 or lower (all priority levels) disabled 2: Interrupt programs with priority 2 or lower disabled 3: Interrupt programs with priority 3 or lower disabled ⋮ 30: Interrupt programs with priority 30 or lower disabled 31: Interrupt programs with priority 31 or lower disabled 32: Interrupt programs with priority 32 or lower disabled 0: No interrupt program disabled (interrupt programs with any priority level enabled)	S (Status change)
SD771	Specification of the number of write instruction executions to data memory	Specification of the number of write instruction executions to data memory	In this register, the maximum number of the data memory writing instruction (SP.DEVST) executions per day is specified. When the number of data memory writing instruction executions exceeds the value specified in this register, "4113: OPERATION ERROR" is generated. Setting range is from 1 to 32767. If a value is set outside the range, "4113: OPERATION ERROR" is generated during the data memory writing instruction execution.	U
SD775	Selection of refresh processing during the COM instruction execution	b0 to b3, b4, b6 0: Not executing refresh 1: Executing refresh b15 0: Execute device/ label access service processing 1: Not execute device/label access service processing	In this register, whether or not each processing is executed during the COM instruction execution is selected (Default: 0). The specification on the SD775 is effective when SM775 is turned on.  ■ Refresh processing (0: Not executed, 1: Executed) b0: I/O refresh b1: Link refresh of the CC-Link module b2: Link refresh for the CC-Link IE Controller Network module b3: Intelligent function module refresh b6: Link refresh of the CC-Link IE Field Network module ■ Device/label access service processing execution (0: Executed, 1: Not executed) b15: Device/label access service processing (communications with the engineering tool, GOT, or other external devices)	U

<table>
<tr><th>No.</th><th>Name</th><th>Data stored</th><th>Details</th><th>Set by (setting timing)</th></tr>
<tr><td>SD792 and SD793</td><td>PID limit setting (for complete derivative)</td><td>0: Limit restriction applied
1: No limit restriction</td><td>The limit restriction for each PID loop is specified as follows: (for the PIDCONT instruction)
<table><tr><td></td><td>b15</td><td></td><td>b1</td><td>b0</td></tr><tr><td>SD792</td><td>16</td><td>to</td><td>2</td><td>1</td></tr><tr><td>SD793</td><td>32</td><td>to</td><td>18</td><td>17</td></tr></table>1 to 32: Loop 1 to 32</td><td>U</td></tr>
<tr><td>SD794 and SD795</td><td>PID limit setting (for incomplete derivative)</td><td>0: Limit restriction applied
1: No limit restriction</td><td>The limit restriction for each PID loop is specified as follows: (for the S.PIDCONT instruction)
<table><tr><td></td><td>b15</td><td></td><td>b1</td><td>b0</td></tr><tr><td>SD794</td><td>16</td><td>to</td><td>2</td><td>1</td></tr><tr><td>SD795</td><td>32</td><td>to</td><td>18</td><td>17</td></tr></table>1 to 32: Loop 1 to 32</td><td>U</td></tr>
</table>

Latch area

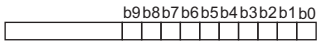
The following is the list of special register areas relating to the latch area.

No.	Name	Data stored	Details	Set by (setting timing)
SD940	Debug function Stop direction at file change on label specification	Stop direction at file change on label specification	Specify the operation for changing sequence program files or the global label setting file. When the stop direction is given, an error occurs in the corresponding function (setting No.). (On: Stop the function, Off: Do not stop the function (The function continues to operate.))  b0: Data logging setting No.1 b1: Data logging setting No.2 b2: Data logging setting No.3 b3: Data logging setting No.4 b4: Data logging setting No.5 b5: Data logging setting No.6 b6: Data logging setting No.7 b7: Data logging setting No.8 b8: Data logging setting No.9 b9: Data logging setting No.10 b10 to b14: Not used b15: Real-time monitor	U
SD972	Communication cycle intervals measure setting	Communication cycle intervals measure setting	• Enables/disables communication cycle intervals measure. A501H: Communication cycle intervals measure enabled Other than A501H: Communication cycle intervals measure disabled • If SM972 (communication cycle intervals measure setting request) is on when the controller is powered off and on or is reset, SM973 (communication cycle intervals measure setting status) is set in accordance with the set value held.	U
SD974 SD975	Event history filter count	Event history filter count	• The number of times the event history has been filtered is stored. The count stops at 4294967295. • "0" is set at the following timing. When the event history is cleared and when the event history file is generated	S (Status change)
SD976 SD977	Motion control event history filter count	Motion control event history filter count	• The number of times the motion control event history has been filtered is stored. The count stops at 4294967295. • "0" is set at the following timing. When the motion control event history is cleared and when the motion control event history file is generated	S (Status change)
SD1084	Event history save limit mode setting	Event history save limit mode setting	An applicable mode is used in accordance with the following values as well as the SD1085 value if SM1084 is on when the power is turned on or the controller is reset or when the status changes from off to on in the STOP or RUN state. • Change in save restriction mode Setting value: A501H • No change in save restriction mode Setting value: Other than A501H	U
SD1085	Event history save restriction mode operation mode change setting value	Event history save restriction mode operation mode change setting value	Sets the operation mode of event history save restriction mode. 0: Cancel save restriction mode	U
SD4100*1	Current latch interval time	Current latch interval time (Lower)	• The latch processing interval (after starting a latch processing until the next latch processing starts) is measured and stored. • Data is stored regardless of the latch save destination setting. • Data is stored in units of ms. • The time is updated when the operating status is RUN state.	S (Status change)
SD4101*1		Current latch interval time (Higher)		
SD4102*1	Max latch interval time	Max latch interval time (Lower)	• The latch processing interval (after starting a latch processing until the next latch processing starts) is measured and the maximum latch interval is stored. • Data is stored regardless of the latch save destination setting. • Data is stored in units of ms. • These areas can be cleared by turning off and on the max latch interval time clear request (SM4102). • The time is updated when the operating status is RUN state.	S (Status change)
SD4103*1		Max latch interval time (Higher)		

*1 Refer to the stored value as a reference. The value may be greater than the value set in the latch interval setting depending on the scan time and latch size.

Data logging function

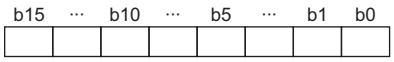
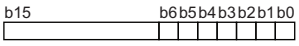
The following is the list of special register areas relating to the data logging function.

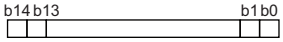
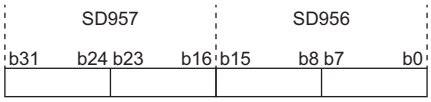
No.	Name	Data stored	Details	Set by (setting timing)
SD1200	Data logging Function memory use condition	Data logging Function memory use condition	• The status of the data logging when the function memory or data memory is set for the storage location of data logging files are stored in the following bit patterns.  b0: Setting No.1 b1: Setting No.2 ⋮ b9: Setting No.10 b10 to b15: Not used • Each bit turns on when a relevant data logging starts and turns off when the data logging stops.	S (Status change)
SD1210 SD1211	Data logging setting No.1 Latest storage file number	Latest storage file number	• The latest storage file number • This register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD1212 SD1213	Data logging setting No.1 Oldest storage file number	Oldest storage file number	• The oldest storage file number • This register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD1214	Data logging setting No.1 Internal buffer free space	Free space size of the internal buffer (K bytes)	• The amount of free space of the internal buffer is stored in K bytes. The smaller the value, the higher the generating ratio of processing overflow. • For the trigger logging, it refers to the total capacity of internal buffer until the data for the number of records is collected after a trigger occurred. • This register is cleared to 0 by the stop command from the programming tool.	S (Status change)
SD1215	Data logging setting No.1 Number of processing overflow occurrences	Number of processing overflow occurrences	• The number of data logging processing overflow occurrences • When overflow occurs, data is lost. • When the count exceeds 65535, it returns to 0 and starts a new cycle. • With "Stop" set for the operation at the time when the number of storage files exceeds the limit, a processing overflow may occur until the stop operation is completed after the collection of data corresponding to the specified number of storage files was completed. • This register is cleared to 0 when the setting is registered or by the stop command from the programming tool.	S (Error)
SD1216	Data logging setting No.1 Data logging error cause	Data logging error cause	• Cause of the error generated during data logging operations is stored. 0: No error Other than 0:For details on the values stored when an error occurs, refer to the list of error codes. (☞ Page 1776 ERROR CODES) • This register is cleared to 0 when the setting is registered or by the stop command from the programming tool.	S (Error)
SD1217	Data logging setting No.1 Data logging file transfer error cause	Data logging file transfer error cause	• An error cause that is detected last in a transferring of data logging files to the data memory is stored. 0: No error Other than 0: For the values stored when an error occurs, refer to the list of error codes. (☞ Page 1776 ERROR CODES) • This register is cleared to 0 when data logging is started.	S (Error)
SD1220 to SD1227	Data logging setting No.2	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1230 to SD1237	Data logging setting No.3	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1

No.	Name	Data stored	Details	Set by (setting timing)
SD1240 to SD1247	Data logging setting No.4	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1250 to SD1257	Data logging setting No.5	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1260 to SD1267	Data logging setting No.6	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1270 to SD1277	Data logging setting No.7	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1280 to SD1287	Data logging setting No.8	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1290 to SD1297	Data logging setting No.9	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1
SD1300 to SD1307	Data logging setting No.10	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD1210 to SD1217).	Same configuration as the setting No.1

Controller data backup/restoration function

The following is the list of special register areas relating to the controller data backup/restoration function.

No.	Name	Data stored	Details	Set by (setting timing)
SD944	Controller data backup/restoration Backup function	Backup function setting	Set the backup function using the following bit pattern. (Off: Disabled, On: Enabled)  b0: Automatic backup setting by specification of day and time b1: Automatic backup setting by specification of time and day of the week b5: Backup data upper limit enable setting b10: Retry execution for the automatic backup b15: Automatic backup setting at occurrence of the stop error	U
SD947		Day and time setting for automatic backup (day)	Stores the day when the automatic backup on the specified day and time is executed using the BIN code. • Day (1 to 31)	U
SD948		Day and time setting for automatic backup (hour)	Stores the hour when the automatic backup on the specified day and time is executed using the BIN code. • Hour (0 to 23)	U
SD949		Day and time setting for automatic backup (minute)	Stores the minute when the automatic backup on the specified day and time is executed using the BIN code. • Minute (0 to 59)	U
SD950		Time and day of the week setting for automatic backup (hour)	Stores the hour when the automatic backup on the specified day of the week and time is executed using the BIN code. • Hour (0 to 23)	U
SD951		Time and day of the week setting for automatic backup (minute)	Stores the minute when the automatic backup on the specified day of the week and time is executed using the BIN code. • Minute (0 to 59)	U
SD952		Time and day of the week setting for automatic backup (day of the week)	Set the day of the week when the automatic backup is executed using the following bit pattern. (Off: Disabled, On: Enabled)  b0: Sunday, b1: Monday, b2: Tuesday, b3: Wednesday, b4: Thursday, b5: Friday, b6: Saturday	U
SD953		Backup error cause	• The cause of an error that occurred during the controller data backup is stored. 0H: No error Other than 0H: Error code (☞ Page 1776 ERROR CODES) • Sets "0" when the backup data upper limit enable setting is changed at the start of the controller data backup.	S (Error)

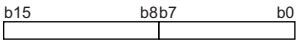
No.	Name	Data stored	Details	Set by (setting timing)
SD954	Controller data backup/restoration Restoration function	Restoration target data setting	Set the target data to be restored with the controller data restoration function. Bit 0 is on: Device/label data (only the latch data) Bit 1 is on: All the target data except for the device/label data (only the latch data) and motion data Bit 2 is on: Motion data All bits are off or all target bits are on: All the target data	U
SD955		Restoration function setting	Set the controller data restoration function using the following bit pattern. (Off: Disabled, On: Enabled)  b0: Automatic restoration b1: Initialization at automatic restoration (enabled only when SD954 is set for all the target data) b13: Latest data restoration b14: Special relay and special register restoration	U
SD956		Restoration target date folder setting	Store the target folder (date folder) of the controller data restoration using BCD code.  (1) Day: 1 to 31 (2) Month: 1 to 12 (3) Year (last two digits): 0 to 99 (4) Year (first two digits): 0 to 99 (Example) To specify the date folder of June 15 2025, store "H20250615".	U
SD957				U
SD958		Restoration target number folder setting	Specify the target folder of the controller data restoration. 1 to 32767: Serial number of the backup folder (*****) in a date folder (00001 to 32767)	U
SD959		Restoration error cause	• The cause of an error that occurred during the controller data restoration is stored. 0H: No error Other than 0H: Error code (☞ Page 1776 ERROR CODES) • This register sets 0 at the start of the controller data restoration.	S (Error)
SD960	Controller data backup/restoration Backup function	Upper limit status for the number of CPU module backup data	This register indicates the upper limit value of the number of the backup data that is set based on the backup data upper limit enable setting for the controller backup. 0: Bit 5 of SD944 (backup data upper limit enable setting) is off 1 to 100: Bit 5 of SD944 (backup data upper limit enable setting) is on	S (Status change)
SD963		Backup destination specification setting	When backup is being executed, the backup destination switches based on the following setting value. 2: Data is stored in the SD memory card.	U
SD964		Automatic backup destination specification setting	When automatic backup is being executed, the backup destination switches based on the following setting value. 2: Data is stored in the SD memory card.	U
SD965	Controller data backup/restoration Restoration function	Restoration source specification setting	When restoration is being executed, the restoration source switches based on the following setting value. 2: Data is restored from the SD memory card.	U
SD966	Controller data backup/restoration Backup function	Backup target data setting	The backup target data in the controller is set. 0: All the target data 1: Motion data only	U
SD967		Automatic backup target data setting	The automatic backup target data in the controller is set. 0: All the target data 1: Motion data only	U
SD968		Duplicated backup request error cause	• The cause of an error that occurred during the duplicated request for the controller data backup is stored. 0h: No error Other than 0H: Error code (☞ Page 1776 ERROR CODES) • "0" is set when the backup data upper limit enable setting is changed at the start of the controller data backup.	S (Error)

No.	Name	Data stored	Details	Set by (setting timing)
SD1350	Controller data backup/restoration	Number of uncompleted folders/ files of controller data backup/restoration	• This register indicates the number of folders/files where the backup/restoration of the controller is not completed. • When the backup/restoration processing of the controller is started, the total number of folders and files to be backed up or restored is stored. • The number is reduced by one each time one folder/file is backed up or restored, and 0 is stored when all the data is backed up or restored.	S (Status change)
SD1351		Progression status of controller data backup/ restoration	• This register indicates the progression status of the controller data backup or restoration in percentage. Range of the value: 0 to 100 (%) When program files are restored, the display stops while data is being written (transferred) to the program memory in the restoration processing because the data is transferred from the program cache memory to the program memory. The progress of data transfer to the program memory can be checked with SD629 (program memory write (transfer) status). • 0 is set at the start of the controller data backup/restoration.	S (Status change)
SD1353	Controller data backup/restoration Backup function	Setting of the upper limit value for the number of backup data	Set the upper limit value for the number of the backup data for the controller data backup. Range of the value: 1 to 100	U

Data backup/restoration function of iQ Sensor Solution

The following is the list of special register areas relating to the data backup/restoration function of iQ Sensor Solution.

No.	Name	Data stored	Details	Set by (setting timing)
SD1360	Right-to-use request number for iQ Sensor Solution data backup/ restoration	Right-to-use request number for data backup/restoration	Set the request number (desired 4-digit number) to acquire/release the right to use. Use the request number as follows depending on the request source. 0000H: Right-to-use release request 1000H to 1FFFH: Request from the program C000H to CFFFH: Request from the CC-Link IE Field Network module or CC-Link IE TSN module (individual development) D000H to DFFFH: Request from MELSOFT Navigator E000H to EFFFH: Request from GOT F000H to FFFFH: Request from engineering tool	U
SD1361	Right-to-use acquisition number for iQ Sensor Solution data backup/ restoration	Right-to-use acquisition number for data backup/ restoration	This register stores the request number of when the right to use for the iQ Sensor Solution data backup/ restoration has been acquired. (0000H is stored when the right to use is not acquired or has been released)	S (Status change)
SD1362	Target module/ execution unit setting for iQ Sensor Solution data backup/ restoration	Target module/ execution unit setting for data backup/ restoration	Set the target module and execution unit of the iQ Sensor Solution data backup/restoration. ■Lower 8 bits (target module) 1H: AnyWireASLINK 2H: CC-Link 4H: CC-Link IE Field Network 5H: CC-Link IE TSN ■8th bit (CC-Link IE TSN specification unit) 0: Station code specification 1: IP address specification (This register is valid only when the target model of the lower 7 bits is CC-Link IE TSN (5H), and is not used for anything other than CC-Link IE TSN (set to 0).) ■Upper 8 bits (execution unit) <AnyWireASLINK> 1H: In module units 2H: In ID units <CC-Link, CC-Link IE Field Network, CC-Link IE TSN> 1H: In module units 2H: In station units 3H: In station sub ID units	U
SD1363	Target folder number setting for iQ Sensor Solution data backup/ restoration	Target folder number setting for data backup/restoration	Set a number of folder in which the backup data is to be stored or a folder in which the data to be restored is stored. 00 to 99: Target folder specification FFFEH: Automatic specification (Folder deletion supported) FFFFH (default): Automatic specification	U
SD1364	Target setting for iQ Sensor Solution data backup/restoration (target module)	Target setting for data backup/restoration (target module)	Set the target module of the iQ Sensor Solution data backup/ restoration. I/O number[*1]: Module	U
SD1365	Target setting for iQ Sensor Solution data backup/restoration (target device 1)	Target setting for data backup/restoration (target device 1)	Set the target device of the iQ Sensor Solution data backup/ restoration. <AnyWireASLINK> ID number <CC-Link, CC-Link IE Field Network, CC-Link IE TSN (set when the CC-Link IE TSN specification unit is the station number. Set 0 (not used) when the unit is the IP address specification.)> Station number	U
SD1366	Target setting for iQ Sensor Solution data backup/restoration (target device 2)	Target setting for data backup/restoration (target device 2)	Set the target device of the iQ Sensor Solution data backup/ restoration. <AnyWireASLINK> 0 (Not used) <CC-Link, CC-Link IE Field Network, CC-Link IE TSN> Station sub-ID number	U

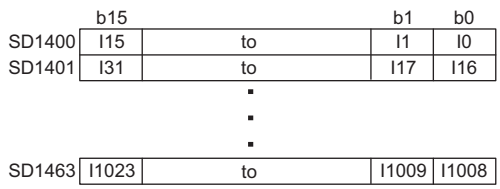
No.	Name	Data stored	Details	Set by (setting timing)
SD1367	Operation setting for iQ Sensor Solution data backup/restoration	Operation setting for data backup/ restoration	Set the operation of the iQ Sensor Solution data backup/restoration.  b0 to b7: Operation setting at error occurrence (0: Continue, 1: Stop) b8 to b15: Not used	U
SD1368	Communication timeout time of iQ Sensor Solution data backup/restoration	Communication timeout time of data backup/restoration	Specify the communication timeout time of the iQ Sensor Solution data backup/restoration in increments of 100ms. 0: 60000ms (default) 1 to 65535 (×100ms): 100 to 6553500ms	U
SD1371	Execution status of iQ Sensor Solution data backup/restoration (total number of target devices)	Execution status of data backup/ restoration (total number of target devices)	• This register stores the total number of target devices of the data backup/restoration of iQ Sensor Solution for each execution unit. • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change)
SD1372	Execution status of iQ Sensor Solution data backup/restoration (normal completion count)	Execution status of data backup/ restoration (normal completion count)	• This register indicates the execution status (the number of devices where the processing has been completed normally) of the iQ Sensor Solution data backup/restoration. • Among the devices where the operation has been completed, the number of devices where the operation has been completed normally is stored. • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change)
SD1373	Execution status of iQ Sensor Solution data backup/restoration (error completion count)	Execution status of data backup/ restoration (error completion count)	• This register indicates the execution status (the number of devices where the processing has been completed with an error) of the iQ Sensor Solution data backup/restoration. • Among the devices where the operation has been completed, the number of devices where the operation has been completed with an error is stored. • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change)
SD1374	Execution status of iQ Sensor Solution data backup/restoration (progress per device)	Execution status of data backup/ restoration (progress per device)	• This register indicates the progression status of the iQ Sensor Solution data backup/restoration of the device in progress in percentage (0 to 100%). Range of the value: 0 to 100 (%) • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change)
SD1375	Folder number of iQ Sensor Solution data backup	Backup target folder number	• This register stores a number of the target folder where the backup data of the device supporting iQSS is stored. 0 to 99: Folder number FFFFH: Backup data not saved • This register stores FFFFH when the right to use is acquired or the backup/restoration is requested.	S (Status change)
SD1376	Module error cause of iQ Sensor Solution data backup/ restoration	Module error cause of data backup/ restoration	• This register stores the error cause that is detected in the module during the iQ Sensor Solution data backup/restoration. When errors are detected in multiple devices, the error detected first is stored. • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)
SD1377	Target device error cause of iQ Sensor Solution data backup/ restoration	Target device error cause of data backup/ restoration	• This register stores the error cause that is detected in the target device during the iQ Sensor Solution data backup/restoration. When errors are detected in multiple devices, the error detected first is stored. (For details on the error cause stored, refer to the manual for the target device.) • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)

No.	Name	Data stored	Details	Set by (setting timing)
SD1378	Module information/ execution unit information of iQ Sensor Solution data backup/restoration error	Module information/ execution unit information of an error	• At an occurrence of the iQ Sensor Solution data backup/ restoration error, this register stores the information of the module where the error has been occurred and the execution unit information. When errors are detected in multiple devices, the information of a device where the error detected first is stored. ■Lower 8 bits (target module) 1H: AnyWireASLINK 2H: CC-Link 4H: CC-Link IE Field Network 5H: CC-Link IE TSN ■8th bit (CC-Link IE TSN specification unit) 0: Station code specification 1: IP address specification (This register is valid only when the target model of the lower 7 bits is CC-Link IE TSN (5H), and is not used for anything other than CC-Link IE TSN (set to 0).) ■Upper 8 bits (execution unit) <AnyWireASLINK> 1H: In module units 2H: In ID units <CC-Link, CC-Link IE Field Network, CC-Link IE TSN> 1H: In module units 2H: In station units 3H: In station sub ID units • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)
SD1379	Folder number information of iQ Sensor Solution data backup/restoration error	Folder number information of an error	• At an occurrence of the iQ Sensor Solution data backup/ restoration error, this register stores the folder number (0 to 99) of the backup/restoration target. If the folder number cannot be specified or a backup error is detected before creating a backup folder (I/O number_station number), FFFFH is stored. • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)
SD1380	Details on iQ Sensor Solution data backup/ restoration error (module)	Information of the module where an error has occurred	• This register stores the information of a module where an error of the iQ Sensor Solution data backup/restoration has been occurred. When errors are detected in multiple modules, the information of a module where the error detected first is stored. I/O number[*1]: Module • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)
SD1381	Details on iQ Sensor Solution data backup/ restoration error (device 1)	Information of the device (device 1) where an error has occurred	• This register stores the information of a device (device 1) where an error of the iQ Sensor Solution data backup/restoration has been occurred. When errors are detected in multiple devices, the information of a device (device 1) where the error detected first is stored. <AnyWireASLINK> ID number <CC-Link, CC-Link IE Field Network, CC-Link IE TSN (stored when the CC-Link IE TSN specification unit is the station number. Store 0 (not used) when the unit is the IP address specification.)> Station number • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)
SD1382	Details on iQ Sensor Solution data backup/ restoration error (device 2)	Information of the device (device 2) where an error has occurred	• This register stores the information of a device (device 2) where an error of the iQ Sensor Solution data backup/restoration has been occurred. When errors are detected in multiple devices, the information of a device (device 2) where the error detected first is stored. <AnyWireASLINK> 0 (Not used) <CC-Link, CC-Link IE Field Network, CC-Link IE TSN> Station sub-ID number • This register is cleared to 0 when the right to use is acquired or the backup/restoration is requested.	S (Status change/Error)

*1 The start I/O number (first three digits in four-digit hexadecimal representation) of each module

Interrupt pointer mask pattern

The following is the list of special register areas relating to the mask pattern for interrupt pointers.

No.	Name	Data stored	Details	Set by (setting timing)
SD1400 to SD1463	Interrupt pointer mask pattern	Mask pattern	The mask pattern for interrupt pointers is stored as shown in the following figure:  	S (at execution)

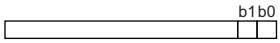
Event history function

The following is the list of special relay areas relating to the event history function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1396	Event history file use ratio	Event history file use ratio	The size of data in use in the event history file/size of the entire event history file × 100 is stored. (The values after the decimal point are rounded up.)	S (Status change)
SD1397	Motion control event history file use ratio	Motion control event history file use ratio	The size of data in use in the motion control event history file/size of the entire motion control event history file × 100 is stored. (The values after the decimal point are rounded up.)	S (Status change)
SD1464 to SD1467	Module information on event history logging restriction	Module information on event history logging restriction from module	The bit pattern of the module from which logging is restricted in the event history function of each module is stored as follows. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SD1464: 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 SD1465: 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 SD1466: 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 32 SD1467: 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 48 The numbers in the table indicate slot numbers. • Off: Event history logging is not restricted. • On: Event history logging is restricted. The bits of the slots to which the corresponding modules are mounted turn on. The bits remain on even after the event history logging restriction is lifted.	S (Status change)
SD2376	Event history clear target specification	Event history clear target specification	Specify the target event history for clearing the event history. • 0: Not specified • 1: Controller event history • 2: Motion control event history	U
SD2377	Event history clear execution status	Event history clear execution status	The execution status of the event history clear is displayed. • -1: Error (Error) • 0: Waiting for execution request (Ready) • 1: Executing (Executing) • 2: Execution completed (Done)	S (Status change)

Program monitor function

The following is the special register area relating to the program monitor function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2396	Program monitor file status	Program monitor file status	The program monitor file write status is stored.  b0: Program monitor file write status flag ·0: Not writing ·1: Writing b1: Program monitor file update failure flag 0: Update has not failed 1: Update has failed At the start of updating the program monitor file when the power is on or at the start of writing the program monitor file from the engineering tool, b0 is turned on and other bits are turned off. When the update of the program monitor file is complete, b0 is turned off, and b1 is turned on at the same time if the update fails.	S (Status change)

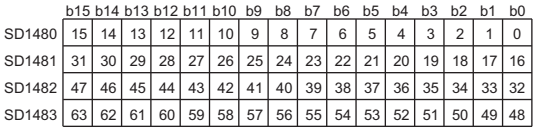
User authentication function

The following is the list of special register area relating to the user authentication function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1468	Number of login users	Number of login users	The number of users logged in to the controller is stored. Logon operations increase the number by one and logoff operations or automatic logoffs decrease the number by one.	S (Status change)
SD1469	Logoff judgment time current value	Logoff judgment time to the current automatic logoff (unit: second)	Logoff judgment time to the current automatic logoff is stored. (When the user authentication function is disabled, 300 seconds (default value) is stored.) Range: 60 to 7200 seconds	S (initial/Request)

Communication enable setting function

The following is the special register area relating to the communication enable setting function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1480 to SD1483	Communication enable setting	Communication enable setting	Valid when allowed by user authentication operation setting. Specify the slot position to mount the intelligent function module for communicating with the controller without logon using a bit pattern. Invalid when an intelligent function module that does not communicate with the controller for the applicable slot or when no module is mounted. A slot occupied by the controller is also invalid.  The numbers in the table indicate the mounting slot positions. On: Logon not required for communication Off: Logon required for communication	U

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
SD1480	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SD1481	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
SD1482	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
SD1483	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48

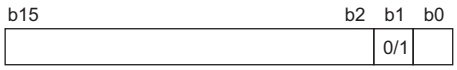
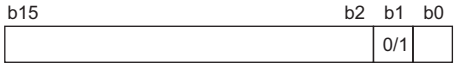
Real-time monitor function

The following is the special register area relating to the real-time monitor function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1484	Real-time monitor internal buffer free space	Free space size of the internal buffer (K bytes)	The amount of free space of the internal buffer of the real-time monitor is stored in K bytes. The smaller the value, the higher the generating ratio of processing overflow.	S (Status change)

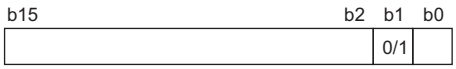
FUNCTION LED indication function

The following is the list of special register areas relating to the FUNCTION LED indication function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1486	FUNCTION LED indication setting	FUNCTION LED indication setting	The display setting for the FUNCTION LED of each function is stored. (Default value: FFFFH)  b0: Not used b1: Checking the program restoration information write status 1: Display 0: Hide b2 to b15: Not used	S (Initial)/U
SD1487	FUNCTION LED indication setting status	FUNCTION LED indication setting status	The display setting status for FUNCTION LED of each function is stored during initial processing.  b0: Not used b1: Checking the program restoration information write status 1: Display 0: Hide b2 to b15: Not used	S (Initial)

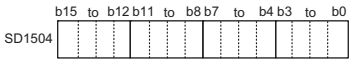
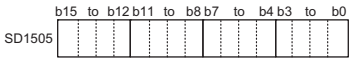
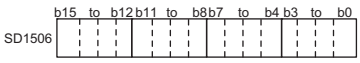
Debug function

The following is the special register area relating to the debug function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1488	Debug function usage status	Debug function usage status	The usage status of the debug function is stored.  b0: Not used b1: Program restoration information write status 0: All written 1: Not all written b2 to b15: Not used	S (Status change)

Ethernet function

The following is the list of special register areas relating to the Ethernet function.

No.	Name	Data stored	Details	Set by (setting timing)
SD1504	Open completion signal	In this register, open completion status is stored. (RCPU compatible)	Open statuses of connection No.1 to 16 are stored. 0: Closed/Open not completed 1: Open completed  A special register area compatible with RCPU Use this special register area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of SD2100 is recommended. b0: Connection 1 b1: Connection 2 b2 to b15: Connection 3 to 16	S (Status change)
SD1505	Open request signal	In this register, open request status is stored. (RCPU compatible)	Open processing statuses of connection No.1 to 16 are stored. 0: No open request 1: Requesting open  A special register area compatible with RCPU Use this special register area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of SD2106 is recommended. b0: Connection 1 b1: Connection 2 b2 to b15: Connection 3 to 16	S (Status change)
SD1506	Socket communications receive status signal	In this register, receive status is stored. (RCPU compatible)	Receiving statuses of connections No.1 to 16 are stored. 0: Data not received 1: Data reception completed  A special register area compatible with RCPU Use this special register area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of SD2132 is recommended. b0: Connection 1 b1: Connection 2 b2 to b15: Connection 3 to 16	S (Status change)
SD1516	Target port setting	Target port setting	Specify the target port of the network setting change function. The target port switches based on the following setting value. 2H: P3	U

<table>
<tr><th>No.</th><th>Name</th><th>Data stored</th><th>Details</th><th>Set by (setting timing)</th></tr>
<tr><td>SD1520</td><td rowspan="10">IP address setting</td><td>IP address (lower)</td><td rowspan="2">• Specify the IP address to be stored into the network setting storage area (system memory). Range: 00000001H to DFFFFFFEH (0.0.0.1 to 223.255.255.254)
• Upon completion of writing or clearing the IP address to/from the network setting storage area (system memory), the value of IP address stored in the network setting storage area (system memory) is stored.
<table><tr><th></th><th>b15 to b8</th><th>b7 to b0</th></tr><tr><td>SD1520</td><td>3</td><td>4</td></tr><tr><td>SD1521</td><td>1</td><td>2</td></tr></table>1 to 4: First to fourth byte</td><td rowspan="2">S (Status change)/U</td></tr>
<tr><td>SD1521</td><td>IP Address (upper)</td></tr>
<tr><td>SD1522</td><td>Subnet mask pattern (lower)</td><td rowspan="2">• Specify the Subnet mask pattern to be stored into the network setting storage area (system memory). Setting range: C0000000H to FFFFFFFCH (192.0.0.0 to 255.255.255.252), 00000000H (no setting)
• Upon completion of writing or clearing the IP address to/from the network setting storage area (system memory), the value of subnet mask pattern stored in the network setting storage area (system memory) is stored.
<table><tr><th></th><th>b15 to b8</th><th>b7 to b0</th></tr><tr><td>SD1522</td><td>3</td><td>4</td></tr><tr><td>SD1523</td><td>1</td><td>2</td></tr></table>1 to 4: First to fourth byte</td><td rowspan="2">S (Status change)/U</td></tr>
<tr><td>SD1523</td><td>Subnet mask pattern (upper)</td></tr>
<tr><td>SD1524</td><td>Default gateway IP address (lower)</td><td rowspan="2">• Specify the default gateway IP address to be stored into the network setting storage area (system memory). Setting range: 00000001H to DFFFFFFEH (0.0.0.1 to 223.255.255.254), 00000000H (no setting)
• Upon completion of writing or clearing the IP address to/from the network setting storage area (system memory), the value of default gateway IP address stored in the network setting storage area (system memory) is stored.
<table><tr><th></th><th>b15 to b8</th><th>b7 to b0</th></tr><tr><td>SD1524</td><td>3</td><td>4</td></tr><tr><td>SD1525</td><td>1</td><td>2</td></tr></table>1 to 4: First to fourth byte</td><td rowspan="2">S (Status change)/U</td></tr>
<tr><td>SD1525</td><td>Default gateway IP address (upper)</td></tr>
<tr><td>SD1526</td><td>Network setting write error cause</td><td>The error cause for cases where failure to write into the network setting storage area is stored.</td><td>The cause of the error generated when writing into the network setting storage area (system memory) will be stored. (Linked with SM1521)
0H: No error
100H:SD1515, SD1516, SD1520 to SD1525 are out of the specified range.
200H:Write error
400H:Impossible to execute the write processing because clear processing is in progress.</td><td>S (Status change)</td></tr>
<tr><td>SD1527</td><td>Network setting clear error cause</td><td>The cause of the error for cases where failure to clear the network setting storage area is stored.</td><td>The cause of the error generated when clearing the network setting storage area (system memory) will be stored. (Linked with SM1523)
0H: No error
200H:Error occurred during clearing.
300H:Clear processing cannot be executed because the controller backup/restoration function is being executed.
400H:Clear processing cannot be executed because write processing is being executed.
500H:The value of 'Target port setting' (SD1516) is out of the setting range during clear processing.
600H:"Set in Network Setting Change Function" is not selected for the IP address setting method of the module parameter.</td><td>S (Status change)</td></tr>
</table>

Open completion signal function

The following is the special register area relating to the open completion signal function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2100 to SD2103	Open completion signal	In this register, open completion status is stored.	The open status of each connection of the Ethernet port is stored. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SD2100: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SD2101: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SD2102: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SD2103: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 The numbers in the table indicate connection numbers. 0: Closed/Open not completed 1: Open completed	S (Status change)

Open request signal function

The following is the special register area relating to the open request signal function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2116 to SD2119	Open request signal	In this register, open request status is stored.	The open processing status of each connection of the Ethernet port is stored. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SD2116: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SD2117: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SD2118: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SD2119: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 The numbers in the table indicate connection numbers. 0: Before open request 1: Open request	S (Status change)

Socket communications receive status signal function

The following is the special register area relating to the socket communications receive status signal function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2132 to SD2135	Socket communications receive status signal	In this register, receive status is stored.	The receive status of each connection of the Ethernet port is stored. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SD2132: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SD2133: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SD2134: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SD2135: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 The numbers in the table indicate connection numbers. 0: Data not received 1: Data reception completed	S (Status change)

Data logging setting function

The following is the list of special register areas relating to the data logging setting function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2210	Data logging setting No.1 Logging type	Logging type	• Type of registered data logging ?00H: Not registered, 01H: Continuous logging, 02H: Trigger logging • The type is stored at the registration and this register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD2211	Data logging setting No.1 Number of trigger occurrences	Number of trigger occurrences	• Number of trigger occurrences in trigger logging • This register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD2212	Data logging setting No.1 Number of ignored triggers	Number of ignored triggers	• The number of ignored triggers that occurred again while collecting data after a data logging trigger • This register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD2213	Data logging setting No.1 Details of trigger condition satisfied	Details of trigger condition satisfied	State where the trigger condition specified by trigger setting is satisfied b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SD2213: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SD2214: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 The numbers in the table indicate trigger condition numbers. Off: Trigger condition not satisfied, On: Trigger condition satisfied • From the start of trigger logging until the trigger condition is satisfied, the corresponding bit turns on when each trigger condition is satisfied and turns off when the condition is no longer satisfied. • This register is cleared to 0 when the state changes to trigger waiting (collecting before trigger) while the trigger count has not been reached the required count. • This register is cleared to 0 by the stop command from CPU Module Logging Configuration Tool.	S (Status change)
SD2214	Data logging setting No.1 Details of trigger condition satisfied			
SD2220 to SD2224	Data logging setting No.2	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2230 to SD2234	Data logging setting No.3	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2240 to SD2244	Data logging setting No.4	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2250 to SD2254	Data logging setting No.5	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2260 to SD2264	Data logging setting No.6	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2270 to SD2274	Data logging setting No.7	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2280 to SD2284	Data logging setting No.8	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2290 to SD2294	Data logging setting No.9	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1
SD2300 to SD2304	Data logging setting No.10	Same configuration as the setting No.1	Data configuration is the same as the setting No.1 (SD2210 to SD2214).	Same configuration as the setting No.1

Label allocating information management function

The following table lists the special register areas relating to the label allocating information management function.

No.	Name	Data stored	Details	Set by (setting timing)
SD2404	Label allocating information manage area capacity	Label allocating information manage area capacity lower digits (unit: K bytes)	The capacity of the label allocating information manage area is stored in increments of 1K byte.	S (Initial)
SD2405		Label allocating information manage area capacity higher digits (unit: K bytes)		S (Initial)
SD2406	Label allocating information manage area free space capacity	Label allocating information manage area free space capacity lower digits (unit: K bytes)	The free space of the label allocating information manage area is stored in increments of 1K byte.	S (Status change)
SD2407		Label allocating information manage area free space capacity higher digits (unit: K bytes)		S (Status change)

Appendix 8 List of Link Special Relay (SB)

The link special relay (SB) is turned on/off depending on various factors during data link. Any error status of the data link can be checked by using or monitoring it in the program.

Application of link special relay (SB)

By using link special relay (SB), the status of CC-Link IE TSN can be checked from HMI (Human Machine Interfaces) as well as the engineering tool.

Ranges turned on/off by users and by the system

The following ranges correspond to when the link special relay areas (SB) are assigned from SB0000 to SB0FFF.

- Turned on/off by users: SB0000 to SB001F
- Turned on/off by the system: SB0020 to SB0FFF

List of link special relay (SB)

The following table lists the link special relay areas (SB) when they are assigned from SB0000 to SB0FFF.

Point

Do not turn on or off areas whose numbers are not on the following list or ranges turned on/off by the system. Doing so may cause malfunction of the programmable controller system.

No.	Name	Description
SB0006	Clear communication error count	Clears the link special register areas related to communication errors (SW0074 to SW0077, SW007C to SW007F) to 0. Off: Clear not requested On: Clear requested (valid while on)
SB0014	Cyclic data receive status clear	Clears 'Cyclic data receive status' (SB0064). While SB0014 is on, 'Cyclic data receive status' (SB0064) does not turn on. Off: Clear not requested On: Clear requested (enabled while on)
SB0040	Network type of own station	Stores the network type of the own station. On: CC-Link IE TSN
SB0043	Module operation mode of own station	Stores the setting status of the module operation mode of the own station. Off: Online On: Other than online
SB0044	Station setting 1 of own station	Stores the setting status of the station type of the own station. On: Master station
SB0045	Station setting 2 of own station	Stores the setting status of the communication mode of the own station. Off: Unicast mode
SB0046	Station number setting status of own station	Stores the station number setting status. Off: Station number set
SB0049	Data link error status of own station	Stores the data link error status of the own station. Off: Normal On: Error When this relay is turned on, the cause of the error can be checked with 'Cause of data link stop' (SW0049). Depending on the link refresh timing, the update of 'Cause of data link stop' (SW0049) may be offset by one sequence scan. (Updated even if set as an error invalid station.)
SB004A	Minor error status of own station controller	Stores the minor error occurrence status of own station controller. Off: No minor error is occurring in the controller. On: A minor error is occurring in the controller.
SB004B	Moderate/major error status of own station controller	Stores the moderate/major error occurrence status of own station controller. Off: No moderate/major error is occurring in the controller. On: A moderate/major error is occurring in the controller.
SB004C	CPU operating status of own station	Stores the CPU operating status of own station controller. Off: RUN, PAUSE On: STOP or moderate/major error

No.	Name	Description
SB004D	Received parameter error	Stores the status of received parameter. (For the master station, this relay stores the parameter status of the own station) Off: Normal On: Error
SB0064	Cyclic data receive status	Shows the receive status in the communication cycle in which the cyclic data from the device station is set using "Disconnection Detection Setting" in the master station. Off: Cyclic data received On: Cyclic data not received consecutively (Conditions) • Turns on when the cyclic data of one or more device stations is not received consecutively. • Stations that surpass the maximum station number are ignored. (Updated even if set as an error invalid station.) (Updated even if set as a reserved station.)
SB006A	PORT1 link-down status of own station	Stores the link-down status of the own station port 1 side. Off: Link-up On: Link-down The time until link-up starts after power-on or Ethernet cable connection may vary. Normally link-up takes several seconds. Depending on device status on the line, link-up processing is repeated and may increase the time. (Updated even if set as an error invalid station.) (Updated even if set as a reserved station.)
SB006B	PORT2 link-down status of own station	Stores the link-down status of the own station port 2 side. Off: Link-up On: Link-down The time until link-up starts after power-on or Ethernet cable connection may vary. Normally link-up takes several seconds. Note, however, that the time may be extended further if the link-up processing is repeated depending on the status of the device on the line. (Updated even if set as an error invalid station.) (Updated even if set as a reserved station.)
SB0074	Reserved station specification status	Stores the status of reserved station specification by parameter. The station number of the station set as a reserved station can be checked with 'Reserved station setting status' (SW00C0 to SW00C7, SW02B0 to SW02BF). Off: Not specified On: Specified
SB0075	Error invalid station setting status	Stores the status of error invalid station setting by parameter. The station number of the station set as an error invalid station can be checked with 'Error invalid station setting status' (SW00D0 to SW00D7, SW02D0 to SW02DF). Off: Not specified On: Specified
SB0078	Network topology setting	Stores the setting status of "Network Topology" for the own station (master operating station). Off: Line topology, star topology, or coexistence of star and line topologies
SB007B	Input data status of data link faulty station	Stores the setting status of "Data Link Error Station Setting" of the own station. Off: Clear On: Hold
SB007D	Hold/clear status setting during controller STOP	Stores the setting status of "Output Hold/Clear Setting during controller STOP" of the own station. Off: Hold On: Clear
SB007E	Type of IP Address	Stores the type of IP address. Off: IPv4
SB007F	IP address setting status	Stores the setting status of the IP address. Off: No setting On: Set
SB00B0	Data link error status of each station	Stores the data link status of each station. Off: All stations normal On: Faulty station exists When this relay area is turned on, the status of each station can be checked with 'Data link status of each station' (SW00B0 to SW00B7, SW0290 to SW029F) and 'Data link error status of master station' (SB00B1). Depending on the link refresh timing, the update of 'Data link status of each station' (SW00B0 to SW00B7, SW0290 to SW029F) and 'Data link error status of master station' (SB00B1) may be offset by one sequence scan. Reserved stations and stations that surpass the maximum station number are ignored.
SB00B1	Data link error status of master station	Stores the data link status of the master station. Off: Normal On: Error

No.	Name	Description
SB00C0	Reserved station setting status	Stores whether a reserved station is set. Off: No setting On: Set When this relay is turned on, the status of each station can be checked with 'Reserved station setting status' (SW00C0 to SW00C7, SW02B0 to SW02BF). Depending on the link refresh timing, the update of 'Reserved station setting status' (SW00C0 to SW00C7, SW02B0 to SW02BF) may be offset by one sequence scan.
SB00D0	Error invalid station setting current status	Set whether an error invalid station is set. Off: No setting On: Set When this relay is turned on, the status of each station can be checked with 'Error invalid station setting status' (SW00D0 to SW00D7, SW02D0 to SW02DF). Depending on the link refresh timing, the update of 'Error invalid station setting status' (SW00D0 to SW00D7, SW02D0 to SW02DF) may be offset by one sequence scan.
SB00E8	Station type match status of each station	Stores the match status between the station type of the parameter set in the master station and that of all actually connected device stations. Off: Station type match in all stations On: Station type mismatch exists The status of each station can be checked with 'Station type match status' (SW00E8 to SW00EF, SW0300 to SW030F). When all are 0: Station type match, the relay should be off. Depending on the link refresh timing, the update of 'Station type match status' (SW00E8 to SW00EF, SW0300 to SW030F) may be offset by one sequence scan.
SB00F0	CPU operating status of each station	Stores the operating status of the CPU module on each station. Off: All stations are at RUN or PAUSE state On: Station at STOP or station with a moderate/major error exists. When this relay is turned on, the status of each station can be checked in 'CPU operating status of each station' (SW00F0 to SW00F7, SW0310 to SW031F). Depending on the link refresh timing, the update of 'CPU operating status of each station' (SW00F0 to SW00F7, SW0310 to SW031F) may be offset by one sequence scan.
SB00F1	CPU operating status of master station	Stores the CPU operating status of master station controller. Off: RUN, PAUSE On: STOP or moderate/major error This register is valid during cyclic transmission or when cyclic transmission is stopped. If all stations are disconnected, the data immediately before disconnection is held.
SB0100	CPU moderate/major error occurrence status of each station	Stores the moderate/major error occurrence status of each station. Off: No station with a moderate/major error On: Station with a moderate/major error exists When this relay is turned on, the status of each station can be checked with 'CPU moderate/major error status of each station' (SW0100 to SW0107, SW0330 to SW033F). Depending on the link refresh timing, the update of 'CPU moderate/major error status of each station' (SW0100 to SW0107, SW0330 to SW033F) may be offset by one sequence scan.
SB0101	Moderate/major error occurrence status of master station controller	Stores the moderate/major error occurrence status of master station controller. Off: No moderate/major error is occurring in the controller. On: A moderate/major error is occurring in the controller. This register is valid during cyclic transmission or when cyclic transmission is stopped. If all stations are disconnected, the data immediately before disconnection is held.
SB0110	CPU minor error occurrence status of each station	Stores the minor error occurrence status of each station. Off: All stations normal or station with a moderate/major error exists On: Station with a minor error exists When this relay is turned on, the status of each station can be checked with 'CPU minor error status of each station' (SW0110 to SW0117, SW0350 to SW035F). Depending on the link refresh timing, the update of 'CPU minor error status of each station' (SW0110 to SW0117, SW0350 to SW035F) may be offset by one sequence scan.
SB0111	Minor error occurrence status of master station controller	Stores the minor error occurrence status of master station controller. Off: No minor error is occurring, or a moderate/major error is occurring in the controller. On: A minor error is occurring in the controller. This register is valid during cyclic transmission or when cyclic transmission is stopped. If all stations are disconnected, the data immediately before disconnection is held.
SB0190	Parameter error (buffer memory)	Stores the status of the set parameter from the buffer memory. Off: Normal On: Error
SB01E1	Setting status of CC-Link IE TSN Network synchronous communication function	Stores the setting status of the CC-Link IE TSN Network synchronous communication function. Off: No setting On: Set

No.	Name	Description
SB01E9	Network synchronous communication function cycle over occurrence flag	Stores the cycle over occurrence status of the network synchronous communication function. This relay turns on when cyclic send processing is not completed within the cycle of the network synchronous communication function. After that, it remains turned on even if the processing is operated within the specified network synchronous communication function cycle. The status is cleared by powering off and on the system or by resetting the controller. Off: Network synchronous communication function cycle over has not occurred. On: Network synchronous communication function cycle over has occurred.
SB0520	121 or more stations line topology non-support detection status	Stores the detection status of device stations that do not support line topology with 121 or more stations. Off: Station that does not support line topology with 121 or more stations is not detected. On: Station that does not support line topology with 121 or more stations is detected. When this relay area is turned on, the status of each station can be checked with '121 or more stations line topology non-support detection status' (SW0520 to SW052F).

Appendix 9 List of Link Special Register (SW)

The link special register (SW) stores the information during data link as a numerical value. Faulty areas and causes can be checked by using or monitoring the link special register (SW) in programs.

Application of link special register (SW)

By using link special register (SW), the status of CC-Link IE TSN can be checked from HMI (Human Machine Interfaces) as well as the engineering tool.

Range where data is stored by users and range where data is stored by the system

The following ranges correspond to when the link special register areas (SW) are assigned from SW0000 to SW0FFF.

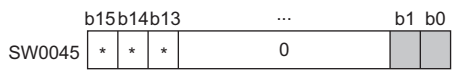
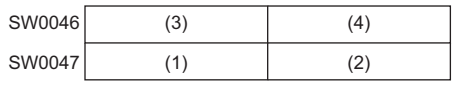
- Stored by users: SW0000 to SW001F
- Stored by the system: SW0020 to SW0FFF

List of link special register (SW)

The following table lists the link special register areas (SW) when they are assigned from SW0000 to SW0FFF.

Point

Do not write any data to an area whose number is not on the following list or ranges where data is stored by the system. Doing so may cause malfunction of the system.

No.	Name	Description
SW0040	Network number	Stores the network number set in the own station. Range: 1 to 239
SW0042	Station number	Stores the station number set in the own station. Range: • Master station: 7DH
SW0043	Mode status of own station	Stores the module operation mode setting or communication mode of the own station. 0: Online mode/Unicast mode B: Module communication test mode
SW0045	Module type	Stores the hardware status of the own station.  ■b0 to b1: Model type 00: Module ■b13 to b15: Variable (Used by the system)
SW0046 to SW0047	IPv4 address	Indicates the IP address (IPv4) set in the own station.  (1) First octet (2) Second octet (3) Third octet (4) Fourth octet
SW0049	Cause of data link stop	Stores the cause which stopped the data link of the own station. 00H: At normal communication or power-on 02H: Monitoring time timeout 05H: No device station (master station only) 14H: Master station duplication (master station only) 18H: Parameter error 19H: Parameter processing in progress 20H: CPU/Motion function error stop 60H: Illegal ring connection (master station only) 70H: No device station information (Updated even if set as an error invalid station.) (Updated even if set as a reserved station.)

No.	Name	Description
SW004B	Own station controller status	Stores the CPU operating status and error occurrence status of own station controller. 01H: STOP (normal) 02H: STOP (moderate/major error) 03H: STOP (minor error) 04H: RUN (normal) 05H: RUN (minor error) 07H: PAUSE 0EH: Reset in progress 0FH: Initial processing in progress
SW004C	Parameter setting status	Stores the status of parameter settings. 0: Normal 1 or greater: Error definition (Error code is stored.) • This register is enabled when 'Received parameter error' (SB004D) is on.
SW0058	Total number of device stations setting value	Stores the total number of device stations that are set by the parameters. Range: 1 to 253
SW0059	Total number of device stations present value	Stores the total number of device stations that are actually connected by data link. Range: 1 to 253 (0 when own station is disconnected)
SW005B	Maximum data link station number	Stores the maximum station number of the station where the data link is normally performed. 00H: When own station is disconnected 01H to 78H: Station number 1 to 120 7CH: Station number 121 to 253 (refer to SW025B) • This register is enabled when 'Data link error status of own station' (SB0049) is off.
SW0060	Communication cycle intervals	Stores the setting value of the communication cycle intervals set with the module parameter of the master station. (Unit: μs)
SW0061	System reserved time	Stores the setting value of the system reserved time set with the module parameter of the master station. (Unit: μs)
SW0062	Cyclic transmission time	Stores the setting value of the cyclic transmission time set with the module parameter of the master station. (Unit: μs)
SW0063	Transient transmission time	Stores the setting value of the transient transmission time set with the module parameter of the master station. (Unit: μs)
SW0064	Multiple cycle setting (medium speed)	Stores the setting value of the multiple cycle setting (medium speed) set with the module parameter of the master station.
SW0065	Multiple cycle setting (low speed)	Stores the setting value of the multiple cycle setting (low speed) set with the module parameter of the master station.
SW0066	Connection status of own station	Stores the connection status of the own station. 00H: Normal (communication in progress on P1 and P2) 01H: Normal (communication in progress on P1, cable disconnected on P2) 10H: Normal (cable disconnected on P1, communication in progress on P2) 11H: Disconnected (cable disconnected on P1 and P2) 12H: Disconnected (cable disconnected on P1, establishing line on P2) 21H: Disconnected (establishing line on P1, cable disconnected on P2) 22H: Disconnected (establishing line on P1 and P2)
SW0074	PORT1 cable disconnection detection count	Stores the cumulative count that was detected for cable disconnections at the port 1 side. When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared. When FFFFH (maximum value 65535) is counted, the value returns to 1 and the module continues to count.
SW0075	PORT1 receive error detection count	Stores the cumulative count that error data was received at the port 1 side. When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared. When FFFFH (maximum value 65535) is counted, counting stops.
SW0076	PORT1 total number of received data (lower 1 word)	Stores the cumulative count that data was received at the port 1 side. When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared. When FFFFFFFFH (maximum value 4294967295) is counted, counting stops.
SW0077	PORT1 total number of received data (upper 1 word)	
SW007B	Station No./IP address setting method	Stores the station No./IP address setting method set in the own station. 0: Parameter Editor
SW007C	PORT2 cable disconnection detection count	Stores the cumulative count that was detected for cable disconnections at the port 2 side. When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared. When FFFFH (maximum value 65535) is counted, the value returns to 1 and the module continues to count.
SW007D	PORT2 receive error detection count	Stores the cumulative count that error data was received at the port 2 side. When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared. When FFFFH (maximum value 65535) is counted, counting stops.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>SW007E</td><td>PORT2 total number of received data (lower 1 word)</td><td rowspan="2">Stores the cumulative count that data was received at the port 2 side.
When 'Clear communication error count' (SB0006) is turned on, the stored count is cleared.
When FFFFFFFFH (maximum value 4294967295) is counted, counting stops.</td></tr>
<tr><td>SW007F</td><td>PORT2 total number of received data (upper 1 word)</td></tr>
<tr><td>SW00B0
to
SW00B7</td><td>Data link status of each station</td><td>Stores the data link status of each station. (Station number: 1 to 120)
0: Data link normally operating station
1: Data link faulty station
• If multiple stations change from faulty to normal, because they are reconnected to the network one by one per communication cycle, the time until the status changes to "0: Data link normally operating station" may vary by several seconds.
• If no response is received for several communication cycles, the station is determined to be a data link faulty station.

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW00B0</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW00B1</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW00B2</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW00B3</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW00B4</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW00B5</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW00B6</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW00B7</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• Stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW00C0
to
SW00C7</td><td>Reserved station setting status</td><td>Stores the reserved station setting status of each station. (Station number: 1 to 120)
0: Station other than a reserved station
1: Reserved station

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW00C0</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW00C1</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW00C2</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW00C3</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW00C4</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW00C5</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW00C6</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW00C7</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• Stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW00C8
to
SW00CF</td><td>Parameter setting status</td><td>Stores the status of parameter settings. (Station number: 1 to 120)
0: Station not set in the parameter
1: Station set in the parameter

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW00C8</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW00C9</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW00CA</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW00CB</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW00CC</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW00CD</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW00CE</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW00CF</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• Stations that surpass the maximum station number are ignored.</td></tr>
</table>

No.	Name	Description
SW00D0 to SW00D7	Error invalid station setting status	Stores the error invalid station setting status of each station. (Station number: 1 to 120) 0: Station other than an error invalid station 1: Error invalid station b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SW00D0: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SW00D1: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SW00D2: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SW00D3: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 SW00D4: 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 SW00D5: 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 SW00D6: 112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 SW00D7: — — — — — — — — 120 119 118 117 116 115 114 113 Each number in the table represents a station number. — is fixed to 0. • Stations that surpass the maximum station number are ignored.
SW00E8 to SW00EF	Station type match status	Stores the match status between the station type of the parameter set in the master station and that of each actually connected device station. (Station number: 1 to 120) 0: Station type match 1: Station type mismatch b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SW00E8: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SW00E9: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SW00EA: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SW00EB: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 SW00EC: 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 SW00ED: 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 SW00EE: 112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 SW00EF: — — — — — — — — 120 119 118 117 116 115 114 113 Each number in the table represents a station number. — is fixed to 0. This register is valid only for the number of connected modules.
SW00F0 to SW00F7	CPU operating status of each station	Stores the CPU operating status of each station. (Station number: 1 to 120) 0: RUN, PAUSE 1: STOP or moderate/major error b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 SW00F0: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 SW00F1: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 SW00F2: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 SW00F3: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 SW00F4: 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 SW00F5: 96 95 94 93 92 91 90 89 88 87 86 85 84 83 82 81 SW00F6: 112 111 110 109 108 107 106 105 104 103 102 101 100 99 98 97 SW00F7: — — — — — — — — 120 119 118 117 116 115 114 113 Each number in the table represents a station number. — is fixed to 0. This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped. For device stations that are disconnected, the data immediately before disconnection is held. Reserved stations and stations that surpass the maximum station number are ignored.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>SW0100
to
SW0107</td><td>CPU moderate/major error status of each station</td><td>Stores the moderate/major error occurrence status of each station. (Station number: 1 to 120)
0: No moderate/major error
1: Moderate/major error occurring

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0100</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0101</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0102</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW0103</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW0104</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW0105</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW0106</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW0107</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>

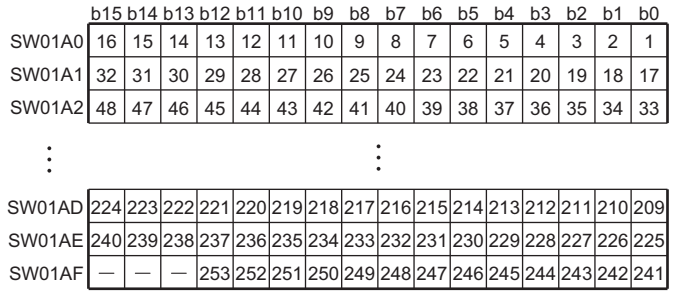
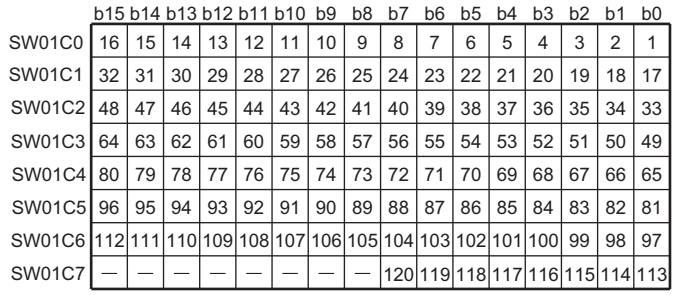
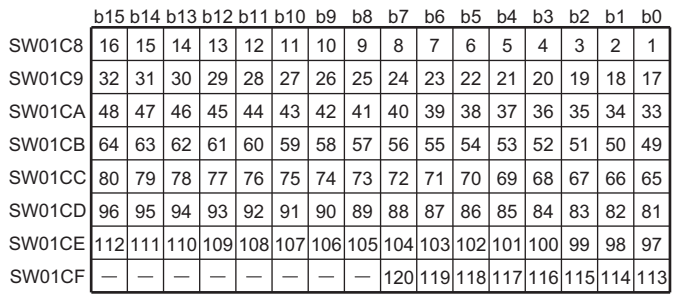
Each number in the table represents a station number. — is fixed to 0.
This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped.
For device stations that are disconnected, the data immediately before disconnection is held.
Reserved stations and stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW0110
to
SW0117</td><td>CPU minor error status of each station</td><td>Stores the minor error occurrence status of each station. (Station number: 1 to 120)
0: Normal, or a moderate or serious error occurring
1: Minor error occurring

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0110</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0111</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0112</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW0113</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW0114</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW0115</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW0116</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW0117</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>

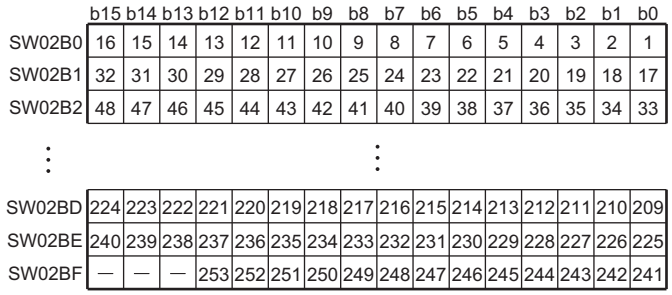
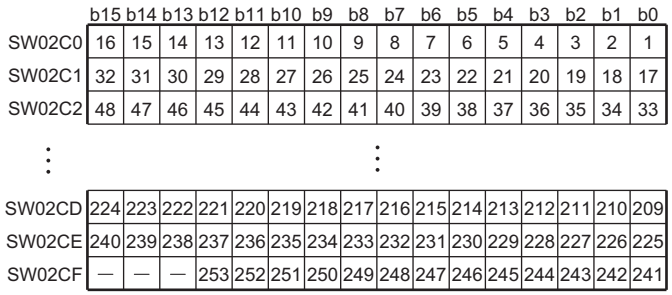
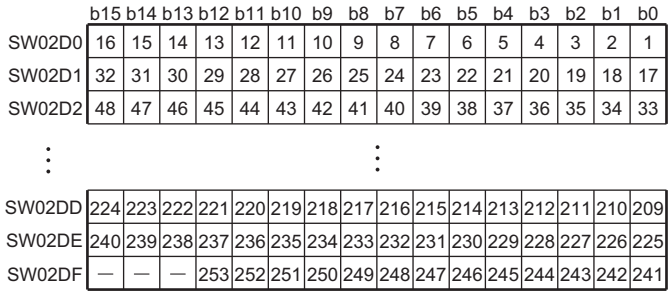
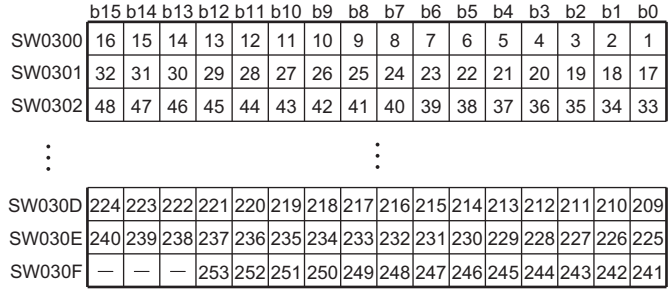
Each number in the table represents a station number. — is fixed to 0.
This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped.
For device stations that are disconnected, the data immediately before disconnection is held.
Reserved stations and stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW0160
to
SW0167</td><td>Execution result of device station parameter automatic setting function</td><td>When the device station parameter automatic setting is completed with an error, the bit of the target station is turned on. (Station number: 1 to 120)
Off: Completed successfully
On: Completed with an error
When completed with an error, the error code is stored in the SW0194.
When completed with an error caused by the master station, the bit is not turned on.

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0160</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0161</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0162</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>SW0163</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr>
<tr><td>SW0164</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr>
<tr><td>SW0165</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr>
<tr><td>SW0166</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr>
<tr><td>SW0167</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr>
</table>

Each number in the table represents a station number. — is fixed to 0.</td></tr>
<tr><td>SW0190</td><td>Parameter setting status (buffer memory)</td><td>Stores the status of the parameter setting that was set from the buffer memory.
0: Normal
1 or greater: Error definition (error code)
This register is enabled when 'Parameter error' (SB0190) is on.</td></tr>
<tr><td>SW0194</td><td>Detailed execution result of device station parameter automatic setting</td><td>When the device station parameter automatic setting is completed with an error, the error code is stored.
When completed with an error caused by the device station, the bit of the target station of 'Execution result of device station parameter automatic setting function' (SW0160 to SW0167, SW0200 to SW020F) is turned on.</td></tr>
</table>

No.	Name	Description
SW01A0 to SW01AF	Station protocol version 2.0 support status	Stores the protocol version 2.0 compatibility status of each actually connected station. (Station number: 1 to 253) 0: Not supported 1: Supported  Each number in the table represents a station number. — is fixed to 0. • Stations that surpass the maximum station number are ignored.
SW01C0 to SW01C7	Information of CC-Link IE TSN Network synchronous communication function of each station	Stores the status of each actually connected station regarding whether it supports or does not support the CC-Link IE TSN Network synchronous communication function. (Station number: 1 to 120) 0: Not supported 1: Supported  Each number in the table represents a station number. — is fixed to 0. • Stations that surpass the maximum station number are ignored.
SW01C8 to SW01CF	Synchronous/asynchronous operating status information of each station	Stores the information about the operating status of CC-Link IE TSN Network synchronous communication for each station. 0: Asynchronous setting 1: Synchronous setting  Each number in the table represents a station number. — is fixed to 0. • Stations that surpass the maximum station number are ignored.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>SW01D0
to
SW01D7</td><td>Information on whether each station is equipped with a watchdog counter</td><td>Stores information on whether each station is equipped with a watchdog counter used in CC-Link IE TSN network synchronous communication. (Station number: 1 to 120)
0: Not equipped
1: Equipped
Stations which are not performing data links are treated as "0: Not equipped" because the information indicates that device stations in communication are equipped with the watchdog counter.
<table><tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr><tr><td>SW01D0</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>SW01D1</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr><tr><td>SW01D2</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr><tr><td>SW01D3</td><td>64</td><td>63</td><td>62</td><td>61</td><td>60</td><td>59</td><td>58</td><td>57</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>50</td><td>49</td></tr><tr><td>SW01D4</td><td>80</td><td>79</td><td>78</td><td>77</td><td>76</td><td>75</td><td>74</td><td>73</td><td>72</td><td>71</td><td>70</td><td>69</td><td>68</td><td>67</td><td>66</td><td>65</td></tr><tr><td>SW01D5</td><td>96</td><td>95</td><td>94</td><td>93</td><td>92</td><td>91</td><td>90</td><td>89</td><td>88</td><td>87</td><td>86</td><td>85</td><td>84</td><td>83</td><td>82</td><td>81</td></tr><tr><td>SW01D6</td><td>112</td><td>111</td><td>110</td><td>109</td><td>108</td><td>107</td><td>106</td><td>105</td><td>104</td><td>103</td><td>102</td><td>101</td><td>100</td><td>99</td><td>98</td><td>97</td></tr><tr><td>SW01D7</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>120</td><td>119</td><td>118</td><td>117</td><td>116</td><td>115</td><td>114</td><td>113</td></tr></table>Each number in the table represents a station number. — is fixed to 0.
• Stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW01E9</td><td>Network synchronous communication function cycle over detection count</td><td>Indicates the number of times cyclic send processing is not completed within the cycle of the network synchronous communication function in the three communication cycles: basic cycle, medium speed, and low speed. The status is cleared by powering off and on the system or by resetting the controller.
0: Network synchronous communication function cycle over has not occurred.
1 to 65535: Cumulative number of times
When FFFFH (maximum value 65535) is counted, counting stops.</td></tr>
<tr><td>SW0200
to
SW020F</td><td>Device station parameter automatic setting function
Execution result</td><td>When the device station parameter automatic setting is completed with an error, the bit of the target station is turned on. (Station number: 1 to 253)
Off:Completed successfully
On:Completed with an error
When completed with an error, the error code is stored in the SW0194.
When completed with an error caused by the master station, the bit is not turned on.</td></tr>
<tr><td>SW0242</td><td>Station number</td><td>Stores the station number set in the own station.
FF7DH: Master station</td></tr>
<tr><td>SW025B</td><td>Maximum data link station number</td><td>Stores the maximum station number of the station where the data link is normally performed.
0000H: When own station is disconnected
0001H to 00FDH: Station number 1 to 253
This register is enabled when Data link error status of own station (SB0049) is off.</td></tr>
<tr><td>SW0290
to
SW029F</td><td>Data link status of each station</td><td>Stores the data link status of each station. (Station number: 1 to 253)
0: Data link normally operating station
1: Data link faulty station
• If multiple stations change from faulty to normal, because they are reconnected to the network one by one per cycle, the time until the status changes to "0: Data link normally operating station" may vary by several seconds.
• If no response is received for several cycles, the station is determined to be a data link faulty station.
<table><tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr><tr><td>SW0290</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr><tr><td>SW0291</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr><tr><td>SW0292</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr><tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>SW029D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr><tr><td>SW029E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr><tr><td>SW029F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr></table>Each number in the table represents a station number. — is fixed to 0.</td></tr>
</table>

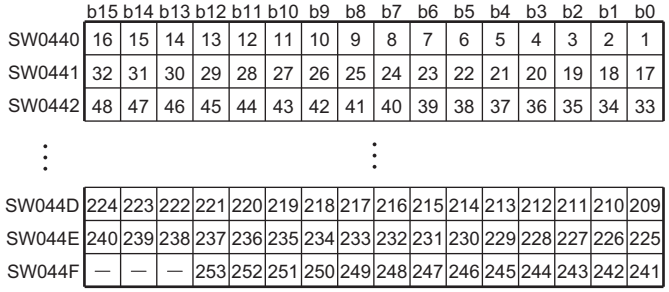
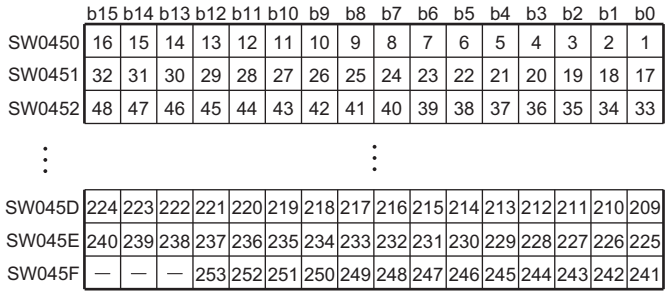
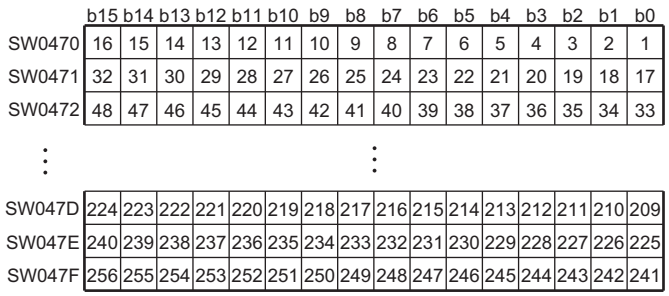
No.	Name	Description
SW02B0 to SW02BF	Reserved station setting status	Stores the reserved station setting status of each station. (Station number: 1 to 253) 0: Other than the reserved station (including stations for which reservation is temporarily canceled) 1: Reserved station  Each number in the table represents a station number. — is fixed to 0. Stations that surpass the maximum station number are ignored.
SW02C0 to SW02CF	Parameter setting status	The station set with the parameter is indicated within the bit. (Station number: 1 to 253) 0: No parameter setting 1: Parameter setting available  Each number in the table represents a station number. — is fixed to 0. Stations that surpass the maximum station number are ignored.
SW02D0 to SW02DF	Error invalid station setting status	Stores the error invalid station setting status of each station. (Station number: 1 to 253) 0: Station other than an error invalid station 1: Error invalid station  Each number in the table represents a station number. — is fixed to 0. Stations that surpass the maximum station number are ignored.
SW0300 to SW030F	Station type match status	Stores the match status between the station type of the parameter set in the master station and that of each actually connected device station. (Station number: 1 to 253) 0: Station type match 1: Station type mismatch  Each number in the table represents a station number. — is fixed to 0. Stations that are not performing data links are ignored.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>SW0310
to
SW031F</td><td>CPU operating status of each station</td><td>Stores the CPU operating status of each station. (Station number: 1 to 253)
0: RUN, PAUSE
1: STOP or moderate/major error

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0310</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0311</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0312</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW031D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW031E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW031F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped.
• For device stations that are disconnected, the data immediately before disconnection is held.
• Reserved stations and stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW0330
to
SW033F</td><td>CPU moderate/major error status of each station</td><td>For remote stations, the moderate/major error occurrence status of each station is stored. (Station number: 1 to 253)
0: No moderate/major error
1: Moderate/major error occurring

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0330</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0331</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0332</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW033D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW033E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW033F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped.
• For device stations that are disconnected, the data immediately before disconnection is held.
• Reserved stations and stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW0350
to
SW035F</td><td>CPU minor error status of each station</td><td>For remote stations, the minor error occurrence status of each station is stored. (Station number: 1 to 253)
0: Normal, or a moderate or serious error occurring
1: Minor error occurring

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0350</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0351</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0352</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW035D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW035E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW035F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• This register is valid only for device stations during cyclic transmission or when cyclic transmission is stopped.
• For device stations that are disconnected, the data immediately before disconnection is held.
• Reserved stations and stations that surpass the maximum station number are ignored.</td></tr>
</table>

No.	Name	Description
SW0440 to SW044F	Information of CC-Link IE TSN Network synchronous communication function of each station	Stores the status of each actually connected station regarding whether it supports or does not support the CC-Link IE TSN Network synchronous communication function. (Station number: 1 to 253) 0: Not supported 1: Supported  Each number in the table represents a station number. — is fixed to 0. Stations that surpass the maximum station number are ignored.
SW0450 to SW045F	Synchronous/asynchronous operating status information of each station	Stores the information about operating status of each station for the network synchronous communication function of CC-Link IE TSN. (Station number: 1 to 253) 0: Asynchronous setting 1: Synchronous setting  Each number in the table represents a station number. — is fixed to 0. Stations that surpass the maximum station number are ignored.
SW0470 to SW047F	NMT state machine	Stores the communication status of the device station that supports CANopen communications. 0: In the CANopen function initialization sequence, the NMT state machine is not yet in the Operational state or the device station is disconnected. 1: In the CANopen function initialization sequence, the NMT state machine is in the Operational state. The value of the device station that does not support CANopen communications is set to 0. This value is stored by each module number of the device stations set in the network configuration setting.  The numbers in the table indicate the module numbers.

<table>
<tr><th>No.</th><th>Name</th><th>Description</th></tr>
<tr><td>SW0490
to
SW049F</td><td>Information on whether each station is equipped with a watchdog counter</td><td>Stores information on whether each station is equipped with a watchdog counter used in CC-Link IE TSN network synchronous communication. (Station number: 1 to 253)
0: Not equipped
1: Equipped
Stations which are not performing data links are treated as "0: Not equipped" because the information indicates that device stations in communication are equipped with the watchdog counter.

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0490</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0491</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0492</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW049D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW049E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW049F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
Stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW04A0</td><td>Time synchronization method</td><td>Stores the time synchronization method that is applied when performing time synchronization.
0x00: IEEE1588
0x01: IEEE802.1AS</td></tr>
<tr><td>SW04B0
to
SW04BF</td><td>Time synchronization status of each station</td><td>Stores the information on whether time synchronization is performed for each actually connected station. (Station number: 1 to 253)
0: Station that does not perform time synchronization
1: Station that performs time synchronization
The time synchronization method can be checked in 'Time synchronization method' (SW04A0).

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW04B0</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW04B1</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW04B2</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW04BD</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW04BE</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW04BF</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
• Stations that surpass the maximum station number are ignored.</td></tr>
<tr><td>SW0520
to
SW052F</td><td>121 or more stations line topology non-support detection status</td><td>Stores the detection status of device stations that do not support line topology with 121 or more stations. (Station number: 1 to 253)
0: Line topology with 121 or more stations is supported.
1: Line topology with 121 or more stations is not supported.

<table>
<tr><th></th><th>b15</th><th>b14</th><th>b13</th><th>b12</th><th>b11</th><th>b10</th><th>b9</th><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>b0</th></tr>
<tr><td>SW0520</td><td>16</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td></tr>
<tr><td>SW0521</td><td>32</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td></tr>
<tr><td>SW0522</td><td>48</td><td>47</td><td>46</td><td>45</td><td>44</td><td>43</td><td>42</td><td>41</td><td>40</td><td>39</td><td>38</td><td>37</td><td>36</td><td>35</td><td>34</td><td>33</td></tr>
<tr><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>⋮</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>SW052D</td><td>224</td><td>223</td><td>222</td><td>221</td><td>220</td><td>219</td><td>218</td><td>217</td><td>216</td><td>215</td><td>214</td><td>213</td><td>212</td><td>211</td><td>210</td><td>209</td></tr>
<tr><td>SW052E</td><td>240</td><td>239</td><td>238</td><td>237</td><td>236</td><td>235</td><td>234</td><td>233</td><td>232</td><td>231</td><td>230</td><td>229</td><td>228</td><td>227</td><td>226</td><td>225</td></tr>
<tr><td>SW052F</td><td>—</td><td>—</td><td>—</td><td>253</td><td>252</td><td>251</td><td>250</td><td>249</td><td>248</td><td>247</td><td>246</td><td>245</td><td>244</td><td>243</td><td>242</td><td>241</td></tr>
</table>
Each number in the table represents a station number. — is fixed to 0.
Only the bits for station numbers of connected device stations are enabled, and those for unconnected device stations are set to 0.</td></tr>
</table>

Appendix 10 Buffer Memory

The buffer memory is used to exchange data between the CPU function part and the CC-Link IE TSN/motion function part.
Buffer memory values are reset to default (initial values) when the controller is reset or powered off.
For the assignment of each function part, refer to the following.
☞ Page 374 Buffer memory specification method

List of buffer memory addresses

CPU function part

The following table lists classifications of the buffer memory of the CPU function part.

Address (decimal)	Description
G50 to G1023	Port for Ethernet
G1500 to G1509	Security function
G2032 to G10139	Port for Ethernet
G10140 to G10270	For synchronization control function
G10350 to G10449	Port information
G10450 to G11039	Synchronization refresh
G11300 to G11391	For synchronization control function
G11400 to G14199	For Ethernet function

The following table lists buffer memory addresses of the CPU function part.

Address		Application	Name	
Decimal	Hexadecimal			
50 to 51	32H to 33H	Own node setting status storage area	Own node IP address	
60 to 61	3CH to 3DH		Subnet mask	
64 to 65	40H to 41H		Default gateway IP address	
74 to 76	4AH to 4CH		Own node MAC address	
82	52H		Communication speed setting	
83	53H		Auto-open UDP port number	
84	54H		MELSOFT connection TCP port number	
85	55H		MELSOFT connection UDP port number	
86	56H		MELSOFT direct connection port number	
100	64H	Communication load status of the built-in Ethernet port	Receive packet count per unit time (one second)	Receive packet count (current) per unit time (one second)
101	65H			Receive packet count (maximum) per unit time (one second)
102	66H		Send packet count per unit time (one second)	Send packet count (current) per unit time (one second)
103	67H			Send packet count (maximum) per unit time (one second)
130 to 145	82H to 91H	Connection status storage area	Connection No.1 latest error code to Connection No.16 latest error code	
146	92H	System port latest error code storage area	FTP server latest error code	
147	93H		MELSOFT direct connection latest error code	
148	94H		FTP client latest error code	

Address		Application	Name	
Decimal	Hexadecimal			
150 to 151	96H to 97H	Status for each protocol	IP packet	Received packet total count
152 to 153	98H to 99H			Received packet checksum error discard count
154 to 155	9AH to 9BH			Sent packet total count
179	B3H			Receive abort count
182 to 183	B6H to B7H		ICMP packet	Received packet total count
184 to 185	B8H to B9H			Received packet checksum error discard count
186 to 187	BAH to BBH			Sent packet total count
188 to 189	BCH to BDH			Received echo request total count
190 to 191	BEH to BFH			Sent echo reply total count
192 to 193	C0H to C1H			Sent echo request total count
194 to 195	C2H to C3H			Received echo reply total count
196 to 197	C4H to C5H		TCP packet	Received packet total count
198 to 199	C6H to C7H			Received packet checksum error discard count
200 to 201	C8H to C9H			Sent packet total count
204 to 205	CCH to CDH		UDP packet	Received packet total count
206 to 207	CEH to CFH			Received packet checksum error discard count
208 to 209	D0H to D1H			Sent packet total count
242	F2H	Own node operation status storage area	Connection status area	Communication mode
243	F3H			Connection status
244	F4H			Communication speed
245	F5H			Disconnection count
251	FBH		IP address duplication status storage area	Same IP address detection flag
258	102H		Network information setting status	
275	113H	Discard received data at CPU STOP setting area	Discard received data setting	Discard received data setting connection No.1 to 16
290	122H	Time setting function (SNTP) area	Time setting function operation result	
291	123H		Time setting function execution time	(Year)
292	124H			(Month)
293	125H			(Day)
294	126H			(Hour)
295	127H			(Minute)
296	128H			(Second)
297	129H			(Day of the week)
298	12AH		Time setting function required response time	
299	12BH		Time setting function (SNTP client) execution	
310 to 311	136H to 137H	IP packet transfer function area	IP packet transfer latest data volume	
312 to 313	138H to 139H		IP packet transfer maximum data volume	
350	15EH	Predefined protocol support function execution status check area	Connection No.1	Protocol execution status
352 to 367	160H to 16FH			Received data verification result (receive packet No.1 to 16)
368	170H			Protocol execution count
369	171H			Protocol cancellation specification
370 to 669	172H to 29DH		Connection No.2 to Connection No.16	
680	2A8H	Open completion signal (RCPU compatible)	Open completion signal	
681	2A9H	Open request signal (RCPU compatible)	Open request signal	
682	2AAH	Socket communications reception status signal (RCPU compatible)	Socket communications reception status signal	
683	2ABH	Initial status	Initial status	
684	2ACH	Initial error code	Initial error code	

Address		Application	Name	
Decimal	Hexadecimal			
692	2B4H	Predefined protocol support function check area	Predefined protocol ready	
710	2C6H	Predefined protocol setting data check area	Predefined protocol setting data error information	Protocol number
711	2C7H			Setting type
712	2C8H			Packet number
713	2C9H			Element number
714	2CAH		Number of registered predefined protocols	
722 to 729	2D2H to 2D9H		Predefined protocol registration	
1090 to 1093	442H to 445H	Simple CPU communication function	Request to start communication at request for each setting number	
1094	446H		Request to stop fixed interval communication for each setting number	Stop request setting No.1 to 16
1095	447H			Stop request setting No.17 to 32
1096	448H			Stop request setting No.33 to 48
1097	449H			Stop request setting No.49 to 64
1098	44AH		Request to restart fixed interval communication for each setting number	Restart request setting No.1 to 16
1099	44BH			Restart request setting No.17 to 32
1100	44CH			Restart request setting No.33 to 48
1101	44DH			Restart request setting No.49 to 64
1102	44EH		Execution status flag for each setting number	Execution status flag setting No.1 to 16
1103	44FH			Execution status flag setting No.17 to 32
1104	450H			Execution status flag setting No.33 to 48
1105	451H			Execution status flag setting No.49 to 64
1106	452H		Preparation completion for each setting number	Preparation completion setting No.1 to 16
1107	453H			Preparation completion setting No.17 to 32
1108	454H			Preparation completion setting No.33 to 48
1109	455H			Preparation completion setting No.49 to 64
1130 to 1193	46AH to 4A9H		Simple CPU communication status for each setting number	Simple CPU communication status setting No.1 to Simple CPU communication status setting No.64
1194 to 1257	4AAH to 4E9H		Simple CPU communication error code for each setting number	Simple CPU communication error code setting No.1 to Simple CPU communication error code setting No.64
1258 to 1321	4EAH to 529H		Execution interval (current value) for each setting number	Execution interval (current value) setting No.1 to Execution interval (current value) setting No.64
1322 to 1385	52AH to 569H		Abnormal response code for each setting number	Abnormal response code setting No.1 to Abnormal response code setting No.64
1500	5DCH	Encrypted communications	Certificate expiration date within 90 days flag	
1501	5DDH		Certificate expiration flag	
2032	7F0H	Communication load status of the built-in Ethernet port	Data size of received packets per unit time (1s) [Kbps]	Current data size of received packets per unit time (1s) [Kbps] (L)
2033	7F1H			Current data size of received packets per unit time (1s) [Kbps] (H)
2034	7F2H			Maximum data size of received packets per unit time (1s) [Kbps] (L)
2035	7F3H			Maximum data size of received packets per unit time (1s) [Kbps] (H)
2036	7F4H		Data size of sent packets per unit time (1s) [Kbps]	Current data size of sent packets per unit time (1s) [Kbps] (L)
2037	7F5H			Current data size of sent packets per unit time (1s) [Kbps] (H)
2038	7F6H			Maximum data size of sent packets per unit time (1s) [Kbps] (L)
2039	7F7H			Maximum data size of sent packets per unit time (1s) [Kbps] (H)
2064	810H		Request to clear maximum values	
2080 to 2143	820H to 85FH	Connection status storage area	Connection No.1 to No.64 latest error code	

Address		Application	Name	
Decimal	Hexadecimal			
2336	920H	System port latest error code storage area	FTP server latest error code	
2337	921H		MELSOFT direct connection latest error code	
2338	922H		FTP client latest error code	
2721	AA1H	Discard received data at CPU STOP setting area	Discard received data setting connection No.1 to 16	
2722	AA2H		Discard received data setting connection No.17 to 32	
2723	AA3H		Discard received data setting connection No.33 to 48	
2724	AA4H		Discard received data setting connection No.49 to 64	
2737	AB1H	Predefined protocol support function execution status check area	Connection No.1	Protocol execution status
2739 to 2754	AB3H to AC2H			Received data verification result (receive packet No.1 to 16)
2755	AC3H			Protocol execution count
2756	AC4H			Protocol cancellation specification
2757 to 4016	AC5H to FB0H		Connection No.2 to No.64	
7857	1EB1H	Open completion signal	Open completion signal connection No.1 to 16	
7858	1EB2H		Open completion signal connection No.17 to 32	
7859	1EB3H		Open completion signal connection No.33 to 48	
7860	1EB4H		Open completion signal connection No.49 to 64	
7873	1EC1H	Open request signal	Open request signal connection No.1 to No.16	
7874	1EC2H		Open request signal connection No.17 to No.32	
7875	1EC3H		Open request signal connection No.33 to No.48	
7876	1EC4H		Open request signal connection No.49 to No.64	
7889	1ED1H	Socket communications reception status signal	Socket communications receive status signal connection No.1 to 16	
7890	1ED2H		Socket communications receive status signal connection No.17 to 32	
7891	1ED3H		Socket communications receive status signal connection No.33 to 48	
7892	1ED4H		Socket communications receive status signal connection No.49 to 64	
8992	2320H	Connection monitoring timer information storage area	MELSOFT connection auto-open TCP port	MELSOFT connection Auto-open TCP port connection monitoring timer time (L)
8993	2321H			MELSOFT connection Auto-open TCP port connection monitoring timer time (H)
8994	2322H			MELSOFT connection Auto-open TCP port connection monitoring timer unit
9014	2336H		Connection No.1	Connection monitoring timer time connection No.1 (L)
9015	2337H			Connection monitoring timer time connection No.1 (H)
9016	2338H			Connection monitoring timer unit connection No.1
9018 to 9268	233AH to 2434H		Connection No.2 to No.64	Connection monitoring timer time connection No.2 to No.64 (L)
				Connection monitoring timer time connection No.2 to No.64 (H)
				Connection monitoring timer unit connection No.2 to No.64

Address		Application	Name	
Decimal	Hexadecimal			
10200	27D8H	Communication cycle intervals measure area	Communication cycle intervals (actual measurement value) (ns units)	Communication cycle intervals (actual measurement value) (ns units) (L)
10201	27D9H			Communication cycle intervals (actual measurement value) (ns units) (H)
10202	27DAH		Information on waiting for start of cyclic processing	Processing immediately before cyclic send processing
10210	27E2H		Basic cycle processing time	Input refresh time of synchronous station (basic period) (ns units) (L)
10211	27E3H			Input refresh time of synchronous station (basic period) (ns units) (H)
10212	27E4H			Program execution time (basic period) (ns units) (L)
10213	27E5H			Program execution time (basic period) (ns units) (H)
10214	27E6H			Output refresh time of synchronous station (basic period) (ns units) (L)
10215	27E7H			Output refresh time of synchronous station (basic period) (ns units) (H)
10216	27E8H			Input processing time of motion operation (basic period) (ns units) (L)
10217	27E9H			Input processing time of motion operation (basic period) (ns units) (H)
10218	27EAH			Operation processing time of motion operation (basic period) (ns units) (L)
10219	27EBH			Operation processing time of motion operation (basic period) (ns units) (H)
10220	27ECH			Output processing time of motion operation (basic period) (ns units) (L)
10221	27EDH			Output processing time of motion operation (basic period) (ns units) (H)
10222	27EEH		Processing time of medium speed	Processing time of medium speed (ns units) (L)
10223	27EFH			Processing time of medium speed (ns units) (H)
10224	27F0H			Input refresh time of synchronous station (medium speed period) (ns units) (L)
10225	27F1H			Input refresh time of synchronous station (medium speed period) (ns units) (H)
10226	27F2H			Program execution time (medium speed period) (ns units) (H)
10227	27F3H			Program execution time (medium speed period) (ns units) (H)
10228	27F4H			Output refresh time of synchronous station (medium speed period) (ns units) (H)
10229	27F5H			Output refresh time of synchronous station (medium speed period) (ns units) (H)
10230	27F6H			Input processing time of motion operation (medium speed period) (ns units) (H)
10231	27F7H			Input processing time of motion operation (medium speed period) (ns units) (H)
10232	27F8H			Operation processing time of motion operation (medium speed period) (ns units) (H)
10233	27F9H			Operation processing time of motion operation (medium speed period) (ns units) (H)
10234	27FAH			Output processing time of motion operation (medium speed period) (ns units) (H)
10235	27FBH			Output processing time of motion operation (medium speed period) (ns units) (H)

Address		Application	Name	
Decimal	Hexadecimal			
10236	27FCH	Communication cycle intervals measure area	Processing time of low speed period	Processing time of low speed (ns units) (H)
10237	27FDH			Processing time of low speed (ns units) (H)
10238	27FEH			Input refresh time of synchronous station (low speed period) (ns units) (H)
10239	27FFH			Input refresh time of synchronous station (low speed period) (ns units) (H)
10240	2800H			Program execution time (low speed period) (ns units) (H)
10241	2801H			Program execution time (low speed period) (ns units) (H)
10242	2802H			Output refresh time of synchronous station (low speed period) (ns units) (H)
10243	2803H			Output refresh time of synchronous station (low speed period) (ns units) (H)
10244	2804H			Input processing time of motion operation (low speed period) (ns units) (H)
10245	2805H			Input processing time of motion operation (low speed period) (ns units) (H)
10246	2806H			Operation processing time of motion operation (low speed period) (ns units) (H)
10247	2807H			Operation processing time of motion operation (low speed period) (ns units) (H)
10248	2808H			Output processing time of motion operation (low speed period) (ns units) (H)
10249	2809H			Output processing time of motion operation (low speed period) (ns units) (H)
10264	2818H		Cyclic processing time	Cyclic transmission time (ns units) (H)
10265	2819H			Cyclic transmission time (ns units) (H)
10266	281AH			Cyclic receive processing time (basic period) (ns units) (H)
10267	281BH			Cyclic receive processing time (basic period) (ns units) (H)
10268	281CH			Cyclic send processing time (ns units) (H)
10269	281DH			Cyclic send processing time (ns units) (H)
10270	281EH		Clear request of communication cycle intervals (actual measurement value)	
10272 to 10273	2820H to 2821H		Cyclic transmission time (calculation value)	Cyclic transmission time (calculation value) (ns units) (H)
				Cyclic transmission time (calculation value) (ns units) (H)
10350	286EH	Port information storage area (P1)	Network type	
10351	286FH		Station type	
10352	2870H		Network information setting status	
10353	2871H		Network number	
10354	2872H		Station number	
10355	2873H		Transient transmission group number	
10356	2874H		IP address	Own node IP address (+0)
10357	2875H			Own node IP address (+1)
10366	287EH		MAC address	Own node MAC address (5th byte, 6th byte)
10367	287FH			Own node MAC address (3rd byte, 4th byte)
10368	2880H			Own node MAC address (1st byte, 2nd byte)
10369	2881H		Communication speed setting	

Address		Application	Name	
Decimal	Hexadecimal			
10390	2896H	Port information storage area (P2)	Network type	
10391	2897H		Station type	
10392	2898H		Network information setting status	
10393	2899H		Network number	
10394	289AH		Station number	
10395	289BH		Transient transmission group number	
10396	289CH		IP address	Own node IP address (+0)
10397	289DH			Own node IP address (+1)
10406	28A6H		MAC address	Own node MAC address (5th byte, 6th byte)
10407	28A7H			Own node MAC address (3rd byte, 4th byte)
10408	28A8H			Own node MAC address (1st byte, 2nd byte)
10409	28A9H		Communication speed setting	
10430	28BEH	Port information storage area (P3)	Network type	
10451 to 10706	28D3H to 29D2H	Synchronization refresh status	Synchronous communication received data transfer status (Module No.1 to No.256)	
10708 to 10963	29D4H to 2AD3H		Restart transfer of synchronous communication received data (Module No.1 to No.256)	
11400	2C88H	OPC UA server function area	OPC UA server function operation status	
11401	2C89H		Number of client connections	
11402	2C8AH		Number of subscriptions	
11403	2C8BH		OPC UA server start request	
11404	2C8CH		OPC UA server start error	
11405	2C8DH		OPC UA server start error cause	
11406	2C8EH		OPC UA server stop request	
11407	2C8FH		OPC UA server stop error	
11408	2C90H		OPC UA server stop error cause	
11409	2C91H		Number of defined nodes	
11410	2C92H		Address space capacity	Address space capacity (L)
11411	2C93H			Address space capacity (H)
11412	2C94H		Free address space	Free address space (L)
11413	2C95H			Free address space (H)

Point

- Do not write any data to the system area. Doing so may cause malfunction of the programmable controller system.
- If the value in an area of one word in size becomes equal to or higher than 65536, the count stops at 65535 (FFFFH).

CC-Link IE TSN function part

The following table lists buffer memory addresses of the CC-Link IE TSN function part. The buffer memory of the CC-Link IE TSN function part is used for the CC-Link IE TSN port.

←: Same as the address of P1

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
57344 to 58367	E000H to E3FFH	←		Device area	Remote input (RX)	Read
58368 to 59391	E400H to E7FFh	←			Remote output (RY)	Read, write
59392 to 67583	E800H to 107FFH	←			Remote register (RWw)	
67584 to 75775	10800H to 127FFH	←			Remote register (RWr)	Read
94208 to 94463	17000H to 170FFH	←			Link special relay (SB)	Read, write
94464 to 98559	17100H to 180FFH	←			Link special register (SW)	
1245440 to 1245441	130100H to 130101H	←		Timeslot 0 information	Cycle start offset (ns unit)	Read
1245442	130102H	←			Cycle start offset (s unit)	
1245444 to 1245445	130104H to 130105H	←			Cycle end offset (ns unit)	Read
1245446	130106H	←			Cycle end offset (s unit)	
1245452	13010CH	←			VID (VLAN Identifier)	Read
1245453	13010DH	←			PCP (Priority Code Point)	Read
1245454	13010EH	←			Ether Type	Read
1245456 to 1245567	130110H to 13017FH	←		Timeslot 1 to 7 information	Same as Timeslot 0 information	Read
1245696 to 1245697	130200H to 130201H	←		RX offset/size information	Station No.0 RX offset	Read
1245698 to 1245699	130202H to 130203H	←			Station No.0 RX size	Read
⋮		←			⋮	
1246708 to 1246709	1305F4H to 1305F5H	←			Station No.253 RX offset	Read
1246710 to 1246711	1305F6H to 1305F7H	←			Station No.253 RX size	Read
1246720 to 1246721	130600H to 130601H	←		RY offset/size information	Station No.0 RY offset	Read
1246722 to 1246723	130602H to 130603H	←			Station No.0 RY size	Read
⋮		←			⋮	
1247732 to 1247733	1309F4H to 1309F5H	←			Station No.253 RY offset	Read
1247734 to 1247735	1309F6H to 1309F7H	←			Station No.253 RY size	Read
1247744 to 1247745	130A00H to 130A01H	←		RWw offset/size information	Station No.0 RWw offset	Read
1247746 to 1247747	130A02H to 130A03H	←			Station No.0 RWw size	Read
⋮		←			⋮	
1248756 to 1248757	130DF4H to 130DF5H	←			Station No.253 RWw offset	Read
1248758 to 1248759	130DF6H to 130DF7H	←			Station No.253 RWw size	Read

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
1248768 to 1248769	130E00H to 130E01H	←		RWr offset/size information	Station No.0 RWr offset	Read
1248770 to 1248771	130E02H to 130E03H	←			Station No.0 RWr size	Read
⋮		←			⋮	
1249780 to 1249781	1311F4H to 1311F5H	←			Station No.253 RWr offset	Read
1249782 to 1249783	1311F6H to 1311F7H	←			Station No.253 RWr size	Read
1252096	131B00H	←		Own station (network card) information	Manufacturer code	Read
1252097	131B01H	←			Model type	
1252098	131B02H	←			Model code (lower 2 bytes)	
1252099	131B03H	←			Model code (upper 2 bytes)	
1252100	131B04H	←			Version	
1252101 to 1252103	131B05H to 131B07H	←			MAC address	
1252104	131B08H	←		Own station (controller) information	Controller information valid/ invalid flag	Read
1252105	131B09H	←			Manufacturer code	
1252106	131B0AH	←			Model type	
1252107	131B0BH	←			Model code (lower 2 bytes)	
1252108	131B0CH	←			Model code (upper 2 bytes)	
1252109	131B0DH	←			Version	
1252110 to 1252119	131B0EH to 131B17H	←			Model name string	
1252120 to 1252121	131B18H to 131B19H	←			Vendor-specific device information	
1260544	133C00H	←		Communication path determination status (network No.1 to 16)		Read
1260545 to 1260559	133C01H to 133C0FH	←		Communication path determination status (network No.17 to 239)		Read
1275136	137500H	←		Controller time delivery interval setting		Read, write
1275904	137800H	←		Time synchronization information (Grandmaster information)	Grandmaster	Read
1275907 to 1275909	137803H to 137805H	←			Grandmaster MAC address	Read
1275933	13781DH	←		Time synchronization information (Time synchronization setting)	PTP frame send source check enable/disable	Read, write
1275934	13781EH	←			PTP frame send source check result (Port 1)	Read
1275935	13781FH	←			PTP frame send source check result (Port 2)	Read
1277442	137E02H	←		Communication cycle information (Cyclic data send/ receive assurance information)	Multiple period setting (low speed)	Read
1277443	137E03H	←			Communication cycle intervals (calculation value)	Read

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
1277648 to 1277649	137ED0H to 137ED1H	←		PDO information (Multidrop No.0 of the station No.1)	Start offset of link device using RPDO (master station: RWw)	Read
1277650 to 1277651	137ED2H to 137ED3H	←			RPDO size: in units of words	Read
1277652 to 1277653	137ED4H to 137ED5H	←			Start offset of link device using TPDO (master station: RWr)	Read
1277654 to 1277655	137ED6H to 137ED7H	←			TPDO size: in units of words	Read
1277656 to 1277703	137ED8H to 137F07H	←		⋮		Read
1277704 to 1277705	137F08H to 137F09H	←		PDO information (Multidrop No.7 of the station No.1)	Start offset of link device using RPDO (master station: RWw)	Read
1277706 to 1277707	137F0AH to 137F0BH	←			RPDO size: in units of words	Read
1277708 to 1277709	137F0CH to 137F0DH	←			Start offset of link device using TPDO (master station: RWr)	Read
1277710 to 1277711	137F0EH to 137F0FH	←			TPDO size: in units of words	Read
1277712 to 1293775	137F10H to 13BDCFH	←		⋮		Read
1293776 to 1293777	13BDD0H to 13BDD1H	←		PDO information (Multidrop No.0 of station No.253)	Start offset of link device using RPDO (master station: RWw)	Read
1293778 to 1293779	13BDD2H to 13BDD3H	←			RPDO size: in units of words	Read
1293780 to 1293781	13BDD4H to 13BDD5H	←			Start offset of link device using TPDO (master station: RWr)	Read
1293782 to 1293783	13BDD6H to 13BDD7H	←			TPDO size: in units of words	Read
1293784 to 1293831	13BDD8H to 13BE07H	←		⋮		Read
1293832 to 1293833	13BE08H to 13BE09H	←		PDO information (Multidrop No.7 of station No.253)	Start offset of link device using RPDO (master station: RWw)	Read
1293834 to 1293835	13BE0AH to 13BE0BH	←			RPDO size: in units of words	Read
1293836 to 1293837	13BE0CH to 13BE0DH	←			Start offset of link device using TPDO (master station: RWr)	Read
1293838 to 1293839	13BE0EH to 13BE0FH	←			TPDO size: in units of words	Read
1294016	13BEC0H	←		Protocol information	Protocol operating status	Read
1294017	13BEC1H	←			Write request	Read, write
1294018	13BEC2H	←			Protocol setting	Read, write
1294019	13BEC3H	←			State where setting has been completed	Read
1294020	13BEC4H	←			Setting result	Read
1294021	13BEC5H	←			Protocol setting status	Read
1294022 to 1294031	13BEC6H to 13BECFH	←			System area	
1294032 to 1294047	13BED0H to 13BEDFH	←		System area		

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
1294048	13BEE0H	←		Timeslot information for device station cyclic transmission	Timeslot for station number 1 cyclic transmission	Read
1294049 to 1294299	13BEE1H to 13BFDBH	←			⋮	Read
1294300	13BFDCH	←			Timeslot for station number 253 cyclic transmission	Read
1294304	13BFE0H	←		Information for device station cyclic transmission	Multiplier for CC-Link IE TSN Class A (low speed)	Read
1294368	13C020H	←			Station No.1 CC-Link IE TSN Class A group send number	Read
1294369 to 1294619	13C021H to 13C11BH	←			⋮	Read
1294620	13C11CH	←			Station No.253 CC-Link IE TSN Class A group send number	Read
1294624	13C120H	←			CC-Link IE TSN Class A group send number with maximum cyclic transmission time	Read
1294640	13C130H	←		Cyclic transmission distribution information	Communication period setting for station No.1	Read
1294641	13C131H	←			Timing of cyclic transmission of station No.1	Read
1294642 to 1295143	13C132H to 13C327H	←			⋮	Read
1295144	13C328H	←			Communication period setting for station No.253	Read
1295145	13C329H	←			Timing of cyclic transmission of station No.253	Read
1295152	13C330H	←			Timing of cyclic transmission with maximum cyclic transmission time	Read
2097156 to 2097157	200004H to 200005H	—	—	Own node setting status storage area	Own node IP address	Read
2097166 to 2097167	20000EH to 20000FH	—	—		Subnet mask	Read
2097170 to 2097171	200012H to 200013H	—	—		Default gateway IP address	Read
2097180 to 2097182	20001CH to 20001EH	—	—		Own node MAC address	Read
2097183	20001FH	—	—		Own node network number	Read
2097184	200020H	—	—		Station No.	Read
2097185	200021H	—	—		Transient transmission group No.	Read
2097189	200025H	—	—		Auto-open UDP port port number	Read
2097190	200026H	—	—		MELSOFT transmission port (TCP/IP) port number	Read
2097191	200027H	—	—		MELSOFT transmission port (UDP/IP) port number	Read
2097193	200029H	—	—		SLMP transmission port (TCP/IP) port number	Read
2097194	20002AH	—	—		SLMP transmission port (UDP/IP) port number	Read
2097195	20002BH	—	—		Network information setting status (CC-Link IE TSN)	Read

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
2098154	2003EAH	4195306	4003EAH	System port latest error code storage area	Auto-open UDP port latest error code	Read
2098155	2003EBH	4195307	4003EBH		MELSOFT transmission port (UDP/IP) latest error code	Read
2098157	2003EDH	4195309	4003EDH		SLMP transmission port (UDP/IP) latest error code	Read
2098159	2003EFH	4195311	4003EFH		SLMPSND instruction latest error code	Read
2098176 to 2098183	200400H to 200407H	4195328 to 4195335	400400H to 400407H		MELSOFT transmission port (TCP/IP) latest error code	Read
2098304 to 2098311	200480H to 200487H	4195456 to 4195463	400480H to 400487H		SLMP transmission port (TCP/IP) latest error code	Read
2101104 to 2101105	200F70H to 200F71H	—	—	Connection monitoring timer information storage area (MELSOFT transmission port (TCP/IP))	Time	Read
2101106	200F72H	—	—		Unit	Read
2101108 to 2101109	200F74H to 200F75H	—	—	Connection monitoring timer information storage area (SLMP transmission port (TCP/IP))	Time	Read
2101110	200F76H	—	—		Unit	Read
2102152 to 2102153	201388H to 201389H	4199304 to 4199305	401388H to 401389H	Status for each protocol (IP packet)	Received packet total count	Read
2102154 to 2102155	20138AH to 20138BH	4199306 to 4199307	40138AH to 40138BH		Received packet checksum error discard count	Read
2102156 to 2102157	20138CH to 20138DH	4199308 to 4199309	40138CH to 40138DH		Sent packet total count	Read
2102174 to 2102175	20139EH to 20139FH	4199326 to 4199327	40139EH to 40139FH		Simultaneous transmission error detection count (Receive buffer full count)	Read
2102181	2013A5H	4199333	4013A5H		Receive abort count	Read
2102192 to 2102193	2013B0H to 2013B1H	4199344 to 4199345	4013B0H to 4013B1H	Status for each protocol (ICMP packet)	Received packet total count	Read
2102194 to 2102195	2013B2H to 2013B3H	4199346 to 4199347	4013B2H to 4013B3H		Received packet checksum error discard count	Read
2102196 to 2102197	2013B4H to 2013B5H	4199348 to 4199349	4013B4H to 4013B5H		Sent packet total count	Read
2102198 to 2102199	2013B6H to 2013B7H	4199350 to 4199351	4013B6H to 4013B7H		Received echo request total count	Read
2102200 to 2102201	2013B8H to 2013B9H	4199352 to 4199353	4013B8H to 4013B9H		Sent echo reply total count	Read
2102202 to 2102203	2013BAH to 2013BBH	4199354 to 4199355	4013BAH to 4013BBH		Sent echo request total count	Read
2102204 to 2102205	2013BCH to 2013BDH	4199356 to 4199357	4013BCH to 4013BDH		Received echo reply total count	Read
2102232 to 2102233	2013D8H to 2013D9H	4199384 to 4199385	4013D8H to 4013D9H	Status for each protocol (TCP packet)	Received packet total count	Read
2102234 to 2102235	2013DAH to 2013DBH	4199386 to 4199387	4013DAH to 4013DBH		Received packet checksum error discard count	Read
2102236 to 2102237	2013DCH to 2013DDH	4199388 to 4199389	4013DCH to 4013DDH		Sent packet total count	Read
2102272 to 2102273	201400H to 201401H	4199424 to 4199425	401400H to 401401H	Status for each protocol (UDP packet)	Received packet total count	Read
2102274 to 2102275	201402H to 201403H	4199426 to 4199427	401402H to 401403H		Received packet checksum error discard count	Read
2102276 to 2102277	201404H to 201405H	4199428 to 4199429	401404H to 401405H		Sent packet total count	Read

P1		P2		Name		Read, write
Address (decimal)	Address (hexadecimal)	Address (decimal)	Address (hexadecimal)			
2102341	201445H	—	—	Own node operation status storage area (LED on/off status)		Read
2102343	201447H	4199495	401447H	Own node operation status storage area (connection information area)	Communication mode	Read
2102344	201448H	4199496	401448H		Connection status	Read
2102345	201449H	4199497	401449H		Communication speed	Read
2102346	20144AH	4199498	40144AH		Disconnection count	Read
2102352	201450H	—	—	Own node operation status storage area (IP address duplication status storage area)	Same IP address detection flag	Read
2102353 to 2102355	201451H to 201453H	—	—		MAC address of the station already connected to the network	Read
2102356 to 2102358	201454H to 201456H	—	—		MAC address of the station with the IP address already used	Read
2108352 to 2108353	202BC0H to 202BC1H	4205504 to 4205505	402BC0H to 402BC1H	IP filter area	IP filter blocking count	—
2108354	202BC2H	4205506	402BC2H		IP address format	—
2108356 to 2108357	202BC4H to 202BC5H	4205508 to 4205509	402BC4H to 402BC5H		Latest blocked send source IP address (IPv4)	—
2108358 to 2108359	202BC6H to 202BC7H	4205510 to 4205511	402BC6H to 402BC7H		Latest blocked target IP address (IPv4)	—
2108416 to 2108417	202C00H to 202C01H	—	—	Connection monitoring timer information storage area	System connection close (connection monitoring timer excess) count	—
2108418	202C02H	—	—		Latest disconnected system connection information	—
2162687	20FFFFH	—	—	Network type information		Read
3989847	3CE157H	—	—	Ethernet device individual error log (latest)	Error code	Read
6291480	600018H	←		Ethernet PORT1/2 common information	Initial status	Read
6291481	600019H	←			Initial error code	Read
6291486	60001EH	←		State of Receive buffer		Read

Motion function part

Address		Name
Decimal	Hexadecimal	
14032767.0	D61F7F.0	Accessibility to labels for motion function

Details of buffer memory addresses (CPU function part)

This section describes the details of buffer memory addresses of the CPU function part.

Port for Ethernet

■Own node IP address

Address	Name	Description
U3E0\G50	Own node IP address	The own node IP address of the Ethernet port is stored. G50: Third octet, fourth octet G51: First octet, second octet (Example) The IP address is 192.168.3.40 (C0A80328H). b15 b8 b7 b0 G50: 03_H(3) 28_H(40) G51: $C0_H$(192) $A8_H$(168)
U3E0\G51		

■Subnet mask

Address	Name	Description
U3E0\G60	Subnet mask	The subnet mask of the Ethernet port is stored. G60: Third octet, fourth octet G61: First octet, second octet (Example) The subnet mask is 255.255.255.0 (FFFFFF00H). b15 b8 b7 b0 G60: FF_H(255) 00_H(0) G61: FF_H(255) FF_H(255)
U3E0\G61		

■Default gateway IP address

Address	Name	Description
U3E0\G64	Default gateway IP address	The default gateway IP address of the Ethernet port is stored. G64: Third octet, fourth octet G65: First octet, second octet (Example) The default gateway IP address is 192.168.3.254 (C0A803FEH). b15 b8 b7 b0 G64: 03_H(3) FE_H(254) G65: $C0_H$(192) $A8_H$(168)
U3E0\G65		

■Own node MAC address

Address	Name	Description
U3E0\G74	MAC address (5th byte, 6th byte)	The MAC address of the Ethernet port is stored. G74: 5th byte, 6th byte G75: 3rd byte, 4th byte G76: 1st byte, 2nd byte (Example) The MAC address is 123456789ABC. b15 b8 b7 b0 G74: $9A_H$ BC_H G75: 56_H 78_H G76: 12_H 34_H
U3E0\G75	MAC address (3rd byte, 4th byte)	
U3E0\G76	MAC address (1st byte, 2nd byte)	

■Communication speed setting

Address	Description
U3E0\G82	The communication speed setting value of the Ethernet port is stored. Corresponding numbers are shown below. 0: Automatic negotiation 255: Not connected

■Auto-open UDP port number

Address	Description
U3E0\G83	The auto-open UDP port number of the Ethernet port is stored.

■MELSOFT connection TCP port number

Address	Description
U3E0\G84	The port number used in MELSOFT connection TCP of the Ethernet port is stored.

■MELSOFT connection UDP port number

Address	Description
U3E0\G85	The port number used in MELSOFT connection UDP of the Ethernet port is stored.

■MELSOFT direct connection port number

Address	Description
U3E0\G86	The port number used in MELSOFT direct connection of the Ethernet port is stored.

■Number of receive packets per unit time (one second) at Ethernet port

Address	Name	Description
U3E0\G100	Receive packet count (current) per unit time (one second)	The number of receive packets per unit time (one second) at Ethernet port is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)
U3E0\G101	Receive packet count (maximum) per unit time (one second)	The maximum value of the number of receive packets per unit time (one second) at Ethernet port is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)

■Number of send packets per unit time (one second) at Ethernet port

Address	Name	Description
U3E0\G102	Send packet count (current) per unit time (one second)	The number of send packets per unit time (one second) at Ethernet port is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)
U3E0\G103	Send packet count (maximum) per unit time (one second)	The maximum value of the number of send packets per unit time (one second) at Ethernet port is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)

■Connection No.1 latest error code to Connection No.16 latest error code

Address	Name	Description
U3E0\G130 U3E0\G2080	Connection No.1 latest error code	The latest error code for each connection is stored. 0:No error Other than 0: Error code
U3E0\G131 U3E0\G2081	Connection No.2 latest error code	
⋮		
U3E0\G144 U3E0\G2094	Connection No.15 latest error code	
U3E0\G145 U3E0\G2095	Connection No.16 latest error code	

■FTP server latest error code

Address	Name	Description
U3E0\G146 U3E0\G2336	FTP server latest error code	The latest error code that was generated in the system port used by the FTP server function is stored. 0:No error Other than 0: Error code

■MELSOFT direct connection latest error code

Address	Name	Description
U3E0\G147 U3E0\G2337	MELSOFT direct connection latest error code	The latest error code that was generated in the system port for MELSOFT direct connection is stored. 0:No error Other than 0: Error code

■FTP client latest error code

Address	Name	Description
U3E0\G148 U3E0\G2338	FTP client latest error code	The latest error code that was generated in the system port used by the FTP client is stored. 0:No error Other than 0: Error code

■IP packet

Address	Name	Description
U3E0\G150 U3E0\G151	Received packet total count	The total number of received IP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G152 U3E0\G153	Received packet checksum error discard count	The total number of IP packets discarded due to a checksum error is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G154 U3E0\G155	Sent packet total count	The total number of sent IP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G179	Receive abort count	The number of times that received data was discarded due to an insufficient receive buffer is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)

■ICMP packet

Address	Name	Description
U3E0\G182 U3E0\G183	Received packet total count	The total number of received ICMP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G184 U3E0\G185	Received packet checksum error discard count	The total number of ICMP packets discarded due to a checksum error is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G186 U3E0\G187	Sent packet total count	The total number of sent ICMP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G188 U3E0\G189	Received echo request total count	The total number of received echo requests is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G190 U3E0\G191	Sent echo reply total count	The total number of sent echo replies is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G192 U3E0\G193	Sent echo request total count	The total number of sent echo requests is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G194 U3E0\G195	Received echo reply total count	The total number of received echo replies is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)

■TCP packet

Address	Name	Description
U3E0\G196 U3E0\G197	Received packet total count	The total number of received TCP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G198 U3E0\G199	Received packet checksum error discard count	The total number of TCP packets discarded due to a checksum error is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G200 U3E0\G201	Sent packet total count	The total number of sent TCP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)

■UDP packet

Address	Name	Description
U3E0\G204 U3E0\G205	Received packet total count	The total number of received UDP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G206 U3E0\G207	Received packet checksum error discard count	The total number of UDP packets discarded due to a checksum error is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)
U3E0\G208 U3E0\G209	Sent packet total count	The total number of sent UDP packets is stored. Range: 0 to 4294967295 (The value does not change once it reaches the maximum value.)

■Connection status area

Address	Name	Description
U3E0\G242	Communication mode	Stores the communication mode. 0: Half-duplex 1: Full-duplex
U3E0\G243	Connection status	Stores the connection status. 0: Hub not connected or disconnected 1: Hub connected
U3E0\G244	Communication speed	Stores the communication speed. 1: Operating at 100BASE-TX
U3E0\G245	Disconnection count	The number of times the cable was disconnected is stored. Range: 0 to 65535 (The value does not change once it reaches the maximum value.)

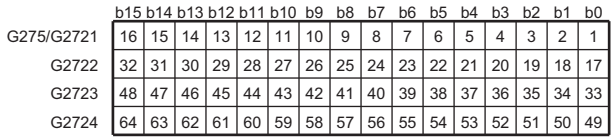
■IP address duplication status storage area

Address	Name	Description
U3E0\G251	Same IP address detection flag	Stores IP address duplication status. 0: IP address not duplicated 1: IP address duplicated

■Network information setting status

Address	Name	Description
U3E0\G258	Network information setting status	The operating status of the network setting change function is stored. 0: Operation according to the parameter settings 2: Operation according to the default value of the network setting change function 3: Operation according to the setting value of the network setting change function

■Discard received data setting

Address	Name	Description
U3E0\G275 U3E0\G2721	Discard received data setting	Stores the setting to discard received data at CPU STOP of each connection of the Ethernet port. The numbers in the table indicate each bit and connection numbers.  0: Disable (The received data is not discarded during controller STOP.) 1: Enable (The received data is discarded during controller STOP.)
U3E0\G2722		
U3E0\G2723		
U3E0\G2724		

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
G275/G2721	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
G2722	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
G2723	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
G2724	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Time setting function operation result

Address	Description
U3E0\G290	Stores the operation result of the time setting function. 0: Unexecuted 1: Success FFFFH: Failure

■Time setting function execution time

Address	Name	Description
U3E0\G291	Year	Stores the year that the time setting function was executed.
U3E0\G292	Month	Stores the month that the time setting function was executed.
U3E0\G293	Day	Stores the date that the time setting function was executed.
U3E0\G294	Hour	Stores the time (hour) that the time setting function was executed.
U3E0\G295	Minute	Stores the time (minute) that the time setting function was executed.
U3E0\G296	Second	Stores the time (second) that the time setting function was executed.
U3E0\G297	Day of the week	Stores the day of the week that the time setting function was executed. 0: Sunday 1: Monday 2: Tuesday 3: Wednesday 4: Thursday 5: Friday 6: Saturday
U3E0\G298	Required response time	Stores the time required for the module to set the time after sending to the SNTP server. (Unit: ms) Range: 0 to 65534
U3E0\G299	(SNTP client) execution	Executes the time setting function when b0 is turned off and on. The time setting function can be executed at a random time from a program. The function is not executed if b0 is turned off and on during execution of the time setting function. This is valid only when "Use" is set for "Time Setting (SNTP Client)" under "Time Setting" in "Application Settings".

■IP packet transfer latest data volume

Address	Name	Description
U3E0\G310	IP packet transfer latest data volume	Stores the latest value (byte/s) of the total size (byte) per unit time (one second) of the transferred IP packet. Range: 0 to 4294967295
U3E0\G311		

■IP packet transfer maximum data volume

Address	Name	Description
U3E0\G312	IP packet transfer maximum data volume	Stores the maximum value (byte/s) of the total size (byte) per unit time (one second) of the transferred IP packet. Range: 0 to 4294967295
U3E0\G313		

■Predefined protocol support function execution status check area (connection No.1)

Address	Name	Description
U3E0\G350 U3E0\G2737	Protocol execution status	Stores the status of the protocol being executed at connection No.1. 0: Unexecuted 1: Waiting for transmission 2: Sending 3: Waiting for data reception 4: Receiving 5: Execution completed
U3E0\G352 U3E0\G2739	Received data verification result (receive packet No.1)	Stores the verification results of receive packet No.1. ■Element No. where the verification result did not match (b0 to b7) 0: Verification matched 1 to 32: Element No. where the verification result did not match FFH: Verification not performed ■The cause of mismatch (verification result code) (b8 to b15) 00H (Normal): — 01H (insufficient receive data): The total packet size of receive data is smaller than that set in protocol data. 10H (data not matched): The receive data do not match the value set in protocol data. 11H (ASCII-binary conversion error): When the code type setting is ASCII Hexadecimal, data not in ASCII code are received. 12H (data length error): The received length value exceeded 2046 bytes. 30H (data length size error): The length value received from the external device does not match the actual length. FFH (verification not performed): —
U3E0\G353 to U3E0\G367 U3E0\G2740 to U3E0\G2754	Received data verification result (receive packet No.2 to 16)	The configuration is the same as receive packet No.1.
U3E0\G368 U3E0\G2755	Protocol execution count	Stores the number of protocol executions in Connection No.1. 0: Protocol not executed 1 to 65535: Number of executions (When the number exceeds 65535, the value remains 65535.)
U3E0\G369 U3E0\G2756	Protocol cancellation specification	Cancels the protocol executed in Connection No.1. 0: No cancellation instruction 1: Cancellation request (set by user) 2: Cancellation completed (set by system)

■Predefined protocol support function execution status check area (connection No.2 to 16)

Address	Name	Description
U3E0\G370 to U3E0\G669 U3E0\G2757 to U3E0\G3056	Predefined protocol support function execution status check area (Connection No.2 to 16)	Same as connection No.1.

■Predefined protocol support function execution status check area (connection No.17 to 64)

Address	Name	Description
U3E0\G3057 to U3E0\G4016	Predefined protocol support function execution status check area (Connection No.17 to 64)	Same as connection No.1.

■Open completion signal

Address	Name	Description
U3E0\G680 U3E0\G7857	Open completion signal	The open status of each connection of the Ethernet port is stored. The numbers in the table indicate each bit and connection numbers. G680 is a buffer memory area compatible with RCPU. Use this buffer memory area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of G7857 is recommended. 0: Closed/Open not completed 1: Open completed
U3E0\G7858		
U3E0\G7859		
U3E0\G7860		

	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
G680/G7857	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
G7858	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17
G7859	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33
G7860	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Open request signal

Address	Name	Description
U3E0\G681 U3E0\G7873	Open request signal	The open processing status of each connection of the Ethernet port is stored. The numbers in the table indicate each bit and connection numbers. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 G681/G7873: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 G7874: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 G7875: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 G7876: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 G681 is a buffer memory area compatible with RCPU. Use this buffer memory area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of G7873 is recommended. 0: No open request 1: Open request in progress, or the connection can be closed by changing the value from 1 to 0.
U3E0\G7874		
U3E0\G7875		
U3E0\G7876		

■Socket communications reception status signal

Address	Name	Description
U3E0\G682 U3E0\G7889	Socket communications reception status signal	The receive status of each connection of the Ethernet port is stored. The numbers in the table indicate each bit and connection numbers. b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 G682/G7889: 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 G7890: 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 G7891: 48 47 46 45 44 43 42 41 40 39 38 37 36 35 34 33 G7892: 64 63 62 61 60 59 58 57 56 55 54 53 52 51 50 49 G682 is a buffer memory area compatible with RCPU. Use this buffer memory area when sharing the program with a MELSEC iQ-R series CPU module. For other cases, the use of G7889 is recommended. 0: Data not received 1: Data reception completed
U3E0\G7890		
U3E0\G7891		
U3E0\G7892		

■Initial status

Address	Name	Description
U3E0\G683	Initial status	The initial processing status of the Ethernet function is stored. ■Initial normal completion status (b0) 0: Completed with an error 1: Initialization normal completion ■Initial abnormal completion status (b1) 0: Completed normally 1: Initialization abnormal completion ■b2 to b15: Use prohibited

■Initial error code

Address	Name	Description
U3E0\G684	Initial error code	Information on the initial processing of the Ethernet function that completed with an error is stored. 0: In initial processing or initial normal completion Other than 0: Initial processing error code (An error code is stored.)

■Predefined protocol ready

Address	Name	Description
U3E0\G692	Predefined protocol ready	Stores the ready status of the protocol setting data. 1 is stored when the check and reflection of the predefined protocol setting are completed successfully with the controller in RUN state. 0 is stored when the controller changes to STOP state. 0: Preparing or no predefined protocol setting 1: Ready

■Predefined protocol setting data error information

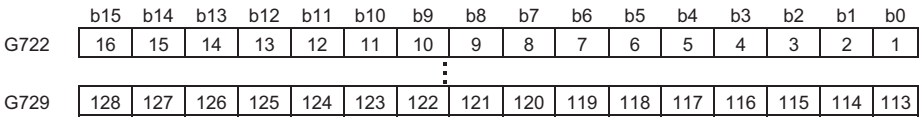
Address	Name	Description
U3E0\G710	Protocol number	When a protocol setting data error is detected, stores the protocol number where the error was detected. Protocol is checked in order from smallest protocol number. The protocol number where an error was detected first is stored. 0: No error 1 to 128: Protocol number 65535: Cannot identify*1
U3E0\G711	Setting type	0 is stored if an error is detected in the packet setting or element setting. 1 is stored if an error is detected in the protocol detailed setting. (Valid when protocol number value is 1 to 128) 0: Packet setting or element setting 1: Protocol preferences 65535: Cannot identify*1
U3E0\G712	Packet number	When an error is detected in the protocol setting data, stores the packet number where the error was detected. The packets are checked in order of send packets and then receive packets (expected packets) from smallest number. The packet number where an error was detected first is stored. (Valid when setting type value is 0) 0: Send packet 1 to 16: Receive packet number 65535: Cannot identify*1
U3E0\G713	Element number	When an error is detected in the protocol setting data, stores the element number where the error was detected. The elements are checked in order of smallest element number. The element number where an error was detected first is stored. (Valid when setting type value is 0) 1 to 32: Element number 65535: Cannot identify*1

*1 The setting value may be unidentifiable (65535) in the following cases.
· When a setting that cannot be detected by the current controller version is written in
· When protocol setting data is broken (hardware failure)

■Number of registered predefined protocols

Address	Name	Description
U3E0\G714	Number of registered predefined protocols	Stores the protocol number of the registered protocol setting data. 0 is stored if the protocol setting data check result is abnormal. 0: No registration 1 to 128: Number of registrations

■Predefined protocol registration

Address	Name	Description
U3E0\G722 to U3E0\G729	Predefined protocol registration No.1 to 128	Whether protocol setting data is registered or not is stored. All bits are set to 0 if the protocol setting data check result is abnormal.  0: No registration 1: Registered

Simple CPU communication function

■Request to start communication at request for each setting number (U3E0\G1090 to U3E0\G1093)

This request contact sends and receives the data when the communication setting is "On Request" and is stored using the following bit pattern for each setting number.

- Off → On: Requested (start request)
- On → Off: Completed (start completion)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1090	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1093	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Request to stop fixed interval communication for each setting number (U3E0\G1094 to U3E0\G1097)

This request contact stops the data send when the communication setting is "Fixed Interval" and is stored using the following bit pattern for each setting number.

- Off → On: Requested (stop request)
- On → Off: Completed (stop completion)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1094	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1097	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Request to restart fixed interval communication for each setting number (U3E0\G1098 to U3E0\G1101)

This request contact restarts the data send when the communication setting is "Fixed Interval" and is stored using the following bit pattern for each setting number.

- Off → On: Requested (restart request)
- On → Off: Completed (restart completion)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1098	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1101	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Execution status flag for each setting number (U3E0\G1102 to U3E0\G1105)

The status of data communication is stored using the following bit pattern for each setting number.

- Off: Communication stop (function not used)
- On: Communicating

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1102	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1105	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Preparation completion for each setting number (U3E0\G1106 to U3E0\G1109)

The preparation completion status of the simple CPU communication is stored using the following bit pattern for each setting number.

- Off: Not ready (function not used)
- On: Ready

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1106	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1109	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49

■Simple CPU communication status for each setting number (U3E0\G1130 to U3E0\G1193)

Address	Name	Description
Un\G1130	Simple CPU communication status setting No.1	The simple CPU communication status is stored. 0H: Unset (function not used) 1H: Preparing 2H: Waiting for the request 3H: Communicating 4H: Communication stop 5H: Retry being executed 6H: Monitoring at error AH: Communications impossible
Un\G1131	Simple CPU communication status setting No.2	
⋮		
Un\G1192	Simple CPU communication status setting No.63	
Un\G1193	Simple CPU communication status setting No.64	

■Simple CPU communication error code for each setting number (U3E0\G1194 to U3E0\G1257)

Address	Name	Description
Un\G1194	Simple CPU communication error code setting No.1	The cause of the error detected in the simple CPU communication is stored. 0: No error (function not used) Other than 0: Error code (☞ Page 1776 ERROR CODES) The value is cleared to 0 with a clear request from the engineering tool.
Un\G1195	Simple CPU communication error code setting No.2	
⋮		
Un\G1256	Simple CPU communication error code setting No.63	
Un\G1257	Simple CPU communication error code setting No.64	

■Execution interval (current value) for each setting number (U3E0\G1258 to U3E0\G1321)

Address	Name	Description
Un\G1258	Execution interval (current value) setting No.1	If "Fixed Interval" is set for communication setting, the current value of the execution interval is stored. 0: Unset (function not used), communications impossible, "Communication Setting" is "On Request" Other than 0: Execution interval (unit: ms)
Un\G1259	Execution interval (current value) setting No.2	
⋮		
Un\G1320	Execution interval (current value) setting No.63	
Un\G1321	Execution interval (current value) setting No.64	

■Abnormal response code for each setting number (U3E0\G1322 to U3E0\G1385)

Address	Name	Description
Un\G1322	Abnormal response code setting No.1	The abnormal response code detected in the simple CPU communication is stored. 0: No error (function not used) Other than 0: Abnormal response code For abnormal response codes, refer to the manual for the external device.
Un\G1323	Abnormal response code setting No.2	
⋮		
Un\G1384	Abnormal response code setting No.63	
Un\G1385	Abnormal response code setting No.64	

Security function

■Certificate expiration date

Address	Name	Description
U3E0\G1500	Certificate expiration date within 90 days flag	On: Certification expiration date is within 90 days. Off: No certificate/there are at least 91 days until the expiration date/Expired
U3E0\G1501	Certificate expiration flag	On: Expired Off: No certificate/Not expired yet

Port for Ethernet

■Data size of received packets per unit time (one second) at Ethernet port [Kbps]

Address	Name	Description
U3E0\G2032 U3E0\G2033	Current data size of received packets per unit time (one second) [Kbps]	• The data size of received packets per unit time (one second) of the Ethernet port [Kbps] is stored. • Range: 0 to 4294967295 (Values less than 1 [Kbps] are rounded down.)
U3E0\G2034 U3E0\G2035	Maximum data size of received packets per unit time (one second) [Kbps]	• The maximum data size of received packets per unit time (one second) [Kbps] of the Ethernet port is stored. • Range: 0 to 4294967295 (Values less than 1 [Kbps] are rounded down.)

■Data size of sent packets per unit time (one second) at the Ethernet port [Kbps]

Address	Name	Description
U3E0\G2036 U3E0\G2037	Current data size of sent packets per unit time (one second) [Kbps]	• The data size of sent packets per unit time (one second) [Kbps] of the Ethernet port is stored. • Range: 0 to 4294967295 (Values less than 1 [Kbps] are rounded down.)
U3E0\G2038 U3E0\G2039	Maximum data size of sent packets per unit time (one second) [Kbps]	• The maximum data size of sent packets per unit time (one second) [Kbps] of the Ethernet port is stored. • Range: 0 to 4294967295 (Values less than 1 [Kbps] are rounded down.)

■Request to clear the maximum value (Ethernet port)

Address	Name	Description
U3E0\G2064	Request to clear the maximum value (Ethernet port)	0: Before the request to clear maximum values 1: Request to clear maximum values • The maximum value of the number of receive/send packets per unit time (one second) of the Ethernet port is cleared. • The maximum value of the data size of the received/sent packets per unit time (one second) of the Ethernet port is cleared.

■Connection No.17 latest error code to Connection No.64 latest error code

Address	Name	Description
U3E0\G2096	Connection No.17 latest error code	The latest error code for each connection is stored. 0:No error Other than 0: Error code
U3E0\G2097	Connection No.18 latest error code	
⋮		
U3E0\G2142	Connection No.63 latest error code	
U3E0\G2143	Connection No.64 latest error code	

■Connection monitoring timer information MELSOFT connection auto-open TCP port

Address	Name	Description
U3E0\G8992 U3E0\G8993	Time	The time set in the connection monitoring timer setting is stored. Unit [s]: 1 to 16383 Unit [ms]: 100 to 16383000
U3E0\G8994	Unit	The unit set in the connection monitoring timer setting is stored. 0: s 1: ms

■Connection monitoring timer information connection No.1

Address	Name	Description
U3E0\G9014	Time	The time set in the connection monitoring timer setting is stored. Unit [s]: 1 to 16383 Unit [ms]: 100 to 16383000
U3E0\G9015		
U3E0\G9016	Unit	The unit set in the connection monitoring timer setting is stored. 0: s 1: ms

■Connection monitoring timer information connection No.2 to 64

Address	Name	Description
U3E0\G9018 to U3E0\G9268	Same as connection No.1.	

Communication cycle measurement function

■Communication cycle intervals (actual measurement value) (ns units)

Address	Name	Description
U3E0\G10200 U3E0\G10201	Communication cycle intervals (actual measurement value) (ns units)	• The time in a case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum is stored (unit: ns). Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.

■Information on waiting for start of cyclic processing

Address	Name	Description
U3E0\G10202	Processing immediately before cyclic send processing	Stores the process that was being executed immediately before cyclic send processing in the case where the time from the start of the basic cycle to the completion of the cyclic send processing is the maximum. 0: Undetermined (SM973: Communication cycle intervals measure setting status is off or is on while measurement is in progress.) 1: Output refresh of synchronous station (basic period) or output processing of motion operation (basic period) 2: Output refresh of synchronous station (medium speed period) or output processing of motion operation (medium speed period) 3: Output refresh of synchronous station (low speed period) or output processing of motion operation (low speed period) 5: Cyclic receive processing (basic period)

■Basic cycle processing time

Address	Name	Description
U3E0\G10210 U3E0\G10211	Input refresh time of synchronous station (basic period) (ns units)	• Stores the input refresh time of the synchronous station (basic period) in a case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10212 U3E0\G10213	Program execution time (basic period) (ns units)	• Stores the program execution time (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10214 U3E0\G10215	Output refresh time of synchronous station (basic period) (ns units)	• Stores the output refresh time of the synchronous station (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10216 U3E0\G10217	Input processing time of motion operation (basic period) (ns units)	• Stores the input processing time of motion operation (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10218 U3E0\G10219	Operation processing time of motion operation (basic period) (ns units)	• Stores the operation processing time of motion operation (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10220 U3E0\G10221	Output processing time of motion operation (basic period) (ns units)	• Stores the output processing time of motion operation (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.

■Processing time of medium speed

Address	Name	Description
U3E0\G10222 U3E0\G10223	Processing time of medium speed (ns units)	• Stores the time in the case where the time from the start of medium speed cycle to the output refresh of synchronous station (medium speed period) or the completion of output processing of motion operation (medium speed period) is the maximum (unit: ns). Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10224 U3E0\G10225	Input refresh time of synchronous station (medium speed period) (ns units)	• Stores the input refresh time of the synchronous station (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10226 U3E0\G10227	Program execution time (medium speed period) (ns units)	• Stores the program execution time (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10228 U3E0\G10229	Output refresh time of synchronous station (medium speed period) (ns units)	• Stores the output refresh time of the synchronous station (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10230 U3E0\G10231	Input processing time of motion operation (medium speed period) (ns units)	• Stores the input processing time of motion operation (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10232 U3E0\G10233	Operation processing time of motion operation (medium speed period) (ns units)	• Stores the calculation processing time of motion operation (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10234 U3E0\G10235	Output processing time of motion operation (medium speed period) (ns units)	• Stores the output processing time of motion operation (medium speed period) in the case where the time from the start of the medium speed period to the output refresh of synchronous station (medium speed period) or the completion of the output processing of motion operation (medium speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.

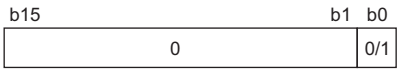
■Processing time of low speed period

Address	Name	Description
U3E0\G10236 U3E0\G10237	Processing time of low speed period (ns units)	• Stores the time in the case where the time from the start of low speed period to the output refresh of synchronous station (low speed period) or the completion of output processing of motion operation (low speed period) is the maximum (unit: ns). Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10238 U3E0\G10239	Input refresh time of synchronous station (low speed period) (ns units)	• Stores the input refresh time of the synchronous station (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10240 U3E0\G10241	Program execution time (low speed period) (ns units)	• Stores the program execution time (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10242 U3E0\G10243	Output refresh time of synchronous station (low speed period) (ns units)	• Stores the output refresh time of the synchronous station (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10244 U3E0\G10245	Input processing time of motion operation (low speed period) (ns units)	• Stores the input processing time of motion operation (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10246 U3E0\G10247	Operation processing time of motion operation (low speed period) (ns units)	• Stores the calculation processing time of motion operation (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10248 U3E0\G10249	Output processing time of motion operation (low speed period) (ns units)	• Stores the output processing time of motion operation (low speed period) in the case where the time from the start of the low speed period to the output refresh of synchronous station (low speed period) or the completion of the output processing of motion operation (low speed period) is the maximum. Range: 0 to 4294967295 • This includes the time for processing whose priority is higher than this processing. • This is valid when SM973 (communication cycle intervals measure setting status) is on.

■Cyclic processing time

Address	Name	Description
U3E0\G10264 U3E0\G10265	Cyclic transmission time [ns]	• Stores the cyclic transmission time in the case where the time from the start of the period to the completion of cyclic send processing is the maximum. Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10266 U3E0\G10267	Cyclic receive processing time (basic period) (ns units)	• Stores the cyclic receive processing time (basic period) in the case where the time from the start of the basic period to the completion of the cyclic send processing is the maximum. Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.
U3E0\G10268 U3E0\G10269	Cyclic send processing time [ns]	• Stores the cyclic send processing time in the case where the time from the start of the period to the completion of cyclic send processing is the maximum. Range: 0 to 4294967295 • This is valid when SM973 (communication cycle intervals measure setting status) is on.

■Clear request of communication cycle intervals (actual measurement value)

Address	Name	Description
U3E0\G10270	Clear request of communication cycle intervals (actual measurement value)	■b0: Clear request of communication cycle intervals (actual measurement value)  0: Do not clear 1: Clear Clears the communication cycle interval (actual measurement value) as well as G10202 to G10269 values when this buffer memory is changed from off to on. It is turned off by the system when the clearing process completes. ■b1 to b15: Not used

■Cyclic transmission time (calculation value)

Address	Name	Description
U3E0\G10272 to U3E0\G10273	Cyclic transmission time (calculation value)	Stores the cyclic transmission time (calculation value). Range: 0 to 4294967295 (ns units) These memory addresses are valid when SM973 (communication cycle intervals measure setting status) is on.

Port information function

■Port 1 network type

Address	Name	Description
U3E0\G10350	Port 1 network type	Stores the network type of P1. 5: CC-Link IE TSN

■Port 1 station type

Address	Name	Description
U3E0\G10351	Port 1 station type	Stores the station type of P1. 0: Master station

■Port 1 network setting information

Address	Name	Description
U3E0\G10352	Port 1 network setting information	The operating status of the network setting change function of P1 is stored. 0: Operation according to the parameter settings

■Port 1 network number

Address	Name	Description
U3E0\G10353	Port 1 network number	Stores the network number of P1. 1 to 239: 1 to 239

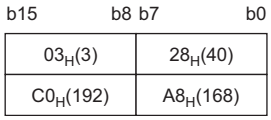
■Port 1 station number

Address	Name	Description
U3E0\G10354	Port 1 station number	Stores the station number of P1. 0: 0

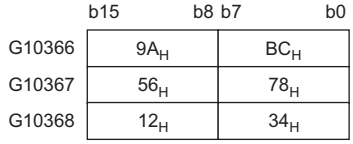
■Port 1 transient transmission group number

Address	Name	Description
U3E0\G10355	Port 1 transient transmission group number	Stores the transient transmission group number of P1. 0: No group setting

■Port 1 own node IP address

Address	Name	Description
U3E0\G10356 U3E0\G10357	Port 1 own node IP address	Stores the own node IP address of port 1. G10356: Third octet, fourth octet G10357: First octet, second octet (Example) The IP address is 192.168.3.40 (C0A80328H). 

■Port 1 MAC address

Address	Name	Description
U3E0\G10366	Port 1 MAC address (5th byte, 6th byte)	Stores the MAC address of port 1. G10366: 5th byte, 6th byte G10367: 3rd byte, 4th byte G10368: 1st byte, 2nd byte (Example) The MAC address is 123456789ABC. 
U3E0\G10367	Port 2 MAC address (3rd byte, 4th byte)	
U3E0\G10368	Port 3 MAC address (1st byte, 2nd byte)	

■Port 1 communication speed setting

Address	Name	Description
U3E0\G10369	Port 1 communication speed setting	Stores the communication speed setting for P1. 1: 100Mbps 2: 1Gbps 255: Not connected

■Port 2 network type

Address	Name	Description
U3E0\G10390	Port 2 network type	Stores the network type of P2. 999: Not used

■Port 2 station type

Address	Name	Description
U3E0\G10391	Port 2 station type	Stores the station type of P2. 999: Not used

■Port 2 network setting information

Address	Name	Description
U3E0\G10392	Port 2 network setting information	The operating status of the network setting change function of P2 is stored. 999: Not used

■Port 2 network number

Address	Name	Description
U3E0\G10393	Port 2 network number	Stores the network number of P2. 999: Not used

■Port 2 station number

Address	Name	Description
U3E0\G10394	Port 2 station number	Stores the station number of P2. 999: Not used

■Port 2 transient transmission group number

Address	Name	Description
U3E0\G10395	Port 2 transient transmission group number	Stores the transient transmission group number of P2. 999: Not used

■Port 2 own node IP address

Address	Name	Description
U3E0\G10396	Port 2 own node IP address	Stores all 0 which indicates that the own node IP address of P2 is the same as the own node IP address of P1.
U3E0\G10397		

■Port 2 MAC address

Address	Name	Description
U3E0\G10406	Port 2 MAC address (5th byte, 6th byte)	Stores all 0 which indicates that the MAC address of P2 is the same as the MAC address of P1.
U3E0\G10407	Port 2 MAC address (3rd byte, 4th byte)	
U3E0\G10408	Port 2 MAC address (1st byte, 2nd byte)	

■Port 2 communication speed setting

Address	Name	Description
U3E0\G10409	Port 2 communication speed setting	Stores the communication speed setting for P2. 1: 100Mbps 2: 1Gbps 255: Not connected

■Port 3 network type

Address	Name	Description
U3E0\G10430	Port 3 network type	Stores the network type of P3. 0: Ethernet

Synchronization refresh function

■Synchronous communication received data transfer status (Module No.1) to Synchronous communication received data transfer status (Module No.256)

Address	Name	Description
U3E0\G10451 to U3E0\G10706	Synchronous communication received data transfer status (Module No.1) to Synchronous communication received data transfer status (Module No.256)	Stores the status of transferring the received data to a device/label during refreshing that is synchronous to the communication cycle of the network. 0: Not stopped (including no setting) 1: Stopped

■Restart transfer of synchronous communication received data (Module No.1) to Restart transfer of synchronous communication received data (No.256)

Address	Name	Description
U3E0\G10708 to U3E0\G10963	Restart transfer of synchronous communication received data (Module No.1) to Restart transfer of synchronous communication received data (No.256)	Restarts the transfer of received data to a device/label during refreshing that is synchronous to the communication cycle of the network. 0: Restart accepted 1: Restart request

Ethernet function

■OPC UA server function operation status

Address	Name	Description
U3E0\G11400	OPC UA server function operation status	Stores the operation status of the OPC UA server function. 0: Startup processing in progress 1: Started 2: Stop processing in progress 3: Stopped

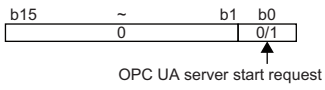
■Number of client connections

Address	Name	Description
U3E0\G11401	Number of client connections	Stores the number of OPC UA clients connected to the OPC UA server function.

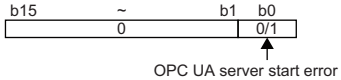
■Number of subscriptions

Address	Name	Description
U3E0\G11402	Number of subscriptions	Stores the number of subscriptions created by the OPC UA server function.

■OPC UA server start request

Address	Name	Description
U3E0\G11403	OPC UA server start request	Starts up the OPC UA server in accordance with the settings of the module parameter when this buffer memory changes from off to on. Once the OPC UA server start request is completed, regardless of whether it is successful or failed, this buffer memory turns off. 

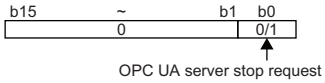
■OPC UA server start error

Address	Name	Description
U3E0\G11404	OPC UA server start error	Turns on when the OPC UA server start request or the startup processing fails. Turns off when the start request is completed successfully. 

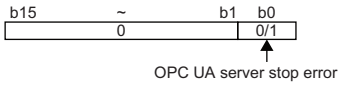
■OPC UA server start error cause

Address	Name	Description
U3E0\G11405	OPC UA server start error cause	Stores the error cause that occurred when the OPC UA server start was requested. (Linked with OPC UA server start error (U3E0\G11404)) 0:No error Other than 0: For the values stored when an error occurs, refer to the list of error codes. (☞ Page 1776 ERROR CODES)

■OPC UA server stop request

Address	Name	Description
U3E0\G11406	OPC UA server stop request	Stops the OPC UA server when this buffer memory changes from off to on. Once the OPC UA server stop request is completed, regardless of whether it is successful or failed, this buffer memory turns off. 

■OPC UA server stop error

Address	Name	Description
U3E0\G11407	OPC UA server stop error	Turns on when the OPC UA server stop request fails, and turns off when it succeeds. 

■OPC UA server stop error cause

Address	Name	Description
U3E0\G11408	OPC UA server stop error cause	Stores the error cause that occurred when the OPC UA server stop was requested. (Linked with OPC UA server stop error (U3E0\G11407)) 0:No error Other than 0: For the values stored when an error occurs, refer to the list of error codes. (☞ Page 1776 ERROR CODES)

■Number of defined nodes

Address	Name	Description
U3E0\G11409	Number of defined nodes	Stores the number of nodes defined by the OPC UA server function.

■Address space capacity

Address	Name	Description
U3E0\G11410	Address space capacity lower digits (in K bytes)	Stores the address space capacity in increments of 1K byte.
U3E0\G11411	Address space capacity upper digits (in K bytes)	

■Free address space

Address	Name	Description
U3E0\G11412	Free address space lower digits (in K bytes)	Stores the free address space in increments of 1K byte.
U3E0\G11413	Free address space upper digits (in K bytes)	

Details of buffer memory addresses (CC-Link IE TSN function part)

This section describes the details of buffer memory addresses of the CC-Link IE TSN function part.

Link device area

The RX, RY, RWw, RWr, LB, LW, SB, and SW values are stored.

■Remote input (RX) (Un\G57344 to Un\G58367)

The RX value is stored. The RX start number and number of points for each station number can be checked by the RX offset/size information (Un\G1245696 to Un\G1246719). (☞ Page 2064 RX offset/size information)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G57344	RX F	RX E	RX D	RX C	RX B	RX A	RX 9	RX 8	RX 7	RX 6	RX 5	RX 4	RX 3	RX 2	RX 1	RX 0
⋮																
Un\G58367	RX 3FFF	RX 3FFE	RX 3FFD	RX 3FFC	RX 3FFB	RX 3FFA	RX 3FF9	RX 3FF8	RX 3FF7	RX 3FF6	RX 3FF5	RX 3FF4	RX 3FF3	RX 3FF2	RX 3FF1	RX 3FF0

Each bit corresponds to 1 bit of RX.

■Remote output (RY) (Un\G58368 to Un\G59391)

The RY value is stored. The RY start number and number of points for each station number can be checked by the RY offset/size information (Un\G1246720 to Un\G1247743). (☞ Page 2064 RY offset/size information)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G58368	RY F	RY E	RY D	RY C	RY B	RY A	RY 9	RY 8	RY 7	RY 6	RY 5	RY 4	RY 3	RY 2	RY 1	RY 0
⋮																
Un\G59391	RY 3FFF	RY 3FFE	RY 3FFD	RY 3FFC	RY 3FFB	RY 3FFA	RY 3FF9	RY 3FF8	RY 3FF7	RY 3FF6	RY 3FF5	RY 3FF4	RY 3FF3	RY 3FF2	RY 3FF1	RY 3FF0

Each bit corresponds to 1 bit of RY.

■Remote register (RWw) (Un\G59392 to Un\G67583)

The RWw value is stored. The RWw start number and number of points for each station number can be checked by the RWw offset/size information (Un\G1247744 to Un\G1248767). (☞ Page 2064 RWw offset/size information)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G59392	RWw0															
Un\G59393	RWw1															
⋮																
Un\G67583	RWw1FFF															

■Remote register (RWr) (Un\G67584 to Un\G75775)

The RWr value is stored. The RWr start number and number of points for each station number can be checked by the RWr offset/size information (Un\G1248768 to Un\G1249791). (☞ Page 2065 RWr offset/size information)

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G67584	RWr0															
Un\G67585	RWr1															
⋮																
Un\G75775	RWr1FFF															

■Link special relay (SB) (Un\G94208 to Un\G94463)

The SB value is stored.

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G94208	SBF	SBE	SBD	SBC	SBB	SBA	SB9	SB8	SB7	SB6	SB5	SB4	SB3	SB2	SB1	SB0
⋮																
Un\G94463	SB1FF	SB1FE	SB1FD	SB1FC	SB1FB	SB1FA	SB1F9	SB1F8	SB1F7	SB1F6	SB1F5	SB1F4	SB1F3	SB1F2	SB1F1	SB1F0

Each bit corresponds to 1 bit of SB.

■Link special register (SW) (Un\G94464 to Un\G98559)

The SW value is stored.

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G94464	SW0															
Un\G94465	SW1															
⋮																
Un\G98559	SW0FFF															

Timeslot information

■Timeslot 0 information (Un\G1245440 to Un\G1245454)

Cycle start offset (ns, s unit) and cycle end offset (ns, s unit) of timeslot 0 are stored.

Address	Name	Description
Un\G1245440 to Un\G1245441	Cycle start offset (ns unit)	The ns digits of cycle start offset are stored. Stored range: 0 to 999999999 (ns)
Un\G1245442	Cycle start offset (s unit)	The s digits of cycle start offset are stored. Stored range: 0 to 65535 (s)
Un\G1245444 to Un\G1245445	Cycle end offset (ns unit)	The ns digits of cycle end offset are stored. Stored range: 0 to 999999999 (ns)
Un\G1245446	Cycle end offset (s unit)	The s digits of cycle end offset are stored. Stored range: 0 to 65535 (s)
Un\G1245452	VID (VLAN Identifier)	Stores the VID of Timeslot 0. Storage range: 1 to 4094, 65535 (Do not use VID or do not judge frames to be relayed from VID.)
Un\G1245453	PCP (Priotiy Code Point)	Stores the PCP of Timeslot 0. Storage range: 0 to 7, 65535 (Do not use PCP or do not judge frames to be relayed from PCP.)
Un\G1245454	EtherType	Stores the EtherType of the frame to be relayed in Timeslot 0. Storage range: EtherType value of the frame to be relayed, 65535 (Do not judge frames to be relayed from EtherType.) Timeslot 0 stores 65535.

■Timeslot 1 to 7 information (Un\G1245456 to Un\G1245567)

Timeslot 1 to 7 information is stored in the same order as Timeslot 0 information.

RX offset/size information

■RX offset/size information (Un\G1245696 to Un\G1246711)

The start number and the number of points of RX for each station are stored.

Address	Description
Un\G1245696 to Un\G1245697	Station No.0 RX offset
Un\G1245698 to Un\G1245699	Station No.0 RX size (in units of words)
Un\G1245700 to Un\G1245701	Station No.1 RX offset
Un\G1245702 to Un\G1245703	Station No.1 RX size (in units of words)
⋮	
Un\G1246708 to Un\G1246709	Station No.253 RX offset
Un\G1246710 to Un\G1246711	Station No.253 RX size (in units of words)

The buffer memory address for the offset and size of each station number can be calculated using the following formulas:

- Offset buffer memory address = 1245696 + (station No.) × 4
- Size buffer memory address = 1245698 + (station No.) × 4

RY offset/size information

■RY offset/size information (Un\G1246720 to Un\G1247735)

The start number and the number of points of RY for each station are stored.

Address	Description
Un\G1246720 to Un\G1246721	Station No.0 RY offset
Un\G1246722 to Un\G1246723	Station No.0 RY size (in units of words)
Un\G1246724 to Un\G1246725	Station No.1 RY offset
Un\G1246726 to Un\G1246727	Station No.1 RY size (in units of words)
⋮	
Un\G1247732 to Un\G1247733	Station No.253 RY offset
Un\G1247734 to Un\G1247735	Station No.253 RY size (in units of words)

The buffer memory address for the offset and size of each station number can be calculated using the following formulas:

- Offset buffer memory address = 1246720 + (station No.) × 4
- Size buffer memory address = 1246722 + (station No.) × 4

RWw offset/size information

■RWw offset/size information (Un\G1247744 to Un\G1248759)

The start number and the number of points of RWw for each station are stored.

Address	Description
Un\G1247744 to Un\G1247745	Station No.0 RWw offset
Un\G1247746 to Un\G1247747	Station No.0 RWw size (in units of words)
Un\G1247748 to Un\G1247749	Station No.1 RWw offset
Un\G1247750 to Un\G1247751	Station No.1 RWw size (in units of words)
⋮	
Un\G1248756 to Un\G1248757	Station No.253 RWw offset
Un\G1248758 to Un\G1248759	Station No.253 RWw size (in units of words)

The buffer memory address for the offset and size of each station number can be calculated using the following formulas:

- Offset buffer memory address = 1247744 + (station No.) × 4
- Size buffer memory address = 1247746 + (station No.) × 4

RWr offset/size information

■RWr offset/size information (Un\G1248768 to Un\G1249783)

The start number and the number of points of RWr for each station are stored.

Address	Description
Un\G1248768 to Un\G1248769	Station No.0 RWr offset
Un\G1248770 to Un\G1248771	Station No.0 RWr size (in units of words)
Un\G1248772 to Un\G1248773	Station No.1 RWr offset
Un\G1248774 to Un\G1248775	Station No.1 RWr size (in units of words)
⋮	
Un\G1249780 to Un\G1249781	Station No.253 RWr offset
Un\G1249782 to Un\G1249783	Station No.253 RWr size (in units of words)

The buffer memory address for the offset and size of each station number can be calculated using the following formulas:

- Offset buffer memory address = 1248768 + (station No.) × 4
- Size buffer memory address = 1248770 + (station No.) × 4

Own station information

The information of the own station on the network is stored.

■Own station (network card) information (Un\G1252096 to Un\G1252103)

Address	Name	Description
Un\G1252096	Manufacturer code	The information of the own station is stored. (Updated even if set as an error invalid station.) (Updated even if set as a reserved station.)
Un\G1252097	Model type	
Un\G1252098	Model code (lower 2 bytes)	
Un\G1252099	Model code (upper 2 bytes)	
Un\G1252100	Version	
Un\G1252101 to Un\G1252103	MAC address	The own station MAC address is stored. Un\G1252101: 5th byte, 6th byte of the MAC address Un\G1252102: 3rd byte, 4th byte of the MAC address Un\G1252103: 1st byte, 2nd byte of the MAC address

■Own station (controller) information (Un\G1252104 to Un\G1252121)

Address	Name	Description
Un\G1252104	Controller information valid/invalid flag	Whether the value stored in the own station (controller) information is valid or invalid is stored. 0: Invalid
Un\G1252105	Manufacturer code	The information of the own station is stored.
Un\G1252106	Model type	
Un\G1252107	Model code (lower 2 bytes)	
Un\G1252108	Model code (upper 2 bytes)	
Un\G1252109	Version	
Un\G1252110 to Un\G1252119	Model name string	
Un\G1252120 to Un\G1252121	Vendor-specific device information	

Communication path determination status

■Communication path determination status (Un\G1260544 to Un\G1260559)

The determination information on the communication path for each network number of the destination station is stored.

- 0: Path undetermined
- 1: Path determined

Address	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Un\G1260544	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
⋮																
Un\G1260558	Empty	239	238	237	236	235	234	233	232	231	230	229	228	227	226	225
Un\G1260559	Empty															

The numbers in the table indicate network numbers.

Time synchronization

■Time distribution interval setting of the controller (Un\G1275136)

Set the interval at which the controller time is distributed from the master station to the device station.

When the setting is changed, the new setting value is enabled after the interval of the distribution operating with the old setting value has elapsed. The setting value is distributed once after the distribution interval elapses. If the new setting value needs to be enabled immediately, stop the distribution and set the value.

- 0000H: 10s
- 0001H to FFFEH: (Send using the set time interval (second))
- FFFFH: (Distribution stop)

(Default: 0000H)

Grandmaster information

The grandmaster status of the own station and MAC address are stored.

■Grandmaster (Un\G1275904)

When the own station is the grandmaster, "1" is stored.

- 1: Own station is the grandmaster
- 0: Another station is the grandmaster

■Grandmaster MAC address (Un\G1275907 to Un\G1275909)

The grandmaster MAC address is stored.

- Un\G1275907: 5th byte, 6th byte of the MAC address
- Un\G1275908: 3rd byte, 4th byte of the MAC address
- Un\G1275909: 1st byte, 2nd byte of the MAC address

Time synchronization setting

■PTP frame send source check enable/disable (Un\G1275933)

- 0: Do not check
- 1: Check

■PTP frame send source check result (P1) (Un\G1275934)

- 0: One send source
- 1: Two or more send sources

■PTP frame send source check result (P2) (Un\G1275935)

- 0: One send source
- 1: Two or more send sources

Cyclic data send/receive assurance information

■Multiple cycle setting (low speed) (Un\G1277442)

The calculation value of the multiple cycle setting (low speed) that ensures the cyclic data communications (send/receive) is stored.

- 0: Calculation not performed
- 16, 32, 64, 128: "Low-Speed" cycle for a basic period [times]

The calculation value is stored in the following cases.

- There is a device station with "Communication Period Setting" set to "Low-Speed" and with "CC-Link IE TSN Class A" selected in the "CC-Link IE TSN Configuration" window.
- The error code 3A60H or 1854H occurs.

■Communication cycle interval (calculation value) (Un\G1277443)

The calculation value of the communication cycle interval that ensures the cyclic data communications (send/receive) is stored.

- 0: Calculation not performed
- 125 to 10000: Communication cycle interval [μs]

The calculation value is stored in the following cases.

- There is a device station with "Communication Period Setting" set to "Low-Speed" and with "CC-Link IE TSN Class A" selected in the "CC-Link IE TSN Configuration" window.
- The error code 3A60H or 1854H occurs.

PDO information

■PDO information (Un\G1277648 to Un\G1293839)

Address	Name		Description
Un\G1277648 to Un\G1277649	Multidrop No.0 of the station No.1	Start offset of link device using RPDO	The link device start offset using RPDO is stored. (Master station: RWw)
Un\G1277650 to Un\G1277651		RPDO size	The RPDO size is stored in units of words.
Un\G1277652 to Un\G1277653		Start offset of link device using TPDO	The link device start offset using TPDO is stored. (Master station: RWr)
Un\G1277654 to Un\G1277655		TPDO size	The TPDO size is stored in units of words.
⋮			
Un\G1277704 to Un\G1277705	Multidrop No.7 of the station No.1	Start offset of link device using RPDO	The link device start offset using RPDO is stored. (Master station: RWw)
Un\G1277706 to Un\G1277707		RPDO size	The RPDO size is stored in units of words.
Un\G1277708 to Un\G1277709		Start offset of link device using TPDO	The link device start offset using TPDO is stored. (Master station: RWr)
Un\G1277710 to Un\G1277711		TPDO size	The TPDO size is stored in units of words.
⋮			
Un\G1293776 to Un\G1293777	Multidrop No.0 of the station No.253	Start offset of link device using RPDO	The link device start offset using RPDO is stored. (Master station: RWw)
Un\G1293778 to Un\G1293779		RPDO size	The RPDO size is stored in units of words.
Un\G1293780 to Un\G1293781		Start offset of link device using TPDO	The link device start offset using TPDO is stored. (Master station: RWr)
Un\G1293782 to Un\G1293783		TPDO size	The TPDO size is stored in units of words.
⋮			
Un\G1293832 to Un\G1293833	Multidrop No.7 of the station No.253	Start offset of link device using RPDO	The link device start offset using RPDO is stored. (Master station: RWw)
Un\G1293834 to Un\G1293835		RPDO size	The RPDO size is stored in units of words.
Un\G1293836 to Un\G1293837		Start offset of link device using TPDO	The link device start offset using TPDO is stored. (Master station: RWr)
Un\G1293838 to Un\G1293839		TPDO size	The TPDO size is stored in units of words.

Protocol information

■Protocol information (Un\G1294016 to Un\G1294021)

Address	Name	Description
Un\G1294016	Protocol operating status	Stores the operating status of the protocol. 0: Operating protocol not determined or "CC-Link IE TSN Class Setting" is set to "CC-Link IE TSN Class B Only" 1: Operating with the protocol version 1.0 2: Operating with the protocol version 2.0
Un\G1294017	Write request	Write the protocol setting to the module. 0: Do not write 1: Write
Un\G1294018	Protocol setting	Set the operating protocol. 0: Automatic setting 1: Protocol version 1.0 fixed 2: Protocol version 2.0 fixed
Un\G1294019	Write implementation status	Stores the implementation status of writing to the module. 0: Writing not executed, or in progress 1: Writing completed
Un\G1294020	Setting result	Stores the setting result. 0: Completed successfully Other than 0: Completed with an error (error code)
Un\G1294021	Protocol setting status	Stores the protocol settings held by the module. 0: Automatic setting*1 1: Protocol version 1.0 fixed 2: Protocol version 2.0 fixed

*1 Set to 0 by factory default

Timeslot information for device station cyclic transmission

■Timeslot information for device station cyclic transmission (Un\G1294048 to Un\G1294300)

Address	Name	Description
Un\G1294048	Timeslot for station number 1 cyclic transmission	Stores the Timeslot for cyclic transmission of station number 1. 0: Undetermined 1: Timeslot 1 3: Timeslot 3 4: Timeslot 4 5: Timeslot 5 6: Timeslot 6
⋮		
Un\G1294300	Timeslot for station number 253 cyclic transmission	Stores the timeslot for cyclic transmission of station number 253. 0: Undetermined 1: Timeslot 1 3: Timeslot 3 4: Timeslot 4 5: Timeslot 5 6: Timeslot 6

Information for device station cyclic transmission

■CC-Link IE TSN Class A (low speed) multiple (Un\G1294304)

The multiple n, used when calculating transmission delay time of the device station with "CC-Link IE TSN Class" set to "CC-Link IE TSN Class A" and "Communication Period Setting" set to "Low-Speed" in the "CC-Link IE TSN Configuration" window, is stored. (☞ Page 2111 Details of n by which communication cycle intervals are multiplied)

- 0: There is no device station set in the "CC-Link IE TSN Configuration" window with "CC-Link IE TSN Class A" and "Communication Period Setting" set to "Low-Speed".
- 1 or greater: Value of n (When 'Protocol operating status' (Un\G1294016) is '1: Operating with the protocol version 1.0', it is set to 1.)

■CC-Link IE TSN Class A group send information (CC-Link IE TSN protocol version 2.0) (Un\G1294368 to Un\G1294624)

This setting is enabled when 'Protocol operating status' (Un\G1294016) is '2: Operating with the protocol version 2.0'.
Even when operating with protocol version 1.0, the value when operating with protocol version 2.0 is stored.

Address	Name	Description
Un\G1294368	Station No.1 CC-Link IE TSN Class A group send number	The CC-Link IE TSN Class A group send number of station No.1 is stored. 0: Station No.1 is not a device station with CC-Link IE TSN Class A and "Communication Period Setting" set to "Low-Speed". 1 to CC-Link IE TSN Class A (low speed) multiple (Un\G1294304): CC-Link IE TSN Class A group send number
⋮		
Un\G1294620	Station No.253 CC-Link IE TSN Class A group send number	The CC-Link IE TSN Class A group send number of station No.253 is stored. 0: It is not a device station with CC-Link IE TSN Class A and "Communication Period Setting" set to "Low-Speed". 1 to CC-Link IE TSN Class A (low speed) multiple (Un\G1294304): CC-Link IE TSN Class A group send number
Un\G1294624	CC-Link IE TSN Class A group send number with maximum cyclic transmission time	During CC-Link IE TSN Class A group send, the CC-Link IE TSN Class A group send number that has the maximum cyclic transmission time among all groups is stored. 0: There is no device station with CC-Link IE TSN Class A and "Communication Period Setting" set to "Low-Speed". 1 to multiple of CC-Link IE TSN Class A (low speed) (Un\G1294304): CC-Link IE TSN Class A group send number with the maximum cyclic transmission time (CC-Link IE TSN Class A group send number used in the cyclic transmission time calculation formula)

Cyclic transmission distribution information

■Cyclic transmission distribution information (Un\G1294640 to Un\G1295152)

Address	Name	Description
Un\G1294640	Communication period setting for station No.1	Communication period setting for station No.1 (When "Cyclic Transmission Distribution Setting" is set to "Distribute" for one or more stations) • 0: Basic period • 1: Normal-speed • 2: Low-speed
Un\G1294641	Timing of cyclic transmission of station No.1	Timing of cyclic transmission of station No.1 (The value M of the Mth cycle in cycle n is stored.) 0: No device station setting (when "Cyclic Transmission Distribution Setting" is set to "Do not distribute" for all stations) 1 to the multiple specified in the medium speed/low speed setting in Multiple Period Setting: The timing of cyclic transmission The setting range for each communication cycle is as follows. • Basic period: 1 • Medium speed: Multiple specified in the medium speed setting of 1 to multiple cycle settings • Low speed: Multiple specified in the low speed setting of 1 to multiple cycle settings
⋮		
Un\G1295144	Communication period setting for station No.253	Communication period setting for station No.253 (When "Cyclic Transmission Distribution Setting" is set to "Distribute" for one or more stations) • 0: Basic period • 1: Normal-speed • 2: Low-speed
Un\G1295145	Timing of cyclic transmission of station No.253	Timing of cyclic transmission of station No.253 (Mth cycle in cycle n) 0: No device station setting ("Cyclic Transmission Distribution Setting" is set to "Do not distribute" for all stations.) 1 to the multiple specified in the medium speed/low speed setting in Multiple Period Setting: The timing of cyclic transmission The setting range for each communication cycle is as follows. • Basic period: 1 • Medium speed: Multiple specified in the medium speed setting of 1 to multiple cycle settings • Low speed: Multiple specified in the low speed setting of 1 to multiple cycle settings
Un\G1295152	Timing of cyclic transmission with maximum cyclic transmission time	Stores the cyclic transmission time at which the cyclic transmission time is the maximum in all communication cycles when cyclic transmission is distributed. 0: "Cyclic Transmission Distribution Setting" is set to "Do not distribute" for all stations. 1 to the multiple specified in the medium speed/low speed setting of Multiple Period Setting: Cyclic transmission timing at which the cyclic transmission time is the maximum in all communication cycles This cyclic transmission timing is applied the performance formula for cyclic transmission time.

Own node setting status storage area

■Own node IP address (Un\G2097156 to Un\G2097157)

The setting values of the IP address are stored.

Range: 1H to DFFFFFFEH

■Subnet mask (Un\G2097166 to Un\G2097167)

The setting values of the subnet mask are stored.

Range: 1H to FFFFFFFFH

0: No setting

■Default gateway IP address (Un\G2097170 to Un\G2097171)

The setting values of the default gateway are stored.

Range: 1H to DFFFFFFEH

0: No setting

■Own node MAC address (Un\G2097180 to Un\G2097182)

The own node MAC addresses are stored.

- Un\G2097180: 5th byte, 6th byte of the MAC address
- Un\G2097181: 3rd byte, 4th byte of the MAC address
- Un\G2097182: 1st byte, 2nd byte of the MAC address

■Own node network number (Un\G2097183)

The setting value of the network number is stored.

Range: 1 to 239

0: Network number not set

■Station number (Un\G2097184)

The setting value of the station number is stored.

FF7DH: Master station

■Transient transmission group No. (Un\G2097185)

The setting value of the transient transmission group number is stored.

0: No group specification

■Auto-open UDP port port number (Un\G2097189)

The port number used for the auto-open UDP port is stored.

■MELSOFT transmission port (TCP/IP) port number (Un\G2097190)

The port number used for the MELSOFT transmission port (TCP/IP) is stored.

■MELSOFT transmission port (UDP/IP) port number (Un\G2097191)

The port number for the MELSOFT transmission port (UDP/IP) is stored

■SLMP transmission port (TCP/IP) port number (Un\G2097193)

The port number used for the SLMP transmission port (TCP/IP) is stored.

■SLMP transmission port (UDP/IP) port number (Un\G2097194)

The port number used for the SLMP transmission port (UDP/IP) is stored.

■Network information setting status (CC-Link IE TSN) (Un\G2097195)

The setting information of "Station No./IP Address Setting Method" in the module parameters is stored.

0: Operation according to the parameter settings

System port latest error code storage area

■Auto-open UDP port latest error code (Un\G2098154, Un\G4195306)

The latest error code of the auto-open UDP port is stored.

■MELSOFT transmission port (UDP/IP) latest error code (Un\G2098155, Un\G4195307)

The latest error code of the MELSOFT transmission port (UDP/IP) is stored.

■SLMP transmission port (UDP/IP) latest error code (Un\G2098157, Un\G4195309)

The latest error code of the SLMP transmission port (UDP/IP) is stored.

■SLMPSND instruction latest error code (Un\G2098159, Un\G4195311)

The latest error code of the SLMPSND instruction is stored.

■MELSOFT transmission port (TCP/IP) latest error code (Un\G2098176 to Un\G2098183, Un\G4195328 to Un\G4195335)

The latest error code of the MELSOFT transmission port (TCP/IP) is stored.

■SLMP transmission port (TCP/IP) latest error code (Un\G2098304 to Un\G2098311, Un\G4195456 to Un\G4195463)

The latest error code of the SLMP transmission port (TCP/IP) is stored.

Connection monitoring timer information storage area

For system connection monitoring timer setting, refer to the following.

☞ Page 1586 Setting to Use or Not to Use Default Open Port

■MELSOFT transmission port (TCP/IP) (time) (Un\G2101104 to Un\G2101105)

The time set in the system connection monitoring timer setting is stored.

System connection monitoring timer setting is disabled: 0

System connection monitoring timer setting is enabled:

- When the unit is s: 1 to 16383s
- When the unit is ms: 100 to 16383000ms

■MELSOFT transmission port (TCP/IP) (unit (Un\G2101106)

The setting value of the unit (s, ms) in the system connection monitoring timer setting is stored.

System connection monitoring timer setting is disabled: 0

System connection monitoring timer setting is enabled:

- 0: s
- 1: ms

■SLMP transmission port (TCP/IP) (time) (Un\G2101108 to Un\G2101109)

The time set in the system connection monitoring timer setting is stored.

System connection monitoring timer setting is disabled: 0

System connection monitoring timer setting is enabled:

- When the unit is s: 1 to 16383s
- When the unit is ms: 100 to 16383000ms

■SLMP transmission port (TCP/IP) (unit) (Un\G2101110)

The setting value of the unit (s, ms) in the system connection monitoring timer setting is stored.

System connection monitoring timer setting is disabled: 0

System connection monitoring timer setting is enabled:

- 0: s
- 1: ms

Status for each protocol (IP packet)

■Received packet total count (Un\G2102152 to Un\G2102153, Un\G4199304 to Un\G4199305)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received packet checksum error discard count (Un\G2102154 to Un\G2102155, Un\G4199306 to Un\G4199307)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent packet total count (Un\G2102156 to Un\G2102157, Un\G4199308 to Un\G4199309)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Simultaneous transmission error detection count (receive buffer full count) (Un\G2102174 to Un\G2102175, Un\G4199326 to Un\G4199327)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Receive abort count (Un\G2102181, Un\G4199333)
The status is counted from 0 to 65535 (FFFFH).

Status for each protocol (ICMP packet)

■Received packet total count (Un\G2102192 to Un\G2102193, Un\G4199344 to Un\G4199345)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received packet checksum error discard count (Un\G2102194 to Un\G2102195, Un\G4199346 to Un\G4199347)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent packet total count (Un\G2102196 to Un\G2102197, Un\G4199348 to Un\G4199349)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received echo request total count (Un\G2102198 to Un\G2102199, Un\G4199350 to Un\G4199351)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent echo reply total count (Un\G2102200 to Un\G2102201, Un\G4199352 to Un\G4199353)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent echo request total count (Un\G2102202 to Un\G2102203, Un\G4199354 to Un\G4199355)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received echo reply total count (Un\G2102204 to Un\G2102205, Un\G4199356 to Un\G4199357)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

Status for each protocol (TCP packet)

■Received packet total count (Un\G2102232 to Un\G2102233, Un\G4199384 to Un\G4199385)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received packet checksum error discard count (Un\G2102234 to Un\G2102235, Un\G4199386 to Un\G4199387)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent packet total count (Un\G2102236 to Un\G2102237, Un\G4199388 to Un\G4199389)
The status is counted from 0 to 4294967295 (FFFFFFFFH).

Status for each protocol (UDP packet)

■Received packet total count (Un\G2102272 to Un\G2102273, Un\G4199424 to Un\G4199425)

The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Received packet checksum error discard count (Un\G2102274 to Un\G2102275, Un\G4199426 to Un\G4199427)

The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Sent packet total count (Un\G2102276 to Un\G2102277, Un\G4199428 to Un\G4199429)

The status is counted from 0 to 4294967295 (FFFFFFFFH).

Own node operation status storage area (LED on/off status)

■Own node operation status storage area (LED on/off status) (Un\G2102341)

ERR (software LED) (b0)

- 0: Off
- 1: On/flashing

Own node operation status storage area (connection information area)

■Communication mode (Un\G2102343, Un\G4199495)

- 0: Half-duplex/not connected
- 1: Full-duplex

■Connection status (Un\G2102344, Un\G4199496)

- 0: Not connected/disconnected
- 1: Connected

■Communication speed (Un\G2102345, Un\G4199497)

- 0: Not connected
- 1: Operating at 100BASE-TX
- 2: Operating at 1000BASE-T

■The number of disconnection (Un\G2102346, Un\G4199498)

The number of times the cable was disconnected is stored.

Own node operation status storage area (IP address duplication status storage area)

■IP address duplication flag (Un\G2102352)

- 0: IP address not duplicated
- 1: IP address duplicated

■MAC address of the station already connected to the network (Un\G2102353 to Un\G2102355)

It is stored in the station with duplicated IP address.

■MAC address of the station with the IP address already used (Un\G2102356 to Un\G2102358)

It is stored in the station that has been already connected to the network.

IP filter area

■IP filter blocking count (Un\G2108352 to Un\G2108353, Un\G4205504 to Un\G4205505)

The status is counted from 0 to 4294967295 (FFFFFFFFH).

■IP address format (Un\G2108354, Un\G4205506)

The format of the IP address that was most recently blocked is stored.

0: IPv4 format

■Latest blocked send source IP address (IPv4) (Un\G2108356 to Un\G2108357, Un\G4205508 to Un\G4205509)

The send source IP address that was most recently blocked is stored. (Range: 1H to FFFFFFFFH)

0: No blocked IP addresses

■Latest blocked target IP address (IPv4) (Un\G2108358 to Un\G2108359)

The target IP address that was most recently blocked is stored. (Range: 1H to FFFFFFFFH)

0: No blocked IP addresses

Connection monitoring timer information storage area

■System connection close (connection monitoring timer excess) count (Un\G2108416 to Un\G2108417)

The status is counted from 0 to 4294967295 (FFFFFFFFH).

■Latest disconnected system connection information (Un\G2108418)

The information of the system connection that was most recently disconnected is stored.

- 0: No disconnected connections
- 1: SLMP transmission port (TCP/IP) connection
- 2: MELSOFT transmission port (TCP/IP) connection

Network type information area (Network type information)

■Network type information area (Network type information) (Un\G2162687)

5: CC-Link IE TSN

Ethernet device individual error log (latest)

■Error code (Un\G3989847)

The latest error code is stored.

Ethernet P1/2 common information

■Initial status (Un\G6291480)

The initial processing status of the Ethernet connection is stored.

[b0]: Initial normal completion status

- 1: Initialization normal completion
- 0: —

[b1]: Initial abnormal completion status

- 1: Initialization abnormal completion
- 0: —

[b2 to b15]: Not used (Use prohibited)

■Initial error code (Un\G6291481)

The information when the initial processing is completed with an error is stored.

- 1 or more: Initialization abnormal code
- 0: In initial processing or initial normal completion

Receive buffer status storage area (Receive buffer status)

■Receive buffer status storage area (Receive buffer status) (Un\G6291486)

The receive buffer status is stored.

- 0: Receive buffer not full
- 1: Receive buffer full

Details of buffer memory addresses (motion function part)

Address	Name	Description
U(n+2)\G14032767.0	Accessibility to labels for motion function	Indicates that the label for the motion function can be accessed from the program or others. Off: Inaccessible On: Accessible

Appendix 11 Parameter List

This section lists parameters.

Point

For the parameters that are not described in this chapter, refer to the manuals for each module used.

System parameters

The following shows the list of system parameters.

Item			Parameter No.
I/O Assignment	Base/Power/Extension Cable Setting	Base No.	0201H
		Slots	
		Base	0203H
		Power Supply Module	
		Extension Cable	
	I/O Assignment Setting	Slot	0200H
		Module Name	
		Module Status Setting	
		Points	
		Start XY	
		Controller Operation Setting at Error Detection	3600H
	Setting of Points Occupied by Empty Slot	Points Occupied by Empty Slot	0100H

CPU parameters

The following shows the list of CPU parameters.

Item			Parameter No.	Reference
Name Setting	Title Setting	Title	3100H	—
	Comment Setting	Comment	3101H	
Operation Related Setting	Timer Limit Setting	Low Speed Timer/Low Speed Retentive Timer	3200H	Page 359 Timer limit setting
		High Speed Timer/High Speed Retentive Timer		
		Long Timer/Long Retentive Timer		
	RUN-PAUSE Contact Setting	RUN	3201H	Page 1609 Setting RUN-PAUSE Contacts
		PAUSE		
	Remote Reset Setting	Remote Reset	3202H	Page 1610 Remote reset setting
	Output Mode Setting at STOP to RUN	Output Mode at STOP to RUN	3203H	Page 281 Output mode at operating status change (STOP to RUN)
	Module Synchronous Setting	Module Rising	3207H	—
	Clock Related Setting	Time Zone	3209H	Page 1940 Setting time zone
		Comment		—
		Setting to Adjust Clock for Daylight Saving Time		Page 1941 Setting to Adjust Clock for Daylight Saving Time
Interrupt Settings	Fixed Scan Interval Setting	Interrupt Setting from Internal Timer	3A00H	Page 268 Fixed Scan Interval Setting
	Fixed Scan Execution Mode Setting	Fixed Scan Execution Mode		Page 250 Fixed scan execution mode setting
	Save/Recover Setting for Index Register	Index Register (Z/LZ)		Page 270 Save/Recover Setting for Index Register
	Block No. Save/Recovery Setting	File Register (R) Block No. of Basic Core		Page 269 Block No. Save/Recovery Setting
	Interrupt Priority Setting		3A01H	Page 275 Interrupt Priority Setting
Service Processing Setting	Device/Label Access Service Processing Setting	Specifying Method	3B00H	Page 226 Device/label access service processing setting
		Setting for Constant Wait of Service Processing	3B01H	
File Setting	File Register Setting	Use Or Not Setting	3300H	Page 381 File register setting
	Initial Value Setting	Target Memory	3301H	Page 427 Initial value setting
		Setting of Device Initial Value Use Or Not		
		Global Device Initial Value File Name		
	Device/Label Initial Value Reflection Setting	Device/Label Initial Value Reflection Setting at STOP to RUN	3302H	
	File Setting for Device Data Storage	Use Or Not Setting	3303H	MELSEC MX Controller MX-R Model Programming Manual
Memory/Device Setting	Device/Label Memory Area Setting	Device/Label Memory Area Capacity Setting	3400H	Page 320 Device/label memory area setting
		Device/Label Memory Area Detailed Setting	3400H 3401H 3405H 3407H 3408H	
	Index Register Setting	Points Setting	3402H	Page 377 Index register setting
		Local Setting		
	Refresh Memory Setting	Total Points	3403H	Page 383 Refresh memory setting
	Device/Label Latch Interval Setting	Latch Interval Operation Setting	3406H	Page 420 Device/label latch interval setting
	Pointer Setting	Global Pointer Start	340BH	Page 387 Pointer setting
		Total Points		
	Internal Buffer Capacity Setting	Total Capacity	340AH	Page 1501 Internal buffer capacity setting

Item			Parameter No.	Reference
RAS Setting	Scan Time Monitoring Time (WDT) Setting	Initial Scan	3500H	Page 1743 Scan Time Monitoring Time (WDT) Setting
		After 2nd Scan		
	Constant Scan Setting	Constant Scan	3503H	Page 224 Constant scan setting
	Error Detection Setting	Battery Error	3501H	Page 1746 Error detection setting
		Module Verification Error		
		Fuse Blown		
		Synchronous Interrupt Program (Network Communication Period Synchronization) Executing Time Excessive		
	Controller Operation Setting at Error Detection	Instruction Execution Error	3501H	Page 1747 Controller Operation Setting at Error Detection
		Network/Motion Function Error		
		Memory Card Error		
		Module Verification Error		
		Fuse Blown		
		Synchronous Interrupt Execution Interval Error (Controller)		
	LED Display Setting	ERROR LED	3502H	Page 1750 LED display setting
		USER LED		
	Event History Setting	Save Destination	3507H*1	Page 1755 Event history setting
		Storage Capacity Setting per File		
		Save Setting of Device/Label Operations	3507H	
		Storage Capacity Setting for Motion Control Event		
		Filter Setting		
		Check Falsification	3507H	
		Execute Order		
		Program Name		
		Execution Type	3700H*2	
		Interrupt Priority	3505H	
		Execution Core Setting	3504H	
		Refresh Group Setting	3700H	
		Device/File Use or not		
		Fixed Scan Interval	3700H	
		Trigger Type	3701H	
		ON of Bit Data (TRUE)		
		Passing Time		
		Network Communication Period Synchronization		
	FB/FUN File Setting		3702H	—
Routing Setting	Routing Setting		3800H	Page 1255 Routing setting
Advanced Setting	Core Setting	Basic Core	3D00H	—
		Extended Core 1		
		Extended Core 2		
		Extended Core 3		

*1 When Save Setting of Device/Label Operations is set to "Not to Save", the value is 3504H.

*2 When the execution type is "Event", the value is 3701H.

Module parameters

The following shows the lists of module parameters.

Common setting

The following shows a list of module parameters related to the module operation mode and security.

Item			Parameter No.	Reference
Module Operation Mode	Module Operation Mode		7100H A10DH	Page 1769 Module Operation Mode
Security	Setting to Use or Not to Use Default Open Port To Set or Not to Use Default Open Port		A01EH	Page 1586 Setting to Use or Not to Use Default Open Port
	Setting to Use or Not to Use Default Open Port CC-Link IE TSN	CC-Link IE TSN Connection		
		Auto-open UDP Port		
		MELSOFT Transmission Port (UDP/IP)		
		MELSOFT Transmission Port (TCP/IP)		
		CPU Module Search		
		SLMP Transmission Port (UDP/IP)		
		SLMP Transmission Port (TCP/IP)		
	Setting to Use or Not to Use Default Open Port Ethernet	MELSOFT Transmission Port (UDP/IP)		
		Auto-open UDP Port		
		MELSOFT Transmission Port (TCP/IP)		
		MELSOFT Direct Connection Port		
		CPU Module Search		

CC-Link IE TSN

The following shows a list of module parameters related to CC-Link IE TSN.

Item					Parameter No.	Reference
Required Settings	Station Type		Station Type		7100H 7700H	Page 144 Station Type
	Network No.		Network No.		7100H	Page 145 Network No.
	Parameter Setting Method		Setting Method of Basic/Application Settings		7100H	Page 145 Parameter Setting Method
	Station No./IP Address Setting		Station No./IP Address Setting Method		7100H	Page 146 Station No./IP Address Setting
			Station No.			
			IP Address Setting		A012H A013H	
Basic Settings	Network Configuration Settings (CC-Link IE TSN Configuration)	Total No. of Stations			A100H	Page 153 "CC-Link IE TSN Configuration" Window (Network Configuration Settings)
		Total number of modules			A10BH	
		Number of extension modules per main module				
		Detailed Setting	STA#		A104H	
			Station Type			
			RX Setting		A101H A10BH	
			RY Setting			
			RWr Setting			
			RWw Setting			
			LB Setting			
			LW Setting			
			Parameter Automatic Setting		A104H	
			PDO Mapping Setting		A109H	
			IP Address		A105H	
			Subnet Mask		A105H	
			Default Gateway			
			Reserved Station		A001H	
			Error Invalid Station		A002H	
			Network Synchronous Communication		A045H	
			Communication Period Setting		A108H	
			Station Information	Alias	A011H	
				Comment	A011H	
				Station-specific mode setting	A106H	
			CC-Link IE TSN Class		A104H	
			Cyclic Transmission Distribution Setting		A108H	
	Refresh Settings				7401H	Page 1236 Link Refresh
	Network Topology				A100H	Page 147 Network Topology
	Communication Period Setting		Basic Period Setting		A100H	Page 287 Basic period setting
			Multiple Period Setting		A108H	Page 293 Multiple period setting
	Connection Device Information		CC-Link IE TSN Class Setting		A100H	Page 148 Connection Device Information
			CC-Link IE TSN Class A Group Send Upper Limit Size Setting			
			TSN HUB Setting			
	Device Station Setting		Disconnection Detection Setting		A100H	Page 150 Device Station Setting

Item				Parameter No.	Reference
Application Settings	Communication Speed	Communication Speed		7100H	Page 152 Communication Speed
	Supplementary Cyclic Settings	Station-based Block Data Assurance		A100H	Page 1246 Station-based block data assurance
		I/O Maintenance Settings	Output Hold/Clear Setting during Controller STOP	A110H	Page 1247 I/O Maintenance Settings
			Data Link Error Station Setting		
			Output Mode Setting upon Controller Error	7101H	
	Transient Transmission Group No.			A010H	—
	Communication Mode Setting	Communication Mode		A110H	Page 152 Communication Mode Setting
	Parameter Name			7310H 7311H	Page 152 Parameter Name
	Dynamic Routing			A110H	Page 1255 Dynamic routing setting
	Event Reception from Other Stations			A016H	Page 1757 Event Reception from Other Stations
	Security	IP Filter Settings		A03AH	Page 1582 IP Filter Function
	LED Display Setting	Dot Matrix LED/ERR LED		A111H	Page 1770 LED display setting

Ethernet

The following shows a list of module parameters related to Ethernet.

Item			Parameter No.	Reference
Required Settings	IP Address Setting Method		7100H	Page 1432 IP Address Setting Method
	IP Address Setting	IP Address	A012H	Page 190 IP Address Setting
		Subnet Mask	A012H	
		Default Gateway	A013H	
Basic Settings	Transmission Setting	Opening Method	A030H	Page 191 Transmission Setting
	External Device Configuration		A031H A032H	Page 194 "Ethernet Configuration" Window (External Device Configuration Setting)
Application Settings	FTP Server Settings	FTP Server	A037H	Page 1347 FTP server settings
		To Use or Not to Use User Authentication		
		Login Name		
		Advanced Settings		
	FTP Client Settings	To Use or Not to Use FTP Client Settings	A03DH	Page 1375 FTP client settings
		FTP Server Specification		
		Login Name		
		Password		
		Connection Method		
		Port No.		
		To Use or Not to Use Encrypted Communication		
	DNS Settings	To Use or Not to Use DNS Server Settings	A03EH	Page 1437 DNS settings
		DNS Server 1 Address		
		DNS Server 2 Address		
	Web Server Settings	To Use or Not to Use Web Server Settings	A035H	Page 1384 Web server settings
		To Use or Not to Use User Authentication		
		Protocol		
		Host Station Port No.		
		Account Settings		
	Simple CPU Communication Setting	To Use or Not to Use Simple CPU Communication	7A10H	Page 193 Simple CPU Communication Setting
		Simple CPU Communication Setting		
	Time Setting	Time Setting (SNTP Client)	A039H	Page 1938 Time Setting (SNTP Client)
		Specify SNTP Server		
		Timer Setting After Power-on and Reset		
		Execution Timing		
	Timer Settings for Data Communication	Change/Set Timer Value	A038H	Page 1771 Timer settings for data communication
		Destination Alive Check Start Interval Timer		
		Destination Alive Check Interval Timer		
		Destination Alive Check Resend Count		
		Advanced Settings		
	Security	IP Filter Settings	A03AH	Page 1582 IP Filter Function
		Band Area Limit Setting	A0E7H	Page 1589 Bandwidth limit settings
		Encrypted Communication Setting	A01DH	Page 1575 Version setting for encrypted communication
	Gateway Parameter Settings	Gateway Other Than Default Gateway	A013H	Page 193 Gateway Parameter Settings
		Gateway Information		
	IP Packet Transfer Setting	IP Packet Transfer Function	A030H	Page 193 IP Packet Transfer Setting
	OPC UA Server Settings	To Use or Not to Use OPC UA Server Settings	7A50H	Page 1416 OPC UA Server Settings
		Polling Cycle		
		Security Parameter		

Memory card parameters

The following is the list of memory card parameters.

Item		Parameter No.	Reference
Boot Setting	Operation Setting at CPU Built-in Memory Boot	2001H	Page 326 Boot setting
	Boot File Setting		
Setting of File/Data Use or Not in Memory Card	Module Extended Parameter	2010H	—
	Device Station Parameter		

Appendix 12 Processing Time of CPU Function Part

The controller sequence scan time is the total of the following.

- Program execution time (instruction processing time + extension time)
- END processing time (including I/O refresh time) (☞ Page 2088 END processing time)
- END processing extension time (☞ Page 2096 END processing extension time)
- Execution time of used functions (☞ Page 2100 Execution time of data logging function, ☞ Page 2106 Real-time monitor execution time, ☞ Page 2107 File operation execution time)

Program execution time

In addition to instruction processing time, extension time occurs when multiple programs, interrupt programs or fixed-cycle execution type programs, and multiple program blocks are executed.

Instruction processing time

The instruction processing time is the total of each instruction processing time used for the controller program. For the processing time for each instruction, refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Point

Processing is optimized according to the program, so use the instruction processing time value as a guide.

Processing time when multiple programs are executed (program switching time)

When multiple programs are executed, the scan time becomes longer.

■When multiple programs run

The processing time [μs] with multiple programs run is given by: the number of program files × KM1.

Constant	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1	0.6	0.4

Overhead time at execution of interrupt or fixed scan execution type program

When executing the interrupt program or fixed scan execution type program, overhead time is required, resulting in extension time.

Point

The instruction processing time for the interrupt program and fixed scan execution type program is as shown below.

Instruction processing time for each instruction + Overhead time + Each refresh processing time (when setting)

■Interrupt program overhead time

Interrupt program overhead time includes the overhead time before starting the interrupt program and overhead time when the interrupt program is finished.

• Overhead time before executing the interrupt program

Interrupt factor	Index register and file register (R) block number conditions	Overhead time	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Internal timer interrupt (I28 to I31)	Save/Recover	7.7μs	6.4μs
	Not Saved/Recovered	7.6μs	6.1μs
High-speed internal timer interrupt 2 (I48), High-speed internal timer interrupt 1 (I49)	Save/Recover	7.6μs	6.6μs
	Not Saved/Recovered	6.2μs	6.0μs
Interrupt from module (I0 to I15, I50 to I1023)	Save/Recover	8.5μs	7.5μs
	Not Saved/Recovered	8.4μs	7.1μs

• Overhead time when finishing the interrupt program

Interrupt factor	Index register and file register (R) block number conditions	Overhead time	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Internal timer interrupt (I28 to I31)	Save/Recover	4.3μs	3.2μs
	Not Saved/Recovered	3.5μs	2.7μs
High-speed internal timer interrupt 2 (I48), high-speed internal timer interrupt 1 (I49)	Save/Recover	4.3μs	3.2μs
	Not Saved/Recovered	3.5μs	2.7μs
Interrupt from module (I0 to I15, I50 to I1023)	Save/Recover	4.7μs	3.7μs
	Not Saved/Recovered	3.8μs	3.1μs

■Overhead time of fixed scan execution type program

Index register and file register (R) block number conditions	Overhead time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Save/Recover	11.6μs	9.9μs
Not Saved/Recovered	11.4μs	8.9μs

Overhead time when executing the event execution type program

When the event execution type program is executed, overhead time is required, resulting in extension time.

■Overhead time of the event execution type program which uses occurrence of an interrupt as a trigger

Since the same overhead time occurs with the time of the interrupt program execution, refer to the following for details.

☞ Page 2086 Interrupt program overhead time

■Overhead time of the event execution type program which uses the network communication cycle synchronization as a trigger

Overhead time is required before starting the event execution type program and at the end of the program.

The instruction processing time of the event execution type program which uses the network communication cycle synchronization as a trigger is as follows.

Instruction processing time for each instruction + Overhead time[*1] + I/O refresh processing time in the synchronous station (when setting)[*2]

*1 The network communication cycle synchronization interrupt is included.

*2 For the I/O refresh processing time of the synchronous station, refer to the following.

☞ Page 2099 Synchronous station refresh execution time

The following shows the overhead time under the following conditions:

- Ladder program: None
- Refresh group setting: Not set
- Synchronous station: None

- Overhead time before the start of the event execution type program which uses the network communication cycle synchronization as a trigger

Index register and file register (R) block number conditions	Overhead time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Save/Recover	12.8μs	10.6μs
Not Saved/Recovered	12.1μs	10.1μs

- Overhead time at the end of the event execution type program which uses network communication cycle synchronization as a trigger

Index register and file register (R) block number conditions	Overhead time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Save/Recover	8.5μs	6.8μs
Not Saved/Recovered	8.0μs	6.6μs

END processing time

The END processing time includes the following:

- Common processing time
- I/O refresh processing time
- Link refresh processing time for the CC-Link IE TSN function part/network module
- Refresh processing time with intelligent functional module
- END processing extension time caused by the functions used (☞ Page 2096 END processing extension time)

Common processing time

The following table lists the common processing time of the controllers to be treated by the system.

Condition	Common processing time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
One controller	50μs	45μs

I/O refresh processing time

The I/O refresh processing time for the CC-Link IE TSN function part/motion function part or for modules mounted on the main base unit and extension base unit can be calculated by the following formula.

■CC-Link IE TSN function part/motion function part

Condition	Common processing time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
One controller	12.3μs	11.2μs

■Main base unit and extension base unit

I/O refresh processing time [μs] = ((Number of input refresh points[*1] × KM1) + (Number of units having number of input points × KM2) + KM3[*3]) + ((Number of output refresh points[*2] × KM4) + (Number of units having number of output points × KM5) + KM6[*3])

*1 The value indicates the numeric value that is obtained through dividing the number of input points by 16.

*2 The value indicates the numeric value that is obtained through dividing the number of output points by 16.

*3 When the number of I/O points is 0, this value is handled as 0.

Condition			Constant value	
			MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Main base unit	Input	KM1	0.006	0.003
		KM2	1.62	1.62
		KM3	3.50	2.50
	Output	KM4	0.006	0.003
		KM5	0.60	0.60
		KM6	4.50	3.50
Extension base unit	Input	KM1	0.006	0.003
		KM2	1.62	1.62
		KM3	3.50	2.50
	Output	KM4	0.006	0.003
		KM5	0.60	0.60
		KM6	4.50	3.50

Link refresh processing time for the CC-Link IE TSN function part/network module

This section describes the link refresh processing time with the CC-Link IE TSN function part or network module of the controller.

■Link refresh processing time for the CC-Link IE TSN function part (when network labels are not used)

The table below lists the processing time under the following conditions:

- Station-based block data assurance: None
- Refresh setting

Rwr	RWw
192	64
768	256
6144	2048

Link refresh processing time for the CC-Link IE TSN master/local module is calculated by the following formula.

$\alpha T1, \alpha R1$ [ms] = KM1 + KM2 × ((RX + RY + SB) ÷ 16 + RWr + RWw + SW) + αU

- $\alpha T1$: RX/RY/RWr/RWw/SB/SW link refresh time (sending side)
- $\alpha R1$: RX/RY/RWr/RWw/SB/SW link refresh time (receiving side)
- KM1, KM2: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1
- SB: Number of points of link special relay (SB)*2
- SW: Number of points of link special register (SW)*2

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1 ($\times 10^{-3}$)	10.00	10.00
KM2 ($\times 10^{-3}$)	0.007	0.006

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window.

*2 Number of points here indicates the one of when module label is not used. Calculation is executed while it is regarded as "0" when module label is used.

■Link refresh processing time for the CC-Link IE TSN function part (when network labels are used)

The table below lists the processing time under the following conditions:

- Station-based block data assurance: None
- Refresh setting

Rwr	RWw
192	64
768	256
6144	2048

Link refresh processing time for the CC-Link IE TSN master/local module is calculated by the following formula.

$\alpha T1, \alpha R1$ [ms] = KM1 + KM2 × ((RX + RY) ÷ 16 + RWr + RWw) + KM3 × (RX[*2] + RY[*2])

- $\alpha T1$: RX/RY/RWr/RWw/SB/SW link refresh time (sending side)
- $\alpha R1$: RX/RY/RWr/RWw/SB/SW link refresh time (receiving side)
- KM1, KM2, KM3: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station[*1]
- RY: Total number of points of remote output (RY) refreshed by the master station/local station[*1]
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station[*1]
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station[*1]

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1 ($\times 10^{-3}$)	10.00	10.00
KM2 ($\times 10^{-3}$)	0.104	0.096
KM3 ($\times 10^{-3}$)	0.008	0.008

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window.

*2 Total number of non-array bit type network labels

■Link refresh processing time for the CC-Link IE TSN master/local module

The table below lists the processing time under the following conditions:

- CC-Link IE TSN master/local module installation location: Slot adjacent to the controller on the main base unit
- Station-based block data assurance: None
- Refresh setting

Rwr	RWw	LW sending	LW receiving
192	64	256	768
768	256	2048	6144
6144	2048	4096	12288

Link refresh processing time for the CC-Link IE TSN master/local module is calculated by the following formula.

$\alpha T1, \alpha R1$ [ms] = KM1 + KM2 × ((RX + RY + SB) ÷ 16 + RWr + RWw + SW)

$\alpha T2, \alpha R2$ [ms] = KM1 + KM2 × (LB ÷ 16 + LW)

- $\alpha T1$: RX/RY/RWr/RWw/SB/SW link refresh time (sending side)
- $\alpha T2$: LB/LW link refresh time (sending side)
- $\alpha R1$: RX/RY/RWr/RWw/SB/SW link refresh time (receiving side)
- $\alpha R2$: LB/LW link refresh time (receiving side)
- KM1, KM2: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1
- LB: Total number of points of link relay (LB) that is refreshed by the station*2
- LW: Total number of points of link register (LW) that is refreshed by the station*2
- SB: Number of points of link special relay (SB)*3
- SW: Number of points of link special register (SW)*3

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	55.00	52.00
KM2($\times 10^{-3}$)	0.013	0.012

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window.

*2 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window. Note that the number of points that has been assigned in the reserved station is excluded.

*3 Number of points here indicates the one of when module label is not used. Calculation is executed while it is regarded as "0" when module label is used.

■Link refresh processing time for the CC-Link IE Controller Network module

The table below lists the processing time under the following conditions:

- CC-Link IE Controller Network module installation location: Slot adjacent to the controller on the main base unit
- Station-based block data assurance: None
- Refresh setting

LW sending	LW receiving
256	768
2048	6144
4096	12288

Link refresh processing time for the CC-Link IE Controller Network module is calculated by the following formula.

$\alpha T, \alpha R$ [ms] = KM1 + KM2 × ((LB + LX + LY + SB) ÷ 16 + LW + SW)

- αT: Link refresh time (sending side)
- αR: Link refresh time (receiving side)
- KM1, KM2: Constants
- LB: Total number of points of link relay (LB) that is refreshed by the station*1
- LW: Total number of points of link register (LW) that is refreshed by the station*1
- LX: Total number of points of link input (LX) that is refreshed by the station*1
- LY: Total number of points of link output (LY) that is refreshed by the station*1
- SB: Number of points of link special relay (SB)*2
- SW: Number of points of link special register (SW)*2

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	45.00	42.00
KM2($\times 10^{-3}$)	0.013	0.012

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window. Note that the number of points that has been assigned in the reserved station is excluded.

*2 Number of points here indicates the one of when module label is not used. Calculation is executed while it is regarded as "0" when module label is used.

■Link refresh processing time for the CC-Link IE Field Network module

The table below lists the processing time under the following conditions:

- CC-Link IE Field Network module installation location: Slot adjacent to the controller on the main base unit
- Station-based block data assurance: None
- Refresh setting

Rwr	RWw
192	64
768	256
6144	2048

Link refresh processing time for the CC-Link IE Field Network module is calculated by the following formula.

$\alpha T, \alpha R$ [ms] = KM1 + KM2 × ((RX + RY + SB) ÷ 16 + RWr + RWw + SW)

- αT: Link refresh time (sending side)
- αR: Link refresh time (receiving side)
- KM1, KM2: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1
- SB: Number of points of link special relay (SB)*2
- SW: Number of points of link special register (SW)*2

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	45.00	42.00
KM2($\times 10^{-3}$)	0.013	0.012

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window. The number of points that has been assigned in the reserved station is included.

*2 Number of points here indicates the one of when module label is not used. Calculation is executed while it is regarded as "0" when module label is used.

■Link refresh processing time for the CC-Link module

The table below lists the processing time under the following conditions:

- CC-Link network module installation location: Slot adjacent to the controller on the main base unit
- Station-based block data assurance: None
- Number of occupied stations: 4
- CC-Link: Ver.2
- Refresh setting

Rwr	RWw
24	8
48	16
96	32

Link refresh processing time for the CC-Link module is calculated by the following formula. (Remote net Ver.1 mode, Remote net Ver.2 mode)

$\alpha T, \alpha R$ [ms] = KM1 + KM2 × ((RX + RY + SB) ÷ 16 + RWr + RWw + SW)

- αT: Link refresh time (sending side)
- αR: Link refresh time (receiving side)
- KM1, KM2: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1
- SB: Number of points of link special relay (SB)*2
- SW: Number of points of link special register (SW)*2

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	45.00	42.00
KM2($\times 10^{-3}$)	0.013	0.012

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window. The number of points that has been assigned in the reserved station is included.

*2 Number of points here indicates the one of when module label is not used. Calculation is executed while it is regarded as "0" when module label is used.

Intelligent function module refresh processing time

This section describes the refresh processing time with the intelligent function module mounted on the main base unit (including the use of Ethernet/IP in the CC-Link IE TSN Plus master/local module).

Point

The refresh processing time described in this manual is for the case when the "Target" is set to "Device" in the refresh setting. For the refresh processing time of when the refreshing target is set to the module label or refresh data register (RD), refer to the manual for the module used.

Refresh processing time of one module [μs] = Read refresh time*1 + Write refresh time*1

*1 When the number of settings of read refresh (Module → Controller) or write refresh (Controller → module) is 0, each processing time is 0.

■Read refresh time [μs]

Number of read refresh settings × KM1 + Refresh time for the first item (A) + Refresh time for the second item (A) + ··· + Refresh time for the nth item (A) + KM2

■Write refresh time [μs]

Number of write refresh settings × KM4 + Refresh time for the first item (B) + Refresh time for the second item (B) + ··· + Refresh time for the nth item (B) + KM5

- A: KM3 × Number of refresh transfers (words) [μs]
- B: KM6 × Number of refresh transfers (words) [μs]
- n: Number of blocks for refresh settings*1
- KM1 to KM6: Constant value as shown below

Condition		Constant value	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1	Module → Controller	0.22	0.21
KM2	Module → Controller	11.50	10.50
KM3	Module → Controller	0.02	0.02
KM4	Controller → Module	0.16	0.15
KM5	Controller → Module	8.20	7.20
KM6	Controller → Module	0.01	0.01

*1 The number of blocks for refresh settings can be checked in "Auto Refresh Setting Total Counts" of "Module Parameter List" window. For details, refer to the manual for the module used.

END processing extension time

This section describes the prolonged time of END processing when using the following functions.

Latch function

If the latch function is used and the range for the latch time setting is effective, the END processing time becomes longer.
When the time setting is configured for the latch time setting, the following occurs in the next END processing after the specified time has passed.

Save destination	END processing extension time	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Built-in memory	5μs	4μs
SD memory card	6μs	5μs

Data logging function

When the data logging function is used, the END processing time becomes longer.
The calculation formula is as follows.
Increase in END processing time [μs] = KM1 + (KM2 × (Number of data logging settings - 1)) + (KM3 × Number of device points of internal device (Total number of points of data logging settings No.1 to No.10)) × KM4
Condition: All columns are output using the output format of Unicode text file.)

Logging result file save destination	Constant value	END processing extension time	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Built-in memory/SD memory card	KM1	44	40
	KM2	34	34
	KM3	0.075	0.065
	KM4	1.43	1.23

Data logging file transfer function

Even if the data logging file transfer function is used, the END processing time does not increase.

Processing time of the sequence scan synchronization sampling function

When the sequence scan synchronization sampling function is used, the END processing time becomes longer.
The following table shows the END processing time when the sequence scan synchronization sampling function is executed under the following conditions.

- Device with logging set: "D device (data type: Word [signed] (decimal format))", "X device (data type: Bit)"

Extension time of END processing [μs] = (K1 × N1) + (K2 × N2) + (K3 × M) + (K4 × U) + K5

- N1: Number of bit devices with logging set*1
- N2: Number of word devices with logging set*1
- M: Number of settings*1
- U: Number of modules*2

*1 For the device types and number of settings that can be set, refer to the manuals for each module used.
*2 The number of modules indicates the total number of modules which has executed this function.

Constant	Base unit	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
K1	Main base unit	0.105	0.085
	Extension base unit		
K2	Main base unit	0.080	0.065
	Extension base unit		
K3	Main base unit	0.20	0.20
	Extension base unit		
K4	Main base unit	1.20	1.20
	Extension base unit		
K5	Main base unit	45.0	45.0
	Extension base unit		

Controller data backup/restoration function

When the controller data backup/restoration function is executed, the END processing time becomes longer.

The following shows the END processing time when the controller data backup/restoration function is executed during RUN state under the following conditions:

- Controller state: RUN
- Program memory (drive 0): Number of programs: 1 (9K bytes)
- Device/label memory (drive 3): Not set for the file register
- Backup target device (drive 6): For the devices that can be latched, all the numbers of default device points are specified as the latch range.
- Backup target label (drive 6): Latch label area: 4K words (default), number of label settings: 0
- Motion data setting (drive 4): Number of operation profile data: 300, number of coordinates per file: 600
- Any backup target files are as follows. The other files are to be written as default.
  - Program memory (drive 0): CPU parameters, system parameters, module parameters, global label setting files, global/local label initial values
  - Data memory (drive 4): Event history file
- Backup destination and restoration source: SD memory card

Backup destination/ restoration source	END processing time when the controller backup/restoration function is executed during RUN state			
	MXR300-16, MXR300-32, MXR300-64		MXR500-128, MXR500-256	
	Not encrypted	Encrypted	Not encrypted	Encrypted
SD memory card	42.0μs	42.0μs	39.0μs	39.0μs

Real-time monitor

The execution of the real-time monitor results in an increase in the END processing time.

The calculation formula is as follows.

Increase in END processing time [μs] = KM1 + (KM2 × Number of points of word device) + (KM3 × Number of points of bit device)

- Global device, global label, local device, local label, file register

Constant	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1 (Common processing time)	11.00	11.00
KM2 (Word device processing time)	0.10	0.10
KM3 (Bit device processing time)	0.20	0.10

- Module access device, link direct device

Constant	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1 (Common processing time)	11.00	7.50
KM2 (Word device processing time)	10.00	8.50
KM3 (Bit device processing time)	8.00	6.00

Synchronous station refresh execution time

The following shows refresh time with the device station set in the synchronous station.

When network labels are not used

The table below lists the processing time under the following condition:

- Refresh setting

Rwr	RWw
195	65
780	260

The processing time can be calculated by the following formula.

$\alpha T1, \alpha R1$ [ms] = KM1 + KM2 × ((RX + RY) ÷ 16 + RWr + RWw)

- $\alpha T1$: RX/RY/RWr/RWw/SB/SW link refresh time (sending side)
- $\alpha R1$: RX/RY/RWr/RWw/SB/SW link refresh time (receiving side)
- KM1, KM2: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	2.10	1.60
KM2($\times 10^{-3}$)	0.0006	0.0006

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the network configuration settings.

When network labels are used

The table below lists the processing time under the following condition:

- Network label assignment setting

Rwr	RWw
195	65
780	260

The processing time can be calculated by the following formula.

$\alpha T1, \alpha R1$ [ms] = KM1 + KM2 × ((RX + RY) ÷ 16 + RWr + RWw) + KM3 × (RX^{*2} + RY^{*2})

- $\alpha T1$: RX/RY/RWr/RWw/SB/SW link refresh time (sending side)
- $\alpha R1$: RX/RY/RWr/RWw/SB/SW link refresh time (receiving side)
- KM1, KM2, KM3: Constants
- RX: Total number of points of remote input (RX) refreshed by the master station/local station*1
- RY: Total number of points of remote output (RY) refreshed by the master station/local station*1
- RWr: Total number of points of remote register (RWr) refreshed by the master station/local station*1
- RWw: Total number of points of remote register (RWw) refreshed by the master station/local station*1

Condition	Constant value	
	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1($\times 10^{-3}$)	2.10	1.60
KM2($\times 10^{-3}$)	0.012	0.011
KM3($\times 10^{-3}$)	0.032	0.018

*1 The total number of points here indicates the range set in "Refresh Setting" and the total number of link devices set in the "CC-Link IE TSN Configuration" window.

*2 Total number of non-array bit type network labels

Execution time of data logging function

This section describes the time required to execute the data logging function.

The tables below list the minimum intervals that data can be collected without any loss while continuous data logging is executed under the following conditions.

- Scan time: 1.5ms (up to 3ms)
- Internal buffer capacity setting: 1024K bytes per setting (default setting)
- Collection setting: After the execution of the specified program (an interrupt pointer of I□□ is used and an interrupt priority of I□□ is set to a higher level than the interrupt priority of the network communication cycle synchronization.)
- Data setting: Data register (D) (Data-type: word-signed (decimal number type))
- Output setting: Day/time column (output format is default) and index column are output.
- File switching timing: 1024K bytes when the save destination is function memory or data memory, 10000 records when it is an SD memory card, and the operation is overwritten when the number of storage files setting is exceeded
- Functions that require access to the same file as the save destination (including function memory for data memory) are not active, except for the data logging function.
- Number of points for collection: 1024
- Number of settings: 10

When the output format is Unicode text file

■When a global device or global label is specified

File save destination	Number of points	Minimum value for data collection interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
SD memory card	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.5ms	0.5ms
	1024 points (1024 points × 1 setting)	1.9ms	1.7ms
	2048 points (1024 points × 2 settings)	3.9ms	3.7ms
	5120 points (1024 points × 5 settings)	8.2ms	8.0ms
	10240 points (1024 points × 10 settings)	20.9ms	19.8ms
Data memory / function memory	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.2ms	0.2ms
	1024 points (1024 points × 1 setting)	0.5ms	0.5ms
	2048 points (1024 points × 2 settings)	0.8ms	0.8ms
	5120 points (1024 points × 5 settings)	2.0ms	1.9ms
	10240 points (1024 points × 10 settings)	3.8ms	3.8ms

■When a local device or local label is specified

The same applies when a global device or global label is specified.

When the output format is binary file

■When a global device or global label is specified

File save destination	Number of points	Minimum value for data collection interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
SD memory card	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.2ms	0.2ms
	1024 points (1024 points × 1 setting)	1.0ms	0.8ms
	2048 points (1024 points × 2 settings)	2.2ms	2.0ms
	5120 points (1024 points × 5 settings)	6.1ms	5.9ms
	10240 points (1024 points × 10 settings)	13.2ms	13.2ms
Data memory / function memory	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.2ms	0.2ms
	1024 points (1024 points × 1 setting)	0.4ms	0.4ms
	2048 points (1024 points × 2 settings)	0.6ms	0.5ms
	5120 points (1024 points × 5 settings)	0.9ms	0.9ms
	10240 points (1024 points × 10 settings)	2.0ms	1.8ms

■When a local device or local label is specified

The same applies when a global device or global label is specified.

When the output format is CSV (Unicode) file

■When a global device or global label is specified

File save destination	Number of points	Minimum value for data collection interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
SD memory card	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.5ms	0.5ms
	1024 points (1024 points × 1 setting)	1.9ms	1.7ms
	2048 points (1024 points × 2 settings)	3.9ms	3.7ms
	5120 points (1024 points × 5 settings)	8.2ms	8.0ms
	10240 points (1024 points × 10 settings)	20.9ms	19.8ms
Data memory / function memory	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.2ms	0.2ms
	1024 points (1024 points × 1 setting)	0.5ms	0.5ms
	2048 points (1024 points × 2 settings)	0.8ms	0.8ms
	5120 points (1024 points × 5 settings)	2.0ms	1.9ms
	10240 points (1024 points × 10 settings)	3.8ms	3.8ms

■When a local device or local label is specified

The same applies when a global device or global label is specified.

When the output format is CSV (Shift-JIS)

■When a global device or global label is specified

File save destination	Number of points	Minimum value for data collection interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
SD memory card	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.3ms	0.3ms
	1024 points (1024 points × 1 setting)	1.8ms	1.4ms
	2048 points (1024 points × 2 settings)	3.3ms	3.1ms
	5120 points (1024 points × 5 settings)	9.4ms	8.8ms
	10240 points (1024 points × 10 settings)	17.6ms	16.5ms
Data memory / function memory	8 points (8 points × 1 setting)	0.1ms	0.1ms
	128 points (128 points × 1 setting)	0.2ms	0.2ms
	1024 points (1024 points × 1 setting)	0.5ms	0.5ms
	2048 points (1024 points × 2 settings)	0.8ms	0.7ms
	5120 points (1024 points × 5 settings)	1.7ms	1.7ms
	10240 points (1024 points × 10 settings)	3.8ms	3.2ms

■When a local device or local label is specified

The same applies when a global device or global label is specified.

When the output format is JSON

■When a global device or global label is specified

File save destination	Number of points	Minimum value for data collection interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
SD memory card	8 points (8 points × 1 setting)	1.2ms	1.2ms
	128 points (128 points × 1 setting)	1.8ms	1.8ms
	512 points (512 points × 1 setting)	2.9ms	2.7ms
	1024 points (1024 points × 1 setting)	4.1ms	4.1ms
	2048 points (1024 points × 2 settings)	7.4ms	7.4ms
	5120 points (1024 points × 5 settings)	20.9ms	19.8ms
	10240 points (1024 points × 10 settings)	44.0ms	41.8ms
Data memory / function memory	8 points (8 points × 1 setting)	0.4ms	0.3ms
	128 points (128 points × 1 setting)	0.5ms	0.5ms
	512 points (512 points × 1 setting)	1.3ms	1.1ms
	1024 points (1024 points × 1 setting)	2.1ms	2.0ms
	2048 points (1024 points × 2 settings)	4.3ms	4.1ms
	5120 points (1024 points × 5 settings)	10.8ms	10.5ms
	10240 points (1024 points × 10 settings)	20.9ms	20.9ms

■When a local device or local label is specified

The same applies when a global device or global label is specified.

Controller data backup/restoration function execution time

This section describes the time required to execute the controller data backup/restoration function.
The time is required from the start to the completion when the controller backup/restoration function is executed under the following conditions:

- Program memory (drive 0): Number of programs: 1 (9K bytes)
- Device/label memory (drive 3): Not set for the file register
- Backup target device (drive 6): For the devices that can be latched, all the numbers of default device points are specified as the latch range.
- Backup target label (drive 6): Latch label area: 4K words (default), number of label settings: 0
- Motion data setting (drive 4): Number of operation profile data: 300, number of coordinates per file: 600
- Any backup target files are as follows. The other files are to be written as default.
  - Program memory (drive 0): CPU parameters, system parameters, module parameters, global label setting files, global/local label initial values
  - Data memory (drive 4): Event history file
- Backup destination and restoration source: SD memory card

The time required from the start to the completion of the backup

Backup destination	Controller state	Time required from start to completion of the backup			
		MXR300-16, MXR300-32, MXR300-64		MXR500-128, MXR500-256	
		Not encrypted	Encrypted	Not encrypted	Encrypted
SD memory card	RUN	20.4s	26.3s	20.3s	25.7s
	STOP	20.6s	28.0s	19.7s	25.5s

The time required from the start to the completion of the restoration

Restoration source	Controller state	Time required from start to completion of the restoration			
		MXR300-16, MXR300-32, MXR300-64		MXR500-128, MXR500-256	
		Not encrypted	Encrypted	Not encrypted	Encrypted
SD memory card	RUN	—	—	—	—
	STOP	9.9s	14.5s	11.7s	15.4s

Real-time monitor execution time

This section describes the time required to run the real-time monitor.
It lists the minimum interval that data can be monitored without any loss while real-time monitoring is executed under the following conditions.

- Scan time: 1.5ms (up to 3ms), with average scan time of 1.0ms during non-execution of the real-time monitor
- Data: Agrees with the "Number of device points" column in the table below. (The value of monitor interval does not change when a local device or label is specified.)
- Timing: Condition specification (Step No. specification), Program name: Optional, Step No.: Head step of the program, Execution condition: Set to Always
- Internal buffer capacity: 2048K bytes (default)
- Type of data to be collected: Double-precision real number

Condition	Number of device points	Value of monitor interval	
		MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Connected via USB	1 point	0.15ms	0.15ms
	8 points	0.65ms	0.65ms
	16 points	1.25ms	1.25ms
	32 points	2.25ms	2.25ms
When connecting the Ethernet port (TCP)	1 point	0.15ms	0.15ms
	8 points	0.65ms	0.60ms
	16 points	1.25ms	1.20ms
	32 points	2.30ms	2.25ms
When connecting the Ethernet port (UDP)	1 point	0.15ms	0.15ms
	8 points	0.65ms	0.65ms
	16 points	1.25ms	1.25ms
	32 points	2.25ms	2.25ms

File operation execution time

This section describes the required time from the start of the file operation instruction until the completion of the file operation.

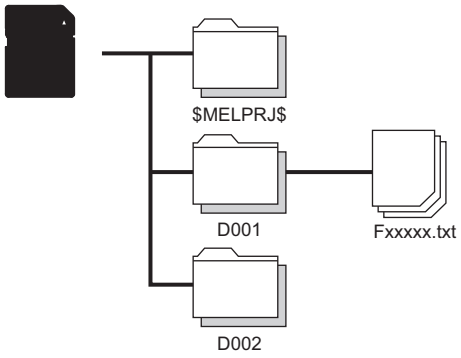
Changes in the processing time according to the number of files

The processing time changes according to the number of files stored in folders. The table below lists the processing time under the following conditions:

- Folder/file structure (drive 2: SD memory card)
- SD memory card
- Size of target files to be operated: 1K byte
- Instruction argument of each file operation instruction shown in the following table

Instruction name	First argument	Second argument	Third argument	Fourth argument	Fifth argument	Sixth argument	Seventh argument
SP.FDELETE	U0	K2	D0	"D001"	M0	—	—
SP.FCOPY	U0	D0	K2	"D001"	K2	"D002"	M0
SP.FMOVE	U0	D0	K2	"D001"	K2	"D002"	M0
SP.FRENAME	U0	K2	D0	"D001"	"D002"	M0	—
SP.FSTATUS	U0	K2	D0	"D001"	D10	M0	—

- File/folder structures except those shown below do not exist.



- Overwriting setting: Not overwrite (SP.FCOPY, SP.FMOVE only)
- Target type setting: Folder specification
- Empty folder deletion setting: Delete folders even when they are not empty (SP.FDELETE only)

■Processing time

Instruction name	Number of operated files in the folder (D001)			
	1	10	100	1000
SP.FDELETE	20ms	150ms	1000ms	12000ms
SP.FCOPY	40ms	400ms	1200ms	20000ms
SP.FMOVE	10ms	10ms	10ms	10ms
SP.FRENAME	5ms	5ms	5ms	5ms
SP.FSTATUS	1ms	1ms	1ms	1ms

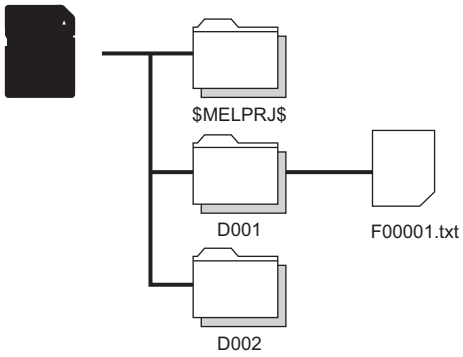
Changes in the processing time according to the file size

The processing time changes according to the size of the files stored in the folder. The table below lists the processing time under the following conditions:

- Folder/file structure (drive 2: SD memory card)
- SD memory card
- Number of files in the folder: 1
- The following table lists the instruction argument of each file operation instruction.

Instruction name	First argument	Second argument	Third argument	Fourth argument	Fifth argument	Sixth argument	Seventh argument
SP.FDELETE	U0	K2	D0	"D001\F00001.txt"	M0	—	—
SP.FCOPY	U0	D0	K2	"D001\F00001.txt"	K2	"D002"	M0
SP.FMOVE	U0	D0	K2	"D001\F00001.txt"	K2	"D002"	M0
SP.FRENAME	U0	K2	D0	"D001\F00001.txt"	"F00002.txt"	M0	—
SP.FSTATUS	U0	K2	D0	"D001\F00001.txt"	D10	M0	—

- File/folder structures except those shown below do not exist.



- Overwriting setting: Not overwrite (SP.FCOPY, SP.FMOVE only)
- Target type setting: File specification

■Processing time

Instruction name	Size of operated files in the folder (D001)			
	1MB	16MB	64MB	256MB
SP.FDELETE	10ms	10ms	10ms	10ms
SP.FCOPY	300ms	1200ms	5500ms	55000ms
SP.FMOVE	20ms	20ms	20ms	20ms
SP.FRENAME	5ms	5ms	5ms	5ms
SP.FSTATUS	1ms	1ms	1ms	1ms

Firmware update execution time

This section describes the time required to execute a firmware update.

The following table lists the values when using the engineering tool under the following conditions.

- Connection method: USB
- Reset time: 10s
- Controller ROM size: 118026KB (on Windows)
- RJ71GN11-T2 ROM size: 5145KB (on Windows)
- RJ71EN71 ROM size: 2969KB (on Windows)
- RJ71C24 ROM size: 520KB (on Windows)

Execution condition			Processing time	
Total number of modules	**Mounting location**	**Applicable module**	**MXR300-16, MXR300-32, MXR300-64**	**MXR500-128, MXR500-256**
1	CPU slot	Controller	780.0s	780.0s
1	Right side of controller	RJ71GN11-T2	88.0s	88.0s
1	Right side of controller	RJ71EN71	130.0s	130.0s
1	Right side of controller	RJ71C24	8.5s	8.5s
63	CPU slot	Controller	9300.0s	9300.0s
	Right side of controller to Slot No.63	RJ71EN71		
63	CPU slot	Controller	496.0s	496.0s
	Right side of controller to Slot No.63	RJ71C24		

Appendix 13 CC-Link IE TSN Processing Time

This section describes the formula for calculating each processing time when using CC-Link IE TSN.

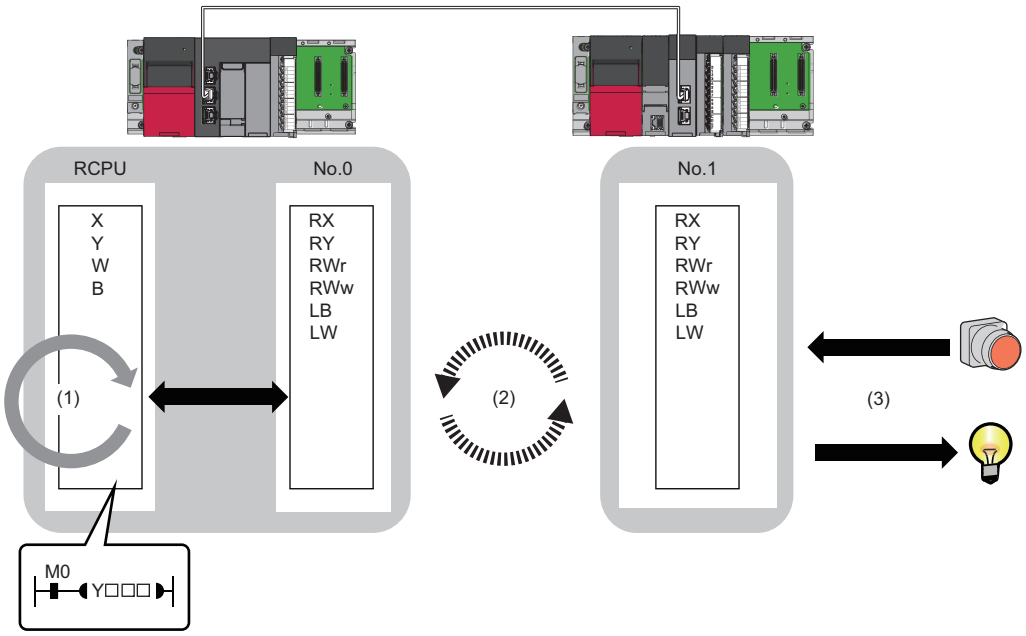
Transmission delay time

Transmission delay time refers to the following in CC-Link IE TSN cyclic transmission.

- The time between the transmission source device turning on or off and the transmission destination device turning on or off
- The time between data setting in the transmission source device and the data being stored in the transmission destination device

The transmission delay time is basically the total of (1), (2), and (3) shown below.

However, the time is affected by the presence of station-based block data assurance and sequence scan timing.



- (1) SM: Master station sequence scan time (☞ Page 2085 Processing Time of CPU Function Part)
- (2) LS: Communication cycle interval (cyclic transmission time + cyclic processing time) (☞ Page 2116 Shortening method of the communication cycle interval and cyclic transmission time)
- (3) Rio: Device station processing time: (📖Manual for the device station used)

Point

When "Communication Period Setting" of the communication destination in the "CC-Link IE TSN Configuration" window of the master station has been set to an option other than "Basic Period", multiply the LS: Communication cycle intervals by the multiplier corresponding to the set option and n.

At this time, the multiple and n are as follows, depending on the settings in "CC-Link IE TSN Configuration" window.

- For "CC-Link IE TSN Class B": The multiple specified in "Multiple Period Setting" in "Communication Period Setting" under "Basic Settings"
- When "CC-Link IE TSN Class A" and "Communication Period Setting" are "Normal-Speed": The multiple specified in "Multiple Period Setting" in "Communication Period Setting" under "Basic Settings"
- When "CC-Link IE TSN Class A" and "Communication Period Setting" are "Low-Speed": The multiple × n specified in "Multiple Period Setting" in "Communication Period Setting" under "Basic Settings"

n can be checked with the CC-Link IE TSN Class A (low speed) multiple (Un\G1294304). (☞ Page 2111 Details of n by which communication cycle intervals are multiplied)

Details of n by which communication cycle intervals are multiplied

The stations in the "CC-Link IE TSN Configuration" window of the master station are checked in the order of the "STA#" column. Then, for CC-Link IE TSN Class A devices, device stations whose "Communication Period Setting" is set to "Low-Speed" are divided into groups according to the total cyclic data size. (☞ Page 312 CC-Link IE TSN Class A group send)
The following table shows the algorithm for determining n from the number of the CC-Link IE TSN Class A groups.

No.	Processing	Branch		Loop 1	Loop 2	Detailed description
		Yes	No			
No.1	Loop No.1 to No.10 for the number of stations. (i = 1; i ≤ the number of set stations; i++)	—	—	No.1 to No.10	—	Check device stations with "STA#" of 1 to 253 in the "CC-Link IE TSN Configuration" window for the master station one by one.
No.2	Check that "Communication Period Setting" is set to "Low-Speed" for CC-Link IE TSN Class A devices.	→No.3	→No.1 (1 loop completed)		—	In the "CC-Link IE TSN Configuration" window of the master station, check the "CC-Link IE TSN Class" and "Communication Period Setting" of the i-th device station. If "CC-Link IE TSN Class A" and "Low-Speed" are set, perform the processing starting from No.3.
No.3	Calculate send/receive data size. DMsi = (HBL × n1i) + (16 × n2i) + ndmi DSsi = (HBL × n3i) + (20 × n4i) + ndsi	—	—		—	DMsi is the size of cyclic data to be sent from the master station to a device station. DSsi is the size of cyclic data to be received by the master station from a device station.
No.4	Loop No.4 to No.10 up to the maximum number of groups. (j = 1; j ≤ 253; j++)	—	—		No.4 to No.10	Up to a total of 2K bytes can be assigned to a group. Determine which group number (1 to 253) can be assigned to i-th station starting from 1.
No.5	Check whether GMsj + DMsi ≤ 2044 is satisfied.	→No.6	→No.4 (1 loop completed)			GMsj is the total size of cyclic data that is already assigned to the j-th group number and is to be sent from the master station to a device station.
No.6	Check whether GSsj + DSsi ≤ 2044 is satisfied.	→No.7	→No.4 (1 loop completed)			GSsj is the total size of cyclic data that is already assigned to the j-th group number and is to be received by the master station from a device station.
No.7	Update the data size (GMsj, GSsj) of the assigned group.	—	—			The values of GMsj and GSsj are updated when both the conditions No.5 and No.6 are satisfied.
No.8	Assign the group number j to the i-th station.	—	—			When the conditions No.5 and No.6 are both satisfied, assign CC-Link IE TSN Class A group number j to the i-th device station.
No.9	Check "CC-Link IE TSN Class A Group Send Upper Limit Size Setting".	—	—			The setting is checked in "Connection Device Information" under "Basic Settings".
No.10	Calculate the CC-Link IE TSN Class A group send number AGrpSt[i] of the i-th station. →Exit the loop from No.4.	—	—			No.9 is "2K bytes": AGrpSt[i] = j
		—	—			No.9 is "8K bytes": Round up the calculated value to the nearest integer of AGrpSt[i] = j ÷ 4
No.11	Acquire the maximum value J of the CC-Link IE TSN Class A group send number AGrpSt[i].	—	—	—	—	After assigning the CC-Link IE TSN Class A group send number AGrpSt[i] to all device stations that are CC-Link IE TSN Class A devices whose "Communication Period Setting" is set to "Low-Speed", the maximum value J of AGrpSt[i] is obtained. n is equal to J.

• Variables used by the algorithm above

Name of variable	Description
HBL	42
n1i	Round up the calculated value to the nearest integer of (ndmi + (16 × n2i)) ÷ 1484 When the calculation result of n1i is 2 or greater, add 1 to n2i.
n2i	(RYbi + RWwbi) RYbi: Round up the calculated value to the nearest integer of (The "RY Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed") ÷ 11744 RWwbi: Round up the calculated value to the nearest integer of (The "RWw Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed") ÷ 734 ■When the i-th station is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed" and is a CANopen communication compatible device n7i
ndmi	(The "RY Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed") ÷ 8 + (The "RWw Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed") × 2 ■When the i-th station is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed" and is a CANopen communication compatible device n5i × 2
n3i	Round up the calculated value to the nearest integer of (ndsi+(20 × n4i)) ÷ 1484 When the calculation result of n3i is 2 or greater, add 1 to n4i.
n4i	(RXbi + RWrbi) + 1 RXbi: Round up the calculated value to the nearest integer of (The "RX Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed") ÷ 11712 RWrbi: Round up the calculated value to the nearest integer of (The "RWr Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed") ÷ 732 ■When the i-th station is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed" and is a CANopen communication compatible device n7i + 1
ndsi	(The "RX Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed") ÷ 8 + (The "RWr Setting" number of points for the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed") × 2 + 8 ■When the i-th station is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed" and is a CANopen communication compatible device n6i × 2 + 8
n5i	A total number of device points for RPDO set in the PDO mapping of the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed"
n6i	A total number of device points for TPDO set in the PDO mapping of the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed"
n7i	A total number of the main modules and extension modules of the i-th station that is a CC-Link IE TSN Class A device whose "Communication Period Setting" is "Low-Speed"

Ex.

When the inverter FR-E800 (RX: 32 points, RY: 32 points, RWr: 32 points, RWw: 32 points) is used and "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" is set to "8K bytes" in "Connection Device Information" under "Basic Settings"

When 1 ≤ the number of inverters ≤ 44, n = 1

When 45 ≤ the number of inverters ≤ 88, n = 2

When 89 ≤ the number of inverters ≤ 132, n = 3

When 133 ≤ the number of inverters ≤ 176, n = 4

When 177 ≤ the number of inverters ≤ 220, n = 5

When 221 ≤ the number of inverters ≤ 253, n = 6

Calculation formula for transmission delay time of the master station ← remote station

The following table lists the calculation formula for when data is transmitted from a remote station (input) to the master station (RX/RWr).

Calculation value	Station-based block data assurance	No station-based block data assurance
Normal value	(SM × 1) + (LS × n1) + Rio	(SM × 1) + (LS × 1) + Rio
Maximum value	(SM × 1) + (LS × (n1 + 1)) + Rio	(SM × 1) + (LS × 2) + Rio

■Variable

Name of variable	Description	Unit
SM	Master station sequence scan time	μs
LS	Communication cycle intervals (can be checked in the SW0060)	μs
Rio	Processing time of the remote station	μs
n1	Round up the calculated value to the nearest integer of (SM ÷ LS)	—

Point

When "Communication Period Setting" of the communication destination in the "CC-Link IE TSN Configuration" window has been set to an option other than "Basic Period", multiply the LS (communication cycle intervals) by the multiplier corresponding to the set option, which is specified in "Multiple Period Setting" under "Basic Settings".

The multiple is as follows, depending on the settings of "CC-Link IE TSN Class Setting" in the "CC-Link IE TSN Configuration" window.

- For "CC-Link IE TSN Class B", the multiple is the one specified in "Multiple Period Setting" under "Basic Settings".
- For "CC-Link IE TSN Class A" with "Normal-Speed", the multiple is the one specified in "Multiple Period Setting" under "Basic Settings". With "Low-Speed", the multiple is obtained by multiplying the value specified in "Multiple Period Setting" under "Basic Settings" by n.

n can be checked with the buffer memory G1294304 (Information for device station cyclic transmission).

Calculation formula for transmission delay time of the master station → remote station

The following table lists the calculation formula for when data is transmitted from the master station (RY/RWw) to a remote station (output).

Calculation value	Station-based block data assurance	No station-based block data assurance
Normal value	(SM × n2) + (LS × 1) + Rio	(SM × 1) + (LS × 1) + Rio
Maximum value	(SM × n2) + (LS × 2) + Rio	(SM × 2) + (LS × 2) + Rio

■Variable

Name of variable	Description	Unit
SM	Master station sequence scan time	μs
LS	Communication cycle intervals (can be checked in the SW0060)	μs
Rio	Processing time of the remote station	μs
n2	Round up the calculated value to the nearest integer of (LS ÷ SM)	—

Point

When "Communication Period Setting" of the communication destination in the "CC-Link IE TSN Configuration" window has been set to an option other than "Basic Period", multiply the LS (communication cycle intervals) by the multiplier corresponding to the set option, which is specified in "Multiple Period Setting" under "Basic Settings".

The multiple is as follows, depending on the settings of "CC-Link IE TSN Class Setting" in the "CC-Link IE TSN Configuration" window.

- For "CC-Link IE TSN Class B", the multiple is the one specified in "Multiple Period Setting" under "Basic Settings".
- For "CC-Link IE TSN Class A" with "Normal-Speed", the multiple is the one specified in "Multiple Period Setting" under "Basic Settings". With "Low-Speed", the multiple is obtained by multiplying the value specified in "Multiple Period Setting" under "Basic Settings" by n.

n can be checked with the buffer memory G1294304 (Information for device station cyclic transmission).

Calculation formula for transmission delay time of the master station ← remote station

The following table lists the calculation formula for when data is transmitted from a remote station (input) to the master station (RX/RWr).

Calculation value	Transmission delay time
Normal value	(LS × 1) + Rio
Maximum value	(LS × 2) + Rio

■Variable

Name of variable	Description	Unit
LS	Communication cycle intervals (can be checked in the SW0060)	μs
Rio	Processing time of the remote station	μs

Point

When "Communication Period Setting" of the communication destination in the "CC-Link IE TSN Configuration" window has been set to an option other than "Basic Period", multiply the LS (communication cycle intervals) by the multiplier corresponding to the set option, which is specified in "Multiple Period Setting" under "Basic Settings".

Calculation formula for transmission delay time of the master station → remote station

The following table lists the calculation formula for when data is transmitted from the master station (RY/RWw) to a remote station (output).

Calculation value	Transmission delay time
Normal value	(LS × 2) + Rio
Maximum value	(LS × 3) + Rio

■Variable

Name of variable	Description	Unit
LS	Communication cycle intervals (can be checked in the SW0060)	μs
Rio	Processing time of the remote station	μs

Point

When "Communication Period Setting" of the communication destination in the "CC-Link IE TSN Configuration" window has been set to an option other than "Basic Period", multiply the LS (communication cycle intervals) by the multiplier corresponding to the set option, which is specified in "Multiple Period Setting" under "Basic Settings".

Shortening method of the communication cycle interval and cyclic transmission time

By setting "Communication Period Interval Setting" and "Cyclic Transmission Time" in "Communication Period Setting" under "Basic Settings" by referring to values stored in buffer memory addresses listed below, the communication cycle interval and cyclic transmission time are shortened.

- Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201)
- Cyclic transmission time (calculation value) (U3E0\G10272 to U3E0\G10273)

Point

The key points to shorten the communication cycle interval and cyclic transmission time are shown below. *4

- Connect the equal number of device stations to each port of the master station.
- In the connected device information, set "CC-Link IE TSN Class A Group Send Upper Limit Size Setting" to 2K bytes*1.
- In the "CC-Link IE TSN Configuration" window, reduce the number of device stations to be set.*3
- In the "CC-Link IE TSN Configuration" window, set RX, RY, RWr, and RWw that are not used in each device station to empty (no assignment).*3
- In the "CC-Link IE TSN Configuration" window, reduce the significant number of RX, RY, RWr, and RWw points for each device station.*3
- In the "CC-Link IE TSN Configuration" window, avoid setting "Synchronous" and "Asynchronous" simultaneously for "Network Synchronous Communication" of each device station.
- In the "CC-Link IE TSN Configuration" window, set "Cyclic Transmission Distribution Setting" for each device station to "Distribute".
- In the "Device No. Reassignment" window of the "CC-Link IE TSN Configuration" window, select "Communication Period Interval Shortening Assignment" in the assignment method and reassign the device number.*2

*1 This setting is enabled when there is a device station selected for CC-Link IE TSN Class A device and "Communication Period Setting" is set to "Low-Speed" in the "CC-Link IE TSN Configuration" window.

*2 This setting is enabled when there is a device station whose "Network Synchronous Communication" is set to "Synchronous" in the "CC-Link IE TSN Configuration" window.

*3 This setting is enabled for the device stations other than the ones selected for CC-Link IE TSN Class A device and "Communication Period Setting" is set to "Low-Speed" in the "CC-Link IE TSN Configuration" window.

*4 Since Communication cycle intervals (actual measurement value) (U3E0\G10200 to U3E0\G10201) are the actual measurement values, the value displayed after the controller reset may be a little larger or smaller.

Appendix 14 Ethernet Processing Time

This section describes the formula for calculating each processing time when using Ethernet.

Processing time of the simple CPU communication function

Extended scan time

When the simple CPU communication function is executed, the scan time becomes longer.

The extended scan time is as follows.

[Conditions]

- Measure for each protocol (UDP, DSTL).

[Calculation formula]

Processing time for simple CPU communication = KM1 + αT1 + αT2 + ··· + αTn [μs]

αTn = KM2 + KM3 × (number of bit points to be communicated ÷ 16 + number of word points to be communicated) + αEn [μs]

αEn = KM4 + KM5 × (number of bit points to be communicated ÷ 16 + number of word points to be communicated) [μs]

- αTn: Simple CPU communication processing time per setting
- αEn: Additional time when the file register (R, ZR) is used (It is added when the file register (R, ZR) is used.)
- KM1 to KM5: Constants
- n: Number of settings

Constant	MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
KM1	60.00	60.00
KM2	0.90	0.90
KM3	0.024	0.024
KM4	1.60	1.60
KM5	0.10	0.10

Performance of the simple CPU communication function

The following shows the performance of the simple CPU communication function.

It depends on the number of settings, the number of communication points, the scan time of the own station and communication destination module (device/label access service processing setting), the implementation status of other functions, and the status of Ethernet communication.

[Conditions]

- Measure for each protocol (UDP, DSTL).
- Sequence scan time (own station): 1ms (scan time before the execution of simple CPU communication)
- Communication destination: Controller (The sequence scan time for the communication destination is 1ms (for any model).)
- Device data: Bit device (M), Word device (D)
- Each with different communication destinations
- Perform measurement when no retry of communication occurs.

Communication setting	Encrypted communication	Number of communication points for one setting*1	Processing time until data of all settings are sent and received [ms]				
			Number of settings: 1	Number of settings: 8*2	Number of settings: 16*2	Number of settings: 32*2	Number of settings: 64*2
During read	During unencrypted communication	32 words each (64 words in total)	10	11	17	34	76
		64 words each (128 words in total)	10	11	17	35	77
		256 words each (512 words in total)	10	13	20	—	—
	During encrypted communication	32 words each (64 words in total)	10	11	17	34	76
		64 words each (128 words in total)	10	11	17	35	77
		256 words each (512 words in total)	10	13	20	—	—
During write	During unencrypted communication	32 words each (64 words in total)	10	11	18	35	77
		64 words each (128 words in total)	10	11	18	35	80
		256 words each (512 words in total)	10	13	20	—	—
	During encrypted communication	32 words each (64 words in total)	10	11	18	35	77
		64 words each (128 words in total)	10	11	18	35	80
		256 words each (512 words in total)	10	13	20	—	—

*1 Number of points for each device (bit device and word device)

*2 Duplicated communication destinations may increase the execution interval. The more duplicates, the larger the delay in the execution interval, which is approximately eight times longer at maximum.

Processing time of the Web server function

This section describes the processing time of the Web server function.

Measurement environment

■Network configuration

Perform one-to-one Ethernet connection between the controller and one personal computer.

■Measurement method

- Display update interval: Set it to an appropriate value that will allow the page to refresh in time.
- Measurement section: Measure the time from when a request is sent until when a response is received using the web browser developer tool.*1

*1 Select "Disable cache" in the upper section of the developer tool to include the web content download time.

Function	Operation/display	Target value	Actual measurement value
User authentication (web server)	Press the login button to display the detailed module information window.	0.7s	0.523s
	Press the logout button to display the user authentication window.	0.25s	0.187s
CPU diagnostics	Press the CPU diagnostics button to display 16 pieces of error information.	0.1s	0.019s
Event history	Press the event history button to display 32 pieces of event history information.	0.1s	0.021s
Device batch monitor	Press the device batch monitor button to display any 32 device monitor results.	0.1s	0.025s
Watch	Press the watch button to display any 32 device monitor results.	0.1s	0.020s
Device test	Select a device to write the setting value of any one device (user authentication function: disabled).	0.01s	0.006s
	Select a device to write the setting value of any one device (user authentication function: enabled).	0.04s	0.0024s
Language switching	Select a language to display a window in the language.	0.6s	0.466s
Program monitor	Select a program to monitor from the combo box menu to display the program monitor window (number of splitting steps: 300).	0.4s	0.389s
	Press the verification button to display the consistency check result window (display update interval: 0.2s, number of program splitting steps: 300, number of device points: 16 bits and 16 words (32 points in total))	0.03s	0.023s
System Web page update	Press the Execute button to display the write success window.	12.0s	11.930s
User Web page	Press the user Web page button to display the user Web page on the SD memory card. (A sample page scheduled to be released is used. For the sample page, please contact your local Mitsubishi representative.)	0.25s	0.072s

Processing time of the OPC UA server function

The following table lists the processing time of the OPC UA server function.

[Conditions]

In the read/write processing time measurement, the time is measured from when an OPC UA client sends a read or write request to the OPC UA server until the response is received.

In the subscription processing time measurement, the interval at which the OPC UA client receives Publish of the subscription target node is measured.

Item	Description
Polling cycle	• Subscription: 10ms (minimum value that can be set) • Read/write: 1000ms
Label data type	• Non-array: Word [signed] • Array: Word [signed] (0..99)
Security policy	• Encrypted communication: Basic256Sha256
Security mode	• Encrypted communication: Sign & Encrypt
Scan time	20ms (a program with a specified scan time is used instead of a constant scan.)
Device/label access service processing setting	10% (default value)
Program description	A program that increments 50% of the label assigned to the address space setting every scan
OPC UA client	• SDK to be used = UA-.NETStandard-1.4.368.58 developed by OPC Foundation • Publish Interval = 100ms • Sapmling Interval = 50ms
Number of measurements	The average is calculated by measuring 10 times.

Non-array and non-structured node

Encryption	Access type	Number of access target nodes	Time	
			MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Encrypted communications	Read	100	56ms	48ms
		1000	467ms	467ms
		5000	2516ms	1740ms
		10000	3634ms	3601ms
	Write	100	90ms	58ms
		1000	620ms	661ms
		1500	873ms	840ms
		3000	2029ms	1820ms
	Subscription	100	175ms	115ms
		1000	1228ms	1019ms
		1500	2033ms	1895ms
		3000	4637ms	5046ms

Array type node

Encryption	Access type	Number of access target nodes*1	Time	
			MXR300-16, MXR300-32, MXR300-64	MXR500-128, MXR500-256
Encrypted communications	Read	1000 (10)	37ms	25ms
		5000 (50)	65ms	65ms
		10000 (100)	98ms	153ms
		20000 (200)	184ms	233ms
		50000 (500)	456ms	430ms
	Write	1000 (10)	50ms	43ms
		5000 (50)	85ms	84ms
		10000 (100)	134ms	186ms
		20000 (200)	311ms	271ms
		50000 (500)	704ms	734ms
	Subscription	1000 (10)	112ms	113ms
		5000 (50)	126ms	223ms
		10000 (100)	257ms	231ms
		20000 (200)	410ms	413ms
		50000 (500)	969ms	926ms

*1 The number in parentheses represents the number of array type nodes. (100 elements per array)

Appendix 15 Service Processing

Target list and operation details of the device/label access service processing setting

Target list

This section describes the targets of the device/label access service processing setting.

Applicable function	Description
Functions to perform read/write to files accessed by programs	When read/write is performed to the relevant files during execution of a program, file inconsistency may occur. Therefore, such operation is performed during the END processing.
Functions to perform write to devices/labels	When write is performed to devices/labels during execution of a program, the result of operation processing may become inconsistent. Therefore, such operation is performed during the END processing.

■Communication functions via the SLMP/MC protocol

Among communication functions using the SLMP/MC protocol, those to which the device/label access service processing setting can be applied are as follows.

Function			Command
Device memory	Multiple blocks batch read		0406 (00□0)
	Multiple blocks batch write		1406 (00□0)
	Batch read	In units of bits	0401 (00□1)
		In units of words	0401 (00□0)
	Batch write	In units of bits	1401 (00□1)
		In units of words	1401 (00□0)
	Random read		0403 (00□0)
	Test (Random write)	In units of bits	1402 (00□1)
		In units of words	1402 (00□0)
	Monitor		0802 (00□0)
Files	New file creation*1		1820 (0000)
	File copy*1	File password 32 function incompatible	1824 (0000)
	File open*1	File password 32 function incompatible	1827 (0000)
	File read*1		1828 (0000)
	File write*1		1829 (0000)
	File close*1		182A (0000)
Programmable controller CPU monitoring	Registration*2		0630 (0000)
	Clear*2		0631 (0000)

*1 Only the file register file can support it. (Other file access is always executed asynchronously from the program.)

*2 When registration/clear command is executed, it does not affect the scan time. However, since the serial communication module will periodically access into the device memory of the controller when the function is enabled, it becomes the target for Device/Label access service processing setting.

■Communication function using an engineering tool

Of the communication functions using an engineering tool, the functions targeted for the setting of the Device/Label access service processing are indicated.

Function	
Writing data to the programmable controller	File register file
	Device data (Local device also included)
Reading data from the programmable controller	File register file
	Device data (Local device also included)
	Device data storage file
Monitor function	Circuit monitor*2*3
	Device/buffer memory batch monitor*2*3
	Label batch monitor (local label included)*2*3
Ethernet function	File transfer (FTP server)*1
	File transfer (FTP client)*1
Debug function	Current value change

*1 Only the file register file can support it. (Other file access is always executed asynchronously from the program.)

*2 Depending on the startup source, the function may be executed asynchronously with END processing regardless of the service processing setting.

*3 Depending on the startup source, data inconsistency may occur.

Operation details

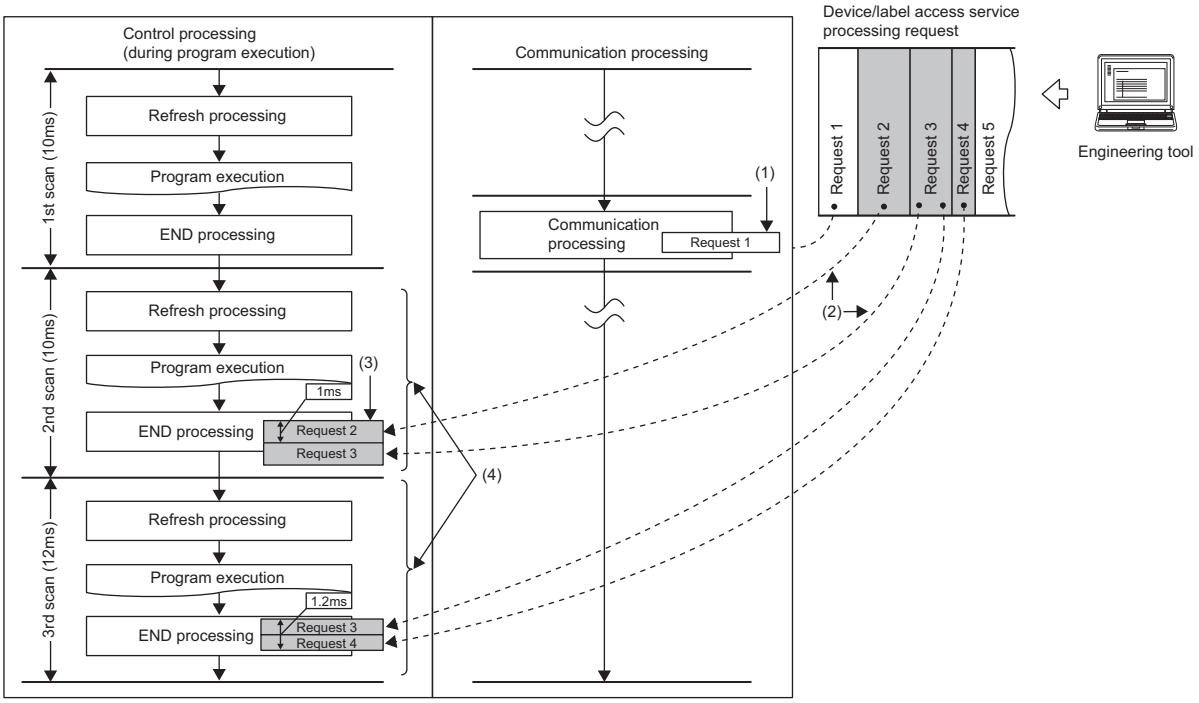
Operations enabled by setting details of the device/label access service processing setting are as follows.

■Execute the Process as Scan Time Proceeds

This setting is useful to execute the device/label access service processing in a way commensurate with the system size. It allows the system to be designed without considering the device/label access service processing time because it is determined as a function of the scan time.

Ex.

When "Scan time ratio = 10%" is set



(1) Synchronization with program is unnecessary.

(2) Multiple requests are processed until the specified device/label access service processing ratio (10%) is exceeded. When the specified device/label access service processing ratio is exceeded, the remaining requests are processed in the END processing of the next scan. Also, for scan which has the device/label access service processing time shorter than 0.1ms, it is assumed as "The device/label access service processing time per scan = 0.1ms".

(3) Operations such as access to device, which are synchronized with the program, are processed in the END processing.

(4) The maximum device/label access service processing time available varies because the scan time (program execution time) varies.

Point

For operations such as access to devices, which are synchronized with the program, adjust the time by this setting because they are processed during the END processing. If no request data for the device/label access service processing exists, the scan time is shortened by the specified ratio as the controller proceeds to the next scan without waiting for requests.

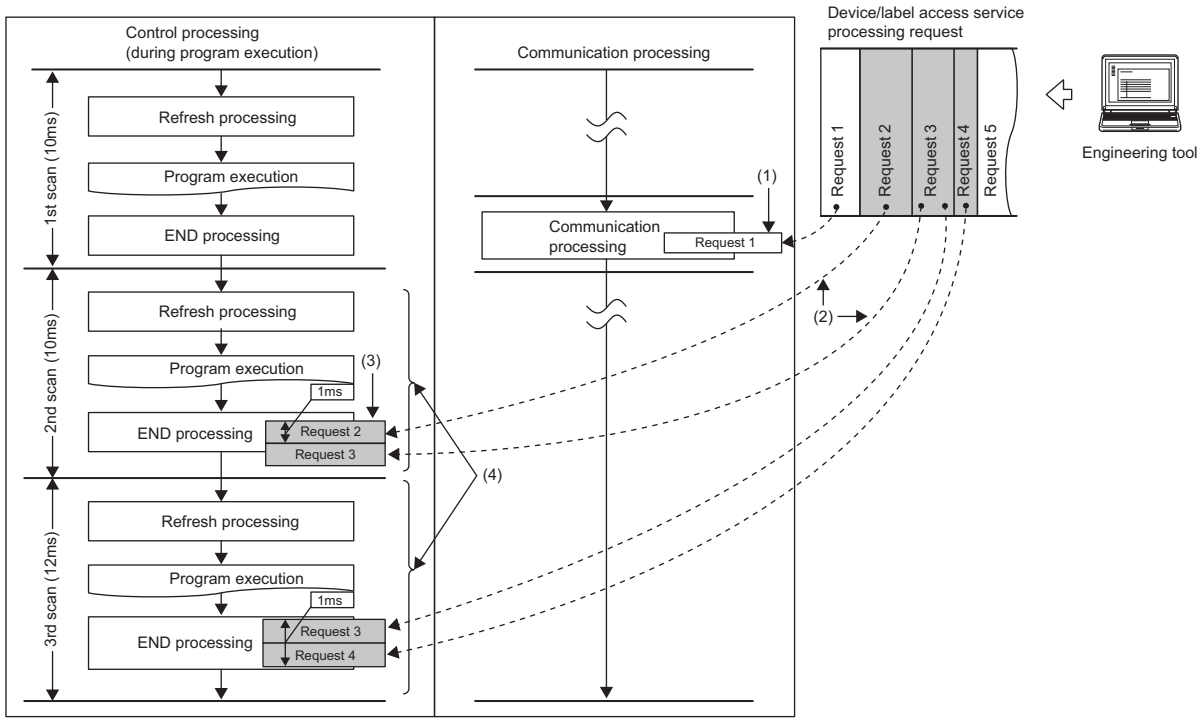
However, when the device/label access service processing constant wait function is enabled, until the ratio set for the device/label access service processing setting of the CPU parameters is reached, the CPU module waits for requests even if requests for service processing do not exist.

■Set Processing Time

This setting is useful to give priority to the device/label access service processing. It allows for stable communication because the controller can always process a constant amount of the device/label access service processing without affecting the scan time.

Ex.

When "Processing time = 1ms" is set



(1) Synchronization with program is unnecessary.
(2) Multiple requests are processed until the specified processing time (1ms) is exceeded. If the specified processing time is exceeded, the remaining requests are processed in the END processing of the next scan.
(3) Operations such as access to device, which are synchronized with the program, are processed in the END processing.
(4) The maximum device/label access service processing time available is the same even when the scan time (program execution time) varies.

Point

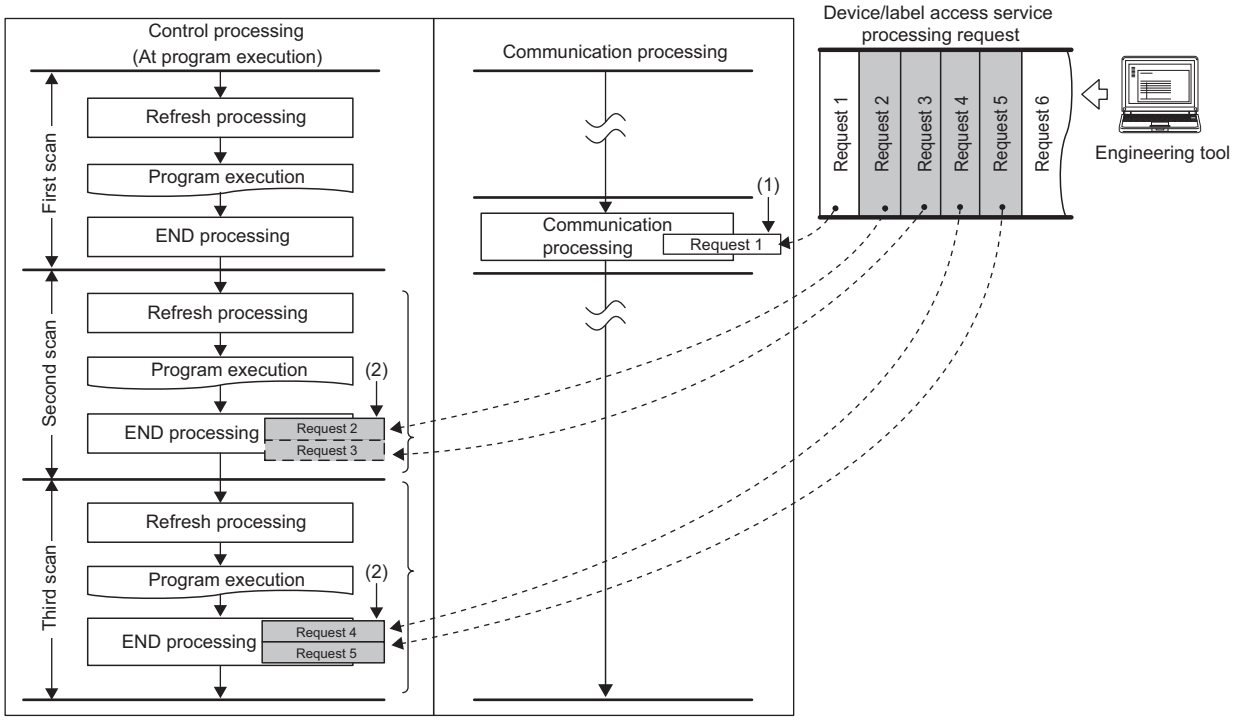
For operations such as access to devices, which are synchronized with the program, adjust the time by this setting because they are processed during the END processing. If no request data for the device/label access service processing exists, the scan time is shortened by the specified ratio as the controller proceeds to the next scan without waiting for requests.

■Set Processing Counts

This setting is useful to stably execute the device/label access service processing in a system where requests come from multiple peripherals. It provides stable communication in a system where multiple peripherals exist because the controller can execute the device/label access service processing based on the number of request sources.

Ex.

When "Processing counts = 2" is set



(1) Synchronization with program is unnecessary.

(2) Two requests are processed in one END processing independently of the requested processing time.

Point

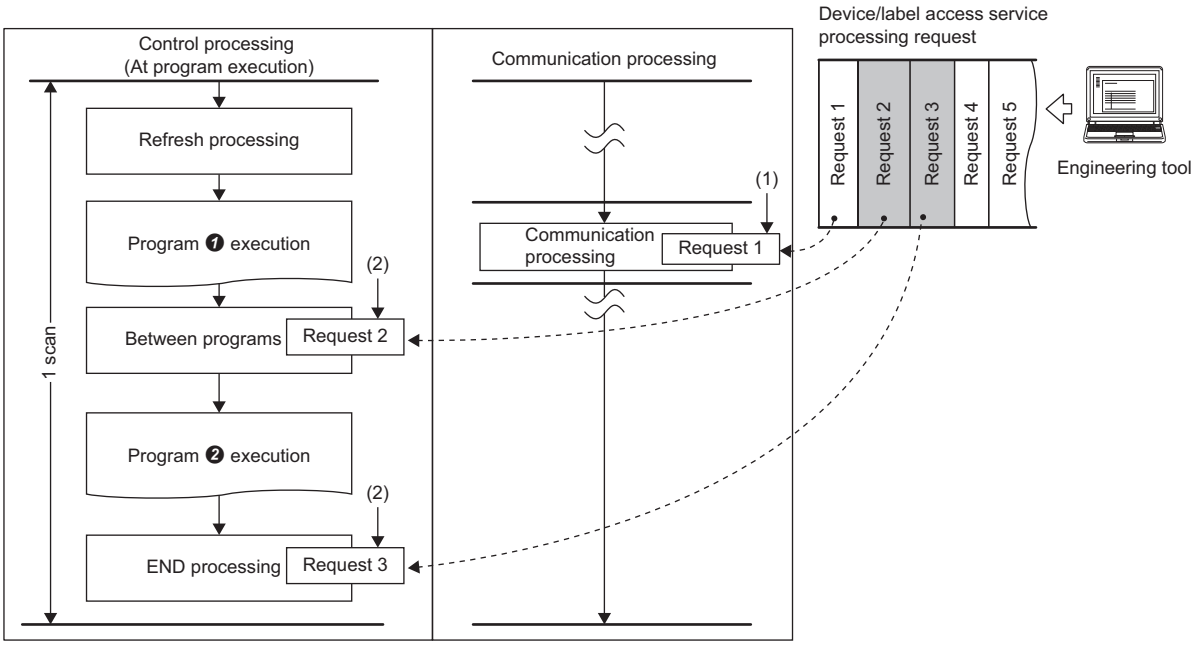
For operations such as access to devices, which are synchronized with the program, adjust the number of executions by this setting because they are processed during the END processing. If no request data for the device/label access service processing exists, the controller proceeds to the next scan without waiting for requests.

■Execute END Processing between Programs

This setting is useful to give priority to the device/label access service processing in a system with a large number of programs. Because operations such as access to devices are performed between program executions and during the END processing, requests as many as the number of programs can be processed during a single scan. As a result, it can reduce the response for the device/label access service processing.

Ex.

When "Execute END Processing between Programs" is enabled



(1) Synchronization with program is unnecessary.

(2) Requests for operations such as access to devices are processed between program executions and during the END processing.

Motion service processing

This section describes the motion service processing that is executed in the service task.

Operation of this function for each system status

○: Yes

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

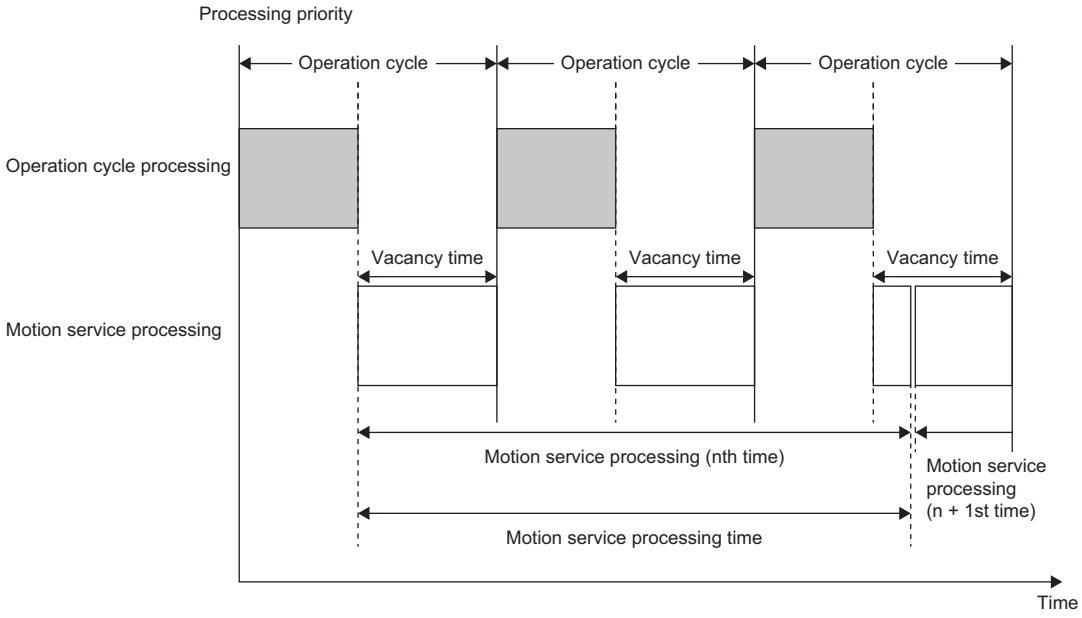
Motion service processing control

The following shows the operation by the motion service processing setting.

The motion service processing is executed in vacancy time of the operation cycle processing.

For the motion service processing time, refer to the following.

☞ Page 528 Motion Operation Processing Time Monitor



Motion service processing details

The following shows the list of the motion service processing.

Applicable function	Description
File access processing	Executes the access processing to the file. The file access processing by a part of FBs is executed in higher priority task than the motion service processing. Refer to the specifications of each FB.
Variable import/reflection processing	Imports/reflects variables whose import timing is set as service.
Initialization processing of each function	Performs the initialization processing of each function. For details, refer to the specifications of each function.

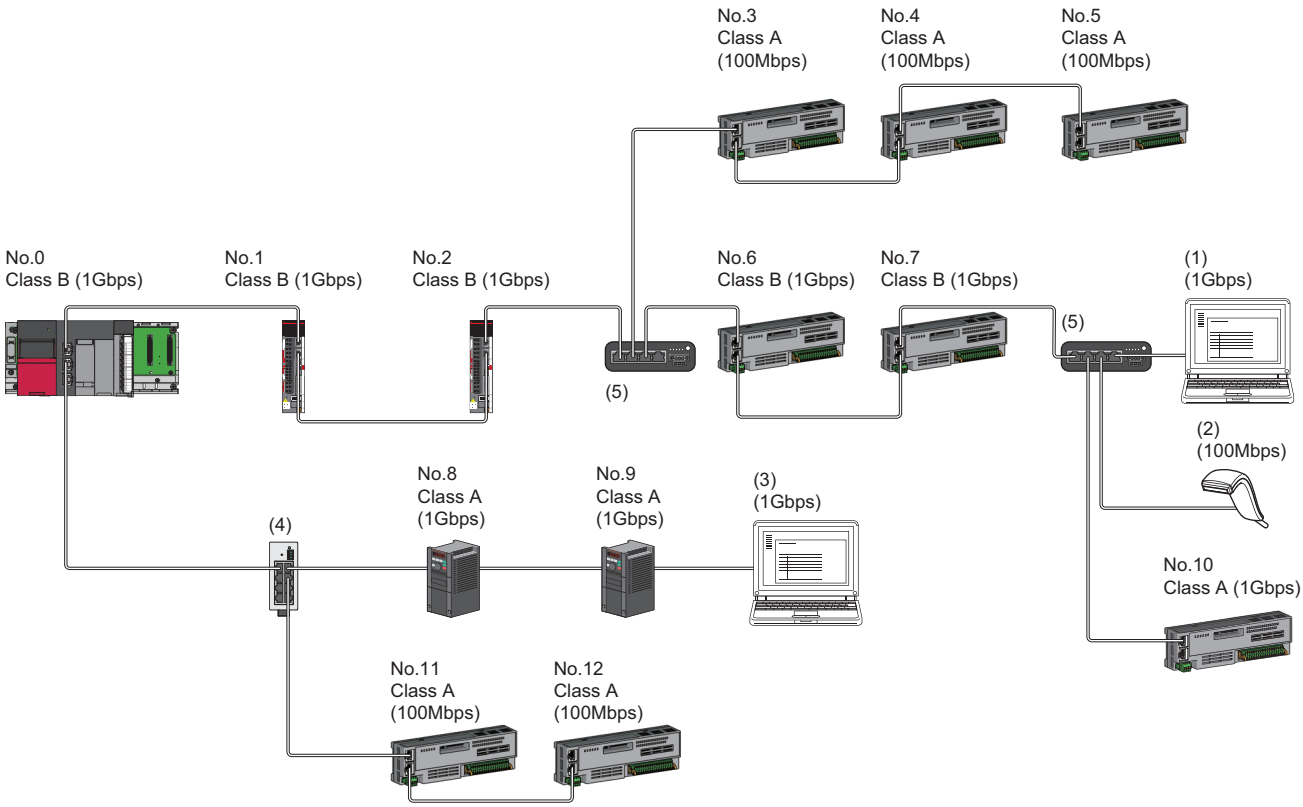
Appendix 16 Connection of CC-Link IE TSN Class B/A Devices

Configuration with CC-Link IE TSN Class B/A devices (Protocol version 2.0/1.0)

The following diagram shows the system configuration under the conditions below:

- CC-Link IE TSN modules support a mixture of protocol versions 2.0 and 1.0.
- "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only" is set for "Connection Device Information" under "Basic Settings" in the engineering tool.

When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only", up to 254 stations (1 master station and 253 device stations (256 modules)) can be connected.



No.0: Master station
No.1 to 12: Remote stations
(1), (2), and (3): Ethernet device
(4) Industrial switch (CC-Link IE TSN Class A certified)
(5) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

Device time synchronization method and connection specifications

The following describes the time synchronization method and connection specification references according to the protocol version 2.0 compatible conditions of the network configuration device.

Protocol version 2.0 only: Devices which support protocol version 2.0 only

With protocol version 1.0: Includes devices which support the protocol version 1.0

None: Works without time synchronization.

Protocol version of the device station		Time synchronization method for each device				Connection specification reference
CC-Link IE TSN Class B device	CC-Link IE TSN Class A device	CC-Link IE TSN Class B device		CC-Link IE TSN Class A device		
		Protocol version 2.0	Protocol version 1.0	Protocol version 2.0	Protocol version 1.0	
Protocol version 2.0 only	Protocol version 2.0 only	IEEE802.1AS	—	Not available	—	Page 178 Structure with CC-Link IE TSN Class B/A Devices
With protocol version 1.0		IEEE802.1AS	IEEE 802.1AS	Not available	—	
Protocol version 2.0 only	With protocol version 1.0	IEEE 1588	—	Not available	IEEE 1588	Page 2132 Connection of CC-Link IE TSN Class B/A Devices
With protocol version 1.0		IEEE 1588	IEEE 1588	Not available	IEEE 1588	

Precautions

- A device station with the protocol version 1.0 may not perform a data link when the master station is operating with the protocol version 2.0. If a device station that does not support protocol version 2.0 is detected, that station does not perform data link, event code 00C80H is registered in the master station, and the information on stations that do not support protocol version 2.0 is stored in 'Station protocol version 2.0 support status' (SW01A0 to SW01A7).
- In the system configuration with a mix of the devices that support the protocol version 2.0 and devices that support the protocol version 1.0, if the device supporting the protocol version 1.0 delays to join the network because the power-on order or startup time of the device at the system start-up varies, the master station operates with the protocol version 2.0 and the device supporting the protocol version 1.0 may not perform a data link. (Event code 00C80H is registered in the master station.)

Point

- The operating protocol can be checked with 'Protocol operating status' (Un\G1294016).
- In a system configuration with a mix of devices that support protocol version 2.0 and those that do not, the master station operates with protocol version 2.0, and devices not supporting protocol version 2.0 may not perform a data link (master station event code 00C80H) due to variations in power-on order or startup time. To operate with protocol version 1.0 fixed in that case, set the operating protocol using the buffer memory. (☞ Page 2131 Operating protocol setting)

■Operating protocol setting

The operating protocol for the network with a mix of the devices that support the protocol version 2.0 and devices that support the protocol version 1.0 can be set in 'Protocol information' (Un\G1294016 to Un\G1294021) in the buffer memory.
The setting value is enabled after resetting or after the power is turned off and on, and is held by the controller.

1. Check the protocol currently held by the controller with 'Protocol setting state' (Un\G1294021).
2. If the protocol needs to be changed, store the setting value in 'Protocol setting' (Un\G1294018), and set 'Write request' (Un\G1294017) to 1.
3. Check that 'Write implementation status' (Un\G1294019) is 1 and 'Setting result' (Un\G1294020) is 0. If 'Setting result' (Un\G1294020) is other than 0, check the error code and set the protocol again.
4. Reset the controller or power off and on the system.

Point

- The operating protocol is determined during the initialization sequence and stored in 'Protocol operating status' (Un\G1294016). Also, if the protocol needs to be changed before resetting the controller or turning the power off and on in step 4, change the protocol setting value after changing the write request to 0. After the change, change 'Write request' (Un\G1294017) to 1 again.
- When setting the operating protocol, do so without cables connected before running the system. If the settings are changed while the system is running, there is a possibility that the link special relay (SB) and link special register (SW) will temporarily not be updated.

■Precautions

- The operating protocol can be checked from 'Protocol operating status' (Un\G1294016).
- When the device station used is set to "CC-Link IE TSN Class A" and "Communication Period Setting" is set to "Low-Speed", depending on the maximum response time during the time-managed polling method, the communication cycle interval, and the setting value of low-speed, send/receive of the cyclic data cannot be guaranteed with the device station within the period of "Low-Speed". In this case, a communication period setting error (error code: 31ABH) occurs, and the controller stops.
- If there is a device station in the CC-Link IE TSN Class A device whose "Communication Period Setting" is set to "Low-Speed", parameter values for guaranteeing receiving/sending cyclic data within the "Low-Speed" period from/to the device station are stored in 'Multiple cycle setting (low speed)' (Un\G1277442) and 'Communication cycle intervals (calculation value)' (Un\G1277443). Set "Multiple Period Setting" to "Low-Speed" and set "Communication Period Interval Setting" to a value equal to or larger than that parameter value. However, if modules selected in the "CC-Link IE TSN Configuration" window are all general CC-Link IE TSN modules, the parameter values are not stored.
- If the general CC-Link IE TSN modules added to the "CC-Link IE TSN Configuration" window are CC-Link IE TSN Class A devices, and "Low-Speed" in "Multiple Period Setting" and "Communication Period Interval Setting" are set to values of 'Multiple cycle setting (low speed)' (Un\G1277442) and 'Communication cycle intervals (calculation value)' (Un\G1277443), the cyclic data may not be sent/received. In this case, add the actual device to be used to the "CC-Link IE TSN Configuration" window or refer to the manual for the device used to check the maximum response time for the time-managed polling method, calculate and set the communication cycle interval setting.

■Operation when devices with protocol version 2.0/1.0 are combined

The following table lists the restrictions when combining the protocol version 2.0/1.0 in connected devices.

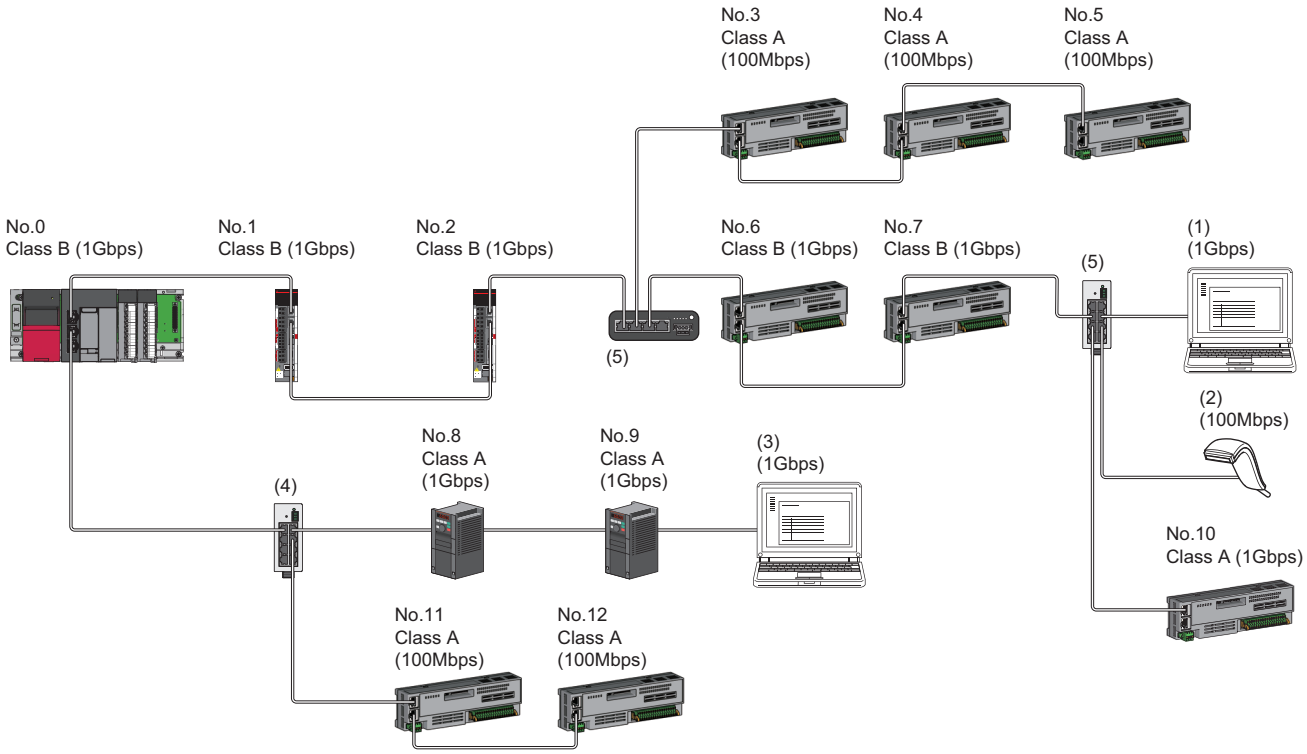
Protocol version 2.0/1.0		Restrictions
CC-Link IE TSN Class B device	CC-Link IE TSN Class A device	
Protocol version 2.0 only	Protocol version 2.0 only	Not available
With protocol version 1.0		A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes.
Protocol version 2.0 only	With protocol version 1.0	• Up to eight CC-Link IE TSN Class B devices can be connected to each port of a master station. • A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes.
With protocol version 1.0		

Configuration with CC-Link IE TSN Class B/A devices (Protocol version 1.0 only)

The following diagram shows the system configuration under the conditions below:

- The CC-Link IE TSN module supports protocol version 1.0 only
- Set "Connection Device Information" under "Basic Settings" of the engineering tool to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only".

When "Connection Device Information" under "Basic Settings" of the master station is set to "Mixture of CC-Link IE TSN Class B/A or CC-Link IE TSN Class A Only", up to 121 stations (1 master station and 120 device stations) can be connected.



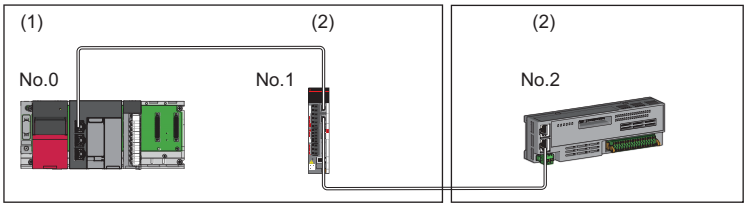
No.0: Master station
No.1 to No.12: Remote stations
(1), (2), and (3): Ethernet device
(4) Industrial switch (CC-Link IE TSN certified)
(5) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- Unicast mode

☞ Page 2133 Structure of unicast mode

☞ Page 2134 Structure of unicast mode

The following terms are used to describe the terms in the tables referenced.



No.0: Master station
No.1, No.2: Remote station
(1) Device on the master station side (The master station or a device near the master station)
(2) Device on the end side (A device far from the master station)

Structure of unicast mode

This mode indicates the availability of connection with a network configuration device when "Communication Mode" under "Application Settings" is set to "Unicast".

■When the communication speed for the master station is set to 1Gbps

This mode indicates the availability of connection with a network configuration device when "Communication Speed" of the master station is set to "1Gbps".

○: Connection available, △: Connection available via an Ethernet switch, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)					
		Remote station (CC-Link IE TSN Class B device)		Remote station (CC-Link IE TSN Class A device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1	○SH	△SH*1	○SH	△SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	○S	△S*1*3	○SH*2	△SH*1*2	○SH	△SH
	100Mbps	×	○S*1*3	×	○SH*1*2*3	×	○SH
Remote station (CC-Link IE TSN Class A device)	1Gbps	×	×	○SH*2	△SH*1*2	○SH	△SH
	100Mbps	×	×	×	○SH*1*2	×	○SH

*1 For a device station with a communication speed of 100Mbps, set "Communication Period Setting" to "Low-Speed".

*2 A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes. (☞ Page 189 Calculation of the total cyclic data size)

*3 A connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps. (☞ Page 189 Calculation of the total cyclic data size)

Precautions

When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

■When the communication speed for the master station is set to 100Mbps

This mode indicates the availability of connection with a network configuration device when "Communication Speed" of the master station set to "100Mbps".

○: Connection available, △: Connection available via an Ethernet switch, ×: Connection not available

S: Industrial switches (CC-Link IE TSN Class B certified) can be used.

H: Ethernet switches can be used.

Device on the master station side (A device near the master station)		Device on the end side (A device far from the master station)					
		Remote station (CC-Link IE TSN Class B device)		Remote station (CC-Link IE TSN Class A device)		Ethernet device	
		1Gbps	100Mbps	1Gbps	100Mbps	1Gbps	100Mbps
Master station (CC-Link IE TSN Class B device)	100Mbps	×	○S*2	×	○SH	×	○SH
Remote station (CC-Link IE TSN Class B device)	1Gbps	×	×	×	×	×	×
	100Mbps	×	○S*2	×	○SH*1	×	○SH
Remote station (CC-Link IE TSN Class A device)	1Gbps	×	×	×	×	×	×
	100Mbps	×	×	×	○SH*1	×	○SH

*1 A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes. (☞ Page 189 Calculation of the total cyclic data size)

*2 For a device station with a communication speed of 100Mbps, set "Communication Period Setting" to "Basic Period" or "Normal-Speed".

Precautions

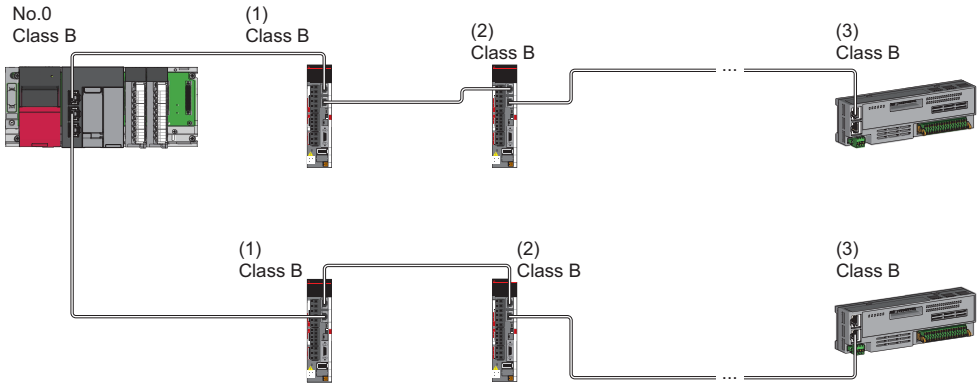
When using an industrial switch (CC-Link IE TSN Class B certified), be sure to check the specifications of the industrial switch (CC-Link IE TSN Class B certified) on the CC-Link Partner Association website at www.cc-link.org.

Connection with modules on CC-Link IE TSN only

■Line topology

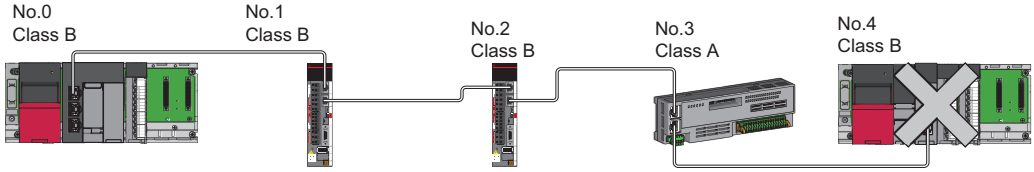
The network is configured in a line topology.

- Up to eight CC-Link IE TSN Class B devices can be connected to P1 or P2 of the master station.



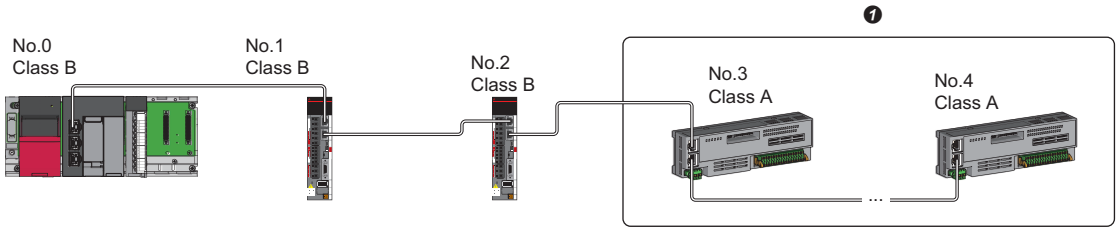
No.0: Master station
(1) Remote station (1st device)
(2) Remote station (2nd device)
(3) Remote station (8th device)
Class B: CC-Link IE TSN Class B device

- A CC-Link IE TSN Class B device cannot be connected to a CC-Link IE TSN Class A device.



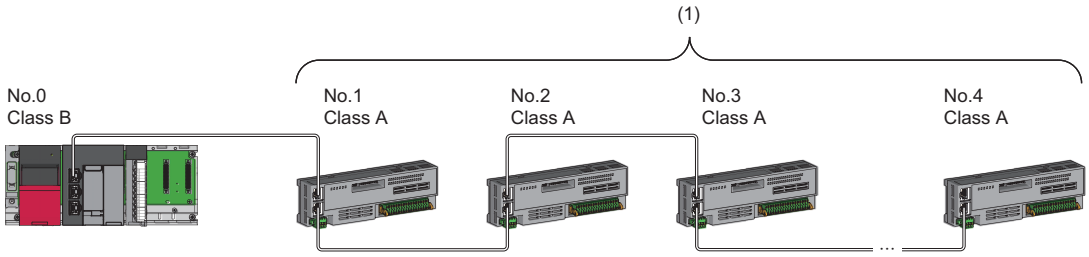
No.0: Master station
No.1 to 4: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side including the CC-Link IE TSN Class A device that forms the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes.



No.0: Master station
No.1 to 4: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
❶ Set the total cyclic data size within 2K bytes.

• When the device stations are CC-Link IE TSN Class A devices only, up to 120 device stations can be connected.

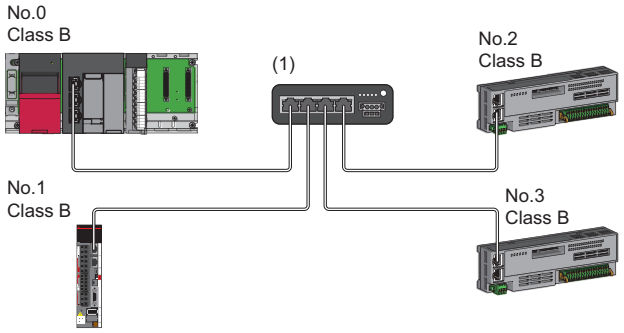


No.0: Master station
No.1 to 4: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1) Total of the device stations: Up to 120

■Star topology

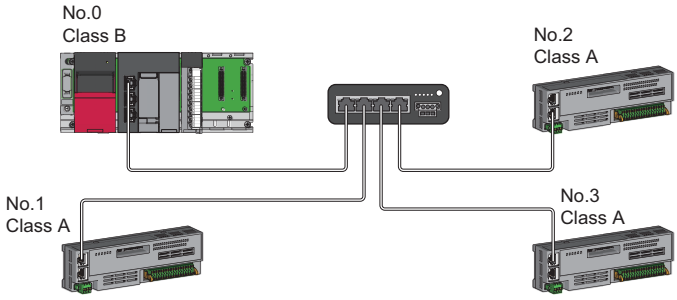
Modules are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

• When connecting a CC-Link IE TSN Class B device in a star topology, use an industrial switch (CC-Link IE TSN Class B certified).



No.0: Master station
No.1, No.2, and No.3: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
Class B: CC-Link IE TSN Class B device

• When connecting a CC-Link IE TSN Class A device to a CC-Link IE TSN Class B device or a CC-Link IE TSN Class A device to another CC-Link IE TSN Class A device in a star topology, connect them via an industrial switch (CC-Link IE TSN certified).

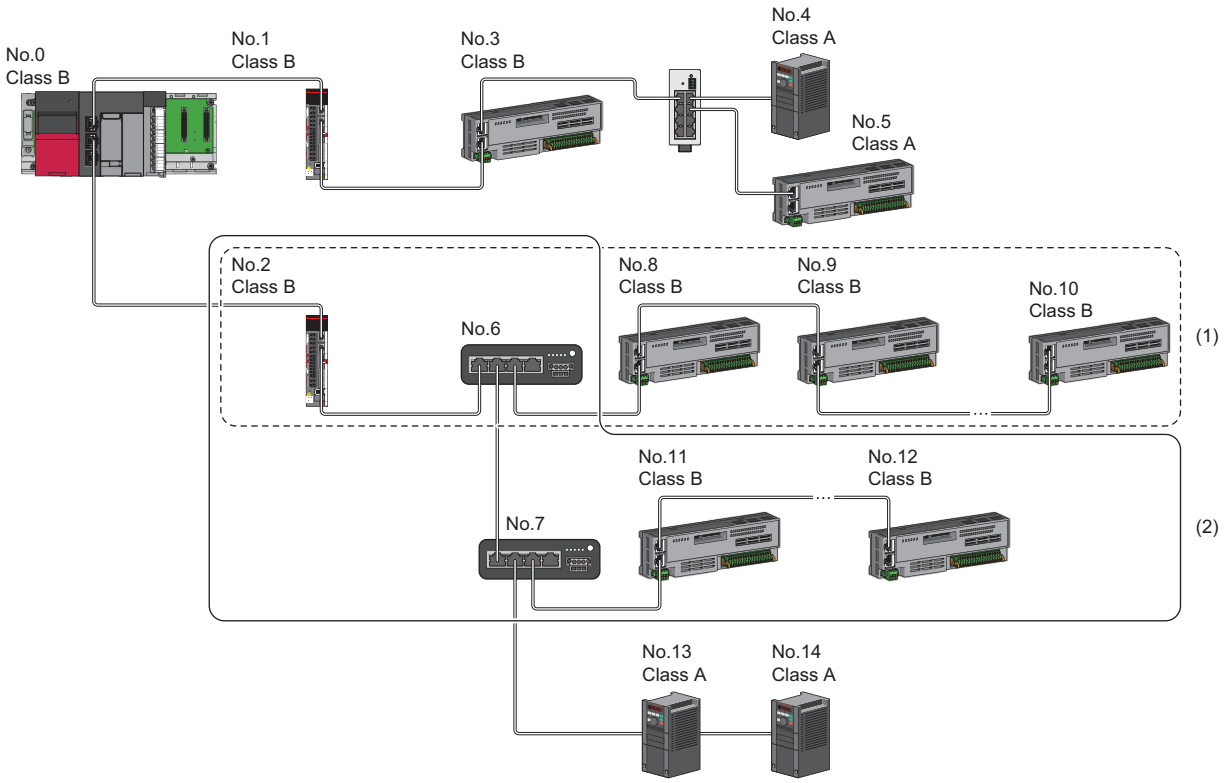


No.0: Master station
No.1, No.2, and No.3: Remote station
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

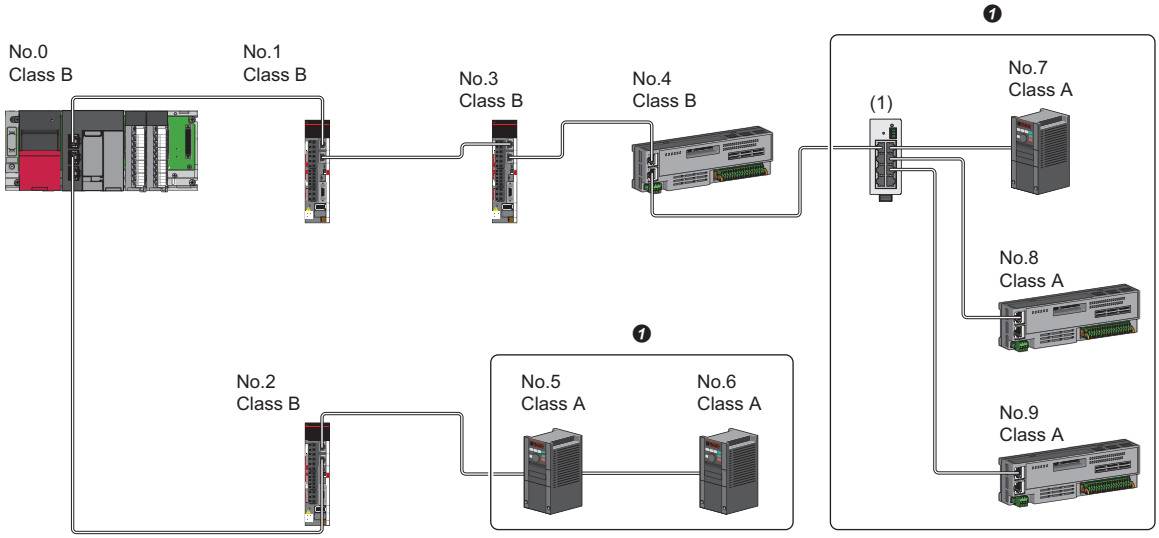
Line and star topologies can be mixed according to the connection requirements described below.

- Up to eight CC-Link IE TSN Class B devices (including industrial switches (CC-Link IE TSN Class B certified)) can be connected from the master station to the end of each network.
- When connecting a CC-Link IE TSN Class A device, connect it to the end of a CC-Link IE TSN Class B device or to an industrial switch (CC-Link IE TSN Class B certified). A star topology is also possible using the industrial switch (CC-Link IE TSN certified).



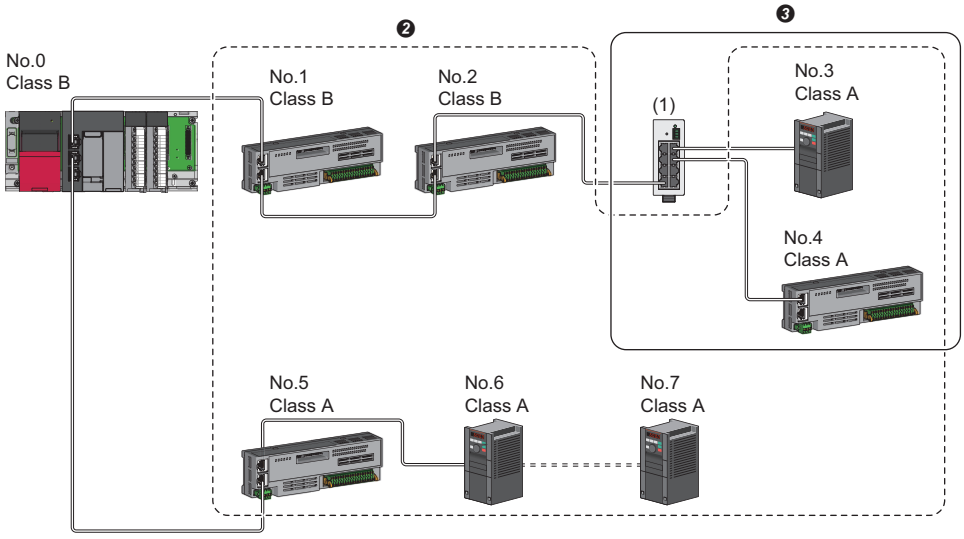
No.0: Master station
No.1, No.3, No.4, No.5, No.13, No.14: Device stations
No.2: Device station (1st device)
No.6: Industrial switch (CC-Link IE TSN Class B certified) (2nd device)
No.7: Industrial switch (CC-Link IE TSN Class B certified) (3rd device)
No.8: Device station (3rd device)
No.9, No.11: Device stations (4th device)
No.10, No.12: Device stations (8th device)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1), (2): Up to eight CC-Link IE TSN Class B devices (including industrial switches (CC-Link IE TSN Class B certified)) can be connected

• A connection cannot be made if the total cyclic data size of all device stations on the CC-Link IE TSN Class A device side at the boundary between CC-Link IE TSN Class B and CC-Link IE TSN Class A exceeds 2K bytes.



No.0: Master station
No.1 to 9: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1) Industrial switch (CC-Link IE TSN certified)
❶ Set the total cyclic data size within 2K bytes.

• Up to 120 device stations can be connected by using the appropriate master station port in accordance with the CC-Link IE TSN Class.



No.0: Master station
No.1 to 7: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
(1) Industrial switch (CC-Link IE TSN certified)
❷ Up to 120 devices can be connected in total.
❸ Set the total cyclic data size within 2K bytes.

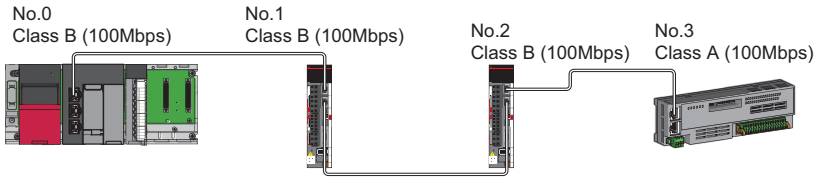
Connection with modules on CC-Link IE TSN with a communication speed of 100Mbps

This section describes the network topology when "Communication Speed" under "Application Settings" is set to "100Mbps".

■Line topology

The network is configured in a line topology.

- Up to eight CC-Link IE TSN Class B devices can be connected to each of P1 and P2 of the master station.
- Ensure that the communication speed of each module is the same when connecting them.
- When connecting modules with different communication speeds, connect the modules via an industrial switch (CC-Link IE TSN certified).

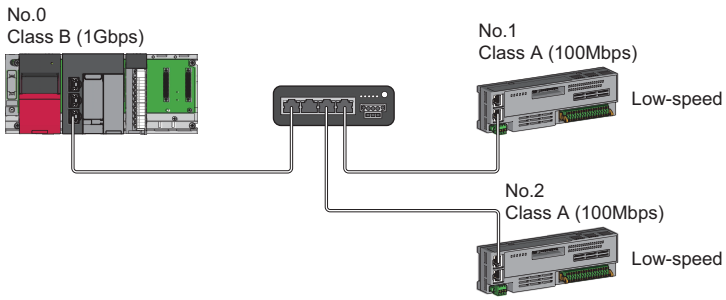


No.0: Master station
No.1, No.2, and No.3: Remote station
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Star topology

Modules are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

- When the master station with a communication speed of 1Gbps and a remote station with a communication speed of 100Mbps exist in the structure, set "Communication Period Setting" to "Low-Speed" for the remote station with a communication speed of 100Mbps.

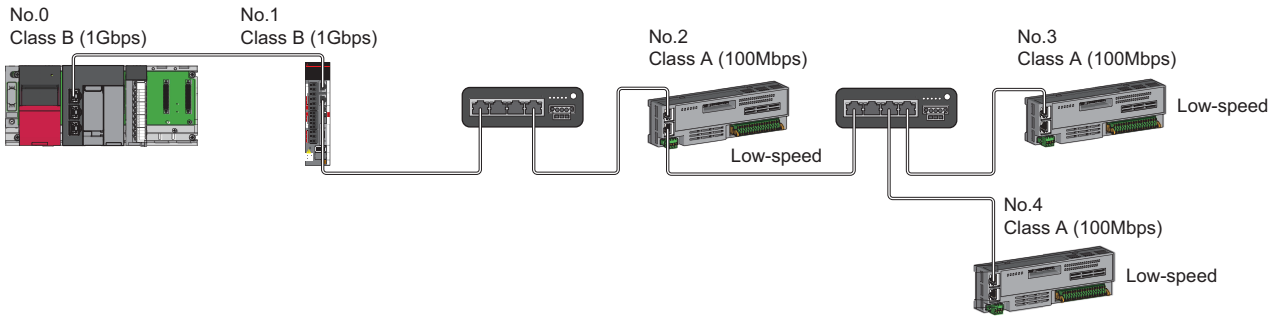


No.0: Master station
No.1, No.2: Remote station
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

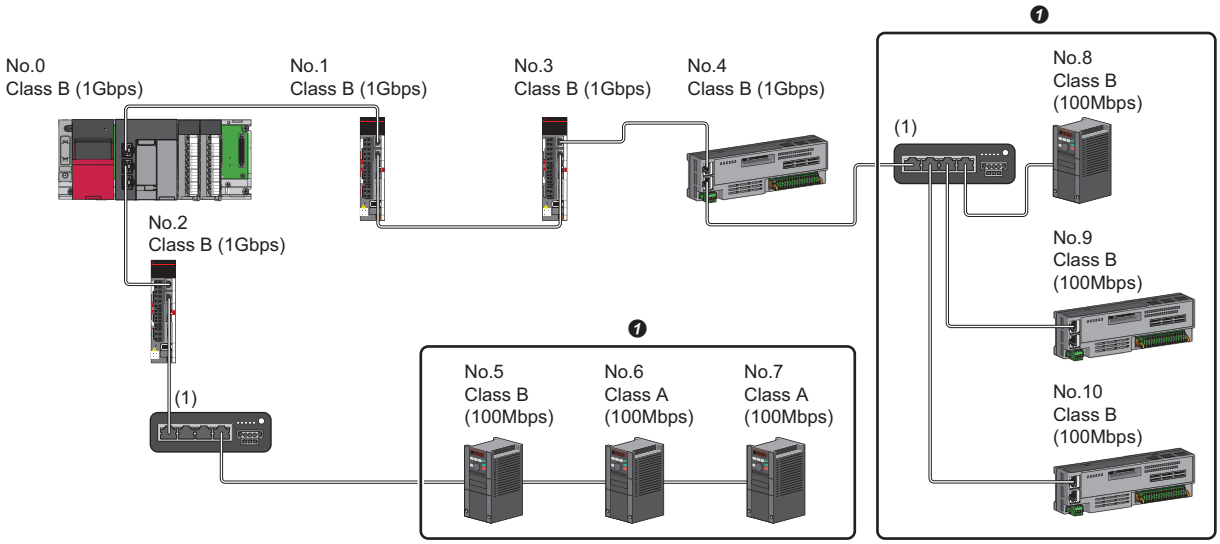
Line and star topologies can be mixed in the same network configuration.

- Up to eight CC-Link IE TSN Class B devices (including industrial switches (CC-Link IE TSN Class B certified)) can be connected from the master station to the end of each network.
- For the configuration where the master station with a communication speed of 1Gbps and a remote station with a communication speed of 100Mbps exist, set "Communication Period Setting" to "Low-Speed" for the remote station with a communication speed of 100Mbps.



No.0: Master station
No.1 to 4: Remote stations
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

- When the communication speed of the master station is 1Gbps, a connection cannot be established if the total cyclic data size of all device stations on the 100Mbps device side exceeds 2K bytes. This includes the devices with a communication speed of 100Mbps that form a boundary between the communication speed of 1Gbps and 100Mbps.



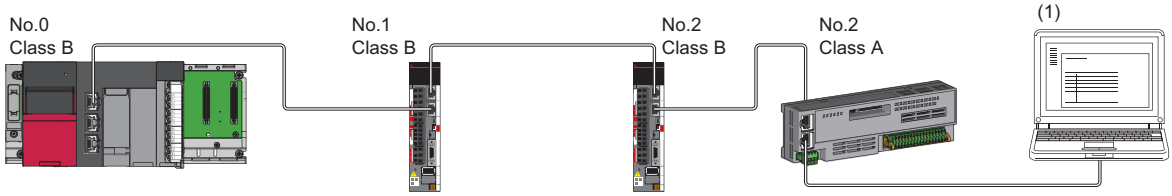
No.0: Master station
No.1 to 10: Remote stations
(1) Industrial switch (CC-Link IE TSN Class B certified)
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device
❶ Set the total cyclic data size within 2K bytes.

Connection with modules on CC-Link IE TSN and Ethernet devices

■Line topology

The network with modules and devices is configured in a line topology. An industrial switch (CC-Link IE TSN certified) is not required for connection.

Up to eight CC-Link IE TSN Class B devices can be connected to each of P1 and P2 of the master station.



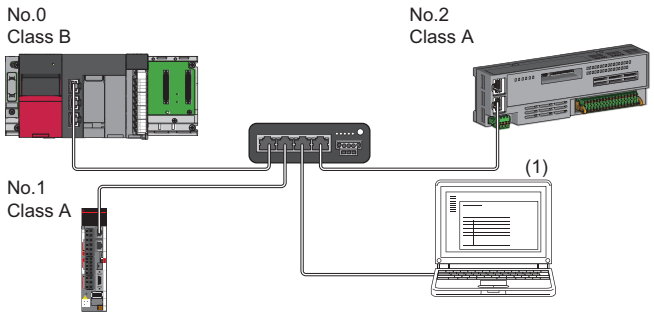
No.0: Master station
No.1, No.2, and No.3: Remote station
(1) Ethernet device
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

Connect Ethernet devices to the end of the network.

When an error occurs in a device station, the stations connected after the faulty station will be disconnected.

■Star topology

Modules and devices are connected in a star topology via an industrial switch (CC-Link IE TSN certified).

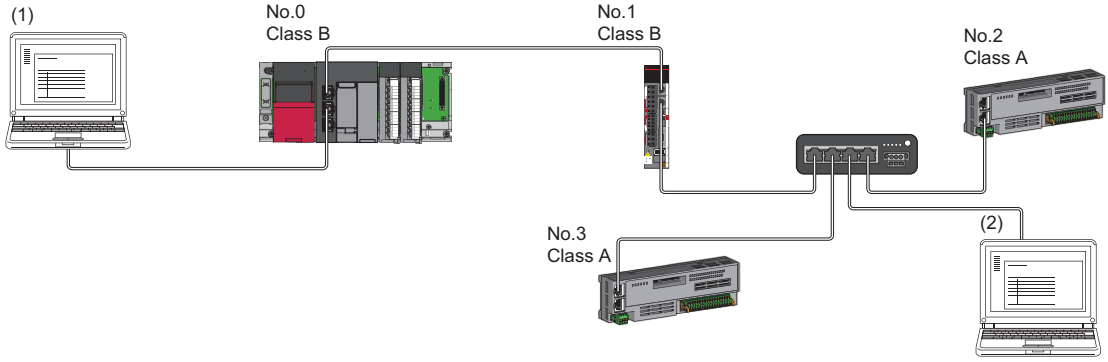


No.0: Master station
No.1, No.2: Remote station
(1) Ethernet device
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

■Coexistence of line and star topologies

Line and star topologies can be mixed according to the connection requirements described below.

- Up to eight CC-Link IE TSN Class B devices (including industrial switches (CC-Link IE TSN Class B certified)) can be connected from the master station to the end of each network.
- Connect Ethernet devices at the end of line topology.
- When connecting Ethernet devices in a star topology, connect them to an Ethernet switch.



No.0: Master station
No.1, No.2, and No.3: Remote station
(1), (2): Ethernet device
Class A: CC-Link IE TSN Class A device
Class B: CC-Link IE TSN Class B device

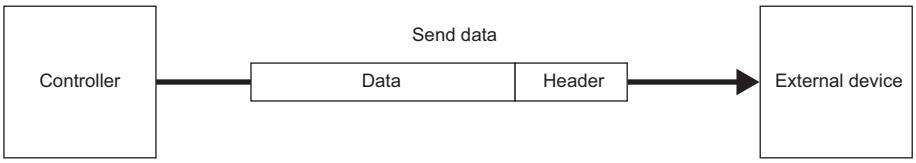
Appendix 17 Operation Image and Data Structure of Predefined Protocol

Operation image of each communication type of protocol

With the predefined protocol support function, data is communicated with the external device using the "Send Only", "Receive Only", and "Send & Receive" communication types.
This section describes the operation images of each communication type.

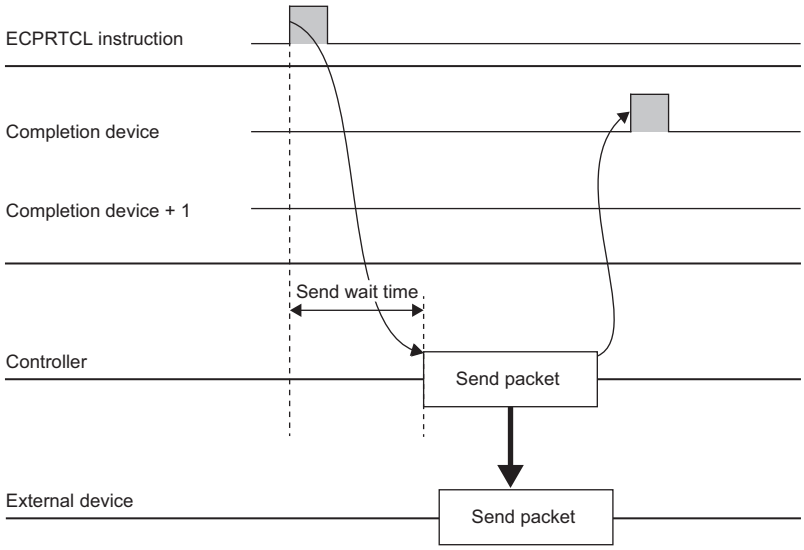
For "Send Only" communication type

The specified packet is sent once.

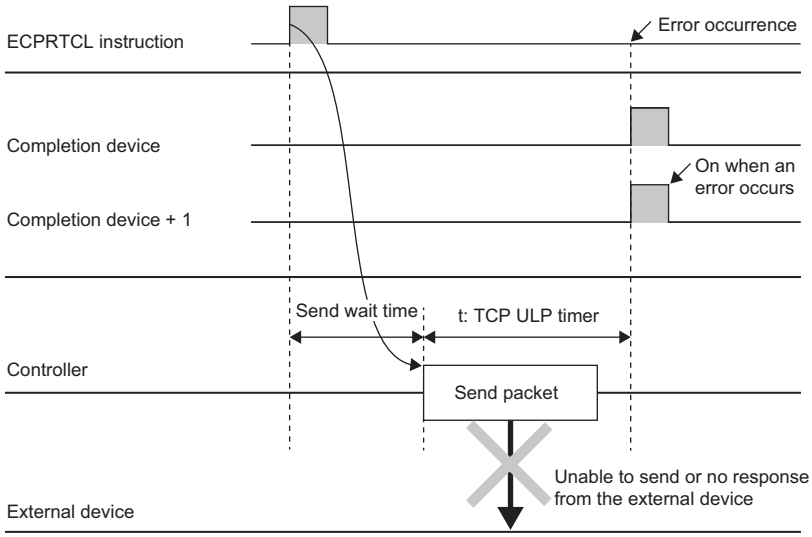


The operation image of "Send Only" is shown below.

■When the instruction completed successfully



■When the instruction completed with an error at TCP/IP (timeout error)



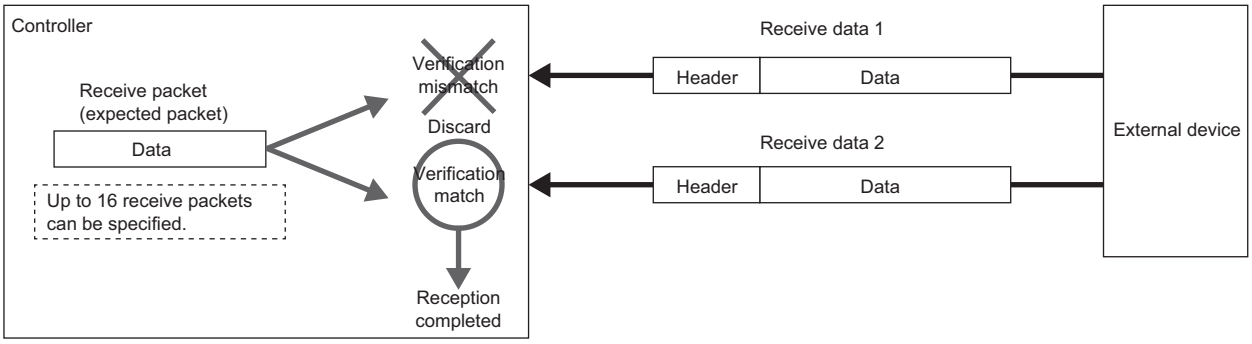
Point

For details on errors that occur when the communication completed abnormally, refer to the error code stored in the buffer memory.

☞ Page 1776 ERROR CODES

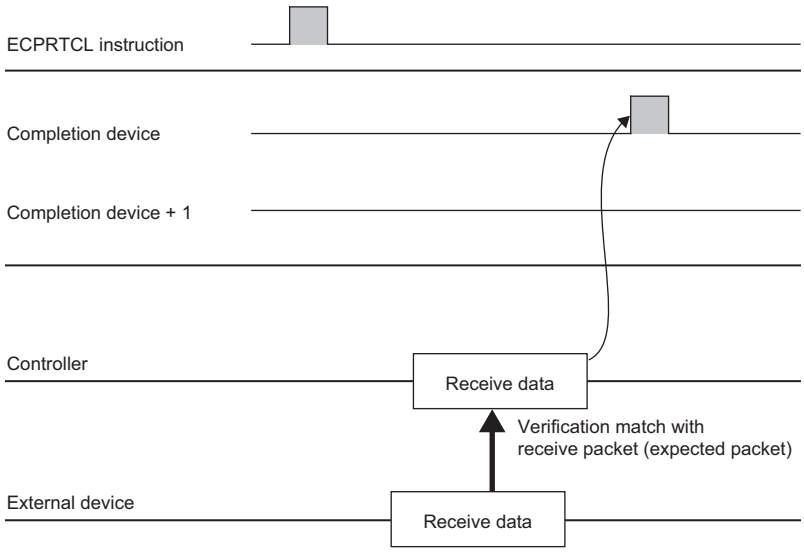
For "Receive Only" communication type

When data is received from the external device, it is verified with the receive packet (expected packet). If it matches, the receive processing ends. If the verification does not match, the received data is discarded.

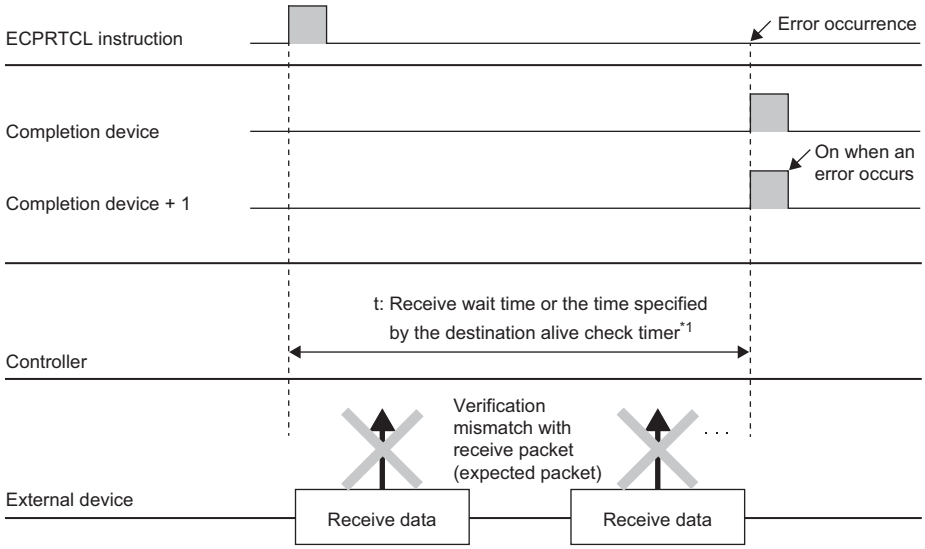


The operation image of "Receive Only" is shown below.

■When the instruction completed successfully



■When the instruction completed with an error (timeout error)



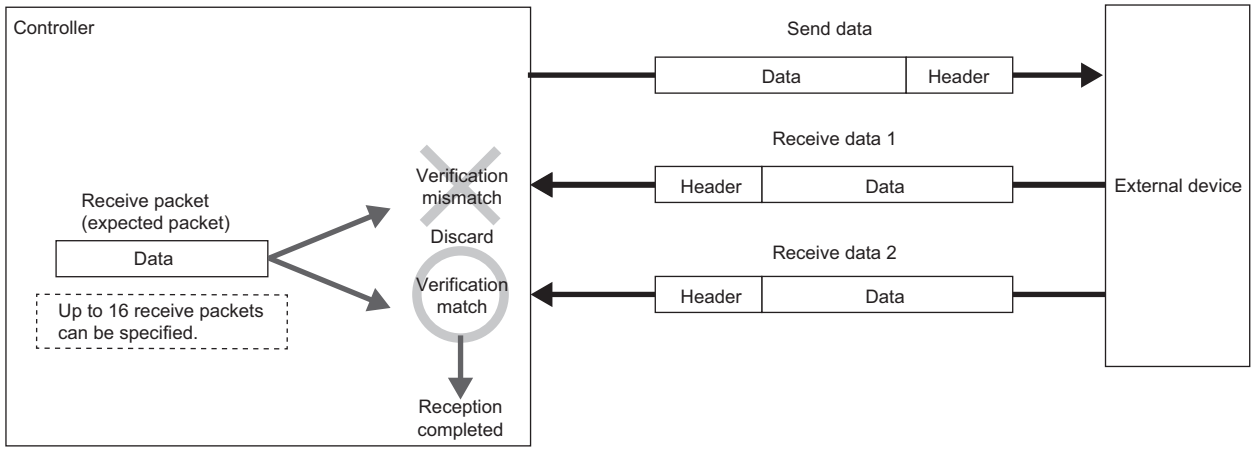
*1 When the receive packet (expected packet) verification does not match before the reception wait time, or when other device existence cannot be checked within the destination alive check time (time calculated from destination alive check start interval timer value, destination alive check interval timer value, and destination alive check resend count).

Point

- When variables are included in receive packet (expected packet) elements, variable data are not verified.
- Up to 16 receive packets (expected packets) can be specified.
- When multiple packets are specified, the received data is verified with the registered receive packet (expected packet) in the order of registration. The receive processing is completed when a matching receive packet (expected packet) is found, and the subsequent verification is canceled.
- The number of the matching received packet is stored in the control data of the ECPRTCL instruction and the buffer memory.
- For details on errors that occur when the communication completed abnormally, refer to the error code stored in the buffer memory. (☞ Page 1776 ERROR CODES)

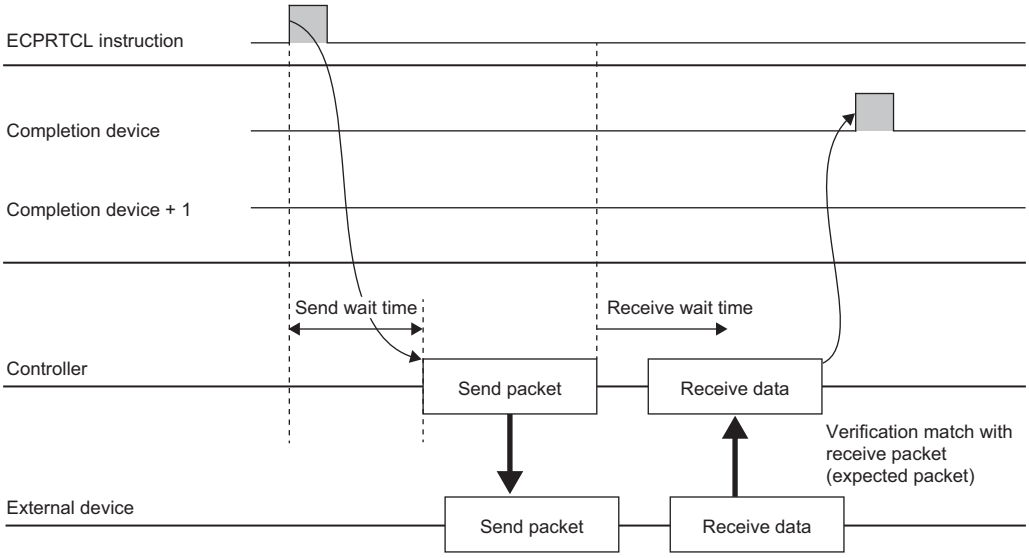
For "Send & Receive" communication type

The packet is sent once. If the send completed successfully, the module shifts to the receiving standby state. When data is received from the external device, it is verified with the receive packet (expected packet). If it matches, the receive processing ends.

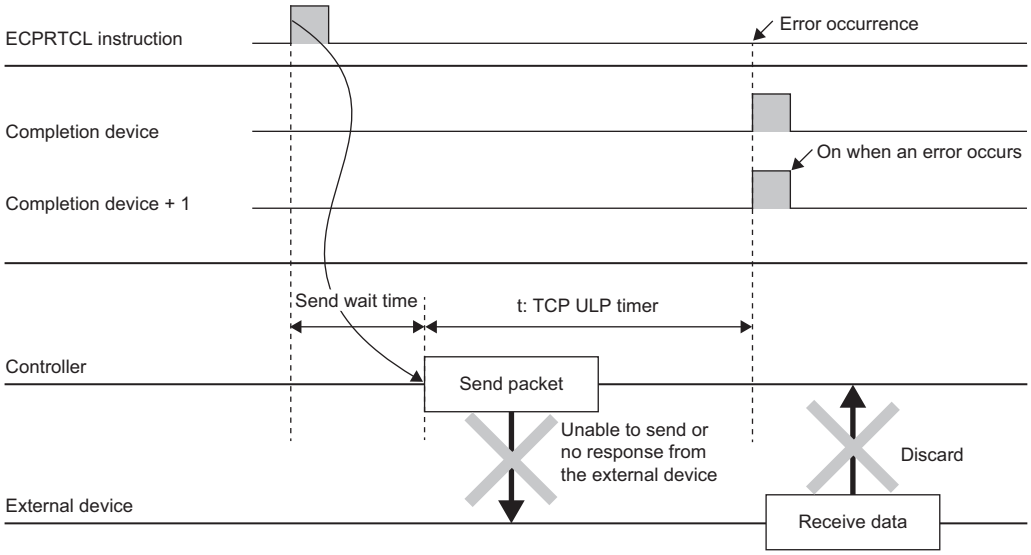


The operation image of "Send & Receive" is shown below.

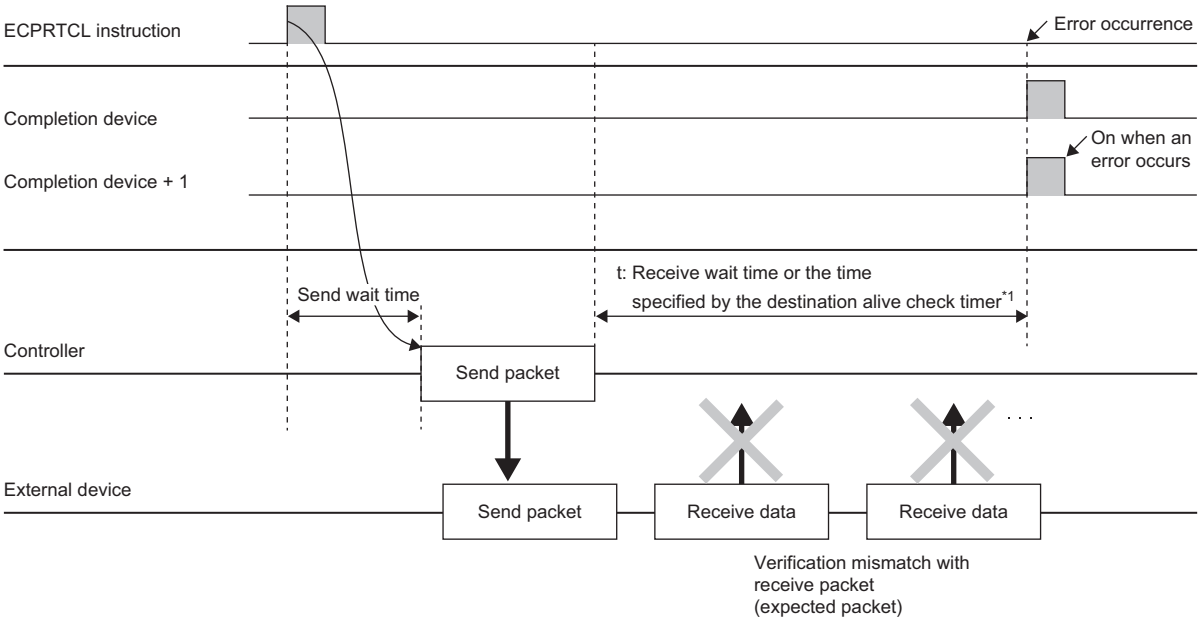
■When the instruction completed successfully



■When the instruction completed with an error (timeout error at sending)



■When the instruction completed with an error (timeout error of waiting time to receive)



*1 When the receive packet (expected packet) verification does not match before the reception wait time, or when other device existence cannot be checked within the destination alive check time (time calculated from destination alive check start interval timer value, destination alive check interval timer value, and destination alive check resend count).

Point

For details on errors that occur when the communication completed abnormally, refer to the error code stored in the buffer memory.

(☞ Page 1776 ERROR CODES)

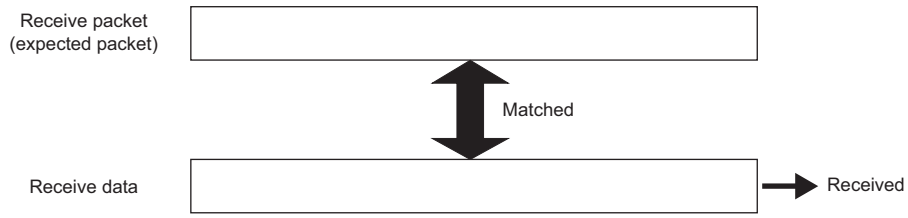
Verification operation of receive packet

This section describes the receive packet (expected packet) verification operation for communication with an external device when the protocol communication type contains reception.
Verification is performed for the following elements.

- Static data
- Length
- Non-conversion variable
- Non-verified reception

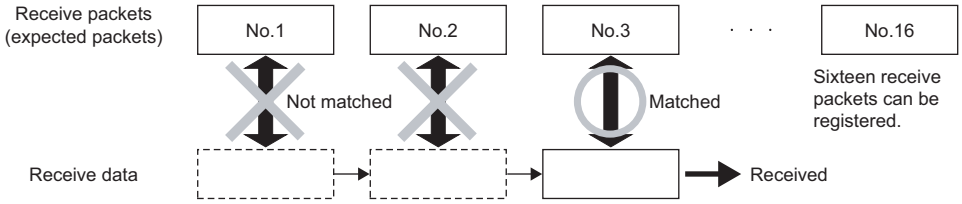
When received data are matched with a receive packet (expected packet)

The received data is compared against the receive packet (expected packet), and the receive processing completes when the verification matches.



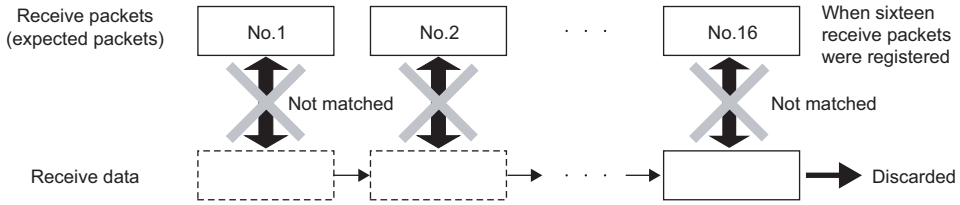
When multiple receive packets (expected packets) are specified

Up to 16 receive packets (expected packets) can be registered with the predefined protocol support function. When the data are received, the registered receive packet (expected packet) is verified in the order of registration. The receive processing completes as soon as a matching receive packet (expected packet) is found.



When received data does not match with all receive packet (expected packet)

If the received data does not match any of the registered receive packets (expected packets), the received data is discarded.



Example of packet element data

The element processing procedures that can be set for the packets, the actual data examples, and others are shown below.

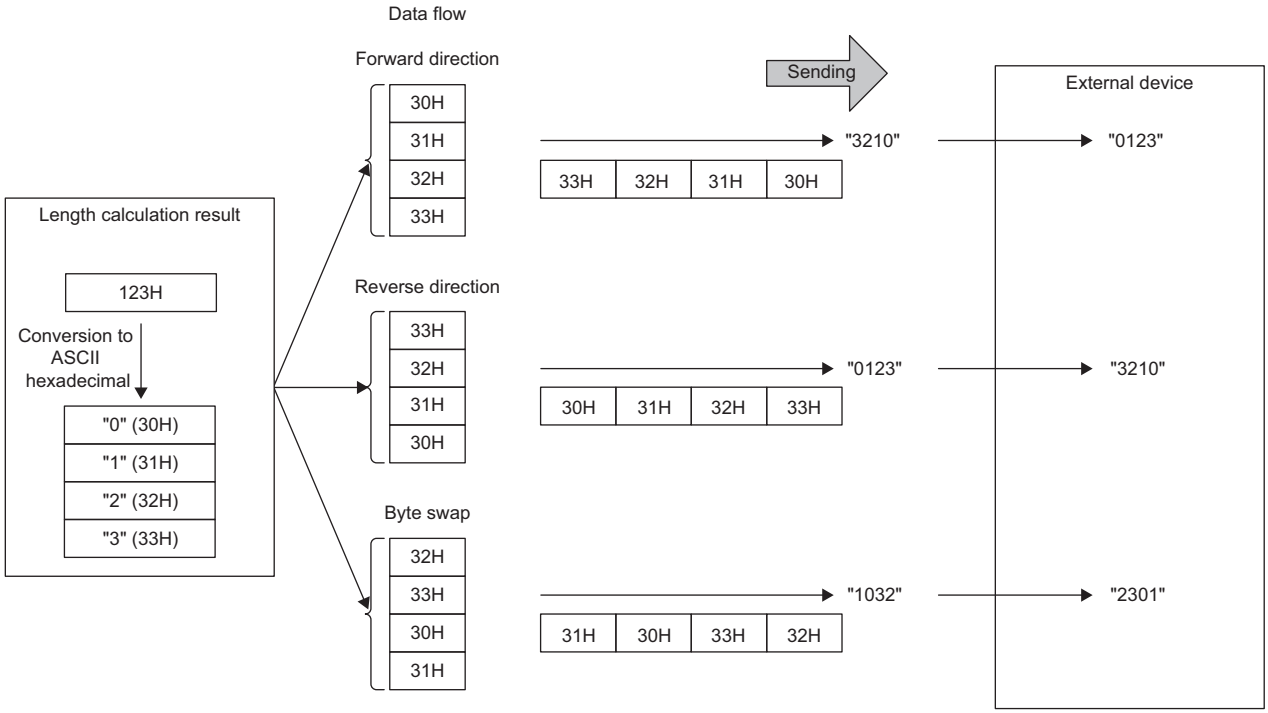
A

Length

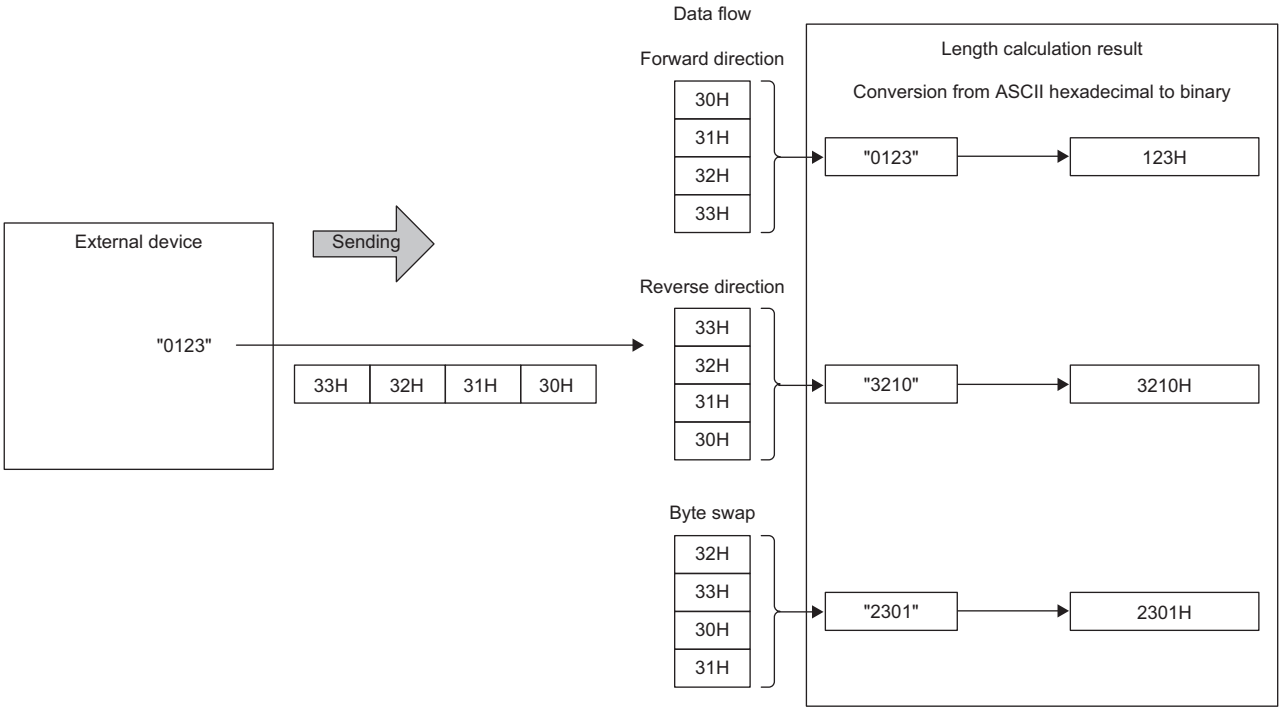
■Process procedure

The controller performs the length processing according to the procedure below.

[During send]



[During receive]



■Data flow

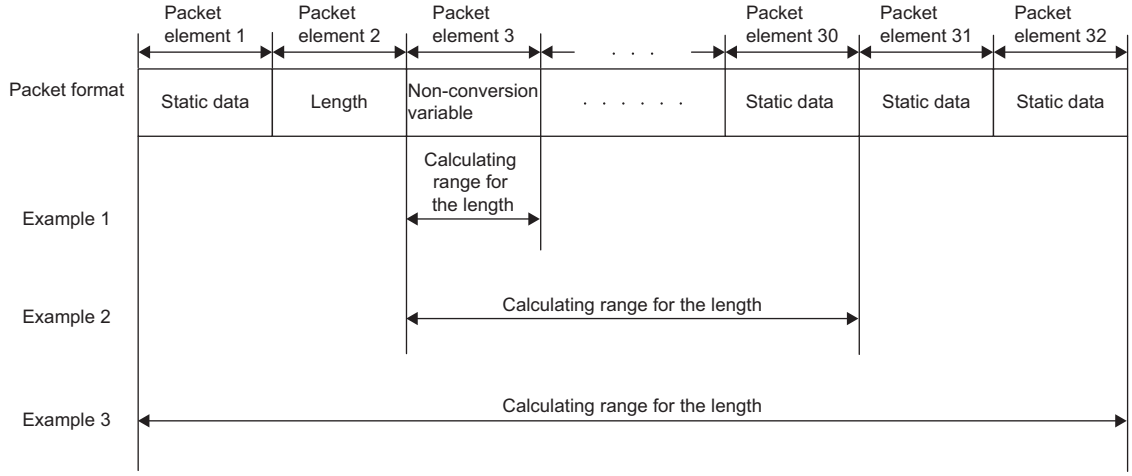
Data flow is used to specify the order of send data and receive data.

The data flow can be specified in forward direction (upper byte → lower byte), reverse direction (lower byte → upper byte), and byte swap (by word).

- Forward direction, reverse direction: Available when the data length is 2 bytes or more.
- Byte swap: Available only when the data length is 4 bytes.

■Calculating range

Examples of specifying the length calculating range are shown below.



Example 1:Calculating range when start of range is set as 3 and end is set as 3
Example 2:Calculating range when start of range is set as 3 and end is set as 30
Example 3:Calculating range when start of range is set as 1 and end is set as 32

Non-conversion variable

■Process procedure

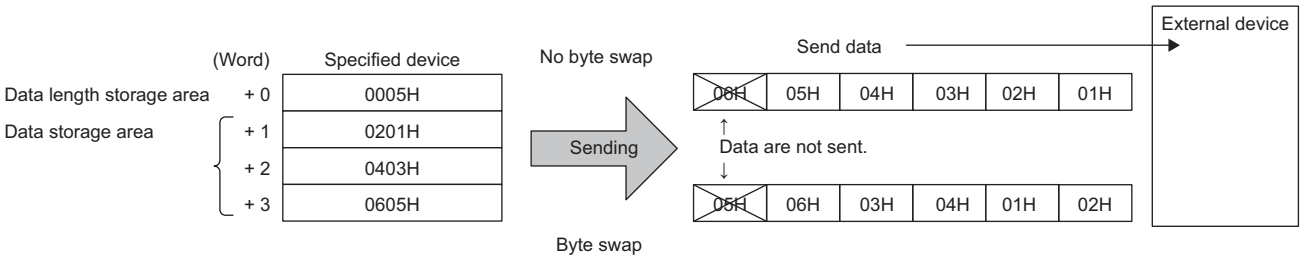
The controller performs the processing of non-conversion variable according to the procedure below.

When unit of stored data is "Lower Byte + Upper Byte"

- When the data length of a send packet is an odd number, the upper byte (lower byte when bytes are swapped) of the end device is not sent.
- When the data length of a receive packet is an odd number, the last data is stored with one byte of 00H.

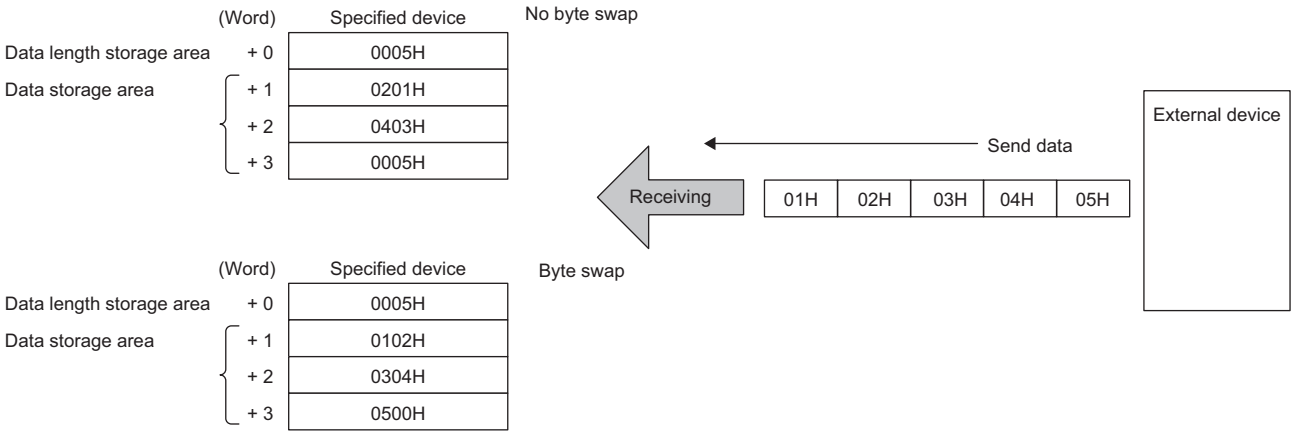
Ex.

When sending data whose length is an odd number



Ex.

When receiving data whose length is an odd number



When unit of stored data is "Lower Byte Only"

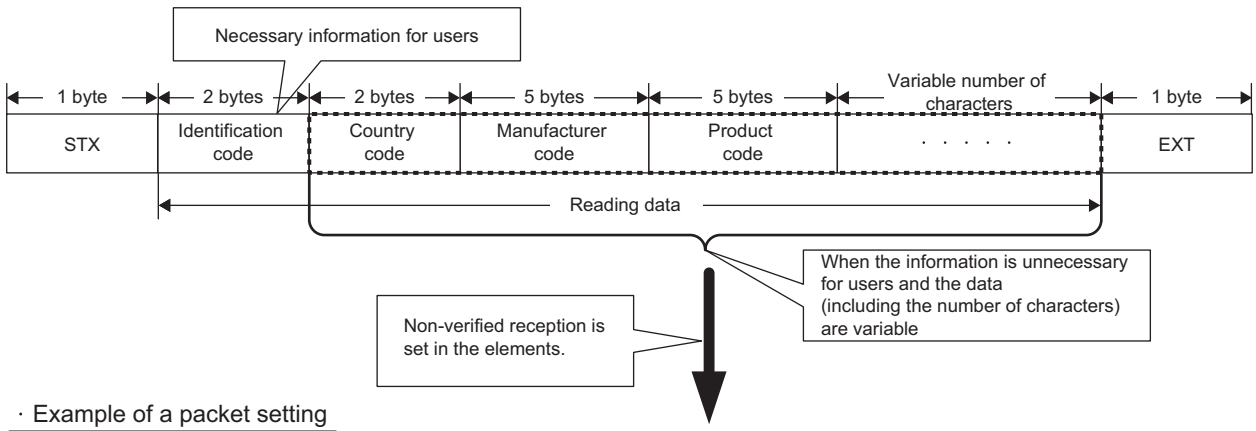
- A size double the data length is occupied. For upper data, the controller ignores it when sending data, and the controller adds 00H to it when receiving data.

Non-verified reception

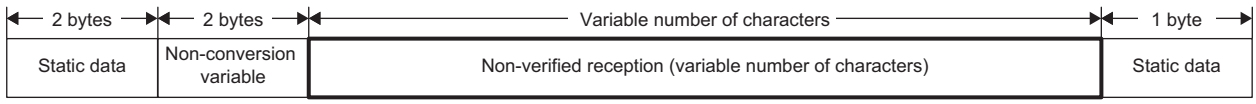
The usage examples for a non-verified reception element is shown below.

Ex.

· Example of a packet format of the external device



· Example of a packet setting



In the above type of packet format, the following operation can be executed by setting reception without verification.

- Only necessary information can be stored in the devices and buffer memory of the controller.
- Even if the received packet contains data that changes with each communication, it can be handled with one protocol (packet).

Appendix 18 Connection to Servo Amplifier That Supports CC-Link IE TSN

This section describes settings and usage when connecting a controller and a servo amplifier that supports the CC-Link IE TSN.

For details on the wiring and the parameters, refer to the manual for each device used.

Point

For the network label creation procedure, refer to the following.

☞ Page 108 Creation procedure for network labels

MR-J5(W)-G (cyclic synchronous mode) connection method

This section describes how to set when connecting the MR-J5(W)-G (Cyclic synchronous mode) and use various functions.

For details on wiring and parameters of the MR-J5(W)-G, refer to MR-J5(W)-G manuals.

Setting method

■Parameter setting value to use the MR-J5(W)-G

Set the parameters of the MR-J5(W)-G as below when executing motion control with the MR-J5(W)-G.

No.	Name	Default value	Setting value
PA06	Electronic gear - Numerator	1	■MR-J5(W)-G (version A3) or earlier Set 1 or 2^n when using for positioning control.*4 Set 1 when using for other than positioning control. ■MR-J5(W)-G (version A4) or later Set 1 or 2^n when using for positioning control.*4 Set as follows when using for other than positioning control. • If "Speed/acceleration/deceleration unit selection (PT01.1)" is set to "0h", the setting value is 1 and if PT01.1 is "1h", it is 1 or 2^n.
PA07	Electronic gear - Denominator	1	■MR-J5(W)-G (version A3) or earlier Set 1 or 2^n when using for positioning control.*4 Set 1 when using for other than positioning control. ■MR-J5(W)-G (version A4) or later Set 1 or 2^n when using for positioning control.*4 Set as follows when using for other than positioning control. • If "Speed/acceleration/deceleration unit selection (PT01.1)" is set to "0h", the setting value is 1 and if PT01.1 is "1h", it is 1 or 2^n.
PC29.5	[AL. 0E3 Absolute position counter warning] selection	1h	0h (Available for infinite feed function.) (When using the absolute position system)
PT01.1*1	Velocity / acceleration/deceleration unit selection	0h	Any setting value can be used for positioning control. For using other than positioning control, set 1h when [Pr. PA06 Electronic gear - Numerator] and [Pr. PA07 Electronic gear - Denominator] are other than 1:1 (velocity command unit: command unit/s, acceleration/deceleration unit: command unit/s^2) and it is arbitrary when they are 1:1.*2
PT01.2*5	Unit of position data	3	3h (pulse)
PT15	Software position limit +	0	0*3
PT17	Software position limit -	0	0*3
PV23*1	Speed unit conversion electronic gear - numerator	1	1
PV24*1	Speed unit conversion electronic gear - denominator	1	1

*1 Available since MR-J5(W)-G (version A4)

*2 If "0h" is set for velocity/acceleration/deceleration unit selection, the object data "Velocity actual value (606CH)" may not be acquired correctly when the setting other than 1:1 is set for electronic gear.

*3 This function is the same as the software stroke limit function of motion system. Therefore, use the function of the motion system to restrict the command position.

*4 Set "1" when the resolution of the encoder connected with the MR-J5(W)-G is not multiple of 2 to the power of n.

*5 Applicable to the MR-J5(W)-G (version B6) or later

For the following parameters, the setting values of the table below are recommended.

No.	Name	Default value	Overview
PD01	Input signal automatic on selection 1	00000000h	00000000h
PD41.2	Limit switch enabled status selection	0h	1h: Enabled only in homing mode*1
PD41.3	Sensor input method selection	0h	1h: Input from controller (FLS/RLS/DOG)*2
PT29.0	Device input polarity 1	0h	1h: Dog detection with on (When "Sensor input method selection (PD41.3)" is set to "1h: input from controller (FLS/RLS/DOG)")

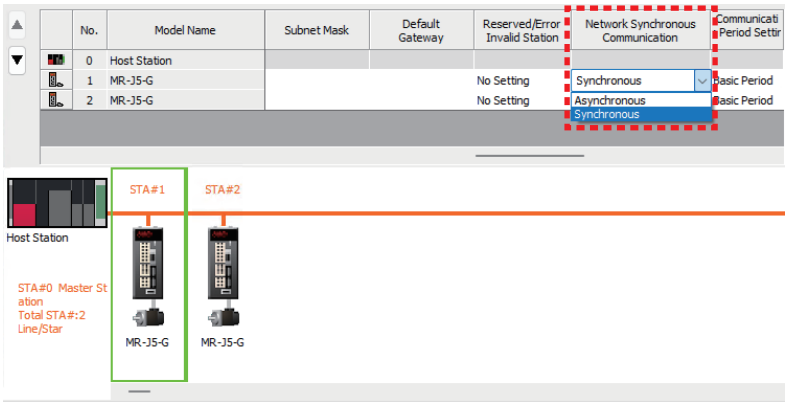
*1 When "0h" is set, the command of motion system is ignored and the motor stops as the limit switch signal is detected in the MR-J5(W)-G during control. Consider any of the following to stop the system safely.
· Invalidates the detected signal of the MR-J5(W)-G, and detects the limit by the hardware stroke limit function of the motion system.
· Sets Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored) to valid to stop the command of the motion side when the motor is stopped due to the signal detection of the MR-J5(W)-G side.

*2 When "1h" is set, wire the limit switch to the controller because the input to the MR-J5(W)-G becomes invalid. When wired to the MR-J5(W)-G, the motor does not stop even if the limit is detected.

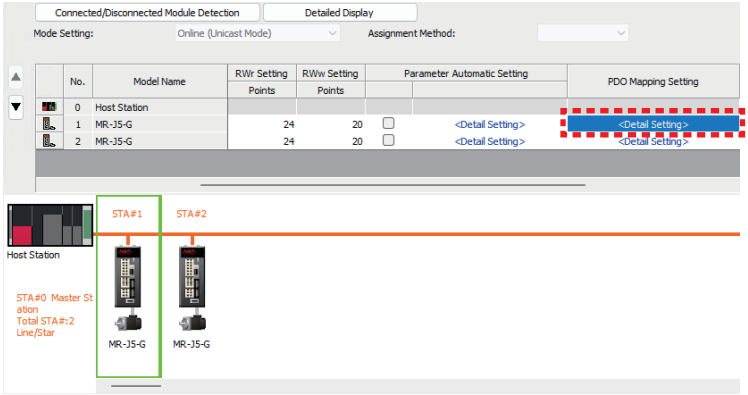
■Network parameter setting for using the MR-J5(W)-G

1. Set "Network Synchronous Communication" to "Synchronous" when performing motion control using the MR-J5(W)-G. (Setting "Asynchronous" will cause an error.)

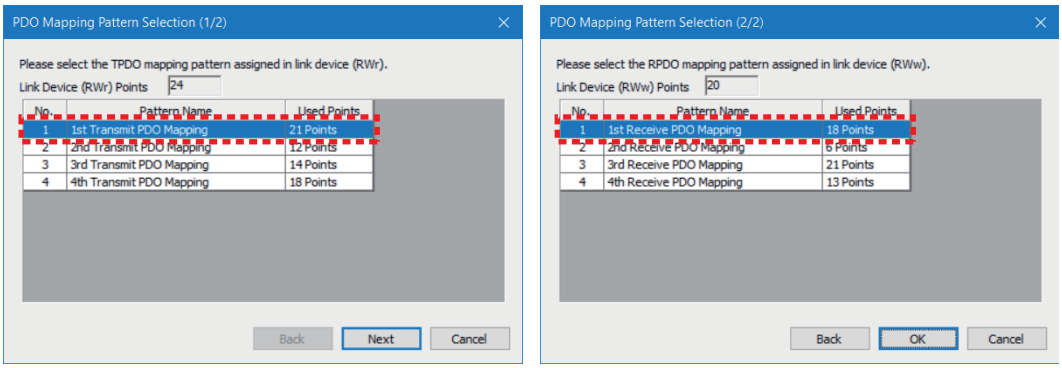
Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



2. Set the PDO mapping of the MR-J5(W)-G.

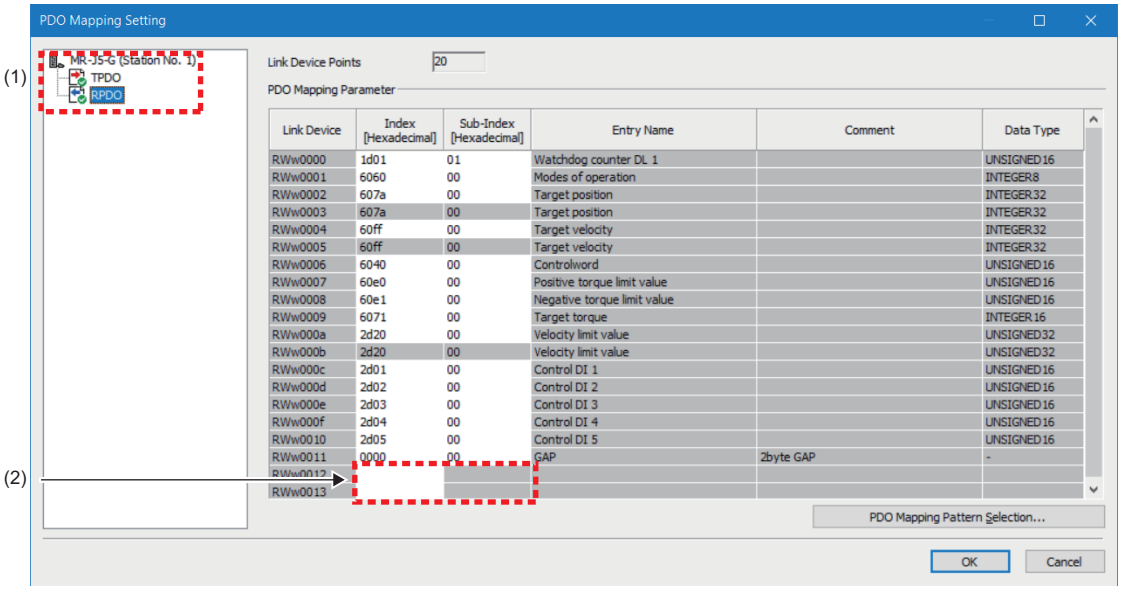


3. In the "PDO Mapping Pattern Selection" window, set TPDO and RPDO mapping patterns.



When using the MR-J5(W)-G with cyclic synchronous mode, set "1st Transmit PDO Mapping" for TPDO mapping pattern and "1st Receive PDO Mapping" for RPDO mapping pattern.

4. In the "PDO Mapping Setting" window, add or change PDO mapping in accordance with the function to use.



(1) Change the TPDO and RPDO setting windows.
(2) When adding an object to communicate via PDO, set an index and subindex.

How to use

■How to operate external signal of the MR-J5(W)-G via communication

1. Preparation

Generate the network label of the required object. External signals for the MR-J5(W)-G are assigned to the following objects.

Object	
Input	Control DI1 to Control DI10
Output	Status DO1 to Status DO10

Also, when using functions of each external signal, some parameters should be changed. For details, refer to the manuals for the MR-J5(W)-G.

2. How to use

Operating/referencing external signals of the MR-J5(W)-G are allowed by changing/referencing the values of generated labels from the program or watch. A sample program to execute gain switching using the network label is shown below. (Generate the label previously as Control DI1 and Status DO1 are used for gain switching.)

```
[Global label]
bGainChange //Bit type label
```

```
[ST program]
//Issue the gain switching request to the MR-J5-G
MR_J5_G_001_ControlDI1.4 := bGainChange;

//check the gain of the MR-J5-G is switched or not
IF(MR_J5_G_001_StatusDO1.4 = TRUE) THEN
                //describes the process after the gain switching
END_IF;
```

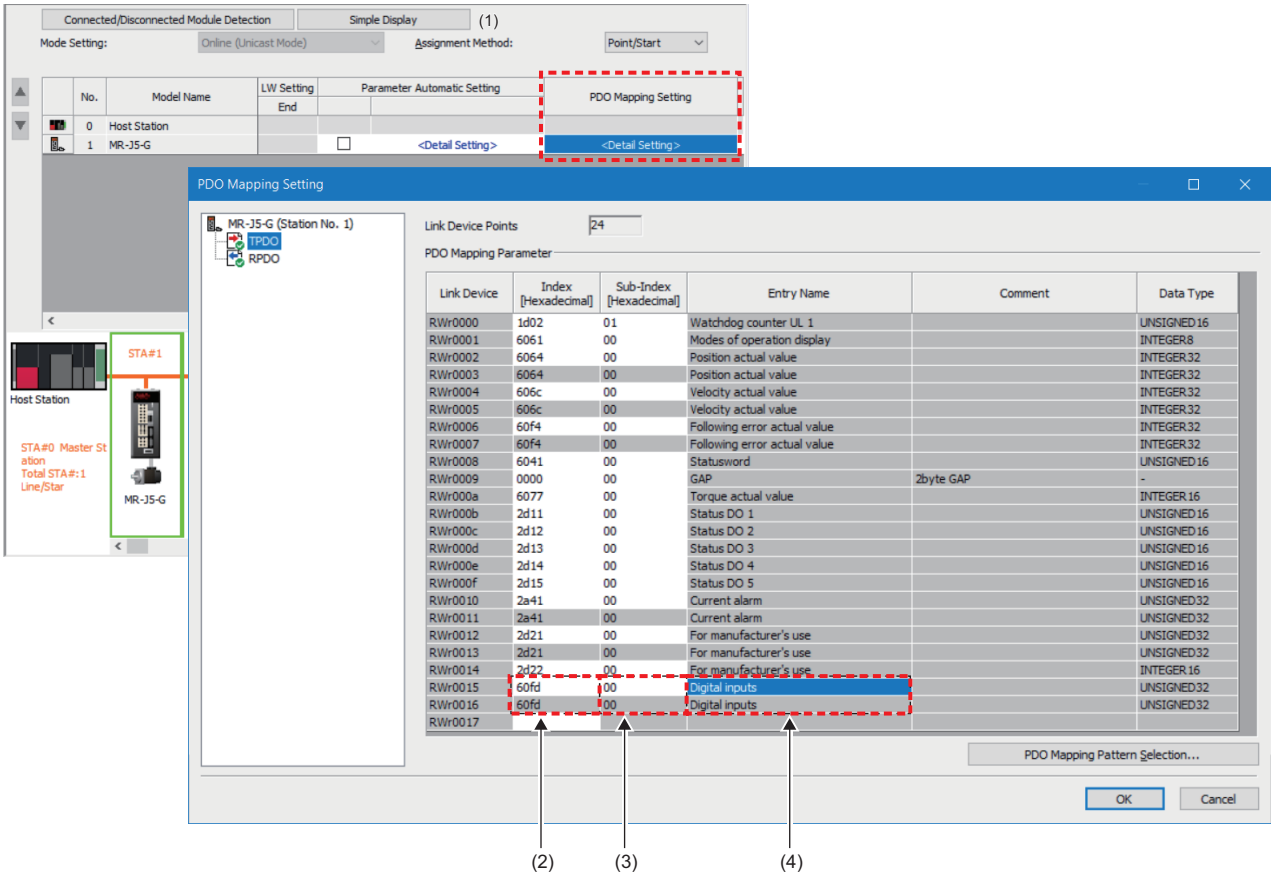
The bit 4 of ControlDI1 is the gain switching request.
This program switches the gain of the MR-J5-G by operating bit 4 of ControlDI1 with bGain Change.

The bit 4 of StatusDO1 is the gain switching status.
The process which is performed only during the gain switching can be created by checking the bit 4 status.

■Method for setting (LSP/LSN/DOG) input to the MR-J5(W)-G to the upper limit/lower limit and home position switch of the motion system

(LSP/LSN/DOG) input signal of the servo amplifier can be used as the FLS/RLS, and home position switch signal of the motion system by assigning the object, [Digital inputs (60FDh)] to TPDO mapping of the MR-J5(W)-G and creating the network label.

1. Map [Digital inputs (60FDh)] to TPDO.



In the "CC-Link IE TSN Configuration" window, click (1) of "PDO Mapping Setting" of the target servo amplifier to open the "PDO Mapping Setting" window.

Selecting the following [Index] (2) and [Sub-index] (3) in the "PDO Mapping Setting" window adds "Digital inputs" to [Entry Name] (4).

- Index: 60FDh
- Sub-index: 00h

When completed, click the [OK] button to close the "PDO Mapping Setting" window.

In the "Module Parameter" window, click the [Apply] button to fix the changed objects.

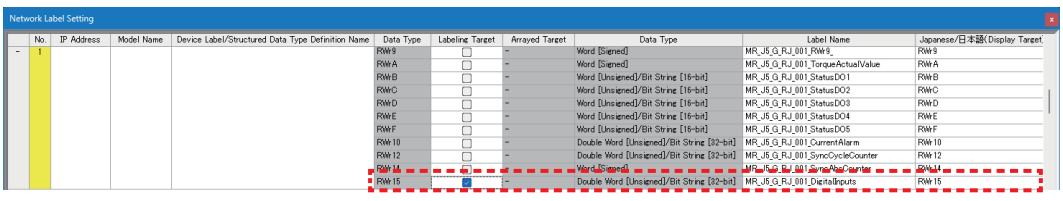
2. Make [Digital inputs (60FDh)] the network label.

For the method of the network labeling, refer to the following.

☞ Page 108 Creation procedure for network labels

Ex.

When the labeling is performed with the label name "MR_J5_G_001_DigitalInputs" (5)



(5)

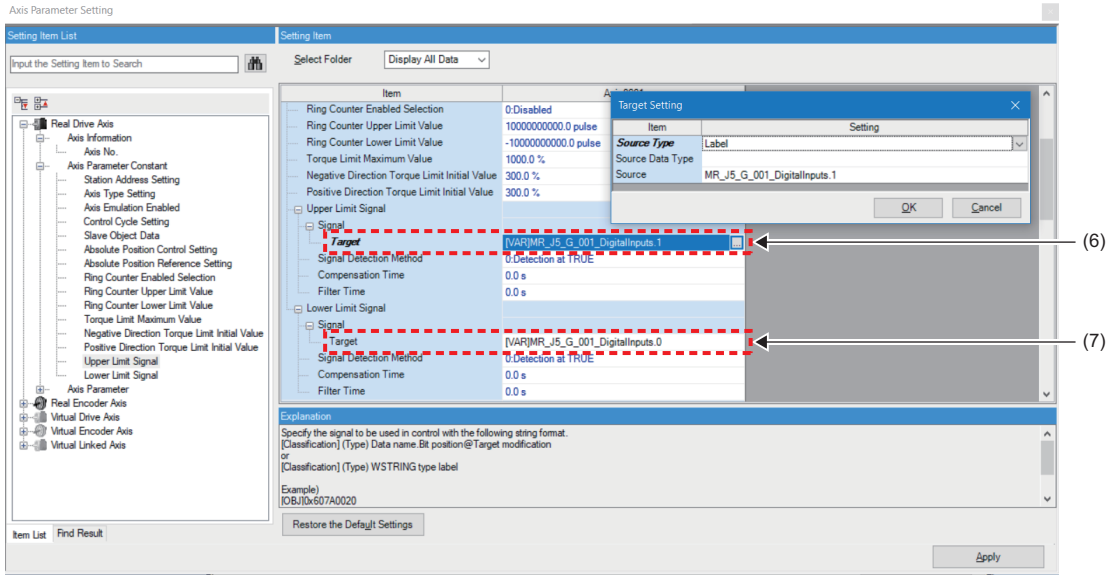
3. Specify the network label to the home position switch of FLS/RLS or MC_Home (Homing).

• The upper limit/lower limit setting

Set the target of the upper limit signal (6)/lower limit signal (7) of the "Axis Parameter Setting" window.

Navigation window ⇨ [Motion Setting] ⇨ [Axis] ⇨ Data name

Variable	Setting value (when "Travel direction selection (PA14)" is 0)
Target (AxisName.PrConst.HwStrokeLimit_FlsSignal.Source.Target)	[VAR]MR_J5_G_001_DigitalInputs.1
Target (AxisName.PrConst.HwStrokeLimit_RlsSignal.Source.Target)	[VAR]MR_J5_G_001_DigitalInputs.0



• Specify the DOG signal at homing

Set the following to Home position switch (AbsSwitch) to be input to MC_Home (homing).

Variable	Setting value (when "Travel direction selection (PA14)" is 0)
MC_INPUT_REF.Signal.Source.Target	[VAR]MR_J5_G_001_DigitalInputs.2

- This setting is not required if "0h: Input from servo amplifier (LSP/LSN/DOG)" is selected in "Sensor input method selection (PD41.3)". Directly input the DOG signal to the MR-J5(W)-G.
- Set "1: Dog detection with on" to "Device input polarity 1 (PT29.0)" if "1h: Input from controller (FLS/RLS/DOG)" is selected in "Sensor input method selection (PD41.3)".

4. Disable some axes of the multi-axis amplifier.

When disabling some axes of the multi-axis amplifier (MR-J5(W)-G), disable the latter part of axes first. (For example, with the MR-J5W3-G, disabling only the C axis or both the B and C axes is possible, but disabling only the A axis or only the B axis is not possible.)

Follow the instruction below to set the servo amplifier and GX Works3.

• Servo amplifier: Set the control axis disable switch. For details, refer to the following.

MR-J5-G/MR-J5W-G User's Manual (Parameters)

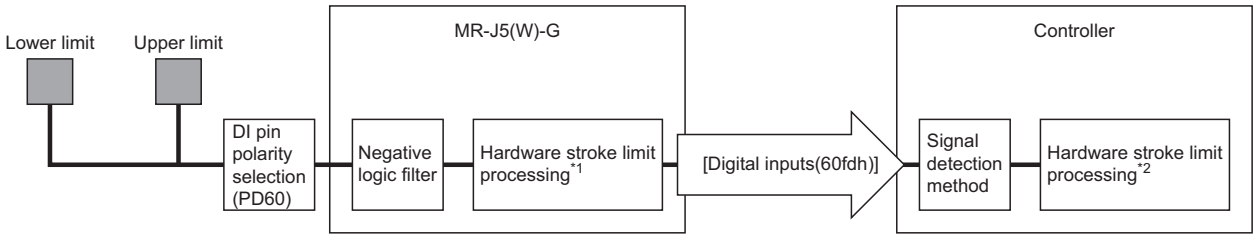
• GX Works3: Delete the disabled axes from the network configuration settings.

Precautions

- Assign LSP/LSN/DOG signal to "Input device selection 1 to 3" (PD03 to PD05) of the MR-J5(W)-G to use the signal of the motion system.
- The polarities of Bit 0 (Negative limit switch) and Bit 1 (Positive limit switch) of the object, [Digital inputs (60FDh)] are changed according to the setting of "Travel direction selection (PA14)". For details, refer to the manuals for each drive unit. For MR-J5(W)-G: MR-J5-G/MR-J5W-G User's Manual (Parameters)
- Set the following for signal detection method of the motion system side to be the same polarity of Bit 0 (Negative limit switch) and Bit 1 (Positive limit switch) of object [Digital inputs (60FDh)] of the MR-J5(W)-G. If the setting is different, unintended operation may occur.

Variable	Setting value
Signal Detection Method (AxisName.PrConst.HwStrokeLimit_FlsSignal.Detection)	Set either of the following in accordance with the setting of "Limit switch status read selection (PC76.3)". • 0 (initial value): Detection at FALSE (LowLevel) • 1: Detection at TRUE (HighLevel)
Signal Detection Method (AxisName.PrConst.HwStrokeLimit_RlsSignal.Detection)	

- The data flow of object [Digital inputs (60FDh)] is shown below when "0h: Input from servo amplifier (LSP/LSN/DOG)" is selected in "Sensor input method selection (PD41.3)".



Signal input	MR-J5(W)-G			→	"Limit switch status read selection (PC76.3)"*4	[Digital inputs (60FDh)] Bit 0, Bit 1	→	Controller	
	"DI pin polarity selection (PD60)"	External input signal logic	Hardware stroke limit error detection*1					External input signal logic setting	Hardware stroke limit error detection*2
On	0	Negative logic	Not detect	→	0	TRUE	→	Negative logic (1: Detection at FALSE (LowLevel))	Not detect
								Positive logic (0: Detection at TRUE (HighLevel))	Detect*3
	1		Detect			FALSE		Negative logic (1: Detection at FALSE (LowLevel))	Detect
								Positive logic (0: Detection at TRUE (HighLevel))	Not detect*3
Off	0		Detect			FALSE		Negative logic (1: Detection at FALSE (LowLevel))	Detect
								Positive logic (0: Detection at TRUE (HighLevel))	Not detect*3
	1		Not detect			TRUE		Negative logic (1: Detection at FALSE (LowLevel))	Not detect
								Positive logic (0: Detection at TRUE (HighLevel))	Detect*3
On	0		Not detect		1	FALSE		Negative logic (1: Detection at FALSE (LowLevel))	Detect*3
								Positive logic (0: Detection at TRUE (HighLevel))	Not detect
	1		Detect			TRUE		Negative logic (1: Detection at FALSE (LowLevel))	Not detect*3
								Positive logic (0: Detection at TRUE (HighLevel))	Detect
Off	0		Detect			TRUE		Negative logic (1: Detection at FALSE (LowLevel))	Not detect*3
								Positive logic (0: Detection at TRUE (HighLevel))	Detect
	1		Not detect			FALSE		Negative logic (1: Detection at FALSE (LowLevel))	Detect*3
								Positive logic (0: Detection at TRUE (HighLevel))	Not detect

*1 When "Limit switch enabled status selection (PD41.2)" is set to "0: Limit switch always enabled", the error stop is executed in the servo amplifier not even during homing.

*2 The error stop is executed even in the controller during homing. The hardware stroke limit error detection in homing can be temporarily disabled by setting Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override).

*3 Do not configure any settings as the detection operation will differ on the controller and amplifier sides.

*4 This parameter can be set with an MR-J5(W)-G that supports "Limit switch status read selection (PC76.3)". (If the parameter is not supported, the operation is the same as when 0 is set.) For details, refer to the manuals for the MR-J5(W)-G.

- When data sent from the motion system is labeled, changes made by the program are not reflected as the label values are overwritten by the motion system.
- When parameter automatic setting is enabled in the network configuration settings on the engineering tool, according to the communication load condition, the changed parameters might not be reflected in the controller as the parameter is changed for the multiple stations at the same time in the communication on MR Configurator2. Change them one by one. Otherwise, write the project to the controller after starting MR Configurator2 and changing the parameters via GX Works3.
- A servo alarm [AL. 035_Command frequency error] may be detected in the MR-J5(W)-G when an operation cycle over occurs in the motion system during a motor operation and the command differs greatly before the operation cycle over and after a restoration. Check the program and increase the operation cycle setting or decrease the loading if necessary.
- Do not assign an MR-J5(W)-G set to CC-Link IE TSN Class A to an axis. When an MR-J5(W)-G set to CC-Link IE TSN Class A is assigned to an axis, a servo alarm [AL. 19E.2_Control mode setting warning 2] occurs in the MR-J5(W)-G when connected.

MR-J5(W)-G (other than cyclic synchronous mode) connection method

This section describes how to set when connecting the MR-J5(W)-G (other than yclic synchronous mode) and use various functions.

For details on wiring and parameters of the MR-J5(W)-G, refer to the manuals for the MR-J5(W)-G.

The firmware for the MR-J5(W)-G which is available with the mode other than the cyclic synchronous mode is shown below.

Model name	Mode	Version
MR-J5(W)-G	Profile mode	A4 or later
	Point table mode	B8 or later

Setting method

An example for using two MR-J5-Gs as the first station (192.168.3.1) set with the cyclic synchronous mode and the second station (192.168.3.2) set in other than the cyclic synchronous mode. For details on the objects used in each mode, refer to the manual for the MR-J5(W)-G.

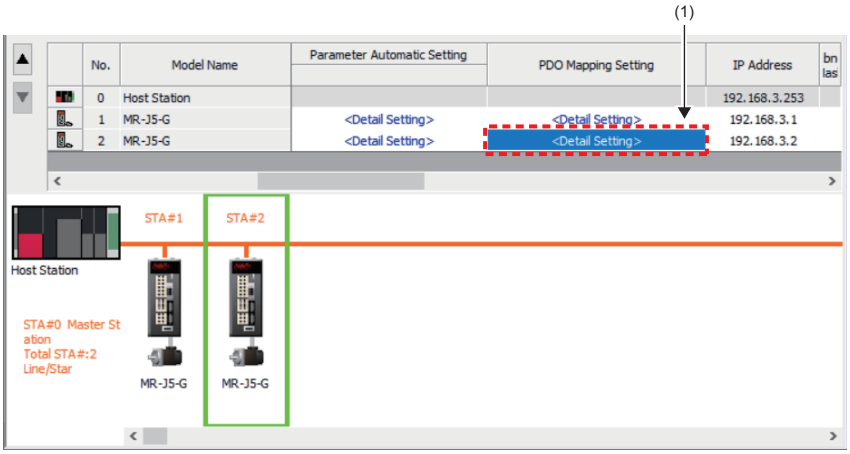
■Settings of the controller (GX Works3)

Set PDO mapping and map required objects in the mode to use in the "CC-Link IE TSN Configuration" window.

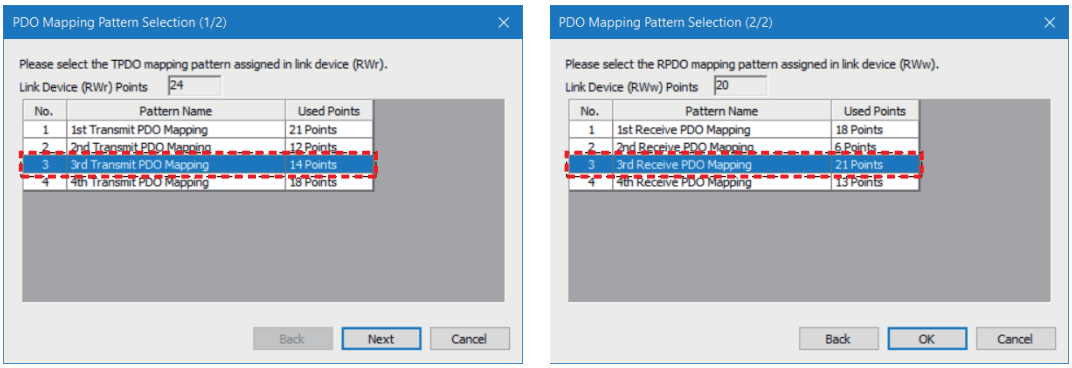
1. To set the second station as a mode other than the cyclic synchronous mode, conduct the PDO mapping settings for the second station.

In the "CC-Link IE TSN Configuration" window, click (1) of "PDO Mapping Setting" of the target servo amplifier to open the "PDO Mapping Setting" window.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



2. In the "PDO Mapping Pattern Selection" window, select the PDO mapping pattern to use.

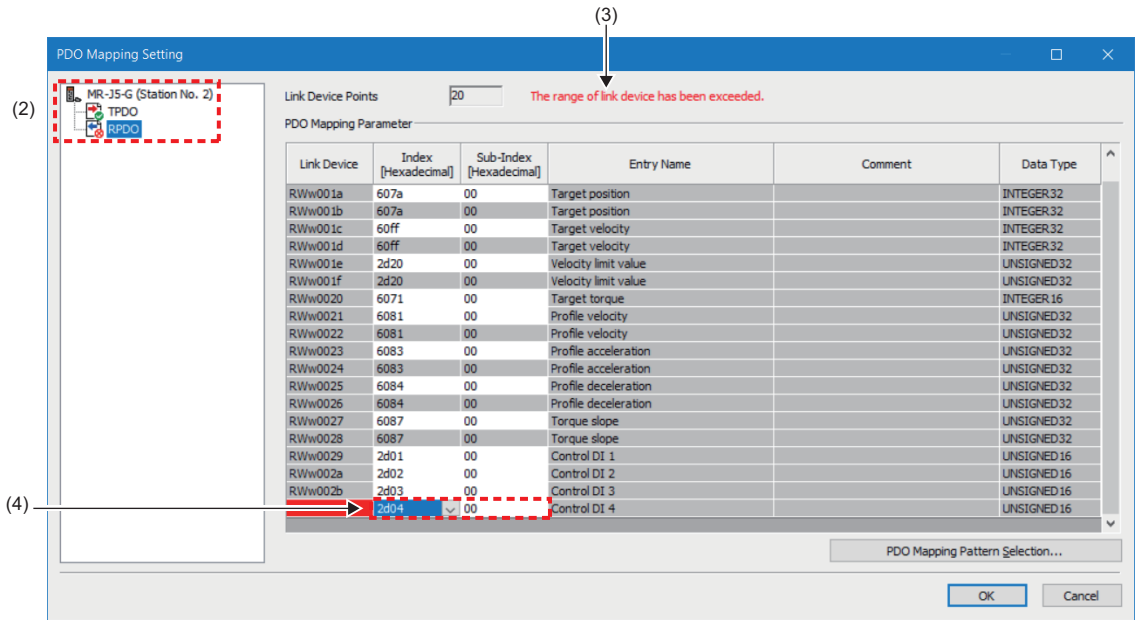


Select a PDO mapping pattern as shown below according to the operation mode.

Mode	TPDO	RPDO
Profile mode (pp, pv, tq)	3rd Transmit PDO Mapping	3rd Receive PDO Mapping*1
Point table mode (pt)	4th Transmit PDO Mapping	4th Receive PDO Mapping

*1 When the RWw number of points set in the "CC-Link IE TSN Configuration" window is the default value (20 points), the size of the object to be mapped exceeds the limit. Change the RWw number of points to 24 or more in advance or delete any unnecessary objects in the "PDO Mapping Setting" window.

3. In the "PDO Mapping Setting" window, add or change the objects to map to the PDO.



(2) Switch the TPDO and RPDO setting windows.
(3) When the size of the objects mapped to TPDO/RPDO is larger than the RWr/RWw number of points, delete the objects that have been mapped or increase the RWw/RWr number of points then perform the process again.
(4) To change the object to map, select Index/Subindex from the drop-down list. To delete, select an index then press the Delete key.

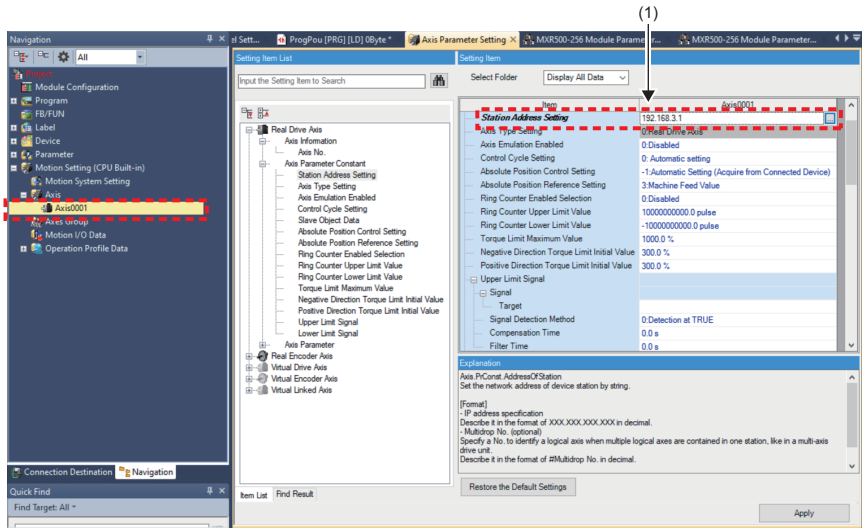
4. When completed, click the [OK] button to close the "PDO Mapping Setting" window.

5. In the "Module Parameter" window, click the [Apply] button to fix the changed objects.

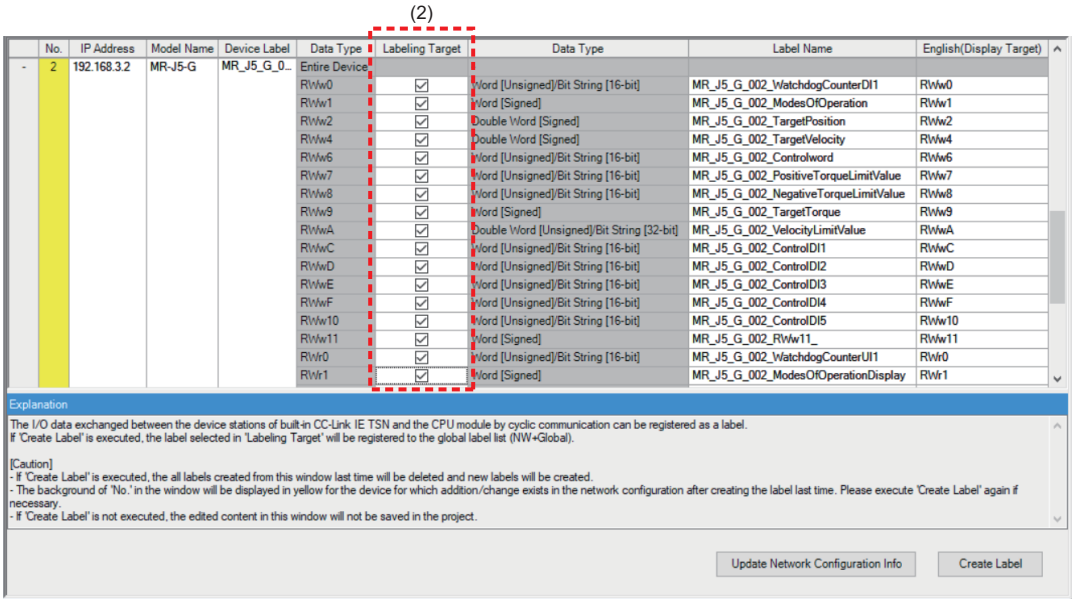
■Settings of the motion system

The axis to be used in other than the cyclic synchronous mode must not be set.

1. Set only the axis used with cyclic synchronous mode (first station (192.168.3.1)) (1). The axis used with a mode other than the cyclic synchronous mode (second station (192.168.3.2)) is not set as it is used with a mode other than the cyclic synchronous mode.



2. Generate the network label of the MR-J5-G (second station (192.168.3.2)) used in other than cyclic synchronous mode by checking all the labeling targets (2) and clicking the [Create Label] button.
   For using with a mode other than the cyclic synchronous mode, generate labels of the entire device as the labeling target.

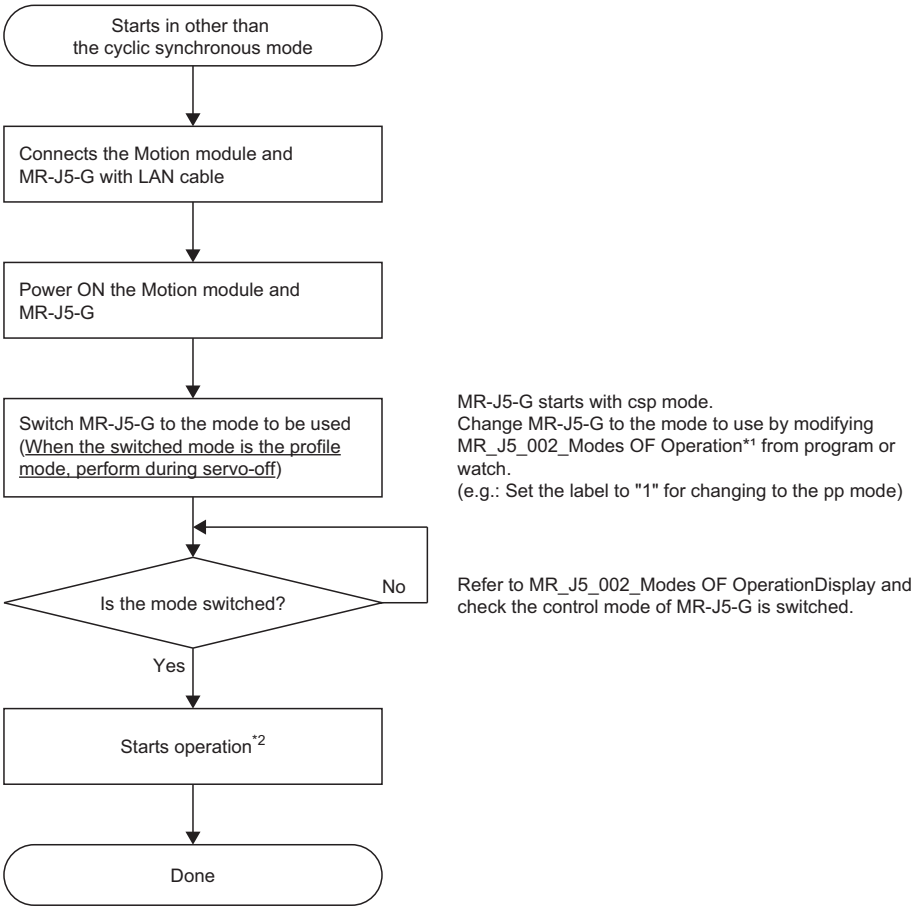


■Settings of the MR-J5-G [MR Configurator2]

Refer to the manual for the MR-J5(W)-G because the required settings differ depending on the mode to use.

How to use

The following is the procedure for driving motors with other than the cyclic synchronous mode.



*1 A label name differs depending on a labeled device. The name described in this procedure indicates the name for generating the label targeting the second station of the MR-J5-G.

*2 When Watch dog counter DL is mapped to PDO, map Watch dog counter UL to PDO as well. An error occurs if Watch dog counter UL is not mapped to PDO. (☞ Page 166 "PDO Mapping Setting")

Precautions

- Do not execute servo-on before switching to the profile mode. An improper operation, such as sudden acceleration of the motors, might occur.
- Do not switch to the cyclic synchronous mode after switching to the profile mode. An improper operation, such as sudden acceleration of the motors, might occur.
- When using the motion system in other than cyclic synchronous mode, the system does not perform the limit check of the commands or issue the forced stop command. Provide safety measures in the user program or on the MR-J5(W)-G side.
- Do not switch the MR-J5(W)-G set as the axis to profile mode. In the profile mode and the cyclic synchronous mode after being switched from profile mode again, an improper operation might occur.
- When parameter automatic setting is enabled in the network configuration settings on the engineering tool, according to the communication load condition, the changed parameters might not be reflected in the controller as the parameter is changed for the multiple stations at the same time in the communication on MR Configurator2. Change them one by one. Otherwise, write the project to the controller after starting MR Configurator2 and changing the parameters via GX Works3.

MR-JET-G connection method

Connection and usage methods are the same as those for the MR-J5(W)-G.
For details on wiring and parameters, refer to the manuals for the MR-JET-G.

Precautions

Do not set the following objects as they are not supported.

Index	Sub-Index	Object name	Parameter name
2D35h	2	Encoder status 2	AXIS_NAME.PrConst.SlaveObject.vEncoderStatus2
2D36h	0	Scale cycle counter	AXIS_NAME.PrConst.SlaveObject.vScaleCycleCounter
2D37h	0	Scale ABS counter	AXIS_NAME.PrConst.SlaveObject.vScaleAbsCounter
2D38h	0	Scale measurement encoder resolution	AXIS_NAME.PrConst.SlaveObject.vScaleMeasurementEncoderResolution
2D3Ch	0	Scale measurement encoder reception status	AXIS_NAME.PrConst.SlaveObject.vScaleMeasurementEncoderReceptionStatus

- Set the communication cycle interval to 125μs or longer. (Communications at 31.25μs or 62.5μs are not supported.)
- When parameter automatic setting is enabled in the network configuration settings on the engineering tool, according to the communication load condition, the changed parameters might not be reflected in the controller as the parameter is changed for the multiple stations at the same time in the communication on MR Configurator2. Change them one by one. Otherwise, write the project to the controller after starting MR Configurator2 and changing the parameters via GX Works3.
- [AL. 035_Command frequency error] may be detected in the MR-JET-G when an operation cycle over occurs in the motion system during a motor operation and the command differs greatly before the operation cycle over and after a restoration. Check the program and increase the operation cycle setting or decrease the loading if necessary.

Relevant functions

Driver control mode

The motion system supports the following control modes.

Control mode supported		Description	Reference
Homing mode (hm)	6: hm	Executes homing operation by a driver.	Page 620 Driver homing method
Cyclic position mode (csp)	8: csp	Executes control following the sequential positioning command from the controller in each communication cycle.	Page 710 DIRECT CONTROL
Cyclic velocity mode (csv)	9: csv	Executes control following the velocity command from the controller in each communication cycle.	
Cyclic torque mode (cst)	10: cst	Executes control following the torque command from the controller in each communication cycle.	
Continuous operation to torque control mode (ct)	-104: ct	Switches the mode to the continuous operation to torque operation smoothly without stopping from the cyclic position mode or the cyclic velocity mode.	Page 2166 Continuous operation to torque control mode

For details on the driver control mode, refer to the following.
☞ Page 453 Driver control mode transition

Continuous operation to torque control mode

For the drive unit which supports the continuous operation to torque control mode, when MC_TorqueControl (Torque Control) is started with selecting "1: ct (continuous operation to torque control mode)" by Control mode switching selection (Options (Options) bit 19), the driver control mode can be switched to the continuous operation to torque control mode (ct) and the driver can be controlled.

The continuous operation to torque control mode is a mode to switch to the continuous operation to torque operation smoothly without stopping from the cyclic position mode in positioning or the cyclic velocity mode in velocity command.

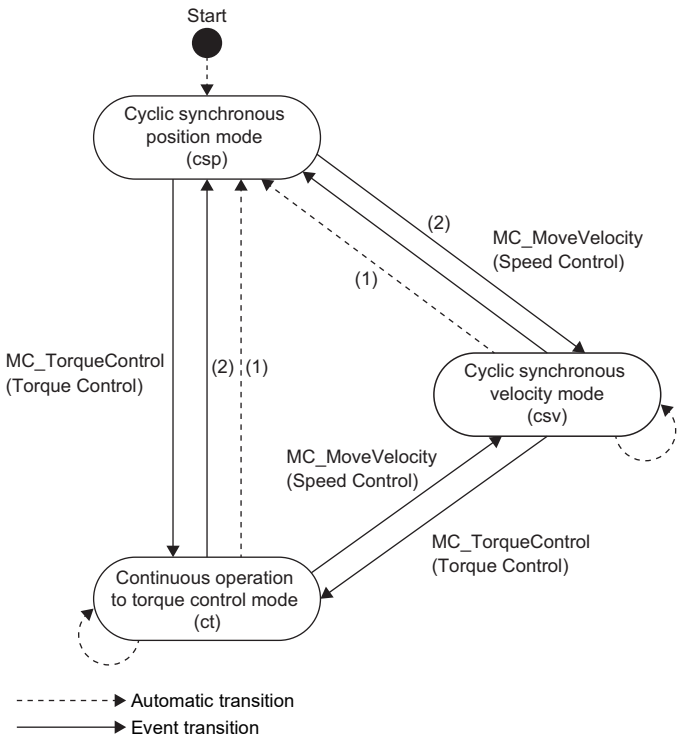
In the continuous operation to torque control mode, the driver executes the torque control with commanded torque set to Target torque (Torque) as accelerating or decelerating to the velocity set to Limit velocity (LimitVelocity).

To finish this FB, start MC_Stop (Forced Stop).

Connected devices which can use the continuous operation to torque control mode are shown below.

Model name	Version
MR-J5(W)-G	For firmware versions that can be used, refer to the manual for each device.
MR-JET-G	

■Transition of continuous operation to torque control mode



No.	State transition description
(1)	Transits at stop completion or error occurrence.
(2)	Transits when motion FBs (such as positioning control FBs) are multiple started in the cyclic synchronous position mode (csp).

"The cyclic torque mode to the continuous operation to torque control mode switching" cannot be executed when multiple start MC_TorqueControl (Torque Control) is executed during MC_TorqueControl (Torque Control) start-up. If switching from the cyclic torque mode to the continuous operation to torque control mode is executed, Control mode switching disabled warning (event code: 00D31H) occurs and operation is performed in the current control mode.

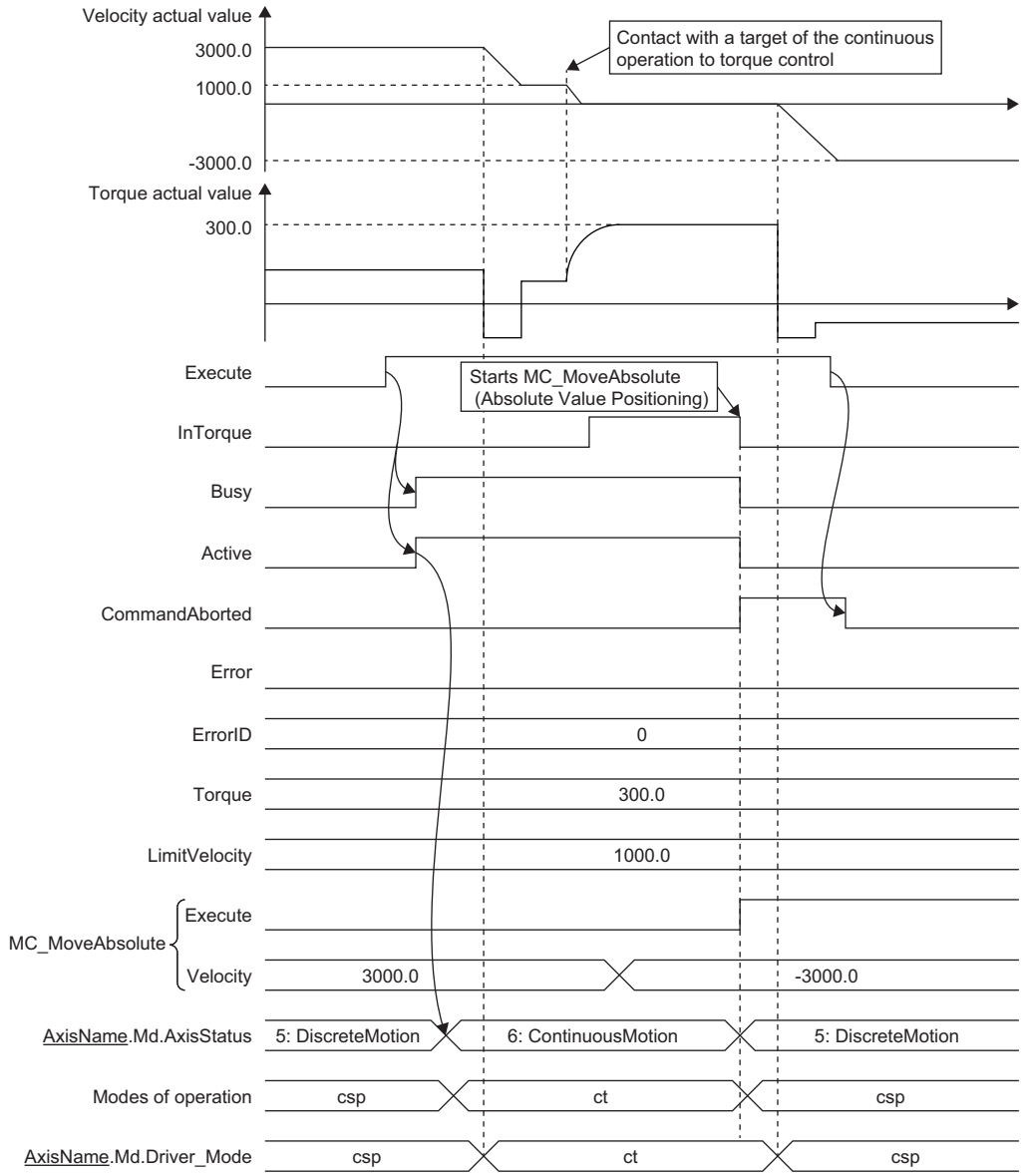
Precautions

- When the control mode does not switch within 1 [s] after requesting the control mode switching to the driver, Control mode switching error (error code: 1A95H) occurs and the axis stops.
- When specified as the master axis for master and slave operation, the mode cannot be switched to continuous operation to torque control mode (ct).

■Timing chart

- When the FB is normally completed

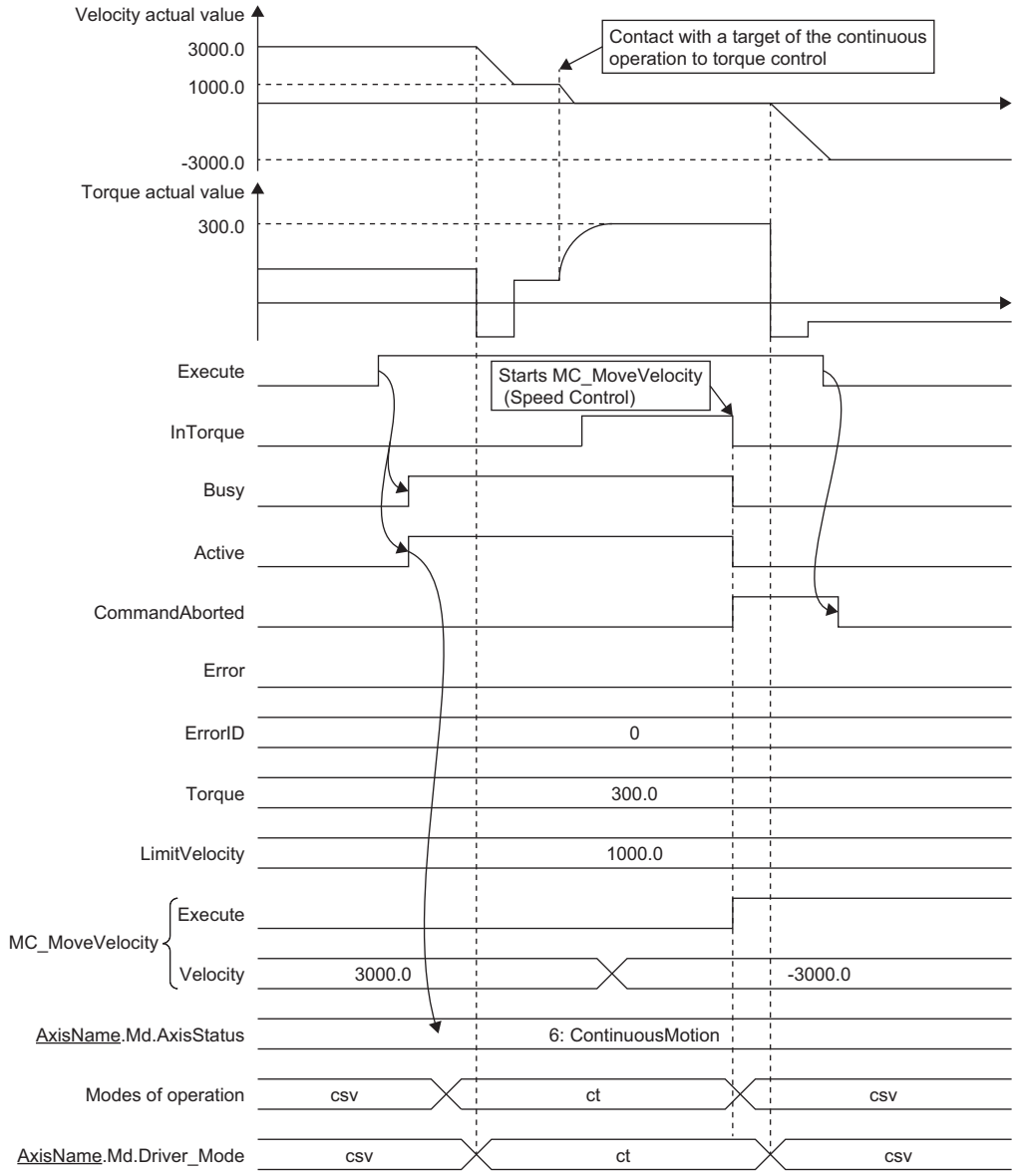
■Operation for switching the cyclic position mode to the continuous operation to torque control mode



Point

Set "1: Actual velocity" to Velocity initial value selection at continuous operation to torque control mode switching (Options (Options) bit 20 and bit 21) to switch to the continuous operation to torque control mode when there is a difference between set velocity and actual velocity such as accelerating and decelerating or the velocity does not reach the set velocity due to the limited torque.

■Operation for switching the cyclic velocity mode to the continuous operation to torque control mode



Point

A torque command value in the continue operation to torque control mode will be disabled when it is switched from the continuous operation to torque control mode to the cyclic velocity mode.

As shown above, when the drive unit is continuously operates to torque to the continuous operation to torque direction, the torque will be output to the torque limit value when it is switched to the cyclic velocity mode.

In this case, execute any of the following before switching to the cyclic velocity mode.

- Start MC_MoveVelocity (Speed Control) in the reverse direction setting to the continuous operation to torque direction and switch to the cyclic velocity mode. (At this time, it is recommended to specify "0: Acceleration/deceleration specification method (mcAccDec)" for Acceleration/deceleration method setting (Options (Options) bit 0 to 2).)
- Change the torque limit value to the lower value.

- When an error occurs

  For details when an error occurs, refer to "Basic operation of Execution command (Execute) type Motion control FBs" in the following manual.

  MELSEC MX Controller MX-R Model Programming Manual

■Relevant variables/FBs

For details, refer to the following.

☞ Page 726 Relevant variables

■Control details

For details, refer to the following.

☞ Page 726 Torque Control

■Precautions

- An actual motor velocity may not reach the limit velocity depending on the machine load during the continuous operation to torque control mode.
- It is recommended to match the direction of the torque command and the velocity command. If they differ, the velocity may decelerate once to 0.
- When switching from the continuous operation to torque control mode to the cyclic position mode, it is recommended to switch after changing the motor to stop status (zero speed status). The zero speed status can be monitored by network labeling Status DO2 (2D12h).
- When switching from the continuous operation to torque control mode to the cyclic position mode without waiting for stop of the motor, set "ZSP disabled selection at control switching (PC76.1)" of the servo parameter to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
- For unavailable functions of the servo amplifier during the continuous operation to torque control mode, refer to the specification of connected driver device.

Point

- Set the system configuration with an unlimited operation range during the continuous operation to torque control mode as a stroke limit signal of the servo amplifier cannot be used during the continuous operation to torque control mode. Use the software stroke limit function of the motion module to restrict the set position.
- If vibration occurs during the continuous operation to torque control, decrease "Torque feedback loop gain (PB03)" and check if the issue has been solved.

Touch probe

Touch probe is a function that records (latches) arbitrary data at trigger input signal detection. A high-accuracy recording (latching) with a device station signal detection time can be performed by setting a signal that supports external signal high-accuracy input as the trigger input signal.

For the specifications, refer to the following.

☞ Page 1166 TOUCH PROBE

■Setting method

For the method of how to set an external signal high-accuracy input with touch probe, the following shows an example where TPR1 of the MR-J5(W)-G series is used as the input signal.

• Required settings for external signal high-accuracy input

External signal high-accuracy input uses a device station signal detection time, so that the setting to obtain the signal detection time is required.

If the required setting is not executed to external signal high-accuracy input, the signals operate with the same accuracy as normal signals.

For details on the setting method, refer to the following.

☞ Page 2175 Required settings for external signal high-accuracy input

• How to check whether high-accuracy input is enabled

Check whether a signal detection time has been stored in the relevant object or link device at the signal detection of each device station by using a method such as device labels.

For details on the check method, refer to the following.

☞ Page 2175 Required settings for external signal high-accuracy input

• Setting for system-specific delay compensation time

Probe data (ProbeData) set with touch probe has a system-specific delay time.

This delay can be compensated for by setting the touch probe compensation time (CompensationTime). In addition, the delay time varies depending on the data set to probe data. Refer to the following for this setting.

Type	Data	Reference value
OBJ	0x60640020 (Position actual value)	Operation cycle × 2
VAR	Axis.MdSetPosition	Operation cycle × 1
	Axis.Md.ActualPosition	Operation cycle × 3
	Axis.Md.Io_TargetPos	Operation cycle × 1
	Axis.Md.Io_PosActualValue	Operation cycle × 3
	MR_J5_XXX_PositionActualValue*1	Operation cycle × 2
AXIS	mcLatestSetValue	0
	mcSetValue	Operation cycle × 1
	mcLatestActualValue	Operation cycle × 2
	mcActualValue	Operation cycle × 3

*1 The device label name differs depending on the model. Set the device label name according to the created device label name.

■Program example

• When TPR1 of the MR-J5-G-RJ (station address 192.168.3.1) is used as the trigger signal of MC_TouchProbe at the rising edge detection

<Settings of the MR-J5-G-RJ>

1. Set a connector pin to assign TPR1 of the input device to be used.
Set "2Ch" to Pr.PD38.0-1. (Assign TPR1 to the connector pin CN3-10.)

<Settings of the Motion system>

1. Set the following object data to TPDO of the PDO mapping.

Index	SubIndex	Object name	Description
60B9h	00h	Touch probe status 1	Set this object when using TPR1 and 2.
60D1h	00h	Touch probe time stamp 1 positive value	Set to detect the rising edge of TPR1. (The setting is not required for detecting the falling edge only.)

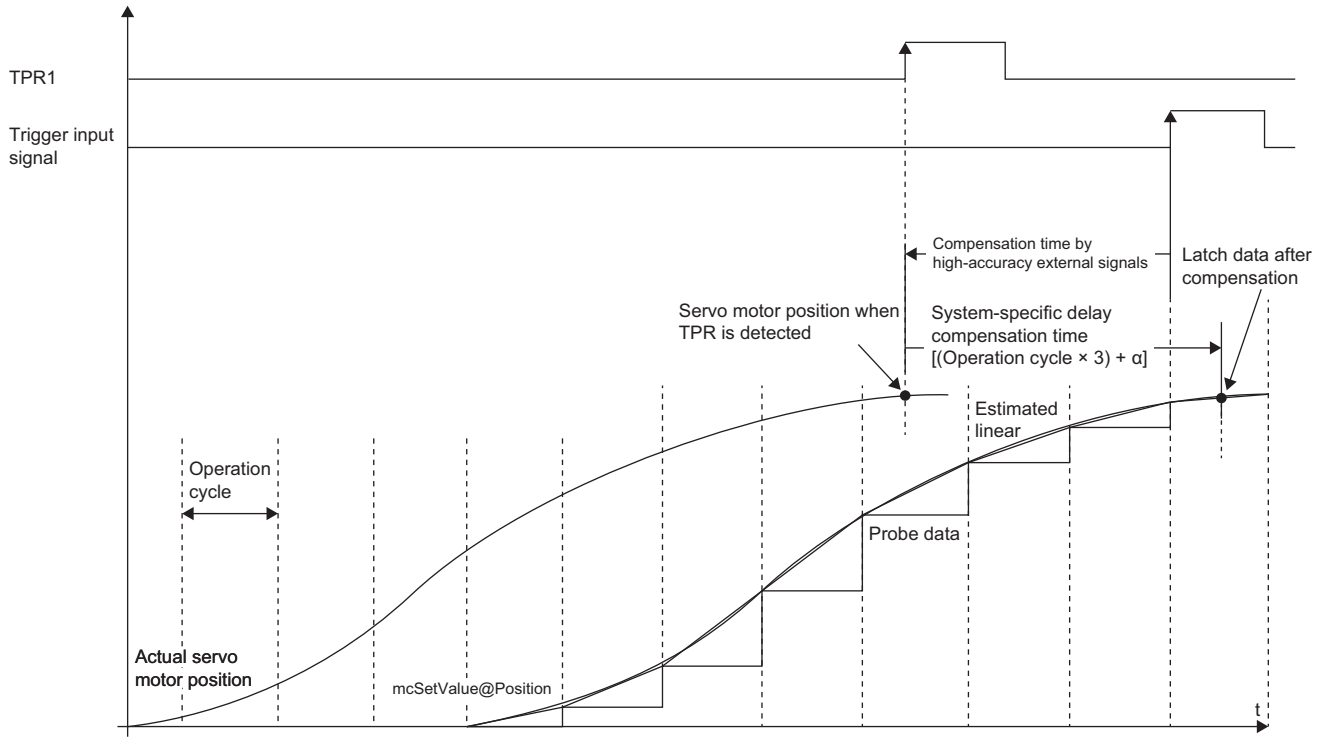
2. Generate a label to be used as the trigger signal (TriggerInput) of MC_TouchProbe.
Create a new data of MC_TRIGGER_REF type and set Toggle status for latch completion (Touch probe status 1 Bit6) of TPR1 to Target.

Data name	Settings of MC_TRIGGER_REF type data			
	Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)	Filter time (FilterTIme)
SignalData0001	[OBJ]0x60B90010.6@192.168.3.1	4: Detection at rising edge/ falling edge (BothEdges)	0.0	0.0

3. Generate a label to be used as Probe data (ProbeData) of MC_TouchProbe.
Create a new data of TARGET_REF type and set the probe data.
The case to set axis data is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0002	[AXIS]mcLatestActualValue@Position

4. Set the compensation time according to the data set to the probe data (ProbeData).
Because the delay time varies depending on the actual equipment configuration, adjust the compensation time based on the setting for system-specific delay compensation time shown below.
☞ Page 2170 Setting method



• Compensation time setting example

Setting item	Setting value
Communication cycle interval setting	1000 [μs]
MotionSystem.PrConst.OperationCycle[1]	0:
Motion Synchronization Station Send/Receive Data Refresh Method (MotionSystem.PrConst.Link_MotionStationRefreshType):	1: Operation Cycle Preferred Method (EmphasisOperationCycle)
MC_TouchProbe.ProbeData.Target	[AXIS]mcLatestActualValue@Position

With the settings above

Setting item	Setting value
MC_TouchProbe.CompensationTime	-0.004 [s] (-(0.001 [s] (Operation cycle) × 4))

5. Enable the touch probe function of the MR-J5-G-RJ by ST program and start MC_TouchProbe.

Digital cam switch

Digital cam switch is a function to output on/off signals according to a value of any data. By setting signals which are compatible with the external signal high-accuracy output as the output signal, high-accuracy output using the signal output time of the device station can be performed.

For details on the digital cam switch, refer to the following.

☞ Page 1175 DIGITAL CAM SWITCH

The method for setting the external signal high-accuracy with the digital cam switch is described in an example where Y0 of a remote I/O module is used for the output signal.

■Required settings for external signal high-accuracy output

External signal high-accuracy output uses a device station signal output time, so that the setting to specify the signal output time is required.

For details on the setting method, refer to the following.

☞ Page 2187 When a remote I/O module (output, I/O combined) is used

■How to check whether high-accuracy output is enabled

Check whether a signal output time of each device station has been stored in the relevant device at the signal output, by using a method such as device labels.

For details on the check method, refer to the following.

☞ Page 2190 Precautions

■Setting for system-specific delay compensation time

Data source (ValueSource) set with the digital cam switch causes delay time specific to the system.

The delay can be compensated by setting On time compensation (TrackOptions.OnCompensation) or Off time compensation (TrackOptions.OffCompensation) of the digital cam switch. Also, the delay time varies depending on data set as the data source.

Refer to the following for this setting.

Type	Data	Reference value
OBJ	0x60640020 (Position actual value)	Operation cycle × 2
VAR	Axis.MdSetPosition	Operation cycle × 1
	Axis.Md.ActualPosition	Operation cycle × 3
	Axis.Md.Io_TargetPos	Operation cycle × 1
	Axis.Md.Io_PosActualValue	Operation cycle × 3
	MR_J5_XXX_PositionActualValue*1	Operation cycle × 2
AXIS	mcLatestSetValue	0
	mcSetValue	Operation cycle × 1
	mcLatestActualValue	Operation cycle × 2
	mcActualValue	Operation cycle × 3

*1 The device label name differs depending on the model. Set the device label name according to the created device label name.

External signal high-accuracy input

When the following signals that support external signal high-accuracy input are used for some functions that have external signal inputs, such as touch probe and advanced synchronization control for those that have trigger input signal (TriggerInput), high-accuracy control with a device station signal detection time is enabled.
For the accuracy of signal detection time, refer to the manuals for the device used.
When the following signals are specified for the function that does not support high-accuracy input, the signals operate with the same accuracy as normal signals.

- Signals that can be used to external signal high-accuracy input
  Signals that can be used to external signal high-accuracy input differs depending on the device to be used.

Device	Signal name	Description	When anything other than high-accuracy input is set
MR-J5(W)-G series	[OBJ]60B90010.6	Toggle status for latch completion at the rising edge of touch probe 1	Operates in the same accuracy as the normal signals.
	[OBJ]60B90010.7	Toggle status for latch completion at the falling edge of touch probe 1	
	[OBJ]60B90010.E	Toggle status for latch completion at the rising edge of touch probe 2	
	[OBJ]60B90010.F	Toggle status for latch completion at the falling edge of touch probe 2	
	[OBJ]2DE90010.6	Toggle status for latch completion at the rising edge of touch probe 3	
	[OBJ]2DE90010.7	Toggle status for latch completion at the falling edge of touch probe 3	
Remote I/O module (Input, I/O combined)	[LINK]X0	External input X0 status	Error
	[LINK]X1	External input X1 status	
	⋮	⋮	
	[LINK]X1E	External input X1E status	
	[LINK]X1F	External input X1F status	

■Relevant variables

I/O signals are expressed by the TARGET_REF structure. For details, refer to the following.
☞ Page 1155 Relevant Variables

■Control details

For the control details on each function when external signal high-accuracy input is used, refer to the specifications of each function. For the list of functions that support external signal high-accuracy input, refer to the following.
☞ Page 1154 EXTERNAL SIGNAL SELECTION

Precautions

- When MR-J5(W)-G series is used as external signal high-accuracy input, the touch probe function of MR-J5(W)-G series is required. The touch probe function of MR-J5(W)-G series has restrictions of the device and the version that can be used. For details, refer to the manuals for MR-J5(W)-G series.
  For MR-J5-G/MR-J5W-G: MR-J5-G/MR-J5W-G User's Manual (Introduction)
  - Connected devices and versions that support the touch probe function

Model name	Supported version
MR-J5-G-RJ	"B6" or later
MR-J5(W)-G	"B6" or later

- When using a remote I/O module as an external signal high-accuracy input, the synchronization timing control mode of the remote I/O module is required. For details, refer to the manual for the remote I/O module. The following models are available as remote I/O modules that can be used for external signal high-accuracy input.

Item	Model	Version
DC input	NZ2GN12A4-16D	"05" or later
	NZ2GN12A4-16DE	
	NZ2GN2B1-16D	
	NZ2GN2S1-16D	
	NZ2GN2B1-32D	
	NZ2GN2S1-32D	
	NZ2GNCF1-32D	
	NZ2GNCE3-32D	
I/O combined module	NZ2GN12A42-16DT	
	NZ2GN12A42-16DTE	
	NZ2GN2B1-32DT	
	NZ2GN2B1-32DTE	
	NZ2GN2S1-32DT	
	NZ2GN2S1-32DTE	
	NZ2GNCE3-32DT	

■Required settings for external signal high-accuracy input

External signal high-accuracy input uses a device station signal detection time, so that the setting to obtain the signal detection time is required.
If the required settings are not applied to external signal high-accuracy input, the operation differs depending on the specified signal. For details, refer to each function.

<When MR-J5(W)-G series is used>
When MR-J5(W)-G series is used, the touch probe function of MR-J5(W)-G series is used. For details on parameters and objects of MR-J5(W)-G series, refer to the manual for the MR-J5(W)-G. The touch probe function of MR-J5(W)-G series has restrictions of the device and the version that can be used. For details, refer to the manuals for MR-J5(W)-G series.

- Settings of MR-J5(W)-G series

1. Set connector pins to assign TPR1, TPR2, and TPR3 of the input device to be used.
<Setting example>
When TPR1, TPR2, and TPR3 is used with the MR-J5-G-RJ
- Set "2Ch" to Pr.PD38.0-1. (Assign TPR1 to the connector pin CN3-10.) Set "2Dh" to Pr.PD39.0-1. (Assign TPR2 to connector the pin CN3-1.) Set "63h" to Pr.PD05.0-1. (Assign TPR3 to connector the pin CN3-19.)

• Settings of the Motion system

1. Set the following object data to TPDO of the PDO mapping.

• When TPR1 is used

Index	SubIndex	Object name	Description
60B9h	00h	Touch probe status 1	Set this object when using TPR1 and TPR2.
60D1h	00h	Touch probe time stamp 1 positive value	Set to detect the rising edge of TPR1. (The setting is not required for detecting the falling edge only.)
60D2h	00h	Touch probe time stamp 1 negative value	Set to detect the falling of TPR1. (The setting is not required for detecting the rising edge only.)

• When TPR2 is used

Index	SubIndex	Object name	Description
60B9h	00h	Touch probe status 1	Set this object when using TPR1 and TPR2.
60D3h	00h	Touch probe time stamp 2 positive value	Set to detect the rising edge of TPR2. (The setting is not required for detecting the falling edge only.)
60D4h	00h	Touch probe time stamp 2 negative value	Set to detect the falling of TPR2. (The setting is not required for detecting the rising edge only.)

• When TPR3 is used

Index	SubIndex	Object name	Description
2DE9h	00h	Touch probe status 2	Set to use TPR3.
2DF8h	00h	Touch probe time stamp 3 positive value	Set to detect the rising edge of TPR3. (The setting is not required for detecting the falling edge only.)
2DF9h	00h	Touch probe time stamp 3 negative value	Set to detect the falling edge of TPR3. (The setting is not required for detecting the rising edge only.)

2. Set high-accuracy input to data of MC_TRIGGER_REF type.

Detection signal	Detection direction	Settings of MC_TRIGGER_REF type data			
		Target (Target)	Signal detection method (Detection)*1	Compensation time (CompensationTime)*2	Filter time (FilterTIme)*3
TPR1	Rising edge	[OBJ]0x60B90010.6@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x60B90010.7@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0
TPR2	Rising edge	[OBJ]0x60B90010.E@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x60B90010.F@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0
TPR3	Rising edge	[OBJ]0x2DE90010.6@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x2DE90010.7@station address	4: Detection at rising edge/falling edge (BothEdges)	Arbitrary value	0.0

*1 Toggle status for latch completion at the rising edge/the falling edge which is set to Target (Target) differs the status (0 and 1) every detection at rising/falling edge. Therefore, set "4: Detection at Rising Edge/Falling Edge (BothEdges)".

*2 For the setting range, refer to the specifications of each function.

*3 To use as the external signal high-accuracy input, set 0.0.

3. Set to the input of function that uses the external signal with MC_TRIGGER_REF type data which has been set.

(Example) Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled)

4. Enable the touch probe function of MR-J5(W)-G series.

Enable the touch probe function of MR-J5(W)-G series using the following objects.

• When TPR1 and TPR2 are used

Index	SubIndex	Size (number of bits)	Object name
60B8h	00h	10h	Touch probe function 1

• When TPR3 is used

Index	SubIndex	Size (number of bits)	Object name
2DE8h	00h	10h	Touch probe function 2

Set the following value to the objects above. There are two methods to set the value to the object, one is using the transient transmission and the other one is using the cyclic transmission.

Detection signal	Detection direction	Object name	Value to be set	Description
TPR1	Rising edge	Touch probe function 1	Set "1" to Bit0, Bit1, and Bit4.	Bit 0: Touch probe 1 enabled Bit 1: Continuous trigger mode Bit 4: Start sampling the rising edge Bit 5: Start sampling the falling edge
	Falling edge	Touch probe function 1	Set "1" to Bit0, Bit1, and Bit5.	
TPR2	Rising edge	Touch probe function 1	Set "1" to Bit8, Bit9, and Bit12.	Bit 8: Touch probe 2 enabled Bit 9: Continuous trigger mode Bit 12: Start sampling the rising edge Bit 13: Start sampling the falling edge
	Falling edge	Touch probe function 1	Set "1" to Bit8, Bit9, and Bit13.	
TPR3	Rising edge	Touch probe function 2	Set "1" to Bit0, Bit1, and Bit4.	Bit 0: Touch probe 3 enabled Bit 1: Continuous trigger mode Bit 4: Start sampling the rising edge Bit 5: Start sampling the falling edge
	Falling edge	Touch probe function 2	Set "1" to Bit0, Bit1, and Bit5.	

Point

If the device that is used is disconnected from the network, reconnect the device and execute the procedure from 4. again.

● How to use transient transmission

Write data to the following object using MC_WriteParameter (Parameter Write). For details on MC_WriteParameter (Parameter Write), refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

Point

Object writing by MC_WriteParameter (Parameter Write) can be executed in the device station in which axis is assigned only. For device stations in which the axis is not assigned, use the method for cyclic transmission.

(Program example)

When TPR1 of the MR-J5-G-RJ is used (When using both of rising edge and falling edge)

ST program

```
// Enable the touch probe function of the MR-J5-G-RJ.
// writeValue is a label of DINT
// writeParameterExecute and writeParameterDone are labels of BOOL type.
writeValue := DINT#16#00000033; //Set Bit 0, 1, 4, and 5.
MC_WriteParameter_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= writeParameterExecute ,
  ParameterNumber:= UDINT#16#60B80010 , //Touch probe function 1
  Value:= DINT_TO_LREAL( writeValue ) ,
  ExecutionMode:= 0 ,
  Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
  Done => writeParameterDone);
```

● How to use cyclic transmission

(a): Set the following object to RPDO of PDO mapping. (☞ Page 165 PDO mapping setting)

• When TPR1 and TPR2 are used

Index	SubIndex	Object name
60B8h	00h	Touch probe function 1

• When TPR3 is used

Index	SubIndex	Object name
2DE8h	00h	Touch probe function 2

(b): Generate a network label of the above object. (☞ Page 108 Creation procedure for network labels)

(c): Execute the following operation to the generated network label.

(Program example)

When TPR1 of the MR-J5-G-RJ is used (When using both of rising edge and falling edge)

ST program
// Enable the touch probe function of the MR-J5-G-RJ. MR_J5_G_RJ_001_ TouchProbeFunction:= UINT#16#0033; //(Set "1" to Bit0, Bit1, Bit4, and Bit5.)

5. Check whether the touch probe function of MR-J5(W)-G series is enabled.

Check whether the touch probe function of MR-J5(W)-G series is enabled using the following object.

• When TPR1 and TPR2 are used

Index	SubIndex	Size (number of bits)	Object name
60B9h	00h	10h	Touch probe status 1

• When TPR3 is used

Index	SubIndex	Size (number of bits)	Object name
2DE9h	00h	10h	Touch probe status 1

Check that the following value is stored to the above object. There are two methods to check the object: one is using the transient transmission and the other one is using the cyclic transmission.

Detection signal	Detection direction	Object name	Value at touch probe enabled	Description
TPR1	Rising edge	Touch probe Status1	Bit 0 is set to 1.	Bit 0: Touch probe 1 enabled
	Falling edge	Touch probe Status1	Bit 0 is set to 1.	
TPR2	Rising edge	Touch probe Status1	Bit 8 is set to 1.	Bit 8: Touch probe 2 enabled
	Falling edge	Touch probe Status1	Bit 8 is set to 1.	
TPR3	Rising edge	Touch probe Status2	Bit 0 is set to 1.	Bit 0: Touch probe 3 enabled
	Falling edge	Touch probe Status2	Bit 0 is set to 1.	

● How to use transient transmission

Read the following object using MC_ReadParameter (Parameter Read). For details on MC_ReadParameter (Parameter Read), refer to the following.

MELSEC MX Controller MX-R Model Programming Manual

(Program example)

When TPR1 of the MR-J5-G-RJ is used

ST program

```
// Obtain the status of touch probe of the MR-J5-G-RJ.
// readValue is a label of LREAL.
// tempValue is a label of INT.
// readParameterEnable and readParameterValid are labels of BOOL type.
MC_ReadParameter_1(
    Axis:= Axis0001.AxisRef ,
    Enable:= readParameterEnable ,
    ParameterNumber:= UDINT#16#60B90010 , //Touch probe status 1
    Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
    Valid => readParameterValid,
    Value => readValue);

// Check whether touch probe of the MR-J5-G-RJ is enabled.
tempValue := LREAL_TO_INT(readValue);
IF tempValue.0 THEN
  //Start the function that uses external signal high-accuracy input.
END_IF;
```

● How to use cyclic transmission

(a) Generate a network label of the following object. For the method to generate network labels, refer to the following.

Page 108 Creation procedure for network labels

• When TPR1 and TPR2 are used

Index	SubIndex	Object name
60B9h	00h	Touch probe status 1

• When TPR3 is used

Index	SubIndex	Object name
2DE9h	00h	Touch probe status 2

(b) Execute the following operation to the generated network label.

(Program example)

When TPR1 of the MR-J5-G-RJ is used (When using both of rising edge and falling edge)

ST program

```
// Check whether touch probe of the MR-J5-G-RJ is enabled.
IF MR_J5_G_RJ_001_ TouchProbeStaus.0 THEN
  //Start the function that uses external signal high-accuracy input.
END_IF;
```

■When a remote I/O module (input, I/O combined) is used

When using a remote I/O module, use the synchronization timing control mode of the remote I/O module.
For details on the operation mode settings and link devices of the remote I/O module, refer to the manual for the remote I/O module.

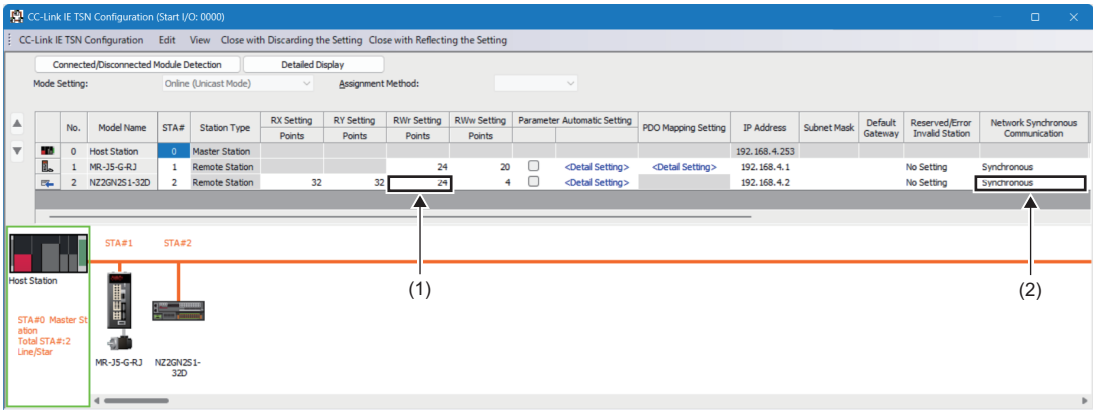
Precautions

For the synchronization timing control mode of the remote I/O module, there are restrictions in versions that can be used. For details, refer to the manual for the remote I/O module.
The following shows the case where high-accuracy input signals are used when the input module is NZ2GN2S1-32D and the station address is 192.168.3.2.

- CC-Link IE TSN configuration

1. In the "CC-Link IE TSN Configuration" window, set "Network Synchronous Communication" of the NZ2GN2S1-32D to "Synchronous". Also, increase the number of RWr points. For the number of required points, refer to the manual for the remote I/O module.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



(1) As RWr18 to RWr2F are used, set the number of points for the RWr setting to 24.
(2) Set the network synchronous communication setting to "Synchronous".

In this section, the following link devices are used.

Device No.	Specification when in synchronization timing control mode
RWr18	Module status area
RWr19	Error code
RWr1A	Function selection status area
RWr28, RWr29	Synchronization input timing information X0 Off → On
RWr2A, RWr2B	Synchronization input timing information X0 On → Off
RWr2C, RWr2D	Synchronization input timing information X1 Off → On
RWr2E, RWr2F	Synchronization input timing information X1 On → Off

• Setting of CC-Link IE TSN Network synchronous communication function

Set the CC-Link IE TSN Network synchronous communication function of the remote I/O module to synchronization timing control mode. For details on the setting method, refer to the manual for the remote I/O module.

• How to check whether the synchronization timing control mode is set

Whether the synchronization timing control mode is set can be checked in the CC-Link IE TSN Network synchronous communication setting status (RWr1A.b4 and RWr1A.b5 in the example). An error occurs in the setting other than the synchronization timing control mode.

For details, refer to each function.

The following table lists the CC-Link IE TSN Network synchronous communication setting status (RWr1A.b4 and RWr1A.b5).

Supported: ○, not supported: ×

Value of RWr1A.b4	Value of RWr1A.b5	Setting status	Support status of high-accuracy input
Off	Off	Asynchronous	×
On	Off	Synchronous (Synchronization X/Y control mode)	×
Off	On	Synchronous (Synchronization timing control mode)	○
On	On	Synchronous (Time synchronization control mode)	×

• High-accuracy input setting for the function to be used (For use on the MC_TRIGGER_REF type)

1. Set high-accuracy input to data of MC_TRIGGER_REF type.

Signal to be used	Detection direction	Settings of MC_TRIGGER_REF type data			
		Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)*1	Filter time (FilterTIme)*2
X0	Rising edge	[LINK]X0@station address	2: Detection at FALSE → TRUE (Rising edge) (RisingEdge)	Arbitrary value	0.0
	Falling edge		3: Detection at TRUE → FALSE (Falling edge) (FallingEdge)		
	Both edges		4: Detection at rising edge/falling edge (BothEdges)		
⋮					
X1F	Rising edge	[LINK]X1F@station address	2: Detection at FALSE → TRUE (Rising edge) (RisingEdge)	Arbitrary value	0.0
	Falling edge		3: Detection at TRUE → FALSE (Falling edge) (FallingEdge)		
	Both edges		4: Detection at rising edge/falling edge (BothEdges)		

*1 For the setting range, refer to each function.

*2 To use as the external signal high-accuracy input, set 0.0.

2. Set to the input of function that uses the external signal with MC_TRIGGER_REF type data which has been set.
(Example) Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled)

■Program example (When MR-J5-G-RJ series is used)

- When TPR1 of the station address 192.168.3.1 is used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled) at the rising edge detection

<Settings of the MR-J5-G-RJ>

1. Set a connector pin to assign TPR1 of the input device to be used.
Set "2Ch" to Pr.PD38.0-1. (Assign TPR1 to the connector pin CN3-10.)

<Settings of the Motion system>

1. Set the following object data to TPDO of the PDO mapping.

Index	SubIndex	Object name
60B9h	00h	Touch probe status 1
60D1h	00h	Touch probe time stamp 1 positive value

2. Generate a label to be used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled).
Create new data of MC_TRIGGER_REF type and set Toggle status for latch completion (Touch probe status 1 Bit6) of TPR1 to Target (Target).

Data name	Settings of MC_TRIGGER_REF type data			
	Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)	Filter time (FilterTIme)
SignalData0001	[OBJ]0x60B90010.6@192.168.3.1	4: Detection at rising edge/ falling edge (BothEdges)	0.0	0.0

3. Generate a label to be used as Probe data (ProbeData) of MC_TouchProbe (Touch Probe Enabled).
Create a new data of TARGET_REF type and set Probe data (ProbeData). As an example, the case to set axis data is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0002	[AXIS]mcSetValue@Position

Point

When data based on the information of the device is set to Probe data (ProbeData), a system-specific delay occurs. Set the compensation time and compensate for the delay.

4. Enable the touch probe function of the MR-J5-G-RJ by ST program and start MC_TouchProbe (Touch Probe Enabled).

ST program

```
// Enable the touch probe function of the MR-J5-G-RJ.
// writeValue is a label of DINT.
// writeParameterExecute, writeParameterDone, and touchProbeExecute are labels of BOOL type.
writeValue := DINT#16#00000013; //Set Bit 0, 1, 4.
MC_WriteParameter_1(
   Axis:= Axis0001.AxisRef ,
   Execute:= writeParameterExecute ,
   ParameterNumber:= UDINT#16#60B80010 , //Touch probe function 1
   Value:= DINT_TO_LREAL( writeValue ) ,
   ExecutionMode:= 0 ,
   Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
   Done => writeParameterDone);

// Obtain the status of touch probe of the MR-J5-G-RJ.
// readValue is a label of LREAL. tempValue is a label of INT.
// readParameterEnable and readParameterValid are labels of BOOL type.
MC_ReadParameter_1(
   Axis:= Axis0001.AxisRef ,
   Enable:= readParameterEnable ,
   ParameterNumber:= UDINT#16#60B90010 , //Touch probe status 1
   Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
   Valid => readParameterValid,
   Value => readValue);

tempValue := LREAL_TO_INT(readValue); // When touch probe of the MR-J5-G-RJ is enabled
IF tempValue.0 THEN
  touchProbeExecute := TRUE; //Set TRUE to Execute of MC_TouchProbe.
  readParameterEnable := FALSE; //Stop readParameter.
END_IF;

// Set external signal high-accuracy input to TriggerInput of MC_TouchProbe.
// Latch the data set to ProbeData at the rising edge of TPR1 of the MR-J5-G-RJ.
// touchProbeRecordedPos is a label of LREAL type.
MC_TouchProbe_1(
   Axis:= Axis0001.AxisRef ,
   Execute := touchProbeExecute,
   TriggerInput := SignalData0001 ,
   ProbeData := SignalData0002 ,
   RecordedPosition => touchProbeRecordedPos);
```

■Program example (When a remote I/O module (input, I/O combined) is used)

• When X1 of the station address 192.168.3.2 is used as the trigger signal of MC_TouchProbe at the rising edge detection

<Settings of the NZ2GN2S1-32D>

1. Set the remote I/O module to synchronization timing control mode.
Set the function setting switches 6 and 7 of the remote I/O module as follows.

Function setting switch 6	Function setting switch 7	Operation mode in CC-Link IE TSN Network synchronous communication	CC-Link IE TSN Class setting
Off	On	Synchronization timing control mode	CC-Link IE TSN Class B

<Settings of the Motion system>

1. Generate a label to be used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled).
By using the external signal selection type [LINK], set X1 of the NZ2GN2S1-32D to Target.

Data name	Settings of MC_TRIGGER_REF type data			
	Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)	Filter time (FilterTIme)
SignalData0001	[LINK]X1@192.168.3.2	2: Detection at FALSE → TRUE (Rising edge) (RisingEdge)	0.0	0.0

2. Generate a label to be used as Probe data (ProbeData) of MC_TouchProbe (Touch Probe Enabled).
Create a new data of TARGET_REF type and set Probe data (ProbeData). As an example, the case to set axis data is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0002	[AXIS]mcSetValue@Position

3. Generate a label to be used as Storage location of latch data (OutputBuffer) of MC_TouchProbe (Touch Probe Enabled).
As an example, the case to use a label (leOutputBuffer) generated as the LREAL type is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0003	[VAR]leOutputBuffer

4. Use the ST program to start MC_TouchProbe (Touch Probe Enabled).

ST program

```
// Set external signal high-accuracy input to TriggerInput of MC_TouchProbe.
// Latch the data set to ProbeData at the rising edge of X1 of the NZ2GN2S1-32D.
MC_TouchProbe_1(
   Axis:= Axis0001.AxisRef ,
   Execute := touchProbeExecute,
   TriggerInput := SignalData0001 ,
   ProbeData := SignalData0002 ,
   OutputBuffer := SignalData0003);
```

■Precautions

- When using external signal high-accuracy input, set 0 to Filter Time (FilterTime) of the external signal selection.
  If the device has the input filter, use the filter of the device.
  When using external signal high-accuracy input and setting other than 0 to Filter Time (FilterTime) of the external signal selection, a signal detection time cannot be detected correctly.
- If the edge detection direction is incorrectly set, the edge detection time cannot be correctly acquired.
- Note that the signal to be input to the device station as high-accuracy input should not be turned on/off several times within a communication cycle. If the signal turns on/off several times within a communication cycle, the signal cannot be detected correctly.
- When the high-accuracy input cannot be operated normally, the check method differs depending on the device station used. Use an object or device described below to check that the high-accuracy is enabled and the signal detection time is stored.

Device station	How to check whether high-accuracy is enabled			How to check whether the signal detection time is stored		
MR-J5(W)-G series	TPR1	Touch probe status	Bit0 = 1	Rising edge detection	Touch probe time stamp 1 positive value (60D1H)	Time information should be stored in the object described on the left.
				Falling edge detection	Touch probe time stamp 1 negative value (60D2H)	Time information should be stored in the object described on the left.
	TPR2	Touch probe status	Bit8 = 1	Rising edge detection	Touch probe time stamp 2 positive value (60D3H)	Time information should be stored in the object described on the left.
				Falling edge detection	Touch probe time stamp 2 negative value (60D4H)	Time information should be stored in the object described on the left.
	TPR3	Touch probe status 2	Bit0 = 1	Rising edge detection	Touch probe time stamp 3 positive value (2DF8H)	Time information should be stored in the object described on the left.
				Falling edge detection	Touch probe time stamp 3 negative value (2DF9H)	Time information should be stored in the object described on the left.
Remote I/O module	RWr2[*1]		Bit4 = 0 Bit5 = 1	Off → On detection	Synchronization input timing information X0[*1] (RWr10, RWr11)[*2]	Time information should be stored in the device described on the left.[*3]
				On → Off detection	Synchronization input timing information X0[*1] (RWr12, RWr13)[*2]	Time information should be stored in the device described on the left.[*3]

*1 The storage location differs depending on the start number of the RWr setting of the module used. For details, refer to the manual for the remote I/O module.
*2 Check the device corresponding to the external signal used. For details, refer to the manual for the remote I/O module.
*3 The watch window cannot be used for the check. Use the logging setting tool.

External signal high-accuracy output

When the following signals which are compatible with the external signal high-accuracy output are used for functions which have Output (output signal) as the output, high-accuracy control using signal output time of device stations can be performed. For the accuracy of signal output time, refer to the manuals for the device station used.

- Signals that can be used to external signal high-accuracy output
  Signals that can be used to external signal high-accuracy output differ depending on the device station to be used.

Device	Signal name	Description	In the setting other than high-accuracy output
Remote I/O module (output, I/O combined)	[LINK]Y0	External output Y0 status	Error
	[LINK]Y1	External output Y1 status	
	⋮	⋮	
	[LINK]Y1E	External output Y1E status	
	[LINK]Y1F	External output Y1F status	

Precautions

- When using a remote I/O module as an external signal high-accuracy output, the synchronization timing control mode of the remote I/O module is required. For details, refer to the manual for the remote I/O module. The following models are available as remote I/O modules that can be used for external signal high-accuracy output.

Item	Model	Version
Transistor output	NZ2GN12A2-16T	"05" or later
	NZ2GN12A2-16TE	
	NZ2GN2B1-16T	
	NZ2GN2B1-16TE	
	NZ2GN2S1-16T	
	NZ2GN2S1-16TE	
	NZ2GN2B1-32T	
	NZ2GN2B1-32TE	
	NZ2GN2S1-32T	
	NZ2GN2S1-32TE	
	NZ2GNCF1-32T	
I/O combined module	NZ2GN12A42-16DT	
	NZ2GN12A42-16DTE	
	NZ2GN2B1-32DT	
	NZ2GN2B1-32DTE	
	NZ2GN2S1-32DT	
	NZ2GN2S1-32DTE	
	NZ2GNCE3-32DT	

■Relevant variables

I/O signals are expressed by the TARGET_REF structure. For details, refer to the following.

☞ Page 1155 Relevant Variables

■Control details

For the control details on each function when external signal high-accuracy output is used, refer to the specifications of each function. For the list of functions that support external signal high-accuracy output, refer to the following.

☞ Page 1154 EXTERNAL SIGNAL SELECTION

■Required settings for external signal high-accuracy output

External signal high-accuracy output uses a device station signal detection time, so that the setting to obtain the signal detection time is required.

If the required setting is not executed to external signal high-accuracy input, an error occurs. For details, refer to each function.

■When a remote I/O module (output, I/O combined) is used

When using a remote I/O module, use the synchronization timing control mode of the remote I/O module.

For details on the operation mode settings and link devices of the remote I/O module, refer to the manual for the remote I/O module.

Precautions

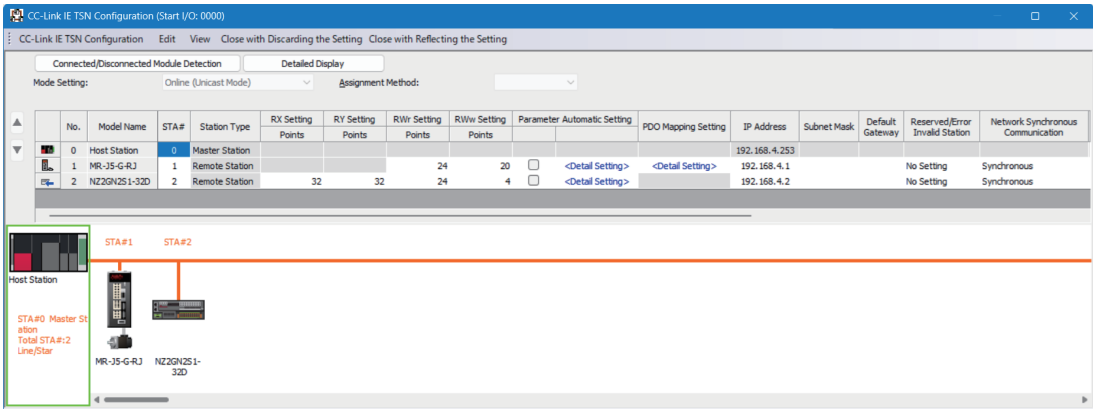
For the synchronization timing control mode of the remote I/O module, there are restrictions in versions that can be used. For details, refer to the manual for the remote I/O module.

The following shows the case where high-accuracy output signals are used when the output module is NZ2GN2S1-32T and the station address is 192.168.3.2.

- CC-Link IE TSN configuration

1. In the "CC-Link IE TSN Configuration" window, set "Network Synchronous Communication" of the NZ2GN2S1-32T to "Synchronous". Also, increase the number of RWw points. For the number of required points, refer to the manual for the remote I/O module.

Navigation window ⇨ [Parameter] ⇨ Controller ⇨ [Module Parameter (Port 1/2: CC-Link IE TSN)] ⇨ [Module Parameter (CC-Link IE TSN)] ⇨ [Basic Settings] ⇨ [Network Configuration Settings]



In this section, the following link devices are used.

Device No.	Specification when in synchronization timing control mode
RWr18	Module status area
RWr19	Error code
RWr20	Function selection status area
RWw24, RWw25	Synchronization output timing information Y0 Off → On
RWw26, RWw27	Synchronization output timing information Y0 On → Off
RWw28, RWw29	Synchronization output timing information Y1 Off → On
RWw2A, RWw2B	Synchronization output timing information Y1 On → Off

• Setting of CC-Link IE TSN Network synchronous communication function

Set the CC-Link IE TSN Network synchronous communication function of the remote I/O module to synchronization timing control mode. For details on the setting method, refer to the manual for the remote I/O module.

• How to check whether the synchronization timing control mode is set

Whether the synchronization timing control mode is set can be checked in the CC-Link IE TSN Network synchronous communication setting status (RWr20.b4 and RWr20.b5 in the example). An error occurs in the setting other than the synchronization timing control mode.

For details, refer to each function.

The following table lists the CC-Link IE TSN Network synchronous communication setting status (RWr20.b4 and RWr20.b5).

Supported: ○, not supported: ×

Value of RWr20.b4	Value of RWr20.b5	Setting status	Support status of high-accuracy output
Off	Off	Asynchronous	×
On	Off	Synchronous (Synchronization X/Y control mode)	×
Off	On	Synchronous (Synchronization timing control mode)	○
On	On	Synchronous (Time synchronization control mode)	×

• High-accuracy output setting for the function to be used (For use on the MC_TRIGGER_REF type)

1. Set high-accuracy output to data of MC_TRIGGER_REF type.

Signal to be used	Detection direction	Settings of MC_TRIGGER_REF type data			
		Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)*1	Filter time (FilterTIme)*2
Y0	TRUE	[LINK]Y0@station address	0: Detection at TRUE (HighLevel)	Arbitrary value	0.0
	FALSE	[LINK]Y0@station address	1: Detection at FALSE (LowLevel)	Arbitrary value	0.0
⋮					
Y1F	TRUE	[LINK]Y1F@station address	0: Detection at TRUE (HighLevel)	Arbitrary value	0.0
	FALSE	[LINK]Y1F@station address	1: Detection at FALSE (LowLevel)	Arbitrary value	0.0

*1 For the setting range, refer to each function.

*2 To use as the external signal high-accuracy output, set 0.0.

2. Set to the output of function that uses the external signal with MC_TRIGGER_REF type data which has been set.
(Example) @@@ (Output) of MCv_DigitalCamSwitch (Digital cam switch output)

■Program example (When a remote I/O module (output, I/O combined) is used)

• When X1 of the station address 192.168.3.2 is used as the trigger signal of MC_TouchProbe at the rising edge detection

<Settings of the NZ2GN2S1-32D>

1. Set the remote I/O module to synchronization timing control mode.
Set the function setting switches 6 and 7 of the remote I/O module as follows.

Function setting switch 6	Function setting switch 7	Operation mode in CC-Link IE TSN Network synchronous communication	CC-Link IE TSN Class setting
On	Off	Synchronization timing control mode	CC-Link IE TSN Class B

<Settings of the Motion system>

1. Generate a label to be used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled).
By using the external signal selection type [LINK], set X1 of the NZ2GN2S1-32D to Target.

Data name	Settings of MC_TRIGGER_REF type data			
	Target (Target)	Signal detection method (Detection)	Compensation time (CompensationTime)	Filter time (FilterTIme)
SignalData0001	[LINK]X1@192.168.3.2	2: Detection at FALSE → TRUE (Rising edge) (RisingEdge)	0.0	0.0

2. Generate a label to be used as Probe data (ProbeData) of MC_TouchProbe (Touch Probe Enabled).
Create a new data of TARGET_REF type and set Probe data (ProbeData). As an example, the case to set axis data is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0002	[AXIS]mcSetValue@Position

3. Generate a label to be used as Storage location of latch data (OutputBuffer) of MC_TouchProbe (Touch Probe Enabled).
As an example, the case to use a label (leOutputBuffer) generated as the LREAL type is shown below.

Data name	Settings of TARGET_REF type data
	Target (Target)
SignalData0003	[VAR]leOutputBuffer

4. Use the ST program to start MC_TouchProbe (Touch Probe Enabled).

ST program

```
// Set external signal high-accuracy input to TriggerInput of MC_TouchProbe.
// Latch the data set to ProbeData at the rising edge of X1 of the NZ2GN2S1-32D.
MC_TouchProbe_1(
   Axis:= Axis0001.AxisRef ,
   Execute := touchProbeExecute,
   TriggerInput := SignalData0001 ,
   ProbeData := SignalData0002,
   OutputBuffer := SignalData0003);
```

■Precautions

- When using external signal high-accuracy output, set 0 to Filter Time (FilterTime) of the external signal selection.
  If the device has the output filter, use the filter of the device.
  When using external signal high-accuracy output and setting other than 0 to Filter Time (FilterTime) of the external signal selection, a signal output time cannot be output correctly.
- Note that the signal to be output to the device station as high-accuracy output should not be turned on/off several times within a communication cycle. If the signal turns on/off several times within a communication cycle, the signal cannot be output correctly.
- When the high-accuracy output cannot be operated normally, the check method differs depending on the device station used. Use an object or device described below to check that the high-accuracy is enabled and the signal output time is stored.

Device station	How to check whether high-accuracy is enabled		How to check whether the signal detection time is stored		
Remote I/O module	RWr2[*1]	Bit4 = 0 Bit5 = 1	Off → On output	Synchronization output timing information Y0[*1] (RWr10, RWr11)[*2]	Time information should be stored in the device described on the left.[*3]
			On → Off output	Synchronization output timing information Y0[*1] (RWr12, RWr13)[*2]	Time information should be stored in the device described on the left.[*3]

*1 The storage location differs depending on the start number of the RWr and RWw settings of the module used. For details, refer to the manual for the remote I/O module.
*2 Check the device corresponding to the external signal used. For details, refer to the manual for the remote I/O module.
*3 The watch window cannot be used for the check. Use the logging setting tool.

Precautions

When using the MR-J5(W)-G with old firmware, "Watchdog counter error (error code: 1A40H)" may occur at connection. When this symptom occurs, update the firmware of the MR-J5(W)-G.

Appendix 19 Port Numbers Used by the System

The port numbers used by the system cannot be specified.
Use a port number corresponding to the contents and method used for the communications with the communication destination.

Ports for CC-Link IE TSN

Port number		Application
Decimal	Hexadecimal	
20 to 21	14H to 15H	For system
161 to 162	A1H to A2H	For system
5000	1388H	Auto-open UDP port (used for connection with SLMP-compatible devices using UDP/IP)
5001	1389H	MELSOFT Transmission Port (UDP/IP)
5002	138AH	MELSOFT Transmission Port (TCP/IP)
5003 to 5009	138BH to 1391H	For system
5010	1392H	SLMP transmission port (UDP/IP) (used for connection with SLMP-compatible devices using UDP/IP)
5011	1393H	SLMP transmission port (TCP/IP) (used for connection with SLMP-compatible devices using TCP/IP)
45237 to 45239	B0B5H to B0B7H	For system
61440 to 61442	F000H to F002H	For system
61448	F008H	For system
61460 to 61464	F014H to F018H	For system
61500 to 61501	F03CH to F03DH	For system
62000 to 65534	F230H to FFFEH	For system

Ports for Ethernet

Port number		Application
Decimal	Hexadecimal	
5000	1388H	For system
5002	138AH	For system
5003	138BH	For system
5004	138CH	For system
5005	138DH	Auto-open UDP port
5006	138EH	MELSOFT application transmission port (UDP/IP)
5007	138FH	MELSOFT application transmission port (TCP/IP)
5008	1390H	MELSOFT application direct connection port
5009	1391H	CPU search

Appendix 20 Password Policy

This appendix describes the common policy for passwords in controllers.

Passwords

There is no default password.

■Supported characters

Item	Supported characters
Number of characters	8 to 64 characters
Type of characters	Depends on password strength setting.
Characters	ASCII characters (alphanumeric characters and special characters) Alphabetical characters are case-sensitive. The following special characters can be used.*1 ` ~ ! @ # $ % ^ & * ( ) _ + - = { } | \ : " ; ' < > ? , . / [ ] (single-byte space)

*1 For passwords to be set with the FTP client function, "$" is not supported.

■Password strength

When setting a password, the password strength according to the number of characters and the type of characters in the input password are displayed.

If the input password does not satisfy the minimum number of characters, the display indicates that the setting cannot be completed.

If the input password satisfies the minimum number of characters, the password strength is displayed according to the number of characters and the type of characters.

Number of characters/type of characters of the input password	Password strength	Display icon	Setting availability
The minimum number of characters is not satisfied (0 to 5 characters)	Setting error		No
6 or more characters	Weak		
8 or more characters, and 2 or less character types are used	Medium		Yes*1
8 or more characters, and 3 or more character types are used	Strong		

*1 With the [Password Strength Setting] button in the "Enable User Authentication" window, the available passwords can be set to a strength of "Strong" (default) or "Medium" or above.

■Expiration date

With the user authentication function, the password expiration date can be set in the user authentication settings.

Item	Description
Expiration date	1 to 999 days (Default: 42 days)
Expiration date setting	Set, Do not set (default)

Point

When the password has expired, online operations other than password change are not possible after login. To login again, the password needs to be set again.

Lockout

■Lockout setting

The password setting function locks out the user for a specified time when the number of non-matching passwords that are input during password unlocking reaches the specified number of times.

Item	Lockout setting
Lockout Setting*1	Do not set (default), Set
Number of times	1 to 999 times (Default: 10 times)
Time	1 to 9999 minutes (Default: 30 minutes)

*1 If this item is not set, lockout is not performed.

■Lockout operation

If the password is incorrectly input a certain number of times in a row during password unlocking, the user is locked out, and an error response is given for a certain period of time even if password input is attempted.
After a certain period of time has elapsed, lockout is released and unlocking becomes possible again.
During lockout, unlocking operation is not accepted, so even if a password input error occurs, the number of password input errors (consecutive unlocking failures) is not counted.
The number of password input errors (number of consecutive unlocking failures) is counted while the power is on and cleared when the power is turned off and on or reset is performed.
When the correct password is input, the number of consecutive unlocking failures is reset. In the user authentication function, only users whose user group is Administrators can unlock users who are locked out.

Number of password input errors	Lockout time
Follows the lockout setting. (The function without the lock out setting is fixed 10 times.)	Follows the lockout setting. (The function without the lock out setting is fixed 30 minutes.)

Appendix 21 Software Licenses and Copyright

This product contains open source software (OSS).
Regarding the parts licensed under GNU General Public License (GPL) and GNU Lesser General Public License (LGPL), Mitsubishi Electric can provide the source code. To obtain the source code, please contact your local Mitsubishi Electric representative.
However, the source code provided by Mitsubishi Electric is not guaranteed to be reused. Mitsubishi Electric shall have no responsibility or liability for any problems involving the source code. Besides, please refrain from inquiring about the OSS.
For the licenses and copyright of the OSS used in this product, refer to the following.
https://www.MitsubishiElectric.com/fa/ref/ref.html?k=mxc&manual=mxr_oss

Other software

The following shows the licenses and copyrights of the software, except for OSS, used in this product.

OPC UA

This product includes the OPC UA SDK developed by Empress Software Japan Inc. (http://www.empressjapan.co.jp/).
Copyright©2006-2024 Empress Software Japan Inc. All rights reserved.
The OPC UA SDK is partially based on the ANSI C Stack, the initial version of which was developed and copyrighted by the OPC Foundation, Inc.
Copyright©2008, 2024 OPC Foundation, Inc. All rights reserved.

Appendix 22 Procedures Before Disposal

This appendix describes the procedures before disposal of the controller.

1. Full initialization of controller information

Erase the data of the controller. (☞ Page 1556 All Information Initialization of Controller)

2. Power-off

Power off the power supply modules on the base unit.

3. Removal of the SD memory card

If an SD memory card is used, remove it. (☞ Page 57 SD memory card removal procedure)

4. Removal of the battery

If a battery is used, remove it. (☞ Page 1621 Battery replacement procedure)

Point

- Full initialization of the controller information does not erase the contents of the SD memory card.
- For general disposal precautions, refer to SAFETY PRECAUTIONS in this manual.

Appendix 23 Added or Enhanced Functions and Supported Versions

This section describes added and enhanced functions of the controller, as well as the firmware versions of the controller and software versions of the engineering tool corresponding to the functions.

Added or enhanced function	Controller firmware version	Engineering tool software version	Reference
Simple CPU communication function	"03" or later	"1.120A" or later	Page 1266 SIMPLE CPU COMMUNICATION FUNCTION
Web server function			Page 1379 WEB SERVER FUNCTION
MES interface module (RD81MES96N) supported			Page 120 Lists of Configuration Devices
CANopen module (RJ71CN91) supported			Page 120 Lists of Configuration Devices
Sequence scan synchronization sampling function			Page 1531 SEQUENCE SCAN SYNCHRONIZATION SAMPLING FUNCTION
"FTP/FTPS" selectable in the protocol setting range of the FTP server settings			Page 1347 FTP server settings
Scan time clear			• GX Works3 Operating Manual • Page 1955 Fixed scan function information
Reading single axis status			• MELSEC MX Controller MX-R Model Programming Manual • Page 448 Single axis status reading
Pressure control			Page 742 Pressure Control
Scaling 16-bit binary data/32-bit binary data/double-precision real number (point coordinates) (SCLN(P)(_U), DSCLN(P)(_U), EDSCLN(P))			MELSEC MX Controller MX-R Model Programming Manual
Scaling 16-bit/32-bit binary data (XY coordinates) (SCL2N(P)(_U), DSCL2N(P)(_U))			MELSEC MX Controller MX-R Model Programming Manual

INDEX

Symbols

"$MELPRJ$" folder 318

0 to 9

32-bit data assurance 1244

A

Absolute position control 510
Absolute value positioning control 627
Acceleration/deceleration processing function 1078
Accuracy of constant scan 225
Accuracy of timers 360
Addition/subtraction positioning 819
Advanced synchronous control 889
Android 1381
Annunciator (F) 212,351
Applicable software 125
ASCII 402
Authority for Window Display 1385
Available devices 1392,1394
Axis 443
Axis control start wait 1191
Axis control wait 1190,1203
Axis emulation 1186
Axis group control start wait 1197
Axis Type 449

B

Backlash compensation filter 1139
Battery replacement procedure 1621
Bit 402
Block number 380
Block switching method 380
BOOL 402
Boot operation 325
Buffer memory 40,210

C

Cam operation 784
CANopen communications 1251
CC-Link IE Controller Network-equipped module 43
CC-Link IE TSN 2152
CC-Link IE TSN master/local module 43
Character string constant 397
Circular interpolation control 655
Clearing file registers 382
Coexistence of line and star topologies 173,175,177,181,186,187,2137,2140,2142
Command in-position 1059
Command input monitoring timer 1348
Communication method 196
Communication mode 216
Communication speed 215
Communication test 1713
Connection status 1710
Consideration for internal current consumption . . 128
Constant 396
Constant scan 212,224
Continuous logging 1453
COUNTER 402,403
Counter 402,403
Counter (C) 212,365
CPU buffer memory 322
CPU buffer memory access device 213,375
CPU parameters 2078
Creating the protocol setting data 1294
CSS3 1381

D

Data link 43
Data logging 1440
Data memory 210,318
Data register (D) 212,368
Data transmission speed 216
Data type 402,403
Decimal 396
Decimal constant (K) 396
Device assignment 400
Device initial value 426
Device station 40
Device supporting iQSS 43
Device/label access service processing 226
Device/label memory 210,319
Diagnostic items 1697
Diagnostics window 1702
DINT 402
Direct control 710
Double word [signed] 402
Double word [unsigned]/bit string [32 bits] 402
Double-precision real number 396,402
Drive name (drive No.) 1355
Driver unit conversion 1130
DWORD 402

E

Edge relay (V) 212,354
END processing 221
Engineering tool 488
Error clear 1751
Error code 1776
ERROR LED 51
Ethernet cable 62
Ethernet diagnostics 1707
Ethernet port 210
Event execution type program 252
Event history 1754
Event history file 1757
Existence confirmation 198
External dimensions 210
External signal selection 1154

F

File 335
File register (R/ZR) 212,380

File register setting 381
File registers common to all programs 381
Firmware update function 1650
Fixed scan execution mode 250
Fixed scan execution type program 248
Fixed scan interval 248
Follow up 504
Function (FUN) 401
Function block (FB) 401
Function device 369
Function input (FX) 212,369
FUNCTION LED 51
Function memory 210,322
Function output (FY) 212,369
Function register (FD) 212,369

G

Gear operation 816
Generic data type (ANY type) 404
Global device 390
Global label 400
Global pointer 385
Google Chrome 1381
GX Works3 1382

H

Hardware stroke limit 1069
Hexadecimal 396
Hexadecimal constant (H) 396
High-speed internal timer interrupt 1 (I49) 212
High-speed internal timer interrupt 2 (I48) 212
High-speed timer 358
High-speed timer (T/ST) 358
Homing 617
HTML5 1381

I

I/O No. specification device (U) 390
I/O numbers 133
I/O refresh 220
Index modification 376
Index register (Z) 213
Index register setting 377
Indirect specification 395
Initial Display Window 1385
Initial execution type program 246
Initial processing (when powered on) 220
Initial processing (when switched to RUN) 220
Initial scan time 222
Initial scan time monitoring time 223
Input (X) 212,349
INT 402
Internal buffer 1501
Internal current consumption (5VDC) 210
Internal relay (M) 212,350
Interrupt factor 388
Interrupt pointer (I) 213,388
Interrupt pointer number 388
Interrupt priority 274
Interrupt using the internal timer (I28 to I31) 212
iOS 1381
IP address duplication status storage area 2044,2045

J

Jerk acceleration/deceleration 1100
Jerk limit value 1097
JOG operation 632
Jumbo frame 216
Jump instructions 385

L

Label initial value 426
Latch (1) 418
Latch (2) 418
Latch clear 422
Latch relay (L) 212,350
LCOUNTER 402,403
Librarization of programs 257
Line topology 173,174,176,180,185,187,2135,2139,2141
Linear interpolation control 649
Link device 41
Link direct device 213,371
Link refresh 372
Link register (W) 212,368
Link relay (B) 212,350
Link special register (SW) 212,368
Link special relay (SB) 212,353
Lists of configuration devices 120
Local label 400
Local pointer 386
Local station 41
Logging start condition 1511
Login name 1347
Long counter 402,403
Long counter (LC) 212,365
Long index register (LZ) 213
Long retentive timer 402,403
Long retentive timer (LST) 212,358
Long timer 402,403
Long timer (LT) 212,357
Low-speed timer 358
Low-speed timer (T/ST) 358
LREAL 402
LRETENTIVETIMER 402,403
LTIMER 402,403

M

Major version 1391
Master control instructions 384
Master station 41
Maximum counting speed for counters 367
Maximum frame size 216
Maximum number of link points per network 215
Maximum number of link points per station 215
Maximum number of networks 215
MELSOFT transmission port (UDP/IP) 2191
Memory capacity 210
Memory card parameters 2084
Memory configuration 315
Minor version 1391
Mobile Google Chrome 1381
Mobile Safari 1381
Module access device 213,373
Module communication test 1769
Module configuration window 129
Module status setting 139

Modules having restrictions on the number of mountable modules . . . 124
Momentary power failure . . . 283
Monitor function . . . 1611
Motion data memory . . . 322
MR-J5(W)-G . . . 2152
Multiple axes positioning control . . . 636
Multiple axes positioning data operation . . . 665
Multiple interrupt . . . 274
Multiple start . . . 547

N

Near pass . . . 570
Nesting (N) . . . 213,384
Nesting structure . . . 384
Network label . . . 399
Network Label/Module Label Assignment Area . . . 383
Network No. specification device (J) . . . 390
Network status . . . 1703
Number of array elements . . . 409
Number of FB files . . . 212
Number of I/O points . . . 212
Number of retries . . . 1774
Number of simultaneous open connections . . . 216

O

Online change . . . 1594
Operation cycle . . . 522
Operation profile data . . . 824
Output (Y) . . . 212,350
Output mode at operating status change (STOP to RUN) . . . 281
Overflow . . . 397
Override function . . . 1116

P

Parameter No. . . . 2077
Password setting . . . 1348
PDO mapping . . . 470
PDO mapping setting . . . 165
PING test . . . 1711
POINTER . . . 402
Pointer . . . 402
Pointer (P) . . . 213,385
Pointer setting . . . 387
Positioning data setting . . . 668
Positioning range . . . 496
Predefined protocol library . . . 1295
Pressure Control . . . 742
Priority for interrupt factors . . . 389
Processing time . . . 2085
Production information marking . . . 52
Program arrangement change . . . 257
Program block . . . 401
Program execution type . . . 246
Program memory . . . 210
PROGRAM RUN LED . . . 51
Programming language . . . 212

R

READY LED . . . 51
REAL . . . 402
Real constant (E) . . . 396
Real drive axis . . . 453
Real encoder axis . . . 455
Real number . . . 396
Refresh data register . . . 213
Refresh data register (RD) . . . 382
Refresh memory . . . 210,322
Refresh memory setting . . . 383
Relative value positioning control . . . 628
Remote operation . . . 1606,1715
Remote RESET . . . 1610
Remote RUN . . . 1606
Remote STOP . . . 1606
Resetting counters . . . 366
Response monitoring timer . . . 1348
Retentive timer . . . 402,403
Retentive timer (ST) . . . 212,357
RETENTIVETIMER . . . 402,403
RUN/STOP/RESET switch . . . 51
RUN-PAUSE contacts . . . 1609

S

Saving/restoring of the file register (R) block number . . . 269
Saving/restoring of the index register (Z, LZ) . . . 270
Scan execution type program . . . 247
Scan monitoring function . . . 1743
Scan time . . . 222
Scan time monitoring time . . . 1743
Scan time monitoring time setting . . . 1743
SD memory card . . . 57,210,324
Searching modules on the network . . . 206
Select diagnostics destination . . . 1702
Selected station communication status monitor . . . 1703
Sending/receiving data storage memory . . . 216
Serial number method . . . 380
Servo ON/OFF . . . 501
Set position . . . 497
Setting RUN-PAUSE contacts . . . 1609
Setting time zone . . . 1940
Shift JIS . . . 402
Signal flow memory . . . 210,323
SIGNAL_SELECT structure . . . 1156
Single axis manual control . . . 631
Single axis positioning control . . . 627
Single axis speed control . . . 629
Single axis synchronous control . . . 780
Single CPU system . . . 119
Single-precision real number . . . 396,402
SLMP commands . . . 1264
Slot numbers on a base unit . . . 130
Smoothing filter . . . 1134
Software stroke limit . . . 1061
Special register (SD) . . . 212,370
Special relay (SM) . . . 212,370
Stack file . . . 1503
Standby type program . . . 257
Star topology . . . 173,174,176,180,185,187,2136,2139,2141
Station sub ID number . . . 43
Station-based block data assurance . . . 1246
Status of each connection . . . 1708
Status of each protocol . . . 1709
STRING . . . 402

String 402
String [Unicode] 402
Structure 403,410
Structure array 411
Subroutine call instruction 260
Supported character code 1381
Supported language 1381
Switching hub 63
System clock 1944
System configuration specifications 123
System device 369
System label 399
System parameter 129
System parameters 2077
System Web page version 1391

T

TARGET_REF structure 1158
TIME 402
Time 402
Time setting 1935
Time zone 1940
TIMER 402,403
Timer 402,403
Timer (T) 212,356
Timer current value 359
Timer limit setting 359
Timer time limit value 359
Torque control 726
Torque limit 1124
Touch probe 1166
Transmission specifications 216
Trigger condition 1454
Trigger logging 1453

U

Underflow 397
Unicode 402
Update System Web Page 1385
USB port 52,210
User device 349
USER LED 51

V

Virtual drive axis 461
Virtual encoder axis 461
Virtual linked axis 465

W

Watchdog timer 1743
Weight 210
Wiring products 62
WORD 402
Word [signed] 402
Word [unsigned]/bit string [16 bits] 402
Write Device 1385
WSTRING 402

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Revision
May 2025	SH(NA)-082641ENG-A	First edition
May 2025	SH(NA)-082641ENG-B	Error correction
October 2025	SH(NA)-082641ENG-C	Addition of the following descriptions • MES interface module (RD81MES96N) • Sequence scan synchronization sampling function • Scan time clear • "FTP/FTPS" selectable in the protocol setting range of the FTP server settings • Simple CPU communication function • Web server function • Reading single axis status • Pressure control

Japanese manual number: SH-082640-C

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses. Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

© 2025 MITSUBISHI ELECTRIC CORPORATION

CONDITIONS OF USE FOR THE PRODUCT

(1) MELSEC programmable controller ("the PRODUCT") shall be used in conditions;
i) where any problem, fault or failure occurring in the PRODUCT, if any, shall not lead to any major or serious accident; and
ii) where the backup and fail-safe function are systematically or automatically provided outside of the PRODUCT for the case of any problem, fault or failure occurring in the PRODUCT.

(2) The PRODUCT has been designed and manufactured for the purpose of being used in general industries.
MITSUBISHI ELECTRIC SHALL HAVE NO RESPONSIBILITY OR LIABILITY (INCLUDING, BUT NOT LIMITED TO ANY AND ALL RESPONSIBILITY OR LIABILITY BASED ON CONTRACT, WARRANTY, TORT, PRODUCT LIABILITY) FOR ANY INJURY OR DEATH TO PERSONS OR LOSS OR DAMAGE TO PROPERTY CAUSED BY the PRODUCT THAT ARE OPERATED OR USED IN APPLICATION NOT INTENDED OR EXCLUDED BY INSTRUCTIONS, PRECAUTIONS, OR WARNING CONTAINED IN MITSUBISHI ELECTRIC USER'S, INSTRUCTION AND/OR SAFETY MANUALS, TECHNICAL BULLETINS AND GUIDELINES FOR the PRODUCT.
("Prohibited Application")
Prohibited Applications include, but not limited to, the use of the PRODUCT in;
- Nuclear Power Plants and any other power plants operated by Power companies, and/or any other cases in which the public could be affected if any problem or fault occurs in the PRODUCT.
- Railway companies or Public service purposes, and/or any other cases in which establishment of a special quality assurance system is required by the Purchaser or End User.
- Aircraft or Aerospace, Medical applications, Train equipment, transport equipment such as Elevator and Escalator, Incineration and Fuel devices, Vehicles, Manned transportation, Equipment for Recreation and Amusement, and Safety devices, handling of Nuclear or Hazardous Materials or Chemicals, Mining and Drilling, and/or other applications where there is a significant risk of injury to the public or property.

Notwithstanding the above restrictions, Mitsubishi Electric may in its sole discretion, authorize use of the PRODUCT in one or more of the Prohibited Applications, provided that the usage of the PRODUCT is limited only for the specific applications agreed to by Mitsubishi Electric and provided further that no special quality assurance or fail-safe, redundant or other safety features which exceed the general specifications of the PRODUCTs are required. For details, please contact the Mitsubishi Electric representative in your region.

(3) Mitsubishi Electric shall have no responsibility or liability for any problems involving programmable controller trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

WARRANTY

Please confirm the following product warranty details before using this product.

1. Gratis Warranty Term and Gratis Warranty Range

If any faults or defects (hereinafter "Failure") found to be the responsibility of Mitsubishi occurs during use of the product within the gratis warranty term, the product shall be repaired at no cost via the sales representative or Mitsubishi Service Company.

However, if repairs are required onsite at domestic or overseas location, expenses to send an engineer will be solely at the customer's discretion. Mitsubishi shall not be held responsible for any re-commissioning, maintenance, or testing on-site that involves replacement of the failed module.

[Gratis Warranty Term]

The gratis warranty term of the product shall be for one year after the date of purchase or delivery to a designated place. Note that after manufacture and shipment from Mitsubishi, the maximum distribution period shall be six (6) months, and the longest gratis warranty term after manufacturing shall be eighteen (18) months. The gratis warranty term of repair parts shall not exceed the gratis warranty term before repairs.

[Gratis Warranty Range]

(1) The range shall be limited to normal use within the usage state, usage methods and usage environment, etc., which follow the conditions and precautions, etc., given in the instruction manual, user's manual and caution labels on the product.

(2) Even within the gratis warranty term, repairs shall be charged for in the following cases.

1. Failure occurring from inappropriate storage or handling, carelessness or negligence by the user. Failure caused by the user's hardware or software design.
2. Failure caused by unapproved modifications, etc., to the product by the user.
3. When the Mitsubishi product is assembled into a user's device, Failure that could have been avoided if functions or structures, judged as necessary in the legal safety measures the user's device is subject to or as necessary by industry standards, had been provided.
4. Failure that could have been avoided if consumable parts (battery, backlight, fuse, etc.) designated in the instruction manual had been correctly serviced or replaced.
5. Failure caused by external irresistible forces such as fires or abnormal voltages, and Failure caused by force majeure such as earthquakes, lightning, wind and water damage.
6. Failure caused by reasons unpredictable by scientific technology standards at time of shipment from Mitsubishi.
7. Any other failure found not to be the responsibility of Mitsubishi or that admitted not to be so by the user.

2. Onerous repair term after discontinuation of production

(1) Mitsubishi shall accept onerous product repairs for seven (7) years after production of the product is discontinued. Discontinuation of production shall be notified with Mitsubishi Technical Bulletins, etc.

(2) Product supply (including repair parts) is not available after production is discontinued.

3. Overseas service

Overseas, repairs shall be accepted by Mitsubishi's local overseas FA Center. Note that the repair conditions at each FA Center may differ.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Changes in product specifications

The specifications given in the catalogs, manuals or technical documents are subject to change without prior notice.

INFORMATION AND SERVICES

For further information and services, please contact your local Mitsubishi Electric sales office or representative.
Visit our website to find our locations worldwide.

MITSUBISHI ELECTRIC Factory Automation Global Website
Locations Worldwide
www.MitsubishiElectric.com/fa/about-us/overseas/

TRADEMARKS

Anywire and AnyWireASLINK are either registered trademarks or trademarks of Anywire Corporation.
CiA® and CANopen® are registered EU trademarks of CiA e. V.
Linux is the registered trademark of Linus Torvalds in the U.S. and other countries.
Microsoft, Microsoft Access, Excel, SQL Server, Visual Basic, Visual C++, Visual Studio, Windows, Windows NT, Windows Server, Windows Vista, and Windows XP are trademarks of the Microsoft group of companies.
Unicode is either a registered trademark or a trademark of Unicode, Inc. in the United States and other countries.
UNIX is either a registered trademark or a trademark of The Open Group in the United States and other countries.
The company names, system names and product names mentioned in this manual are either registered trademarks or trademarks of their respective companies.
In some cases, trademark symbols such as '™' or '®' are not specified in this manual.

COPYRIGHTS

The screens (screenshots) are used in accordance with the Microsoft Corporation guideline.
For the open source software used in this product, refer to the following:
☞ Page 2194 Software Licenses and Copyright

TRANSLATION OF THE ORIGINAL INSTRUCTIONS

SH(NA)-082641ENG-C(2510)
MODEL: MXR-U-E

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: TOKYO BLDG., 2-7-3, MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS: 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA 461-8670, JAPAN

When exported from Japan, this manual does not require application to the Ministry of Economy, Trade and Industry for service transaction permission.

Specifications subject to change without notice.