MITSUBISHI ELECTRIC

Programmable Controller

MELSEC iQ-R series

MELSEC iQ-R
Motion Module
User's Manual (Application)

-RD78G4
-RD78G8
-RD78G16
-RD78G32
-RD78G64
-RD78GHV
-RD78GHW

SAFETY PRECAUTIONS

(Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.

The precautions given in this manual are concerned with this product only. Refer to the MELSEC iQ-R Module Configuration Manual for a description of the PLC system safety precautions.

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 CPU module 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 CPU module 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.
- For the operating status of each station after a communication failure, refer to manuals relevant to the network. Incorrect output or malfunction due to a communication failure may result in an accident.

[Design Precautions]

⚠WARNING

- When connecting an external device with a CPU module 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 CPU module 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 CPU module 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. Failure to do so may result in an accident due to an incorrect output or malfunction.
- To maintain the safety of the programmable controller system against unauthorized access from external devices via the network, take appropriate measures. To maintain the safety against unauthorized access via the Internet, take measures such as installing a firewall.
- 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) Machine homing is controlled by two kinds of data: a homing direction and a homing speed. Deceleration starts when the proximity dog signal turns on. If an incorrect homing direction is set, motion control may continue without deceleration. To prevent machine damage caused by this, configure an interlock circuit external to the programmable controller.
  (2) When the module detects an error, the motion slows down and stops or the motion rapidly stops, depending on the stop group setting in parameter. Set the parameter to meet the specifications of a positioning control system. In addition, set the homing parameter and positioning data within the specified setting range.
  (3) Outputs may remain on or off, or become undefined due to a failure of a component such as an insulation element and transistor in an output circuit, where the module cannot detect any error. In a system that the incorrect output could cause a serious accident, configure an external circuit for monitoring output signals.
- If safety standards (ex., robot safety rules, etc.,) apply to the system using the module, drive unit and servomotor, make sure that the safety standards are satisfied.
- Construct a safety circuit externally of the module or drive unit if the abnormal operation of the module 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. Keep a distance of 100 mm or more between them. Failure to do so may result in malfunction due to noise.
- 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 CPU module is powered on or is reset, the time taken 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 CPU module 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.

[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 the general specifications in the Safety Guidelines included with the base unit. 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, push in the module, and fix it with screw(s). Incorrect interconnection may cause malfunction, failure, or drop of the module.
- Tighten the screws within the specified torque range. Undertightening can cause drop of the screw, short circuit, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- 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.
- Securely insert an extended SRAM cassette or a battery-less option cassette into the cassette connector of the CPU module. After insertion, close the cassette cover and check that the cassette is inserted completely. Poor contact may cause malfunction.
- Do not directly touch any conductive parts of the module, SD memory card, extended SRAM cassette, battery-less option cassette, 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 and an included extension connector protective cover to the unused extension cable connector before powering on the system for operation. Failure to do so may result in electric shock.

[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 signal 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. Incomplete connections may cause short circuit, fire, or malfunction.
- 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. Keep a distance of 100 mm or more between them. Failure to do so may result in malfunction due to noise.
- 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 the modules.
  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, fire, or malfunction.

[Wiring Precautions]

⚠CAUTION

- 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.
- A protective film is attached to the top of the module to prevent foreign matter, such as wire chips, from entering the module during wiring. Do not remove the film during wiring. Remove it for heat dissipation before system operation.
- 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 CPU module 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 CPU module 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) more than 25 cm 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
  - Inserting/removing the extended SRAM cassette or battery-less option cassette to/from the CPU module
  - Mounting/removing the terminal block to/from the module
- After the first use of the product, do not insert/remove the SD memory card to/from the CPU module 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 touch the integrated circuits on the circuit board of an extended SRAM cassette or a batteryless option cassette. 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 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. Failure to do so may cause the module to fail or malfunction.

[Startup and Maintenance Precautions]

⚠CAUTION

- 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 function, on starting up, and when the module or absolute position motor has been replaced, always perform a homing.
- Before starting the operation, confirm the brake function.
- Do not perform a megger test (insulation resistance measurement) during inspection.
- After maintenance and inspections are completed, confirm that the position detection of the absolute position detection function is correct.
- Lock the control panel and prevent access to those who are not certified to handle or install electric equipment.

[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 CPU module 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.
- Note that when the reference axis speed is specified for interpolation operation, the speed of the partner axis (2nd, 3rd, or 4th axis) may exceed the speed limit value.
- Do not go near the machine during test operations or during operations such as teaching. Doing so may lead to injuries.

[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 MELSEC iQ-R series programmable controllers.
This manual describes the functions and programming 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 MELSEC iQ-R series programmable 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.
Please make sure that the end users read this manual.

Relevant products

RD78G4, RD78G8, RD78G16, RD78G32, RD78G64, RD78GHV, RD78GHW

Point

Symbols used in this manual are shown below.

- [RD78G]: Symbols indicating that it corresponds to only RD78G
- [RD78GH]: Symbols indicating that it corresponds to only RD78GH
- Underlined variables (AxisName, etc.): Variables defined by users

COMPLIANCE WITH EMC AND LOW VOLTAGE DIRECTIVES

Method of ensuring compliance

To ensure that Mitsubishi programmable controllers maintain EMC and Low Voltage Directives when incorporated into other machinery or equipment, certain measures may be necessary. Please refer to one of the following manuals.
📖MELSEC iQ-R Module Configuration Manual
📖Safety Guidelines (This manual is included with the base unit.)
The CE mark on the side of the programmable controller indicates compliance with EMC and Low Voltage Directives.

Additional measures

To ensure that this product maintains EMC and Low Voltage Directives, please refer to one of the following manuals.
📖MELSEC iQ-R Module Configuration Manual
📖Safety Guidelines (This manual is included with the base unit.)

CONTENTS

SAFETY PRECAUTIONS 1
INTRODUCTION 10
COMPLIANCE WITH EMC AND LOW VOLTAGE DIRECTIVES 10
RELEVANT MANUALS 20
TERMS 21
GENERIC TERMS AND ABBREVIATIONS 23
HOW TO READ THIS MANUAL 24
FUTURE SUPPORT PLANNED 30

PART 1 BASIC SPECIFICATIONS

CHAPTER 1 AXIS SETTING 32

1.1 Axis 32
Relevant variables 32
Maximum number of controlled axes 32
Required settings for axes 33
Axis variables 33
Axis variable initialization timing 34
How to specify in a user program 34
State transition 35
Precautions 36
1.2 Axis Type 37
Relevant variables/FB 37
Real drive axis 40
Real encoder axis 41
Virtual drive axis 46
Virtual encoder axis 46
Virtual linked axis 50
1.3 Connectable Stations 51
Maximum number of stations that can be connected 51
Precaution 51
1.4 Axis Assignment 52
Relevant variables 53
Slave object settings 54
PDO mapping settings 55
Setting procedure 55
Slave object list 56
Motion system function/command and slave object 60
1.5 Axes Group 61
Relevant variables/FBs 61
Settings required for axes group 65
Axes group variables 66
Axes group variable initialization timing 66
Specify method using a user program 66
Enabling axes group 67
Axes group enabled 68
Axes group disabled 70

1.6 Axes Group Assignment . . . 71
Relevant variables/FB . . . 71
Setting with Engineering tool . . . 72

CHAPTER 2 AXIS MANAGEMENT FUNCTIONS 74

2.1 Technical Units . . . 74
Relevant variables . . . 74
Setting methods . . . 74
Precautions . . . 78
2.2 Positioning Range . . . 79
Relevant variables . . . 79
Set position . . . 80
Combination with other devices . . . 81
Precautions . . . 81
2.3 Velocity Range . . . 82
Relevant variables . . . 82
Velocity set range . . . 83
2.4 Servo ON/OFF . . . 84
Relevant variables/FB . . . 84
Control details . . . 89
Precautions . . . 90
2.5 Follow Up . . . 91
Relevant variables . . . 91
Disabling follow up . . . 92
Precautions . . . 93
2.6 Absolute Position Control . . . 94
Relevant variables . . . 95
Current position restoration . . . 96
Absolute position data backup . . . 99
Current position restoration for each axis type . . . 101
Precautions . . . 104

CHAPTER 3 BASIC FUNCTIONS 105

3.1 Operation Cycle . . . 105
Relevant variables . . . 105
System basic cycle . . . 105
Operation cycle settings . . . 106
Operation cycle assignment . . . 106
Send/Receive data refresh of network connected devices . . . 107
Motion synchronization station link device auto refresh . . . 109
Buffer memory refresh . . . 109
Axis operation process high-speed mode . . . 110
Operation cycle 31.25 setting [RD78GH] . . . 111
3.2 Add-on Function . . . 113
Relevant variables . . . 113
Add-on library configuration . . . 114
Management of add-on library . . . 115
Loading add-on library . . . 115
3.3 System Memory Settings . . . 116
Relevant variables . . . 116

System memory (RAM) . . . 117
System memory (backup RAM) . . . 118
Precautions . . . 118
3.4 Software Reboot . . . 119
Relevant variables . . . 119
Reset . . . 119
Clear . . . 120
Quick clear . . . 120
Precautions . . . 120

PART 2 MOTION CONTROL 1

CHAPTER 4 START AND STOP 122

4.1 Start . . . 122
Relevant variables . . . 122
Starting conditions . . . 123
4.2 Retrigger/Continuous Update . . . 124
4.3 Multiple Start (Buffer Mode) . . . 125
Relevant variables . . . 127
Multiple start during single axis operation . . . 128
Multiple start during multiple axes operation . . . 137
Precautions . . . 144
4.4 Stop . . . 148
Relevant variables/FB . . . 149
Stop cause lists . . . 156
Types of stop processes . . . 158
Order of priority for stop process . . . 160
Overrun at stop cause occurrence . . . 161
Stop during single axis operation . . . 162
Stop during axes group operation . . . 168
4.5 Forced Stop . . . 176
Relevant variables . . . 176
Operation at the forced stop occurrence . . . 178
Operation at the forced stop release . . . 179
Check method . . . 180

CHAPTER 5 HOMING 181

5.1 Outline . . . 181
Relevant variables/FB . . . 182
Homing Request . . . 183
Driver homing method . . . 184
Data set homing method . . . 186
Precautions . . . 186
5.2 Operation Setting for Incompletion of Homing . . . 187
Relevant variables . . . 187
FBs that can be started when homing is incompletion . . . 187
Homing request clear . . . 187
Precautions . . . 187

CHAPTER 6 AXIS CONTROL FUNCTION 188

6.1 Single Axis Positioning Control . . . 188
Relevant FBs . . . 188
Absolute Positioning Control . . . 193
Relative Positioning Control . . . 201
6.2 Single Axis Speed Control . . . 203
Relevant FB . . . 203
Control details . . . 206
BufferMode . . . 207
6.3 Single Axis Manual Control . . . 208
Relevant variables/FB . . . 208
Types of manual control . . . 211
JOG operation . . . 211
6.4 Multiple Axes Positioning Control . . . 216
Relevant variables/FBs . . . 216
Operation in multiple axes positioning control . . . 226
Positioning speed in multiple axes positioning control . . . 227
Command unit in the multiple axes positioning control . . . 235
Acceleration/deceleration processing . . . 237
State transition in the multiple axes positioning control . . . 237
Linear interpolation control . . . 238
Circular interpolation control . . . 247

CHAPTER 7 DIRECT CONTROL 258

7.1 Velocity Control . . . 259
Relevant variables/FB . . . 259
Control details . . . 263
BufferMode . . . 264
Precautions . . . 269
7.2 Torque Control . . . 270
Relevant variables/FB . . . 270
Control details . . . 274
BufferMode . . . 277
Precautions . . . 286

CHAPTER 8 RELEVANT FUNCTIONS to POSITION 287

8.1 Current Position Change Function . . . 287
Relevant FBs . . . 287
Position setting range . . . 293
Current position change . . . 293
Trigger current position change . . . 295
Cancel . . . 296
8.2 Command In-position . . . 298
Relevant variables . . . 298
Command in-position width check . . . 299
8.3 Software Stroke Limit . . . 300
Relevant variables . . . 300
Definition of movable range . . . 300
Specifications of the software stroke limit check . . . 305
Precautions . . . 305

8.4 **Hardware Stroke Limit** 306
Relevant variables 306
Hardware stroke limit check details 308
Returning from outside the hardware stroke limit range 309
Precautions 309

CHAPTER 9 RELEVANT FUNCTIONS TO VELOCITY 312

9.1 **Acceleration/deceleration Processing Function** 312
Relevant variables 314
Acceleration/deceleration method 318
Acceleration/deceleration waveform adjustment when specifying jerk 325
Operation when specifying acceleration/deceleration 0 327
Acceleration limit value/deceleration limit value 328
Jerk limit value 328
Limit of acceleration time/deceleration time 329
Automatic deceleration 330
Changing control of jerk acceleration/deceleration 331
Multiple start of the jerk acceleration/deceleration 336
9.2 **Speed Limit** 337
Relevant variables 337
How to set the speed limit function 337
Operation when the speed limit value is exceeded 338
Operation setting when the speed limit value is exceeded 339
9.3 **Override Function** 340
Relevant variables/FBs 340
How to change control data 346

CHAPTER 10 RELEVANT FUNCTIONS TO TORQUE 351

10.1 **Torque limit** 351
Relevant variables 351
Slave object map 352
Torque limit value setting range 352
Torque limit maximum value setting range 352
Precautions 352
10.2 **Torque Limit Value Change Function** 353
Relevant variables/FB 353
How to change control data 360

CHAPTER 11 CONTROL SUB FUNCTIONS 361

11.1 **Compensation Function** 361
Relevant variables 361
Driver unit conversion function 361
11.2 **Command Filter** 364
Relevant FBs 364
Smoothing filter 373
Movement direction limit filter 377
Speed limit filter 380
Backlash compensation filter 383
Precautions 391
11.3 **Input Variable Change in Execution** 392

Relevant variables . . . 392
Target position/movement distance change . . . 393
Set velocity change . . . 396
Acceleration/deceleration and acceleration/deceleration time change . . . 397

CHAPTER 12 COMMON FUNCTIONS 398

12.1 External Signal Selection . . . 398
Relevant variables . . . 398
SIGNAL_SELECT structure . . . 398
TARGET_REF structure . . . 400
12.2 Touch Probe . . . 403
Relevant FBs . . . 403
Touch probe valid . . . 406
Touch probe invalid . . . 412
Precautions . . . 413
12.3 Slave Emulate . . . 414
Relevant variables . . . 414
Setting procedures . . . 414
Operation during emulate function . . . 414
Precaution . . . 414

PART 3 MOTION CONTROL2

CHAPTER 13 OPERATION PROFILE FUNCTION 416

13.1 Operation Profile Data . . . 416
Relevant variables/FB . . . 417
Creating operation profile data . . . 432
Operation profile data types . . . 433
Operating operation profile data . . . 446
Control of operation profile data . . . 456
Sub function of operation profile data control . . . 459
13.2 Operation Profile Data Format . . . 464
Operation profile data details . . . 464

CHAPTER 14 SYNCHRONOUS CONTROL 470

14.1 Outline of Single Axis Synchronization Function Blocks . . . 470
14.2 Axis Configuration . . . 471
14.3 Master Axis Data Source Selection . . . 471
14.4 Start and Stop Operation . . . 472
14.5 Required Slave Object . . . 473
14.6 Restrictions . . . 473
14.7 Cam Operation . . . 474
Relevant FB . . . 474
Control details . . . 477
Precautions . . . 487
14.8 Gear Operation . . . 488
Relevant FB . . . 488
Control details . . . 490
Precautions . . . 493
14.9 Addition/Subtraction Positioning . . . 494

Relevant FB . . . 494
Control details . . . 497

PART 4 CONTROL/OPERATION/MAINTENANCE

CHAPTER 15 LOGGING 502

15.1 Data Logging/Real-Time Monitor . . . 502
Relevant variables . . . 503
Data logging function . . . 504
Real-time monitor . . . 505
Steps until the collected data is saved . . . 505
Logging setting . . . 509
Data to be collected (DATA) . . . 509
Logging setting (LOGGING) . . . 510
Trigger condition (TRIGGERCONDITION) . . . 514
Application function . . . 516
Precautions . . . 518
Folder configuration . . . 520
15.2 Data Logging Format . . . 521
CSV file data specifications . . . 521
JSON File Data Specifications . . . 523

CHAPTER 16 RAS FUNCTIONS 525

16.1 Execution Time Monitor . . . 525
Relevant variables . . . 526
Control details . . . 527
Processing time over check . . . 529
Precautions . . . 530
16.2 History Data . . . 531
Relevant variables . . . 532
Event history function . . . 533
Positioning data history . . . 536
Precautions . . . 536

CHAPTER 17 MOTION SERVICE PROCESSING 537

17.1 Operation Overview . . . 537
17.2 Processing Description . . . 538

CHAPTER 18 HOW TO CONTROL FROM CPU MODULE 539

18.1 Specifications of I/O Signals with CPU Modules . . . 539
18.2 Using MCFB . . . 542
Relevant variable . . . 542
Control details . . . 542

CHAPTER 19 FILE CONTROL 546

19.1 Memory and File . . . 546
Relevant variables . . . 546
Drive . . . 547
Path setting . . . 549

Operation that can be executed . . . 551
Storage files . . . 552
Module extended parameters . . . 553
Operation folder . . . 554
Precautions . . . 554
19.2 Parameter Read/Write Function . . . 555
Relevant FBs . . . 555
Control Details . . . 559
The response code (SDO Abort code) . . . 562
Precautions . . . 562
19.3 File Transfer Function . . . 563
Relevant variables . . . 564
Access control setting . . . 564
Functions of file transfer . . . 565
Command format . . . 565
Log file . . . 569
Drive operation . . . 569
Precautions . . . 569
19.4 SD Memory Card . . . 570
Relevant variables . . . 570
SD memory card handling . . . 570
Specifications of SD memory card . . . 570
Installation and removal of SD memory card . . . 570
Precautions . . . 571

CHAPTER 20 SECURITY 572

CHAPTER 21 MODULE SOFTWARE INSTALLATION 574

21.1 Motion System Software Installation . . . 574
Relevant variables . . . 574
Software file configuration of motion system . . . 575
Motion software package file configuration details . . . 575
Checking software version . . . 576
21.2 Basic System Software Update Function . . . 578
Software management . . . 578
21.3 Boot Software Update Function . . . 581

CHAPTER 22 TROUBLESHOOTING 584

22.1 LED Control . . . 584
22.2 Checking Errors and Warnings . . . 585
Relevant variables . . . 586
Control details . . . 586
Filter setting . . . 586
22.3 Error and Warning Reset . . . 587
Relevant variables/FB . . . 587
System error reset . . . 591
Axis error reset . . . 594
Axes group error reset . . . 596
22.4 List of Warning Codes . . . 599
22.5 List of Error Codes . . . 606

22.6 List of Logging Error Codes . . . 636
22.7 List of Event Codes . . . 637

PART 5 LISTS

CHAPTER 23 List of Variables 640

CHAPTER 24 List of FBs 669

CHAPTER 25 Add-on library list 671

CHAPTER 26 Bootsoftware List 674

APPENDICES 676

Appendix 1 Connectable device to CC-Link IE TSN . . . 676
Common Items for all devices . . . 676
MR-J5(W)-G (Cyclic synchronous mode) connection method . . . 679
MR-J5(W)-G (Profile mode) connection method . . . 686
How to connect MR-JET-G . . . 691
Appendix 2 Project Setting Example . . . 692
Library Registration Procedure . . . 692
Library Update Procedure . . . 694
Appendix 3 Motion Module Programs . . . 696
Relevant variables/function blocks (FB) . . . 697
Execution of programs . . . 697
Label initialization function . . . 703
Appendix 4 Creation Procedure for Motion Module Programs . . . 704
Program creation procedure for ST programs . . . 704
Creation procedure for programs using the public label function . . . 726
Data transfers using the Motion module buffer memory . . . 735
Appendix 5 Restrictions by the version . . . 736

INDEX 742

REVISIONS . . . 744
WARRANTY . . . 745
TRADEMARKS . . . 746

RELEVANT MANUALS

Manual name [manual number]	Description	Available form
MELSEC iQ-R Motion Module User's Manual(Application) [IB-0300411ENG] (This manual)	Functions, I/O signals, variables, labels, programming, and troubleshooting of the Motion module	Print book e-Manual PDF
MELSEC iQ-R Motion Module User's Manual(Startup) [IB-0300406ENG]	Specifications, procedures before operation, system configuration, and wiring of the Motion module	Print book e-Manual PDF
MELSEC iQ-R Motion Module User's Manual(Network) [IB-0300426ENG]	Functions, parameter settings, troubleshooting, and buffer memory of CC-Link IE TSN	Print book e-Manual PDF
MELSEC iQ-R Programming Manual(Motion Module Instructions, Standard Functions/Function Blocks) [IB-0300431ENG]	Instructions for the Motion module and standard functions/function blocks	Print book e-Manual PDF

For programs, refer to the following.

MELSEC iQ-R Programming Manual (Program Design)

This manual does not include information on the network function blocks.

For details of the network function blocks, refer to the following.

MELSEC iQ-R Ethernet/CC-Link IE Function Block Reference

Point

e-Manual refers to the Mitsubishi Electric FA electronic book manuals that can be browsed using a dedicated tool.

e-Manual has the following features:

- Required information can be cross-searched in multiple manuals.
- Other manuals can be accessed from the links in the manual.
- The hardware specifications of each part can be found from the product figures.
- Pages that users often browse can be bookmarked.
- Sample programs can be copied to an engineering tool.

TERMS

Unless otherwise specified, this manual uses the following terms.

Term	Description
Aborting, Buffered, Blending	Various modes of the buffer mode
Actual position	An address that is rounded a position address returned by a slave device. It is affected by a current position change.
Actual velocity	A value obtained by converting the actual value from the slave device on the real axis into the technical units of the axis
Administrative FB	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
Axes group variable	An AXES_GROUP type variable instance including parameters and data related to the axes group
Axis variable	An AXIS_*type variable instance including parameters and data related to the axis
Axis	A target to carry out the motion control
Buffering	That a motion control FB enters the standby status in multiple start
Buffering FB	A motion control FB that is carried out multiple start and waits for execution (Busy is TRUE)
Buffer memory	A memory in an intelligent function module, where data (such as setting values and monitoring values) are stored.
Buffer mode	A generic term for multiple start
Commanded position	A command position address that is specified in the motion FB
Commanded velocity	Set velocity that is specified in the motion FB
Continuous update	Continuously reflecting input values to the control while the ContinuousUpdate input of the motion control FB is TRUE
Cumulative current position	A command position address that is not rounded by a ring counter. It is affected by a current position change.
Cyclic transmission	A function by which data are periodically exchanged among stations on the same network using a slave label
Dedicated instruction	An instruction for using functions of the module
Device	Various memory data in a CPU module. There are devices handled in each bit and in each word.
Disconnection	A process of stopping data link if a data link error occurs
Execute	Setting TRUE to the Execute/Enable input for the motion control FB.
Feed machine position	A commanded 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.
General FB	A motion control FB that does not take an axis or an axes group for the argument
Global label	A label that is enabled for all program data when creating multiple program data in the project. There are two types of global labels: module label that is automatically generated by GX Works3 and label that can be created for the any of the specified devices.
GX Works3	The product name of the software package for the MELSEC programmable controllers
Hardware reboot	Turning ON the power of the system again or resetting
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
Jerk	Chronological change ratio of the acceleration or the deceleration
Label	A label that represents a device in a given character string
Link device	A device in a module on CC-Link IE
Link refresh	Automatic data transfer between a link device of the Motion module and a device in a CPU module
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. GX Works3 automatically generates this label, which can be used as a global label.
Motion area	Software that performs the motion control in the Motion module
Motion control station	A station that updates a link device in the Motion module
Motion control FB	An FB that is related to the 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 status by execution
Motion syncronization station	A station that performs the synchronous communication among motion control stations
MR-J5-G	MR-J5-_G_(-RJ) servo amplifier
MR-J5W-G	MR-J5W_-_G servo amplifier
MR-JET-G	MR-JET-_G servo amplifier
MR Configurator2	A product name of servo setup software
Multiple axes interpolation control	Control in which multiple axes work such as linear interpolation and circular interpolation. Axes to be cooperated by an axes group are specified.
Multiple start	Executing another motion control FB to the same axis while a motion control FB is executed
Network area	Software that performs the network control in the Motion module

Term	Description
Next FB	Another motion control FB that starts while an axis and an axes group are operated
Object	Various data of a slave device compatible with CANopen
Output variable	An output argument of FB
Previous FB	The previous motion control FB of a buffering FB (If only one FB is performed buffering, it indicates on-going FB)
RD78G	Another term for the MELSEC iQ-R series Motion module (compatible with CC-Link IE TSN)
RD78GH	
Real axis	An axis that is linked with a slave device on network
Real drive axis	An axis that is linked with a slave device which supports CC-Link IE TSN compatible with csp/csv/cst mode (sequential command) of the CiA402 drive profile
Real encoder axis	An axis that generates a commanded position from the current position of the encoder connected with a slave device. It is used for the master axis of the single axis synchronous control.
Return	A process of restarting data link when a station recovers from an error
Retrigger	Starting up the Execute input again while executing an FB to a motion control FB that has the Execute input
RWr	Remote register of a link device. Word data input from a slave 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 output from the master station to a slave 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 slave 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 slave station (For some areas in a local station, data are output in the opposite direction.)
Set position	A commanded position address rounded by the ring counter. It is affected by a current position change.
Set velocity	A current control value that is generated by motion operation[
Single axis synchronization	A control to output the position information (command) of Slave (slave axis) 1-axis that is synchronized with Master (master axis)
Software reboot	Resetting only motion area and network area without a hardware reboot
Standard station	A station other than motion syncronization stations
Start	Executing a motion FB for the first time to an axis or an axes group
Switching speed	• The set velocity of the motion control FB in execution when specifying Aborting • The set velocity when the motion control FB in execution reached the target position when specifying Blending
System basic cycle	A basic cycle of fixed cycle processing such as motion operation processing
System start	Carrying out an initialization processing of the Motion module by power ON or a reboot of the system
Target position	A commanded position address that is specified in the motion FB
Virtual axis	An axis that is not linked with a slave device on network
Virtual encoder axis	An axis that generates commanded position from a variable. It is used for the master axis of the single axis synchronous control.
Virtual drive axis	A virtual axis that can generate a command virtually
Virtual linked axis	An axis that connects FBs and transmits a command in the single axis synchronous control

GENERIC TERMS AND ABBREVIATIONS

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

Term	Description
CC-Link IE	A generic terms of the followings. • 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))
CPU module	The abbreviation for the MELSEC iQ-R series CPU module
csp	The abbreviation for cyclic synchronous position mode (One of the control mode for the driver side)
cst	The abbreviation for cyclic synchronous torque mode (One of the control mode for the driver side)
csv	The abbreviation for cyclic synchronous velocity mode (One of the control mode for the driver side)
GOT	A generic term for Mitsubishi Electric Graphic Operation Terminal GOT1000 and GOT2000 series
hm	The abbreviation for homing mode (One of the control mode for the driver side)
MCFB	The abbreviation for the Motion Control FB
MR-J5(W)-G	A generic term for MR-J5-_G_(-RJ)/MR-J5W_-_G servo amplifier
PDO	A communication object of CANopen (Process Data Object)
RAS	The abbreviation for Reliability, Availability, and Serviceability. This term refers to usability of automated equipment.
RD78G(H)	A generic term for RD78G_, RD78GH_ (high performance version)
SDO	A communication object of CANopen (Service Data Object)
SLMP	A generic term 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 CCLink IE TSN).
Operation profile data	A generic term for waveform data used for each control
Engineering tool	A generic term for GX Works3 and MR Configurator2
Slave station	• A generic term for a local station and remote station on CC-Link IE TSN • A generic term for a local station, remote I/O station, remote device station, and intelligent device station on CC-Link IE Field Network
Data link	Cyclic transmission and transient transmission
Drive unit	A generic term for motor drive devices such as a survo amplifier
Motion system	A generic term for software that performs the motion control which operates in RD78G(H)
Motion module	A generic term for the RD78G(H)_
Reboot	A generic term for hardware reboot and software reboot

HOW TO READ THIS MANUAL

This section describes how to use motion control FBs (MCFB) and the common specifications.
The MCFB that can be used in the motion system includes FBs established by PLCopen®. The basic specifications of I/O signals follow the MCFB of PLCopen®.

How to use MCFB

Procedure to use MCFB is described as follows.

1. Instance of the MCFB (Global label or local level) is created by engineering tool.
2. Program which sets I/O argument is created for the created MCFB instance.
3. When turning Execute input or Enable input of MCFB, the control will be executed. For details, refer to the specification of each control and "Start" and "Stop".

Point

When one MCFB instance is executed (including during buffering), the multiple axes can not be shared by changing axis input (AXIS_REF input or AXES_GROUP_REF input). The axis input of MCFB can be changed only at the nonexecution. When the axis input is changed in execution, a warning will occur and the change will be ignored. Therefore, the MCFB instance is required to be created for only the numbers of the axis to be controled at the same time.

Operation of this function for each system status

The MCFB can be executed only during RUN.
○: Possible, ×: Not possible

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

FB types

The MCFB is classified according to the operation details and the execution method.

■Motion FB/administrative FB/general FB

The following types are included in the MCFB according to the operation details.

Type	Description
Motion FB	The MCFB that takes an axis or an axes group for the argument and changes the axis status or the axes group status by execution.
Administrative FB	The MCFB 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)
General FB	The MCFB that does not take an axis or an axes group for the argument.

[Combination of FBs]

- The motion FB can be basically executed only one to an axis or an axes group. However, some FBs can be executed at the same time. For details, refer to each FB specifications. For specifications for multiple start, refer to the following.
  ☞ Page 125 Multiple Start (Buffer Mode)
- The administrative FB can basically execute multiple instances to an axis or an axes group at the same time. For the case when starting the multiple administrative FBs, refer to each FB specifications.
- Even if an administrative FB is executed while a motion FB is executed, the axis status or the axes group status will not be basically changed. However, some FBs can cause a specific state transition. For details, refer to each FB specifications.
- The general FB can simultaneously execute multiple instances. Since it is not related to the axis, it does not affect the motion FB or the administrative FB each other.

■Execute type/Enable type

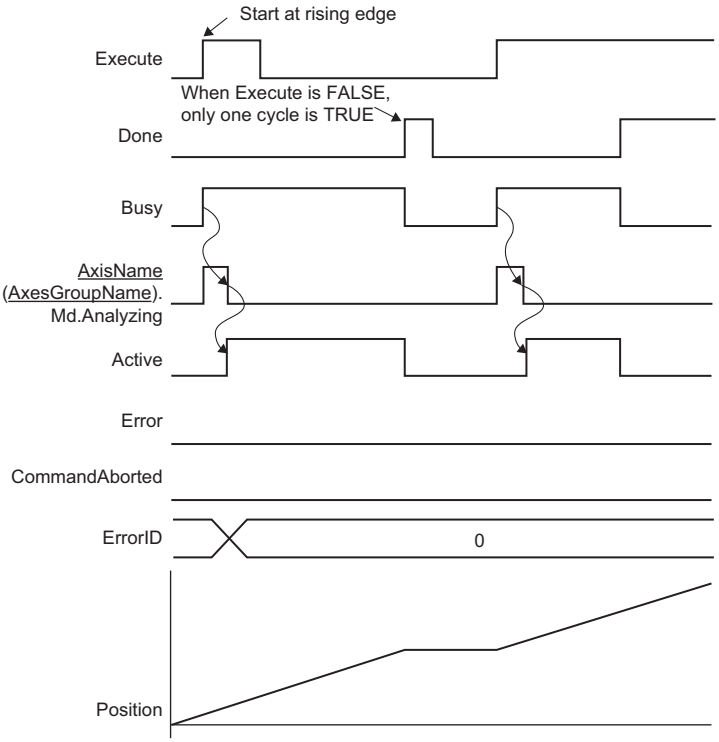
Some MCFBs are executed at an Execute input, and the others are executed at an Enable input. The basic operation of each FB is shown below. However, some FBs have different specifications. For details, refer to each FB specifications.

[Basic operation of Execute type FB]

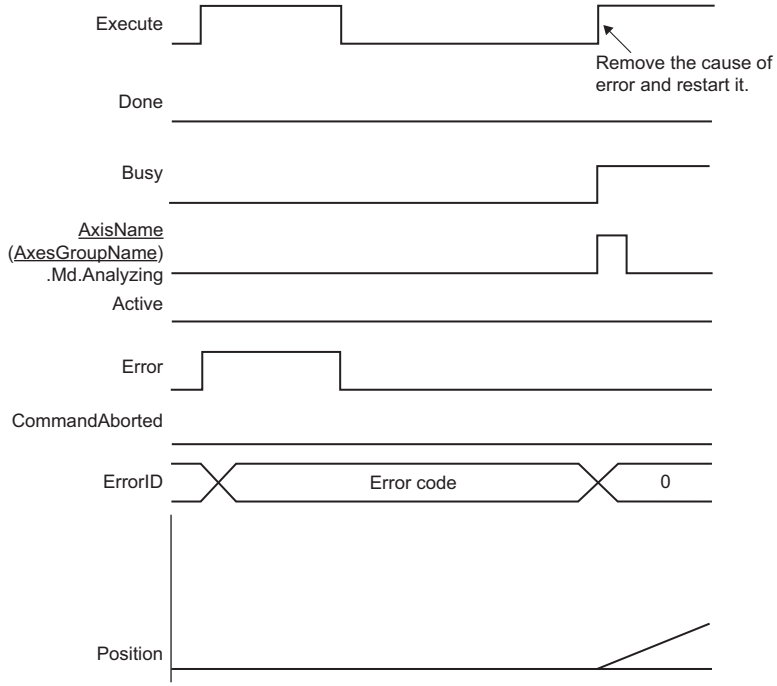
- The Execute type FB reads the input parameters at a rising edge of Execute, then it starts operation. Once operation is started, even if setting FALSE to Execute, the operation will be continued until it is completed.
- When operation is started, only one of outputs among Busy, Done, Error, and CommandAborted, turns TRUE.
- Done, Error, ErrorID, and CommandAborted are reset at a falling edge of Execute. Busy and Active are not affected.
- When changing the input parameter during operation, the change is reflected at restart (retrigger) of Execute or continuous update using the ContinuousUpdate input. For details, refer to the following.
  ☞ Page 124 Retrigger/Continuous Update
- AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing turn TRUE from the rising edge of Busy, AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing turn FALSE after starting the operation.

Basic operation of Enable type FB is shown below.

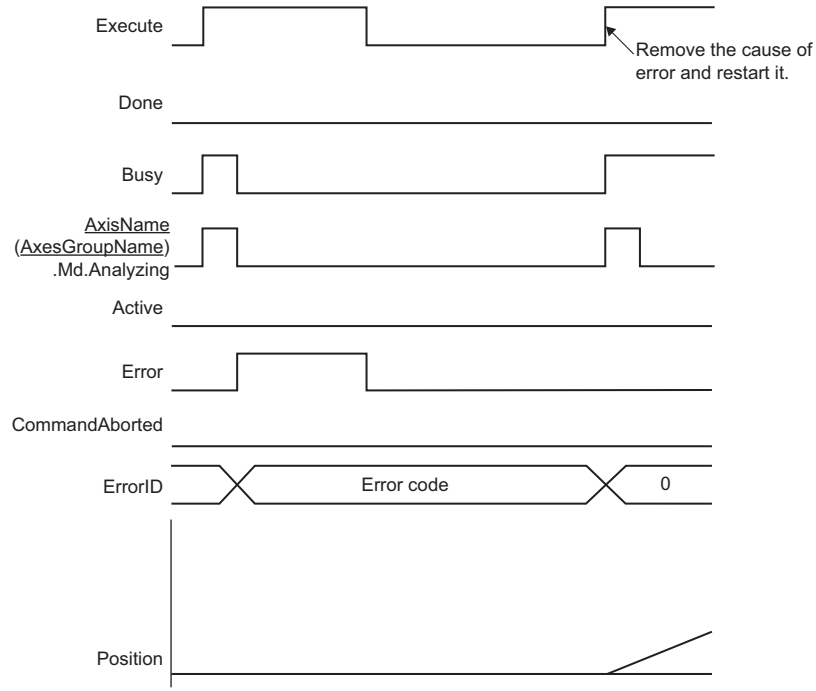
[When the FB is normal]



[When the I/O variables are abnormal]



[When the input variables are abnormal]

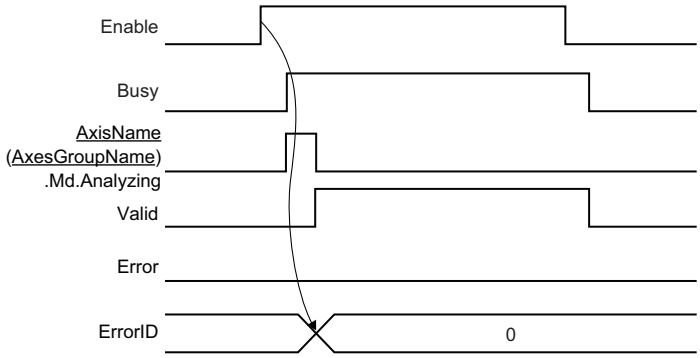


[Basic operation of Enable type FB]

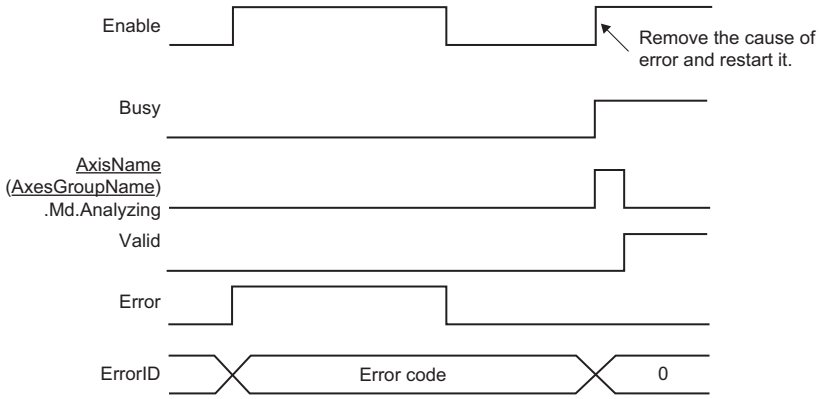
- The Enable type FB is continuously executed while Enable is TRUE.
- Valid indicates that the output is a valid value. After Valid turned FALSE, each output does not change.
- Only one of outputs among Valid/Enabled/Busy, Error, and CommandAborted, turns TRUE.
- AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing turn TRUE from the rising edge of Busy, AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing turn FALSE after starting the operation.

Basic operation of Enable type FB is shown below.

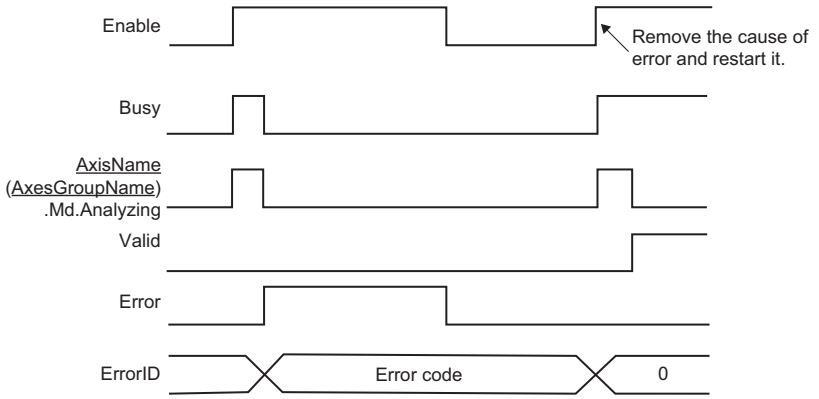
[When the FB is normal]



[When the I/O variables are abnormal]



[When the input variables change is abnormal]



Motion control types

The following types exist in the axis/axes group control that can be executed by the motion MCFB. For details, refer to each function.

Large classification	Middle classification	Small classification	Reference
Axis control	Single axis control	Positioning control	Page 188 Single Axis Positioning Control
		Continuous control	Page 258 DIRECT CONTROL
		Synchronous control	Page 470 SYNCHRONOUS CONTROL Page 364 Command Filter
		Manual control	Page 208 Single Axis Manual Control
		Homing control	Page 181 HOMING
Axes group control	Multiple axes control	Positioning control	

Error processing

If an error occurs while the MCFB is executed, Error turns TRUE and the error code is output to Error ID. At this time, the axis status transits into "1: ErrorStop" and the axes group status transits into "1: GroupErrorStop".
When an available axis transits into the "1: ErrorStop" status, all buffering FBs are interrupted. The interrupted FBs' Error turns TRUE.
After that, an error reset needs to be executed to start the axis/axes group. For how to check an error of the axis/axes group and how to reset the error, refer to the following.
☞ Page 585 Checking Errors and Warnings, ☞ Page 587 Error and Warning Reset

Point

A value same as one of the following (it depends on the control) is output to ErrorID. However, the warning code is not output. For remedy of errors, refer to the following.
☞ Page 584 TROUBLESHOOTING
- Axis error code (AxisName.Md.ErrorID)
- Axes group error code (AxesGroupName.Md.ErrorID)
- System error code (System.Md.ErrorID)

The error codes to be output to MCFB ErrorID are shown below.

Error code	Description
0400H	No response from the Motion module within default time. Execute the FB again.
1C00H	Corresponds to the error code (1800H to 180FH) of the dedicated instruction used within the FB. For the error code of dedicated instruction, refer to the following. MELSEC iQ-R Programming Manual (Motion Module Instructions, Standard Functions/Function Blocks)
1C01H	
1C02H	
1C03H	
1C04H	
1C05H	
1C06H	
1C07H	
1C0FH	

Units used in control

Units of the position, speed, acceleration/deceleration, and jerk that are used in the motion system follow the technical units of the axis to be used. For details, refer to the following.
☞ Page 74 Technical Units
The following types exist in the control value such as the position and the speed that are used in the motion system. For details of the control value related to the position and the speed, refer to the following.
☞ Page 79 Positioning Range, ☞ Page 82 Velocity Range

Name	Meaning
Commanded value	A value based on an input to the MCFB (the target value). Commanded position and commanded speed, etc.
Set value	The curent control value that is generated by motion operation. Set position and set velocity, etc.
Actual value	A value obtained by converting the actual value from the slave device on the real axis into the technical units of the axis. Actual position and actual velocity, etc.

MCFB input/output specifications

The common specifications of MCFB I/O variables are described in this section.

■I/O variable/input variable/output variable

For details, refer to specifications of each FB.

■Omission of input variable

When omitting to input FBs, the default value that is defined for each FB is applied. For details of the default value, refer to specifications of each MCFB.

When omitting to input the speed, etc. in the multiple start FB, the input value of the previous FB is taken over. For details, refer to the following.

☞ Page 125 Multiple Start (Buffer Mode)

■Refresh timing of input/output

Each argument of the FB is refreshed at a call timing of the FB. To control the input/output of the FB synchronizing with the operation cycle, call the FB from a fixed cycle program whose cycle is the same as the operation cycle.

■Specification of I/O No.

When using the MCFB in the CPU module side, needs to specify the I/O No. of the target Motion module to the I/O variables (ex. AxisName.AxisRef.StartIO) that are used in the MCFB. For details, refer to the following.

☞ Page 539 HOW TO CONTROL FROM CPU MODULE

When using the MCFB in the motion system, the I/O No. needs not to be specified. (The specification is ignored.)

Precautions

- I/O arguments of the MCFB are refreshed at a call timing of the FB, but the cycle that the control is actually executed differs depending on the FB. For example, the motion FB performs the control at the operation cycle regardless of the FB call task (normal/fixed cycle). For details, refer to specifications of each FB.
- The FB imports input values when turning TRUE the execution command (Execute and Enable). Therefore, set input values before turning TRUE the execution command (Execute and Enable).
- After turning TRUE the execution command (Execute) of the positioning control FB, in order to turn FALSE the execution command (Execute), turn it FALSE after the executing (Busy) turned into the TRUE status.
- The motion control function uses the real number data (floating-point data) for the axis current position and the command target position, etc. Therefore, it may include the truncation error. For details about the real number data used for MCFB, refer to the folliwing.

  📖MELSEC iQ-R Programming Manual(Motion Module Instructions, Standard Functions/Function Blocks)

  For details about the truncation error by real number data processing in the inside motion control function, refer to the following.

  ☞ Page 79 Positioning Range

Program examples

For details, refer to specifications of each FB.

FUTURE SUPPORT PLANNED

The following model and functions are mentioned in this manual, but it is planned for a future support.

The information in this page might be changed for improvement without prior notice.

Function	Description
Axis assignment	Setting of slave object
Operation cycle	Auto refresh link devices of motion syncronization stations
Send/Receive data refresh of network connected devices	Standard station
Stop	The following setting values of AxesGroupName.Pr.StopMode_ErrorInGroup (Structuring axis operation selection at axis stop by factors) • "4: ServoOffAfterImmediateStop" • "5: ServoOffAfterDecelStop" The following setting values of AxisName.Pr.StopMode_DecelerationCurve/ AxesGroupName.Pr.StopMode_DecelerationCurve(Stop selection at deceleration to stop) • 0: RapidCurve • 2: ContinueCurve
Current position change function	Trigger current position change
External signal selection Touch probe	Data type [OBJ]
Operation profile data	Profile operation Trigger change of current value per cycle Multidimensional profile
Cam operation	"2: mcRelative" of StartMode MasterStartDistance
Logging	Real-time monitor
History data	Current value history
Motion system software installation	Motion software package for the RD78G(H) (including files) • Basic system software simulator DLL • Data definition file (axis data, etc.) • Add-on simulator DLL • The engineering tool window definition file for add-on • Boot software binary for network • Bood software simulator DLL for network

PART 1 BASIC SPECIFICATIONS

1 AXIS SETTING

2 AXIS MANAGEMENT FUNCTIONS

3 BASIC FUNCTIONS

1 AXIS SETTING

1.1 Axis

The target controlled in the motion system is called an axis. Axes are classified into real axes which target the drive units and the I/O devices 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. Included in the number of controlled 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. Only the minimum data required in the single axis synchronous control is defined.

Relevant variables

Variable/Structure name	Name	Details
AxisName.Md.		
AxisStatus	Axis status	Displays the current axis status. -1: Invalid (Axis variable uninitialization/axis parameter error) 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby) 5: DiscreteMotion (Positioning operation) 6: ContinuousMotion (Continuous operation) 7: SynchronizedMotion (Synchronous operation)

Maximum number of controlled axes

The maximum number of controlled axes limited by the motion system is the number of real drive axes. The other type of axes are not counted in the number of axes. Refer to the following table for details.

Axis type	RD78G4	RD78G8	RD78G16	RD78G32	RD78G64	RD78GHV	RD78GHW
Real drive axis*1	4 axes	8 axes	16 axes	32 axes	64 axes	128 axes	256 axes
Virtual drive axis	Total 1024 axes. Settable number of axis varies depending on the system memory capacity setting.						
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.
Ex: The 2-axis drive unit is counted as 2 axes.

If the axis setting exceeds the maximum number of controlled axes, the warning "Maximum Setting Axis Number Over Warning" (warning code: 0F0BH) is output, and the maximum number of axes in ascending order are used for the control and the other axes are ignored.

Required settings for axes

The following items are required to be set in the axis setting window of the engineering tool to set the axes. For axis setting methods, refer to the following.

☞ Page 52 Axis Assignment

Item	Description
Axis name	Sets an arbitrary 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 driver device related to the axis. In case of a multi-axis driver, sets the multidrop No. 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 the detail of 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 or the local label data as an axis variable.

The axis is defined as an axis variable configured with monitor information axes such as the parameter information, the current position, and the status, etc.

An axis variable data type changes depending on the axis type.

For the setting of the engineering tool, refer to the following.

Navigation window ⇨ "Parameter" ⇨ "Module information" ⇨ Target module ⇨ "Module extended parameter" ⇨ [Motion Control Setting Function]

Navigation window ⇨ "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 52 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 the detail of 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 respectively.

Member name	Data type	Description
AxisRef	AXIS_REF	The data structure for input/output of the 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. Reload to the control is not executed after the axis variable initialization.
Pr		Stores the axis parameter data. Opens the default value at the axis variable initialization. The fetch timing to the control changes depending on the parameter.
Md		Stores the axis monitor data. Executes the refresh in the fixed cycle 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
Power ON/CPU module reset	Refers to the label default value file, and initializes all set axis variables.
PLC READY [Y0] OFF→ON	Refers to the label default value file, and reloads uninitialized axes. Initialized axes are not reloaded or deleted.

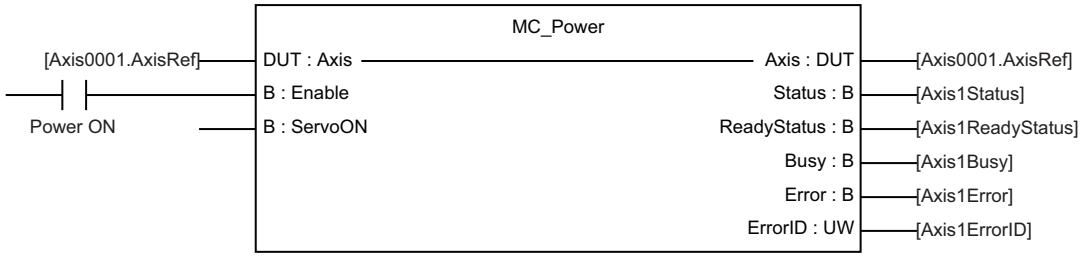
In case of a real axis, the device network connection is required to operate an axis after the axis variable is initialized. If the device of the station address has been connected, it must be disconnected and reconnected. (The axes can be emulated without network connection. (☞ Page 414 Slave Emulate))

How to specify in a user program

When "AXIS_REF" is described in the input/output setting of the motion control FB, the axis can be specified by setting AxisRef (AxisName.AxisRef) which is the AXIS_REF type member of each axis variable.

Ex.

When executing the MC_Power with the following conditions:
axis type: real drive axis, axis No.: 1, axis name: Axis0001



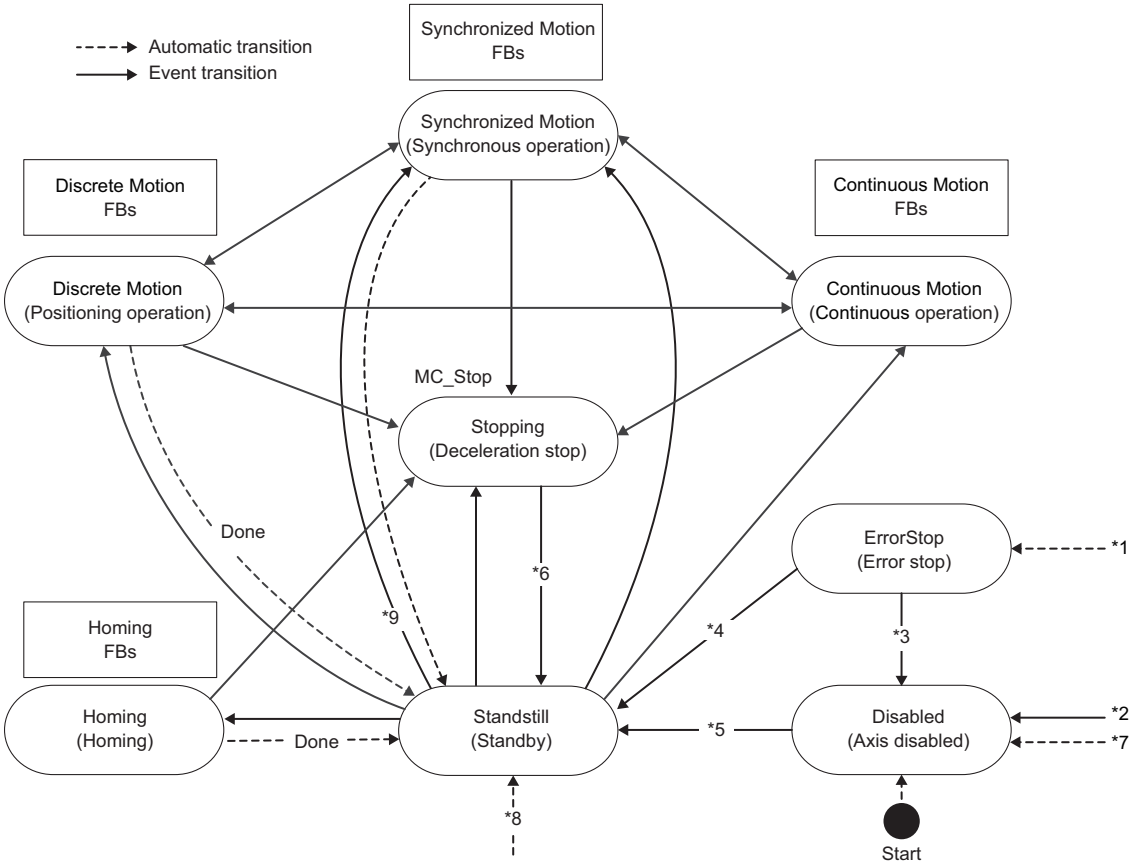
State transition

The following shows the status that a single axis can be in.

The current status can be referred in axis status (AxisName.Md.AxisStatus).

Status	Description
0: Disabled	The status where the axis cannot be used. In case of a real drive axis, this status indicates the servo OFF stop. In case of a real axis, this status occurs also when the slave device is disconnected from the network.
1: ErrorStop	The status where the deceleration stop or stop by error occurrence. In case of a real drive axis, the axis is servo ON or servo OFF depending on the error.
2: Stopping	The status where the deceleration stop has been executed by MC_Stop. After the axis stop is completed, this status continues until the Execute of MC_Stop changes to FALSE. The MCFB cannot be executed in this status.
3: Homing	The status where the homing has been executed in the driver or the motion system.
4: Standstill	The status where the MCFB can be used. In case of a real drive axis, the axis is servo ON stop.
5: DiscreteMotion	The status where the positioning operation has been executed to the target position.
6: ContinuousMotion	.The status where the operation is not stopped after the processing is completed in the FB such as speed control and torque control has been executed.
7: SynchronizedMotion	The status where the axis synchronizes with the master axis by the single synchronous control FB. Transits to this status after the axes group set as the configuration axes changes to the "5: GroupMoving" status.
-1: Invalid	Axes cannot be used in this status due to axis variable uninitialization (parameter error occurrence at an initialization, etc.).

The status transits as shown below according to the start of the MCFB. The state transition may varies depending on the axis type. Refer to the specifications of each axis type.



*1 From any state, transits when an error in the axis occurred.
*2 From any state, transits when MC_Power.Enable = FALSE and there is no error in the axis.
Transits when Enable of the MC_Power = TRUE, SV_ON = FALSE, and no error occurs in the axis from Standstill state
*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 MC_Power.Enable = TRUE, SV_ON = TRUE, and MC_Power.Status = TRUE.
*6 Transits when MC_Stop.Done = TRUE and MC_Stop.Execute = FALSE.
*7 Transits when the forced servo OFF is enabled by the driver from Standstill state.
Transits when a communication with the driver fails from Standstill state.
*8 Transits automatically when the virtual axis is enabled.
*9 Transits when the axes group used as configuration axes turns to the GroupMoving state.

The classification of operation FBs such as DiscreteMotion FBs, SynchronizedMotion FBs, ContinuousMotion FBs, and Homing FBs, refer to the following.

☞ Page 669 List of FBs

Precautions

- An error does not occur even if there is no axis (real axis, virtual axis, or encoder axis) in the system setting. Since there is no axis to be controlled, motion control is not available. Operations other than motion control are available such as program execution with ST language.
- An error occurs if a parameter error occurs at the axis variable initialization. At this time, the axis variable is generated as an instance, however, the axis status (AxisName.Md.AxisStatus) will be "-1: Invalid". The monitor data, etc. of the axis where "-1: Invalid" occurred is not refreshed. If the axis is specified by the user program, an error occurs.

1.2 Axis Type

Relevant variables/FB

Real drive axis data type AXIS_REAL members (excluding AxisRef)

Variable/Structure name	Name	Details
AxisName.PrConst.		
AxisType	Axis type setting	☞ Page 52 Axis Assignment
AddressOfStation	Station address setting	☞ Page 52 Axis Assignment
PosRestoration_AbsPosBase	Absolute position reference setting	☞ Page 53 Absolute position control setting
OperationCycle	Control cycle setting	☞ Page 52 Axis Assignment
SlaveObject	Slave object data	☞ Page 52 Axis Assignment
AxisName.Md.		
AxisStatus	Axis status	Displays the current axis status. -1: Invalid (Axis variable uninitialization/axis parameter error) 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby) 5: DiscreteMotion (Positioning operation) 6: ContinuousMotion (Continuous operation) 7: SynchronizedMotion (Synchronized operation)
UseInGroup	Using axes group	Displays whether the drive unit is used in axes group or not. FALSE: Not used TRUE: Used
Io_PosActualValue	Object data_PosActualValue	Indicates a value of object data_PosActualValue. ☞ Page 52 Axis Assignment
Io_Statusword	Object data_Statusword	Indicates a value of object data_Statusword. ☞ Page 52 Axis Assignment
Io_TargetPos	Object data_TargetPos	Indicates a value of object data_TargetPos. ☞ Page 52 Axis Assignment

Real encoder axis data type AXIS_ENCODER members (excluding AxisRef)

Variable/Structure name	Name	Details
AxisName.PrConst.		
AxisType	Axis type setting	☞ Page 52 Axis Assignment
AddressOfStation	Station address setting	Via the drive unit: 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
Encoder_CounterDisableSignal	Counter disabling signal	☞ Page 91 Follow Up
AxisName.Md.		
AxisStatus	Axis status	Displays the current axis status. 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby)
Encoder_CounterDisable	Counter disabled	Turns 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)

Variable/Structure name	Name	Details
AxisName.PrConst.		
AxisType	Axis type setting	☞ Page 52 Axis Assignment
PosRestoration_AbsPosBase	Absolute position reference setting	☞ Page 53 Absolute position control setting
OperationCycle	Control cycle setting	☞ Page 52 Axis Assignment
AxisName.Md.		
AxisStatus	Axis status	Displays the current axis status. -1: Invalid (Axis variable uninitialization/axis parameter error) 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby) 5: DiscreteMotion (Positioning operation) 6: ContinuousMotion (Continuous operation) 7: SynchronizedMotion (Synchronized operation)
Ip_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)

Variable/Structure name	Name	Details
AxisName.PrConst.		
AxisType	Axis type setting	☞ Page 52 Axis Assignment
Encoder_CounterDisableSignal	Counter disabling signal	☞ Page 91 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	Slave object data	Sets the slave object data
PosActualValue	PosActualValue	Sets the data storing synchronous encoder input. • one-word specified: -32768 to 32767 • two-word specifed: -2147483648 to 2147483647
AxisName.Md.		
AxisStatus	Axis status	Displays the current axis status. 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby)
Encoder_Connected	Connection status	Displays the virtual encoder axis connection status. FALSE: Not connected TRUE: Connecting
Encoder_CounterDisable	Counter disabled	Turns 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.
AxisName.Cd.		
Encoder_Connect	Connection command	The signal for enabling the connection status of the virtual encoder axis input. FALSE: Invalid TRUE: Valid
Encoder_InputValue	Encoder input value	Sets the value sequentially used as the virtual encoder axis input value.

*1 When the out of one-word range value is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) occurs.

Virtual linked axis data type AXIS_VIRTUAL_LINK members (excluding AxisRef)

Variable/Structure name		Name	Details
AxisName.PrConst.			
	AxisType	Axis type setting	☞ Page 52 Axis Assignment
	PosRestoration_AbsPosBase	Absolute position reference setting	☞ Page 53 Absolute position control setting
	OperationCycle	Control cycle setting	☞ Page 52 Axis Assignment
AxisName.Md.			
	AxisStatus	Axis status	Displays the current axis status. -1: Invalid (Axis variable uninitialization/axis parameter error) 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby) 5: DiscreteMotion (Positioning operation) 6: ContinuousMotion (Continuous operation) 7: SynchronizedMotion (Synchronized operation)

Real drive axis

This axis uses a 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

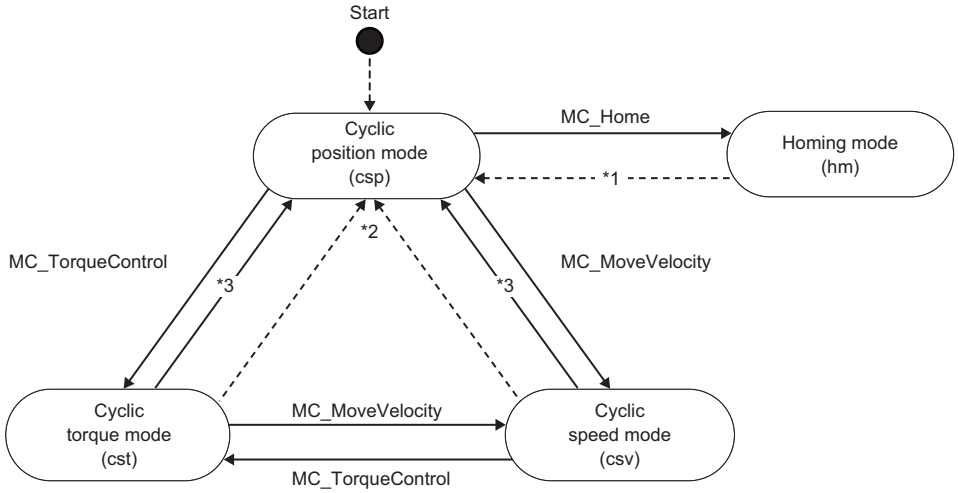
A driver device connected as a real drive axis follows the CiA402 drive protocol, and changes the control mode according to the "Modes of operation" object output from the motion system. The driver inputs the current mode as the "Modes of operation display" object in the motion system and displays it in AxisName.Md.Driver_Mode.

The motion system supports the operations of below modes.

Supported control mode		Description	Reference
Homing mode (hm)	6: hm	Executes homing operation by a driver.	Page 184 Driver homing method
Cyclic position mode (csp)	8: csp	Executes control following the sequential positioning command from the controller in each communication cycle.	Page 258 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 driver must be csp when the driver is connected.

Control mode switching of the driver is executed at the same time when MCFB is executed. The state transition is shown below.



*1 Transits after the axis is stopped by homing completion or error occurrence.

*2 Transits at stop completion or error occurrence.

*3 Transits when a command other than MC_MoveVelocity/MC_TorqueControl is being Aborting/Buffered.

Real encoder axis

This axis generates the current position from the synchronous encoder output pulse connected to the drive unit on 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. For required setting items for each real encoder axis specification, refer to the following.

☞ Page 41 Parameter setting items

Real encoder axis type	Description
Via drive unit	Uses the synchronous encoder connected to the drive unit (such as MR-J5(W)-G) corresponding to the scale measurement function as the real encoder axis.

Parameter setting items

Depending on the real encoder axis type, the following items are required to set up in order to use the 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 52 Axis No.
Axis type		○	Page 52 Axis type
Real encoder axis type setting		○	Page 42 Real encoder axis type setting
Station address		○	Page 42 Station address Page 52 Station address
Absolute position control setting		○	Page 53 Absolute position control setting
Control cycle		○	Page 53 Control cycle
Slave object setting			Page 42 Slave object setting Page 54 Slave object settings
	PosActualValue	—	
	Encoder status 2	□	
	Scale ABS counter	□	
	Scale cycle counter	□	
	Scale measurement encoder Resolution	□	
	Scale measurement encoder reception status	□	
Driver unit conversion numerator		○	Page 361 Compensation Function
Driver unit conversion denominator		○	
Position command unit setting		○	Page 74 Technical Units
Velocity command unit setting		○	
Command unit string		○	
Ring counter enabled selection		○	Page 79 Positioning Range
Ring counter upper limit value		△	
Ring counter lower limit value		△	
Counter disabling signal		△	Page 91 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	Uses the synchronous encoder input value via drive unit connected to the specified drive unit as the synchronous encoder input.

In order to use via drive unit type, set the real drive axis of the same station address and assign the required objects listed below.

☞ Page 42 Slave object setting

For details on the real drive axis setting method, refer to the following.

☞ Page 52 Axis Assignment

Station address

Depending on the real encoder axis type, set the following.

Real encoder axis type	Applicable hardware and software to setup as station address
Via drive unit	Drive unit connected with the synchronous encoder

For details on the setting value, refer to the following.

☞ Page 52 Axis Assignment

Slave object setting

Depending on the real encoder axis type, set the following.

Real encoder axis type	Setting item	Setting required object	Description*1
Via drive unit	Real drive axis of the same station address	Encoder status 2	• Specify the object ID storing the driver scale measurement function setting. bit0: Scale measurement function ABS system correspondent bit1: Scale measurement function (Valid when TRUE) • Reads the value from the setting location when connecting to the driver. When bit1 is FALSE, the error "Drive Module Via Synchronous Encoder Setting Incorrect" (error code: 1A90H) occurs.
		Scale ABS counter*2	• Specify the object ID storing the current synchronous encoder multiple revolution counter. • Setting range is handled as -32768 to 32767.
		Scale cycle counter*2	• Specify the object ID storing the current synchronous encoder position within one revolution. • Setting range is 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. bit0: CPU alarm bit1: LED alarm bit2: Data alarm bit5: Multi-revolution counter alarm bit6: ABS erased alarm (When TRUE, corresponding alarm occurs)

*1 For details on the setting value, refer to the following.
☞ Page 400 TARGET_REF structure

*2 If all of the slave objects are not assigned, the error "Drive Module Via Synchronous Encoder Setting Incorrect" (error code: 1A90H) occurs.

Required functions to use

The required functions to use the real encoder axis are shown below.

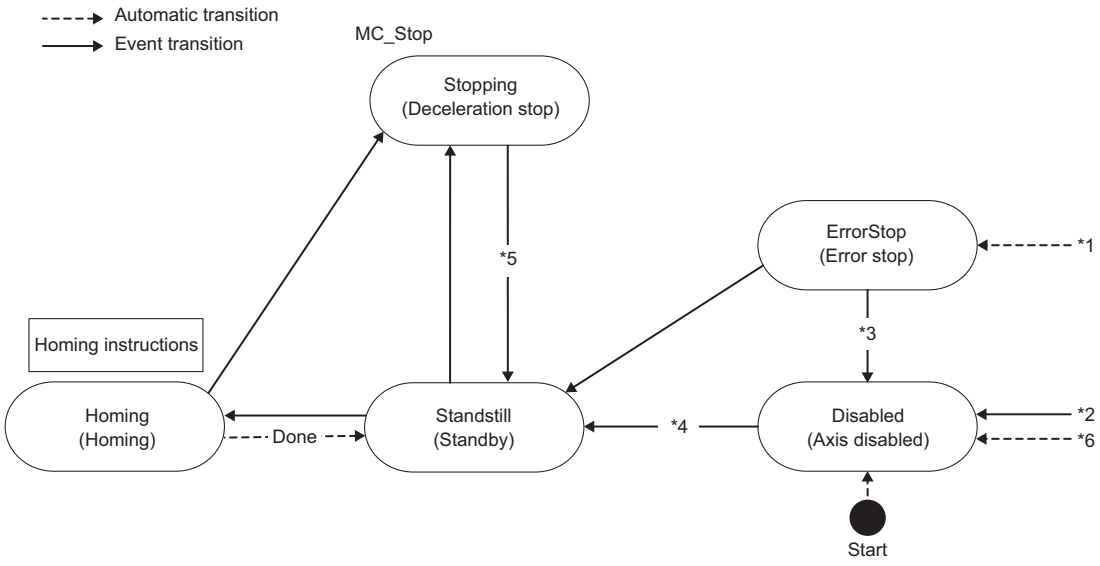
Function		Description	Axis type specific detailed information
Axis assignment		☞ Page 52 Axis Assignment	—
Technical units		☞ Page 74 Technical Units	—
Compensation function	Driver unit conversion function	☞ Page 361 Compensation Function	—
Absolute position control		☞ Page 94 Absolute Position Control	—
Operation cycle		☞ Page 105 Operation Cycle	—
State transition	Single axis state transition	☞ Page 48 Single axis state transition	—
Follow up (counter enabled/counter disabled)		☞ Page 91 Follow Up	—
Servo ON/OFF		☞ Page 84 Servo ON/OFF	—
Ring counter setting		☞ Page 79 Positioning Range	—
Control change function	Current position change function	☞ Page 287 Current Position Change Function	☞ Page 44 Control change function
Command filter	Smoothing filter	☞ Page 364 Command Filter	—
	Movement direction control filter		—

For other functions, refer to each function and check the required slave object for the function. If the axis holds the required slave object, the function is valid.

State transitions

■Single axis state transition

The real encoder axis (via drive unit) transits to the status shown below.



*1 From any state, an error in the axis occurrs.

*2 From any state, Enable of MC_Power/MCv_AllPoweris FALSE and there is no error in the axis.
Enable of MC_Power/MCv_AllPoweris TRUE, ServoON is FALSE and there is no error in the axis from Standstill state.

*3 Transits by the status error cancel for the error reset command during the servo OFF state. (Since no follow up will be done in ErrorStop state, it will be in the current position restoration not executed state when transits state is disabled.)

*4 After the real drive axis of the same station address is connected, it transits when Enable of MC_Power/MCv_AllPower is TRUE, ServoON is TRUE and Status of MC_Poweris TRUE.

*5 Transits when Done of MC_Stop is TRUE and Execute of MC_Stop.Execute is FALSE.

*6 From any state, the real drive axis of the same station address is not connected.

Control change function

When starting the current position change control unconditionally, use MC_SetPosition.

Point

To use the control change function by the real encoder axis, the axis status (AxisName.Md.AxisStatus) of the real encoder axis is required to be set as [4: Standstill] by Servo ON/OFF function.

Setting examples

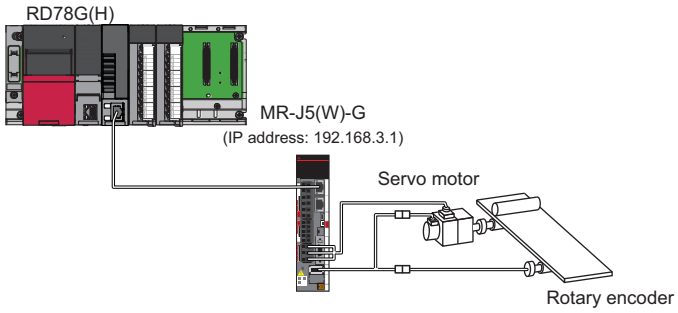
The setting example of the real encoder axis is shown below.

[Via drive unit]

Depending on the connected drive unit or version, available functions and encoders are restricted. For details, refer to the drive unit manuals.

Ex.

To use the real encoder axis1(MR-J5(W)-G station address 192.168.3.1) scale measurement device as the input of the 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: DriveAxis	2: EncoderAxis
Real encoder axis type setting	Unnecessary	1: Via drive unit
Station address	192.168.3.1	192.168.3.1 (Specify the station address of the drive unit that the synchronous encoder is connected)
Absolute position control setting	-1: Auto	Arbitrary*1
Control cycle	0	0*2

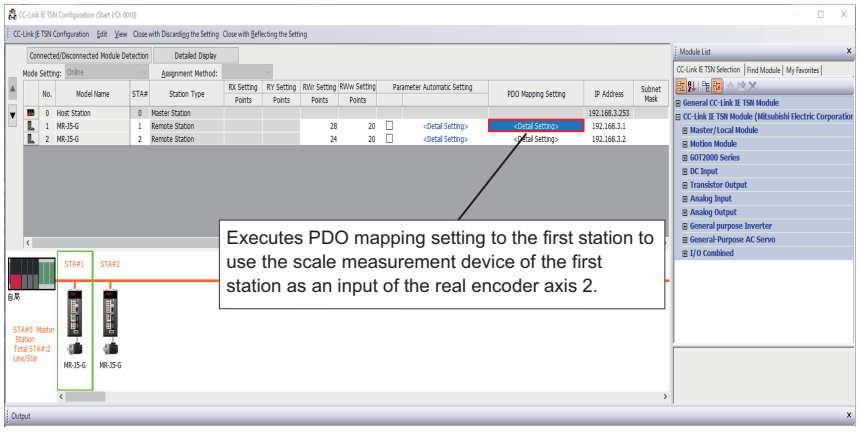
*1 Set the setting that matches with the setting of the synchronous encoder and driver side to be connected.When "-1: Auto" is set, acquires the absolute position system setting from the driver side.

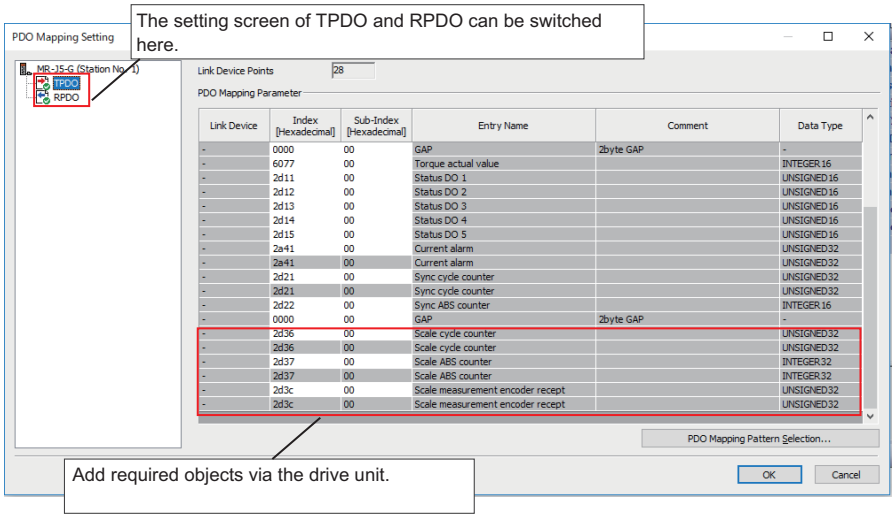
*2 The data refresh cycle of the synchronous encoder is the control cycle of the connected real drive axis and the axis control may not be executed by each data refresh cycle when it differs with the real encoder axis setting. Thus, the setting that the real encoder axis control cycle setting is to be the same cycle setting as the connected real drive axis is recommended.

■PDO mapping setting

Regarding the network configuration setting of GX Works3, set all three objects of the folllowing to the PDO mapping (TxPDO) of the real drive axis 1 (MR-J5(W)-G station address 192.168.3.1).

- Scale cycle counter
- Scale ABS counter
- Scale measurement encoder reception status]





■Driver side (MR-J5(W)-G) setting

To enable the scale measurement function on MR-J5(W)-G, set the parameter below. (For MR-J5W-G, only MR-J5W2-G is supported)

For details of the parameter and connection method of the encoder, refer to the driver device manuals.

No.	Abbreviation	Name	Overview
PA22.3*1	**PCS	Scale measurement function selection	Select scale measurement function. Initial setting: 0 (Invalid) "1" (Used in absolute position detect system) "2" (Used in incremental system)

*1 Applicable to MR-J5(W)-G (A4 version) or later

When the applicable real drive axis is not connected,the real encoder axis connection becomes invalid. (It becomes valid by connecting the applicable real drive axis.)

Virtual drive axis

This axis can generate commands virtually in the motion system. A 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 slave emulate function to the real axis drive. For details, refer to the following.

☞ Page 414 Slave Emulate

Virtual encoder axis

Generates the current position from the values of the motion system variables. Used as an input axis for the single axis synchronous control.

Parameter setting items

The following items are required to set up in order to use the virtual encoder axis.

○: Necessary, △: Optional, —: Unnecessary

Setting item	Virtual encoder axis	Reference
Axis No.	○	Page 52 Axis No.
Axis type	○	Page 52 Axis type
Station address	—	—
Absolute position control setting	○	Page 53 Absolute position control setting
Control cycle	○	Page 53 Control cycle
Slave object setting		
PosActualValue	△	Page 47 Slave object setting
Driver unit conversion numerator	○	Page 361 Compensation Function
Driver unit conversion denominator	○	
Position command unit setting	○	Page 74 Technical Units
Velocity command unit setting	○	
Command unit string	○	
Ring counter enabled selection	○	Page 79 Positioning Range
Ring counter upper limit value	△	
Ring counter lower limit value	△	
Encoder ring counter upper limit value	○	Page 47 Encoder ring counter upper limit value/lower limit value
Encoder ring counter lower limit value	○	
Counter disabling signal	△	Page 91 Follow Up

Slave object setting

Set the following.

Object required setting	Description
PosActualValue	Set the string format data used as the encoder input value.*1 The settable types are only [VAR], [DEV] and [CONST]. If the setting value is not within the valid range, the error "Out of Parameter Range (Axis)" (error code: 1D80H) 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, the error "Out of Parameter Range (Axis)" (error code: 1D80H) 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 nor the data type is other than the above, the error "Out of Parameter Range (Axis)" (error code: 1D80H) occurs. When [VAR] type is used, do not specify the local label. Use "AxisName.Cd.Encoder_InputValue" as the encoder input value when omitted. Set the encoder input value sequentially by encoder pulse unit.

*1 For details of the setting value, refer to the following.
☞ Page 400 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 corresponds to 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, the error "Out of Encoder Ring Counter Setting Range" (error code: 1AE1H) 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.
  One operation cycle movement amount <| the encoder ring counter upper limit value - the 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

Required setting to use

The required functions to use the virtual encoder axis are shown below.

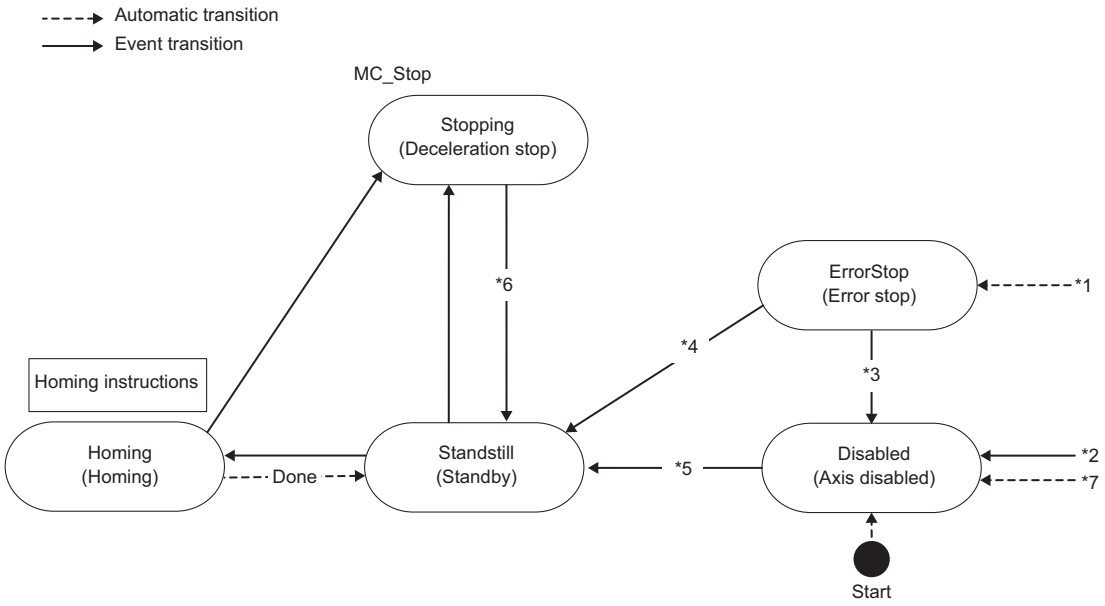
Function		Description	Axis type specific detailed information
Axis assignment		☞ Page 52 Axis Assignment	—
Technical units		☞ Page 74 Technical Units	—
Compensation function	Driver unit conversion function	☞ Page 361 Compensation Function	—
Absolute position control		☞ Page 94 Absolute Position Control	—
Operation cycle		☞ Page 105 Operation Cycle	—
State transition	Single axis state transition	☞ Page 48 Single axis state transition	☞ Page 43 State transitions
Follow up (counter enabled/counter disabled)		☞ Page 91 Follow Up	—
Ring counter setting		☞ Page 79 Positioning Range	—
Control change function	Current position change function	☞ Page 287 Current Position Change Function	☞ Page 44 Control change function
Command filter	Smoothing filter	☞ Page 364 Command Filter	—
	Movementdirection control filter		—

For other functions, refer to each function, check the required slave object for the funtion. If the axis holds the required slave object, the function is valid.

State transition

■Single axis state transition

The virtual encoder axis transits to the following state.



*1 From any state, an error in the axis occurs.
*2 From any state, Enable of MC_Power/MCv_AllPower is FALSE and there is no error in the axis.
Enable of MC_Power/MCv_AllPower is TRUE, ServoON is FALSE and there is no error in the axis from Standstill state.
*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 AxisNameCd.Encoder_Connect is TRUE, transits when Enable of MC_Power/MCv_AllPower is TRUE, ServoON is TRUE and Status of MC_Power is TRUE.
*6 Transits when Done of MC_Stop is TRUE and Execute of MC_Stop is FALSE.
*7 From any state, transits when AxisNameCd.Encoder_Connect = FALSE.

Control change function

When starting the current position change control unconditionally, use the MC_SetPosition.

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.

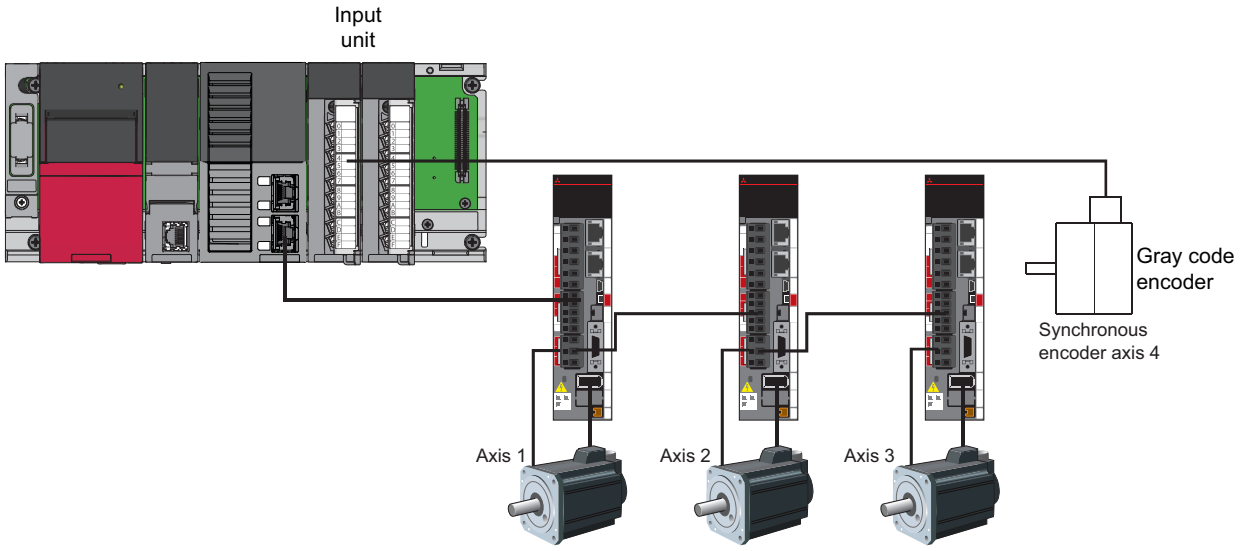
Setting example

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 unit: The resolution 4096 pulse/rev encoder value is used to control)



■Axis setting

Setting items	Setting value
AxisNo.	4
AxisType	4: VirtualEncoderAxis
Absolute position control setting	0: ABSDisabled
Encoder ring counter upper limit value	4095
Encoder ring counter lower limit value	0
Object data_PosActualValue	[DEV](DINT)G8000000

1. Set AxisName.Cd.Encoder_Connect TRUE.
2. Check AxisName.Md.PosRestoration_Status is "2:RestoredInIncSystem", and AxisName.Md.Encoder_Connected is TRUE.
3. Set MC_Power/MCv_AllPower Enable and DriverON TRUE.
4. Check AxisName.Md.AxisStatus is "4: Standstill".
5. Read the encoder value of the gray code encoder by program, update the device setup on PosActualValue with slave object 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 a virtual drive axis, etc.
Without axis assignment in the engineering tool, an axis can be temporarily generated during program execution by only declaring the instance of the AXIS_REF structure in the local label. In this case, the motion system discards the axis data generated temporarily when the PLC READY [Y0] is turned ON to OFF. (If axis assignment is executed in the engineering tool, the axis data will be maintained even after the PLC READY [Y0] is turned ON to OFF.)

How to generate an axis

Set it according to axis assignment. For the method, refer to the following.
☞ Page 52 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 service process.

1.3 Connectable Stations

This section describes stations that are can be connected to the network.

Maximum number of stations that can be connected

The following shows the maximum number of stations that can be connected to the network.

Item	RD78G4	RD78G8	RD78G16	RD78G32	RD78G64	RD78GHV	RD78GHW
Maximum number of stations that can be connected	120 stations*1*2						

*1 Even if the station is a multi-axis drive unit device (a device which can control two axes or more), the number of station is counted as one station when it is recognized as one station. For details, refer to each drive unit instruction manual.

*2 When slave emulate is carried out, the number of stations is counted according to the connected device setting.

Precaution

An error will not occur even if there is no station and axis in the network setting.

1.4 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.

Setting items

The following shows setting items according to the axis type.

○: Necessary, —: Unnecessary

Axis type	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.

Axis No. is an identifier to control in the motion system.

If the same No. is set in the multiple axes, the error "Axis No. Setting Duplication Error" (error code: 1A91H) will occur.

Axis setting	Axis No.
User specification	1 to 10000
Vertual 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: EncodeAxis
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 of data types of each axis type, refer to the following.

☞ Page 32 Axis

■Station address

Specify the station address of the target device to connect a network device as a real axis. Also, specify the axis ID for connecting a device which can control multiple axes with one device (multiple axes device).

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 of the TARGET_REF structure, refer to the following.

☞ Page 400 TARGET_REF structure

Even though the station address have not been set ("") in the real axis, by setting AxisName.PrConst.SlaveEmulate_Enable TRUE, it enables to use as the slave emulate function. If slave emulate function is not used, the error "Station Address Setting Incorrect" (error code: 1A95H) will be output and the axis will not be ready for operation.

■Absolute position control setting

Specify whether applicable axes are used as the absolute position system or not. For details, refer to the following.

☞ Page 94 Absolute Position Control

■Control cycle

Specify which operation cycle is used for the applicable axis to control. For details, refer to the following.

☞ Page 105 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

Variable/Structure name	Name	Details
AxisName.AxisRef.		
AxisNo	Axis No.	Sets the axis No. 0: Not set 1 to 10000: Setting axis No.
AxisName.PrConst.		
AxisType	Axis type setting	Sets the axis type. 0: DriveAxis (Real drive axis) 2: EncoderAxis (Real encoder axis) 3: VirtualDriveAxis (Virtual drive axis) 4: VirtualEncoderAxis (Virtual encoder axis) 5: VirtualLinkAxis (Virtual linked axis)
AddressOfStation	Station address setting	Sets network address of the slave station with a character string.
PosRestoration_AbsPosEnable	Absolute position control setting	Sets the absolute position control setting. 0: ABSDisabled (Not use the absolute position control setting) 1: Enabled (Use the absolute position control setting) -1: Auto (Automatic setting) (Acquire from connected device)
OperationCycle	Control cycle setting	Sets Control cycle setting. For details, refer to the following. ☞ Page 105 Operation Cycle
AxisName.Md.		
AxisName	Axis name	Displays the axis name.
Io_PosActualValue	Object data_PosActualValue	Indicates a value of object data_PosActualValue.
Io_PosEncoderResolution	Object data_PosEncoderResolution	Indicates a value of object data_PosEncoderResolution.
Io_Statusword	Object data_Statusword	Indicates a value of object data_Statusword.
Io_TargetPos	Object data_TargetPos	Indicates a value of object data_TargetPos.

Slave object settings

In the motion system, the data that sends/receives information to/from the connected device in the motion operation processing is called a slave object.

With slave object settings, the motion system can be customized to adjust to the slave device by setting the data related to the slave device to the slave object.

For one slave object, set as the following.

Setting item	Setting value
Each slave object name	Specifies the target data to set. The following items can be specified. • No setting • Object INDEX Specified by INDEX, sub INDEX, and the number of bytes • Link device • Slave label • Buffer memory • Device • Label • Constant For details of the format to specify the data, refer to the following. ☞ Page 400 TARGET_REF structure

Settable data by the axis type and the slave object is shown below.

Axis type	Slave object attribute*1		Settable setting value in the slave object setting (other than no setting)*2	
	PDO mapping	Access	Setting value	Restriction for combination with other settings
Real drive axis	TPDO	RO	Object INDEX	Only objects registered in the mapping setting for input (the slave to the controller) in the "PDO mapping setting".
	RPDO	RW	Object INDEX	Only objects registered in the mapping setting for output (the controller to the slave) in the "PDO mapping setting".
	No	RO	Object INDEX	—
			Buffer memory device Internal address constant	—
		RO	Object INDEX	—
			Buffer memory device Internal address	—

*1 For details of slave object attribute, refer to the following.
☞ Page 56 Slave object list

*2 When the slave label is specified, refer based on data the applicable label is assigned to.

If unavailable data is set, the error "Mapping Communication Error" (error code: 1A5FH) will occur at the axis variable initialization.
There are slave objects whose settings are necessary depending on the axis type. A valid setting value other than "no setting" must be set to the applicable slave object. (If the setting is illegal, the error "Slave Object Setting Incorrect" (error code: 1A96H) will occur at the axis variable initialization.)
For slave objects whose settings are necessary, refer to the following.
☞ Page 56 Slave object list
When "no setting" is set to the slave object setting, the axis cannot use functions/commands that need the applicable slave object.
Data and information of the setting location are sent/received based on the data type of each slave object in the motion operation processing.

Access	Data size	Description of the motion operation processing
R: Slave → Motion system	(Slave object) < (Setting location data)	Converts the setting location data to data size of a slave object and imports it. Exceeded upper bit information is discarded.
	(Setting location data) ≤ (Slave object)	Converts the setting location data to data type of the slave object and imports it.
W: Motion system → Slave	(Setting location data) < (Slave object)	Stores a slave object value as it is to the the setting location data. After it is stored, shorted upper bit does not change before and after refreshing.
	(Slave object) ≤ (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 settings

Data (object) that sent/received between the controller and the slave in cyclic communication (PDO communication) must be mapped in advance in order to control each function in the real drive axis.
For details of PDO mapping settings, refer to the following.
MELSEC iQ-R Motion Module User's Manual (Network)
Mapping is required for some objects to be connected as real drive axes in the motion system. The following objects must be mapped. (If those are not mapped, the error "Necessary Slave Object Unset" (error code: 1AA8H) will occur.)

Mapping	Required object name
Output (RPDO)	Contorl word
	Target position
	Operation mode
Input (TPDO)	Status word
	Current position
	Operation mode display

Setting procedure

This section describes the procedure to newly set a real drive axis by using the engineering tool.

1. Add slave device settings to the network 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 slave object setting, and assign slave objects.
5. Write the parameters in the motion system.

Slave object list

The following shows attributes of slave objects.

Attribute	Description
Data Type	Indicates slave object size.
Access	Indicates whether the object can be read/written or not. • RO: Only read is available. • RW: Read and write are available.
PDO mapping	When the axis type is real drive axis, it indicates whether the mapping to cyclic communication is enabled or not. • No: Mapping to TxPDO and RxPDO is disabled. • TxPDO: Mapping to TxPDO is enabled. • RxPDO: Mapping to RxPDO is enabled. When the axis type is real encoder axis, read shown as below. • No: The motion system will access to the data unperiodically even if the link device is specified. • TxPDO: By specifying the link device inputted from the slave station to the master station, the motion system can read the data from the slave devices in fixed-cycle. • RxPDO: By specifying the link device outputted from the master station to the slave station, the motion system can write the data from the slave devices in fixed-cycle.
Default	Indicates the default value of the slave object for the real drive axis.

The slave object lists are shown below.

Slave object name	DataType	Access	PDO mapping	Default	Description
Supported drive modes	U32	ro	No	65020020	Gets the control mode supported by the driver device.
Modes of operation	I8	rw	RxPDO	60600008	Requires switching the control mode to the driver device.
Modes of operation display	I8	ro	TxPDO	60610008	Gets the control mode of the driver device.
Controlword	U16	rw	RxPDO	60400010	Requires switching the status to the driver device.
Control DI 1	U16	rw	RxPDO	2D010010	Sets the input device in driver device.
Control DI 2	U16	rw	RxPDO	2D020010	Sets the input device in driver device.
Control DI 3	U16	rw	RxPDO	2D030010	Sets the input device in driver device.
Control DI 4	U16	rw	RxPDO	2D040010	Sets the input device in driver device.
Control DI 5	U16	rw	RxPDO	2D050010	Sets the input device in driver device.
Control DI 6	U16	rw	No	2D060010	Sets the input device in driver device.
Control DI 7	U16	rw	No	2D070010	Sets the input device in driver device.
Statusword	U16	ro	TxPDO	2D110010	Gets the status of the driver device.
Status DO 1	U16	ro	TxPDO	2D120010	Sets the output device in driver device.
Status DO 2	U16	ro	TxPDO	2D130010	Sets the output device in driver device.
Status DO 3	U16	ro	TxPDO	2D140010	Sets the output device in driver device.
Status DO 4	U16	ro	TxPDO	2D150010	Sets the output device in driver device.
Status DO 5	U16	ro	TxPDO	2D160010	Sets the output device in driver device.
Status DO 6	U16	ro	No	2D170010	Sets the output device in driver device.
Status DO 7	U16	ro	No	2D110010	Sets the output device in driver device.
Target position	I32	rw	RxPDO	607A0020	The command position to output to the driver device.
Target velocity	I32	rw	RxPDO	60FF0020	The set velocity to output to the driver device.
Target torque	I16	rw	RxPDO	60710010	The command torque to output to the driver device.
Positive torque limit value	U16	rw	RxPDO	60E00010	Sets positive direction torque limit value in the driver device.
Negative torque limit value	U16	rw	RxPDO	60E10010	Sets negative direction torque limit value in the driver device.
Position actual value	I32	ro	TxPDO	60640020	The current value of the driver device.
Velocity actual value	I32	ro	TxPDO	606C0020	The current speed of the driver device.
Following error actual value	I32	ro	TxPDO	60F40020	The droop pulse of the driverdevice.
Torque actual value	I16	ro	TxPDO	60770010	The the current torque of the driver device.
Polarity	U8	rw	No	607E0008	Sets the rotation direction selection of driver device

Slave object name	DataType	Access	PDO mapping	Default	Description
Encoder increments	U32	rw	No	608F0120	Gets the encoder resolution of driver device.
Motor revolutions	U32	rw	No	608F0220	Gets the motor speed of the driver device.
SI unit velocity	U32	rw	No	60A90020	Gets the SI unit velocity of the driver device.
Max motor speed	U32	rw	No	60800020	Gets the maximum speed of the servo motor from the driver device.
Max torque	U16	rw	No	60720010	Gets the maximum torque of the servo motor from the driver device.
Watch dog counter DL	U16	rw	RxPDO	1D010110	Notifies the watch dog counter value to the driver device.
Watch dog counter UL	U16	ro	TxPDO	1D020110	Gets the watch dog counter value to the driver device.
Supported Control DI 1	U16	ro	No	2D000110	Gets the input device supported by the driver device.
Supported Control DI 2	U16	ro	No	2D000210	Gets the input device supported by the driver device.
Supported Control DI 3	U16	ro	No	2D000310	Gets the input device supported by the driver device.
Supported Control DI 4	U16	ro	No	2D000410	Gets the input device supported by the driver device.
Supported Control DI 5	U16	ro	No	2D000510	Gets the input device supported by the driver device.
Supported Control DI 6	U16	ro	No	2D000610	Gets the input device supported by the driver device.
Supported Control DI 7	U16	ro	No	2D000710	Gets the input device supported by the driver device.
Supported Status DO 1	U16	ro	No	2D100110	Gets the output device supported by the driver device.
Supported Status DO 2	U16	ro	No	2D100210	Gets the output device supported by the driver device.
Supported Status DO 3	U16	ro	No	2D100310	Gets the output device supported by the driver device.
Supported Status DO 4	U16	ro	No	2D100410	Gets the output device supported by the driver device.
Supported Status DO 5	U16	ro	No	2D100510	Gets the output device supported by the driver device.
Supported Status DO 6	U16	ro	No	2D100610	Gets the output device supported by the driver device.
Supported Status DO 7	U16	ro	No	2D100710	Gets the output device supported by the driver device.
Home offset	I32	rw	No	607C0020	Sets the difference between zero position and homing position of the machine coordinate system in the driver device.
Home cycle counter	U32	ro	No	2D3D0020	Gets the encoder position within one revolution saved as the home position from the driver device.
Home ABS counter	I16	ro	No	2D3E0010	Gets the encoder multiple revolution counter saved as the home position from the driver device.
Initial position	I32	ro	No	2D3F0020	Gets the current position at power-on from the driver device.
Initial cycle counter	U32	ro	No	2D400020	Gets the encoder position within one revolution at power-on from the driver device.
Initial ABS counter	I16	ro	No	2D410010	Gets the encoder multiple revolution counter at power-on from the driver device.
Max ABS counter	U32	ro	No	2D420020	Gets the maximum value of the encoder multiple revolution counter from the driver device.
Velocity limit value	U32	ro	RxPDO	2D200020	Sets the speed limit value in the driver device.
Encoder status 1	U32	ro	No	2D350120	Gets the encoder status from the driver device.
Encoder status 2	U32	ro	No	2D350220	Gets the scale measurement encoder status from the driver device.

Slave object name	DataType	Access	PDO mapping	Default	Description
Scale measurement encoder resolution	U32	ro	No	2D380020	Gets the scale measurement encoder resolution from the driver device.
Current alarm	U32	ro	TxPDO	2A410020	Gets the occurring alarm from the driver device.
Sync ABS counter	I16	ro	TxPDO	2D220010	Gets the encoder multiple revolution counter from the driver device.
Sync cycle counter	U32	ro	TxPDO	2D210020	Gets the encoder multiple revolution counter from the driver device.
Scale measurement encoder reception status	U32	ro	No	2D3C0020	Gets the encoder position within one revolution from the driver device.
Scale cycle counter	U32	ro	No	2D360020	Gets the position within one revolution of the scale measurement encoder from the driver device.
Scale ABS counter	I16	ro	No	2D370010	Gets the multiple revolution counter of the scale measurement encoder from the driver device.

• Whether or not the setting is required for each axis type

Whether the slave object is available in each axis type or not is as shown below depending on the slave object setting and the PDO mapping setting.

○: Setting possible ... It can be set in the slave object setting of the engineering tool. For a slave object whose PDO mapping attribute is TxPDO or RxPDO in the real drive axis, be sure to set the setting value of the slave object setting to the PDO mapping setting. When the setting is valid, the axis holds the applicable slave object.

×: Setting not possible ... It cannot be set in the slave object setting of the engineering tool. The axis does not hold the applicable slave object.

□: Unnecessary ... It cannot be set in the slave object setting of the engineering tool. However, since it is emulated in the motion system, the axis holds the applicable slave object.

Slave object name	Real drive axis	Real Encoder axis[*1]	Virtual drive axis	Virtual Encoder axis	Virtual linked axis
Supported drive modes	○	×	×	×	×
Modes of operation	○	×	×	×	×
Modes of operation display	○	×	×	×	×
Controlword	○	×	×	×	×
Control DI 1	○	×	×	×	×
Control DI 2	○	×	×	×	×
Control DI 3	○	×	×	×	×
Control DI 4	○	×	×	×	×
Control DI 5	○	×	×	×	×
Control DI 6	○	×	×	×	×
Control DI 7	○	×	×	×	×
Statusword	○	×	×	×	×
Status DO 1	○	×	×	×	×
Status DO 2	○	×	×	×	×
Status DO 3	○	×	×	×	×
Status DO 4	○	×	×	×	×
Status DO 5	○	×	×	×	×
Status DO 6	○	×	×	×	×
Status DO 7	○	×	×	×	×
Target position	○	×	□	×	×
Target velocity	○	×	×	×	×
Target torque	○	×	×	×	×
Positive torque limit value	○	×	×	×	×
Negative torque limit value	○	×	×	×	×
Position actual value	○	×	□	○	×
Velocity actual value	○	×	×	×	×
Following error actual value	○	×	×	×	×

Slave object name	Real drive axis	Real Encoder axis*1	Virtual drive axis	Virtual Encoder axis	Virtual linked axis
Torque actual value	○	×	×	×	×
Polarity	○	×	×	×	×
Encoder increments	○	×	×	×	×
Motor revolutions	○	×	×	×	×
SI unit velocity	○	×	×	×	×
Max motor speed	○	×	×	×	×
Max torque	○	×	×	×	×
Watch dog counter DL	○	×	×	×	×
Watch dog counter UL	○	×	×	×	×
Supported Control DI 1	○	×	×	×	×
Supported Control DI 2	○	×	×	×	×
Supported Control DI 3	○	×	×	×	×
Supported Control DI 4	○	×	×	×	×
Supported Control DI 5	○	×	×	×	×
Supported Control DI 6	○	×	×	×	×
Supported Control DI 7	○	×	×	×	×
Supported Status DO 1	○	×	×	×	×
Supported Status DO 2	○	×	×	×	×
Supported Status DO 3	○	×	×	×	×
Supported Status DO 4	○	×	×	×	×
Supported Status DO 5	○	×	×	×	×
Supported Status DO 6	○	×	×	×	×
Supported Status DO 7	○	×	×	×	×
Home offset	○	×	×	×	×
Home cycle counter	○	×	×	×	×
Home ABS counter	○	×	×	×	×
Initial position	○	×	×	×	×
Initial cycle counter	○	×	×	×	×
Initial ABS counter	○	×	×	×	×
Max ABS counter	○	×	×	×	×
Velocity limit value	○	×	×	×	×
Encoder status 1	○	×	×	×	×
Encoder status 2	○	×	×	×	×
Scale measurement encoder resolution	○	×	×	×	×
Current alarm	○	×	×	×	×
Sync ABS counter	○	×	×	×	×
Sync cycle counter	○	×	×	×	×
Scale measurement encoder reception status	○	×	×	×	×
Scale cycle counter	○	×	×	×	×
Scale ABS counter	○	×	×	×	×

*1 For the real encoder axis, refer to the following.
☞ Page 32 Axis

Motion system function/command and slave object

If no slave object is registered in the axis of the motion system, there will be errors and restrictions in some functions/commands. Set the required objects as the following.

For a real axis, registered slave objects can be checked with the member variable of AxisName.Md.Io_Object.

For a virtual axis, registered slave objects are fixed by each axis type.

For details of each slave object, refer to the following.

☞ Page 56 Slave object list

◎: PDO mapping is required, ○: PDO mapping is recommended, —: PDO mapping is not required

Function/command	Required slave object	PDO mapping (only real drive axis)	Operation with no object
MC_MoveVelocity	TargetVelocity	◎	Necessary Slave Object Unset Errar
MC_TorqueControl	TargetTorque	◎	Necessary Slave Object Unset Errar
Torque limit function	PositiveTorqueLimitValue NegativeTorqueLimitValue	○	The command is ignored.
MC_Home	HomeOffset	—	Operates with data set method.

1.5 Axes Group

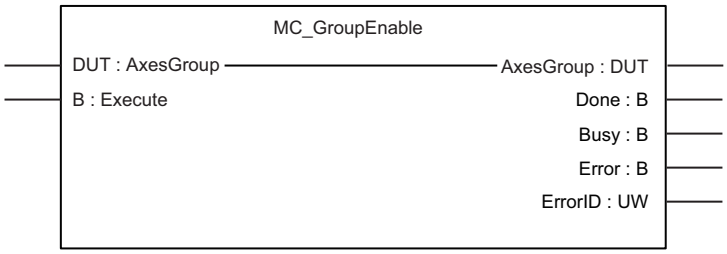
Axes group is used for multiple axes control such as linear interpolation control and 3D linear interpolation control, etc. This section describes an overview of axes group.

The maximum setting number of axes groups depends on the memory. If an axes group cannot be set for memory shortage, the error "Maximum Number of Registrations for Axes Group Over" (error code: 1A60H) will occur. The maximum number of configuration axes of the axes group to be registered is 16.

Relevant variables/FBs

Variable/Structure name	Name	Details
AxesGroupName.AxesGroupRef.		
GroupNo	Axes group No.	Sets axes group No. in the motion system. 0: Not set 1 and later: Setting axes group No.
AxesGroupName.Pr.		
Axis[1..16]	Configuration axis	Sets AxisRef (axis No.) of the axis which configures the axes group.
AxesGroupName.Md.		
GroupStatus	Axes group status	Displays the current axes group status. 0: GroupDisabled (Axes group disabled) 1: GroupErrorStop (Error stop) 2: GroupStopping (Deceleration stop) 4: GroupStandby (Standby) 5: GroupMoving (Operation)
GroupName	Axes group name	Stores the axes group name.
Axis[1..16]	Configuration axis	Sets AxisRef (axis No.) of the axis which configures the axes group.

MC_GroupEnable

Item	Description
Function overview	Transits specified axes group status from "0: GroupDisabled" to "4: GroupStandby".
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
9	5	Subroutine type	Real-time execution

■Function description

This FB transits the axes group status (AxesGroupName.Md.GroupStatus) of the AXES_GROUP_REF structure from "0: GroupDisabled" to "4: GroupStandby".

The FB is executed when Execute is TRUE, and Busy turns TRUE when the processing is normally started.

Done is TRUE and Busy is FALSE when the processing is normally completed.

When an error has occurred in the FB, this FB turns TRUE Error and stores an error code in ErrorID.

For details of error codes, refer to the following.

☞ Page 606 List of Error Codes

For axes group status (AxesGroupName.Md.GroupStatus), refer to the following.

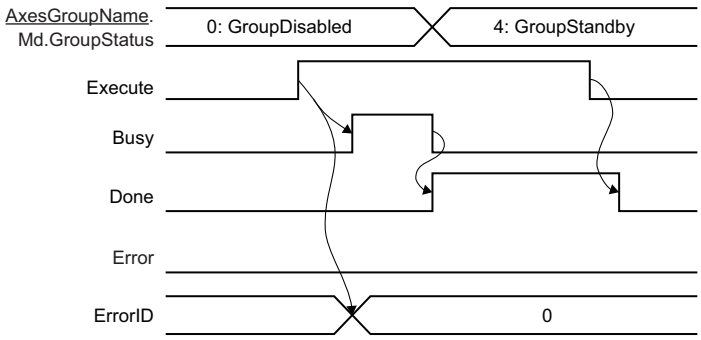
☞ Page 67 Axes group state transition

■Restrictions

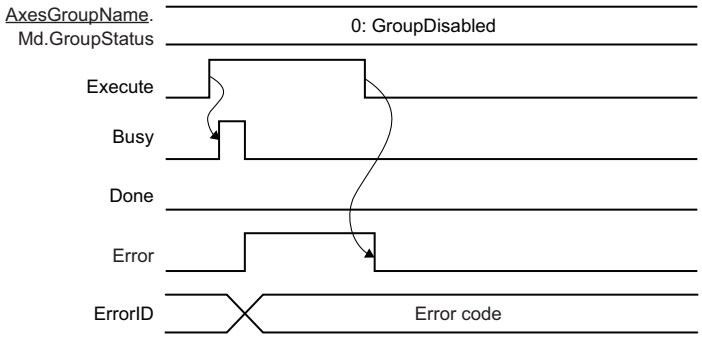
- Axes group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.
- This FB can be executed only when axis status (AxisName.Md.AxisStatus) of all configuration axes is the "4: Standstill" or the "0: Disabled" status.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variable

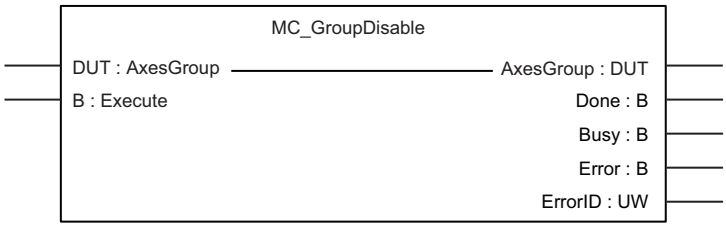
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, the FB is executed.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the status is transited to "4: GroupStandby".
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MC_GroupDisable

Item	Description
Function overview	Transits specified axes group status to "0: GroupDisabled".
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
9	5	Subroutine type	Real-time execution

■Function description

This FB transits the axes group status (AxesGroupName.Md.GroupStatus) of the AXES_GROUP_REF structure to "0: GroupDisabled".

The FB is executed when Execute is TRUE, and Busy becomes TRUE when the processing is normally started.

Done becomes TRUE and Busy becomes FALSE when the processing is normally completed.

When an error has occurred in the FB, the Error is changed to TRUE and stores an error code in ErrorID.

For details of error codes, refer to the following.

☞ Page 606 List of Error Codes

For axes group status (AxesGroupName.Md.GroupStatus), refer to the following.

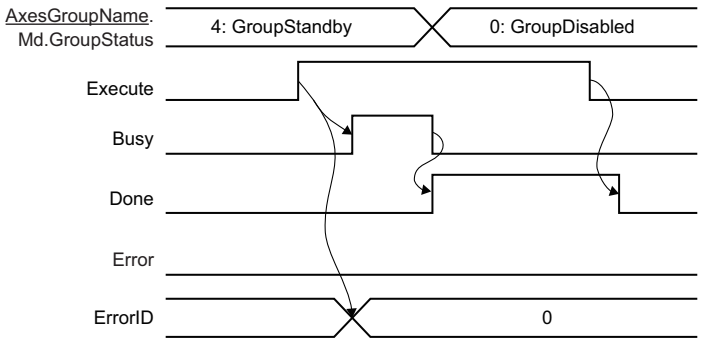
☞ Page 67 Axes group state transition

■Restriction

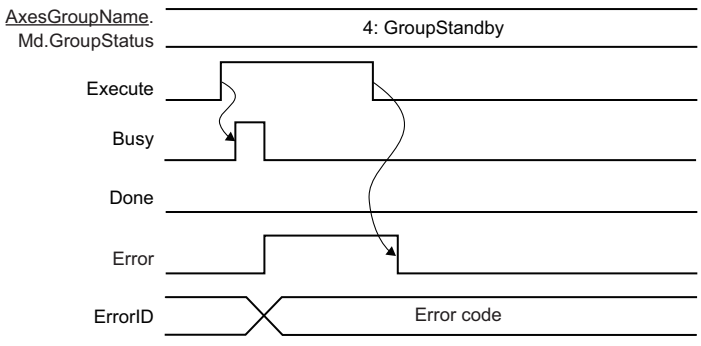
Axes group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variable

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, the FB is executed.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the status is transited to "4: GroupStandby".
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Settings required for axes group

The following parameters must be set in the engineering tool in order to set axes groups.

Configuration axes can be changed from the program.

For setting methods of axes group, refer to the following.

☞ Page 71 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 AxisRef (Axis No.) of the axis 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 or the local 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 setting axes group No. It can be changed to an arbitrary name. For details, refer to the following.
☞ Page 71 Axes Group Assignment

Setting axes group No.	Engineering tool default axis name
1	AxesGroup001
2	AxesGroup002
⋮	⋮

Data type

Data types of axes groups are described with the AXES_GROUP type. Data types of axes groups have the following members respectively.

Member name	Data type	Description
AxesGroupRef	AXES_GROUP_REF	Data structure for input/output of the motion control FB
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. Gets the newest value every control operation cycle and uses it for control.

Axes group variable initialization timing

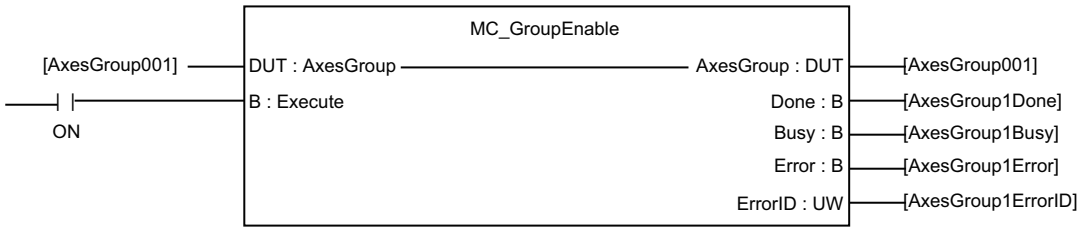
Axes group variables are initialized at the following timings.

Timing	Processing
Power ON/CPU module reset	Refers to the parameter file, and initializes all set axes group variables.
PLC READY [Y0] is turned ON	Refers to the parameter file, and imports uninitialized axes groups again. Initialized axes groups are not imported again or deleted.

Specify method using a user program

When "AXES_GROUP_REF" is written in the input/output setting of the motion control FB, an axes group can be specified by setting the AXES_GROUP_REF type member, AxesGroupRef (AxesGroupName.AxesGroupRef), of the axes group variable.

Ex.
When MC_GroupEnable is executed with the axes group No. of 1 and the axes group name of AxesGroup001



Enabling axes group

When an axes group is used in a motion FB, the axes group status (AxesGroupName.Md.GroupStatus) must be "4: GroupStandby" by executing MC_GroupEnable to the axes group. The axes group can be started in the motion FB when the axes group status (AxesGroupName.Md.GroupStatus) is "4: GroupStandby" and the axis status (AxisName.Md.AxisStatus) of all configuration axes is "4: Standstill".

Axes group state transition

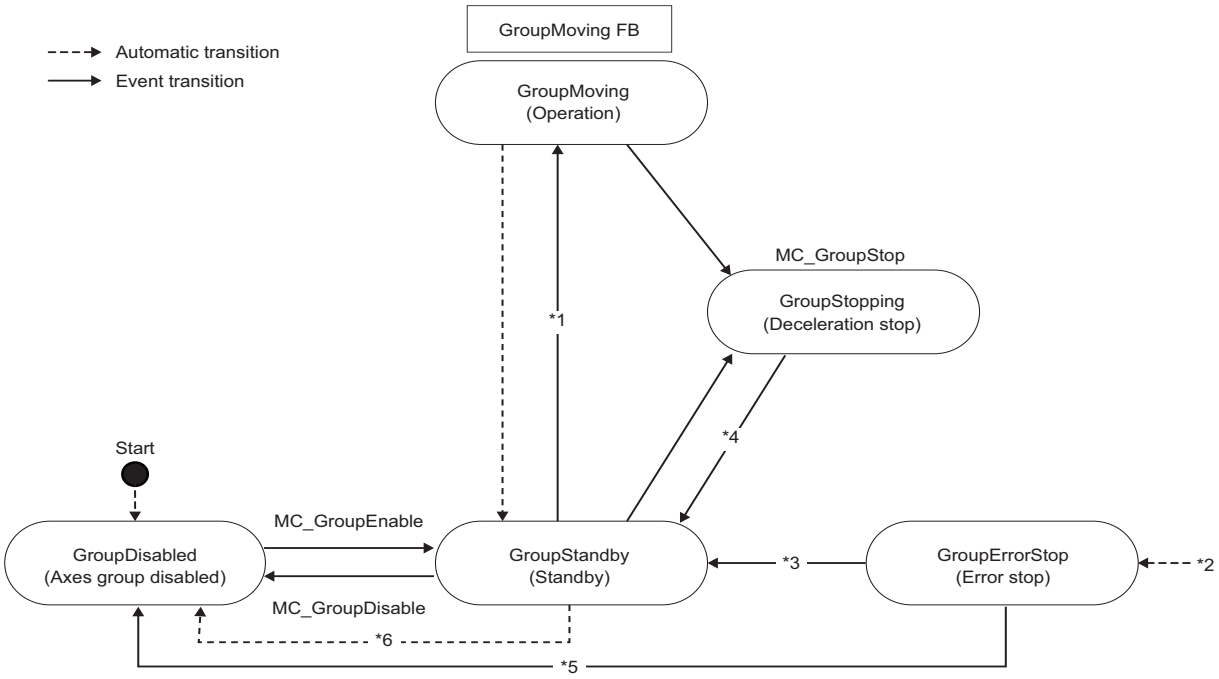
The following shows status that an axes group can enter.

The current status can be referred with axes group status (AxesGroupName.Md.GroupStatus).

When the axes group is set to "4: GroupStandby", AxisName.Md.UseInGroup of the configuration axes turns TRUE.

Status	Description
0: GroupDisabled	Axes group is disabled. MCFB cannot be executed in this status. The instruction which is being executed will be stopped immediately to transit this status.
1: GroupErrorStop	Axes group is in the deceleration stop or the stop status by an error occurrence. When the axis status (AxisName.Md.AxisStatus) is set to "1: ErrorStop" in any of the configuration axes, the axes group also enters this status.
2: GroupStopping	The deceleration stop is executed by MC_GroupStop. After the axis stop is completed, this status will be maintained until the Execute of MC_GroupStop turns FALSE. The MCFB cannot be executed in this status.
4: GroupStandby	Axes group is enabled and stand-by. (Not depending on the servo ON/OFF status.)
5: GroupMoving	The MCFB is executed in an axes group. When transiting into this status, the axis status (AxisName.Md.AxisStatus) of all configuration axes turn to "7: SynchronizedMotion".

The status is transited as the following figure according to start of the MCFB.



*1 All group operation instructions

*2 Transits when an error caused by an axes group occurs in the status other than GroupDisabled.
Transits when an error caused by an configuration axes occurs in the status other than GroupDisabled.

*3 Transits when status error is cleared by the axes group error reset.

*4 Transits when MC_GroupStop.Done = TRUE and MC_GroupStop.Execute = FALSE.

*5 Transits when an axes group is disabled as status error is cleared by carrying out MC_GroupDisable or resetting axes group error.

*6 Transits when a stop of program execution is completed by RUN status → STOP status

For divisions of GroupMoving FB in the operation FB, refer to the following.

☞ Page 669 List of FBs

Axes group enabled

This section describes enabling an axes group.

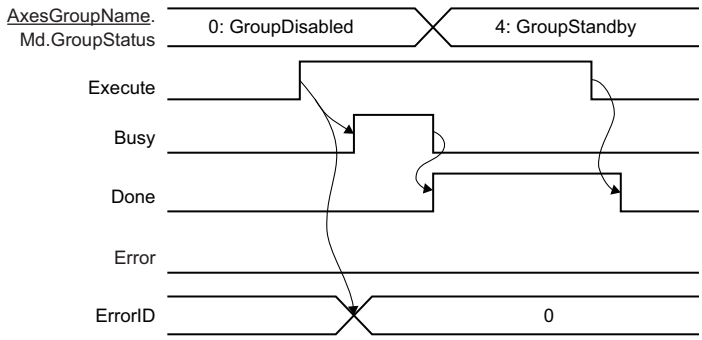
Control details

Specify AxesGroup and change the axes group status (AxesGroupName.Md.GroupStatus) into the "4: GroupStandby" status.

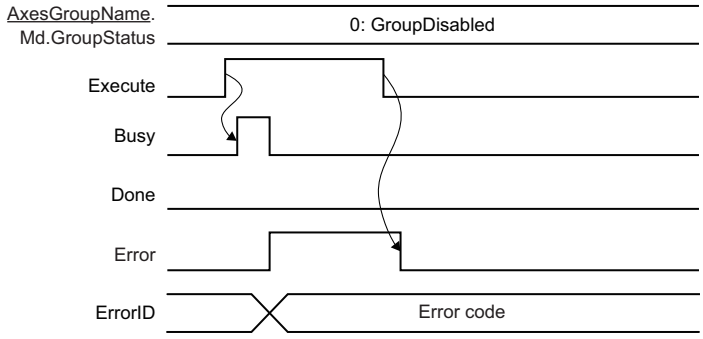
- The axes group can start the motion FB only when the axes group status (AxesGroupName.Md.GroupStatus) is the "4: GroupStandby" status.
- MC_GroupEnable can be executed only when the axis status (AxisName.Md.AxisStatus) of all configuration axes is the "4: Standstill" or the "0: Disabled" status.
- When the axes group status (AxesGroupName.Md.GroupStatus) is set to the "4: GroupStandby" status, AxisName.Md.UseInGroup of the configuration axes becomes TRUE.
- When specifying another axes group including a configuration axis which is AxisName.Md.UseInGroup and executing MC_GroupEnable, the error "Axis Status Incorrect (When Axes Group is Valid)" (error code: 3494H) will occur.
- If the error occurs in any of the configuration axes, the axes group status (AxesGroupName.Md.GroupStatus) will be "1: GroupErrorStop".
- If MC_GroupEnable is executed to the axes group which axes group is already valid, Done becomes TRUE and ends.

■Timing chart

[When the operation is normally completed]



[When an error occurs]



■Details of setting items

- Done (Execution completion)

It turns TRUE when the axes group status (AxesGroupName.Md.GroupStatus) has turned to "4: GroupStandby".

- Busy (Executing)

It turns TRUE during instruction execution. It turns FALSE after the axes group status (AxesGroupName.Md.GroupStatus) turns to "4: GroupStandby".

- Error (Error)

It turns TRUE when an error occurs in this FB.

- ErrorID (Error code)

It returns error code of the error occurred in this FB.

Precautions

Axes group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.
This FB can be executed only when the axis status (AxisName.Md.AxisStatus) of all configuration axes are "4: Standstill" or "0: Disabled".

Axes group disabled

This section describes disabling an axes group.

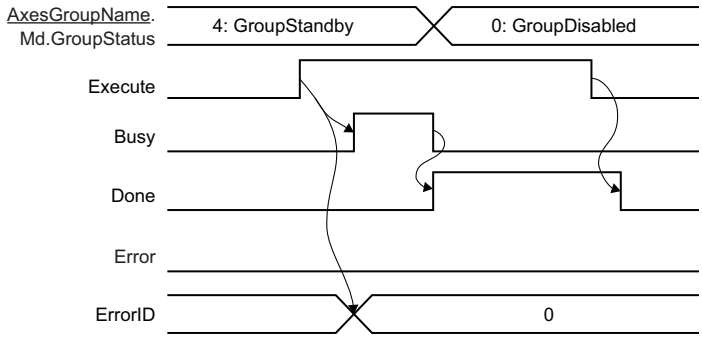
Control details

Specify AxesGroup and change the axes group status (AxesGroupName.Md.GroupStatus) into the "0: GroupDisabled" status.

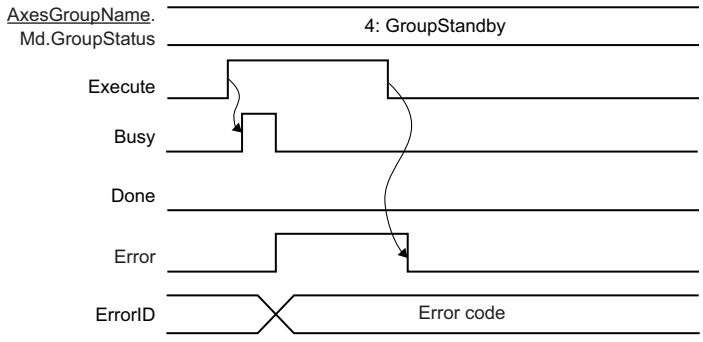
- An axes group cannot execute an operation FB when the axes group status (AxesGroupName.Md.GroupStatus) is the "0: GroupDisabled" status.
- MC_GroupDisable can be executed only when the axes group status (AxesGroupName.Md.GroupStatus) is the "4: GroupStandby" or "1: GroupErrorStop" status. If this FB is executed when the axes group status is "1: GroupErrorStop" and the axes group is in operation, it will transits to "0: GroupDisabled" status after stop completion. If this FB is executed when the axes group status (AxesGroupName.Md.GroupStatus) is other than the "4: GroupStandby" status or "1: GroupErrorStop" status, the error "Axes Group Status Incorrect (When Axes Group is Valid)" (error code: 3495H) will occur.
- When the axes group status(AxesGroupName.Md.GroupStatus) is set to "0:GroupDisabled", the configuration axes (AxisName.Md.UserInGroup) will be FALSE.
- When MC_GroupDisable is executed to the axes group with invalid axes group, Done becomes TRUE and ends.

■Timing chart

[When the operation is normally completed]



[When an error occurs]



■Details of setting items

- Done (Execution completion)

It turns TRUE when the axes group status (AxesGroupName.Md.GroupStatus) has turned to "0: GroupDisabled".

- Busy (Executing)

It turns TRUE during instruction execution. It turns FALSE after the axes group status (AxesGroupName.Md.GroupStatus) turns to "0: GroupDisabled".

- Error (Error)

It turns TRUE when an error occurs in this FB.

- ErrorID (Error code)

It returns error code of the error occurred in this FB.

Precautions

Axes group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.

1.6 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 power turns ON or when the PLC READY [Y0] turns ON.

Relevant variables/FB

Variable/Structure name	Name	Details
AxesGroupName.AxesGroupRef.		
GroupNo	Axes group No.	Sets the axes group No. 0: No setting 1 to 10000: Set axes group No.
AxesGroupName.Pr.		
Axis[1..16]	Configuration axis	Sets AxisRef of the axis which configures the axes group.
AxesGroupName.Md.		
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 AxisRef of the axis 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, the error "Axes Group No. Setting Duplication Error" (error code: 1A58H) will occur.

Axes group No. setting: 1 to 10000

The axes group whose axes group No. is "0" is regarded as an unset axes group, and it cannot be used for control.

■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 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.

The error "No axis" (error code: 1A99H) and the error "Axes Group Configuration Axis Calculation Cycle Incorrect" (error code: 1A59H) occurs for the following cases.

- When there is no configuration axis
- When the operation cycles of the configuration axes are mismatched.

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 ⇨ "Axis" ⇨ Right click ⇨ [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 ⇨ "Axis" ⇨ Right click ⇨ [New Data]

3. Add an axis to the configuration axes of the axes group.

[Axes group setting]

MEMO

2 AXIS MANAGEMENT FUNCTIONS

2.1 Technical 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

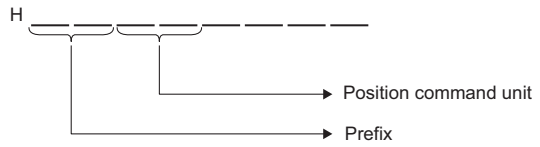
For the setting methods, refer to Help of the engineering tool.

Variable/Structure name	Name	Details
AxisName.Pr. AxesGroupName.Pr.		
Unit_Position	Position command unit	Sets the position command unit to be used in the motion control.
Unit_Velocity	Velocity command unit	Sets the velocity command unit to be used in the motion control.
Unit_PositionString	Position command unit character 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).
AxisName.Md. AxesGroupName.Md.		
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 can be set as the follows.

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 AxisName(AxesGroupName).Pr.Unit_PositionString.

■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(1×10^0).

Setting value	Prefix
H00	1×10^0
HFD	1×10^{-3} (m)
HFA	1×10^{-6} (μ)
HF7	1×10^{-9} (n)

Ex.

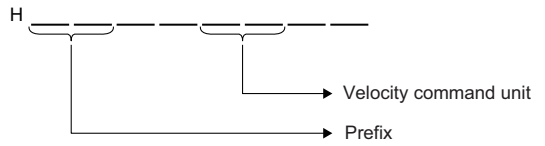
Setting value of AxisName(AxesGroupName).Pr.Unit_Position and display examples of AxisName(AxesGroupName).Md.Unit_PositionDisplay

AxisName(AxesGroupName).Pr.Unit_Position	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 AxisName(AxesGroupName).Pr.Unit_Position is HFD010000, the position will be regarded as 1.0 mm.

AxisName(AxesGroupName).Pr.Unit_Velocity



■Setting value of the velocity command unit

Setting value	Velocity command unit
H03	s
H47	min

■Setting value of prefix

Setting value	Prefix
H00	1×10^{0}
HFD	1×10^{-3} (m)
HFA	1×10^{-6} (μ)
HF7	1×10^{-9} (n)

Ex.

Setting value of the AxisName(AxesGroupName).Pr.Unit_Velocity and display examples of AxisName(AxesGroupName).Md.Unit_VelocityDisplay

AxisName(AxesGroupName).Pr.Unit_Velocity	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 AxisName(AxesGroupName).Pr.Unit_Position is HFD010000 and AxisName(AxesGroupName).Pr.Unit_Velocity is HFD000300, [mm/ms] is displayed on AxisName(AxesGroupName).Md.Unit_VelocityDisplay.
If AxisName(AxesGroupName).Pr.Unit_Position is HFF000000 (An arbitrary unit character string), number of displayable characters from the beginning out of the position command unit character strings is displayed on AxisName(AxesGroupName).Md.Unit_VelocityDisplay.
If "1" is set in the program when AxisName(AxesGroupName).Pr.Unit_Velocity is HFD000300, the velocity will be regarded as 1.0 [position command unit]/ms.

Ex.

Setting value of AxisName(AxesGroupName).Pr.Unit_Position, AxisName(AxesGroupName).Pr.Unit_Velocity and display example of AxisName(AxesGroupName).Md.Unit_VelocityDisplay

AxisName(AxesGroupName).Pr.Unit_Position	AxisName(AxesGroupName).Pr.Unit_Velocity	AxisName(AxesGroupName).Md.Unit_VelocityDisplay
HFD010000	HFD000300	[mm/ms]

Combination of command units during multiple axes positioning control

Set command units of the axes group and the interpolation axis to be matched.

When the command units are mismatched, specify the input value of FB as shown below.

- For the input regarding position in multiple axes positioning control (Position, Distance input, etc.), the value based on the position command unit of the each interpolation axis is required to specify. Refer to the following for details.
  ☞ Page 244 Position (Target position)/Distance (Movement amount)
- For the input of Velocity, Acceleration, Deceleration and Jerk in multiple axes positioning control, the value based on the velocity command unit used for each control is required to specify. Refer to the following for details.
  ☞ Page 245 Velocity (Velocity)
  Velocity command units used for each control are shown below.
  The following operations depend on interpolation controls.

■Linear interpolation control (MCv_MoveLinearInterpolateAbsolute, MCv_MoveLinearInterpolateRelative)

VelocityMode	Operation
0: VectorSpeed (Vector speed)	• The combined movement amount is calculated from the value of the current position and the Position/Distance input. The position command unit of the axes group and the interpolation axis are not affected. • Unit of the axes group is used for the velocity command unit in controling.
1: LongAxisSpeed (Long axis speed)	• The axis whose movement amount value is the largest is regarded as the long axis from the value of the current position and the Position/Distance input. The position command unit of the axes group and the interpolation axis are 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: ReferenceAxisSpeed (Reference axis speed)	The unit of the reference axis (First element of LinearAxes input) is used for the velocity command unit in controlling.

Refer to the following for details.

☞ Page 238 Linear interpolation control

■Circular interpolation control (MCv_MoveCircularInterpolateAbsolute,MCv_MoveCircularInterpolateRelative)

- Calculates circular path from the value of current position, AuxPoint input, and EndPoint input. The position command unit of the axes group and the the configuration axes are not affected.
- The unit of the axes group is used for the velocity command unit in controlling.
  Refer to the following for details.
  ☞ Page 247 Circular interpolation control
- When the combination of the position command unit between the axes group and the interpolation axis is different, the warning "Position Command Unit Mismatch Warning" (warning code: 0D08H) will occur at start and multiple start.
- When the combination is different between the speed command unit and on-going FB at multiple start, the warning "Speed Command Unit Mismatch Warning" (warning code: 0D1EH) will occur at multiple start.

Ex.

Operation when axes group unit and interpolation axis 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.

- Axis setting

Setting item	Setting details	Setting value
Position/Velocity command unit of the axes group	mm/ms	AxesGroupName.Pr.Unit_Position: HFD010000 AxesGroupName.Pr.Unit_Velocity: HFD000300
Position/Velocity command unit of the configuration axis 1	mm/s	AxisName.Pr.Unit_Position: HFD010000 AxisName.Pr.Unit_Velocity: H00000300
Position/Velocity command unit of the configuration axis 2	degree/min	AxisName.Pr.Unit_Position: HFD010000 AxisName.Pr.Unit_Velocity: H00000300

- FB input (MCv_MoveLinearInterpolateAbsolute, MCv_MoveLinearInterpolateRelative)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[100 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [100 100]
Velocity	1000
VelocityMode	0: VectorSpeed (Vector speed)

- Operation

Regards current position[0].

The position/velocity command unit of the axes group is used as the unit of Velocity.

Combined movement amount = $\sqrt{(100^2 + 100^2)}$ = 141 mm is calculated from the movement amount [100 100].

Each axis movement amount of every operation cycle is calculated from the combined movement amount 141 mm and the vector speed 1000 mm/ms.

The calculated each axis movement amount is commanded as the movement amount in the position command unit of each axis.

Precautions

- When the parameter is out of the range,the initial value is stored in AxisName(AxesGroupName).Md.Unit_PositionDisplay and AxisName(AxesGroupName).Md.Unit_VelocityDisplay. (the default value of position command unit: pulse, velocity command unit: pulse/s)
- Even if AxisName(AxesGroupName).Pr.Unit_Position, AxisName(AxesGroupName).Pr.Unit_Velocity and AxisName(AxesGroupName).Pr.Unit_PositionString is changed, the homing request is not TRUE.
- When the number of characters exceeds 31, the 32 or later character is not displayed in the position/velocity command unit display.
- When the character string is not input, the position command unit is not displayed.

2.2 Positioning Range

"Positioning range" is "-10000000000.0 ≤ positioning range < 10000000000.0". The range of AxisName.Md.SetPosition is determined by AxisName.PrConst.RingCount_UpperValue and AxisName.PrConst.RingCount_LowerValue.

Relevant variables

Variable/Structure name	Name	Details
AxisName.PrConst.		
RingCount_Enable	Ring counter enable selection	Selects the ring counter enable/disable. 0: Disabled 1: 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
AxisName.Md.		
SetPosition	Set position	Stores the current position address.*2 • 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 current position change value.
FeedMachinePosition	Feed machine position	Stores the current position address by the machine coordinate. • The accumulative value from the homing complete position is set. • The address is not changed even if the current position is changed.
CommandedPosition	Commanded position	Stores Position/Distance specified in the positioning FB.
ActualPosition	Actual position	Stores the actual current position. • The value of "the current position × driver unit conversion denominator / numerator" is set. For details, refer to the following. ☞ Page 361 Driver unit conversion function

*1 The value is not fetched when the ring counter is disabled.

*2 The stored value includes an error because a floating-point error occurs.

Set position

AxisName.Md.SetPosition can be set to an arbitrary ring address by setting AxisName.PrConst.RingCount_UpperValue and AxisName.PrConst.RingCount_LowerValue. The ring counter upper/lower limit value can be set within the range of -10000000000.0 to 10000000000.0.

Restrictions

The motion control function uses the real number data (floating-point data) for the axis current position and the command target position, etc. Therefore, it may include the truncation error.

Ex.

When the positioning of relative position specification such as MC_MoveRelative is executed repeatedly, it may cumulative the truncation error between the command current position and the specified movement value.
If the truncation error is a problem, execute the positioning of absolute position specification such as MC_MoveAbsolute.
Besides, the truncation error occurred by the real number data processing internal the function can be suppressed to set the number without after the decimal point to the real number type parameter related to the motion control function.

Ex.

When the truncation error is a problem in the following setting (A), the setting (B) becomes a change candidate.

• Setting (A)

Setting item	Setting detail
Position command unit*1	[mm]
Ring counter upper value	100.3 [mm]
Ring counter lower 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 detail
Position command unit*1	[μm]
Ring counter upper value	10300 [μm]
Ring counter lower value	-10700 [μm]
The minimum scale of the target position/movement amount specified by FB input	50 [μm]

*1 For details of the setting method, refer to the following.

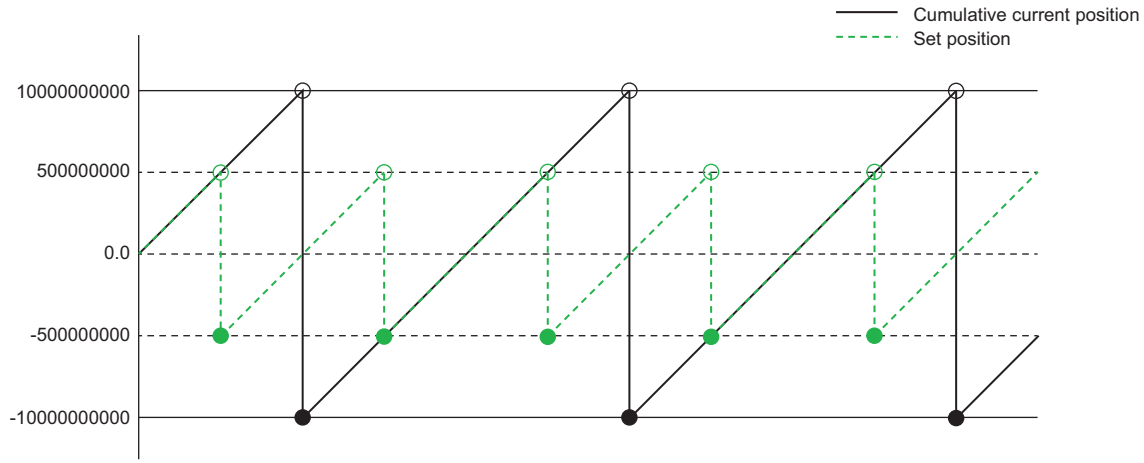
☞ Page 74 Technical Units

Control details

AxisName.Md.SetPosition to be the ring address is calculated based on 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/lower value.

Ex.

When the ring counter lower limit value is -500000000.0 and the ring counter upper limit value is 500000000.0, the 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 devices

The available range of positioning differs depending on the type of the positioning instruction.

- Absolute position specification: Within the range of the ring counter
- Relative position specification: Maximum movement amount | 10000000000.0 |

Precautions

When AxisName.PrConst.RingCount_Enable is "1: Enabled", error is checked.

If the ring counter upper/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

2.3 Velocity Range

Relevant variables

Variable/Structure name		Name	Details
AxisName.Md.			
	SetVelocity	Set velocity	• Stores the set output veocity.*4 • Stores the set velocity of the configuration axes during the axes group operation.*4
	CommandedVelocity	Commanded velocity	• Stores the commanded velocity of the positioning data which is being executed. • Stores "0" after the positioning is completed. • Stores "0" in AxisName.Md.CommandedVelocity of the configuration axes during the axes group operation.
	TargetVelocity	Target velocity	• Stores the actual target velocity whose override and velocity limit value are considered. • Stores "0" after the positioning is completed. • Stores "0" in AxisName.Md.TargetVelocity of the configuration axes during the axes group operation.
	ActualVelocity	Actual velocity	Stores the actual velocity
AxesGroupName.Md.			
	SetVelocity	Set velocity	• Stores the set output veocity during the axes group operation. The value becomes more than "0" as it is regardless of the movement direction of the configuration axes.*1 • Stores "0" after the positioning is completed.
	CommandedVelocity	Commanded velocity	• Stores the commanded velocity of the positioning data.*2 • Stores "0" after the positioning is completed.
	TargetVelocity	Target velocity	• Stores the actual target velocity whose override and velocity limit value are considered.*3 • Stores "0" after the positioning is completed.
	ActualVelocity	Actual velocity	• Stores the actual velocity. It is the vector speed of the actural velocity of the configuration axes. The value becomes more than "0" as it is regardless of the movement direction of the configuration axes. • Stores "0" when the axes group is invalid.

*1 When the reference axis velocity or the long axis velocity is specified in the linear interpolation control, stores the absolute value of the set velocity of the applicable axis.

*2 When the reference axis velocity or the long axis velocity is specified on VelocityMode in the linear interpolation control, stores the commanded velocity of the applicable axis.

*3 When the reference axis velocity or the long axis velocity is specified on VelocityMode in the linear interpolation control, stores the target velocity of the applicable axis.

*4 The stored value includes an error because a floating-point error occurs.

For details of the linear interpolation control, refer to the following.

☞ Page 238 Linear interpolation control

Velocity set range

The following table describes the velocity range that can be specified in each parameter. For the set range when using the override function, refer to the following.

☞ Page 340 Override Function

Name	Range	Condition
Target velocity	0, +0.0001*2 to +2500000000.0*1	When positioning control
	0, ±0.0001*2 to ±2500000000.0*1	When velocity control

*1 If the set velocity is "0" when the FB is executed in the buffer mode, it will be the previous commanded velocity.

*2 The lower limit value of the target velocity is limited by the following restrictions to carry out floating-point operation.

- If the speed that is converted from target velocity to operation cycle is less than 0.00001, the error "Out of Speed Range" (error code: 1A4DH) (if the speed is changed, the warning "Out of Speed Range Warning" (warning code: 0D0FH) occurs) 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 AxisName(AxesGroupName).Pr.Unit_Position or AxisName(AxesGroupName).Pr.Unit_Velocity.

Ex.

AxisName(AxesGroupName).Pr.Unit_Position H00000000(pulse),
AxisName(AxesGroupName).Pr.Unit_Velocity H00000300(pulse/s)
If target velocity is specified to 0.0001 at operation cycle 0.5ms
Operation cycle converted speed = 0.0001 pulse/s ÷ 1000 × 0.5ms = 0.00000005 pulse ...the error "Out of Speed Range"(error code: 1A4DH)
If AxisName(AxesGroupName).Pr.Unit_Position is changed to HFD000000(× 10^{-3}pulse) and target velocity is changed to 0.1,
Operation cycle converted speed = 0.1 × 10^{-3} pulse/s ÷ 1000 × 0.5ms = 0.00005 × 10^{-3} pulse

2.4 Servo ON/OFF

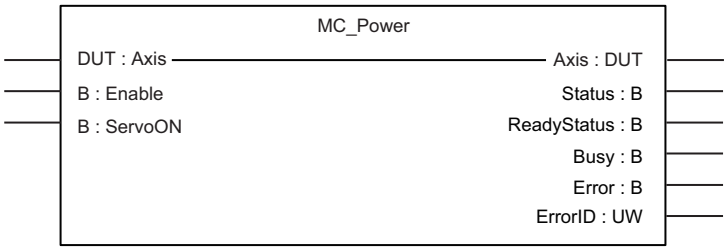
Relevant variables/FB

This function executes servo ON/OFF of the real axis connected to the motion system.

The servo ON enables the operation of the real axis.

Variable/Structure name		Name	Details
AxisName.Md.			
	Driver_ReadyOn	Driver ready ON status	Sets TRUE when the connected driver status (AxisName.Md.Driver_State) is as follows. 5: SwitchedOn 6: OperationEnable 7: QuickStopActive
	Driver_ServoOn	Driver servo ON status	Sets TRUE when the connected driver status (AxisName.Md.Driver_State) is as follows. 6: OperationEnable 7: Quick StopActive

MC_Power

Item	Description
Function overview	Switches a specified axis to the operation possible status.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
10	6	Subroutine type	Real-time execution

■Function description

This FB initializes the information of a selected axis and switches the axis status to the operation possible status.

While Enable and the ServoON input are TRUE, the selected axis is switched to the operation possible status.

Busy turns TRUE when the processing is started.

Status turns TRUE when the drive unit has been switched to the operation possible status.

When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID.

For details of error codes, refer to the following.

☞ Page 606 List of Error Codes

The axis status (AxisName.Md.AxisStatus) of the AXIS_MONI structure transits from "0: Disabled" to "4: Standstill".

For the axis status (AxisName.Md.AxisStatus), refer to the following.

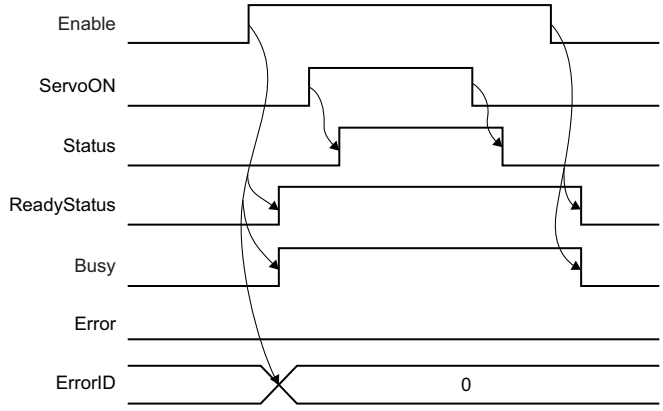
☞ Page 35 State transition

■Restrictions

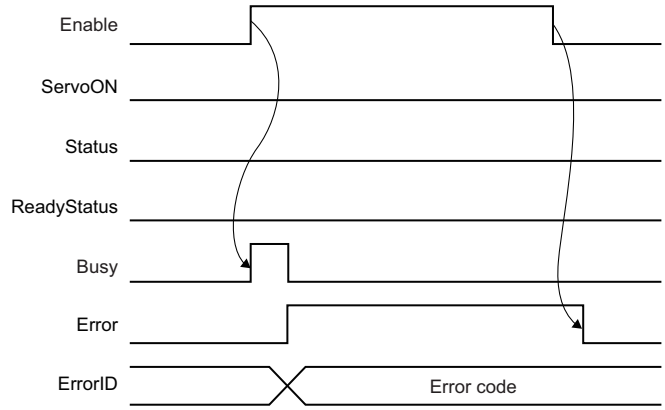
Before executing this FB, set the axis No. (AxisNo) of the AXIS_REF structure.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Imput import⎍: Always

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	⎍	—	Omission not possible	☞ Page 641 Axis variables For MC_Power, the axis information is established when the command is called for the first time after switching to the PLC READY [Y0] ON.

■Input variables

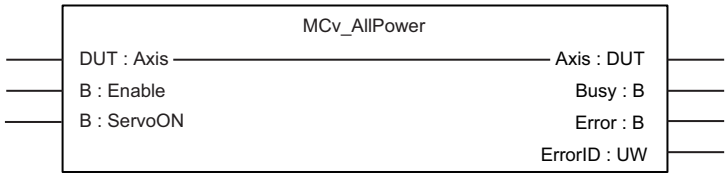
Import ⎍: Always

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	While Enable input is TRUE, the axis control is valid.
Servo ON request	ServoON	BOOL	⎍	TRUE, FALSE	FALSE	Specifies the servo ON request.

■Output variables

Name	Variable name	Data type	Default value	Description
Operable	Status	BOOL	FALSE	Indicates that the servo amplifier is ready for operation.
Ready ON status	ReadyStatus	BOOL	FALSE	Indicates the ready ON/OFF status.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error ID	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MCv_AllPower

Item	Description
Function overview	Switches every axis to the operation possible status.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
10	4	Subroutine type	Real-time execution

■Function description

This FB initializes the information of every axis and switches the axis status to the operation possible status.

While Enable and the ServoON input are TRUE, every axis is switched to the operation possible status.

Busy turns TRUE when the processing is started.

Ignores the setting of Axis.

When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID.

For details of error codes, refer to the following.

☞ Page 584 TROUBLESHOOTING

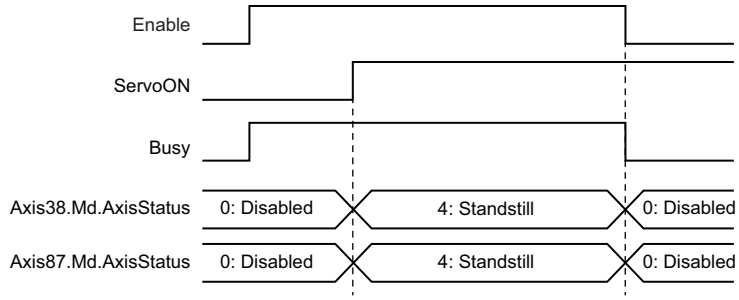
■Restrictions

If the axes specifying MC_Power, MC_Power command is given priority at switching to operable status.

■Timing chart

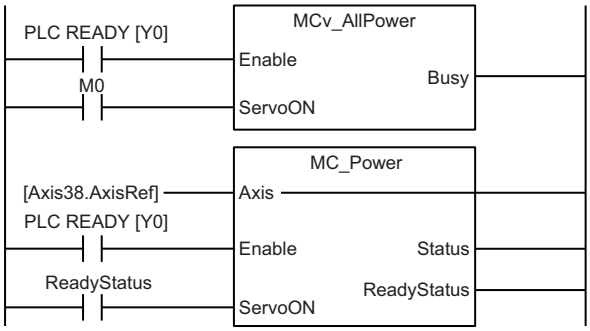
Ex.

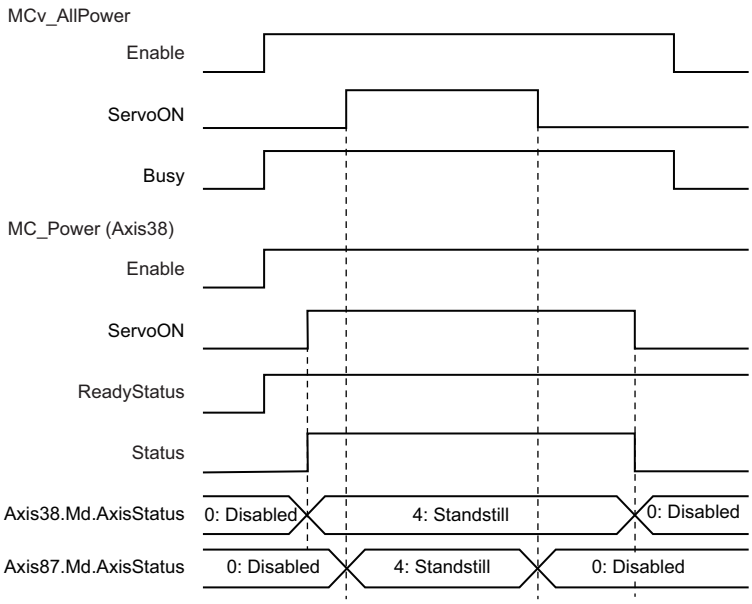
When the axis 38 and 87 are set as real axes



Ex.

When MC_Power is used together to the axis 38





■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission possible	☞ Page 641 Axis variables The setting under MCv_AllPower is ignored.

■Input variables

Import: ⎍: Always

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	While Enable input is TRUE, the axis control is valid.
Servo ON request	ServoON	BOOL	⎍	TRUE, FALSE	FALSE	Specifies the servo ON request.

■Output variable

Name	Variable name	Data type	Default value	Description
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.

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 driver status, refer to the following.

☞ Page 90 Control details

■MC_Power input/output and servo ON/OFF status

The servo ON/OFF status and the driver status of the selected axis can be switched as the follows by inputting Enable and ServoON of MC_Power (operation possible).

Input variables		Output variables		Servo ON/OFF status	Driver status (AxisName.Md.Driver_State)
Enable	ServoON	ReadyStatus	Status		
TRUE	ON	ON	ON	Servo ON	6: OperationEnable
	OFF	ON	OFF	Servo OFF	5: SwitchedOn
FALSE	ON	OFF	OFF	Servo OFF	3: SwitchOnDisabled
	OFF	OFF	OFF	Servo OFF	3: SwitchOnDisabled

■Input/Output of MCv_AllPower and servo ON/OFF status

The servo ON/OFF status and the driver status of all real axes can be switched as follows by inputting Enable and ServoON of MCv_AllPower.

Input variables		Servo ON/OFF status	Driver status
Enable	ServoON		
TRUE	ON	Servo ON	6: OperationEnable
	OFF	Servo OFF	5: SwitchedOn
FALSE	ON	Servo OFF	3: SwitchOnDisabled
	OFF	Servo OFF	3: 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 specification of the driver.
- While the drive unit error occurs, since MC_Power/MCv_AllPower has been sent to the driver, Enable and ServoON are not required to be turned from OFF to ON again.

Point

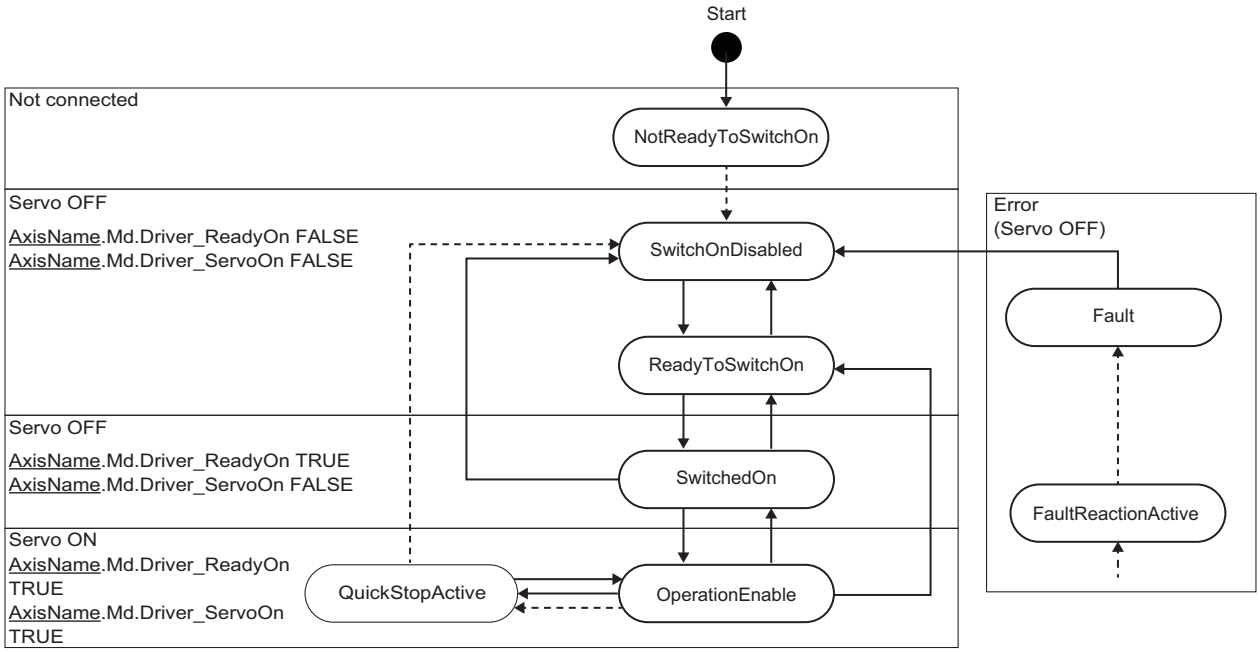
To individually execute servo OFF when using MCv_AllPower, use MC_Power together. When MCv_AllPower and MC_Power are used together, the MC_Power command is given priority.

Driver state transition

The connected driver device as an axis performs operation according to the state transition defined by the CiA402 drive profile shown below. The motion system determines whether the driver is being servo ON or OFF status based on the current driver status.

The current driver status can be monitored by AxisName.Md.Driver_State.

For details of operation in each status, refer to the connected driver manuals.



Precautions

- When MC_Power calls the instruction first after switching to the PLC READY [Y0]ON, the axis information is determined. Even if the axis information is changed while Enable is FALSE, the change is not reflected.
- Do not set two or more FBs of MC_Power for one axis. The operation is not guaranteed if those are set.
- If MC_Power is executed to the virtual axis, both Status and ReadyStatus are turned ON regardless of the ServoON input.

2.5 Follow Up

In an axis which has the current position (Position actual value) as the slave object, 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.

• [For 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.

For the following cases, the follow up is executed when servo status is ON.

• MC_MoveVelocity/MC_TorqueControl are in execution.

• The driver control mode of the driver device is connected by motion system axis control unsupported mode.

[For Real Encoder axis/Virtual 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.

Relevant variables

Variable/Structure name		Name	Details
AxisName.PrConst.			
	Encoder_CounterDisableSignal	Counter disable signal	A signal to switch to the counter disable. Only "HighLevel" or "LowLevel" can be select for Detection (signal detection method). Only "0" can be specified to CompensationTime (Compensation time [s]). "0.0 to 5.0" can be specified to FilterTime (Filter time [s]). If another method is selected, the error "Out of Parameter Range (Axis)" (error code: 1D80H) will occur.
AxisName.Md.			
	FollowupDisable	Follow up disabled	Displays the follow up disable status. When it is disabled, the follow up is not executed. FALSE: Follow up enbled TRUE: Follow up disabled
	Io_PosActualValue	Object data _PosActualValue	Follow up can be used in the axis which has this slave object.
AxisName.Cd.			
	FollowupDisable	Followup disabled	Disables follow up. FALSE: Not execute TRUE: Execute the followup disable request
	Encoder_CounterDisable	Counter disabled	Switches to the counter disable. FALSE: Not execute TRUE: Execute the counter disable request

Disabling follow up

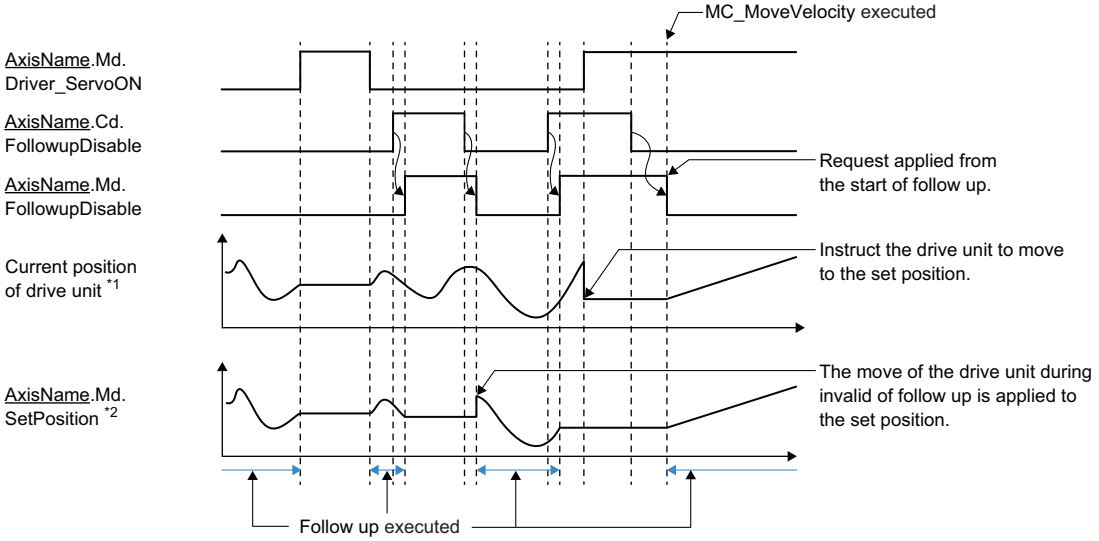
The follow up enabled/disabled can be switched for each axis (default status: enabled). Input from the slave device (the current position) is disabled and not reflected in the set position by switching the follow up to enabled.

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

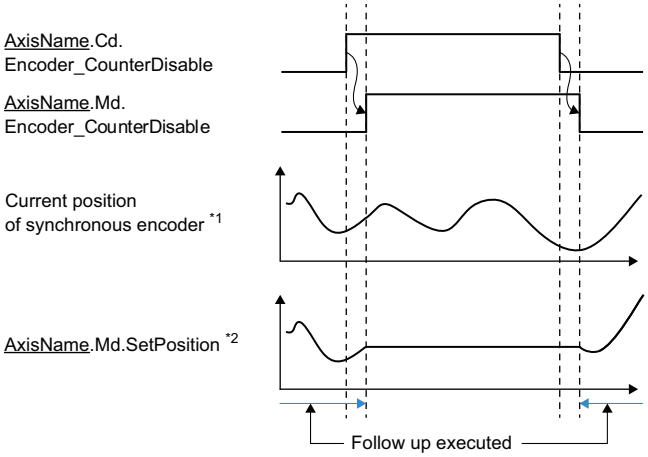
AxisName.Md.FollowupDisable turns TRUE by changing AxisName.Cd.FollowupDisable to TRUE, and the follow up is disabled.



*1 When checking with slave label
*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

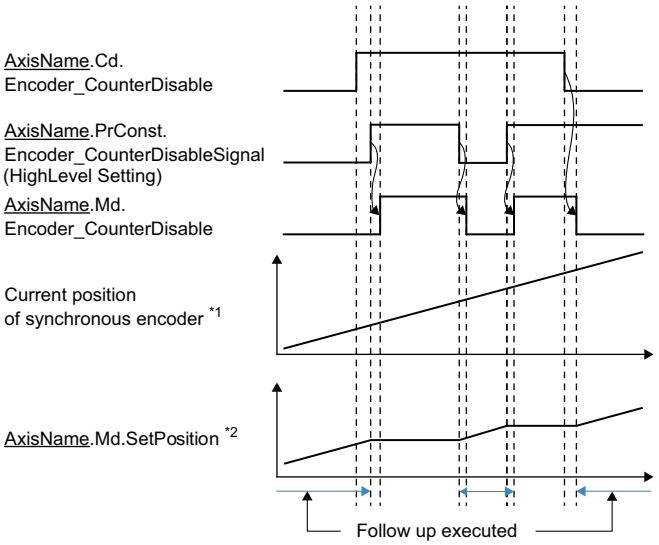
For real encoder axis/virtual encoder axis

If AxisName.PrConst.Encoder_CounterDisableSignal is "no setting", AxisName.Md.Encoder_CounterDisable turns TRUE by setting AxisName.Cd.Encoder_CounterDisable TRUE and the input from the synchronous encoder will be disabled.



*1 When checking with the slave label
*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

When AxisName.PrConst.Encoder_CounterDisableSignal is set, while AxisName.Cd.Encoder_CounterDisable is TRUE, the counter disabling signal will be valid. AxisName.Cd.Encoder_CounterDisable becomes TRUE while the signal is in detection, and becomes the counter disable. While AxisName.Cd.Encoder_CounterDisable is FALSE, the counter disable signal becomes invalid.



*1 When checking with the slave label
*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

Precautions

[Only for real drive axes]

- 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 within 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 within 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 in order to transmit the command under follow up in the single axis synchronous control to the slave axis.

2.6 Absolute Position Control

This function restores the current position of axes.

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 101 Current position restoration for each axis type

The absolute position data used in the absolute position 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 the slave device is connected.

Whether restoration is carried out with the maintained absolute position data or not can be specified in the absolute position control setting of the axis parameter. For details, refer to the following.

☞ Page 96 Current position restoration

Relevant variables

Variable/Structure name	Name	Details
AxisName.PrConst.		
PosRestoration_AbsPosEnable	Absolute position management setting	Sets the absolute position control setting. 0: ABSDisabled (Not use the absolute position system) 1: Enabled (Use the absolute position system) -1: Auto Automatic setting (Acquire from connected device)
PosRestoration_AbsPosBase	Absolute position reference setting	Sets the current position to be the basis at the current position restoration in order to use the absolute position system. 3: FeedMachinePosition (Feed machine position)
AxisName.Pr.		
Homing_Required	Homing required or not	Sets FALSE when the homing is not required. If FALSE is set, the homing request will not turn TRUE at the current position restoration. FALSE: Homing is unnecessary TRUE: Homing is necessary
AxisName.Md.		
Homing_Required	Homing required or not	Displays whether the axis requires the homing or not. If FALSE is set, the homing request will not turn 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: NotExecute (Not executed) 1: WaitingRequest (Waiting restoration request) 2: RestoredInIncSystem (Restoration completed by incremental system) 3: RestoredInAbsSystemUnHomed (Restored in absolute position system (Homing uncompleted)) 4: RestoredInAbsSystem (Restored in absolute position system) "0: NotExecute" is displayed when the slave device is disconnected.
Homing_Request	Homing request	The timing of turning TRUE differs depending on the absolute position control setting. For details, refer to the following. ☞ Page 98 Homing request Turns FALSE when the machine homing is completed.
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. • The address is changed to the current position change value when the current position is changed.
FeedMachinePosition	Feed machine position	Stores the current position address by the machine coordinate. • It is the cumulative current value from the homing completion position. • The address is not change even though the current position is changed.
System.Md.		
BackupRestoreStatus	Backup restore information	Displays the status of backup restore. 0: Backup restore not executed 1: Backup stop required 2: Backup stop 3: Backup stop cancelled 4: Restored data saving 5: Restored data saving completed
System.Cd.		
BackupRestore	Backup restore request	Executes backup stop and restored data saving. 0H: No request ABCDH: Backup stop request FFFEH: Restored data saving request

Current position restoration

Specify whether the absolute position system is used for the current position restoration or not in the absolute position control setting.

Absolute position control setting	Setting value	Details
Not use the absolute position system	0: ABSDisabled	☞ Page 96 Incremental system
Use the absolute position system	1: Enabled	☞ Page 97 Absolute position system
Automatic setting (Acquire from connected device)	-1: Auto	☞ Page 97 Connected device setting

"-1: Auto" can be set when the connected device has the ENCODER_ABS_STATUS object.

When "-1: Auto" is not set, the connected device side setting and the motion system side setting must be matched. When those are mismatched, normal current position control cannot be executed. (If the connected device has the ENCODER_ABS_STATUS object and the settings are mismatched, the error "Absolute Position Management Setting Mismatch" (error code: 1A9AH) will occur at the current position restoration.)

• Setting example

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 MR-J5(W)-G. In the motion system, select "1: Use the absolute position system" for "absolute position control setting" in the real drive axis which uses 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 101 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.

Incremental system

This system restores the current position without using the absolute position data.

When the current position restoration has been completed, the axis current position (cumulative current position and feed machine position) becomes "0", and the homing request turns TRUE. (The set position may not become "0" depending on the ring counter setting. (☞ Page 79 Positioning Range))

When restoration is completed, the axis current position restoration status is "2: RestoredInIncSystem".

If the machine position establishment with the slave device is not required, set FALSE in the homing request setting. This prevents the homing request from turning 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 feed machine position) is restored based on backed up absolute position data. When restoration is completed, the axis current position restoration status becomes "4: RestoredInAbsSystem".
However, if the warning "Absolute Position Data Incorrect Warning" (warning code: 0D00H) has been detected at restoration, the axis current position restoration status becomes "3: RestoredInAbsSystemUnHomed". The current position is restored with the same content as the incremental system and the homing request turns 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, the axis current position restoration status becomes "4: RestoredInAbsSystem".)
When the absolute position system is used, the restoration content differs depending on the axis type. For details, refer to the following.
☞ Page 101 Current position restoration for each axis type
The warning "Absolute Position Data Incorrect Warning" (warning code: 0D00H) occurs in the following case.

- The absolute position data is illegal at the current position restoration by the following causes

  - The axis type has been 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, etc.
  - 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.

[Only for real drive axes]

- "Absolute position erased" is detected in the driver side.
- "Polarity (607EH)" b7: position polarity of the driver object is changed.
- "HomeOffset(607Ch)" of the driver object is changed.
- The connected driver device is changed.
- The encoder resolution of the driver device is changed.

[Real Encoder axes (via drive unit) only]

- "Absolute position erased" is detected in the scale measurement encoder.
- The encoder resolution of the scale measurement encoder is changed.

Connected device setting

The absolute position system setting is taken from the connected device with the ENCODER_ABS_STATUS object by the SDO communication, and the current position is restored.
Set the absolute position system setting in the connected device side.
If the connected device does not have the ENCODER_ABS_STATUS object, it operates as the incremental system without an error.

Homing request

The homing request will be TRUE in the following cases.

Point

The reason why the homing request became TRUE is recorded in event history.

Absolute position control setting[*1]	Cause		Detection timing[*2]
Common	The axis type is changed.		At the current position restoration
	The machine homing is started. (The homing request flag will not become FALSE unless the machine homing is normally completed.)		At the machine homing start
	The axis driver unit conversion (numerator/denominator) is changed.		At the PLC READY [Y0] ON
Not use the absolute position system	The system power is turned ON or reset.		At the system power ON/reset
	The current position restoration is executed.		At the current position restoration
Use the absolute position system	Since the absolute position data has been erased by the memory error, etc., the warning "Absolute Position Data Incorrect Warning" (warning code: 0D00H) is occuring.		At the current position restoration
	Change of the driver and the motor encoder is detected.		
	Only real drive axis	"Polarity (607EH)" b7: position polarity of the driver object is changed.	
		An electric gear of the driver side is changed.	
		"Absolute position erased" is detected in the driver side.	At the current position restoration and cause occuring

*1 For the "-1: Auto" setting, refer based on the connected device setting.

*2 When the homing required setting is FALSE, the homing request will not become TRUE even though the cause is occurring at the current position restoration.

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 linked to the axis variable and the axis type. At the current position restoration, if the setting values do not match with the axis variable and the axis type of the absolute position data, the absolute position data will be discarded. (The warning "Absolute Position Data Incorrect Warning" (warning code: 0D00H) occurs.)
Backup is executed while the homing request is FALSE. (When the homing request becomes TRUE, the absolute position data is discarded.)

- Storage folder and file name

Storage folder: /Ich
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.
Memory capacity per one axis for each axis type is shown below.

Axis type	Memory capacity [byte/axis]
Real drive axis	220
Real encoder axis	170
Virtual drive axis	90
Virtual encoder axis	170
Virtual linked axis	90

Memory capacity used for the absolute position data can be specified in System.PrConst.AddonAbsSystem.BackupRamSizeMax.
If the file size required for backup exceeds specified memory capacity when the current position value of each axis is restored, the error "Insufficient Current Position Backup Capacity" (error code: 1ADFH) occurs and the target axis is not restored completely. Reconsider the memory capacity and carry out software reboot.

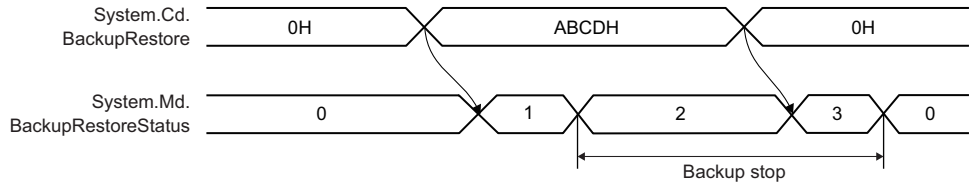
Saving (backup) and restoration (restored) of the absolute position data

The absolute position data maintained inside the motion system can be data saved/restored by saving/restoring functions of the engineering tool, etc. 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. Do not turn OFF the power of the motion system during backup or restoration.
After restring is completed, software reboot is required to enable the restored absolute position data. (The backup is at a standstill and it can not be cleared until software reboot is carried out.)
For real drive axis, the homing request becomes TRUE when the restored absolute position data is different from HomeOffset (home position), the device, and the resolution of the connected driver.

Ex.

When saving absolute position data to an SD card

1. Set "ABCDH: backup stop request" in System.Cd.BackupRestore.
2. Confirm System.Md.BackupRestoreStatus changes to "1: backup stop executed" and "2: backup stop".
3. Transfer absolute position data "/lch/axis_abs.bin" to an arbitrary folder in an SD card by using file transfer (Execution data backup).
4. Set "0H: No request" to System.Cd.BackupRestore after confirming file transfer (Execution data backup).
5. Confirm System.Md.BackupRestoreStatus changes to "3: backup stop cleared" and "0: backup restore not executed".



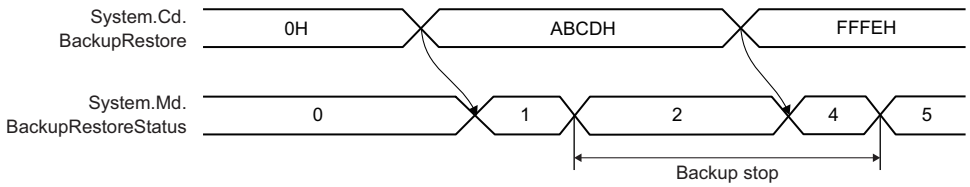
Precautions

The current positon of moved axes after backup stop is not saved.
To execute backup after confirming all axes stop is recommended.

Ex.

When restoring absolute position data saved in an SD card

1. Set "ABCDH: backup stop request" to System.Cd.BackupRestore.
2. Confirm System.Md.BackupRestoreStatus changes to "1: backup stop executed" and "2: backup stop".
3. Transfer the "axis_abs.bin" file backuped in an arbitrary folder in an SD card by by using file transfer (Execution data backup).
4. Set "FFFEH: Restored data saving request" to "System.Cd.BackupRestore" after confirming file transfer (Execution data backup).
5. Confirm System.Md.BackupRestoreStatus changes to "4: Restored data saving" and "5: Restored data saving completed".
6. Carry out software reboot and enable restored data.



Precautions

After saved data required, the absolute position data of motion system may break if software reboot is carried out or power is supplied again before System.Md.BackupRestoreStatus changes to "5: Restored data saving completed". Carry out restoration again.

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 the following.

Current position	Incremental system	Absolute position system
		PosRestoration_AbsPosBase is "3: FeedMachinePosition"
Feed machine value	Restored in "0".	Differs depending on the restoration method. For details, refer to the following. ☞ Page 94 Absolute position system
Cumulative current position	The same value as restored feed machine position.	
Set position	A value obtained by rounding the cumulative current value with the ring counter range.	

■Current position restoration timing

When an object that constructs the absolute position system to execute the 64-bit current position restoration is required, restoration is automatically executed at the initial communication with the slave device. For details of the absolute position system to execute the 64-bit current position restoration, refer to the following.

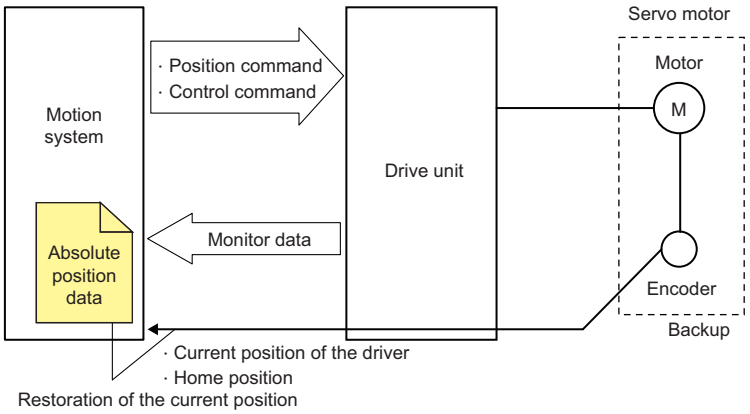
☞ Page 94 Absolute position system

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 of the absolute position system setting of the drive unit side, refer to each drive unit manual.

The current position restoration of the absolute position system can be classified into the following three methods.

Current position restoration method	Basis position	Description	Remark
32-bit restoration (Driver current position restoration)	Home position	Correctly executes the current position restoration within the signed 32-bit integral number range [driver-based] from the reference position. Restores based on the driver current position (Position actual value) by using a part of the backup data of the motion system.	—
64-bit restoration (Driver 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. Restores based on the driver movement amount by using backup data of the motion system.	Some objects are required to execute 64-bit restoration. If the object are not set, 32-bit current position restoration will be executed.
	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. Restores based on the driver home position and the position at restoration by using a part of the backup data of the motion system.	Restoration is executed based on the home position when the connected slave device has been changed.

*1 Actual restoration possible range is - ((multiple revolution counter maximum value) / 2 × (encoder resolution)) to ((multiple revolution counter maximum value) / 2 × (encoder resolution) - 1).

Unit of the restoration possible range from the reference position in 64-bit restoration

- Driver-based or motor encoder-based
- For the motor encoder-based unit, the driver side additional electric gear (Gear Ratio) is required for the Motion module to execute the current position restoration. The restoration possible range is (the driver-based unit range) × (Gear Ratio).

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), or 64-bit restoration (home position)" is recorded in the event history.

The following shows objects required to construct the absolute position system of 64-bit restoration.

Setting item AxisName.PrConst.SlaveObject(STRUCT(SLAVE_OBJECT_REAL))	Setting description
vSyncAbsCounter (SyncAbsCounter)	Specifies the object ID storing the current encoder multiple revolution counter.
vSyncCycleCounter (SyncCycleCounter)	Specifies the object ID storing the current encoder positon within one revolution.
vHomeCycleCounter (HomeCycleCounter)	Specifies the object ID storing the encoder positon 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 positon 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.

If any one of the above parameters is not specified, 32-bit restoration is executed.

Precautions

Even if the above parameters have been specified, an error "Driver Restoration Data Incorrect" (error code: 1AE0H) will occur and the current position restoration will not be completed when the Max ABS counter object is not nth power of zero or two. Execute reconnecting after correcting the parameter of the drive unit.

[When using MR-J5(W)-G]

The following explains the settings and the current position restoration method when the absolute position system is constructed using 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, the error "Driver Restoration Data Incorrect" (error code: 1AE0H) may occur. Correct the following.
  When the resolution of the connected encoder is 2 to the power of n, set the electronic gear of 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 MR-J5(W)-G to "1 : 1".
- The motion system setting
  Select "-1: Auto" or "1: Enabled" in "Absolute position control setting" in the real drive axis whose connected device is MR-J5(W)-G.
- The 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 in "0".	Restores based on the synchronous encoder movement amount by using backup data of the motion system.
Set position	A value which rounds the restored cumulative current position with the ring counter.	

The restoration method for the absolute position system is depending on "the real encoder axis type" 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-based] from the backup position.	Only the synchronous encoder connected to the drive unit can be used. For details of the setting, refer to the following. ☞ Page 32 Axis

*1 The actual restoration possible range is - ((multiple revolution counter maximum value) / 2 x (encoder resolution)) to ((multiple revolution counter maximum value) / 2 x (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 in "0".	Restored in the backup data value.
Set position	A value which rounds the restored cumulative current value with the ring counter.	

■Current position restoration timing

Current position restoration is executed at the axis variable initialization. For details of the axis variable initialization timing, refer to the following.

☞ Page 34 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 in "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.
Set position	A value which rounds the restored cumulative current position with the ring counter.	

■Current position restoration timing

Executes the current position restoration as AxisName.Cd.Encoder_Connect turns TRUE.

Virtual linked axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored in "0".	Restored in the backup data value.
Set position	A value which rounds the restored cumulative current value with the ring counter.	

■Current position restoration timing

Current position restoration is executed at the axis variable initialization. For details of the axis variable initialization timing, refer to the following.

☞ Page 34 Axis variable initialization timing

Precautions

- In the absolute position control setting, when the connected device side setting and the motion system side setting are mismatched, the absolute position control may not be executed correctly. (If there is the ENCODER_ABS_STATUS object in the connected device, the error "Absolute Position Management Setting Mismatch" (error code: 1A9AH) will occur at current position restoration.)
- If TRUE is set in the homing required setting, address information stored in the motion system is not guaranteed.
- During backup/restoration by the engineering tool, do not write in System.Cd.BackupRestore.

3 BASIC FUNCTIONS

3.1 Operation Cycle

In the motion system, operation processing related to the motion control is performed in the fixed cycle (operation cycle). This section describes operation cycles which can be set in the motion system.

Relevant variables

Variable/Structure name		Name	Details
System.PrConst.			
	OperationCycle[1..1].Cycle	Operation cycle setting	Sets the first operation cycle. The following values can be set. 0: Synchronizes with the basic cycle of network -11: Synchronizes with the basic cycle of network (same as "0") -12: Synchronizes with the middle speed cycle of network -13: Synchronizes with the low speed cycle of network -100256 to -100001: Multiplication by n of the system basic processing (1 to 256)
	BuffermemoryRefreshCycle	Buffer memory refresh cycle setting	Sets the buffer memory refresh cycle. The following values can be set. 0: The nth operation cycle ("n" is the slowest operation cycle among operation cycles whose setting is enabled.) -11: Synchronizes with the basic cycle of network -12: Synchronizes with the middle speed cycle of network -13: Synchronizes with the low speed cycle of network -118192 to -110001: Multiplication by n of the first operation cycle (1 to 8192)
	Link_MotionStationRefreshType	Refresh method of send/receive data at motion control station	Sets the send/receive data refresh method of the motion syncronization station.
	FastOperationMode*1	High-speed mode setting	Switch the operation process of the entire system to high-speed mode. 50EFH: High-speed mode Other than the above: Normal mode
AxisName.PrConst.			
	OperationCycle	Control cycle setting	0: Operates at the first operation cycle
	FastOperationMode*1	High-speed mode setting	Switch the operation process of the set axis to high-speed mode.*2 5FE2H: High-speed mode Other than the above: Normal mode
System.Md.			
	SystemBaseCycle_Counter	System basic cycle counter	Counts up every time when executing system basic processing.

*1 In order to switch to the high-speed mode, set both the system parameter and axis parameter to the high-speed mode. If both system parameter and axis parameter are not set to the high-speed mode, it is not switched to the high-speed mode.

*2 Only the real drive axis is supported.

System basic cycle

The system basic cycle is a basic cycle of the motion control such as operation cycle processing. System basic cycle settings are shown below.

System basic cycle is the same as the first operation cycle.

Operation cycle settings

Operation cycle is set in System.PrConst.OperationCycle[1..1].

"Synchronize with the network setting" must be set to control real axes connected to the network.

The following table shows a reference of the operation cycle settings.

Operation cycle	RD78G4	RD78G8	RD78G16	RD78G32	RD78G64	RD78GHV	RD78GHW
31.25 μs	—					—*1	
62.5 μs	1 axis					2 axes*2	
125 μs	4 axes					14 axes	
250 μs	4 axes	8 axes	14 axes			20 axes	
500 μs	4 axes	8 axes	16 axes	20 axes		32 axes	
1.0 ms	4 axes	8 axes	16 axes	32 axes		64 axes	
2.0 ms	4 axes	8 axes	16 axes	32 axes	64 axes	100 axes	
4.0 ms	4 axes	8 axes	16 axes	32 axes	64 axes	128 axes	
8.0 ms	4 axes	8 axes	16 axes	32 axes	64 axes	128 axes	256 axes

*1 Up to 2 axes can be connected by using the high-speed mode.

*2 Up to 4 axes can be connected by using the high-speed mode.

Operation cycle assignment

An operation cycle of the axis can be set by AxisName.PrConst.OperationCycle.

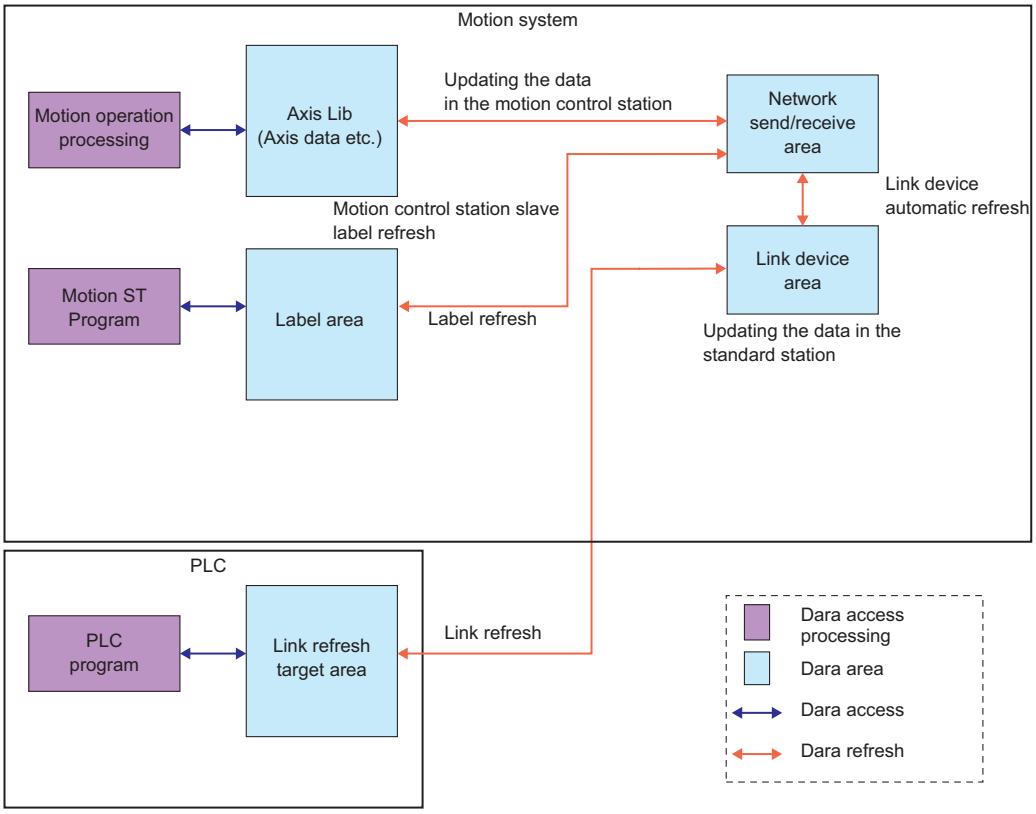
Send/Receive data refresh of network connected devices

Network connected devices are distinguished between stations controlled by the motion system and standard stations, and those data refresh methods are different.

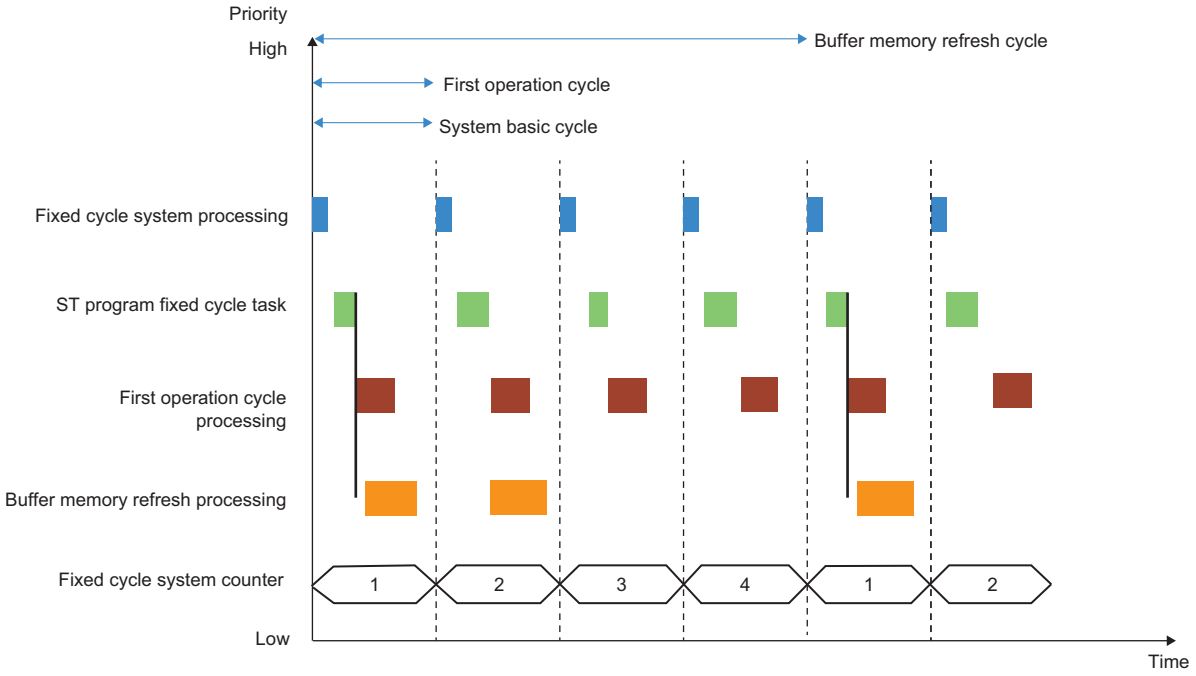
Station	Explanation
Motion syncronization station	• The motion system refreshes data by directly synchronizing the network send/receive with the operation cycle. • The target link device is not refreshed.
Standard station*1	• Stations other than motion syncronization stations are standard stations. • The programmable controller refreshes data. • The link device is refreshed by synchronizing with the programmable controller.

*1 Control by the programmable controller

The following shows the relation of data areas and the refresh.



The internal process timing of the motion system is shown below.



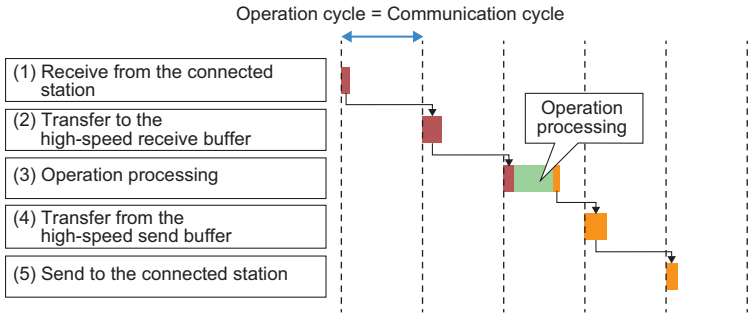
Motion synchronization station

Select a data refresh method from the following for the station which executes the motion control as a real axis. It can be set in System.PrConst.Link_MotionStationRefreshType. It is common in all of the operation cycles.

Motion synchronization station send/receive data refresh method	Description
Operation cycle precedence method	• Data receive, motion operation, and data send are executed in different operation cycles. A high-speed operation cycle can be selected when the motion operation load is high, because these are executed in parallel. • Since the data refresh timing is slower, the responsiveness to feedback is low.

■Operation cycle precedence method

With operation cycle precedence method, data receive, motion operation, and data send are executed in different operation cycles. For the connected device, it takes five cycles to receive a feedback to the data sent from the connected device.



■Slave label

The I/O data which the slave device of motion syncronization stations exchanges with Motion module by cyclic communication registers as labels and enables read/write. Refreshing slave labels are carried out in operation cycle. Refer to Help of the engineering tool for the setting method of slave label.

Standard station

The following stations update the data.

- Programmable controller

For details, refer to the following.

MELSEC iQ-R Motion Module User's Manual (Network)

Motion synchronization station link device auto refresh

Read data (RX, RWr)

Received data is refreshed to the link device. For details, refer to the following.

MELSEC iQ-R Motion Module User's Manual (Network)

Write data (RY, RWw)

Write data to send is refreshed to the link device. It is executed in accordance with the refreshing timing of read data. It is refreshed in the next cycle after the cycle in which the data has been sent to the network.

This function monitors send data, but it cannot write send data.

Buffer memory refresh

Data which are used to issue the MCFB by the following items and to get axis monitor information, etc. are refreshed in the buffer memory refresh cycle.

- Programmable controller

The target of the buffer memory refresh is as follows.

- Area for MCFB

Buffer memory refresh cycle

Data used between the motion system and the programmable controller is refreshed in a buffer memory refresh cycle.

This function is set in System.PrConst.BuffermemoryRefreshCycle.

Axis operation process high-speed mode

The following shows the axis operation process high-speed mode.
If it is switched to the high-speed mode, some of the functions will be restricted, but it may be able to communicate with shorter operation cycle.

Axis operation process high-speed mode restrictions

In the high-speed mode, compared to the normal mode, it has the following function restrictions.

• Function restrictions of the Motion module

No.	Restriction	Detail
1	Slave object unsettable	Operates by fixed initial setting ([OBJ] setting).
2	PDO mapping cannot be changed	Operates by fixed high-speed mode mapping. Cannot delete, add nor change the mapping objects.
3	A part of axis monitor unusable	The following monitor stops the updates. The slave feedback can be confirmed by using the device labels. Use depending on the system load status. • AxisName.Md.SetAcceleration • AxisName.Md.ActualVelocity • AxisName.Md.ActualPosition (For real encoder axis) • AxisName.Md.Io_TargetPos • AxisName.Md.Io_PosActualValue • AxisName.Md.Io_Statusword • AxisName.Md.DriverError • AxisName.Md.DriverErrorID • AxisName.Md.VelocityOverride • AxisName.Md.AccelerationOverride • AxisName.Md.JerkOverride • AxisName.Md.TorqueLimit_Positive • AxisName.Md.TorqueLimit_Negative • AxisName.Md.Driver_ReadyOn • AxisName.Md.Driver_ServoOn
4	A part of axis command unusable	The input of the following command will be ignored. • AxisName.Cd.Homing_ClearRequest • AxisName.Cd.TorqueLimit_Positive • AxisName.Cd.TorqueLimit_Negative • AxisName.Cd.AccelerationOverride • AxisName.Cd.VelocityOverride Do not use the FB that is changed the ignored command.
5	Synchronous control previously used the operation cycle data is unusable	Synchronous control previously used the operation cycle data cannot be used. Use the latest operation cycle data.

• Function restrictions when combined with MR Configurator2

No.	Restriction	Detail
1	Multiple axes graph unusable	Multiple axes function cannot be used. Do not waveform measure including the high-speed mode axis.

Precautions

In the high speed-mode, only the position control can be executed.
If used by direct control (velocity control, torque control), the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs.
Note the following when using the high-speed mode and sift through the function to be used depending on the system load status.

- The operation time increases if the labels are externally exposed, so when using by high-speed mode, set external exposion enabled/disabled depending on the system load status.
- When using the synchronous control, use it depending on the system load status.
- Executing the ST program in fixed-cycle will increase the operation time, so when using by high-speed mode, set the ST program execution cycle depending on the system load status.

Note the following and adjust the parameter setting value depending on the system load status.

- The operation time increases at the cycle over warning output, so set System.PrConst.OperationCycle[1…].NumOfCycleOverWngDetectTimes to 0, and set the warning "Cycle Over Warning" (warning code: 0F08H) to be not output.
- User needs to confirm the normal operation range of System.PrConst.OperationCycle[1…].NumOfCycleOverErrDetectTimes, and change the value to not be the error "Cycle Over" (error code: 1C80H) and the error "Cycle Over" (error code: 320CH).

Operation cycle 31.25 setting [RD78GH]

By using RD78GH enables to communicate by operation cycle 31.25 μs setting.
The procedure to operate by 31.25 μs is shown below.

Procedure to operate by 31.25 μs

- Enabling add-on

When using by 31.25 μs, start from the minimum configuration and add required add-on depending on the system load status.
The add-ons assumed as minimum configuration are shown below.
Enabled: ○ Disabled: ×

No.	Add-on name	Enabled/Disabled
1	baseSystem	○
2	AbsSystem	×
3	Axis	○
4	ExternalSignal	×
5	FileTransfer	×
6	Logging	×
7	MotionEngine	○
8	MotionControl_AxisFilter	○
9	MotionControl_General	○
10	MotionControl_Sync	○
11	MotionEventHist	×
12	NetworkDriver_CCIETSN	○
13	PackagingApp	×
14	PlcInstruction	○
15	ProfileControl	×
16	Program_ST	○
17	ServoDriver_CANopen	○
18	SignalIO	○

- Parameter setting

Set the axis to be operated by 31.25 μs to the high-speed mode. For details, refer to the following.
☞ Page 105 System basic cycle

Point

The system load status can be confirmed by System.Md.OperationCycle[1...].ProcessingTime.
Do not let System.Md.OperationCycle[1...].ProcessingTime keep exceeding the setting operation cycle.

Precautions

- By minimum configuration add-on, the forced stop command cannot be input from the Motion module.
  Depending on the system load status, adding the add-on ExternalSignal make it usuable. If the operation cycle exceeds by adding the above add-on, take an alternative measure such as using the forced stop input from the servo amplifier, not the forced stop command from the Motion module.
- By minimum configuration add-on, the absolute position sytem cannot be used. Depending on the system load status, adding add-on AbsSystem make it usable.
- By minimum configuration add-on, the data logging function cannot be used. Depending on the system load status, adding the add-on Logging make it usable.
- The operation time increases when the number of device labels increases. When using the device labels, adjust the number of device labels depending on the system load status.
- The operation cycle exceeds at start of function block, but soon the operation time will settle within the operation cycle thus the motion control is not affected.

3.2 Add-on Function

This section describes add-on Function.

The Motion module functions are configured with basic functions provided by the Motion module software and functions provided by the add-on library. The Motion module functions can be expanded by installing add-on libraries.

For details of the standard function add-on library, refer to the following.

☞ Page 671 Add-on library list

Operation of this function for each system status

○: Possible

System status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

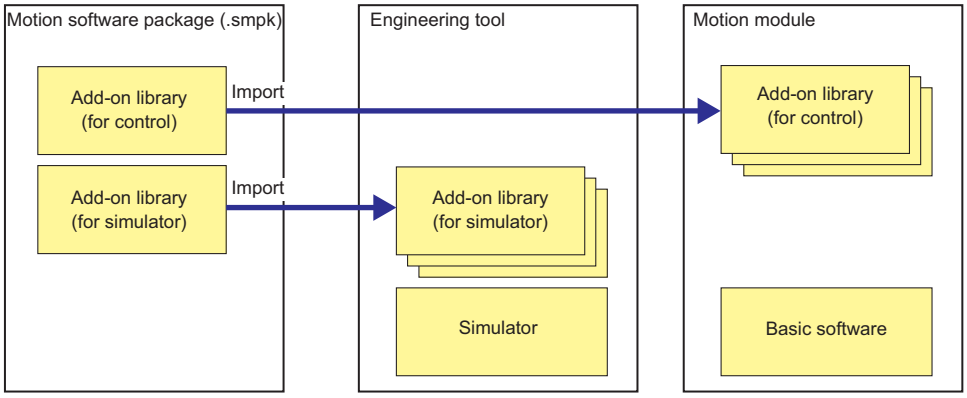
The following shows common variables in each add-on library. Available variables other than the following are different depending on the add-on library. For details, refer to the specifications of each add-on library.

Variable/Structure name		Name	Details
System.PrConst.			
	Addon_AddonLibraryName	AddOn <AddonLibraryName> parameter	ADDON_PARAM structure Refer to the following for add-on used for <AddonLibraryName>
System.MdConst.			
	Addon_AddonLibraryName	AddOn <AddonLibraryName> monitor	ADDON_MON structure Refer to the following for add-on used for <AddonLibraryName>
	ADDON_PARAM		
	RamSizeMax	Maximum RAM size	Specifies the maximum amount of system memory (RAM) used in the add-on in K bytes. For details of the setting method, refer to the following. ☞ Page 116 System Memory Settings
	BackupRamSizeMax	Maximum backup RAM size	Specifies the maximum amount of backup RAM used in the add-on in K bytes. For details of the setting method, refer to the following. ☞ Page 116 System Memory Settings
ADDON_MONI			
	RamUsage	RAM usage	Stores the current amount of system memory (RAM) used in the add-on in K bytes.
	RamMaxUsage	RAM usage maximum	Stores the maximum amount of system memory (RAM) used in the add-on in K bytes.
	BackupRamUsage	Backup RAM usage	Stores the current amount of backup used in the add-on in K bytes.
	BackupRamMaxUsage	Backup RAM usage maximum	Stores the maximum amount of backup used in the add-on in K bytes.
	Version	Version	Stores the version information of the add-on.

Add-on library configuration

File configuration

Add-on libraries are included in the motion software package and controlled by the engineering tool. Add-on library functions can be used by installing add-on libraries in the engineering tool and the Motion module.



Installation file configuration

The installation file of the software is one file.

For details, refer to the following.

☞ Page 575 Motion software package file configuration details

Provision of installation file

The installation file is provided in the MITSUBISHI ELECTRIC FA Global Website, etc.

The installation file is common between RD78G and RD78GH. (The both BootRoms are packed.)

A motion software package includes the simulator module for the engineering tool. It can simulate the functions including add-on library functions by importing it to the engineering tool. For details of configuration of the motion software package, refer to the following.

☞ Page 575 Software file configuration of motion system

Functions configuration

Depending on the add-on library, one of the following lists or all of those are expanded.

- Axis label, system label, or control data of variables for each function (Pr./Md./Cd.)
- Function block (for the CPU module)
- Function block (for internal ST programs)

Management of add-on library

Installation/Uninstallation

Add-on libraries are installed in the system folder (/sys) of the Motion module. The Motion module recognizes direct add-on libraries of the system folder (/sys).

For installation of add-on libraries, refer to the following.

☞ Page 574 Motion System Software Installation

For the uninstallation of add-on libraries, refer to Help of the engineering tool.

Enabling/Disabling

Functions which are infrequently used, such as adjustment functions used for starting up the system and the functions for debugging used only when an error occurs, can be disabled and enabled when needed. However, unlike uninstallation, the occupied capacity of the system folder is not reduced.

The disabled add-on library is moved to /sys/disabled.

Enabling/Disabling status is reflected when the Motion module is initialized next time.

Amount of memory consumed setting

Amount of memory each add-on library can consume can be changed by the parameter, and the amount of memory between each function can be adjusted flexibly according to the application.

For details of the setting method, refer to the following.

☞ Page 116 System Memory Settings

Examples of adjustable memory:

- Buffer size available in logging
- Operation profile open area size
- Label area size
- ST program area

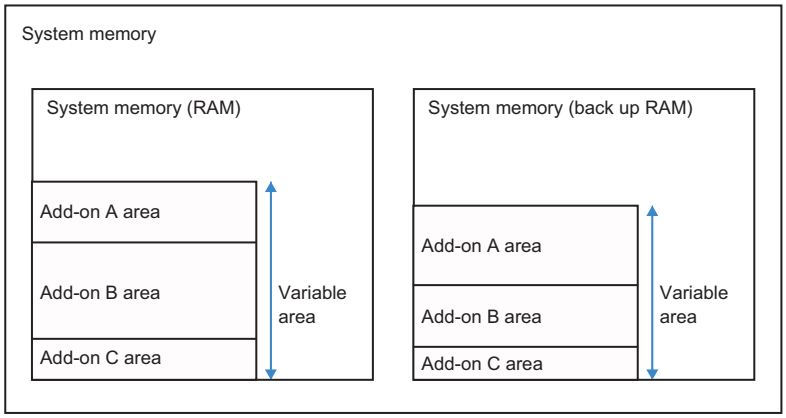
Loading add-on library

Add-on libraries are loaded when the Motion module is initialized.

Loaded add-on libraries can be checked with the boot log file (bootlog.txt).

3.3 System Memory Settings

This section describes setting methods of memory size used in the add-on library in the system memory (RAM) and the system memory (backup RAM).



Relevant variables

The following shows common variables in each add-on library.
Available variables other than the following are different depending on the add-on library.

Variable/Structure name		Name	Details
System.PrConst.			
	Addon_AddonLibraryName	AddOn <AddonLibraryName> parameter	ADDON_PARAM structure Refer to the following for add-on used for <AddonLibraryName>. ☞ Page 652 System variables
	LabelMemorySize	Label memory size	Stores the label memory size in K bytes.
System.Md.			
	Addon_AddonLibraryName	AddOn <AddonLibraryName> monitor	ADDON_MONI structure Refer to the following for add-on used for <AddonLibraryName>. ☞ Page 652 System variables
	LabelMemoryFreeSize	Label memory free size	Stores label memory free size in K bytes.
	MemoryUsage	System memory usage	ADDON_MON structure
	MemorySize	System memory size	ADDON_PARAM structure
ADDON_PARAM			
	RamSizeMax	Maximum RAM size	Specifies the maximum amount of system memory (RAM) used in the add-on in K bytes. For details of the setting method, refer to the following. ☞ Page 117 System memory (RAM) usage setting method
	BackupRamSizeMax	Maximum backup RAM size	Specifies the maximum amount of system memory (backup RAM) used in the add-on in K bytes. For details of the setting method, refer to the following. ☞ Page 118 System memory (backup RAM) usage setting method
ADDON_MONI			
	RamUsage	RAM usage	Stores the current amount of system memory (RAM) used in the add-on bin K bytes.
	RamMaxUsage	RAM usage maximum	Stores the maximum amount of system memory (RAM) used in the add-on in K bytes.
	BackupRamUsage	Backup RAM usage	Stores the current amount of system memory (backup RAM) used in the add-on in K bytes.
	BackupRamMaxUsage	Backup RAM usage maximum	Stores the maximum amount of system memory (backup RAM) used in the add-on in K bytes.

System memory (RAM)

System memory (RAM) stores the data used for the control in an add-on library. The following shows the total size of system memory (RAM).

Model	RD78G	RD78GH
System memory (RAM) size	96 MB	160 MB

System memory (RAM) usage setting

The amount of system memory (RAM) available in each add-on library is set by System.PrConst.Addon_AddonLibraryName.RamSizeMax. Memory usage between each function can be flexibly adjusted according to the application with this parameter.

System memory (RAM) usage setting method

The maximum amount of system memory (RAM) used in the add-on can be set by the engineering tool.

- The maximum usage of system memory (RAM) can be set in K bytes.
- The set maximum usage is applied at system start.

The current/maximum amount of system memory (RAM) used in the add-on can be monitored by System.Md.Addon_AddonLibraryName.RamUsage/System.Md.Addon_AddonLibraryName.RamMaxUsage respectively. The value is stored in K bytes.

The current/maximum total amount of system memory (RAM) used in all add-ons can be monitored by System.Md.MemoryUsage.RamUsage/System.Md.MemoryUsage.RamMaxUsage respectively. The value is stored in K bytes.

Ex.

Examples of adjustable memory:

- Buffer size available in logging
- Operation profile data open area size
- Axis/variable instance size (It determines the total number of available axes.)
- ST program area (It determines the maximum number of program steps.)

Label memory (RAM) usage setting

Set usable memory (RAM) in label by System.PrConst.LabelMemorySize. Current memory free size in label memory can be checked by System.Md.LabelMemoryFreeSize.

System memory (backup RAM)

System memory (backup RAM) is a file system (latch drive) which stores the backup data used for the control in an add-on library. System memory (backup RAM) size is as shown below.

Model	RD78G	RD78GH
System memory (backupRAM) size	20 kB	

System memory (backup RAM) usage setting

The amount of system memory (backup RAM) available in each add-on library is set by System.PrConst.Addon_AddonLibraryName.BackupRamSizeMax. Memory usage between each function can be flexibly adjusted according to the application with this parameter.

System memory (backup RAM) usage setting method

The maximum amount of system memory (backup RAM) used in the add-on can be set by the engineering tool.

- The maximum usage of system memory (backup RAM) can be set in K bytes.
- The set maximum usage is applied at system start.

The current/maximum amount of system memory (backup RAM) used in the add-on can be monitored by System.Md.Addon_AddonLibraryName.BackupRamUsage/System.Md.Addon_AddonLibraryName.BackupRamMaxUsage respectively. The value is stored in K bytes.

The current/maximum total amount of system memory (backup RAM) used in all add-ons can be monitored by System.Md.MemoryUsage.BackupRamUsage/System.Md.MemoryUsage.BackupRamMaxUsage respectively. The value is stored in K bytes.

Ex.

Examples of adjustable memory:

- Number of ABS axes
- Number of event history storage
- Number of synchronous restoration function axes

Precautions

If the maximum usage of system memory (backup RAM) is changed, the backup data stored in the system memory (backup RAM) will be cleared.

Precautions

- The system memory usage can increase/decrease depending on the usage of add-on libraries. Allow a margin for the maximum memory to use.
- When more system memory capacity is required during RUN, an error or a warning is output for each add-on library. If memory cannot be secured in the function that affects the control, the whole module will be stopped as the WDT error.

3.4 Software Reboot

The software reboot (system reset) is executed by writing the reboot command to the control command. When "Clear" is specified at the software reboot command, the system restarts and all data of the system is deleted.
This function is used to fetch such as parameters again and reset the motion system to the factory setting without stopping the system caused by the system power ON again.
The software reboot can execute reset and clear by setting a target specified value in System.Cd.SoftRebootRequest.

Action	Target	Details
Reset	Motion area	Resets parameters and control data while connection to the network communication is kept.
Clear	Motion area	Clears built-in memory.
Quick clear	Motion area	Clears built-in memory quickly.

System.PrConst.SoftRebootEnable setting must be enabled to execute the software reboot. If the software reboot is executed with the setting disabled, the software reboot will not be executed and the warning "Soft Reboot Disabled Warning" (warning code: 0F00H) will be detected.
Register event history (type: operation power ON/reset) after the software reboot.

Relevant variables

Variable/Structure name	Name	Details
System.PrConst.		
SoftReboot_Enable	Soft reboot enabled	Sets the software reboot execution enable/disable. When the setting is disabled, the software reboot is not executed.
System.Cd.		
SoftRebootRequest	Soft reboot request	Executes the software reboot. MOTION_RESET: Resets the motion area only. MOTION_CLEAR: Clears the memory after rebooting the motion area. Other than above: Not executed. Turns "" after the software reboot is completed (after the system restart).

Reset

This function imports parameters, etc., which are imported at system start, again without stopping the whole system.
The each type data and the status of the network communication after the reboot are shown below.

Item	Software reboot	Hardware reboot
	Target: Motion area	
Label	Sets the default value*1	Sets the default value
Device	Clear*1	Clear
Program	Equivalent to STOP→RUN	Equivalent to STOP→RUN
Network communication	Watchdog counter update stop*2	Disconnects all stations and returns it after restart
File transmission by script file	Execute	Execute
Module software/add-on	Reload	Reload
RAM drive	Clear	Clear

*1 The outside data of the reset target is maintained.
*2 The driver alarm may occur. In this case, restart the power of the motion system.
While the reset is operated, the RUN LED turns OFF.

Clear

The following data of the Motion module is deleted after the reboot is carried out.

- User drive (/rom) storage data
- Latch drive (/lch) storage data
- Security information
- A part of system drive (/sys) storage data
- RAM drive (/ram) storage data

Point

- Write required data such as the add-on libraries, the parameters, and the programs after clear is completed.
- Since the password and key information related to security which are registered in the motion system are also deleted, set them again in needed.

It may take some time to carry out a low-level format of the drive.
While the clear is executed, the RUN LED is flashing (every 500 ms).
After the clear is completed, the RUN LED turns ON. The system starts with the parameters, the programs, and the backup data, etc. deleted.
When the clear is failure, the ERR LED is flashing (every 200 ms). In this case, execute clear again.

Quick clear

- The data of the Motion module is deleted after the reboot is carried out. That data is the same as the data from the time of "Clear".
- The drive carries out quick format. Quick format can clear the data faster than low-level format ("Clear" is at run time). However, if an access to the file can not be performed normally after quick clear by reason of file system damage, etc., execute a low-level ("Clear") format.
- While the quick clear is executed, the RUN LED is flashing (every 500 ms).
- After the quick clear is completed normally, the RUN LED turns ON. The system starts with the parameters, the programs, and the backup data, etc. deleted.
- When the quick clear is failed, the ERR LED is flashing (every 200 ms). In this case, execute quick clear or clear again.

Precautions

- It is recommended to execute the software reboot during the PLC READY [Y0] OFF.
- When data reset by the software reboot is executed, the variables and status of the slave device change.
- During software reset of the motion area, the communication with the engineering tool and the dedicated instruction issued from the CPU module may be completed with an error.
- Do not turn OFF the power of the motion system while clear or quick clear is executed. An error "Drive Error" (error code: 3207H) may occur along with format failure of the drive (only for baseSystem add-on "Ver. 1.5" or later). In such a case, execute clear again.

PART 2 MOTION CONTROL 1

4 START AND STOP

5 HOMING

6 AXIS CONTROL FUNCTION

7 DIRECT CONTROL

8 RELEVANT FUNCTIONS to POSITION

9 RELEVANT FUNCTIONS TO VELOCITY

10 RELEVANT FUNCTIONS TO TORQUE

11 CONTROL SUB FUNCTIONS

12 COMMON FUNCTIONS

4 START AND STOP

4.1 Start

This section describes how to start an axis of the motion system.
In the motion system, motion control can be executed by executing motion control function blocks with programs of the control CPU module, such as the PLC CPU and the C language CPU, or the motion system built-in program language such as ST language.
Starting the motion control by executing the motion FB with the axis status (AxisName.Md.AxisStatus) of "4: Standstill" or the axes group status (AxesGroupName.Md.GroupStatus) of "4: GroupStandby" is called "start" of the axis.
Function blocks include the Execute type and the Enable type, and these are started at the rising edge of Execute or Enable which are input variables of the motion control function block.

Relevant variables

Variable/Structure name	Name	Details
AxisName.Md.		
AxisStatus	Axis status	Stores the axis status. 0: Disabled (Axis disabled) 1: ErrorStop (Error stop) 2: Stopping (Deceleration stop) 3: Homing (Homing) 4: Standstill (Standby) 5: DiscreteMotion (Positioning operation) 6: ContinuousMotion (Continuous operation) 7: SynchronizedMotion (Synchronized operation)
UseInGroup	Use in axes group	Displays whether the axis is used in the axes group or not. FALSE: Not used TRUE: Used
Homing_Request	Homing request	Displays TRUE/FALSE of the homing request.
HwStrokeLimit_FlsStatus	Upper limit signal status	Displays TRUE/FALSE of the FLS.
HwStrokeLimit_RlsStatus	Lower limit signal status	Displays TRUE/FALSE of theRLS.
ForcedStop_Released	Forced stop cancelling	Displays forced stop cancel status.
StopStatus	Stop status	Displays TRUE/FALSE of the stop signal (STOP).
AxesGroupName.Md.		
GroupStatus	Axes group status	Stores the axes group status. 0: GroupDisabled (Axes group disabled) 1: GroupErrorStop (Error stop) 2: GroupStopping (Deceleration stop) 4: GroupStandby (Standby) 5: GroupMoving (Operation)
System.Cd.		
SequenceReady	PLC ready	Sets RUN/STOP of the PLC READY [Y0].
System.Md.		
Ready	Ready	Stores ON/OFF of the ready [X0].
Sync	Synchronization flag	Stores ON/OFF of the synchronization flag [X1].

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 function blocks of the axis

■State transition

Name	State	Variable name
Axis state	4: Standstill	AxisName.Md.AxisStatus

■Signal state

Signal name		Signal state		Variable name
I/O signal	PLC READY [Y0]	ON	RUN	System.Cd.SequenceReady
	Ready [X0]	ON	Ready [X0]	System.Md.Ready
	Synchronization flag [X1]	ON	Module access enabled	System.Md.Sync
	Use in 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

Starting conditions for motion function blocks of the axes group

■State transition

Name	State	Variable name
Axis state	4: Standstill	AxisName.Md.AxisStatus
Axes group state	4: GroupStandby	AxesGroupName.Md.AxesGroupStatus

■Signal state

Signal name		Signal state		Variable name
I/O signal	PLC READY [Y0]	ON	RUN	System.Cd.SequenceReady
	Ready [X0]	ON	Ready [X0]	System.Md.Ready
	Synchronization flag [X1]	ON	Module access enabled	System.Md.SyncFlag
	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

4.2 Retrigger/Continuous Update

The following methods can be used to change the control of the on-going FB.

- Retrigger (Inputting Execute again)
- Continuous update (ContinuousUpdate)

With a retrigger/continuous update of the FB, input variables can be imported again to the FB instance in execution without interrupting operation.

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
- Buffer memory refresh cycle (Only when using the FB in the CPU module side)
- Operation cycle

To change input variables when Execute turns FALSE to TRUE and when ContinuousUpdate turns TRUE, be sure to secure time 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.
- Even if a retrigger/continuous update is performed to an instruction being buffered, it may affect on the control in operation.

Retrigger

In an FB whose start condition is Execute, a retrigger can be executed by the re-rising edge of Execute.

For input variables that can be changed by a retrigger, refer to each FB specification.

Continuous update

If ContinuousUpdate is TRUE when Execute turns FALSE to TRUE, input variables will be continuously imported.

For input variables that can be imported, refer to each FB specification.

4.3 Multiple Start (Buffer Mode)

MCFBs can be executed continuously without stopping multiple MCFBs 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 MCFB with the axis and the axes group stop status ("4: Standstill" or "4: GroupStandby") is called "start". For details, refer to the following.
  ☞ Page 122 Start
- When the axis operation state and the axes group operation state are as the following, to execute the motion FB of another instance is called "multiple start".
  [Axis state in which multiple start is available (AxisName.Md.AxisStatus)]
  3: Homing (Only MC_Stop is possible)
  5: DiscreteMotion
  6: ContinuousMotion
  7: SynchronizedMotion
  [Multiple Start possible axes group state (AxesGroupName.Md.GroupStatus)]
  5: GroupMoving
- Multiple start of the single axis control FB cannot be executed to an axis operated in the axes group. It will cause the error "Operation FB Issue Error to the Axis during Axes Group Operating" (error code: 1A7CH).

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
0: mcAborting	Aborting	Interrupts (cancel) the on-going FB and executes next FB immediately.
1: mcBuffered	Buffered	Buffers the next FB on the on-going FB. If the on-going FB has already been buffered, the next FB of the previous FB is buffered. (Up to 2.) Buffering FBs are executed in order after completion of the on-going FB
2: mcBlendingLow	BlendingLow	The lower target velocity between on-going FB and buffering FB is used as the switching speed.*1
3: mcBlendingPrevious	BlendingPrevious	Target velocity of on-going FB is used as the switching speed.*1
4: mcBlendingNext	BlendingNext	Target velocity of buffering FB is used as the switching speed.*1
5: mcBlendingHigh	BlendingHigh	The higher target velocity between on-going FB and buffering FB is used as the switching speed.*1

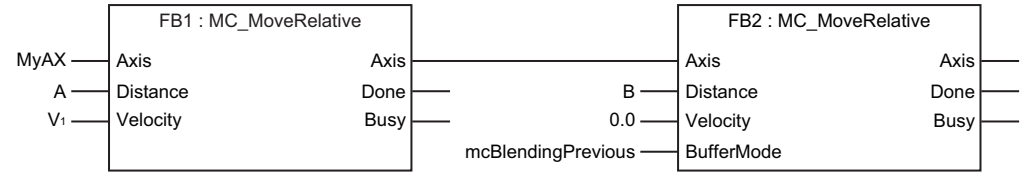
*1 Buffers the next FB on the on-going FB.
If the on-going FB has already been buffered, the next FB of the previous FB is buffered. (Up to 2) Buffering FBs are executed in order after the on-going FB has reached the target position.
Stop is not executed between on-going FB and buffering FB in this mode.

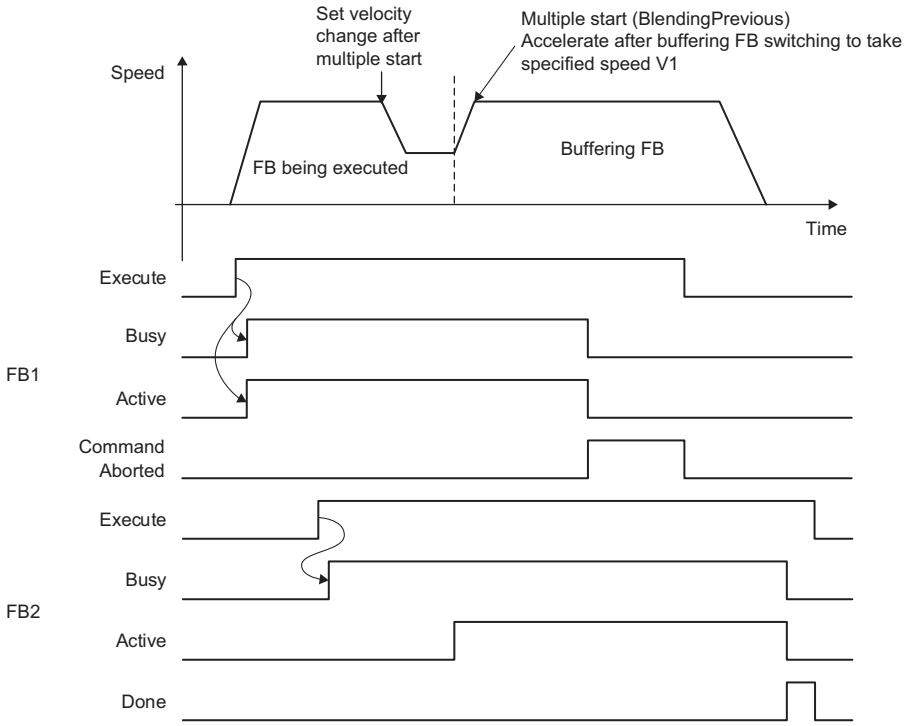
Point

- 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, the error "Warning Starting over Number of Buffering FBs" (warning code: 0D22H) occurs and waits the analysis of the multiple start FB until on-going 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 585 Checking Errors and Warnings
  When an error or a stop cause occurred in on-going FB, FBs which are waiting for the analysis are interrupted.
- When the warning "Warning starting over number of buffering FBs" (warning code: 0D22H) occurs, note that not to execute the multiple start until the on-going 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 on-going FBs include a buffering FB, all buffering FBs are interrupted.)
- When an error or a stop cause occurred, all buffering FBs are interrupted (the output CommandAbort turns TRUE).

Command omission at multiple start

When omitting the specified speed, the acceleration specification, and the deceleration specification in an FB that executes multiple start, specified speed of "the previous FB of buffering FB" at multiple start is taken over. If the specified speed input does not exist in "the previous FB of buffering FB", buffering is executed with speed 0.0.





- 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 312 Acceleration/deceleration method
- When multiple FBs are multiple started at the same execution cycle, the order of FBs to be buffered is uncertain. In order to determine the buffering order, execute multiple start after checking that the previous FB is started (Busy = TRUE).

Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
OverrunOperation	Operation setting at overrun	Sets the operation settings when overrun occurs during operation. 1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep Current Acceleration/Deceleration)
AxisName.Md.		
BufferingFBs	Number of buffering FBs	The number of buffering FBs (0 to 2)
AxesGroupName.Pr.		
OverrunOperation	Operation setting at overrun	Sets the operation settings when overrun occurs during operation. 1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep Current Acceleration/Deceleration)
AxesGroupName.Md.		
BufferingFBs	Number of buffering FBs	The number of buffering FBs (0 to 2)

Multiple start during single axis operation

When axis operation state is as the following, multiple start is enabled by starting a motion FB of another instance. (If the axis operation is in the "4: Standstill" status, it is regarded as "start".)

[Axis state in which multiple start is available (AxisName.Md.AxisStatus)]

3: Homing (Only MC_Stop is possible)

5: DiscreteMotion

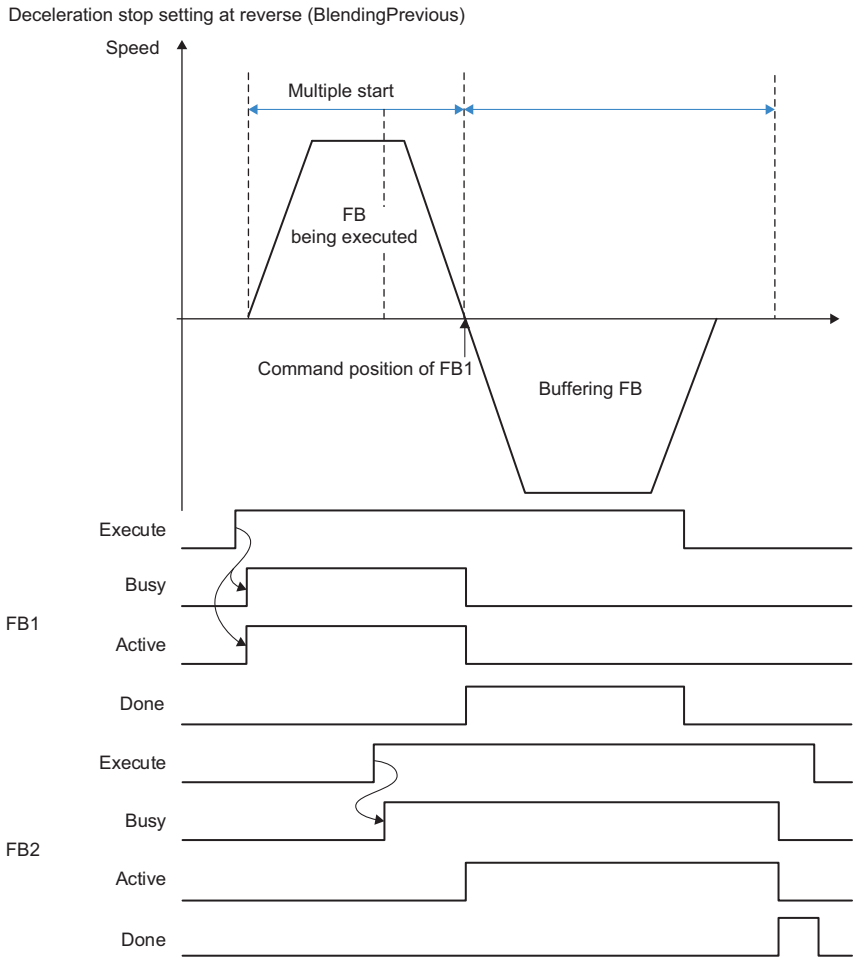
6: ContinuousMotion

7: SynchronizedMotion

When the buffering FB input includes Direction and "4: mcCurrentDirection" is selected, the previous FB operation direction is taken over.

When the directions are different between on-going FB and next FB in the single operation, the operation differs depending on the selection in case of having reverse rotation permission selection (option bit5). The operation is the same as the operation at reverse rotation permission in case of not having reverse rotation permission selection (option bit5).

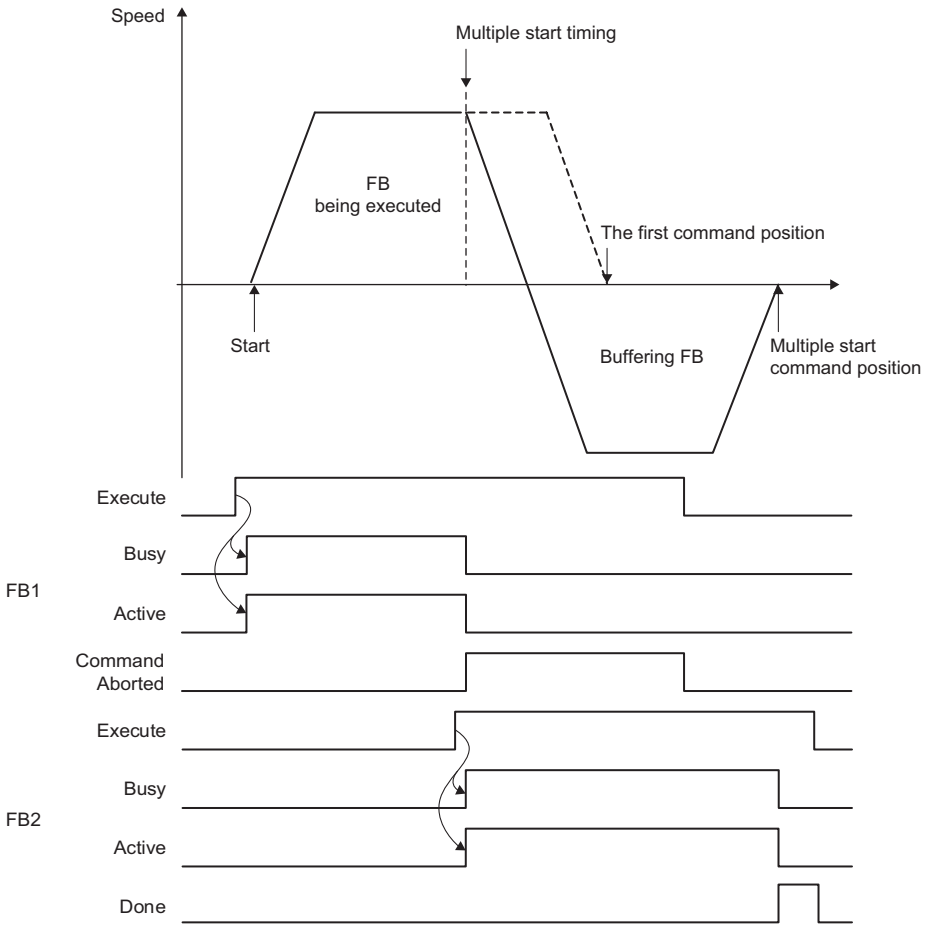
When the direction is reversed at while Blending is specified, a deceleration stop is executed at the target position of the on-going FB, and velocity change is executed to the target velocity of the buffering FB after the on-going FB is switched to the buffering FB. (It is the same operation as Buffered is specified.)



When reverse is enabled

When reverse rotation permission is set in reverse rotation permission selection (option bit5), a deceleration stop is executed once. After the deceleration stop is completed, operation is started to the changed direction.

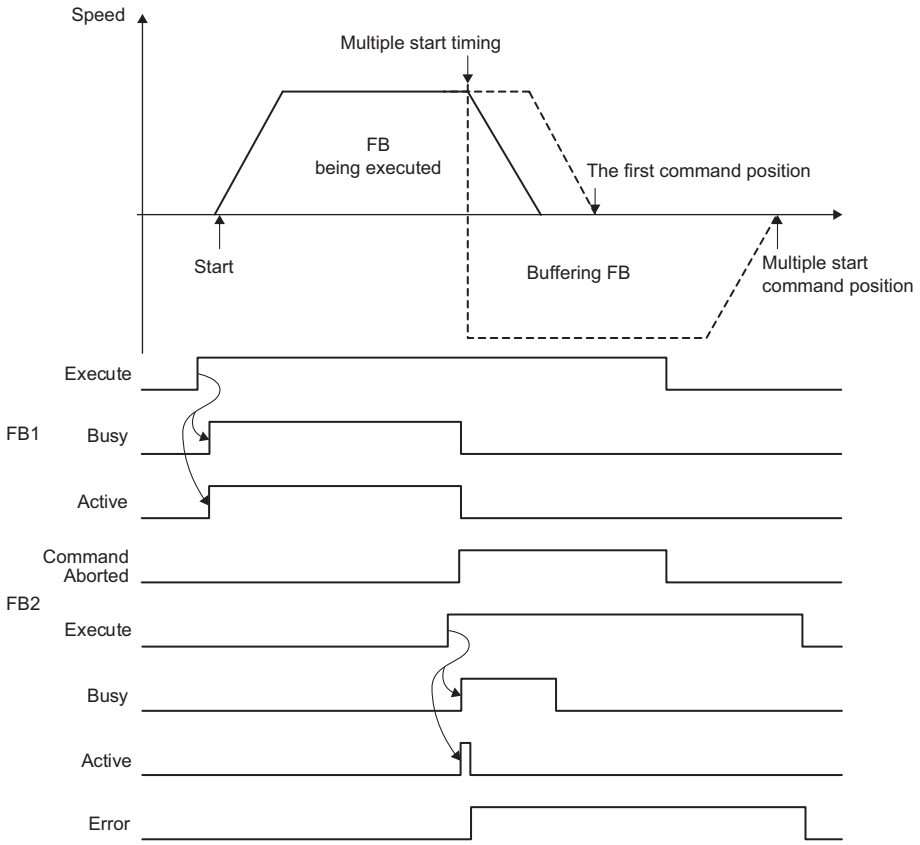
Deceleration stop setting at reverse (Aborting)



When reverse is disabled

When reverse rotation no permission is set in reverse rotation permission selection (option bit5), the error "Overrun Error" (error code: 1A7EH) occurs at switching and the axis decelerates to a stop.

Immediate stop setting at reverse



Buffer mode that can be set

The following shows buffer modes that can be specified in the single axis control FB. For operation details of each FB, refer to each FB specifications.

○: Buffer mode setting possible, —: Buffer mode setting not possible (axis error)

FB	Setting possible in FB			Completion output	Setting possible in the later operation FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_Home	—*1	—	—	Done	○*2	—	—
MC_Stop	○	—	—	Done	○*2	—	—
MC_MoveAbsolute	○	○	○	Done	○	○	○
MC_MoveRelative	○	○	○	Done	○	○	○
MCv_SpeedPositionAbsolute	○	○	○	Done	○	○	○
MCv_SpeedPositionRelative	○	○	○	Done	○	○	○
MCv_Jog	—*1	—	—	Done	○	○	—
MCv_SpeedControl	○	○	○	InVelocity	○	○	—
MC_MoveVelocity	○	○	—	InVelocity	○	○	—
MC_TorqueControl	○	○	—	InTorque	○	○	—
MC_CamIn	○	○	—	EndOfProfile	○	○	—
MC_GearIn	○	○	—	InGear	○	○	—
MC_CombineAxes	○	○	—	InSync	○	○	—
MCv_SmoothingFilter	—*1	—	—	—	○*2	—	—
MCv_DirectionFilter	—*1	—	—	—	○*2	—	—
MCv_SpeedLimitFilter	—*1	—	—	—	○*2	—	—
MCv_BacklashCompensationFilter	—*1	—	—	—	○*2	—	—

*1 Since this FB can be started only when the axis state (AxisName.Md.AxisStatus) is "4: Standstill", multiple start is not possible.

*2 Only MC_Stop is possible.

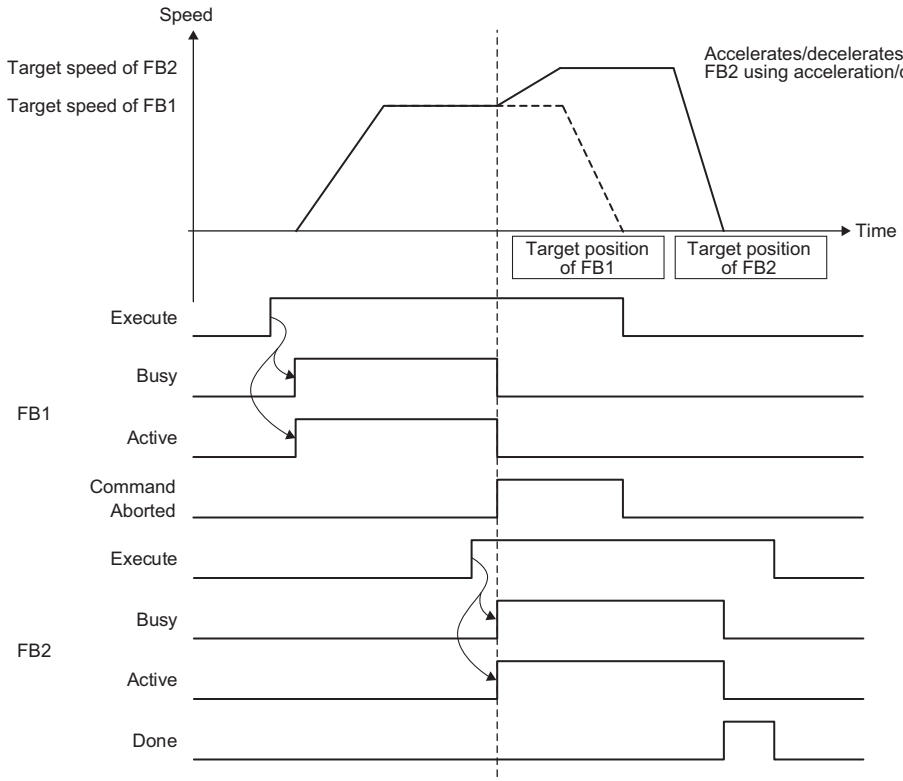
Aborting during single axis operation

On-going FB is interrupted and the next FB is executed.

Since a buffer is not used, an error does not occur even if two of the on-going FBs have already been in buffering, and the FB is executed. (All FBs during buffering are interrupted.)

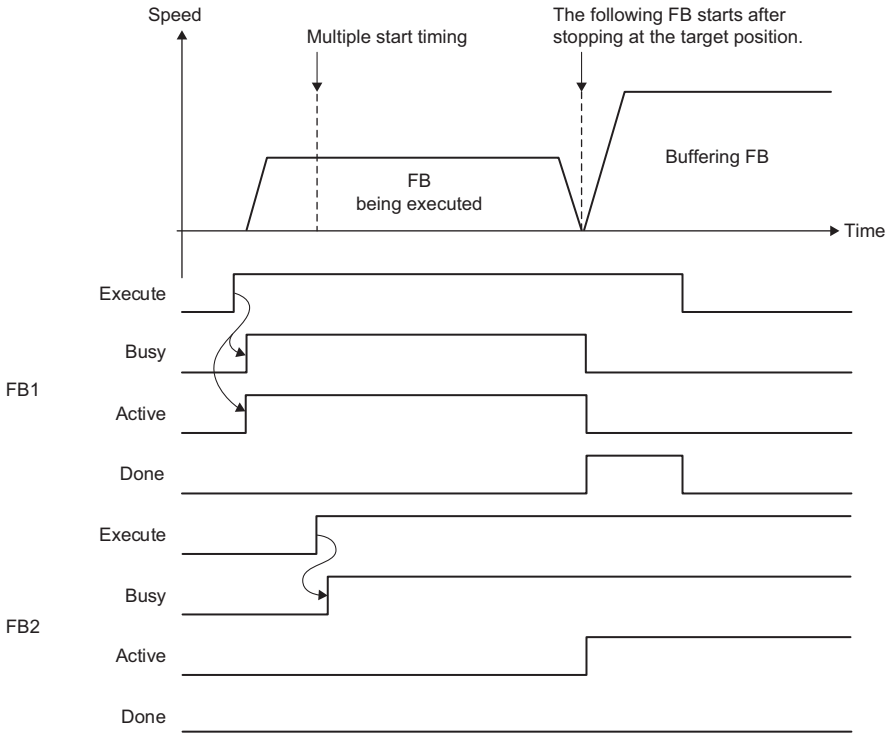
When omitting to specify the buffer mode, this operation is performed.

An operation example when Aborting is executed to the on-going FB1 with the linked start FB2 is shown below.



Buffered during single axis operation

Multiple started FBs are buffered and wait (Busy = TRUE) until the on-going FB is completed. After the on-going FB is normally completed, multiple started FBs are performed in the order of being buffered.

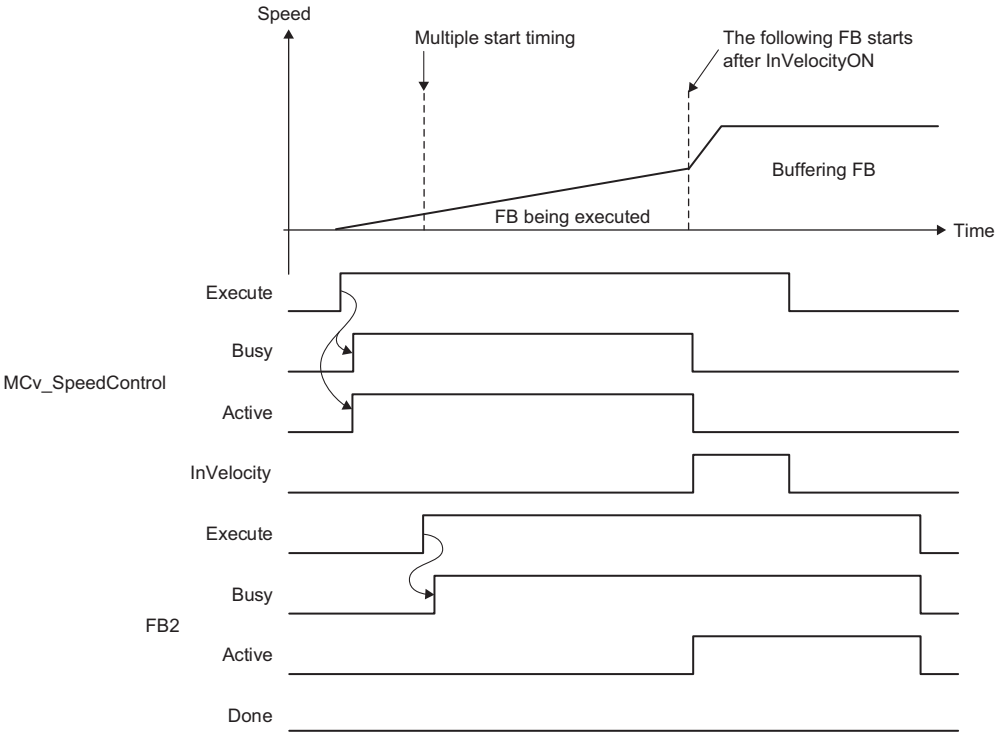


Conditions to determine completion are different depending on the MCFB, and the FB may not be in the stop status with speed 0 at completion. For details, refer to each FB specifications.

Ex.

When an FB is multiple started with Buffered in MCv_SpeedControl

In MCv_SpeedControl, the FB is determined that it is completed when InVelocity turns TRUE, and the following buffering FB is executed. (The current speed at this time is used as the switching speed.)

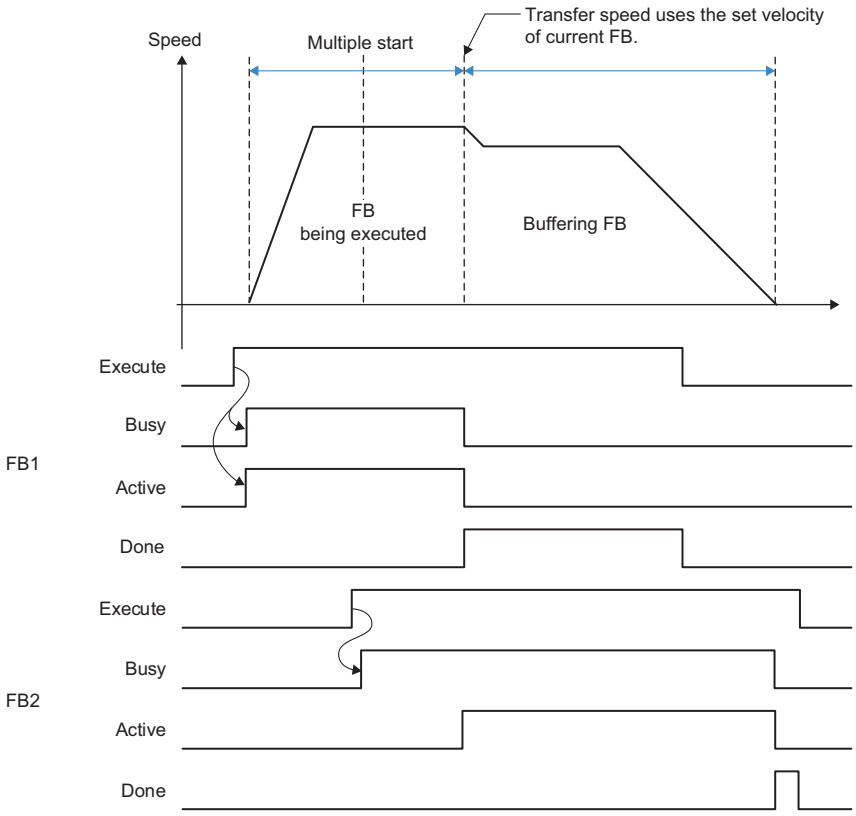


Blending during single axis operation

Multiple started FBs are buffered and wait until the on-going FB is completed. After the on-going 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.

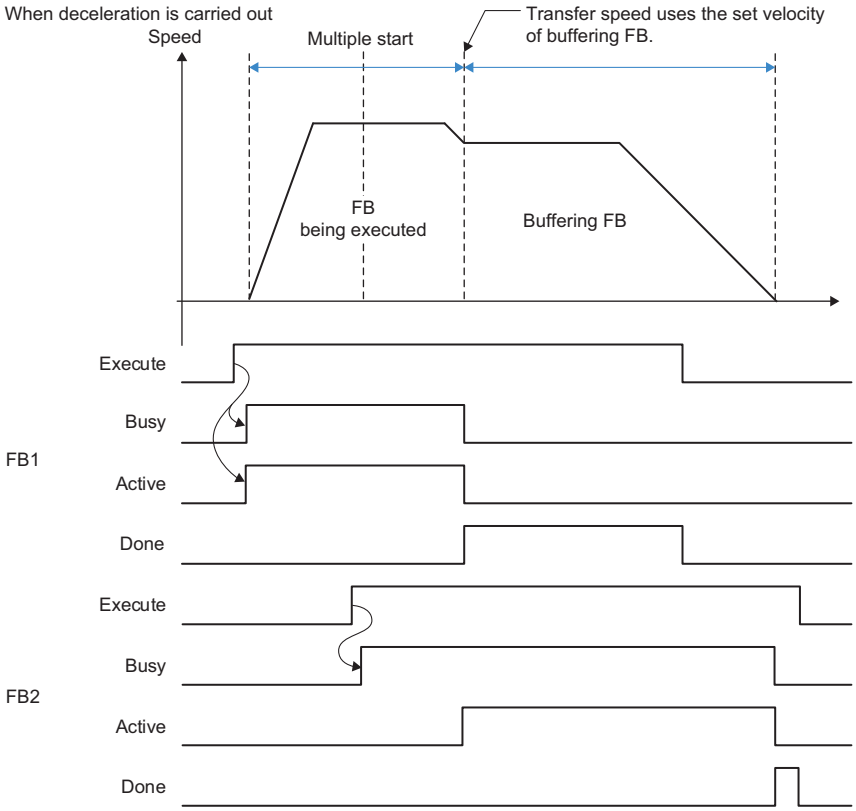
■BlendingPrevious

The FB is operated at the speed of the on-going FB to the target position. After switching to the FB that is during buffering, velocity change is executed to the target velocity of the buffering FB.

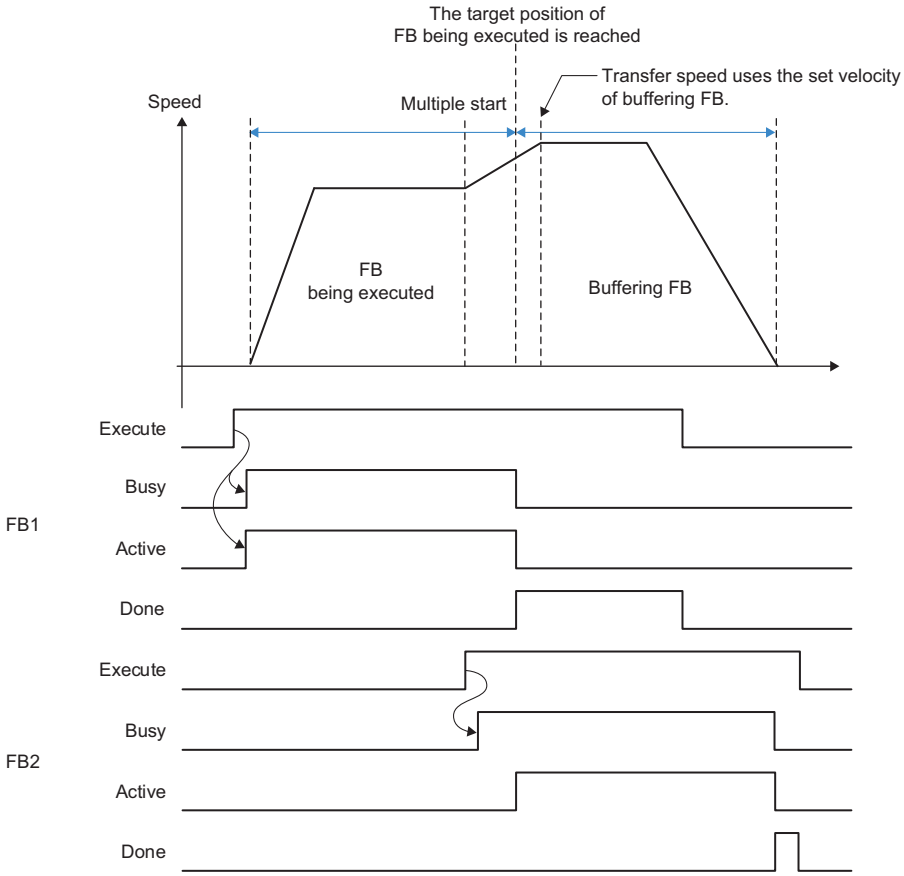


■BlendingNext

The FB is operated so that the velocity becomes the target velocity of the FB in buffering at the target position of the on-going FB.



Depending on the multiple start timing, the movement amount in order to change the speed to the target velocity of the FB in buffering may be in short at the target position of the on-going 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 on-going FB.



■BlendingLow

The slower target velocity between the on-going FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the on-going 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 on-going FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the on-going FB target velocity is higher, and it is same as BlendingNext when the buffering FB target velocity is higher.

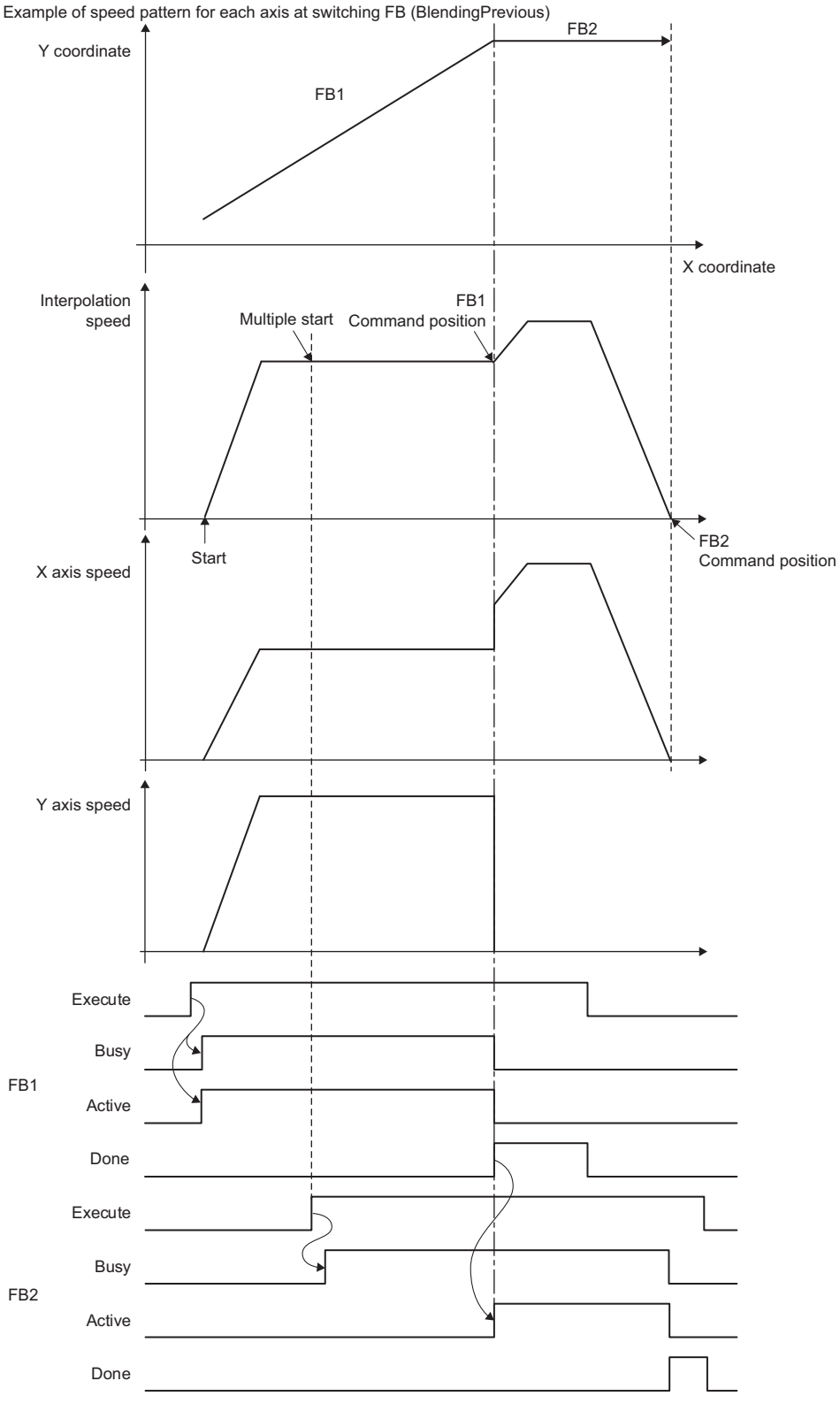
Multiple start during multiple axes operation

When axes group operation state is as the following, multiple start is enabled by executing the motion FB of another instance. (If the axis operation is in the "4: GroupStandby" status, it is regarded as "start".)

[Axes group status that can be multiple started (AxesGroupName.Md.GroupStatus)]

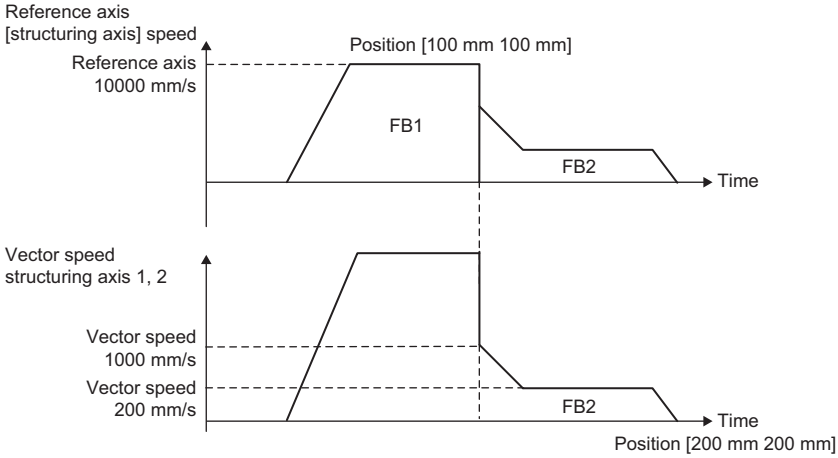
5: GroupMoving

In multiple start during multiple axes operation, the current interpolation speed of the on-going FB is used as the switching speed. Therefore, acceleration/deceleration may not be executed and rapid a velocity change may occur depending on the movement amount and direction of each axis in the buffering FB.



When multiple start by specifying Aborting or Blending, if on-going FB (FB1) or next FB (FB2) has the VelocityMode input and the velocity mode settings are different between FBs, the warning "Multiple Start Speed Mode Specified Mismatch Warning" (warning code: 0D11H) is output because the velocity may change suddenly.
In such a case, FB1 VelocityMode is used in FB1 and FB2 VelocityMode is used in FB2 to control. In this case, the switching speed is controlled using only values. (Unit/speed conversion by VelocityMode is not executed.)

Ex.
Multiple start by specifying BlendingPrevious from FB1 with the reference axis speed to FB2 with the vector speed



The operation is carried out so that the reference axis speed of FB1 becomes the speed set in Velocity (reference axis speed 1000 mm/s). The reference axis speed at the target position of FB1 is regarded as the switching speed and the current vector speed value of FB2 without conversion, and it accelerates and decelerates the vector speed (200 mm/s) set in 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, the error "Operation FB Issue Error to the Axis during Axes Group Operating" (error code: 1A7CH) will occur in the target axis, and the axes group FB that is during 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 of each FB, refer to each FB specifications.
○: Buffer mode setting possible, —: Buffer mode setting not possible (axes group error)

FB	Setting possible in FB			Completion output	Setting possible in the later operation FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_GroupStop	—*1	—	—	Done	○*2	—	—
MCv_MoveLinearInterpolateAbsolute	○	○	○	Done	○	○	○
MCv_MoveLinearInterpolateRelative	○	○	○	Done	○	○	○
MCv_MoveCircularInterpolateAbsolute	○	○	○	Done	○	○	○
MCv_MoveCircularInterpolateRelative	○	○	○	Done	○	○	○

*1 When it is started during axis operation, the operation will be same as Aborting.
*2 Only MC_GroupStop is possible.

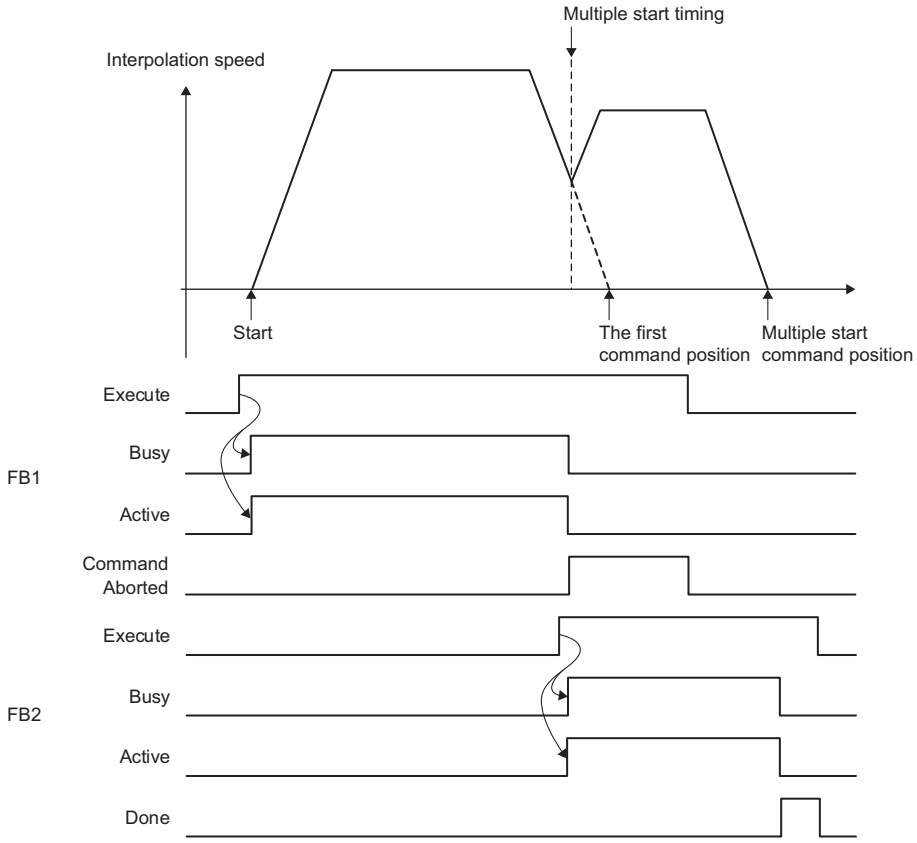
Aborting during multiple axes operation

On-going 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 the on-going FBs have already been in buffering, and the FB is executed. (All FBs during buffering are interrupted.)

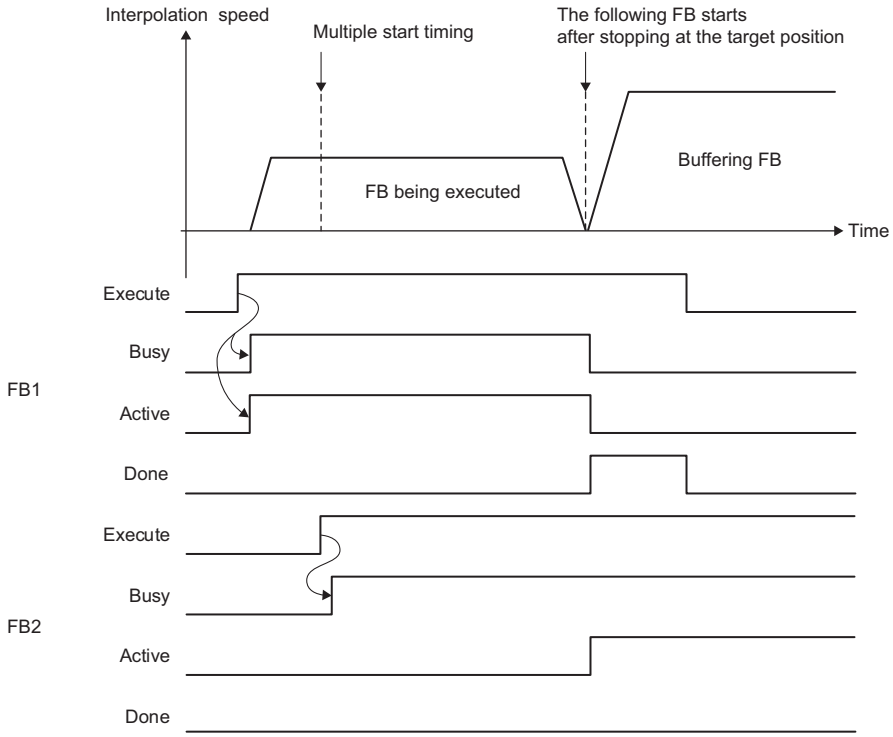
When omitting to specify the buffer mode, this operation is performed.

An operation example when Aborting is executed to the on-going FB1 with the linked start FB2 is shown below.



Buffered during multiple axes operation

Multiple started FBs are buffered and wait until the on-going FB is completed. After the on-going FB is normally completed, multiple started FBs are performed in the order of being buffered.

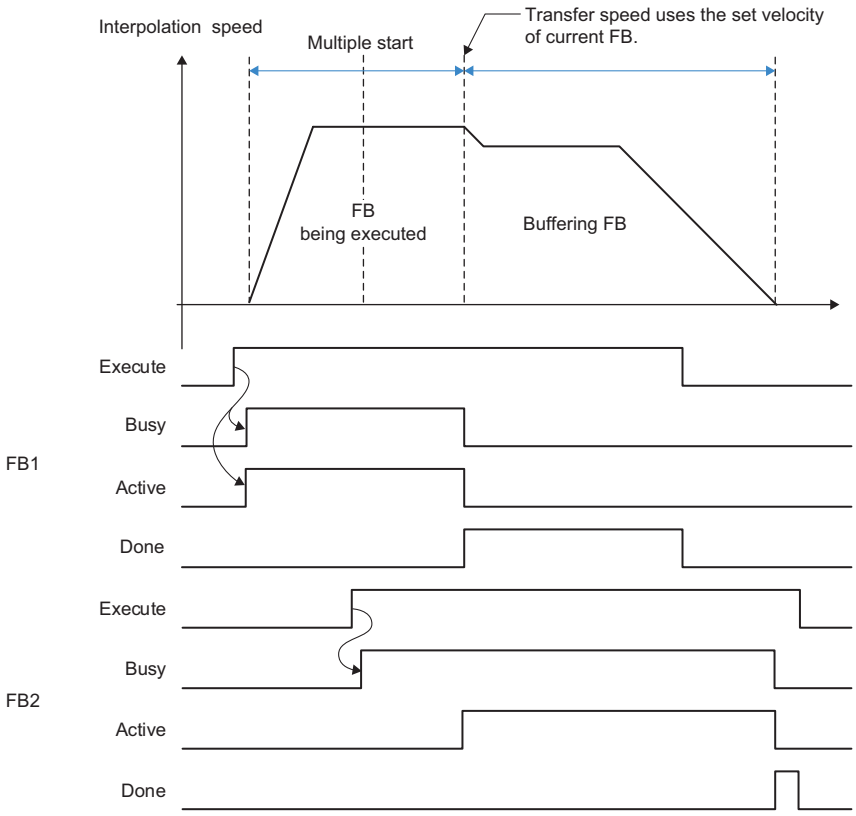


Blending during multiple axes operation

Multiple started FBs are buffered and wait until the on-going FB is completed. After the on-going 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.

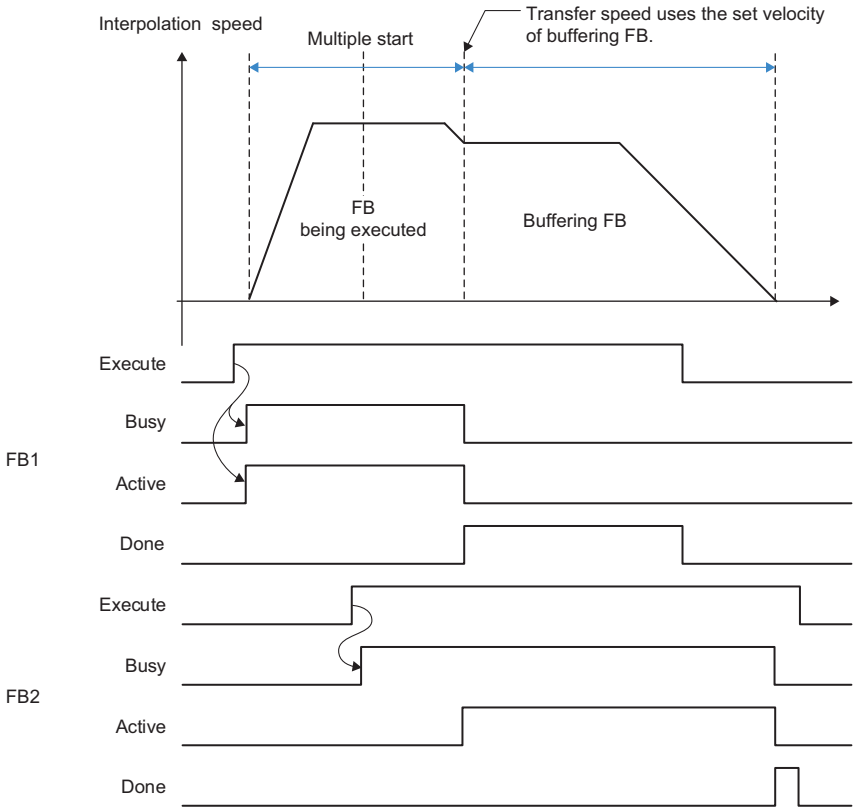
■BlendingPrevious

The FB is operated with the interpolation velocity of on-going FB to the target position. After switching to the FB that is during buffering, velocity change is executed to the target velocity of buffering FB.

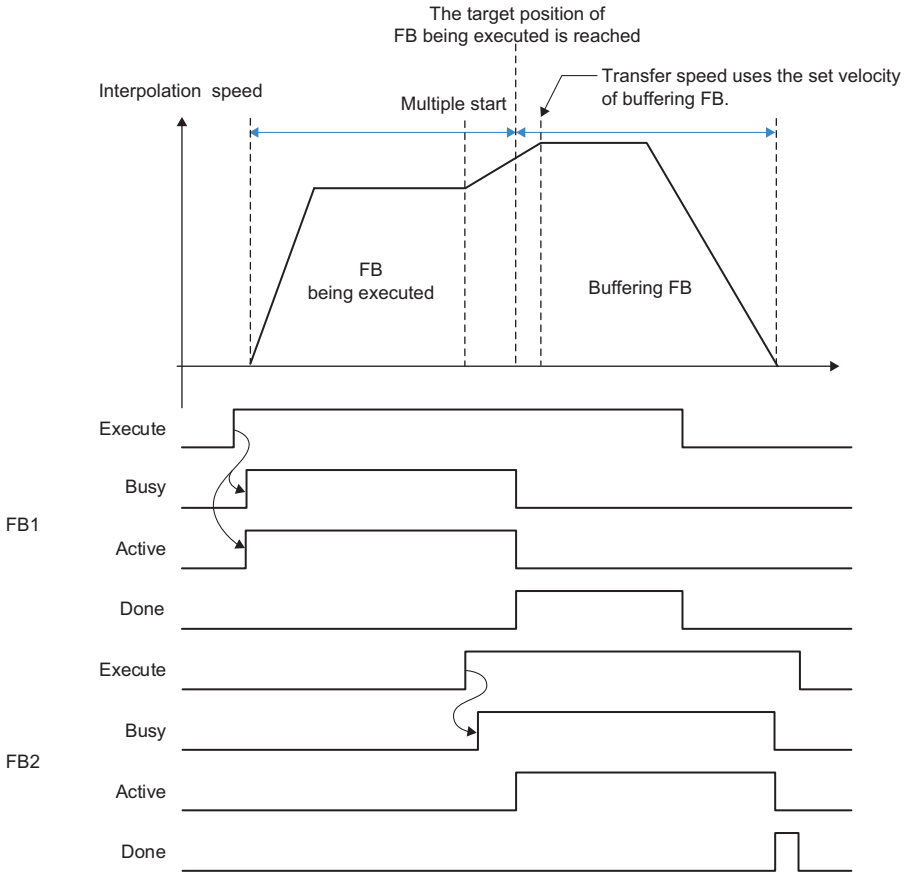


■BlendingNext

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 on-going FB.



Depending on the multiple start timing, the movement amount to change velocity to the target velocity of the FB that is during buffering at the target position of the on-going 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 on-going FB.



■BlendingLow

The slower target velocity between the on-going FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the on-going FB commanded speed is slower, and it is same as BlendingNext when the buffering FB commanded speed is slower.

■BlendingHigh

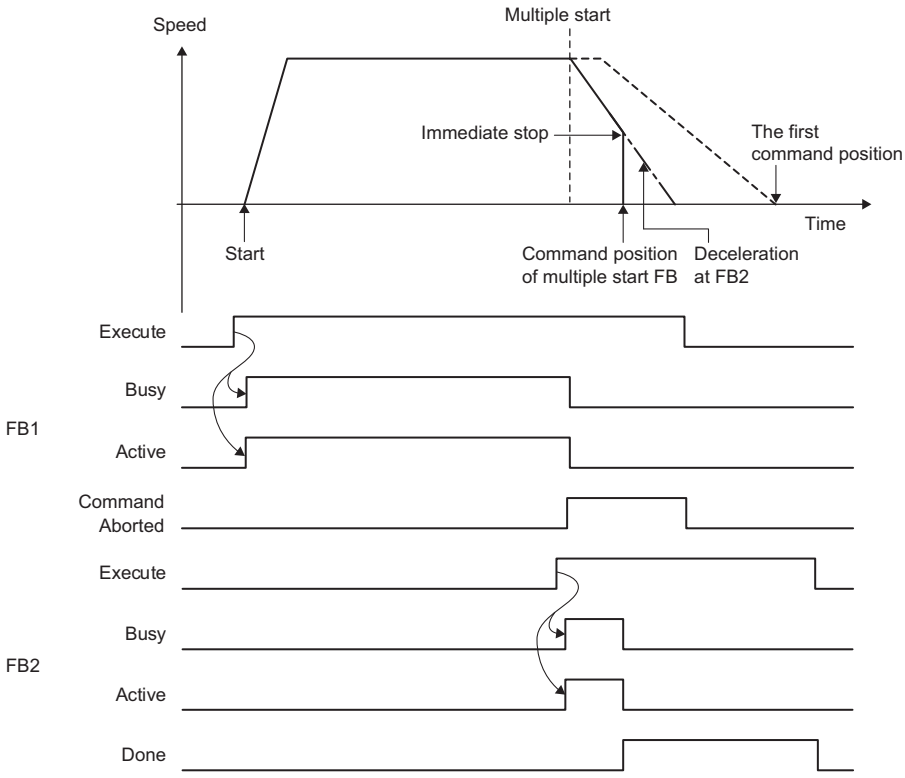
The higher target velocity between the on-going FB and the buffering FB is used as the switching speed.
The operation is same as BlendingPrevious when the on-going FB commanded speed is higher, and it is same as BlendingNext when the buffering FB commanded speed is higher.

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 AxisName(AxesGroupName).Pr.OverrunOperation settings.

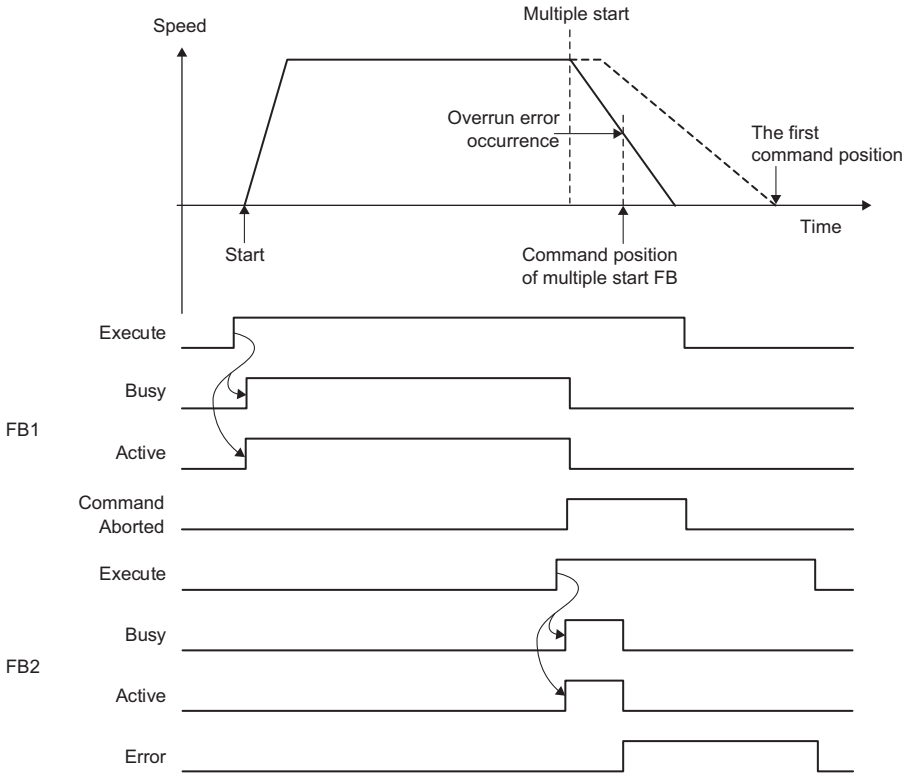
- For "1: ImmediateStop"

The axis starts deceleration immediately, and it stops immediately at reaching the target position after outputting the warning "Overrun Warning" (warning code: 0D10H).



• For "2: KeepCurrentAcc" (Only for single axis)

The axis starts deceleration immediately, and it stops after exceeding the target position. When the stop address is exceeded, the error "Overrun Error" (error code: 1A7EH) is output. However, when the error occurs, the operation stops according to the setting of AxisName.Pr.StopMode_General. To stop the axis after it exceeds the target position, set "2: KeepCurrentAcc" in AxisName.Pr.StopMode_General.



Point

When a new FB is multiple started during deceleration by movement amount shortage, the operation becomes as the following.

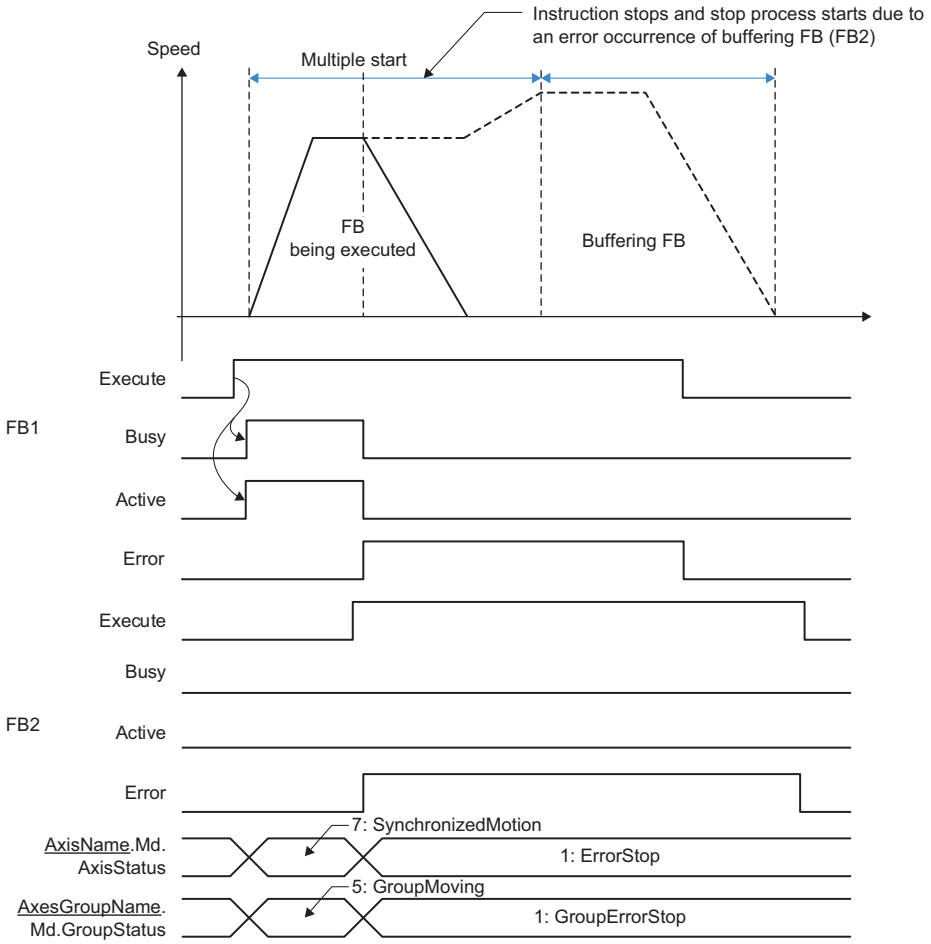
[When AxisName.Pr.OverrunOperation is "2: KeepCurrentAcc" setting]

- If the target position has already been reached when the multiple start happens (when the error "Overrun Error" (error code: 1A7EH) occurs), the multiple started FBs 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 the error "Overrun Error" (error code: 1A7EH) occurrence.

[When AxisName.Pr.OverrunOperation is other than "2: KeepCurrentAcc" setting]

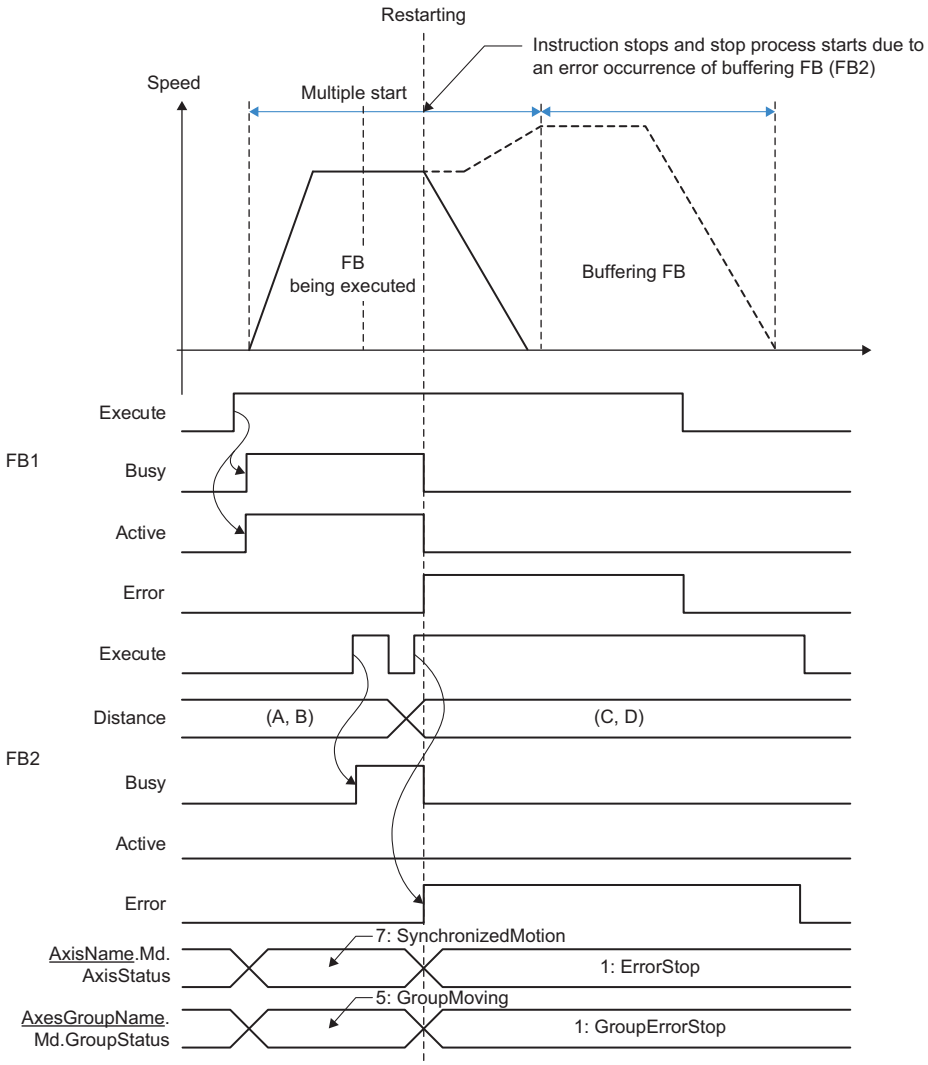
- If a new FB is multiple started when Aborting and Blending are set, deceleration stop will be canceled.
- If a new FB is multiple started when Buffered is set, automatic deceleration will be continued. The multiple started axes will be executed after the axis stops.

If an error occurs in the following FB analysis processing at multiple start, the axis status (AxisName.Md.AxisStatus) and the axes group status (AxesGroupName.Md.GroupStatus) will be error stop and the on-going FBs will stop.



When the target position or the target velocity is changed at restart or continuous update to on-going FB, the buffering FB may have to be reanalyzed.
As a result of reanalysis, if an error occurs in any FB, the axis status (AxisName.Md.AxisStatus) and the axes group status (AxesGroupName.Md.GroupStatus) will be error stop and the on-going FBs will be interrupted and stop. (Buffering FB will be canceled.)

Ex.
When the target position after change is outside the software stroke limit range by restart of buffering FB



If the acceleration/deceleration method settings are different between on-going FB and the next FB, the error "Acceleration/ Deceleration Method Mismatched" (error code: 1A0EH) will occur and the FBs will stop. Set the same acceleration/ deceleration method in the FBs to be carried out multiple start.
When MC_MoveRelative is multiple started, the relative value positioning control from the set position or the actual current value is performed with the position selection at BufferMode (1: mcBuffered Buffered) of the FB (Options bit3).

4.4 Stop

This section describes how to stop control.

Each control is stopped in the following cases.

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" of MC_Power is FALSE
- When "ServoON" of MC_Power is FALSE
- When the hardware stroke limit upper/lower limit error occurs
- When a CPU module error occurs
- When the "PLC READY [Y0]" is turned OFF
- When the software stroke limit upper/lower limit error occurs
- When an axis error is detected
- When "Execute" of MC_Stop is TRUE
- When the "Stop signal" of external input signal is TRUE

Hardware stroke limit upper/lower limit error	Software stroke limit upper/lower limit error
• Error "FLS Signal Detection (at Start)" (error code: 1A2DH) • Error "RLS Signal Detection (at Start)" (error code: 1A2EH) • Error "FLS Signal Detection (Controlling)" (error code: 1A2FH) • Error "RLS Signal Detection (Controlling)" (error code: 1A30H)	• Error "Software Stroke Limit Over (Forward Direction)" (error code: 1A03H) • Error "Software Stroke Limit Over (Reverse Direction)" (error code: 1A04H)

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 "Execute" of MC_GroupStop is TRUE
- When the "Stop signal" of external input signal is TRUE

This section describes stop processing other than when each control in the above cases is completed normally.

For operation details when a stop cause occurs in another function (stop processing of homing, etc.), refer to each function.

Relevant variables/FB

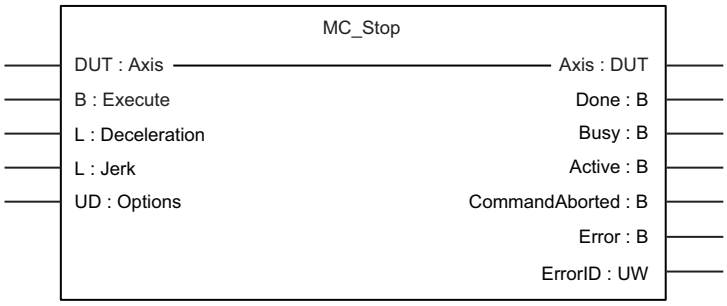
Variable/Structure name	Name	Details
AxisName.Pr.		
StopMode_HwStrokeLimit	Stop selection at H/W stroke limit error occurrence	Selects operation when the hardware stroke limit upper/lower limit error occurs. 1: ImmediateStop (Immediate Stop) (Initial value) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_SwStrokeLimit	Stop selection at S/W stroke limit error occurrence	Selects operation when the software stroke limit upper/lower limit error occurs. 1: ImmediateStop (Immediate stop) (Initial value) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_General	Stop selection at stop by factors	Selects operation when a stop cause for each axis other than the stop cause 1 and 2 occurs. 1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (initial value) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_Deceleration	Deceleration at stop	Specifies the deceleration 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 2,147,483,647 U/s^{2*1} • When acceleration/deceleration method to specify the acceleration/deceleration time Unit: specify with s. Range: 0.0000, a positive number from 0.0001 to 8400.0 s^{*1} If 0 is set, immediately stops regardless of the operation selection at acceleration/deceleration 0 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). 0: RapidCurve (Recreate deceleration curve at increased deceleration) 1: OverrideCurve (Recreate deceleration curve) (Initial value) 2: ContinueCurve (Maintain deceleration curve)
StopMode_ServoOff	Process selection at servo OFF command during operation	Selects operation when ServoON of MC_Power turns FALSE during operation. 0: Ignore (Ignore) (Initial value) 4: ServoOffAfterImmediateStop (Servo OFF after immediate stop) 5: ServoOffAfterDecelStop (Servo OFF after deceleration to stop)
OverrunOperation	Operation setting at overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. 1: ImmediateStop (Immediate stop) (Initial value) 2: KeepCurrentAcc (Keep current acceleration/deceleration)

Variable/Structure name		Name	Details
	StopSignal	Stop signal	Sets a signal that uses the stop signal (STOP) of the external input signal. StopSignal is a structure of SIGNAL_SELECT type. Refer to the following for the details of the SIGNAL_SELECT type. ☞ Page 398 External Signal Selection The specific setting and operation for this signal are below. • IO No. Ignores input values. • Target If the target is unspecified, it is regarded as invalid signal and it is always the signal undetection status. When unavailable data is set, the error "Target of STOP Signal Incorrect" (error code: 1AC6H) is output. • Signal detection method The specification is allowed at the following level detection only.When edge detection specification is set, the error "Out of Signal logical setting of STOP signal range" (error code: 1AD3H) is output. 0: HighLevel (Detection at TRUE) 1: LowLevel (Detection at FALSE) • Compensation time Ignores the input value. • Filter time Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting of STOP Signal Range Warning" (warning code: 0D26H) is output. The fetch timing of the label is at ready ON and the detection timing of the signal is the axis operation cycle.
	StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Select whether to detect the command discard status (Statusword bit12) of the driver module and stop with error during operation of the axis or not. 0: FALSE Detection Disabled 1: TRUE Detection Enabled (Initial value)
AxisName.Md.			
	StopSignal	Stop signal	Displays input status of the stop signal (STOP) of the external input signal. StopSignal is a structure of SIGNAL_SELECT type. Refer to the following for the details of the SIGNAL_SELECT type. ☞ Page 398 External Signal Selection The specific output for this signal is below. • IO No. 0 is always displayed. • Target The fetch result of the parameter is displayed. • Signal detection method The fetch result of the parameter is displayed. • Compensation time 0.0 is always displayed. • Filter time The fetch result of the parameter is displayed.
	StopStatus	Stop status	Displays the input status of stop signal (STOP) among external input signals.
	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 by factors	Displays input status of the stop selection at stop cause occurrence.
	StopMode_HwStrokeLimit	Stop selection at H/W 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 S/W stroke limit error occurrence	Displays input status of the stop selection at the software stroke limit error occurrence.
	OverrunOperation	Operation setting at overrun	Displays input status of the overrun operation setting.
	StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Displays driver command discard detection setting status
AxesGroupName.Pr.			

Variable/Structure name		Name	Details
	StopMode_General	Stop selection at stop by factors	Selects operation when a stop cause of the axes group occurs. 1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (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). 0: RapidCurve (Recreate deceleration curve at increased deceleration) 1: OverrideCurve (Recreate deceleration curve) (Initial value) 2: ContinueCurve (Maintain deceleration curve)
	OverrunOperation	Operation setting at overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. If other than "1: ImmediateStop" (Initial value) is set, an error will occur. 1: ImmediateStop (Immediate stop)
	StopMode_ErrorInGroup	Structuring axis operation selection at axis stop by factors	During operation in the axes group, when the driver servo is turned OFF on the configuration axis and an immediate stop axis error occurs, it sets the operation of the axes other than the axis error occurred. 1: ImmediateStop (Immediate stop) (Default value) 4: ServoOffAfterImmediateStop (Servo OFF after immediate stop)
	StopMode_Deceleration	Deceleration at stop	Specifies the deceleration 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 happen regardless of the operation selection at acceleration/deceleration 0 setting.
AxesGroupName.Md.			
	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	Structuring axis operation selection at axis stop by factors	Displays input status of the configuration axes operation setting at axis stop cause occurrence.
	StopMode_General	Stop selection at stop by factors	Displays input status of the stop selection at stop cause occurrence.
	OverrunOperation	Operation setting at overrun	Displays input status of the overrun operation setting.
System.Pr.			
	StopMode_All	Stop selection at all axes stop by factors	Selects whether to stop immediately or decelerate to stop when an all axes stop cause occurs. 1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (initial value) (Immediate stop will be executed when executing an instruction without deceleration specification.)
	StopMode_AllDeceleration	Deceleration at all axes stop	Specifies the deceleration at deceleration stop when an all axes stop cause occurred. • When acceleration/deceleration methodto specifythe 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 happen regardless of the operation selection at acceleration/deceleration 0 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.

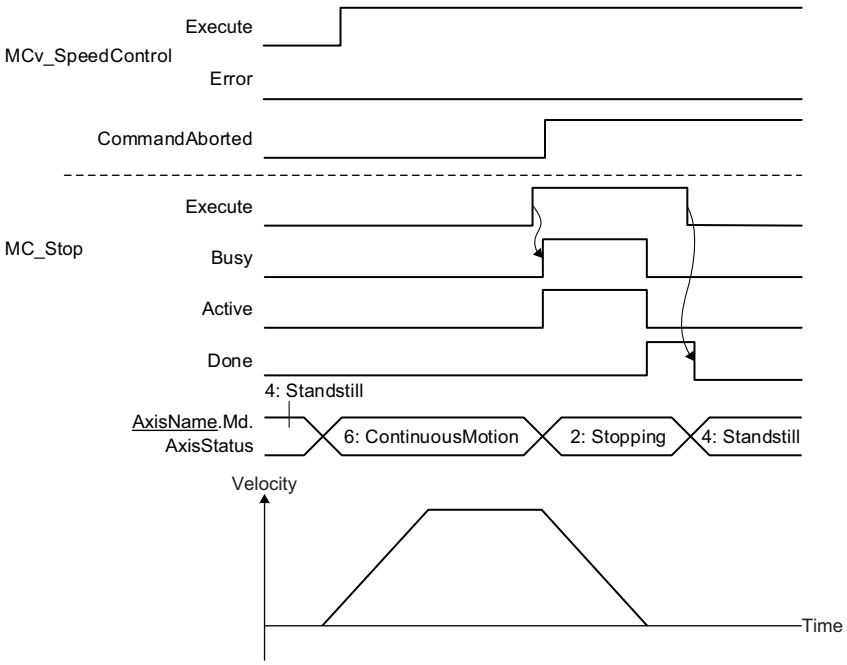
MC_Stop

Item	Description
Function overview	Decelerates specified axis to stop.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input are points (byte)	Number of output area points (byte)	Compiling method	FB operation type
36	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

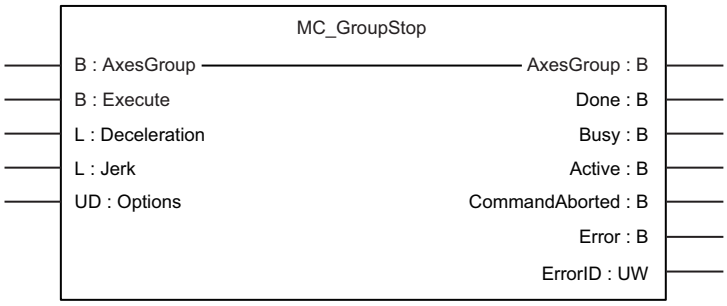
Import ↑: At start, R: Retrigger possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Deceleration	Deceleration	LREAL	↑/R	☞ Page 314 Relevant variables	0.0	Sets the deceleration.
Jerk (Reserved)	Jerk	LREAL	↑/R	☞ Page 314 Relevant variables	0.0	Set "0". (If a value other than "0" is set, an error will occur.)
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (If a value other than "0" is set, an error will occur.)

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the velocity has reached 0.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

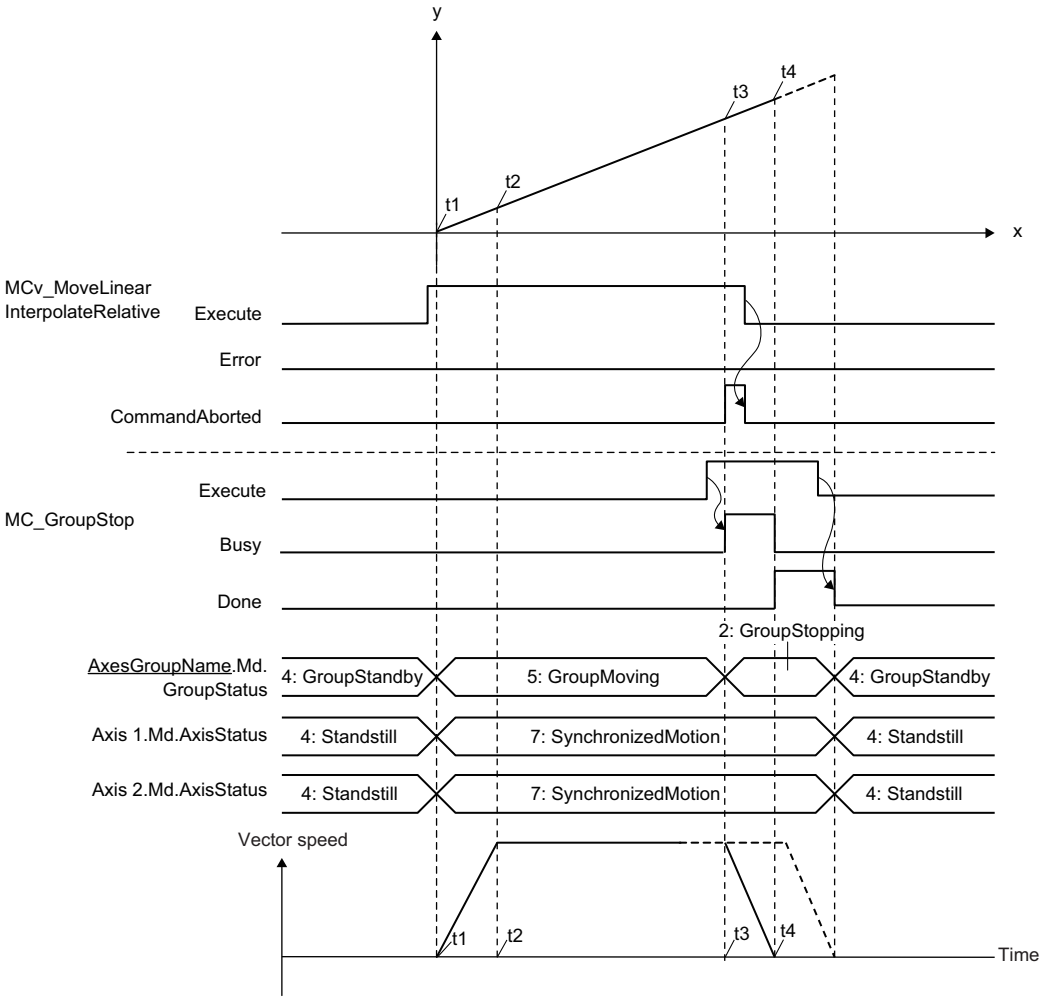
MC_GroupStop

Item	Description
Function overview	Decelerates specified axes group to stop.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text) SWDTD-MIMSn1-M (C++)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
36	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ↑: At start, R: Retrigger possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Deceleration	Deceleration	LREAL	↑/R	☞ Page 314 Relevant variables	0.0	Sets the deceleration.
Jerk (Reserved)	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0.0	Set "0". (If a value other than "0" is set, an error will occur.)
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (If a value other than "0" is set, an error will occur.)

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the velocity has reached 0.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

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: ErrorStop	Immediate stop[*2]
2	Drive unit power supply is OFF	Each axis	—	1: ErrorStop	Immediate stop[*2]
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable of MC_Power is FALSE				
	ServoON of MC_Power is FALSE (When AxisName.Pr.StopMode_ServoOff is "4: Servo OFF After Immediate Stop")[*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: ErrorStop	1: ErrorStop	Deceleration stop/immediate stop (Follows AxisName.Pr.StopMode_HwStrokeLimit)
4	CPU module error occurrence	All axes	1: ErrorStop	1: ErrorStop	Deceleration stop/immediate stop (Follows System.Pr.StopMode_All)
	PLC READY [Y0] is OFF				
5	Software stroke limit upper/lower limit error occurrence	Each axis	1: ErrorStop	1: ErrorStop	Deceleration stop/immediate stop (Follows AxisName.Pr.StopMode_SwStrokeLimit)
6	Axis error detection[*4]	Each axis	1: ErrorStop	1: ErrorStop	Deceleration stop/immediate stop (Follows AxisName.Pr.StopMode_General)
7	Execute of MC_Stop is TRUE	Each axis	2: Stopping	2: Stopping[*5]	Deceleration stop (Follows the deceleration set in the FB)
8	"Stop signal" of external input signal is TRUE	Each axis	No change	4: Standstill	Deceleration stop/immediate stop (Follows AxisName.Pr.StopMode_General)

*1 For each operation of the stop process, refer to the following.
☞ Page 158 Stop processes for single axis

*2 The servo turns OFF in the driver side and immediate stop is performed, and also the motion side command is stopped.

*3 Operation differs depending on the setting value selected in AxisName.Pr.StopMode_ServoOff. For details, refer to the following.
☞ Page 162 Stop causes by ServoON input of MC_Power

*4 If an axis error (the error that transits the state into the "1: ErrorStop" status) occurs in the FB which can be linked by the buffer mode, deceleration stop will be performed from the error occurrence.

*5 When Execute of MC_Stop is FALSE at stop completion, the axis status (AxisName.Md.AxisStatus) after stop will be "4: Standstill".

*6 Immediately stops the motion system side command, and follow up on the current position.

Precautions

Provide the emergency stop circuits outside the servo system to prevent cases where danger may result from abnormal operation of the overall 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: GroupErrorStop	1: GroupErrorStop	Stop cause occurrence axis	Axes group deceleration stop/immediate stop[*2] (For axes group deceleration stop, it follows AxesGroupName.Pr.StopMode_General)
						Other configuration axes	Axes group deceleration stop/immediate stop (For axes group deceleration stop, it follows AxesGroupName.Pr.StopMode_General)[*3]
2		"Stop signal" of external input signal is TRUE	Axes group	No change	4: GroupStandby	Axes group deceleration stop/immediate stop (Follows AxesGroupName.Pr.StopMode_General)	
3	Axes group error detection[*4]		Axes group	1: GroupErrorStop	1: GroupErrorStop	Axes group deceleration stop/immediate stop (Follows AxesGroupName.Pr.StopMode_General)	
4	Execute of MC_GroupStop is TRUE		Axes group	2: GroupStopping	2: GroupStopping[*5]	Axes group deceleration stop (Follows the deceleration set in the FB)	

*1 For each operation of the stop process, refer to the following.
☞ Page 159 Stop processes for axes group

*2 The servo OFF is executed in the driver side and the axis immediately stops, 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 AxesGroupName.Pr.StopMode_ErrorInGroup. For details, refer to the following.
☞ Page 168 Stop cause occurrence in the configuration axis

*4 If an axes group error (the error that transits the state into the "1: 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 Execute of MC_GroupStop is FALSE at stop completion, the axes group status (AxesGroupName.Md.GroupStatus) after stop will be "4: GroupStandby".

Types of stop processes

This section describes types of stop processes for a single axis and an axes group.

Stop processes for single axis

■Deceleration stop

The operation decelerates from the speed during operation to speed 0. The deceleration differs depending on AxisName.Pr.StopMode_General.

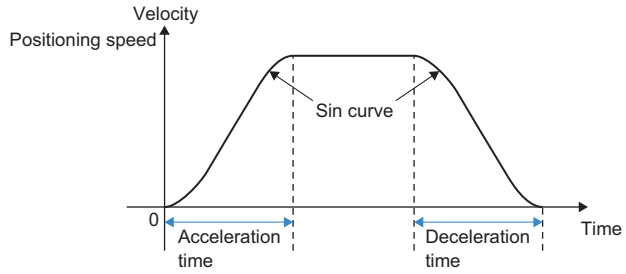
AxisName.Pr.StopMode_General setting value	Deceleration at stop
2: KeepCurrentAcc	Deceleration at instruction during operation
3: AlternativeAcc	AxisName.Pr. StopMode_Deceleration

However, the stop is performed by the MC_Stop execution, the deceleration specified in the Deceleration input is applied.

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.

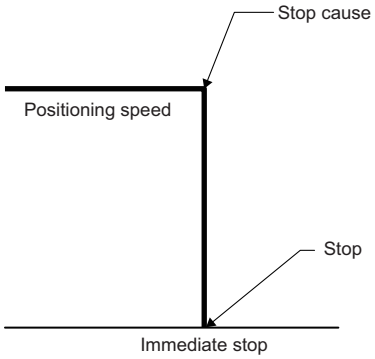
☞ Page 312 Acceleration/deceleration Processing Function



■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.



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 AxesGroupName.Pr.StopMode_General.

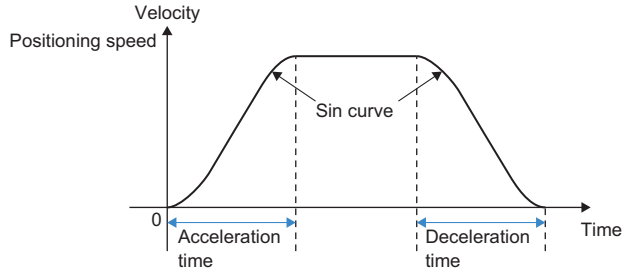
AxesGroupName.Pr.StopMode_General setting value	Deceleration at stop
2: KeepCurrentAcc	Deceleration at instruction during operation
3: AlternativeAcc	AxesGroupName.Pr. StopMode_Deceleration

However, the stop is performed by the MC_GroupStop execution, the deceleration specified in the Deceleration input is applied.

The acceleration/deceleration method and the jerk setting of deceleration stop take over the setting value of FB which was being executed when stop cause occurred.

For specifications of each stop method, refer to the following.

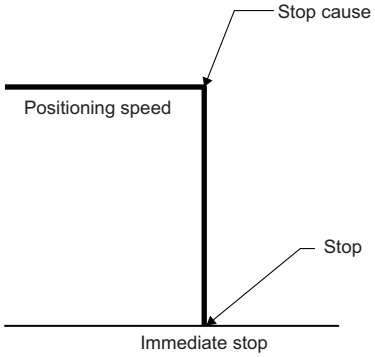
☞ Page 312 Acceleration/deceleration Processing Function



■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.



Order of priority for stop process

This section describe 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.

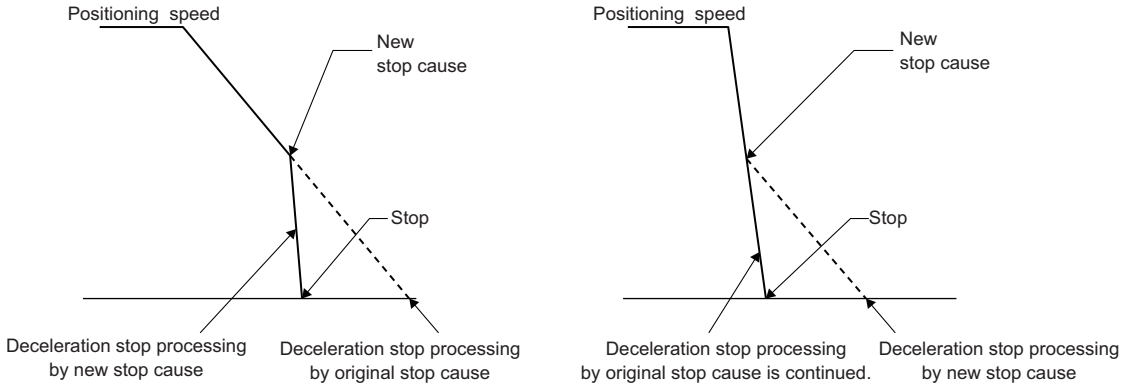
- Single axis: AxisName.Pr.StopMode_DecelerationCurve
- Axes group: AxesGroupName.Pr.StopMode_DecelerationCurve

For AxisName.Pr.StopMode_DecelerationCurve/AxesGroupName.Pr.StopMode_DecelerationCurve, select one of the following three types of operation.

Deceleration curve re-processing for big setting value of the deceleration

0: RapidCurve

A deceleration curve is re-processed when the deceleration setting value of the new stop cause is bigger (when the operation can be stopped earlier).



Deceleration curve re-processing

1: 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: ImmediateStop" in AxisName.Pr.OverrunOperation.

For operation details, refer to the following.

☞ Page 161 Overrun at stop cause occurrence

Deceleration curve continuation

2: ContinueCurve

The current deceleration curve is continued even if multiple stop causes of deceleration stop occurred.

To stop immediately during deceleration, a stop cause whose stop process is the immediate stop needs to be occurred.

Ex.

Forced stop, Enable of MC_Power is FALSE, etc.

Overrun at stop cause occurrence

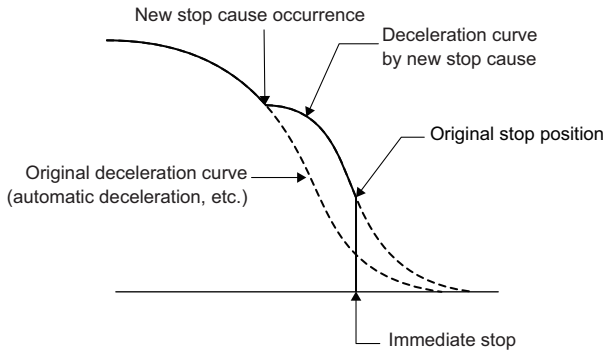
This function selects operation for the case that the positioning address of an instruction which was executed before a stop cause occurs is reached during deceleration stop and immediate stop process.
This function is enabled only when the target position exists at stop cause occurrence.
The following parameters for a single axis or an axes group are need to be set in this function.

- Single axis: AxisName.Pr.OverrunOperation
- Axes group: AxesGroupName.Pr.OverrunOperation

AxisName.Pr.OverrunOperation and AxesGroupName.Pr.OverrunOperation have the following two functions.

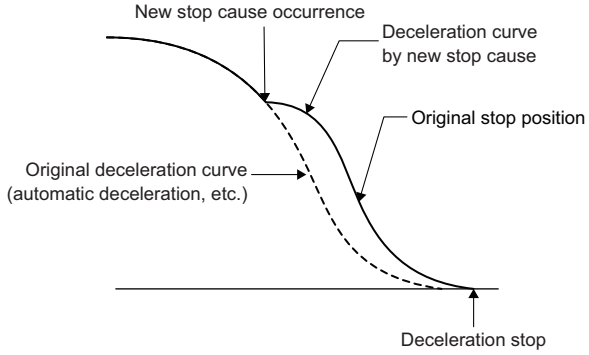
Immediate stop

1: 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 on-going FB.



Keep current acceleration/deceleration (Only for a single axis)

2: 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 on-going FB.



Stop during single axis operation

This section explains 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.

- "Forced stop input" is turned OFF from an external device
- Drive unit power supply OFF
- Drive unit network disconnection detection
- Drive unit error
- Forced stop input to drive unit
- "Enable" of MC_Power is FALSE

The forced stop input is set in AxisName.Pr.ForcedStop_Signal. For operation details, refer to the following.
☞ Page 176 Forced Stop

Stop causes by ServoON input of MC_Power

■Processing selection at servo OFF during operation

When ServoON of MC_Power is turned FALSE, the stop operation differs depending on the AxisName.Pr.StopMode_ServoOff setting. The processing selection at servo OFF command during operation has the following three functions.

- Operation continuation
  0: Ignore

During operation, this function ignores the servo OFF command even though it is input and continues on-going operation. If ServoON of MC_Power is turned FALSE when the axis status (AxisName.Md.AxisStatus) of the operation completion axis turns "4: Standstill", servo OFF will be executed. (The axis will not stop.)

- Immediate stop servo OFF
  4: ServoOffAfterImmediateStop

During operation, the command is immediately stopped by the error "Immediate Stop by Servo OFF During Operation" (error code: 1A3CH) occurrence, and a servo OFF is issued to the driver.

- Deceleration stop, and servo OFF after stop completion
  5: ServoOffAfterDecelStop

During operation, when receiving the servo OFF command input, the error "Deceleration Stop by Servo OFF During Operation" (error code: 1A3BH) occurs and deceleration stop is executed. If ServoON of MC_Power is FALSE when the operation has reached speed 0, servo OFF will be executed.

■Axis state transition

The axis state changes based on the input combination of Enable and ServoON of MC_Power.

Axis status before input operation (AxisName.Md.AxisStatus)	Input		Processing selection at servo OFF command during operation	Axis status after input operation (AxisName.Md.AxisStatus)
	Enable	ServoON		
4: Standstill 0: Disabled	TRUE	TRUE	Independent of the setting	4: Standstill
		FALSE		0: Disabled
	FALSE	TRUE		0: Disabled
		FALSE		0: Disabled
1: ErrorStop	TRUE	TRUE		1: ErrorStop
		FALSE		1: ErrorStop
	FALSE	TRUE		1: ErrorStop
		FALSE		1: ErrorStop
Other than above	TRUE	TRUE		No transition
		FALSE	0: Ignore	No transition*1*2
			4: ServoOffAfterImmediateStop	1: ErrorStop*4
			5: ServoOffAfterDecelStop	1: ErrorStop*3
	FALSE	TRUE	Independent of the setting	1: ErrorStop*4
		FALSE		1: ErrorStop*4

*1 It is "0: Disabled" when the axis status (AxisName.Md.AxisStatus) is "4: Standstill" after deceleration stop.

*2 The axis status (AxisName.Md.AxisStatus) will not transit if the axis status (AxisName.Md.AxisStatus) is "1: ErrorStop" or "2: Stopping" after deceleration stop.

*3 If Enable turns FALSE during operation, the error "Deceleration Stop by Servo OFF During Operation" (error code: 1A3BH) will occur.

*4 When Enable turns FALSE during operation, the error "Immediate Stop by Servo OFF During Operation" (error code: 1A3CH) occurs. In this case, on-going 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 AxisName.Pr.StopMode_HwStrokeLimit.

For details, refer to the following.

☞ Page 306 Hardware Stroke Limit

CPU module error occurrence

When the stop error occurs in the control CPU module, PLC READY [Y0] holds ON, and the motion side will be STOP status.

PLC READY [Y0] OFF

When the PLC READY [Y0] is turned OFF, the operation stops according to the process selected by System.Pr.StopMode_All.

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 AxisName.Pr.StopMode_SwStrokeLimit.

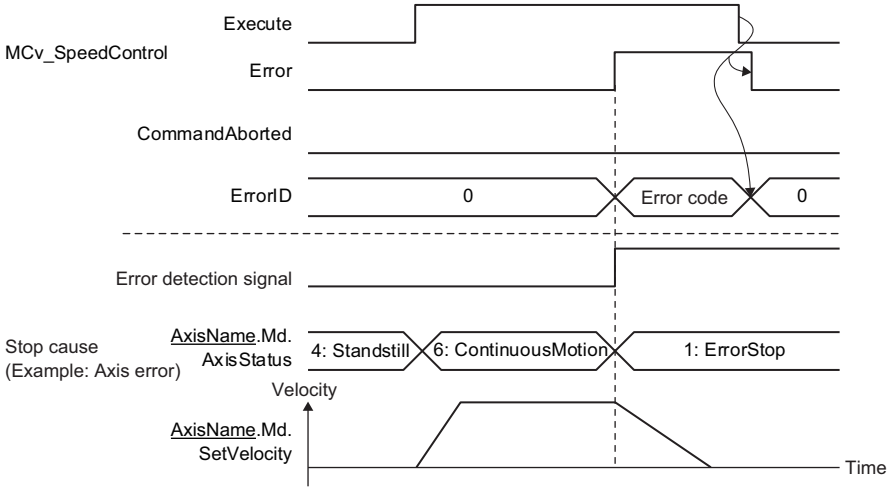
For details, refer to the following.

☞ Page 300 Software Stroke Limit

Axis error detection

When an axis error other than the hardware stroke limit upper/lower limit error, the CPU module error, an error by the PLC READY [Y0] OFF, the software stroke limit upper/lower limit error, and an axis error other than the drive unit error is detected, the operation stops according to the process selected by AxisName.Pr.StopMode_General. In this case, the axis status (AxisName.Md.AxisStatus) transits to "1: ErrorStop".

• Operation of the FB that received a stop cause by axis error occurrence



■Driver command discard detection

By setting AxisName.Pr.StopOption_DriverTargetIgnored, when the driver unit Statusword Bit12 turns ON to OFF during axis operation at the real drive axis, the error "Driver Command Discard Detection" (error code: 1AE6H) is output and can stop the command.

When the error "Driver Command Discard Detection" (error code: 1AE6H) occurs, a stop error may occur before and after of its occurrence as the detection factor. Confirm the details before and after of the error with the event history.

When executing the limit detection at the driver unit side, the controller side command can be stopped to corresponds to the driver side stop operation. (The Statusword of the connected real drive axis can be monitored by AxisName.Md.Io_Statusword.)

For details, refer to the following.

☞ Page 306 Hardware Stroke Limit

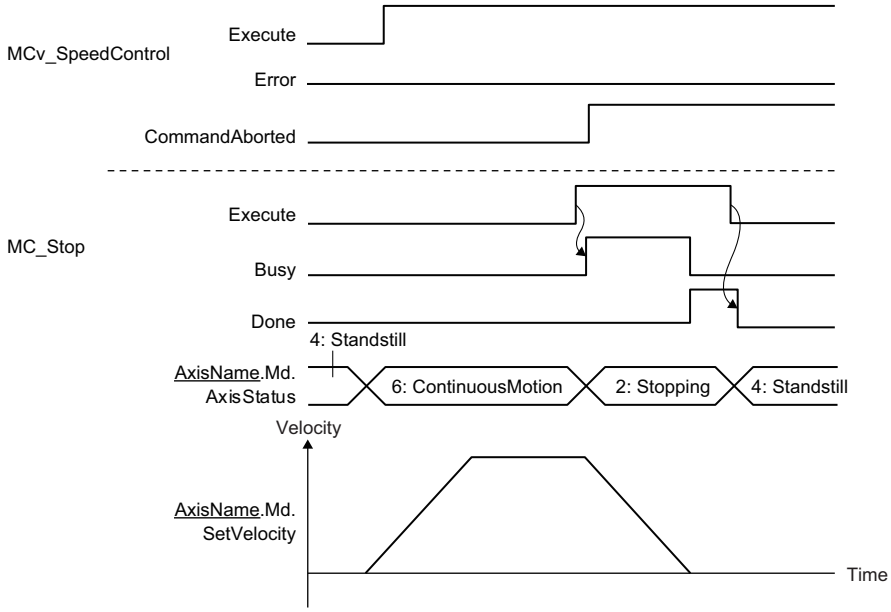
The details of Statusword Bit12 differs depending on the connect driver unit control mode. Also, for Statusword changing conditions etc., refer to the connected device driver unit manuals.

Driver control mode	Statusword[Obj.6041h]Bit12 abbreviation	Description
Cyclic synchronous position control(csp)	Target position ignored	0: Target position [Obj. 607Ah] discarding
Cyclic synchronous velocity control(csv)	Target velocity ignored	0: Target velocity [Obj. 60FFh] discarding
Cyclic synchronous torque control(cst)	Target torque ignored	0: Target torque [Obj. 6071h] discarding
Other than the above	—	Not checked

MC_Stop (Forced stop)

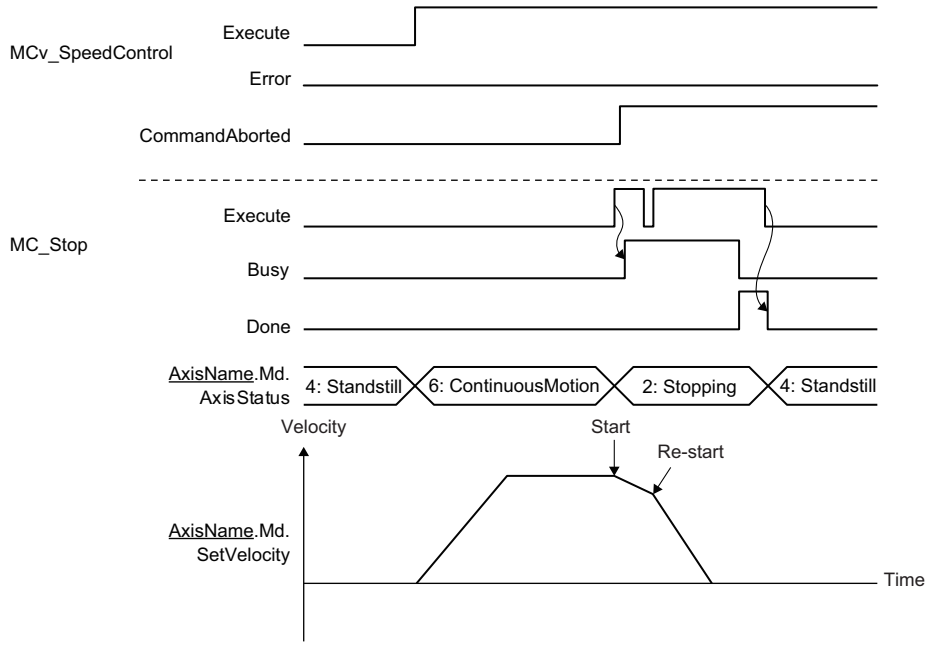
In MC_Stop, the deceleration (Deceleration) is set and on-going instruction is decelerated to a stop.
When MC_Stop is executed, CommandAborted of on-going instruction turns TRUE and the axis status (AxisName.Md.AxisStatus) transits to the "2: Stopping" status. While Execute is TRUE or while the speed does not reach 0, the "2: Stopping" status is maintained. When Done turns TRUE and Execute turns FALSE at stop completion, the axis status changes to the "4: Standstill" status.

■MCv_Stop execution during MC_SpeedControl

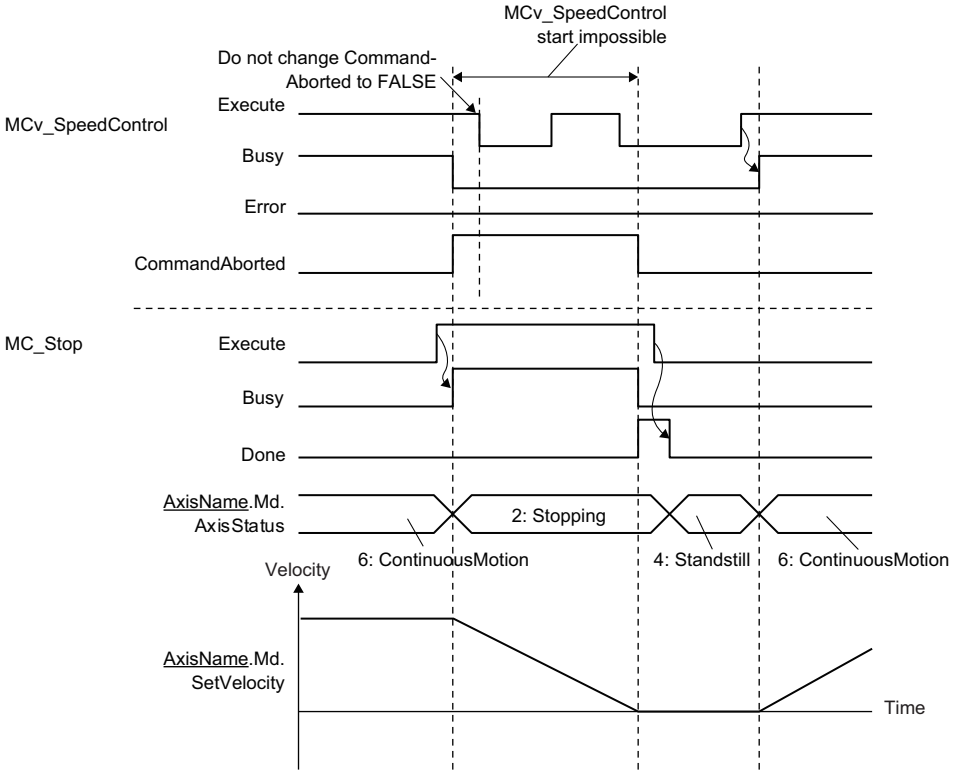


■Operation description

- During deceleration stop by this FB and while Execute (start) of the input variable is TRUE, any operation command other than MC_Stop is not accepted.
- If the deceleration is set to 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 decelerate.
- If MC_GroupStop is executed during single axis synchronous control, synchronization to the master axis will be canceled.
- When the setting value of Deceleration is changed and MC_Stop is restarted
  A deceleration stop is executed from the restart point based on Deceleration set in MC_Stop.



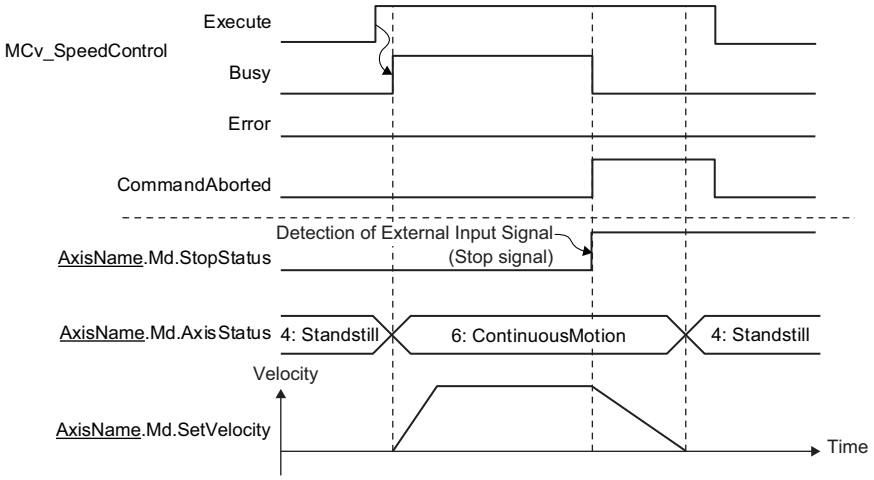
- When an FB that operates axes other than MC_Stop is executed while the axis status (AxisName.Md.AxisStatus) is the "2: Stopping" status
  The error "Start Not Possible" (error code: 1AADH) occurs and Error of MC_Stop turns TRUE, and then the axis status (AxisName.Md.AxisStatus) changes to "1: ErrorStop".
- After axis stop, the axis status can be transited to "4: Standstill" by executing AxisName.Cd.ErrorReset.
- Even if Execute of command aborted FB by MC_Stop set to FALSE, once the stop operation is started, TRUE of CommandAborted will be continued until it is completed. After it stops completely, changes CommandAborted to FALSE if Execute of command aborted FB is FALSE.



"Stop signal" of external input signal is TRUE

The operation executed now is stopped by turnning the stop signal set in AxisName.Pr.StopSignal TRUE.

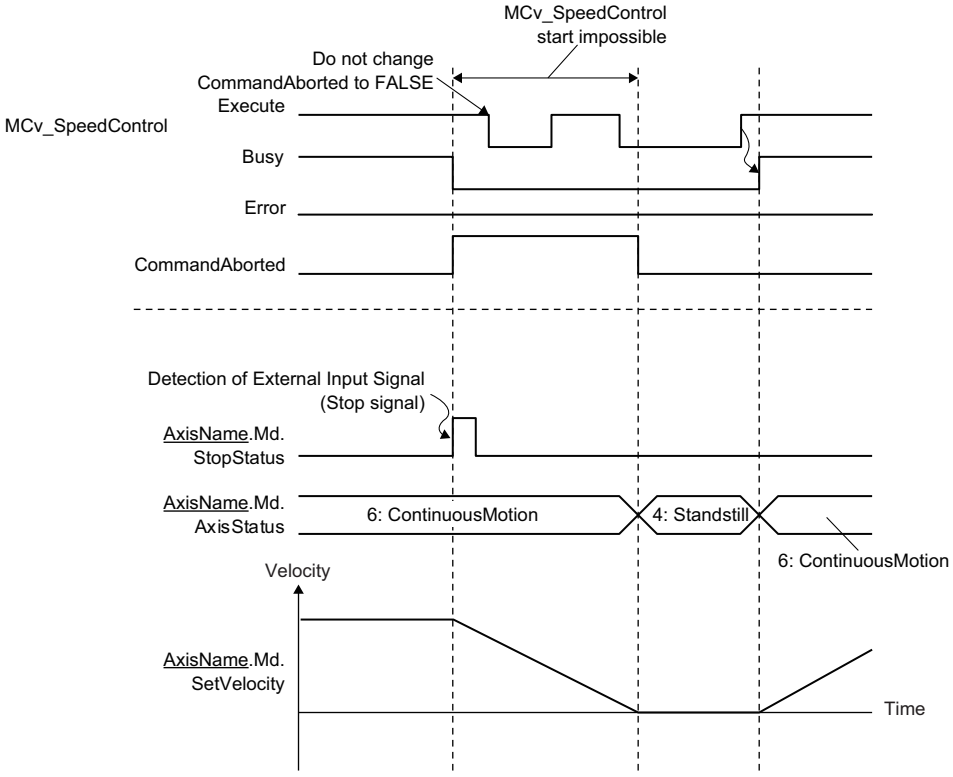
- The operation stops by the operation set in AxisName.Pr.StopMode_General.
- The operation which is executed now turns CommandAborted to TRUE by changing the stop signal to TRUE.
  When the speed reached 0, the axis status (AxisName.Md.AxisStatus) transits to "4: Standstill".



Point

- When the process is stopped by TRUE of AxisName.Pr.StopSignal, the axis status (AxisName.Md.AxisStatus) after stop will not change.
- The deceleration can be changed by executing MC_Stop while process stop is executed by TRUE of AxisName.Pr.StopSignal.
- The deceleration can be changed when AxisName.Pr.StopSignal is TRUE during MC_Stop execution. In this case, the axis status (AxisName.Md.AxisStatus) after deceleration stop will not change.

- Even if Execute of command aborted FB is set to FALSE by the stop signal, TRUE, once the stop operation is started, TRUE of CommandAborted will be continued until it is completed. After it stops completely, changes CommandAborted to FALSE if Execute of command aborted FB is FALSE.



Stop during axes group operation

This section explains each stop cause.

Stop cause occurrence in the configuration axis

The following shows axes group operation when a stop cause of the configuration axis occurs.

Stop cause occurrence axis				Axes group	
Cause No.	Stop cause	Axis status at stop cause occurrence (AxisName.Md.AxisStatus)	Stop process	Axes group status (AxesGroupName.Md.GroupStatus)	Stop process
1	"Forced stop input" is OFF	1: ErrorStop	Immediate stop*1	1: GroupErrorStop	Stop cause occurrence axis: Immediate stop Other configuration axes: Axes group deceleration stop/immediate stop (Follows AxesGroupName.Pr.StopMode_ErrorInGroup)
2	Drive unit power supply is OFF	1: ErrorStop			
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable of MC_Power is FALSE				
	ServoON of MC_Power is FALSE (When AxisName.Pr.StopMode_ServoOff is "4: ServoOffAfterImmediateStop")				
3	Hardware stroke limit upper/lower limit error occurrence	1: ErrorStop	Based on the axes group stop process		Axes group deceleration stop/immediate stop (Follows AxesGroupName.Pr.StopMode_General)
4	CPU module error occurrence	1: ErrorStop			
	PLC READY [Y0] is OFF				
5	Software stroke limit upper/lower limit error occurrence	1: ErrorStop			
6	Axis error detection	1: ErrorStop			
7	Execute of MC_Stop is TRUE	1: ErrorStop*2			
8	"Stop signal" of external input signal is TRUE	No change		No change	Axes group deceleration stop/immediate stop (Follows AxesGroupName.Pr.StopMode_General)

*1 The servo OFF is executed in the driver side and the axis immediately stops, 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 171 Axis error

When a stop cause has occurred in a configuration axis of the axes group, operation differs depending on the following four patterns.

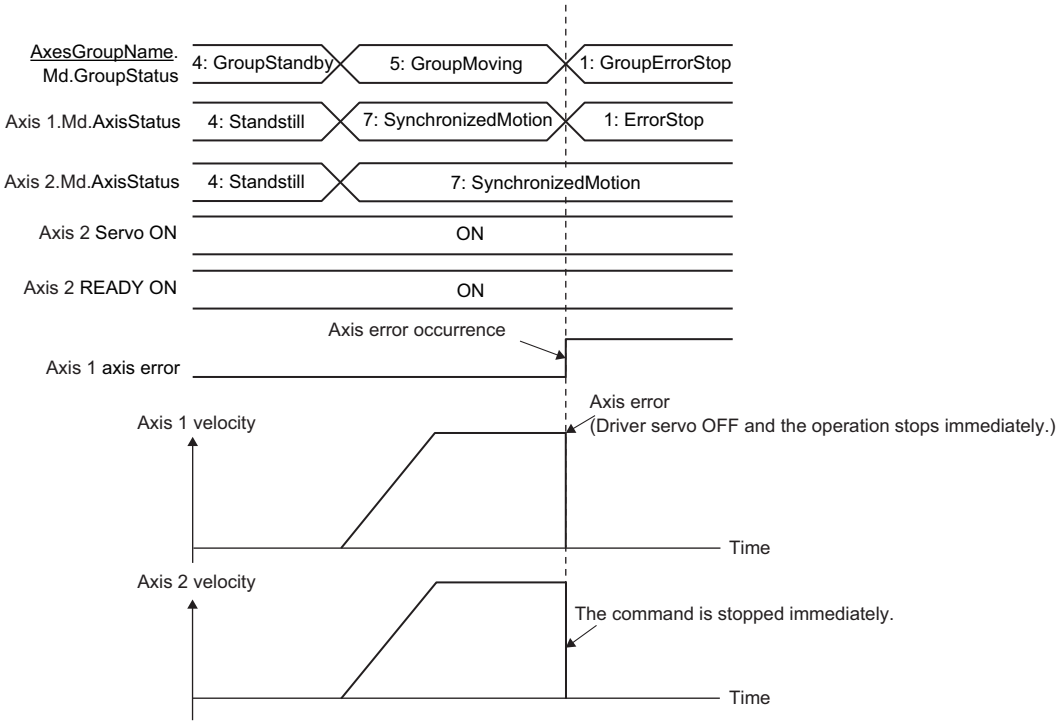
■For an axis error (driver servo OFF and immediate stop)

The error "Stop Cause of Axes Group Configuration Axis" (error code: 1A3DH) occurs in the axes group.
Also, if the driver servo OFF is executed and the configuration axis in which the stop cause occurred stops immediately, the other configuration axes will be operated according to the stop process selected in AxesGroupName.Pr.StopMode_ErrorInGroup.
When a stop cause has occurred in a configuration axis during the axes group operation, one of the following three methods can be selected to stop the other configuration axes.

- Immediate stop

  1: ImmediateStop

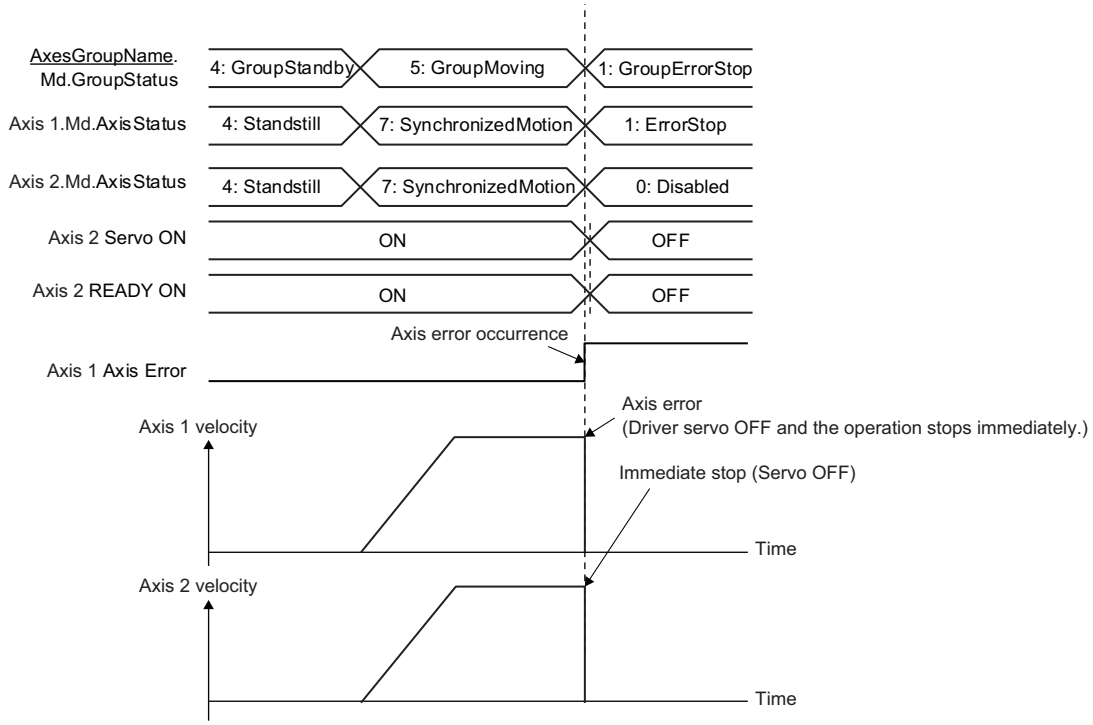
In the axes group configuration axes other than the axis which an axis error has occurred in, a command to the drive unit is stopped.



• Immediate stop and servo OFF

4: ServoOffAfterImmediateStop

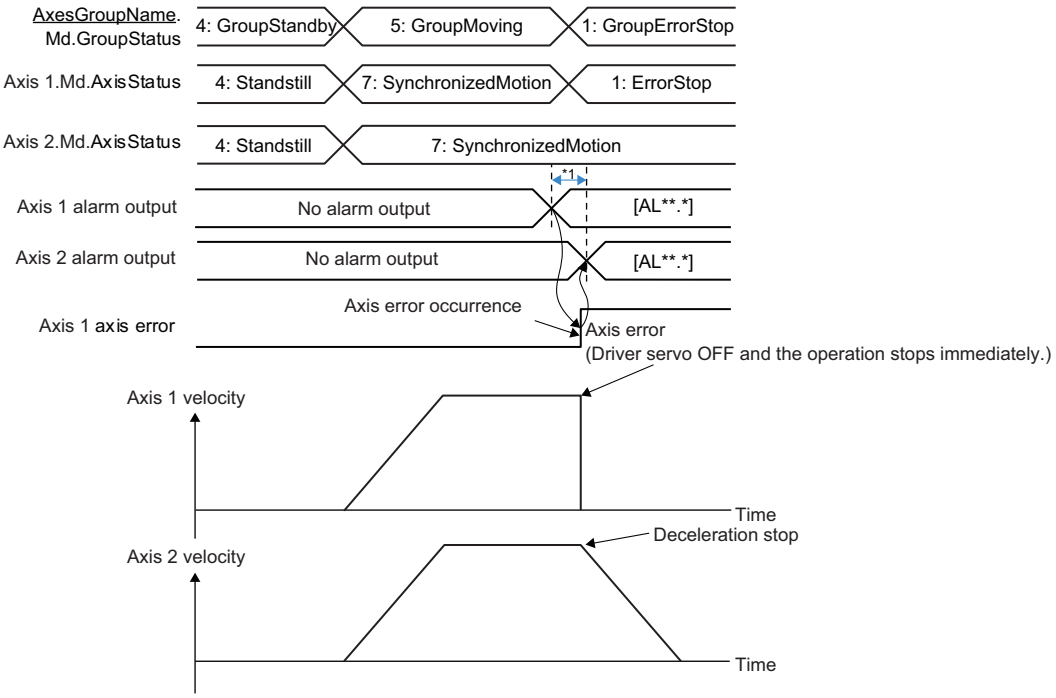
In the axes group configuration axes other than the axis which an axis error has occurred in, a command to the drive unit is stopped, and for real drive axes, the servo OFF command is issued to the drive unit.



• Servo OFF after deceleration to stop

5: ServoOffAfterDecelStop

The axes group configuration axes other than the axis which an axis error has occurred in decelerate to a stop at the deceleration set in AxesGroupName.Pr.StopMode_Deceleration. (The axes during servo OFF will be in the follow up status.)



*1 If a stop cause that performs servo OFF has occurred in the configuration axes, the axis error and the axes group error will be detected in the same operation cycle as the axis error. However, alarm output of the drive unit will be delayed by several cycles to the axis error.

■Axis error

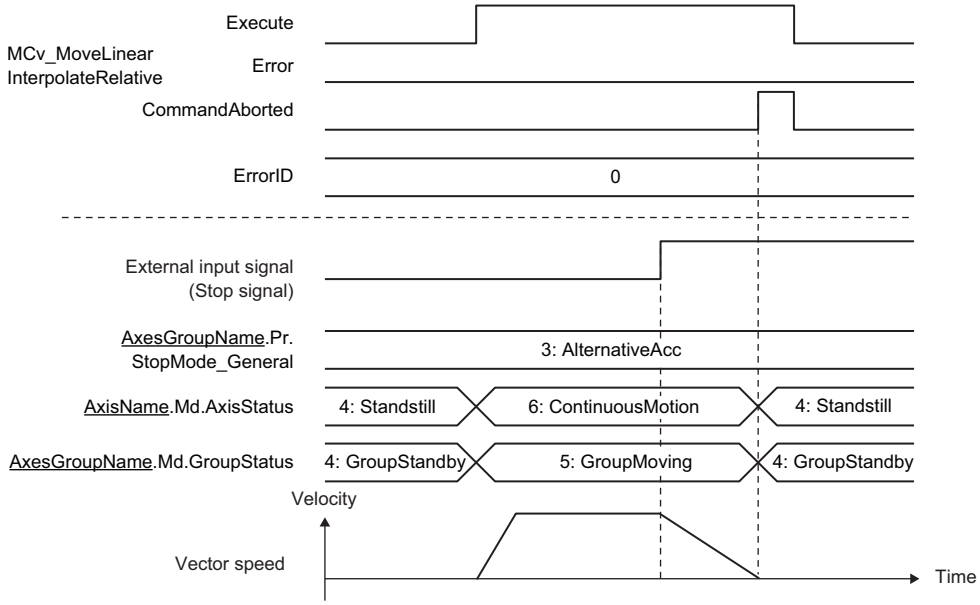
If an axis error has occurred in the configuration axis, the error "Stop Cause of Axes Group Configuration Axis" (error code: 1A3DH) will occur in the axes group. In this case, the axes group will pass through the path and stop according to the AxesGroupName.Pr.StopMode_General setting.

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 the specified axis will change to the "Instruction issue to the configuration axis being operated in the axes group" and then the "1: ErrorStop" status.

By an error occurrence in the configuration axis, the error "Stop Cause of Axes Group Configuration Axis" (error code: 1A3DH) occurs in the axes group, and the axes group will stop according to the process selected in AxesGroupName.Pr.StopMode_General.

■"Stop signal" of external input signal is TRUE

When AxisName.Pr.StopSignal is turned TRUE to the configuration axis, a stop process is executed based on the stop selection at stop by factors for an axis whose stop signal is turned TRUE. The axes group will pass through the path and decelerate to a stop. When the speed reaches 0, CommandAborted will turn TRUE, and the axes group status (AxesGroupName.Md.GroupStatus) will transit to "4: GroupStandby". The value set in AxesGroupName.Pr.StopMode_Deceleration will be used for the deceleration at this time.



Point

- When stopping by turning AxisName.Pr.StopSignal to TRUE, the axes group status (AxesGroupName.Md.GroupStatus) after stop will not change.
- When the stop processing is being executed by turning AxisName.Pr.StopSignal to TRUE, the deceleration can be changed by executing MC_GroupStop.
- The deceleration can be changed by turning AxisName.Pr.StopSignal to TRUE during MC_GroupStop execution. In this case, the axes group status (AxesGroupName.Md.GroupStatus) after the deceleration stop will not change.

■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, the error "Stop Cause of Axes Group Configuration Axis" (error code: 1A3DH) occurs in the axes group and its status changes to the "1: GroupErrorStop".

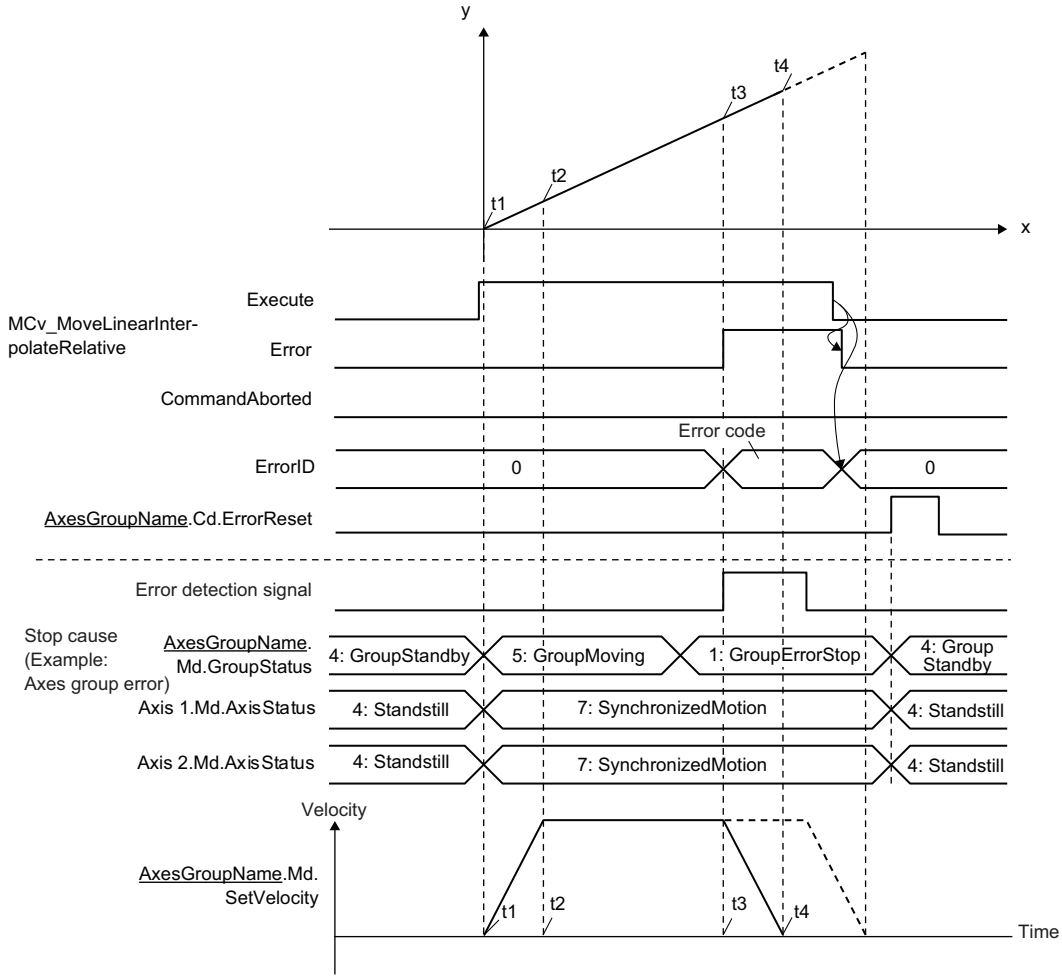
- When the stop cause "Hardware stroke limit error" is occurring in any axis of configuration axes, "1: ImmediateStop" is set to AxisName.Pr.StopMode_HwStrokeLimit in one or more axes.
- When the stop cause "Software stroke limit error" is occurring in any axis of configuration axes, "1: ImmediateStop" is set to AxisName.Pr.StopMode_SwStrokeLimit in one or more axes.

Hardware stroke limit error	Software stroke limit error
• Error "FLS Signal Detection (at Start)" (error code: 1A2DH) • Error "RLS Signal Detection (at Start)" (error code: 1A2EH) • Error "FLS Signal Detection (Controlling)" (error code: 1A2FH) • Error "RLS Signal Detection (Controlling)" (error code: 1A30H)	• Error "Software Stroke Limit Over (Target Position)" (error code: 1A00H) • Error "Software Stroke Limit Over (Start Position)" (error code: 1A01H) • Error "Software Stroke Limit Over (Forward Direction)" (error code: 1A03H) • Error "Software Stroke Limit Over (Reverse Direction)" (error code: 1A04H)

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 AxesGroupName.Pr.StopMode_General. The value set in 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

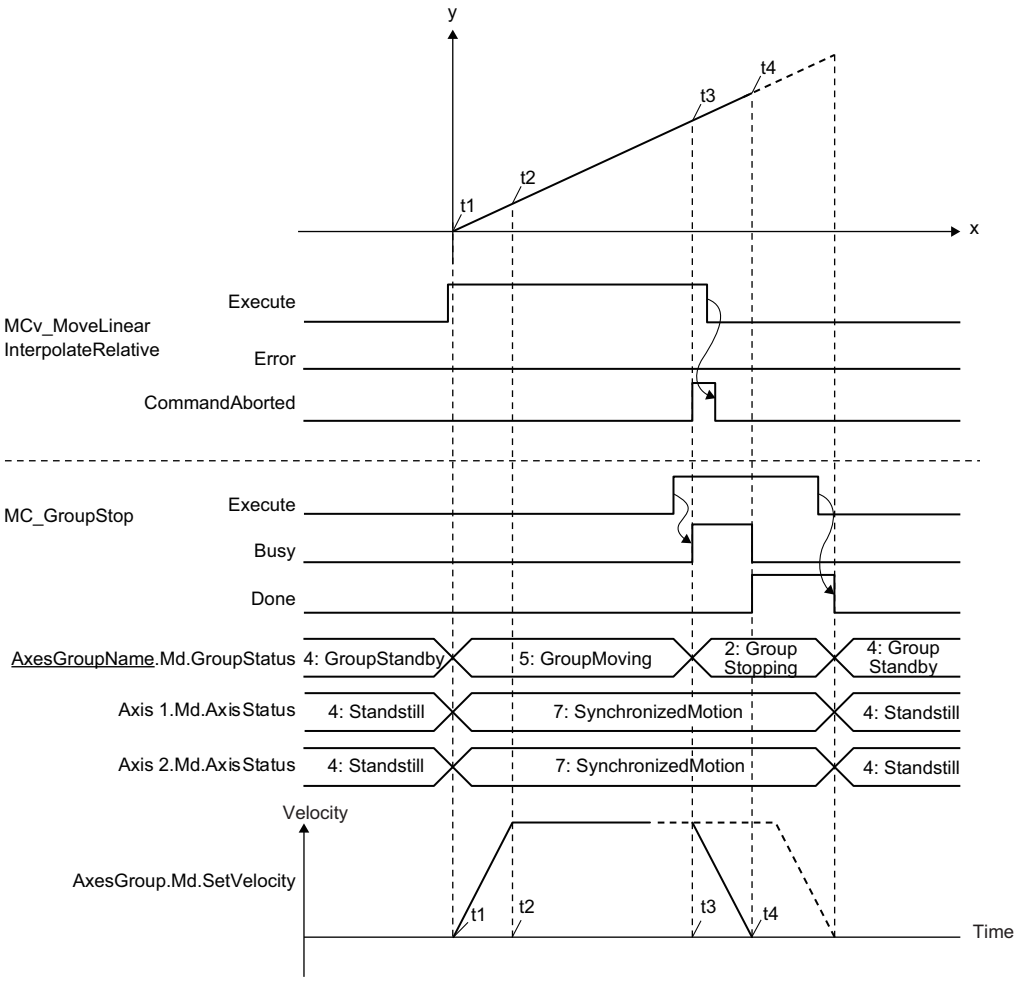


MC_GroupStop (Group forced stop)

In MC_GroupStop, the deceleration (Deceleration) is set and on-going instruction is decelerated to a stop. The axes group passes through the previous operation path and decelerates to a stop.

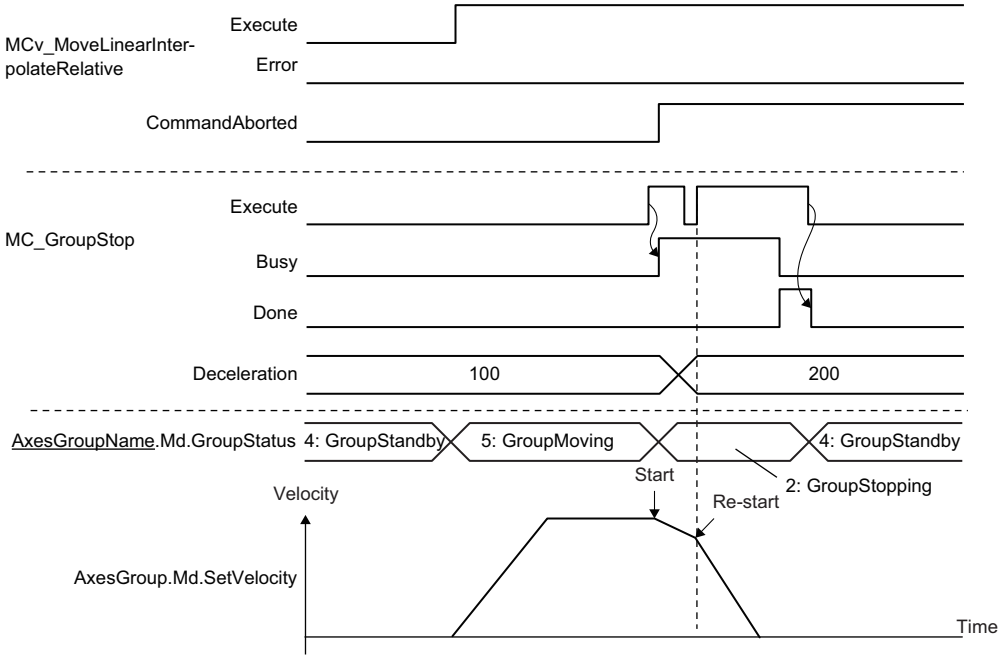
When MC_GroupStop is executed, CommandAborted of on-going instruction turns TRUE and the axes group status (AxesGroupName.Md.GroupStatus) transits to the "2: GroupStopping" status. While Execute is TRUE or while the speed does not reach 0, the "2: GroupStopping" status is maintained. When Done turns TRUE and Execute turns FALSE at stop completion, the axes group status changes to the "4: GroupStandby" status.

■MC_GroupStop execution during MCv_MoveLinearInterpolateRelative

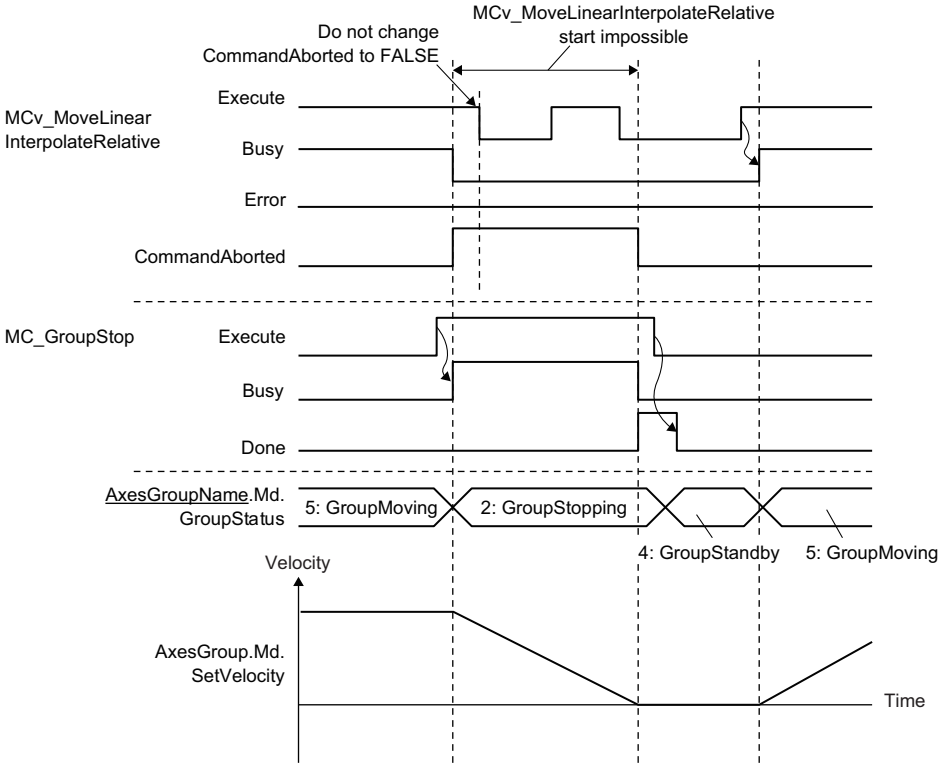


■Operation description

- During deceleration stop by this FB and while Execute (start) of the input variable is TRUE, any operation command other than MC_GroupStop is not accepted.
- If the 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.
- When the setting value of Deceleration is changed and MC_GroupStop is restarted
  A deceleration stop is executed from the restart point based on Deceleration set in MC_GroupStop and Jerk used in the on-going instruction.



- When an FB that operates axes other than MC_GroupStop is executed while axes group status (AxesGroupName.Md.GroupStatus) is the "2: GroupStopping" status, the error "Start Not Possible" (error code: 1AADH) occurs and Error of MC_Stop turns TRUE, and then the axes group status (AxesGroupName.Md.GroupStatus) changes to "1: GroupErrorStop".
- If MC_GroupStop is executed when MC_ MoveDirectAbsolute and MC_ MoveDirectRelative are carried out, the parameter values set in each axis use speed/acceleration/deceleration/jerk.
- Even if Execute of command aborted FB is set to FALSE by MC_GroupStop, once the stop operation is started, TRUE of CommandAborted will be continued until it is completed. After it stops completely, changes CommandAborted to FALSE if Execute of command aborted FB is FALSE.


MCv_MoveLinearInterpolateRelative
start impossible
Do not change
CommandAborted to FALSE
MCv_MoveLinear
InterpolateRelative
Execute
Busy
Error
CommandAborted
MC_GroupStop
Execute
Busy
Done
AxesGroupName.Md.
GroupStatus
5: GroupMoving
2: GroupStopping
4: GroupStandby
5: GroupMoving
Velocity
AxesGroup.Md.
SetVelocity
Time

4.5 Forced Stop

This function stops axes with the forced stop signal. The forced stop function is valid to axes which have function of positioning control and velocity/torque control. For details, refer to the following.

☞ Page 37 Axis Type

⚠WARNING

- When the forced stop is required to be wired, ensure to wire it in the negative logic, and b-contact is recommended.
- When using the forced stop function, confirm the wiring and the settings, and check whether it works or not at startup.

Point

The forced stop function immediately stops the instruction and issues "Quick Stop" to the slave device at the same time. For operation when "Quick Stop" is issued, refer to the manual of the slave device.

Refer to the manual of the driver unit after the forced stop signal is sent.

Relevant variables

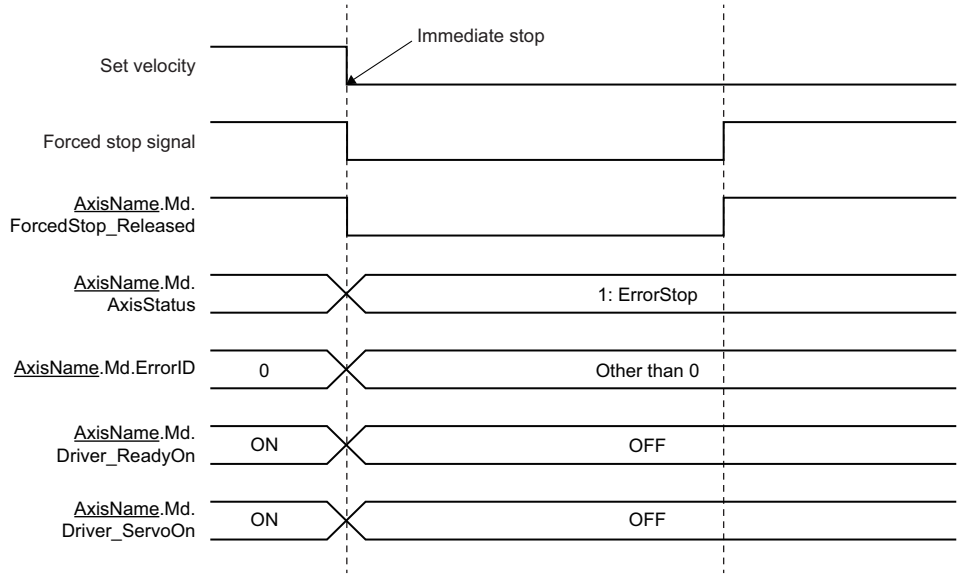
Variable/Structure name	Name	Details
AxisName.Pr.		
ForcedStop_Signal	Forced stop signal	Sets a signal using the each axis forced stop. ForcedStop_Signal is the structure of SIGNAL_SELECT type.For details of SIGNAL_SELECT type, refer to the following. ☞ Page 398 External Signal Selection The specific setting and the operation of this signal are shown below. • IO No. Ignores the input value. • Target When the specification is not set, signal disabled is determined and the signal undetection status is always set. When unavailable data is set, the error "Target of Forced Stop Signal Incorrect" (error code: 1AC7H) is output. • Signal detection method The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Signal Logical Setting of Forced Stop Signal Range" (error code: 1AD4H) is output. 0: HighLevel (Detection at TRUE) 1: LowLevel (Detection at FALSE) • Compensation time Ignores the input value. • Filter time Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting of Forced Stop Signal Range Warning" (warning code: 0D27H) is output. The fetch timing of the label is at ready ON, and the detection timing of the signal is the axis operation cycle.
AxesGroupName.Pr.		
StopMode_General	Stop selection at stop by factors	1: ImmediateStop (Immediate stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration) 3: AlternativeAcc (Alternative acceleration/deceleration) (Immediate stop will be executed when executing instructions without deceleration specification.)
AxisName.Md.		
ForcedStop_Released	Forced stop cancelling	FALSE: Forced stop input TRUE (Forced stop) TRUE: Forced stop input FALSE (Forced stop release)

Variable/Structure name		Name	Details
	ForcedStop_Signal	Forced stop signal	Displays the input status of each axis forced stop signal. ForcedStop_Signal is the structure of SIGNAL_SELECT type. For details of SIGNAL_SELECT type, refer to the following. ☞ Page 398 External Signal Selection The specific output of this signal is shown below. • IO No. 0 is always displayed. • Target The fetch result of the parameter is displayed. • Signal detection method The fetch result of the parameter is displayed. • Compensation time 0.0 is always desplayed. • Filter time The fetch result of the parameter is displayed.
System.Pr.			
	ForcedStop_Signal	All axes forced stop signal	Sets a signal using the all axes forced stop. ForcedStop_Signal is the structure of SIGNAL_SELECT type. For details of SIGNAL_SELECT type, refer to the following. ☞ Page 398 External Signal Selection The specific setting and the operation of this signal are shown below. • IO No. 0 is always displayed. • Target If the target is unspecified, it is regarded as invalid signal and it is always the signal undetection status. When unavailable data is set, the error "Target of All Axes Forced Stop Signal Incorrect" (error code: 1AC8H) is output. • Signal detection method The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Signal Logical Setting of All Axes Forced Stop Signal Range" (error code: 1AD5H) is output. 0: HighLevel (Detection at TRUE) 1: LowLevel (Detection at FALSE) • Compensation time Ignores the input value. • Filter time Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting of All Axes Forced Stop Signal Range Warning" (warning code: 0D28H) is output. The fetch timing of the label is at ready ON, and the detection timing of the signal is the axis operation cycle.
System.Md.			
	ForcedStop_Released	Forced stop cancelling	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. ForcedStop_Signal is the structure of SIGNAL_SELECT type. For details of SIGNAL_SELECT type, refer to the following. ☞ Page 398 External Signal Selection The specific output of this signal is shown below. • IO No. 0 is always displayed. • Target The fetch result of the parameter is displayed. • Signal detection method The fetch result of the parameter is displayed. • Compensation time 0.0 is always displayed. • Filter time The fetch result of the parameter is displayed.

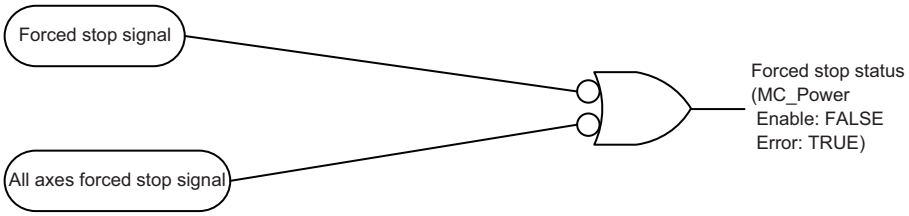
Operation at the forced stop occurrence

The following shows the operation when a forced stop has occurred.

During axis operation



- In the axis that a forced stop occurred, MC_Power is in the error status and the 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.



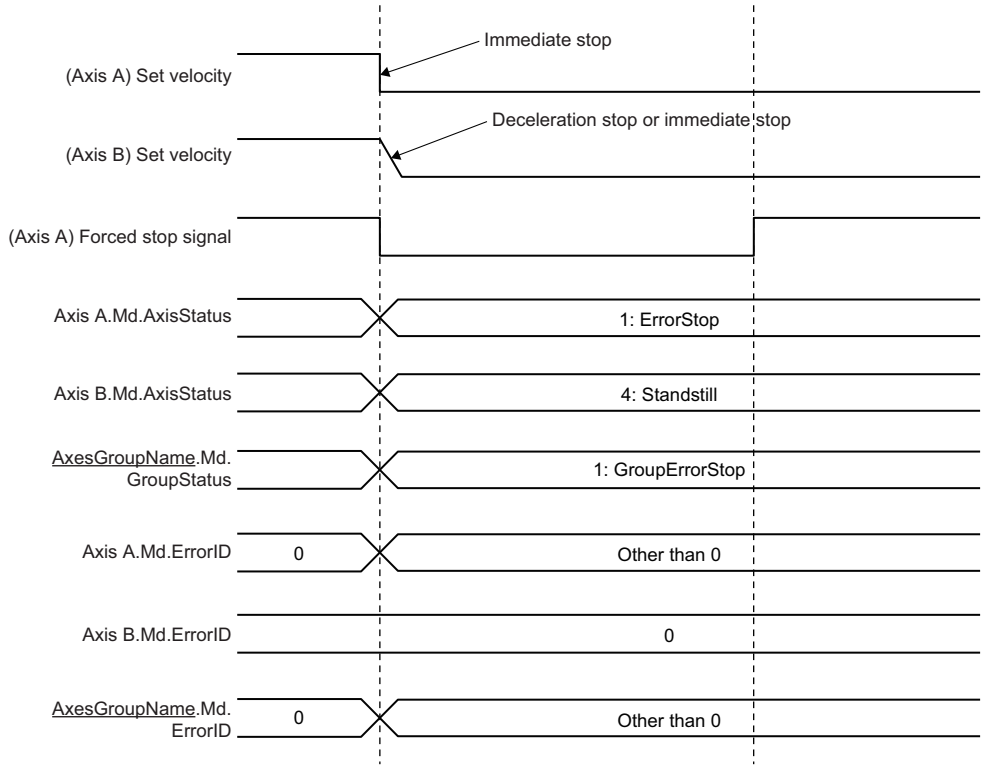
- In positioning or stopping, the event, "Forced stop detection" is registered in the event history.
  The errar "Forced Stop Status" (error code: 1A5BH) is also registered in positioning.
- If the axis was in the forced stop status at start, the command will not be issued, and it will be in the same "1: ErrorStop" status as the forced stop that is in operation.

During stop

If the axis the forced stop occurred in was during stop, the error "Forced Stop Status" (error code: 1A5BH) will not occur. The axis status (AxisName.Md.AxisStatus) transits according to the driver device 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.



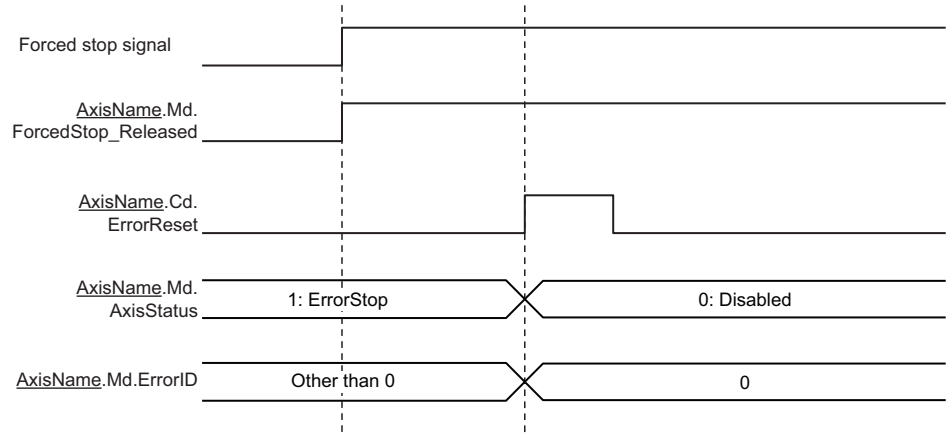
The stop method of the axis B can be set in AxesGroupName.Pr.StopMode_ForcedStopInGroup. For the operation of each setting, refer to the following.

☞ Page 168 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.

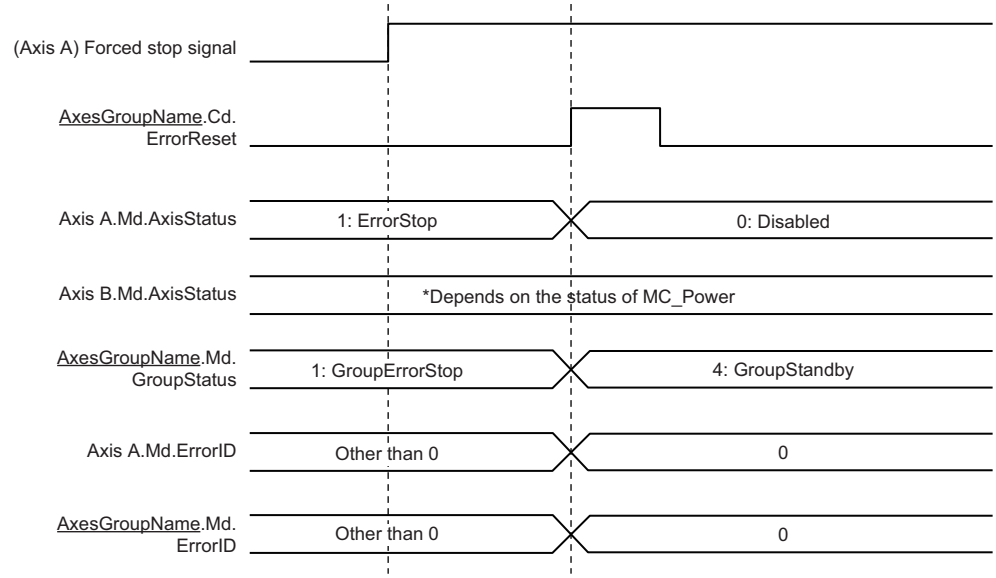
Single axis



1. Release the forced stop.
   The forced stop input changes to "1".
   The axis status (AxisName.Md.AxisStatus) is still "1: ErrorStop".
2. Execute the axis error reset.
   The axis status (AxisName.Md.AxisStatus) changes to "0: 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".
   The axes group status (AxesGroupName.Md.GroupStatus) is still "1: GroupErrorStop".
2. Execute the axes group error reset.
   The axes group status (AxesGroupName.Md.GroupStatus) changes to "4: GroupStandby", and the error Nos. are cleared in both the axis A and the axes group.

Point

During the forced stop, the axes group status cannot be transited from the "1: ErrorStop" / "1: GroupErrorStop" status even if an error reset is executed. Execute it after the forced stop is released.

Check method

Whether the forced stop input is in the TRUE/FALSE status can be checked with AxisName.Md.ForcedStop_Released.

5 HOMING

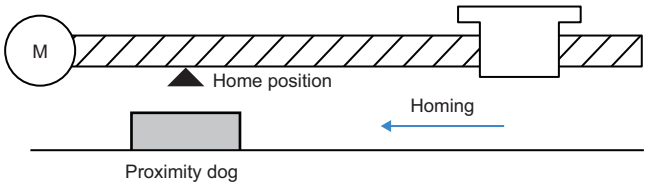
In "homing", a position is established as the starting (or "home position") when carrying out positioning control, and positioning is carried out toward that start point.
It is used to return a machine system at any position other than the home position to the home position when the motion system issues a "homing request" with the power turned ON or others, or after a positioning stop.

Precautions

When using an absolute position system, execute a homig 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 program, etc. before performing the positioning control. Failure to observe this could lead to an accident such as a collision.
The address information stored in the motion system cannot be guaranteed while the AxisName.Md.Homing_Request is TRUE.
AxisName.Md.Homing_Request is FALSE and AxisName.Md.Homing_Complete is TRUE if the homing is executed and is completed normally.

5.1 Outline

In homing, a machine home position is established.
None of the address information stored in the motion system or driver 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.



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
- Driver supports Homing mode
- "Home offset (607CH): Home position" is set to a slave object.

Operation of this function for each system status

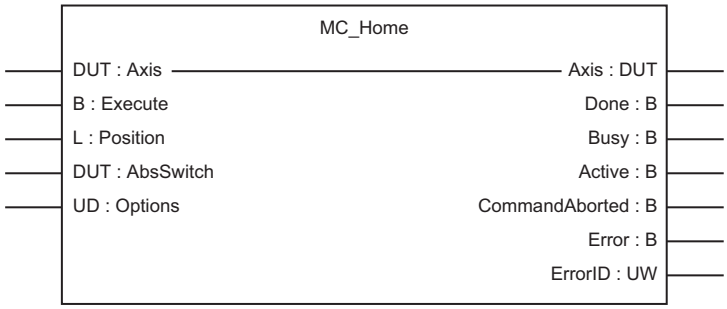
○: Possible, ×: Not possible

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant variables/FB

Variable/Structure name	Name	Details
AxisName.Md		
Homing_Status	Homing operation status	Stores the homing status of the driver.
Homing_Request	Homing request	Turns TRUE when homing is required and turns FALSE when it is completed. For details, refer to the following. ☞ Page 183 Homing Request
Homing_Complete	Homing completed	Turns TRUE when homing is normally completed, and it turns FALSE when operation starts.

MC_Home

Item	Description
Function overview	Executes homing of the specified axis.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
188	8	Subroutine type	Real-time execution

■I/O variable

Input import: ↑: Only at start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_ REF	↑	—	—	☞ Page 641 Axis variables

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Target position	Position	LREAL	↑	☞ Page 79 Positioning Range	0	Sets the home position address.
Home position switch	AbsSwitch	MC_INPUT_REF	↑	—	—	Sets the proximity dog signal that is transmitted to the slave device in the driver homing method. ☞ Page 398 External Signal Selection Only "HighLevel" or "LowLevel" can be selected for Detection (Signal detection method). Only "0" can be specified for CompensationTime (Compensation time [s]). "0.0 to 5.0" can be specified for FilterTime (Filter time [s]). If the setting value is not within the valid range, an error will occur.
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (If a value other than "0" is set, an error will occur.)

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the homing is completed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Homing Request

AxisName.Md.Homing_Request must be TRUE in the motion system, and homing must be executed in the following cases.

Point

The reason of the homing request is TRUE is recorded in event history.

- System's power supply on or reset (When using an absolute position system and when homing has been completed at the system/driver power off or reset, the homing request is not turned TRUE.)
- Homing start (Unless homing is completed normally, the homing request flag does not turn FALSE.)
- If the absolute position data in the motion system is erased by a memory error, etc., the warning "Absolute Position Data Incorrect Warning" (warning code: 0D00H) will occur.
- Axis type change

[Only for real drive axis]

- Driver's power supply on (When using an absolute position system and when homing has been completed at the system/driver power off or reset, the homing request is not turned ON.)
- "Absolute position erased" detection in driver side
- "Polarity (607EH)" b7: position polarity of driver objects change
- Driver and motor encoder change detection
- A driver other than the connected driver at the previous establishment of the home position is connected when using emulate function

AxisName.Md.Homing_Request turns FALSE by the completion of the homing.

When homing is not required

Execute a homing request clear in systems that do not require homing. AxisName.Md.Homing_Request can be turned FALSE by doing so. For details, refer to the following.

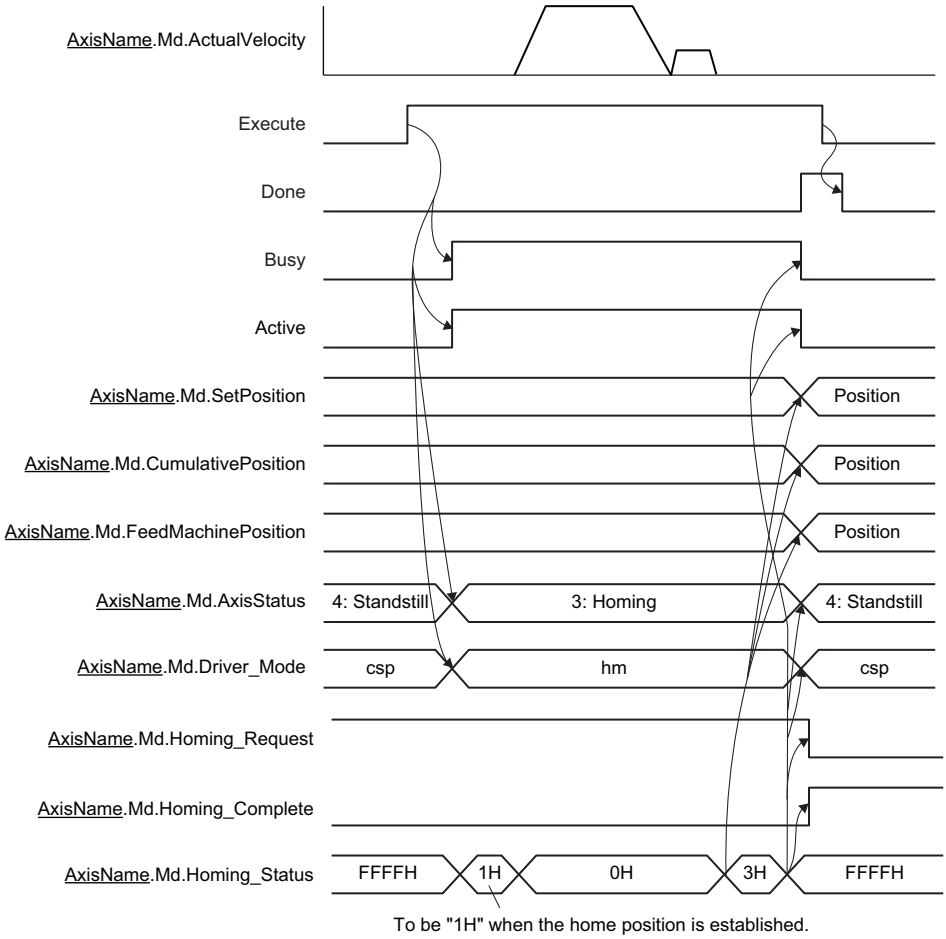
☞ Page 187 Operation Setting for Incompletion of Homing

Driver homing method

The driver is switched to the Homing mode, and the homing is executed based on the positioning pattern set on the driver side. Change the homing data of the driver with MC_WriteParameter to change the homing method or each parameter. Refer to the manual of the driver because the homing operation and parameters depend on the specification of the driver.

Timing chart

■Normal operation



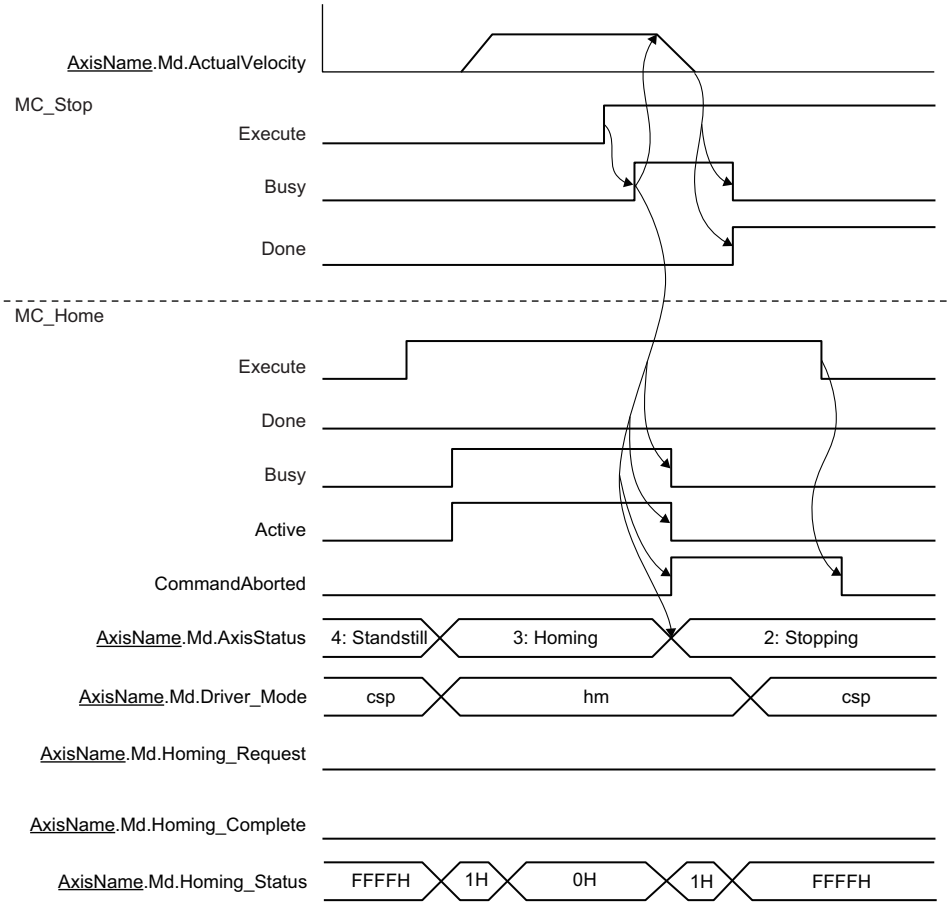
■When an error occurs

The data set method homing is the same.

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■When MC_Stop (forced stop) is executed



- When MC_Stop is turned TRUE at homing, the "HALT" signal is sent to the driver. When using a driver that does not support HALT, use the forced stop because it does not stop with this signal.
- Stop processing at homing depends on the driver specifications. Therefore, Deceleration and Jerk of MC_Stop are ignored.

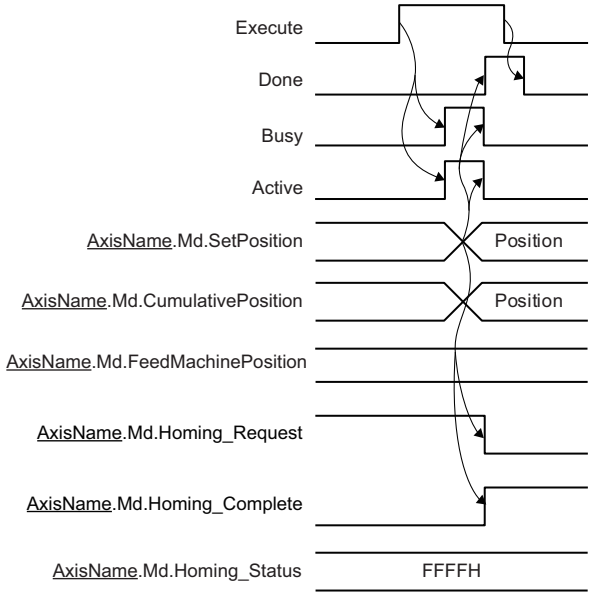
Precautions

- The homing cannot be started during servo-off. Thus, the driver homing method, 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 the AbsSwitch input) are assigned, the external signals are transmitted to the driver. However, when the position accuracy is required in the proximity dog based (not Z-phase based) method, using the driver built-in DI is recommended.
- The set position is not followed up during a driver homing method.
  Set the input source (MC_SOURCE) in the master axis actual value "2: mcActualValue" to execute synchronous control by using the axis that is during homing as the master axis.
- Do not execute the synchronous control by setting the axis that is in homing as the master axis. Because the set value and the actual value are not updated consecutively, the error "Speed Range Over during Controlling" (error code: 1AE8H) may occur at the slave axis.
- If the following items are not mapped, backup is not guaranteed.
  Home cycle counter (2D3DH): Encoder multiple revolution counter
  Home ABS counter (2D3EH): Encoder position within 1 revolution
- DOG signal inputted in the servo amplifier at MR-J5(W)-G connection can be specified as a home position switch signal. For details of the setting method, refer to the following.
  ☞ Page 681 Using methods

Data set homing method

"Data set homing method" is executed to a virtual axis and a real axis that does not have the home position information in the slave device side. It is completed in the motion system, and external signals, etc. are not used. The Position (home position address) at homing is registered in the motion system as the home position, and AxisName.Md.SetPosition and AxisName.Md.CumulativePosition are rewritten to Position (home position address).

Timing chart



Precautions

- FBs other than MC_Stop cannot start during homing.
- The software stroke limit check for the Position (home position address) at homing start is shown below.
  Driver homing method: The software stroke limit check is not carried out.
  Data set homing method: The software stroke limit check is carried out.
- Start position of the software stroke limit check is not carried out at homing start.
- The software stroke limit is not checked during homing.
- The movement direction at homing completion is in positive direction.

Error

Check that the axis status (AxisName.Md.AxisStatus) is "4: Standstill" at MC_Home execution. If it is other than "4: Standstill", an error will occur and the control during operation will stop.

5.2 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 the homing request, AxisName.Md.Homing_Request is TRUE.
When starting the axis at homing incompletion, whether the axis can startup or not is determined by the executed FB and AxisName.Pr.StartableAtUnhomed.
○: Axis start possible, ×: Axis start impossible

FB	Start permission for incompletion of homing	
	"TRUE: Allowed" and the homing request is TRUE	"FALSE: Not allowed" and the homing request is TRUE
FBs that can be started when 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. Refer to each drive unit manual for details.

Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
StartableAtUnhomed	Start permission at homing uncompleted	Sets whether axis start when homing is incompletion is allowed or not. TRUE: Allowed FALSE: Not allowed
AxisName.Md.		
Homing_Request	Homing request	Turns TRUE when homing is required and turns FALSE when it is completed. For details, refer to the following. ☞ Page 183 Homing Request
AxisName.Cd.		
Homing_ClearRequest	Homing request clear	Turns the homing request to FALSE forcibly. After turning FALSE the homing request, FALSE is set in this variable automatically.

FBs that can be started when homing is incompletion

The following FBs can start the axis regardless of the AxisName.Pr.StartableAtUnhomed and AxisName.Md.Homing_Request status.

FBs that can be started when homing is incompletion
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 AxisName.Pr.StartableAtUnhomed is FALSE and AxisName.Md.Homing_Request is TRUE, and the error "Start during Homing Incomplete" (error code: 1A22H) occurs.

Homing request clear

When AxisName.Md.Homing_Request is TRUE, AxisName.Md.Homing_Request can be turned to FALSE forcibly by turning AxisName.Cd.Homing_ClearRequest to TRUE.

Precautions

- In AxisName.Cd.Homing_ClearRequest, when turning AxisName.Md.Homing_Request FALSE and starting the axis, it is operated not based on the home position but based on the current coordinate system.
- Do not turn AxisName.Cd.Homing_ClearRequest TRUE during homing.

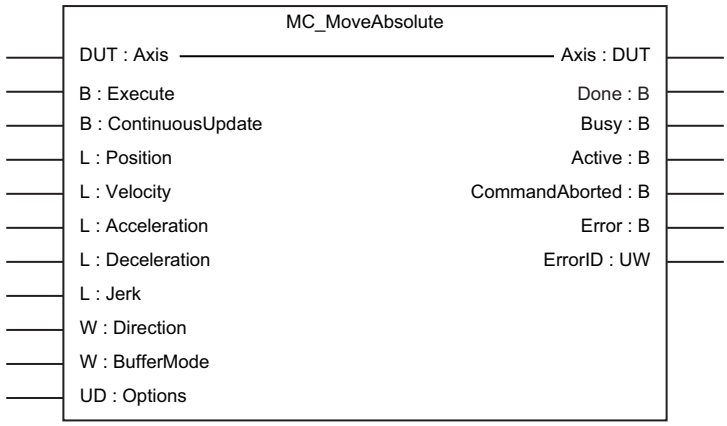
6 AXIS CONTROL FUNCTION

6.1 Single Axis Positioning Control

The details and usage of the single axis positioning controls are explained in this section.
The single axis positioning controls execute positioning to the specified position by using address information.

Relevant FBs

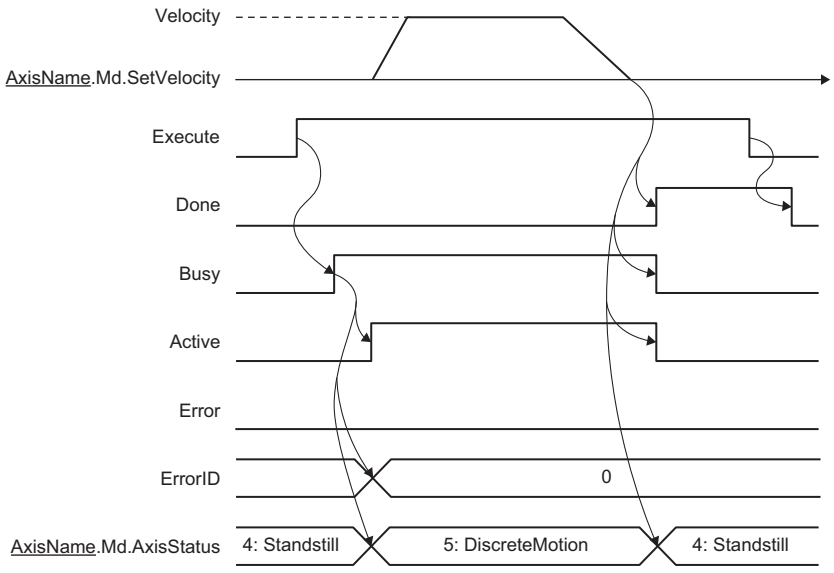
MC_MoveAbsolute

Item	Description
Function overview	Executes positioning after specifying the target position of the absolute position.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
64	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

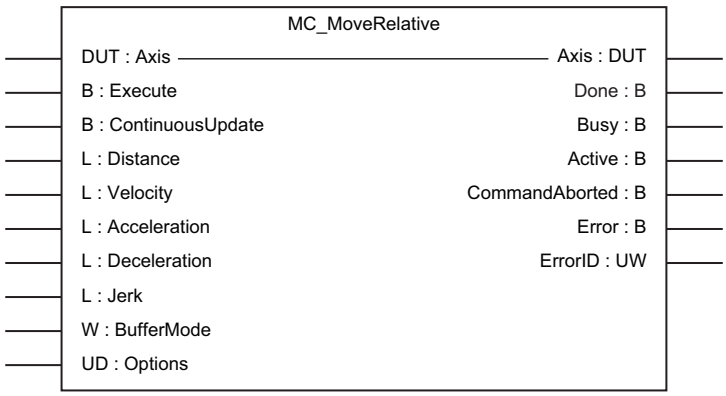
Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the target position, the speed, the acceleration, and the deceleration.
Target position	Position	LREAL	↑/R/C	☞ Page 193 Position (Target position)	0	Sets the target position of the absolute position according to unit of axis.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0	Sets the velocity according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the jerk according to unit of axis.
Direction selection	Direction	MC_DIRECTION	↑	1 to 3	0	Sets the direction selection. 1: mcPositiveDirection (Positive direction) 2: mcNegativeDirection (Negative direction) 3: mcShortestWay (Shortest path)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh)
Option	Options	DWORD(HEX)	↑	☞ Page 200 Options (Options)	00000000H	Sets a function option.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	During TRUE, it indicates that the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled.
Abortion of execution	CommandAborted	BOOL	FALSE	It indicates that another FB has aborted the execution of the FB. Turns TRUE when this FB is stopped by an error or this FB is started during an error occurence. Turns FALSE when Execute = FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

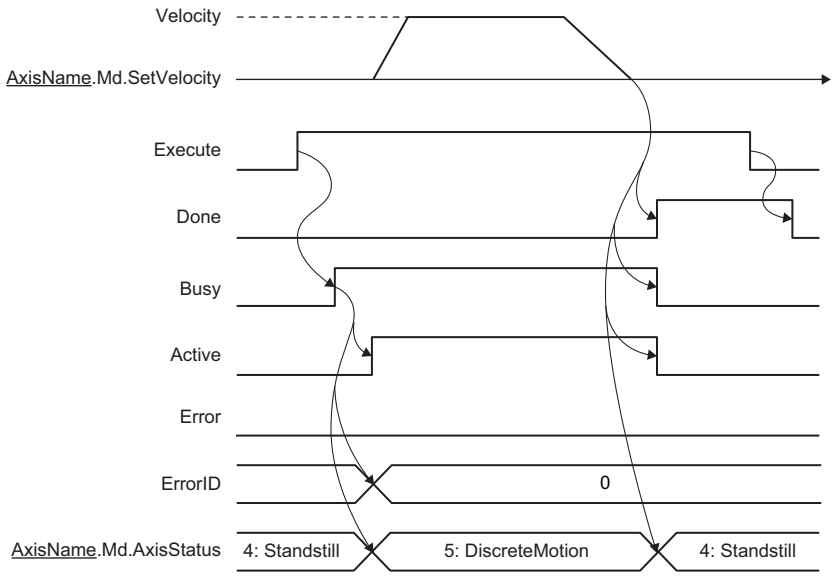
MC_MoveRelative

Item	Description
Function overview	Executes positioning after specifying the movement amount of the relative position.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
64	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the movement amount, the speed, the acceleration, and the deceleration.
Movement amount	Distance	LREAL	↑/R/C	☞ Page 201 Distance (Movement amount)	0	Sets the relative position according to unit of axis from the current position at start to the end point.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0	Sets the velocity according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the jerk according to unit of axis.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh)
Options	Options	DWORD(HEX)	↑	☞ Page 202 Options (Options)	00000000H	Sets a function option.

■Output variables

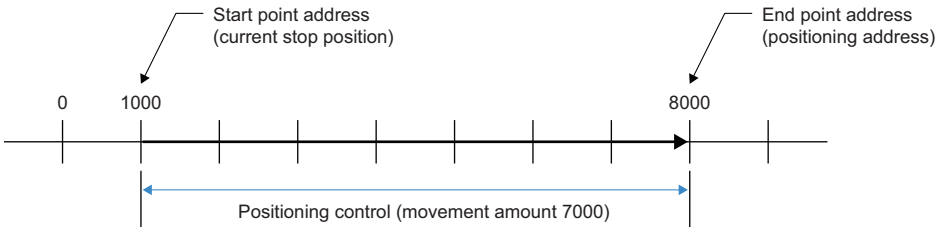
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	When TRUE, it indicates that the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled.
Abortion of execution	CommandAborted	BOOL	FALSE	It indicates that another FB has aborted the execution of the FB. Turns TRUE when this FB is stopped by an error or this FB is started during an error occurence. Turns FALSE when Execute = FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Absolute Positioning Control

In MC_MoveAbsolute, Position, Velocity, Acceleration, Deceleration, Jerk, Direction, BufferMode, and Options can be set, and positioning is executed from the current position at start (start point address) to the address set in Position (end point address).

Ex.

When the start point address (current stop position) is 1000, and Position is 8000, positioning is carried out in the positive direction for a movement amount of 7000 (8000 - 1000).



Details of setting items

■Position (Target position)

Set the target position of the absolute position. The settable range differs depending on the software stroke limit valid/invalid, Direction, and the setting of the target position specification (Options bit16) exceeding the ring counter.

• When the software stroke limit is valid (AxisName.Md.SwStrokeLimit_Target is other than "-1: Invalid")

The settable range is "Ring counter lower limit value ≤ Target position ≤ Ring counter upper limit value" regardless of the setting of Direction or the target position specification (Options bit16) exceeding the ring counter. If a value outside the range is set, the error "Out of Target Position Range" (error code: 1A05H) will occur, and the axis will not start.

Also, even when the value is within the above range, if a position which exceeds the software stroke limit is specified as the target position, the error "Software Stroke Limit Over (Target Position)" (error code: 1A00H) will occur and the axis will not start.

For the movement direction, refer to the following.

☞ Page 194 Direction (Direction selection)

• When the software stroke limit is invalid (AxisName.Md.SwStrokeLimit_Target is "-1: Invalid")

Positioning of the ring counter range 1 revolution or more can be executed by setting "Setting the target position exceeding the ring counter (Options bit16)" is "1: Allow".

Setting value	Direction selection (Direction)	Setting the target position exceeding the ring counter (Options bit16)	
		0: Not allow	1: Allow
mcPositiveDirection	Positive direction	Ring counter lower limit value ≤ Target position < Ring counter upper limit value	Ring counter lower limit value ≤ Target position < Positioning range upper limit value*1
mcNegativeDirection	Negative direction		Positioning range lower limit value*1 ≤ Target position < Ring counter upper limit value
mcShortestWay	Shortest path		Ring counter lower limit value ≤ Target position < Ring counter upper limit value

*1 For the positioning range lower/upper limit value, refer to the following.

☞ Page 79 Positioning Range

If a value outside the above range is set, the error "Out of Target Position Range" (error code: 1A05H) will occur, and the axis will not start.

■Velocity (Velocity)

Set the set velocity at positioning control. For details, refer to the following.

☞ Page 83 Velocity set range

■Acceleration (Acceleration)

Specify the acceleration. The setting details defer depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 237 Multiple Axes Positioning Control

■Deceleration (Deceleration)

Specify the deceleration. The setting details defer depending on the acceleration/deceleration method.For details, refer to the following.

☞ Page 237 Multiple Axes Positioning Control

■Jerk (Jerk)

Set Jerk. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■Direction (Direction selection)

This setting is ignored when the software stroke limit is valid. Positioning control in a direction which does not cross over the area outside the software stroke limit range is carried out. However, when the value does not cross over the area outside the software stroke limit range both in the positive direction and the negative direction, positioning control is carried out in the direction close to the target position (the direction that the absolute value of the movement amount is shorter) based on the current position. If the distance is the same between the positive direction and the negative direction, it is carried out in the current direction.

When the software stroke limit is invalid, the positive direction, the negative direction, and the shortest path can be select, and specify the direction to move from the current position to the target position.

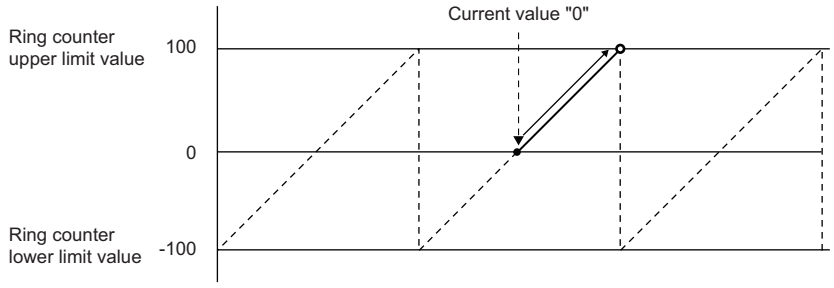
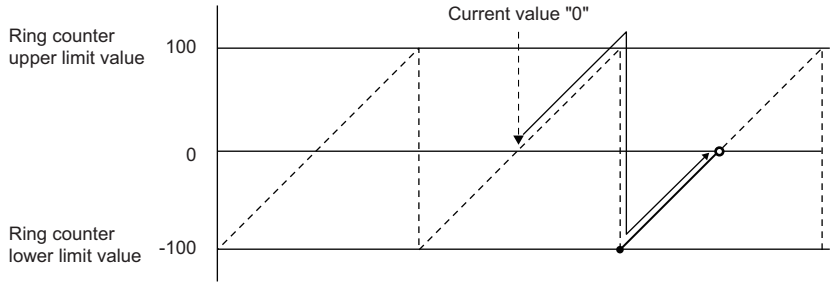
• Positive direction

1: mcPositiveDirection

The positive direction (address increase) positioning is executed from the current position to the target position.

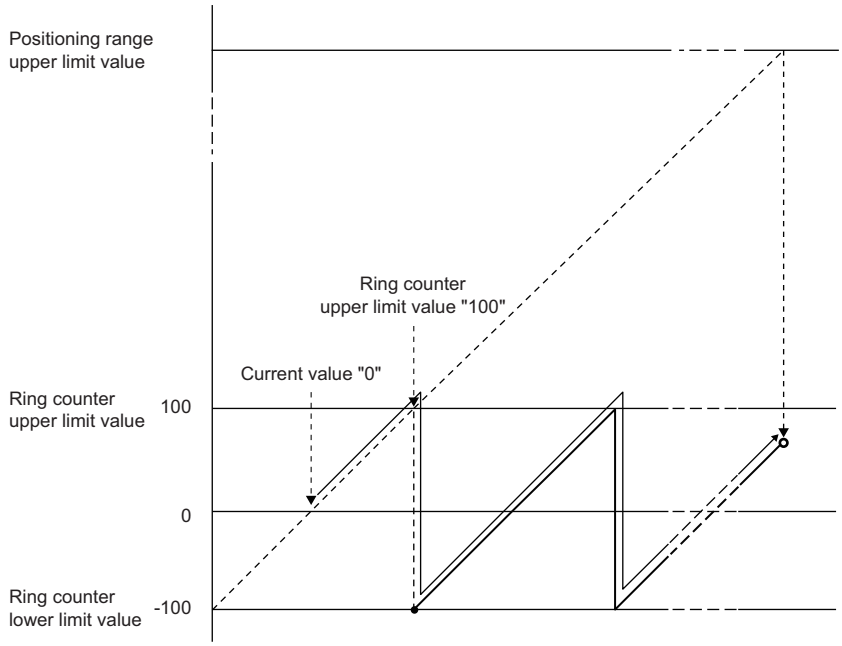
[Setting the target position exceeding the ring counter (Options bit16)] "0: Not allow"

The setting range of the target position is "Ring counter lower limit value ≤ Target position ≤ Ring counter upper limit value."

Setting	Operation
Current value ≤ Target position < Ring counter upper limit value	
Ring counter lower limit value ≤ Target position < Current value	

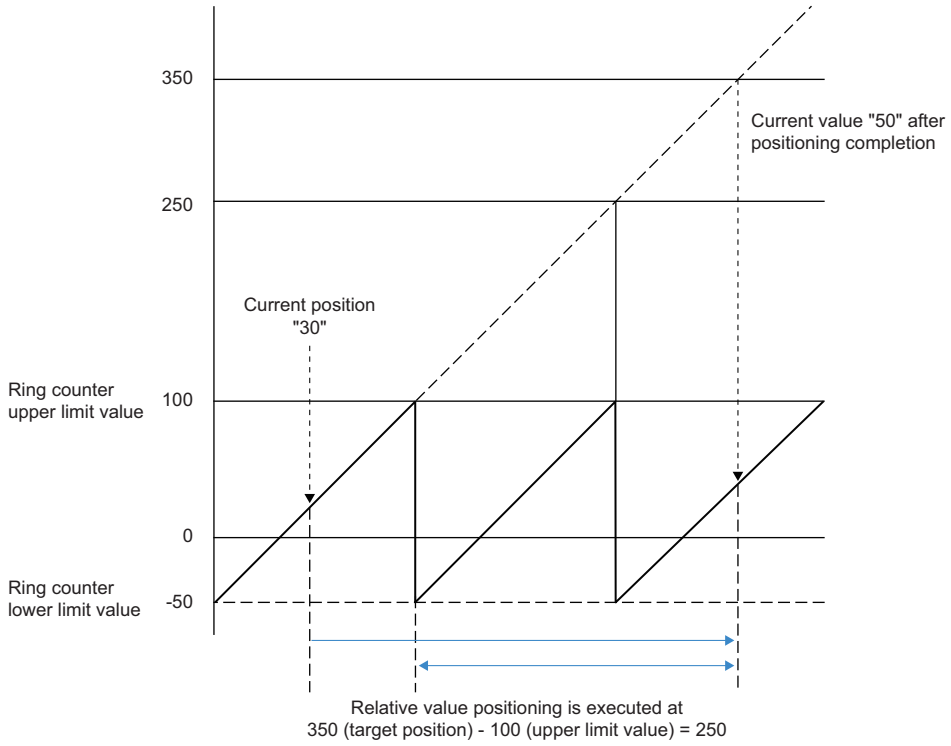
[Setting the target position exceeding the ring counter (Options bit16)] "1: Allow"

The positioning operation that overflows the ring counter upper limit value can be performed. In this case, the ring counter upper limit value is used as a reference, and positioning is performed with the amount of movement exceeded as the relative movement amount. If the target position is set with the value smaller than the ring counter lower limit value, positioning does not start for the error "Out of Ring Counter Range" (error code: 1AA3H).

Setting	Operation
• Current value ≤ Target position < Ring counter upper limit value • Ring counter lower limit value ≤ Target position < Current value	The same operation as the "Setting the Target position exceeding the ring counter: Not allow"
Ring counter upper limit value ≤ Target position < Positioning range upper limit value	

Ex.

Operation when setting the ring counter upper limit value to "100", the ring counter lower limit value to "-50", the current position to "30", and the target position to "350" (the relative value positioning is executed after exceeding the ring counter upper limit value)



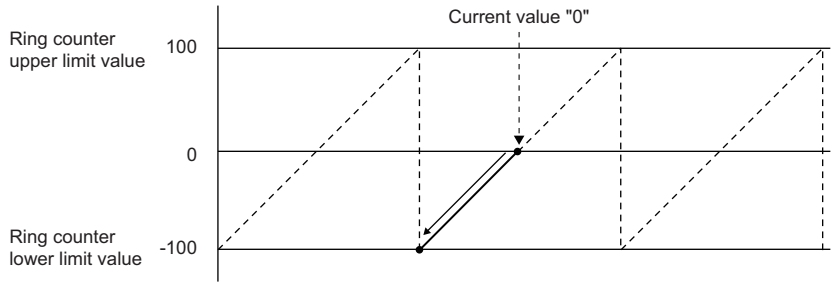
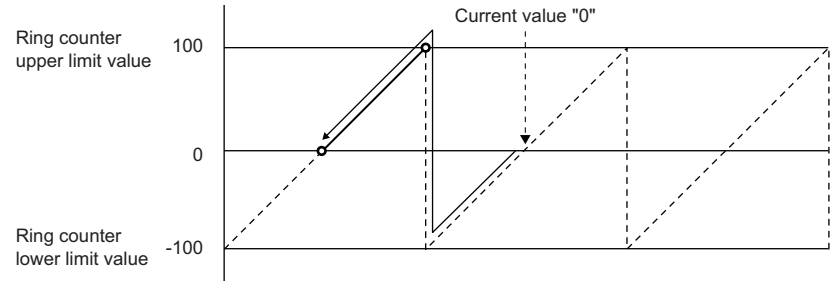
• Negative direction

2. mcNegativeDirection

The positioning is executed from the current position to the target position of negative direction (address decrease).

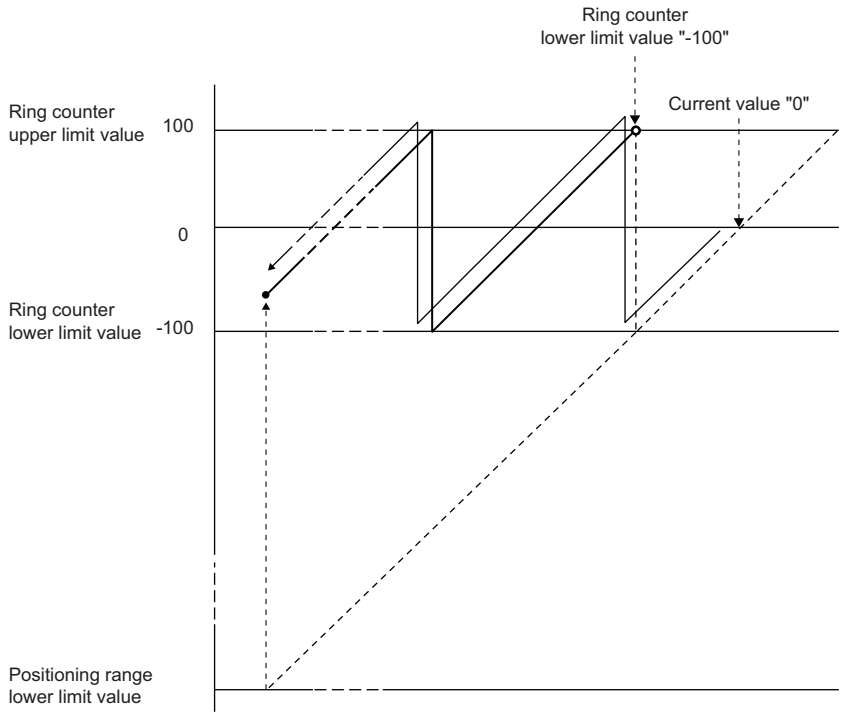
[Setting the target position exceeding the ring counter (Options bit16)] "0: Not allow"

The setting range of the target position is "Ring counter lower limit value ≤ Target position < Ring counter upper limit value".

Setting	Operation
Ring counter lower limit value ≤ Target position ≤ Current value	
Current value < Target position < Ring counter upper limit value	

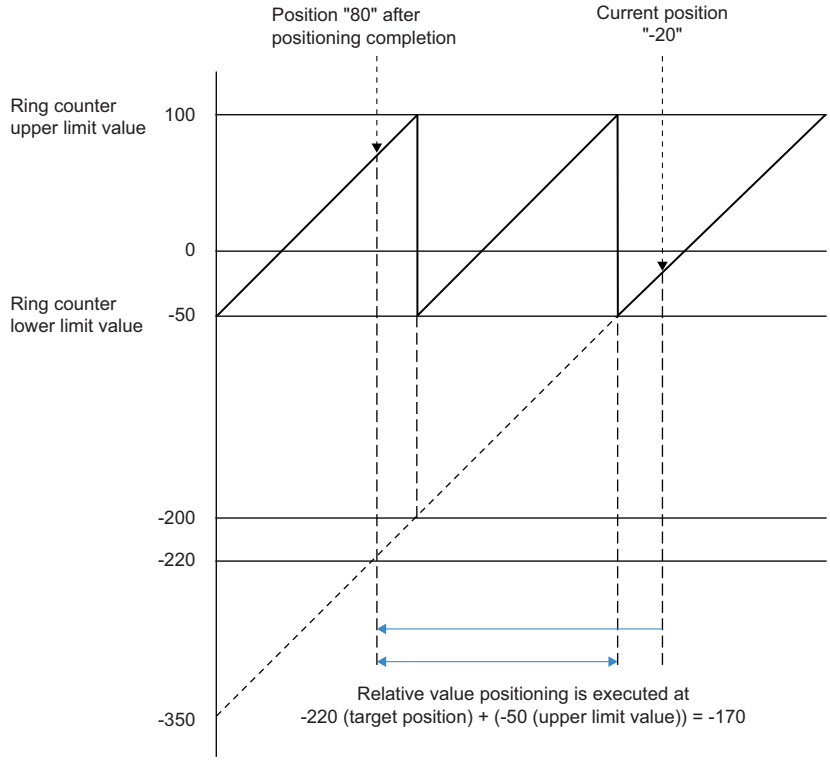
[Setting the target position exceeding the ring counter (Options bit16)] "1: Allow"

The positioning operation that underflows the ring counter lower limit value can be performed. In this case, the ring counter lower limit value is used as a reference, and positioning is performed with the amount of movement exceeded as the relative movement amount. If the target position is set with the value bigger than the ring counter upper limit value, positioning does not start for the error "Out of Ring Counter Range" (error code: 1AA3H).

Setting	Operation
• Ring counter lower limit value ≤ Target position ≤ Current value • Current value < Target position < Ring counter upper limit value	The same operation as the "Setting the target position exceeding the ring counter: Not allow"
Positioning range lower limit value ≤ Target position < Ring counter lower limit value	

Ex.

Operation when setting the ring counter upper limit value to "100", the ring counter lower limit value to "-50", the current position to "-20", and the target position to "-220"



- Shortest path

3: mcShortestWay

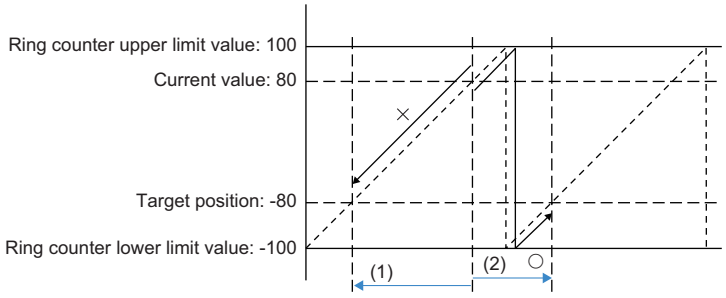
Based on the current position, positioning control is performed in the direction close to the target position (the one with the smaller absolute value of the movement amount). If the distance is the same in the positive direction and the negative direction, it is operated in the current direction.

The setting range of the target position is "Ring counter lower limit value ≤ Target position < Ring counter upper limit value "regardless of the setting of the target position specification (Options bit16) exceeding the ring counter.

If a value outside the above range is specified, the error "Out of Target Position Range" (error code: 1A05H) will occur and the axis will not start.

Ex.

Operation when setting the ring counter upper limit value to "100", the lower limit value to "-100", the current position to "80", and the target position to "-80"



Since the movement amount of (1) is 160 and that of (2) is 40, positioning moves to the positive direction of (2).

■BufferMode (Buffer mode)

Select the buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh can be set. For details, refer to the following.

☞ Page 125 Buffer mode type

■Options (Options)

Set the function options that are used in MC_MoveAbsolute by specifying the bit.

The details of bit and the functions are shown below.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 4	Empty (Specify "0".)*1
5	Reverse rotation permission selection 0: Allow 1: Not allow It is valid when specifying Aborting of buffer mode or changing target position. For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)☞ Page 393 Target position change
6 to 15	Empty (Specify "0".)*1
16	Target position specification exceeding the ring counter Specifies whether the target position that exceeds the ring counter upper/lower limit value is allowed or not when the software stroke limit is invalid. 0: Not allow 1: Allow
17 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) will occur, and the axis will not start.

■Done (Execution completion)

It turns TRUE when reaching the target position.

■Busy (Executing)

It is TRUE during the instruction execution. It turns FALSE after reaching the target position.

■Active (Controlling)

It is TRUE while the axis is controlled. It turns FALSE after reaching the target position.

■CommandAborted (Abortion of execution)

It turns TRUE when another instruction is started during the execution of this FB.

■Error (Error)

It turns TRUE when an error is occurring in this FB.

■ErrorID (Error code)

The error code generated in this FB is returned.

Necessary slave object

When using MC_MoveAbsolute, set the following slave object to the axis.

- Target position

If the above slave object is not set, the error "Necessary Slave Object Unset" (error code: 1AA8H) will occur, and the axis will not start.

For details of the slave object setting, refer to the following.

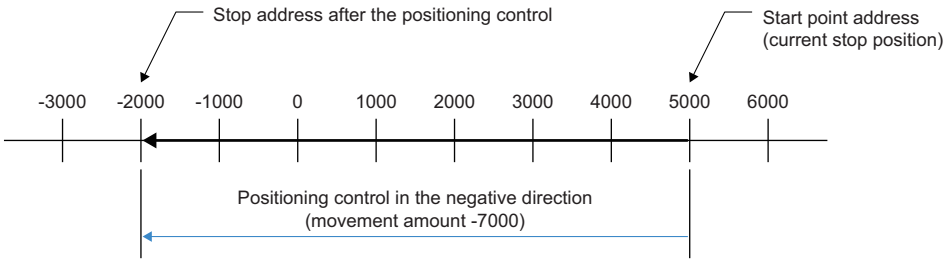
☞ Page 52 Axis Assignment

Relative Positioning Control

In MC_MoveRelative, Distance, Velocity, Acceleration, Deceleration, Jerk, and BufferMode can be set, and positioning of movement amount set in Distance is executed from the current position at start (start point address). The movement direction is determined by the sign of the movement amount. The axis status (AxisName.Md.AxisStatus) becomes "5: DiscreteMotion".

Ex.

When the start point address is 5000, and the movement amount is -7000, positioning is carried out to -2000.



Details of setting items

■Distance (Movement amount)

Set the signed movement amount.

Positive movement amount: Move to positive direction (Address increase direction)

Negative movement amount: Move to negative direction (Address decrease direction)

When movement amount is 0, the axis is not operated, however, the execution completion (Done) will be TRUE.

If "the current value + the movement amount" overflows or underflows the software stroke limit upper/lower limit value when the software stroke limit is valid, the error "Out of Parameter Range (Axis)" (error code: 1D80H) will occur and the FB will not start.

For details of movement amount range, refer to the following.

☞ Page 79 Positioning Range

■Velocity (Velocity)

Set the set velocity at positioning control. For details, refer to the following.

☞ Page 83 Velocity set range

■Acceleration (Acceleration)

Specify the acceleration. The setting details defer depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 237 Multiple Axes Positioning Control

■Deceleration (Deceleration)

Specify the deceleration. The setting details defer depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 237 Multiple Axes Positioning Control

■Jerk (Jerk)

Set Jerk. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■BufferMode (Buffer mode)

Select a buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh can be set. For details, refer to the following.

☞ Page 125 Buffer mode type

■Options (Options)

Set the function options that are used in MC_MoveRelative by specifying the bit.

The details of bit and the functions are shown below.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3	Position selection during buffer mode 0: Set position 1: Actual current value For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
4	Empty (Specify "0".)*1
5	Reverse rotation permission selection 0: Allow 1: Not allow It is valid when specifying Aborting of buffer mode or changing target position. For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)☞ Page 393 Target position change
6 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) will occur, and the axis will not start.

■Done (Execution completion)

It turns TRUE when reaching the target position.

■Busy (Executing)

It is TRUE during the instruction execution. It turns FALSE after reaching the target position.

■Active (Controlling)

It is TRUE while the axis is controlled. It turns FALSE after reaching the target position.

■CommandAborted (Abortion of execution)

It turns TRUE when another instruction is started during the execution of this FB.

■Error (Error)

It turns TRUE when an error is occurring in this FB.

■Error code (ErrorID)

The error code generated in this FB is returned.

Necessary slave object

When using MC_MoveRelative, set the following slave object to the axis.

- Target position

If the above slave object is not set, the error "Necessary Slave Object Unset" (error code: 1AA8H) will occur, and the FB will not start.

For details of the slave object setting, refer to the following.

☞ Page 52 Axis Assignment

Precautions

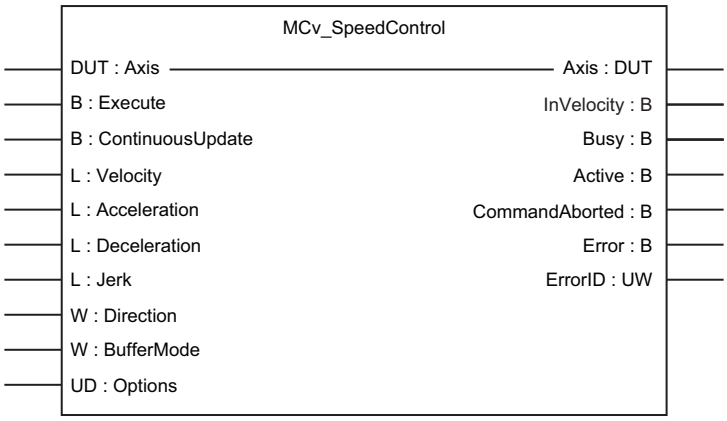
- Even though a FB is restarted or continuously updated, the current position where this FB was started for the first time is the starting address.
- Since it is processed with the floating point type, if the relative value positioning control is repeatedly executed, the movement amount specified may not be reached due to the calculation error.

6.2 Single Axis Speed Control

This section describes operation of the single axis speed control (including position loop).
For speed control excluding position loop, refer to the following.
☞ Page 259 Velocity Control

Relevant FB

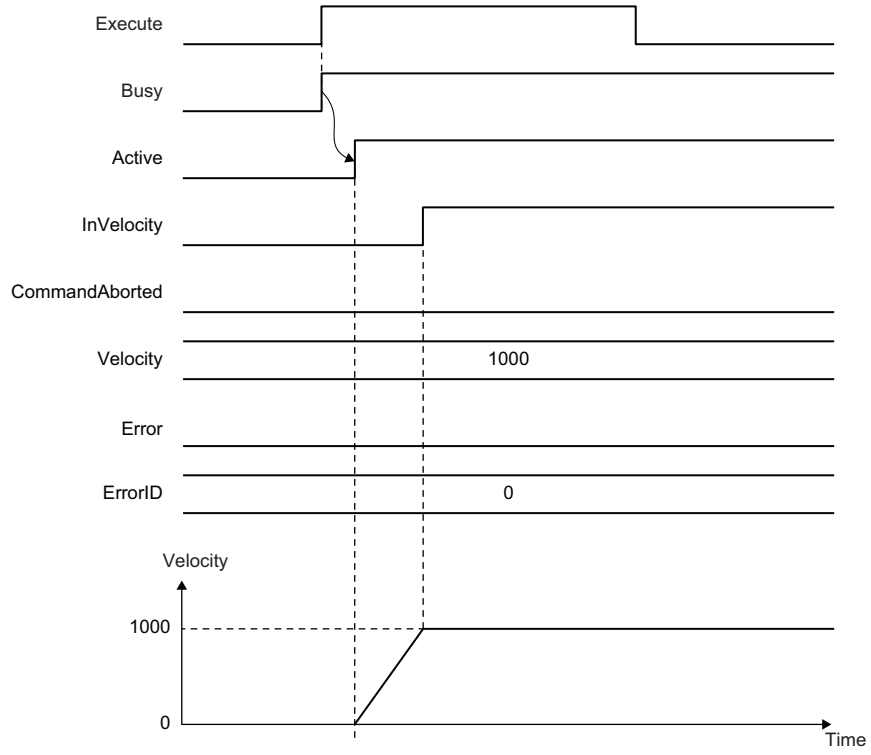
MCv_SpeedControl

Item	Description
Function overview	Executes the speed control including position loop.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
56	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	Target velocity, Acceleration, and Deceleration can be continuously changed during TRUE.
Target velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0	Sets target velocity. If the speed is negative, it moves in the negative direction. If it is omitted, the axis is not operated, however, the axis status (AxisName.Md.AxisStatus) will be "6: ContinuousMotion".
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the acceleration.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets thedeceleration.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets thejerk.
Direction selection	Direction	MC_DIRECTION	↑	1 to 4	0	Sets the direction selection. MC_DIRECTION definition can be used. 1: mcPositiveDirection (Positive direction) 2: mcNegativeDirection (Negative direction) When "2: mcNegativeDirection" is selected and Velocity is negative, the motor movement direction will be positive direction. If this setting is omitted, an error will occur.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 2	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlending (Blending) For details, refer to the following. ☞ Page 207 BufferMode
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets function options with bit designation.

*1 For bits and function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec Acceleration/deceleration specification method 1: mcFixedTime Acceleration/deceleration time-fixed method For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 15	Empty (Reserved)
18 to 31	Empty (Reserved)

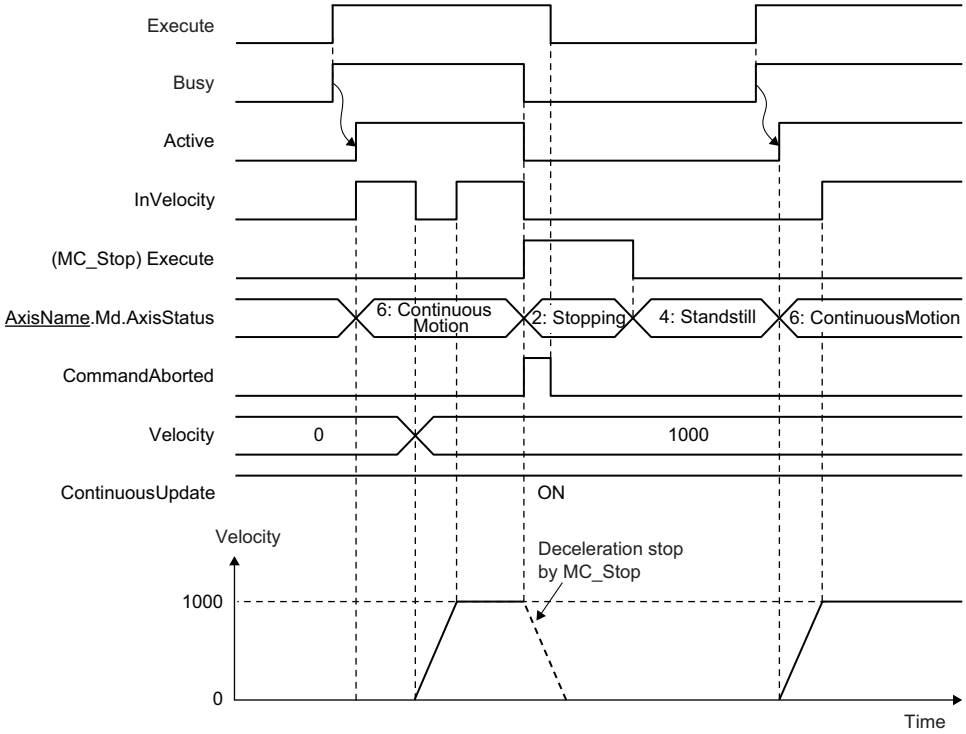
■Output variables

Name	Variable name	Data type	Default value	Description
Target velocity reached	InVelocity	BOOL	FALSE	Indicates that the set velocity has reached the target velocity. After reaching, the speed is maintained until Execute turns FALSE or the control is interrupted. When the target value has been changed due to change at ContinuousUpdate TRUE, it turns FALSE until the set velocity reaches the changed target velocity.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. Turns TRUE when this FB is stopped by an error or this FB is started during an error occurence. Turns FALSE when Execute is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Control details

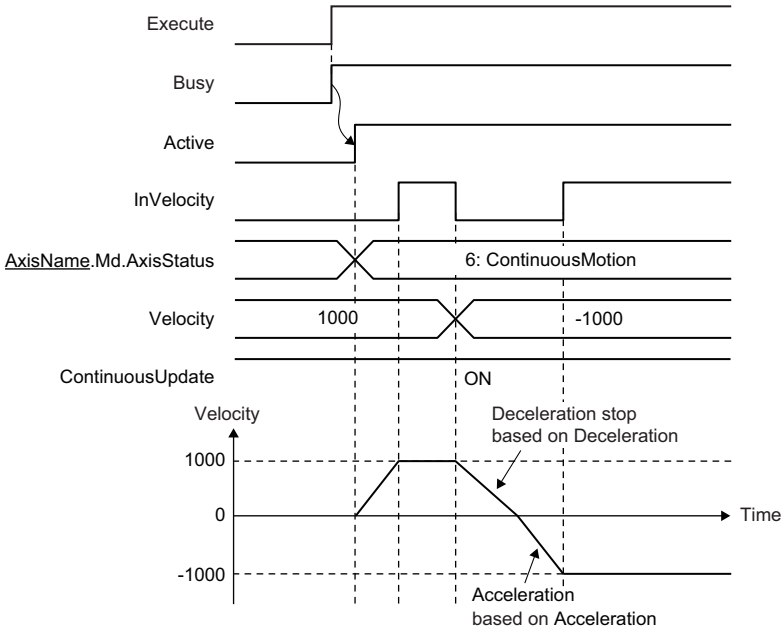
Set the control mode of the driver side to csp and execute the speed control for the specified axis with the specified speed.
MCv_SpeedControl is used to execute. To stop the axis, use MC_Stop or start another operation instruction.
To execute the speed control with csv of the control mode of the driver side, use MC_MoveVelocity, etc.

Timing chart at start and the stop cause occurrence



Timing chart when the operation direction is changed

When the operation direction is changed due to the case that sign of the target velocity is reversed at ContinuousUpdate TRUE, etc., the axis accelerates toward the target velocity once after deceleration stop.



BufferMode

Select a buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext and BlendingHigh can be set.

- 0: mcAborting
  Switches to this FB immediately.
- 1: mcBuffered
  When InVelocity turns TRUE, it regards the FB as completion and switches to the next instruction.

Besides, BlendingLow, BlendingPrevious, BlendingNext and BlendingHigh can not be specified to the subsequent FB. If specifying it, an error "BufferMode Specification Disabled" (error code: 1A80H) will occur.

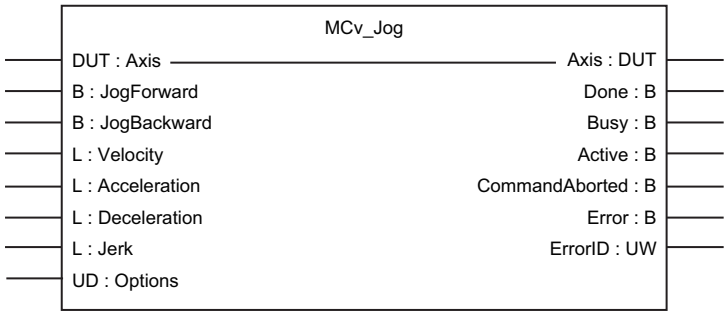
6.3 Single Axis Manual Control

This section describes the single axis manual control.

Relevant variables/FB

Variable/Structure name		Name	Details
AxisName.Cd			
	SwStrokeLimit_Override	Software stroke limit override	Temporarily switches valid/invalid of the software stroke limit check.
	HwStrokeLimit_Override	Hardware stroke limit override	Temporarily switches valid/invalid of the hardware stroke limit check.

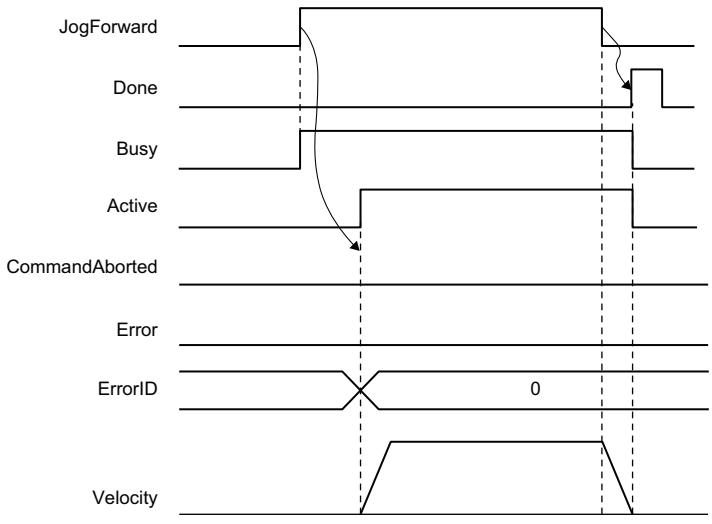
MCv_Jog

Item	Description
Function overview	Executes JOG operation according to the target velocity.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

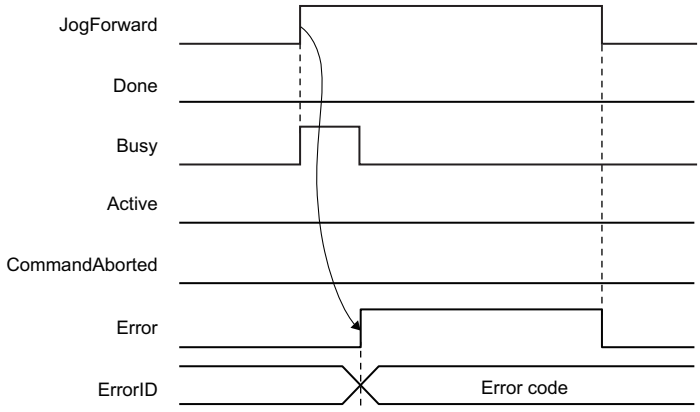
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
52	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always, ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Positive rotation JOG command	JogForward	BOOL	⎍	TRUE, FALSE	FALSE	When TRUE, it executes FB.
Reverse rotation JOG command	JogBackward	BOOL	⎍	TRUE, FALSE	FALSE	When TRUE, it executes FB.
Target velocity	Velocity	LREAL	↑	☞ Page 83 Velocity set range	0	Sets the set velocity.
Acceleration	Acceleration	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the acceleration.
Deceleration	Deceleration	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the deceleration.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the jerk.
Options	Options	DWORD(HEX)	↑	☞ *1	00000000H	Sets a function option with bit specification.

*1 For bits and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specified method) 1: mcFixedTime (Acceleration/deceleation time constant method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 15	Empty (Set "0".)
18 to 31	Empty (Set "0".)

■Output variables

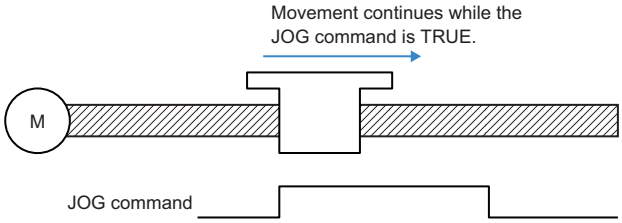
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	When deceleration stop by JOG command OFF is completed, Done bit turns TRUE for only one scan.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

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

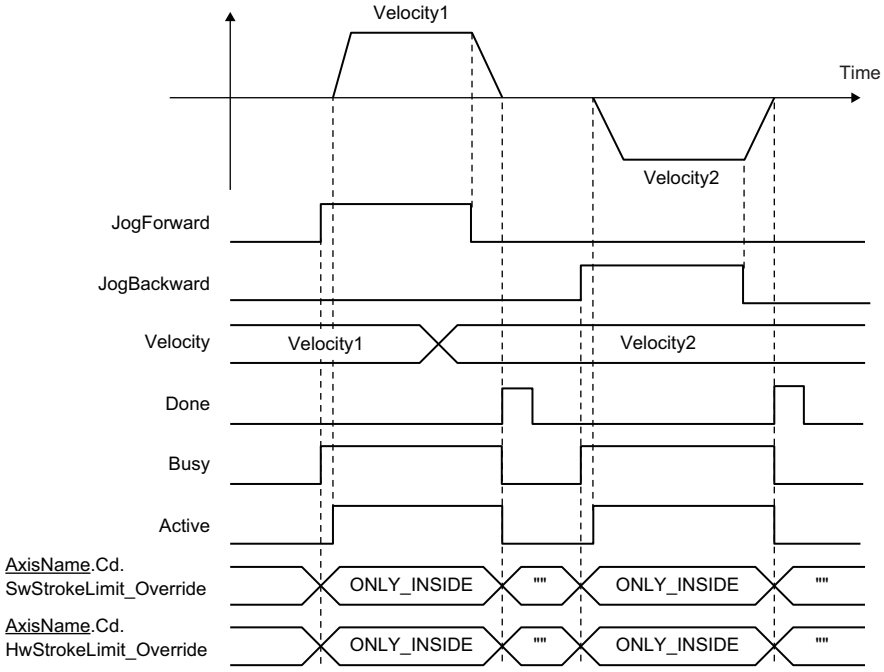
In JOG operation, the command is output from the motion system to the axis while the positive/reverse rotation JOG command is input by using MCv_Jog, and then the axis operates to the specified direction.

Point

- JOG operation can be executed even though 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 to 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 to 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.
- The target axis is moved to the specified direction during TRUE, by turning JogForward or JogBackward TRUE.
- The axis status (AxisName.Md.AxisStatus) during JOG operation is "6: ContinuousMotion".
- A deceleration stop is performed based on the settings of Deceleration and Jerk, by turning JogForward or JogBackward FALSE.
  The axis status (AxisName.Md.AxisStatus) changes to "4: Standstill" after the deceleration stop is completed.
- When Error turns TRUE during the deceleration by turning JogForward or JogBackward FALSE, Error will be TRUE until JogForward or JogBackward is turned TRUE.
- When another operation instruction is started during a JOG operation, the operation is carried out based on the BufferMode setting.
- When a JOG operation is started during another operation instruction, the start request will be ignored and the warning "Start during Operation Warning" (warning code: 0D01H) will occur. Start a JOG operation when the axis status (AxisName.Md.AxisStatus) is "4: Standstill".
- Use velocity change by override function to change the velocity during JOG operation. For details, refer to the following.
  ☞ Page 340 Override Function

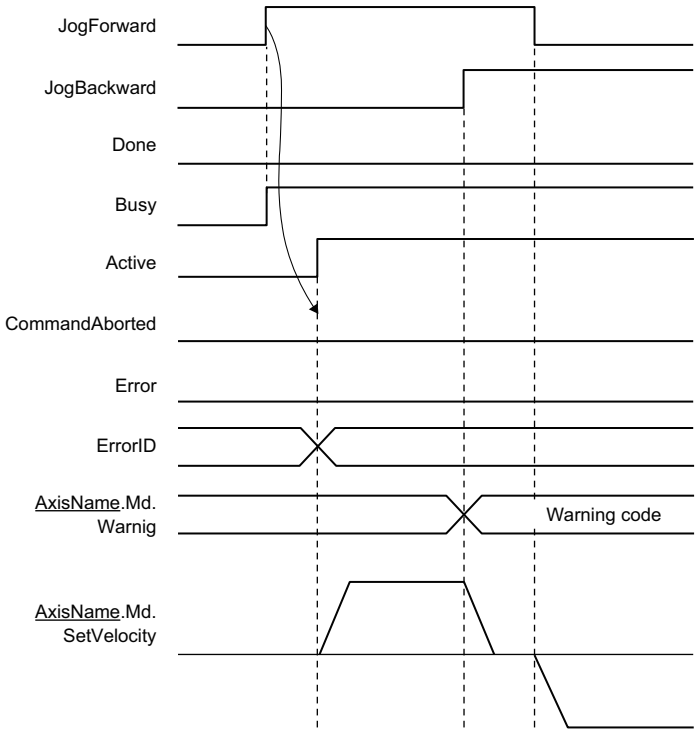
Details of setting items

■JogForward (Positive rotation JOG operation)/JogBackward (Reverse rotation JOG operation)

- Positive rotation JOG operation and reverse rotation JOG operation are started by turning JogForward and JogBackward TRUE respectively, and the target axis is moved to the specified direction during TRUE.
- If JogForward and JogBackward are turned TRUE simultaneously, Busy will turn TRUE, but the warning "JOG Command Input at Both Directions Warning" (warning code: 0D02H) will be detected and the JOG operation will not start.
- If the other JOG command of the same FB turns TRUE during a JOG operation, the warning "JOG Command Input at Both Directions Warning" (warning code: 0D02H) will be detected and a deceleration stop will be executed from the point where TRUE is detected. To execute JOG operation, turn TRUE either JogForward or JogBackward.

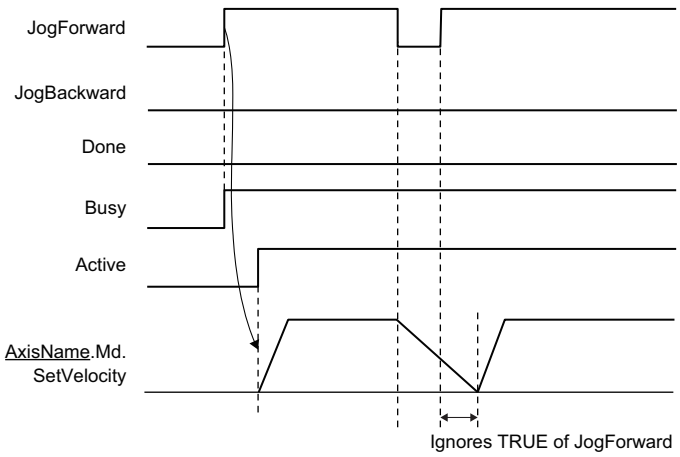
Ex.

When the other JOG command is TRUE during operation



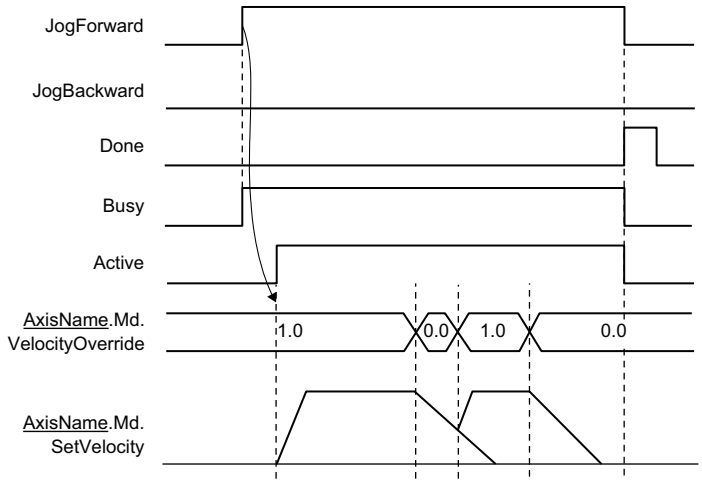
- According to FALSE of JogForward and JogBackward during deceleration, re-acceleration will not be performed even if JOG command turns TRUE. After the deceleration stop is completed, the acceleration will be performed.

Ex.



- Deceleration stop and acceleration are required repeatedly while moving by JOG operation, uses velocity change by override function.
  For details of the override function, refer to the following.
  ☞ Page 340 Override Function

Ex.



■Velocity (Target velocity)/Acceleration (Acceleration)/Deceleration (Deceleration)/Jerk (Jerk)

- Set Target velocity, Acceleration, Deceleration, and Jerk during JOG operation.
- The settings are imported when JOG operation is started by turning JogForward or JogBackward TRUE. A change during JOG operation is not accepted.
- For details of combined operation, refer to the following.
  ☞ Page 83 Velocity set range, ☞ Page 312 Acceleration/deceleration Processing Function

■Options (Options)

- Set the function options to be used. The details of bit and the functions are shown below.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 31	Emtpy (Specify "0".)*1

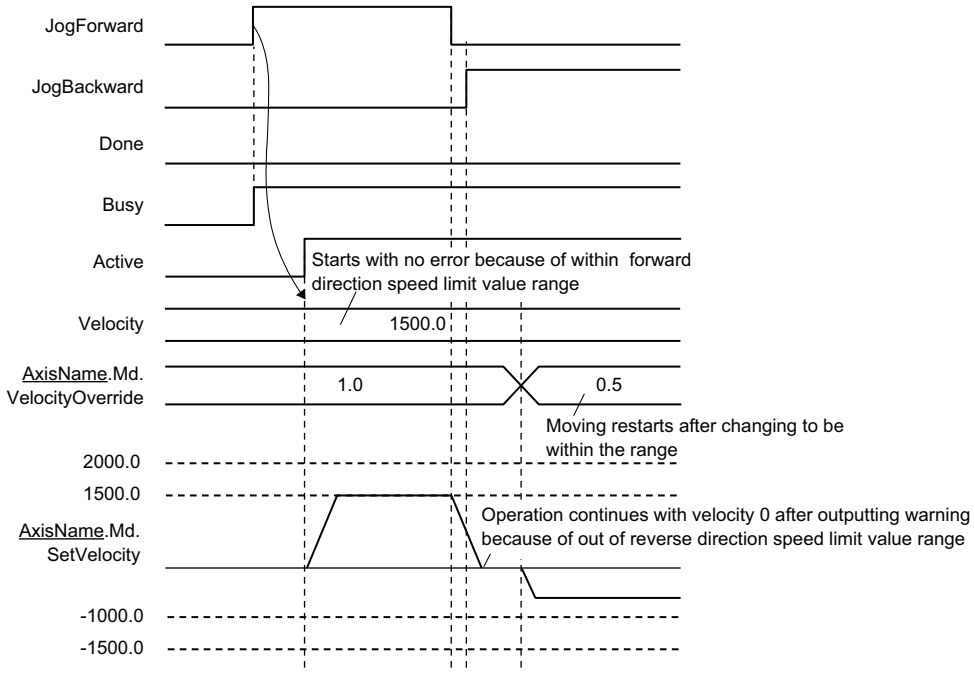
*1 If specifying "1", the error "Out of Options Range" (error code: 1A4EH) will occur and the axis will not start.

Precautions

- For safety, set a small value in 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 software stroke limit function is valid and, AxisName.Cd.SwStrokeLimit_Override is other than DISABLE or ONLY_INSIDE, rewrites AxisName.Cd.SwStrokeLimit_Override into ONLY_INSIDE during MCv_Jog execution, and rewrites it into "" during JOG operation completion.
- When software stroke limit function is valid, and AxisName.Cd.HwStrokeLimit_Override is other than DISABLE or ONLY_INSIDE, rewrites AxisName.Cd.HwStrokeLimit_Override into ONLY_INSIDE during MCv_Jog execution, and rewrites it into "" during JOG operation completion.
- Do not change AxisName.Cd.SwStrokeLimit_Override and AxisName.Cd. HwStrokeLimit_Override during MCv_Jog execution.
- Note that the value of AxisName.Cd.SwStrokeLimit_Override and 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 to negative direction against at start after deceleration stop during JOG operation, and when there is a cause (velocity limit value over, etc.) that an acceleration can not start to the target position, a warning "Out of Speed Range during Direction Change Warning" (warning code: 0D20H) will occur. (The operation continues with velocity 0.) The moving starts after changing control to remove the cause.

Ex.

When setting AxisName.Pr.VelocityLimit_Positive = 2000.0, and AxisName.Pr.VelocityLimit_Negative = 1000.0



6.4 Multiple Axes Positioning Control

The details and usage of the multiple axes positioning controls are explained in this section.
The multiple axes positioning controls use address information and execute positioning to the specified position using interpolation control.

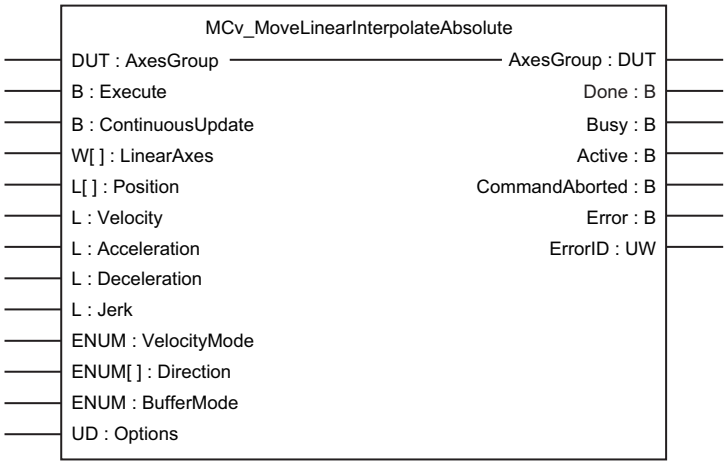
Relevant variables/FBs

Variable/Structure name		Name	Details
AxesGroupName.AxesGroupRef.			
	GroupNo	Axes group No.	Indicates axes group No. 0: No setting From 1 to the maximum number of setting: Set axes group No.
AxesGroupName.Pr.			
	Axis[1..16]	Configuration axis	Sets AxisRef (Axis No.) of the axis configurating the axes group.
	VelocityLimit	Speed limit value	Specifies the speed limit value.
AxesGroupName.Md			
	NumberOfAxes	Number of configuration axes	Indicates the number of configuration axes of the axes group.
	InterpolationAxes	Interpolation axes	Indicates the configuration axis that is executing the interpolation control of the axes group.
	SetVelocity	Set velocity	Indicates 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 AxesGroupName.Md.InterpolationAxes.

MCv_MoveLinearInterpolateAbsolute

Item	Description
Function overview	Specifies the target position of the absolute position of specified axes group, and executes positioning by linear interpolation control.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
248	8	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	—	FALSE	During TRUE, it can continuously reflect the intput of import "C".
Linear interpolation axis	LinearAxes	INT[1..16]	↑	1 to 16	0	Specifies axes to be used in linear interpolation control from the configuration axes. Specifies the index No. (1 to 16) of the configuration axes in array. When VelocityMode is 2: ReferenceAxisSpeed, the first element of the array is regarded as the reference axis.
Target position	Position	LREAL[1..16]	↑	☞ Page 79 Positioning Range	0.0	Sets the target position of the absolute position according to unit of axis. It is N-dimensional array data. It is treated as the absolute position of the configuration axis 1, 2, ..., N.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0.0	Sets the jerk according to unit of axis.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Speed mode	VelocityMode	MC_INTERPOLATE_SPEED_MODE	↑	0 to 2	0	Specifies the speed mode of interpolation control. 0: VectorSpeed (Vector speed) 1: LongAxisSpeed (Long axis speed) 2: ReferenceAxisSpeed (Reference axis speed)
Direction selection	Direction	MC_DIRECTION[1..16]	↑	1 to 3	0	Sets the direction selection. It is N-dimensional array data. It is treated as the direction selection of the configuration axis 1, 2, ..., N. 1: mcPositiveDirection (Positive direction) 2: mcNegativeDirection (Negative direction) 3: mcShortestWay (Shortest way)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh) For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

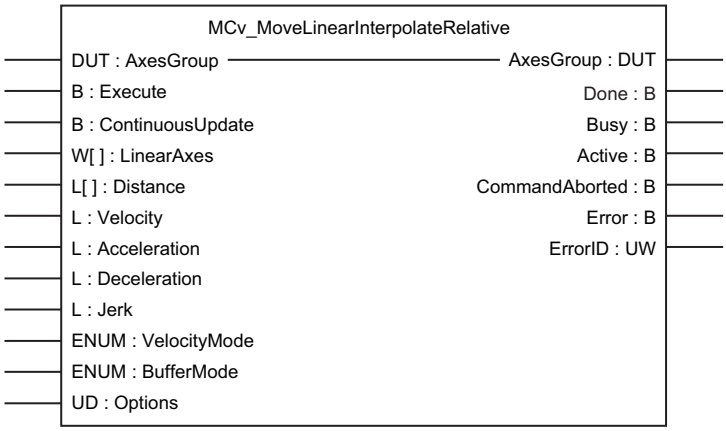
*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec Acceleration/deceleration specification method 1: mcFixedTime Acceleration/deceleration time-fixed method For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 15	Empty (Set "0".)
16	Specifies whether to allow the target position that exceeds the ring counter upper/lower limit value or not when the software stroke limit is invalid. 0: Not allow 1: Allow
17 to 31	Empty (Set "0".)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled. When multiple FBs are executed for the same axes group, Active of only one FB turns TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted due to error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UNIT)	0000H	The generated error code is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MCv_MoveLinearInterpolateRelative

Item	Description
Function overview	Specifies the movement amount of the relative position of specified axes group, and executes positioning by linear interpolation control.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
216	8	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes groupinformation	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	—	FALSE	During TRUE, it reflects intput of the import "C".
Linear interpolation axis	LinearAxes	INT[1..16]	↑	1 to 16	0	Specifies axes to be used in linear interpolation control from the configuration axes. Specifies the index No. (1 to 16) of the configuration axes in array. When VelocityMode is 2: ReferenceAxisSpeed, the first element of the array is regarded as the reference axis.
Movement amount	Distance	LREAL[1..16]	↑	☞ Page 79 Positioning Range	0.0	Sets the relative position according to unit of axis from the current position at start to the end point. It is N-dimensional array data. It is treated as the relative position of the configuration axis 1, 2, ..., N.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0.0	Sets the jerk according to unit of axis.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Speed mode	VelocityMode	MC_INTERPOLATE_SPEED_MODE	↑	0 to 2	0	Specifies the speed mode of interpolation control. 0: VectorSpeed (Vector speed) 1: LongAxisSpeed (Long axis speed) 2: ReferenceAxisSpeed (Reference axis speed)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh) For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

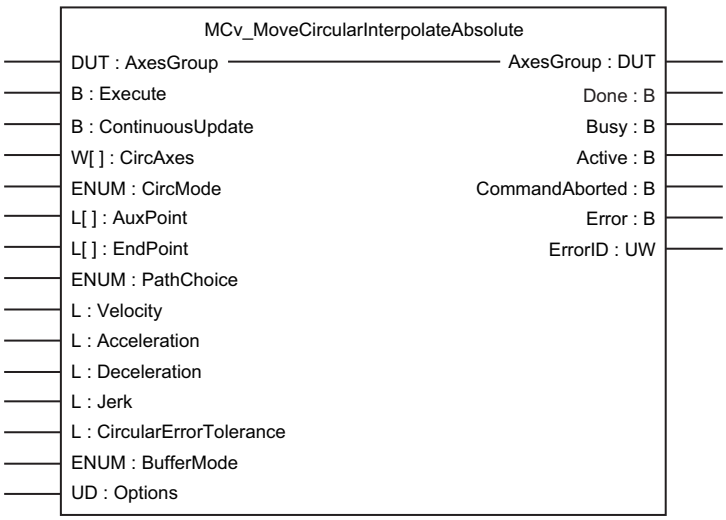
*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3	Position selection during buffer mode FALSE: Set position TRUE: Actual position
4 to 31	Empty (Set "0".)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled. When multiple FBs are executed for the same axes group, Active of only one FB turns TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted due to error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0000H	The generated error code is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MCv_MoveCircularInterpolateAbsolute

Item	Description
Function overview	Executes positioning by 2-axis circular interpolation by using arbitary configuration axes of set axes group, and by using the specified end point and the sub point of the absolute position.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
328	8	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes groupinformation	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	—	FALSE	During TRUE, it reflects intput of the import "C".
Circular interpolation axis	CircAxes	INT[1..2]	↑	1 to 16	0	Specifies axes to be used in circular interpolation control from the configuration axes. Specifies the index No. (1 to 16) of the configuration axes in array. The first element of the array is regarded as the reference axis.
Circular interpolation mode	CircMode	MC_CIRC_MODE	↑	0 to 2	0	Sets circular interpolation mode. 0: mcBorder (Border point designation) AuxPoint input defines a point on the arc connecting the start point and the end point. 1: mcCenter (Center point designation) AuxPoint input defines the center point of the circle. 2: mcRadius (Radius designation) AuxPoint input defines the radius of the circle.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Sub point	AuxPoint	LREAL[1..16]	↑	For "0: mcBorder", "1:mcCenter": ☞ Page 79 Positioning Range For "2: mcRadius": 0.000001 to 2147483647.0	0.0	Sets the absolute position of sub point according to unit of axis. It is N-dimentional array data. It is treated as the absolute position of the configuration axis 1, 2, ..., N. When specifying "2: mcRadius" in CircMode input, the first element is used for the radius, and the second or later elements are ignored.
End point	EndPoint	LREAL[1..16]	↑	☞ Page 79 Positioning Range	0.0	Set the absolute position of end point according to unit of axis. It is N-dimentional array data. It is treated as the absolute position of the configuration axis 1, 2, ..., N.
Path selection	PathChoice	MC_CIRC_PATHCHOICE	↑	0 to 5	0	Sets rotation direction of circular interpolation. 0: mcCW (CW) 1: mcCCW (CCW) 2: mcShortWay (Short way) 3: mcLongWay (Long way) 4: mcCWLongWay (CW long way) 5: mcCCWLongWay (CCW long way) When specifying "0: mcBorder" in CircMode input, the input is ignored. When specifying "2: mcRadius" in CircMode, "0: mcCW" and "1: mcCCW" mean the CW short way and the CCW short way respectively.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0.0	Sets the jerk according to unit of axis.
Circular interpolation error tolerance	CircularErrorTolerance	LREAL	↑	0.000001 to 100000	100.0	Sets the allowable width of circular interpolation error.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh) For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
Options	Options	DWORD(HEX)	↑/R	*1	00000000H	Sets a function option with bit specification.

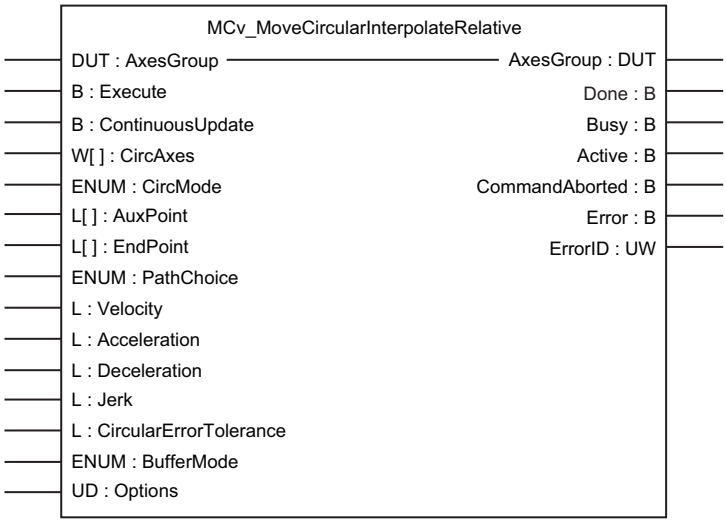
*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec Acceleration/deceleration specification method 1: mcFixedTime Acceleration/deceleration time-fixed method For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 31	Empty (Set "0".)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled. When multiple FBs are executed for the same axes group, Active of only one FB turns TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted due to error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0000H	The generated error code is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MCv_MoveCircularInterpolateRelative

Item	Description
Function overview	Executes positioning by 2-axis circular interpolation by using arbitary configuration axes of set axes group, and by using the relative position from the specified current position at start to the end point and the sub point.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
328	8	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes groupinformation	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	—	FALSE	During TRUE, it reflects intput of the import "C".
Circular interpolation axis	CircAxes	INT[1..2]	↑	1 to 16	0	Specifies axes to be used in circular interpolation control from the configuration axes. Specifies the index No. (1 to 16) of the configuration axes in array. The first element of the array is regarded as the reference axis.
Circular interpolation mode	CircMode	MC_CIRC_MODE	↑	0 to 2	0	Sets circular interpolation mode. 0: mcBorder (Border point designation) AuxPoint input defines a point on the arc connecting the start point and the end point. 1: mcCenter (Center point designation) AuxPoint input defines the center point of the circle. 2: mcRadius (Radius designation) AuxPoint input defines the radius of the circle.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Sub point	AuxPoint	LREAL[1..16]	↑	For "0: mcBorder", "1:mcCenter": ☞ Page 79 Positioning Range For "2: mcRadius": 0.000001 to 2147483647.0	0.0	Sets the relative position according to unit of axis from the current position at start to the sub point. It is N-dimentional array data. It is treated as the relative position of the configuration axis 1, 2, ..., N. When specifying "2: mcRadius" in CircMode input, the first element is used for the radius, and the second or later elements are ignored.
End point	EndPoint	LREAL[1..16]	↑	☞ Page 79 Positioning Range	0.0	Set the relative position according to unit of axis from the current position at start to the end point. It is N-dimentional array data. It is treated as the absolute position of the configuration axis 1, 2, ..., N.
Path selection	PathChoice	MC_CIRC_PATHCHOICE	↑	0 to 5	0	Sets rotation direction of circular interpolation. 0: mcCW (CW) 1: mcCCW (CCW) 2: mcShortWay (Short way) 3: mcLongWay (Long way) 4: mcCWLongWay (CW long way) 5: mcCCWLongWay (CCW long way) When specifying "0: mcBorder" in CircMode input, the input is ignored. When specifying "2: mcRadius" in CircMode, "0: mcCW" and "1: mcCCW" mean the CW short way and the CCW short way respectively.
Velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0.0	Sets the jerk according to unit of axis.
Circular interpolation error tolerance	CircularErrorTolerance	LREAL	↑	0.000001 to 100000	100.0	Sets the allowable width of circular interpolation error.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) 2: mcBlendingLow (BlendingLow) 3: mcBlendingPrevious (BlendingPrevious) 4: mcBlendingNext (BlendingNext) 5: mcBlendingHigh (BlendingHigh) For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3	Position selection during buffer mode FALSE: Set position TRUE: Actual position
4 to 31	Empty (Set "0".)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that axis is being controlled. When multiple FBs are executed for the same axes group, Active of only one FB turns TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted due to error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0000H	The generated error code is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

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 61 Axes Group, ☞ Page 71 Axes Group Assignment
The positioning control includes the following types.

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

Positioning speed in multiple axes positioning control

Positioning speed at multiple axes positioning control can be set in the Velocity input of the motion control FB. In the multiple axes 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 speed
- Long axis speed
- Reference axis speed

The motion system control methods for each set method are described in the following.

■Vector speed specification

0: VectorSpeed

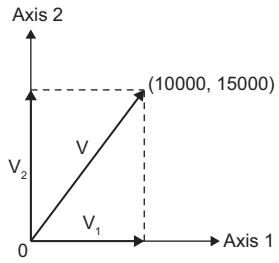
The positioning speed (V1 to V2) of each axis is calculated from the movement amount (D1 to D2) of each axis by the motion system based on the positioning speed of the set control target.

The positioning speed of the control target is called the vector speed.

Set the Position input or the Distance input as the movement amount of each axis and set the Velocity input as the vector speed.

Ex.

The following shows the case for 2-axis linear interpolation control.



Program example

Setting item	Setting value
Axis 1 movement amount (D1)	10000 [pulses]
Axis 2 movement amount (D2)	15000 [pulses]
Velocity unit of axes group	[s]
Vector speed (V)	7000 [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
Axis 1 positioning speed	$V1 = V \times D1 / \sqrt{(D1^2 + D2^2)}$
Axis 2 positioning speed	$V2 = V \times D2 / \sqrt{(D1^2 + D2^2)}$

Point

For the vector speed specification, the set speed limit value is valid to the Velocity input which is as the vector speed. For details, refer to the following.

☞ Page 337 Speed Limit

■Long axis speed specification

1: LongAxisSpeed

The control is carried out based on the positioning speed (the long axis speed: V) of the axis whose movement amount is the largest in the addresses set in each axis.

The positioning speed of the other axes is calculated by the motion system from the movement amount (D1 to D4) of each axis.

Set the Position input or the Distance input as the movement amount of each axis and Velocity input as the long axis speed in the function block for the motion control.

Ex.

The following shows the case for 4-axis linear interpolation control.

Program example

Setting item	Setting value
Axis 1 movement amount (D1)	10000 [pulses]
Axis 2 movement amount (D2)	15000 [pulses]
Axis 3 movement amount (D3)	5000 [pulses]
Axis 4 movement amount (D4)	20000 [pulses]
Axis 4 velocity unit	[s]
Long axis speed (V)	7000 [pulses/s]

In the above case, the reference axis is the axis 4 whose movement amount is the largest, and the control is carried out based on the positioning speed specified to the axis 4. The positioning speed of the other axes is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Axis 1 positioning speed	V1 = D1 / D4 × V
Axis 2 positioning speed	V2 = D2 / D4 × V
Axis 3 positioning speed	V3 = D3 / D4 × V

Point

- For the long axis speed specification, set speed limit value is valid for the Velocity input which is as the long axis speed. For details, refer to the following.

☞ Page 337 Speed Limit

- Note that the vector speed when specifying the long axis speed may be larger than the speed limit value.

(Ex.)

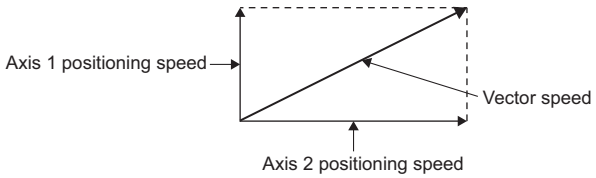
When setting a value like the following in the 2-axis linear interpolation, the vector speed exceeds the speed limit value.

The setting items and the setting values are shown below.

- Axis 1 movement amount (D1): 100 [pulses]
- Axis 2 movement amount (D2): 200 [pulses]
- Long axis speed (V): 50 [pulses/s]
- Speed limit value: 55 [pulses/s]

In the above case, the reference axis is axis 2 whose movement amount is the largest, and the control is carried out based on the positioning speed specified to the axis 2. The positioning speed and the vector speed of each axis are shown below.

- Axis 1 positioning speed: 100 / 200 × 50 = 25 [pulses/s]
- Axis 2 positioning speed: 50 [pulses/s]
- Vector speed: $\sqrt{(25^2 + 50^2)} = 55.9$ [pulses/s]



The vector speed becomes a value that exceeds the speed limit value 55.

■Reference axis speed specification

2: ReferenceAxisSpeed

The motion system calculates the positioning speed (V1 to V3) of other axes based on the positioning speed of the set reference axis (the reference axis speed: V), and carries out the control.

In MCFB, the top array of the LinearAxes input indicates the reference axis. Also, set the Position input or the Distance input as the movement amount of each axis and set the Velocity input as the single axis speed.

- If "0" is set to the axis movement amount of the axis specified as the reference axis, an error "Reference Axis Movement Amount 0" (error code: 1AABH) occurs.

Ex.

The following shows the case for 4-axis linear interpolation control.

Program example

Setting item	Setting value
Axis 1 movement amount (D1)	10000 [pulses]
Axis 2 movement amount (D2)	15000 [pulses]
Axis 3 movement amount (D3)	5000 [pulses]
Axis 4 movement amount (D4)	20000 [pulses]
Axis 4 velocity unit	[s]
Reference axis	Axis 4
Reference axis speed (V)	7000 [pulses/s]

In the above case, the reference axis is the axis 4, and control is carried out at the positioning speed specified to the axis 4. The positioning speed of the other axes is calculated by the motion system with the following calculation formula.

Setting item	Setting value
Axis 1 positioning speed	V1 = D1 / D4 × V
Axis 2 positioning speed	V2 = D2 / D4 × V
Axis 3 positioning speed	V3 = D3 / D4 × V

Point

- For the reference axis speed specification, set speed limit value is valid to the Velocity input which is as the reference axis speed. For details, refer to the following.
  ☞ Page 337 Speed 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 speed.

(Ex.)

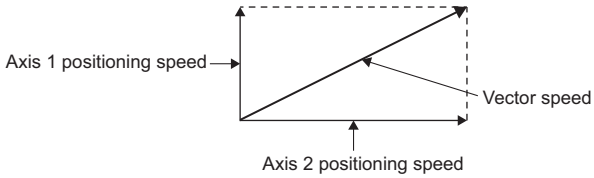
When setting a value like the following in the 2-axis linear interpolation, the positioning speed and the vector speed of the axis 2 exceed the speed limit value.

The setting items and the setting values are shown below.

- Axis 1 movement amount (D1): 100 [pulses]
- Axis 2 movement amount (D2): 200 [pulses]
- Reference axis speed (V): 50 [pulses/s]
- Reference axis: Axis 1
- Speed limit value: 55 [pulses/s]

In the above case, the reference axis is the axis 1, and control is carried out with the speed limit value set to the axis 1. The positioning speed and the vector speed of each axis are shown below.

- Axis 1 positioning speed: 50 [pulses/s]
- Axis 2 positioning speed: 200 / 100 × 50 = 100 [pulses/s]
- Vector speed: $\sqrt{(50^2 + 100^2)} = 111.8$ [pulses/s]



The positioning speed and the vector speed of the axis 2 become a value that exceeds the speed limit value 55.

Circular interpolation control

For the circular interpolation, the control is performed so that the positioning speed on the circular path becomes the specified speed.

The positioning speed for Blending of the multiple axes positioning control

This section explains operation when selecting BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh in the BufferMode input of the function block and setting different speed mode to the VelocityMode input of the first function block (FB1) and the second function block (FB2) in the multiple axes positioning control.

- It can start even when VelocityMode is different between FB1 and FB2.
- The control is carried out using the FB1 VelocityMode in FB1 and using the FB2 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.
- During Blending, when the VelocityMode of FB1 and FB2 is different, the warning "Multiple Start Speed Mode Specified Mismatch Warning" (warning code: 0D11H) will occur.
- Note that the speed of each axis and the vector speed may rapidly change when VelocityMode of FB1 and FB2 is different during Blending.

Setting value	BufferMode	Description
2: mcBlendingLow	BlendingLow	At the end position of FB1, the speed becomes a lower value of the Velocity input between FB1 and FB2. When the Velocity input of FB2 is lower, at the end position of FB1, it operates with VelcityMode of FB1 and the Velocity setting value of FB2.
3: mcBlendingPrevious	BlendingPrevious	At the end position of FB1, the speed becomes the Velocity input value of FB1. At the end position of FB1, it operates with VelcityMode of FB1 and the Velocity setting value of FB1.
4: mcBlendingNext	BlendingNext	At the end position of FB1, the speed becomes the Velocity input value of FB2. At the end position of FB1, it operates with VelcityMode of FB1 and the Velocity setting value of FB2.
5: mcBlendingHigh	BlendingHigh	At the end position of FB1, the speed becomes a higher value of the Velocity input between FB1 and FB2. When the Velocity input of FB2 is higher, at the end position of FB1, it operates with VelcityMode of FB1 and Velocity of FB2.

■Operation example for BlendingPrevious

Blending from the reference axis speed specification to the vector speed specification is as shown below.

It operates so that the FB1 reference axis speed becomes the speed set to Velocity of FB1 (the reference axis speed) at the FB1 target position. The reference axis speed when reaching the FB1 target position is read as the current vector speed value of FB2 without unit conversion, and it accelerates/decelerates the vector speed set to Velocity of FB2.

- Axis setting

Setting item	Setting value
Position and speed command unit of the configuration axis 1	mm/s
Position and speed command unit of the configuration axis 2	mm/s
Position and speed command unit of the axes group	mm/s

- FB1 input (Command unit: mm/s)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[100 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [100 100]
Velocity	1000
VelocityMode	2: ReferenceAxisSpeed

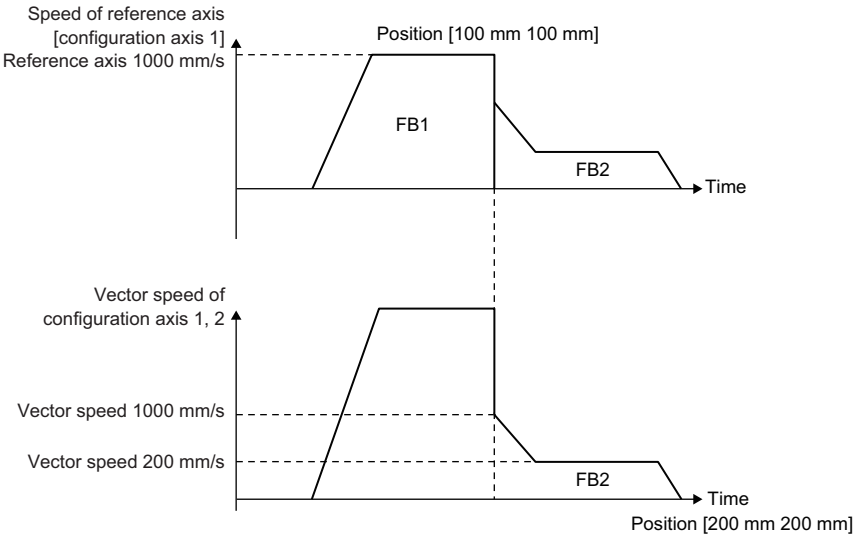
- FB2 input (Command unit: mm/s)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[200 200 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [200 200]
Velocity	200
VelocityMode	0: VectorSpeed
BufferMode	3: mcBlendingPrevious

Ex.

The following shows an operation example.

- Reaches the target position of FB1 of [100 mm 100 mm] at the reference axis speed of 1000 mm/s of the configuration axis 1that is the reference axis, 1000 mm/s.
- Starts operation from the current position of FB2 of [100 mm 100 mm] at the vector speed of 1000 mm/s.
- Decelerates to the vector speed of200 mm/s.
- Performs positioning to the target position of FB2 of [200 mm 200 mm].



■Operation example for BlendingNext

FB1: The reference axis speed → FB2: The vector speed

It operates so that the FB1 reference axis speed becomes the speed set to Velocity of FB2 (the vector speed) at the FB1 target position. The reference axis speed when reaching the FB1 target position is read as the current vector speed value of FB2 without unit conversion, and it accelerates/decelerates the vector speed set to Velocity of FB2.

- Axis setting

Setting item	Setting value
Position and speed command unit of the configuration axis 1	mm/s
Position and speed command unit of the configuration axis 2	mm/s
Position and speed command unit of the axes group	mm/s

- FB1 input (Command unit: mm/s)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[100 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [100 100]
Velocity	1000
VelocityMode	2: ReferenceAxisSpeed

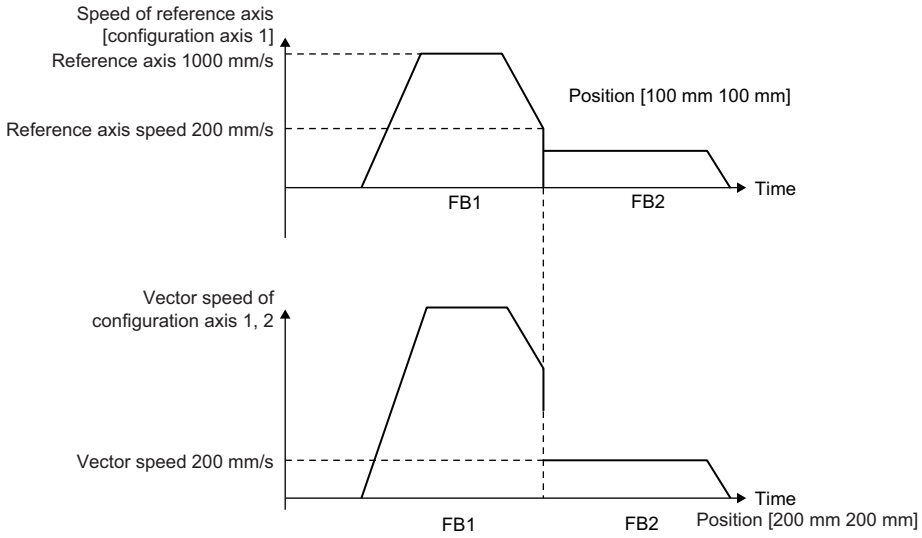
- FB2 input (Command unit: mm/s)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[200 200 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [200 200]
Velocity	200
VelocityMode	0: VectorSpeed
BufferMode	4: mcBlendingNext

Ex.

The following shows an operation example.

- Operates to the middle of the target position of FB1 of [100 mm 100 mm] at the reference axis speed of the configuration axis 1, 1000 mm/s.
- The configuration axis 1 reaches the target position of FB1 of [100 mm 100 mm] at the reference axis speed of 200 mm/s.
- Starts operation from the current position of FB2 of [100 mm 100 mm] at the vector speed 200 mm/s.
- Performs positioning to the target position of FB2 of [200 mm 200 mm].



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 the VelocityMode input of the function block for the motion control. For details and precautions, refer to the following.

☞ Page 74 Technical Units, ☞ Page 137 Multiple start during multiple axes operation

Command unit for Blending of the multiple axes positioning control

This section explains operation when selecting BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh in the BufferMode input of the function block, and the command unit is different between the first function block (FB1) and the second function block (FB2) in the multiple axes positioning control.

- It can start even when the command unit of FB1 and FB2 is different.
- 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.
- When the command unit of FB1 and FB2 is different, the warning "Speed Command Unit Mismatch Warning" (warning code: 0D1EH) will occur.

Setting value	BufferMode	Description
2: mcBlendingLow	BlendingLow	At the end position of FB1, the speed becomes a lower value of the Velocity input between FB1 and FB2. When the Velocity input of FB2 is lower, the speed at the end position of FB1 is FB1 command unit and the value set in Velocity of FB2.
3: mcBlendingPrevious	BlendingPrevious	At the end position of FB1, the speed becomes the Velocity input value of FB1. The speed at the end position of FB1 is FB1 command unit and the value set in Velocity of FB1.
4: mcBlendingNext	BlendingNext	At the end position of FB1, the speed becomes the Velocity input value of FB2. The speed at the end position of FB1 is FB1 command unit and the value set in Velocity of FB2.
5: mcBlendingHigh	BlendingHigh	At the end position of FB1, the speed becomes a higher value of the Velocity input between FB1 and FB2. When the Velocity input of FB2 is higher, the speed at the end position of FB1 is FB1 command unit and the value set in Velocity of FB2.

■Operation example for BlendingPrevious

During Blending, it can start 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.

- Axis setting

Setting item	Setting value
Position and speed command unit of the configuration axis 1	mm/s
Position and speed command unit of the configuration axis 2	mm/s
Position and speed command unit of the configuration axis 3	degree/min
Position and speed command unit of the configuration axis 4	degree/min

- FB1 input (Command unit: mm/s from the command unit of the configuration axis 1)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[100 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [100 100]
Velocity	1000
VelocityMode	2: ReferenceAxisSpeed

• FB2 input (Command unit: degree/min from the command unit of the configuration axis 3)

Setting item	Setting value
LinearAxes	[3 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [3 4]
Position	[0 0 200 200 0 0 0 0 0 0 0 0 0 0 0 0] or [0 0 200 200]
Velocity	200
VelocityMode	2: ReferenceAxisSpeed
BufferMode	3: mcBlendingPrevious

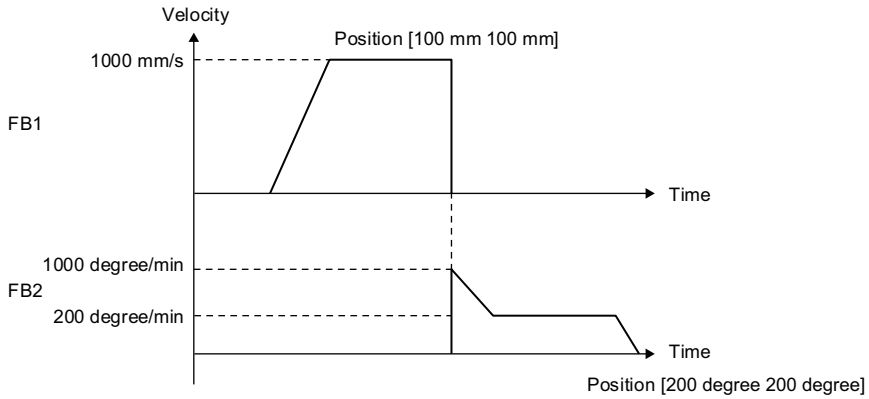
Ex.

The following shows an operation example.

• Reaches the target position of FB1 of [100 mm 100 mm] at the vector speed of 1000 mm/s.

• Starts operation from the current position of FB2 of [0 degree 0 degree] at the vector speed of 1000 degree/min.

• Decelerates to the vector speed of 200 degree/min.



■Operation example for BlendingNext

During Blending, it can start 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.

• Axis setting

Setting item	Setting value
Position and speed command unit of the configuration axis 1	mm/s
Position and speed command unit of the configuration axis 2	mm/s
Position and speed command unit of the configuration axis 3	degree/min
Position and speed command unit of the configuration axis 4	degree/min

• FB1 input (Command unit: mm/s)

Setting item	Setting value
LinearAxes	[1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [1 2]
Position	[100 100 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [100 100]
Velocity	1000
VelocityMode	2: ReferenceAxisSpeed

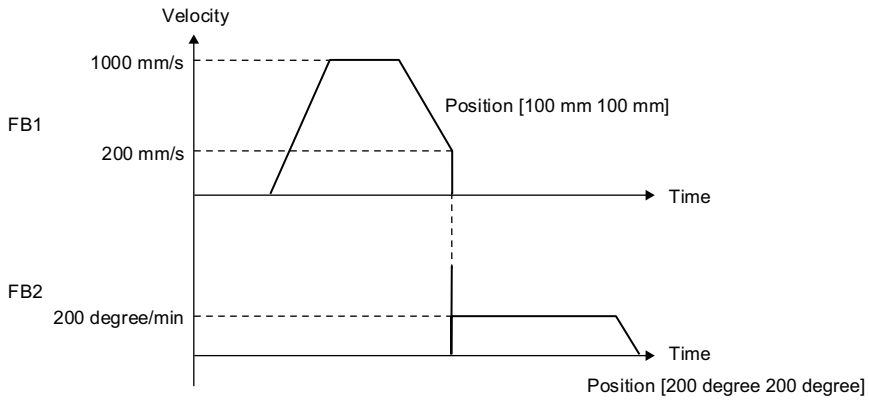
• FB2 input (Command unit: degree/min)

Setting item	Setting value
LinearAxes	[3 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0] or [3 4]
Position	[0 0 200 200 0 0 0 0 0 0 0 0 0 0 0 0] or [0 0 200 200]
Velocity	200
VelocityMode	2: ReferenceAxisSpeed
BufferMode	4: mcBlendingNext

Ex.

The following shows an operation example.

- Operates to the middle of the target position of FB1 of [100 mm 100 mm] at the vector speed of 1000 mm/s.
- Decelerates so that it reaches the target position of FB1 of [100 mm 100 mm] at the vector speed of 200 mm/s.
- Starts operation from the current position of FB2 of [0 degree 0 degree] at the vector speed of 200 degree/min.



Acceleration/deceleration processing

By the VelocityMode input of the function block for the motion control, the relationship between the positioning speed and the acceleration/deceleration processing becomes as shown below.

- Vector speed specification

  0: VectorSpeed

The acceleration/deceleration processing is applied to the vector speed.

- Long axis speed specification

  1: LongAxisSpeed

The acceleration/deceleration processing is applied to the long axis speed.

- Reference axis speed specification

  2: ReferenceAxisSpeed

The acceleration/deceleration processing is applied to the reference axis speed.

There are the following two types of the acceleration/deceleration method. For details of each acceleration/deceleration processing function, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

Acceleration/deceleration method	Description
Acceleration/deceleration specification method (Default)	Accelerats and decelerates using the acceleration, the deceleration, and the jerk specified in the FB.
Acceleration/deceleration fixed-time method	Accelerats and decelerates using the acceleration/deceleration time and the jerk specified in the FB regardless of the speed.

State transition in the multiple axes positioning control

The axes group status (AxesGroupName.Md.GroupStatus) of the axes group in the positioning control is "5: GroupMoving".

For the axes group status (AxesGroupName.Md.GroupStatus), refer to the following.

☞ Page 35 State transition

Linear interpolation control

Linear interpolation control specifies an axes group and performs interpolation control so that the path from the stat point (move start point) to the end point becomes a straight line. In linear interpolation control, interpolation control using maximum 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.

The absolute value linear interpolation control is executed with MCv_MoveLinearInterpolateAbsolute.

The relative value linear interpolation control is executed with MCv_MoveLinearInterpolateRelative.

Operation chart

The following shows examples of interpolation control for each number of configuration axes used in interpolation control.

■1-axis linear interpolation control (absolute value)

1-axis linear interpolation is executed from the current position at start (start address) to the address set to Position (end address).

Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [1000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

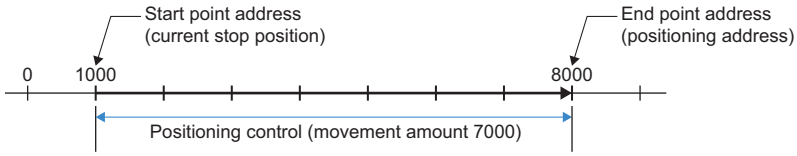
Position: [8000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1]

The current stop address: [1000]

Position: [8000]

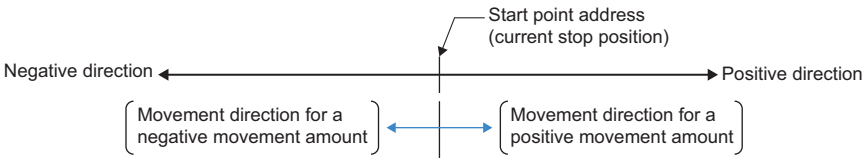


■1-axis linear interpolation control (relative value)

1-axis linear interpolation is executed by the movement amount set to Distance from the current position at start (start address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement direction is positive: Positioning to the positive direction (address increasing direction)
- When the movement direction is negative: Positioning to the negative direction (address decreasing direction)



Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [-3000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

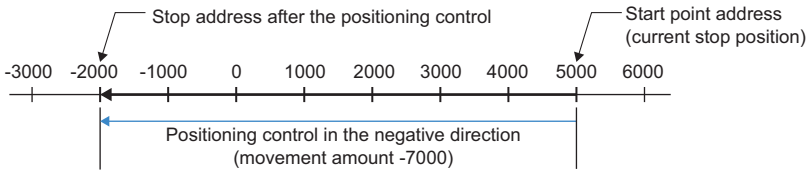
Distance: [-5000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1]

The current stop address: [-3000]

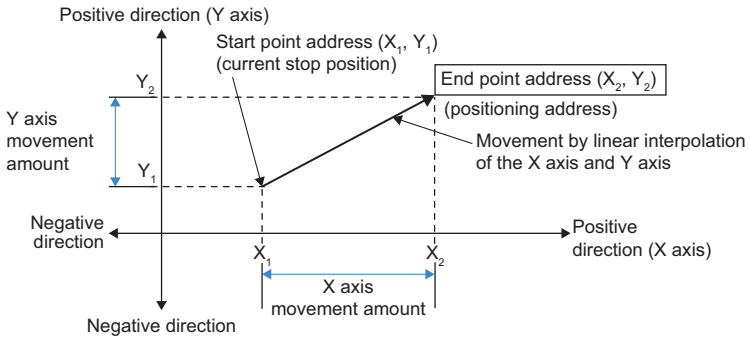
Distance: [-5000]



■2-axis linear interpolation control (absolute value)

2-axis linear interpolation is executed from the current position at start (start address) to the address set to Position (end address).

The movement direction is determined by the current position at start (start address) and the end address of each axis.



Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [1000 4000 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

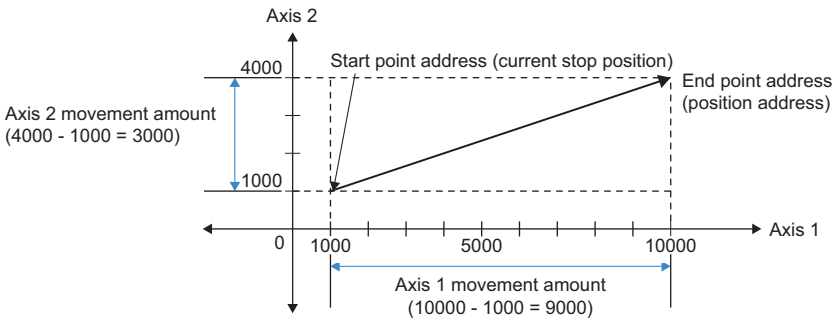
Position: [10000 2000 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1 2]

The current stop address: [1000 4000]

Position: [10000 2000]

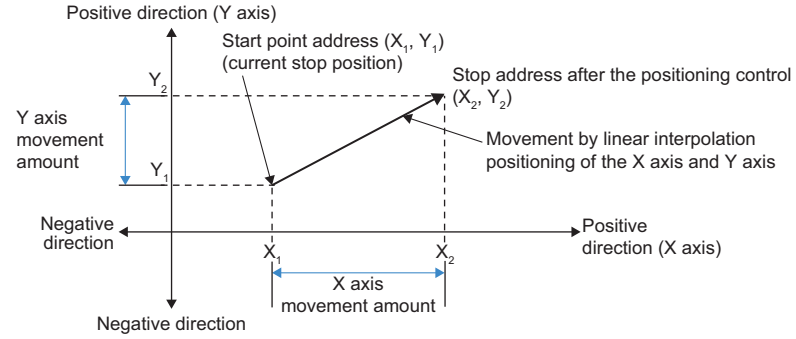


■2-axis linear interpolation control (relative value)

2-axis linear interpolation is executed by the movement amount set to Distance from the current position at start (start address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement direction is positive: Positioning to the positive direction (address increasing direction)
- When the movement direction is negative: Positioning to the negative direction (address decreasing direction)



Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [1000 4000 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

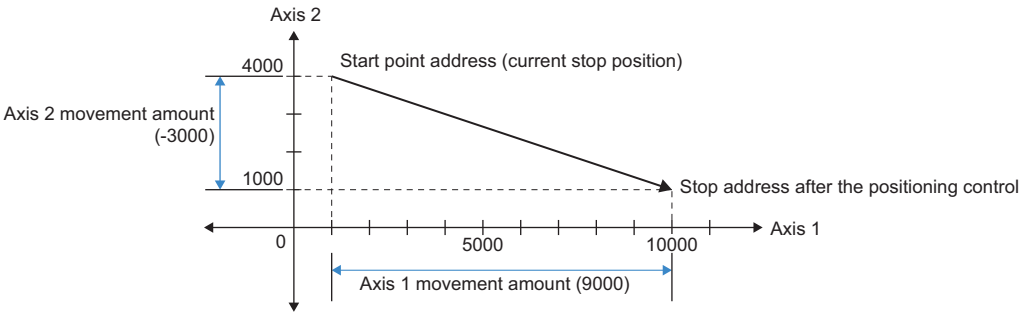
Distance: [9000 -3000 0 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1 2]

The current stop address: [1000 4000]

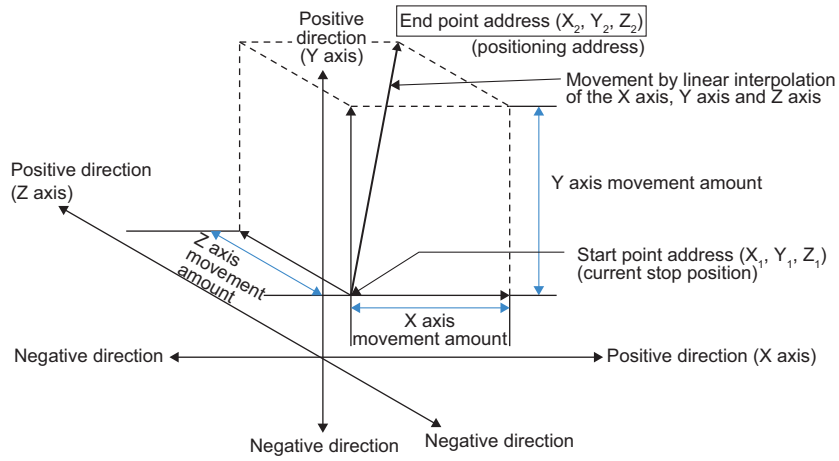
Distance: [9000 -3000]



■3-axis linear interpolation control (absolute value)

3-axis linear interpolation is executed from the current position at start (start address) to the address set to Position.

The movement direction is determined by the current position at start (start address) and the end address of each axis.



Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 2 3 0 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [1000 2000 1000 0 0 0 0 0 0 0 0 0 0 0 0 0]

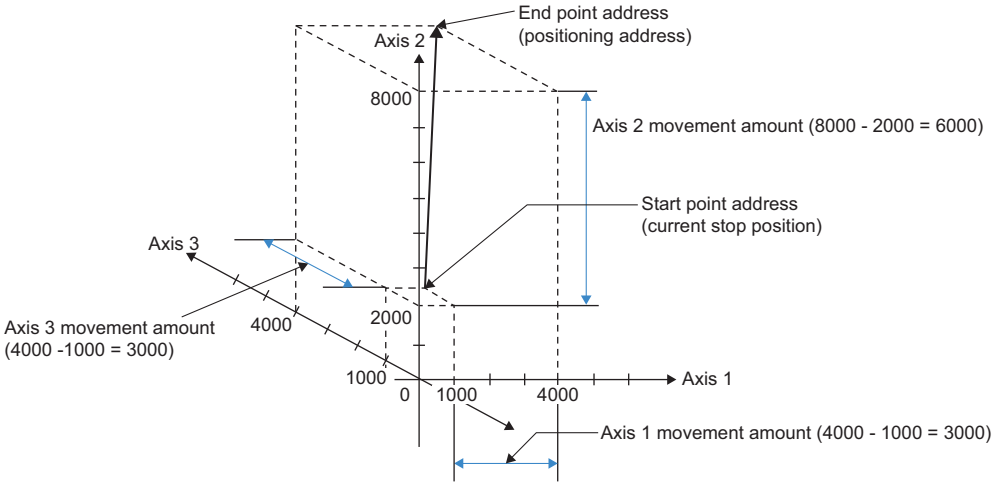
Position: [4000 8000 4000 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1 2 3]

The current stop address: [1000 2000 1000]

Position: [4000 8000 4000]

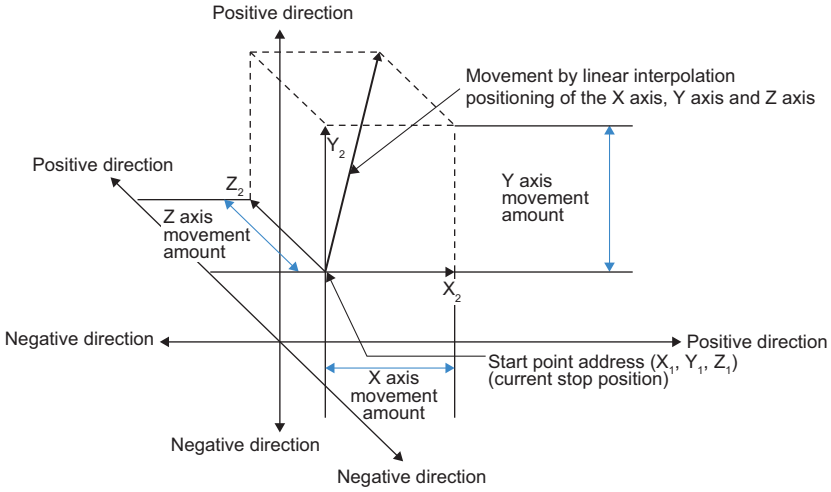


■3-axis linear interpolation control (relative value)

3-axis linear interpolation is executed by the movement amount set to Distance from the current position at start (start address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement direction is positive: Positioning to the positive direction (address increasing direction)
- When the movement direction is negative: Positioning to the negative direction (address decreasing direction)



Ex.

The control is as shown below for the following conditions.

LinearAxes: [1 2 3 0 0 0 0 0 0 0 0 0 0 0 0]

The current stop address: [2000 1000 2000 0 0 0 0 0 0 0 0 0 0 0 0]

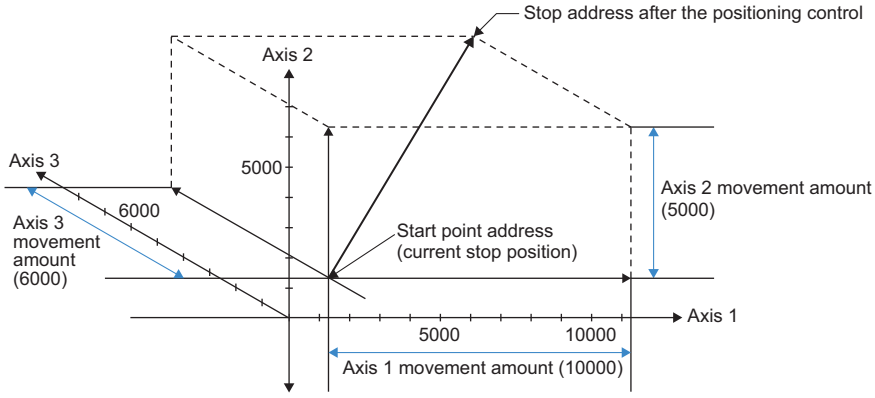
Distance: [10000 5000 6000 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [1 2 3]

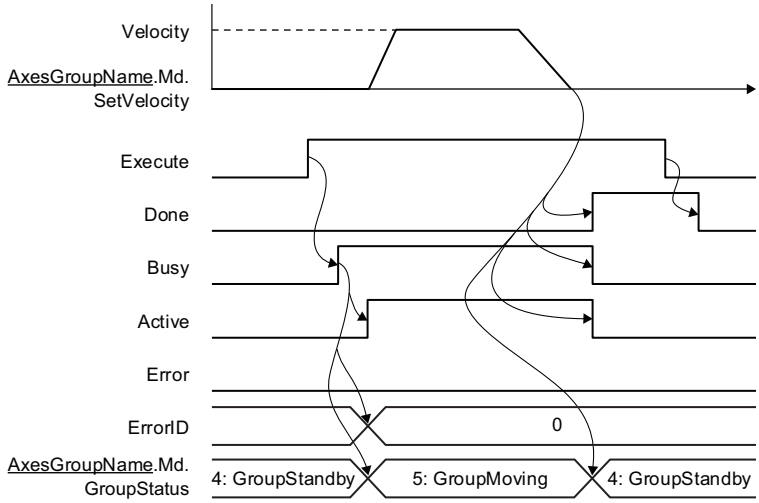
The current stop address: [2000 1000 2000]

Distance: [10000 5000 6000]



Timing chart

■When the FB is normally completed



■When an error occurs

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

Details of setting items

■ContinuousUpdate (ContinuousUpdate)

Continuous update of the FB enables to import input variables again without interrupting the operation to the instance in execution.

Input variables that can be change in restart/continuous update are Position/Distance, Velocity, Acceleration, and Deceleration.

For details, refer to the following.

☞ Page 124 Retrigger/Continuous Update, ☞ Page 312 RELEVANT FUNCTIONS TO VELOCITY

■LinearAxes (Linear interpolation axis)

In linear interpolation control, linear interpolation can be executed using arbitrary axes from the configuration axes set to the axes group.

Set configuration axes to perform linear interpolation by the LinearAxes input from the configuration axes of the axes group. The LinearAxes input has 16 array elements. For the array, specify the index Nos. (1 to 16: configuration axis 1 to configuration axis 16) of configuration axes to be used for interpolation control by just the number of configuration axes used for control, and specify "0" for the rest. "0" can be omitted.

- The setting number of the linear interpolation axes must be the maximum number of the interpolation axes for interpolation control,4, or less.
- The number of configuration axes to be used for interpolation control must be the number of axes registered to the configuration axes or less.
- When VelocityMode is "2: ReferenceAxisSpeed", the configuration axis of the first element in LinearAxes becomes the reference axis.
- When specifying as follows, the error "Liner Interpolation Axis Setting Incorrect" (error code: 1AB9H) will occur and the axis will not start.

- When specifying the configuration axis where the axis is not set
- When the first element of LinearAxes is "0"
- When specifying the same index No. to LinearAxes in duplicate
- When specifying the number of setting axes of LinearAxes to exceed the maximum number of the interpolation axes

Ex.

When setting configuration axis 2, 3, 4 to the linear interpolation axes

LinearAxes: [2 3 4 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [2 3 4]

■Position (Target position)/Distance (Movement amount)

Set the target position of the absolute position or the movement amount from the current position at start by the Position/Distance input. Position/Distance has 16 array elements.

- Position/Distance[0..(N-1)] indicates the target position/movement amount of the configuration axis 1 to N. Set the position to the configuration axes set in LinearAxes.
- The Position/Distance input for the configuration axes which are not set to the linear interpolation axes is ignored.
- The Position/Distance input of axes after all configuration axes set to the linear interpolation axes can be omitted.

Ex.

When setting the configuration axis 2, 3, 4 to the linear interpolation axes, and the target positions of the configuration axis 2, 3, 4 are 2000, 3000, 4000 respectively

LinearAxes: [2 3 4 0 0 0 0 0 0 0 0 0 0 0 0 0]

Position: [0 2000 3000 4000 0 0 0 0 0 0 0 0 0 0 0 0]

or

LinearAxes: [2 3 4]

Position: [0 2000 3000 4000]

■Velocity (Velocity)

Specify the maximum speed of the way. For details, refer to the following.

☞ Page 227 Positioning speed in multiple axes positioning control

■Acceleration (Acceleration)

Specify the acceleration. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■Deceleration (Deceleration)

Specify the deceleration. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■Jerk (Jerk)

Specify the jerk. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■VelocityMode (Velocity mode)

Specify the velocity mode in multiple linear interpolation control. When specifying "2: ReferenceAxisSpeed" in VelocityMode, the reference axis becomes the configuration axis specified to the top elements of the LinearAxes input. For details, refer to the following.

☞ Page 227 Positioning speed in multiple axes positioning control

Setting value	Speed mode name	Description
0: VectorSpeed	Vector speed	Velocity specifies the vector speed.
1: LongAxisSpeed	Long axis speed	Velocity specifies the speed of the long axis.
2: ReferenceAxisSpeed	Reference axis speed	Velocity specifies the speed of the reference axis.

Restriction

- When "0: VectorSpeed" is specified to VelocityMode and the movement value of each axis exceeds "4,294,967,296.0 (= 2^{32})", the error "Out of Liner Movement Amount Range" (error code: 1ADEH) will occur and the axis will not start.
- When Aborting is specified to BufferMode and MCv_MoveLinearInterpolateAbsolute is executed by multiple start, specify "0: VectorSpeed" to VelocityMode. If other than "0: VectorSpeed" is set, the error "Out of Speed Mode Range" (error code: 1A61H) will occur.

■Direction (Dilection selection)

It can be selected from the positive direction, the negative direction, and the shortest way. Specify the direction to move from the current position to the target position. Direction has 16 array elements.

- Direction [0..(N-1)] indicates the direction selection of the configuration axis 1 to N. Set the value in the configuration axis set in LinearAxes.
- The direction input of the configuration axis which is not set as the linear interpolation axis is ignored.
- When selecting other than the positive direction, the negative direction, and the shortest way, the error "Out of Direction Selection Range" (error code: 1A37H) will occur and the axis will not start.
- The linear axis where the software stroke limit is valid ignores this setting. For details of operation of each direction selection, refer to the following.

☞ Page 194 Direction (Direction selection)

Setting value	Direction selection name	Description
1: mcPositiveDirection	Positive direction	Executes positioning from the current position to the target position in the positive direction (address increasing).
2: mcNegativeDirection	Negative direction	Executes positioning from the current position to the target position in the negative direction (address decreasing).
3: mcShortestWay	Shortest way	Executes positioning in the direction where the distance between the current position and the target position is close.

■BufferMode (Buffer mode)

Select the buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh can be set. For details, refer to the following.

☞ Page 125 Buffer mode type

■Options (Options)

Set a function option with bit specification.

Bit details and the function are as the following table. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function, ☞ Page 188 Single Axis Positioning Control

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function)
3*1	Position selection during buffer mode Set "0" for absolute value linear interpolation control.*2 FALSE: Set position TRUE: Actual position For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
4 to 15	Empty (Set "0".)*2
16*3	Specifies whether to allow the target position that exceeds the ring counter upper/lower limit value or not when the software stroke limit is invalid. Set "0" for the relative value linear interpolation control.*2 FALSE: Not allow TRUE: Allow
17 to 31	Empty (Set "0".)*2

*1 It is valid only when the relative value linear interpolation control.

*2 When specifying "1", the error "Out of Options Range" (error code: 1A4EH) will occur and the axiswill not start.

*3 It is valid only when the absolute value linear interpolation control.

Circular interpolation control

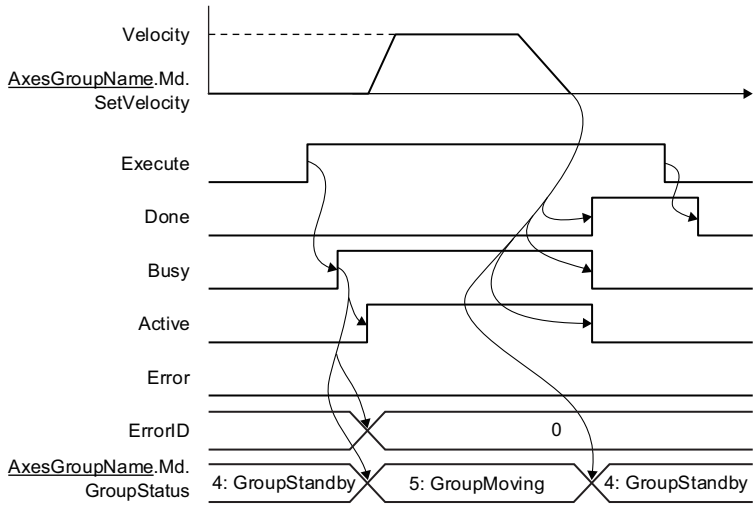
Circular interpolation control specifies an axes group and performs interpolation control so that the path from the stat point (move start point) to the end point becomes an arc to a linear axis which is arranged mechanically orthogonally.
In circular interpolation control, interpolation control using arbitrary two axes from the configuration axes set to the axes group.
Three types of the circular interpolation methods, the border point designation, the center point designation, and the radius designation, can be specified for circular interpolation control.
Circular interpolation control has 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 point, and executes 2-axis circular interpolation control.

The absolute value circular interpolation control is executed with MCv_MoveCircularInterpolateAbsolute.
The relative value circular interpolation control is executed with MCv_MoveCircularInterpolateRelative.

Timing chart

■When the FB is normally completed



■When an error occurs

For details when an error occurs, refer to the following.
☞ Page 25 Execute type/Enable type

Details of setting items

■ContinuousUpdate (Continuous update)

Continuous update of the FB enables to import input variables again without interrupting the operation to the instance in execution.

Input variables that can be change in restart/continuous update are Position/Distance, Velocity, Acceleration, and Deceleration.

For details, refer to the following.

☞ Page 124 Retrigger/Continuous Update, ☞ Page 312 RELEVANT FUNCTIONS TO VELOCITY

■CircAxes (Circular interpolation axis)

In circular interpolation control, circular interpolation can be executed by using arbitrary two axes from the configuration axes set to the axes group.

Set configuration axes to perform circular interpolation by the CircAxes input from the configuration axes of the axes group. The CircAxes input has two array elements. For the array, specify the index Nos. (1 to 16: configuration axis 1 to configuration axis 16) of configuration axes to be used for interpolation control. The first element of the array is regarded as the reference axis.

- If a configuration axis which is not set an axis is specified, an error occurs.

Ex.

When setting configuration axis 2, 3 to the circular interpolation axes

CircAxes: [2 3]

■CircMode (Circular interpolation mode)

In circular interpolation control, three types of the circular interpolation methods, the border point designation, the center point designation, and the radius designation, can be specified by inputting CircMode. The definition of AuxPoint input differs depending on the CircMode input.

Setting value	Circular interpolation mode name	AuxPoint (Sub point)
0: mcBorder	Border point designation	AuxPoint input defines the border point on the arc connecting the start point and the end point.
1: mcCenter	Center point designation	AuxPoint input defines the center point of the arc.
2: mcRadius	Radius designation	AuxPoint input defines the radious of the arc.

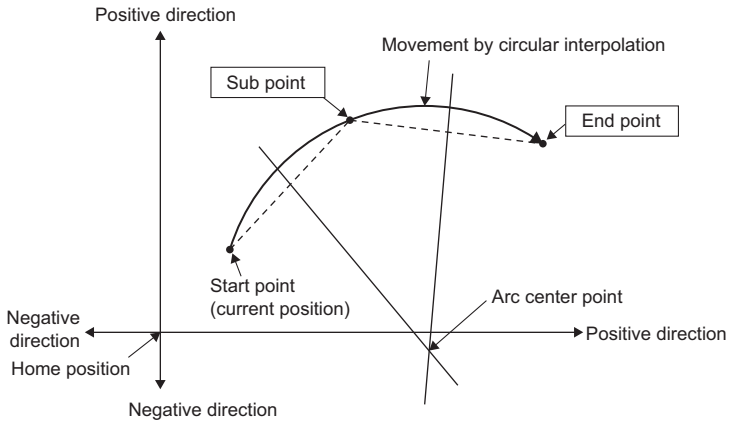
- Circular interpolation control with border point designation

When selecting "0: mcBorder" in the CircMode input, positioning control is carried out in an arc path passing through the specified border point by using two configuration axes specified to CircMode.

• Absolute value circular interpolation control operation with border point designation

In absolute value circular interpolation control with border point designation, positioning is carried out from the current position at start (start point address) to the address set to EndPoint (end point address) in an arc path that passes through the address (border point address) set to AuxPoint.

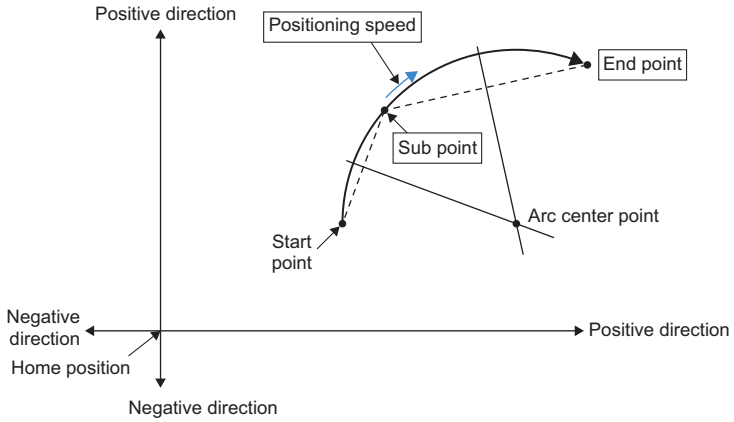
The resulting control path is an arc having as its center the intersection point of perpendicular bisectors of a straight line between the current position at start and the border point address, and a straight line between the border point address and the end point address. However, a perfect circle cannot be drawn with the border point designation. (The end point and the sub point shown in the following figure indicate the data to be set.)



• Relative value circular interpolation control operation with border point designation

In relative value circular interpolation control with border point designation, positioning is carried out from the current position at start (start point address) to the address of the movement amount set to EndPoint in an arc path (end point address) that passes through the address of the movement amount set to AuxPoint (border point address).

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. (The end point, the positioning speed, and the sub point shown in the following figure indicate the data to be set.)



Restriction

2-axis circular interpolation control 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 is 2147483647.0): The error "Out of Radius Range" (error code: 1A6CH) will occur at positioning start.
- When the border point address exceeds positioning range: The error "Out of Boundary Point Address Range" (error code: 1A64H) will occur.
- When the end point address exceeds positioning range: The error "Out of End Point Address Range" (error code: 1A6DH) will occur.
-
- When the start point address, border point address, and end point address are in the same straight line: The error "Start Point - Boundary Point - End Point Address Same Straight Line" (error code: 1A6AH) will occur.
- When the start point address is the same as the end point address: The error "Start Point - End Point Address Same Value" (error code: 1A66H) will occur.
- When the start point address is the same as the border point address: The error "Start Point - Boundary Point Address Same Value" (error code: 1A68H) will occur.
- When the end point address is the same as the border point address: The error "End Point - Boundary Point Address Same Value" (error code: 1A69H) will occur.

• Circular interpolation control with center point designation

When selecting "1: mcCenter" in the CircMode input, two configuration axes specified in CircAxes are used to carry out positioning control in an arc path having the specified center point as a center point.

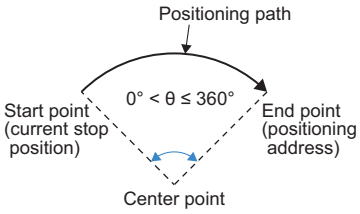
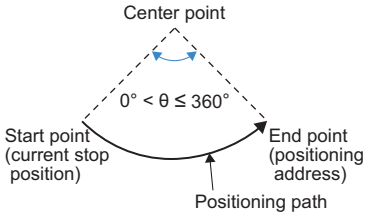
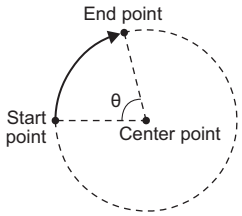
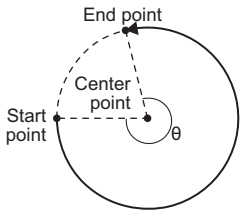
[Circular interpolation path]

The path in the absolute value circular interpolation control with center point designation can be set by the PathChoice input of MCFB. The following table shows the setting value, setting description, arc center angle that can be controlled, and path of PathChoice.

When the start point, end point, and center point are on one straight line, and when selecting "2: mcShortWay" or "3: mcLongWay", a semicircle is drawn in CW direction.

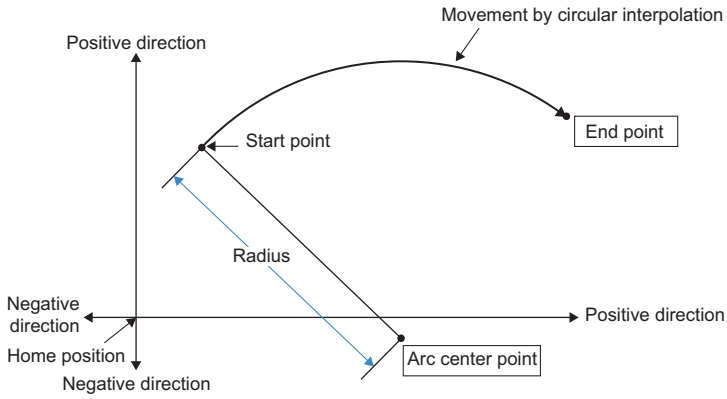
When the start point is same as the end point, and when selecting "2: mcShortWay", an error occurs.

When the start point is same as the end point, and when selecting "3: mcLongWay", a perfect circle is drawn in CW direction.

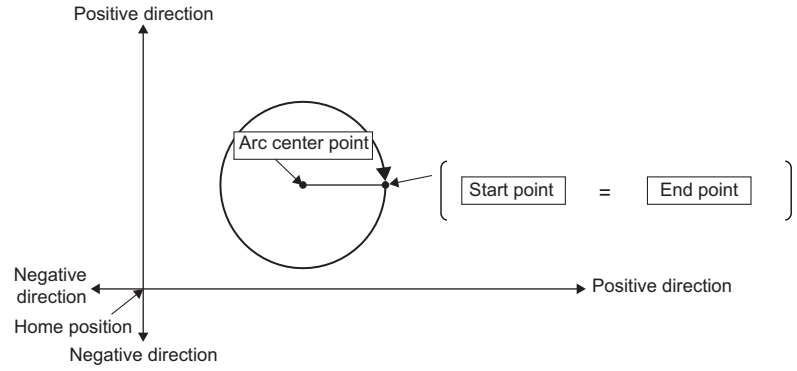
Setting value	Setting description	Arc center angle that can be controlled	Path
0: mcCW	CW	$0° < \theta \leq 360°$	
1: mcCCW	CCW	$0° < \theta \leq 360°$	
2: mcShortWay	Short way • When the start point, end point, and center point are on one straight line, a semicircle is drawn in CW direction. • When the start point is same as the end point, an error occurs.	$0° < \theta \leq 180°$	
3: mcLongWay	Long way • When the start point, end point, and center point are on one straight line, a semicircle is drawn in CW direction. • When the start point is same as the end point, a perfect circle is drawn in CW direction.	$180° \leq \theta \leq 360°$	

• Absolute value circular interpolation control operation with center point designation

In absolute value circular interpolation control operation with center point designation, positioning is carried out from the current position at start (start point address) to the end position set to EndPoint in an arc path having the center point set in AuxPoint as its center. (The end point and the center point of the arc shown in the following figure indicate the data to be set.)



Positioning of a perfect circle with a radius from the start point address to the arc center point can be carried out by setting the EndPoint to the same address as the start point. (The start point, the end point, and the center point of the arc shown in the following figure indicate the data to be set.)



Ex.

To specify EndPoint to the same as the start point, specify the set position of the configuration axes to be used in circular interpolation to the EndPoint input as the following.

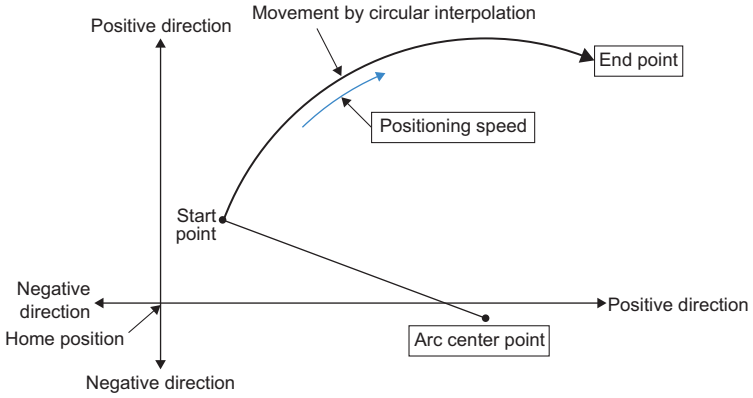
AxesGroupName.Pr.Axis[1] = Axis0001.AxisRef

AxesGroupName.Pr.Pr.Axis[2] = Axis0002.AxisRef

EndPoint = [Axis0001.Md.SetPosition Axis0002.Md.SetPosition]

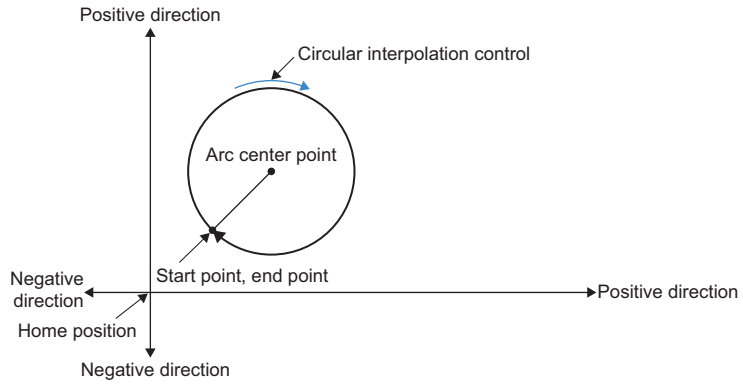
• Relative value circular interpolation control operation with center point designation

In relative value circular interpolation control operation with center point designation, positioning is carried out from the current position at start (start point address) to the address of the movement amount set to EndPoint (end point address) in an arc path having the address of the movement amount set in AuxPoint (center point address) as its center. (The end point, the positioning speed, and the center point of the arc shown in the following figure indicate the data to be set.)



Positioning of a perfect circle with a radius from the start point address to the arc center point can be carried out by setting the EndPoint to the same address as the start point.

The end point and the start point have the same address by setting "0" as the movement amount to the end point which is set to EndPoint.



Restriction

2-axis circular interpolation control cannot be set in the following cases.

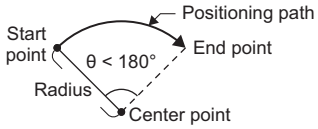
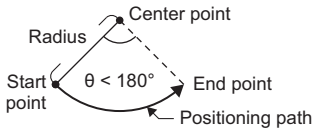
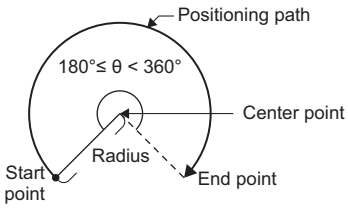
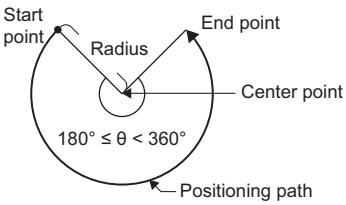
- When the radius exceeds 2147483647.0 (the maximum radius for which 2-axis circular interpolation control is possible is 2147483647.0): The error "Out of Radius Range" (error code: 1A6CH) will occur at positioning start.
- When the center point address exceeds positioning range: The error "Out of Center Point Address Range" (error code: 1A6BH) will occur.
- When the start point address is the same as the center point address: The error "Start Point - Center Point Address Same Value" (error code: 1A65H) will occur.
- When the end point address is the same as the center point address: The error "End Point - Center Point Address Same Value" (error code: 1A67H) will occur.

• Circular interpolation control with radius designation

When selecting "2: mcRadius" in the CircMode input, two configuration axes specified in CircAxes are used to carry out positioning control in an arc path having the specified radius.

[Circular interpolation path]

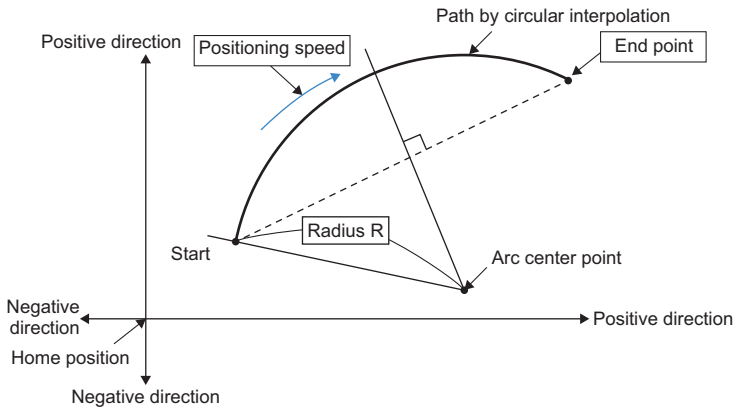
The path in the absolute value circular interpolation control with radius designation can be set by the PathChoice input of the MCFB. The following table shows the setting value, setting description, arc center angle that can be controlled, and path of PathChoice. When setting "4: mcCWLongWay" and "5: mcCCWLongWay" , and when the start point, end point, and center point are on one straight line, a semicircle is drawn. When setting "0: mcCW" and "1: mcCCW", an error will occur and a semicircle can not be drawn.

Setting value	Setting description	Arc center angle that can be controlled	Path
0: mcCW	CW	0° < θ < 180° Short way	
1: mcCCW	CCW	0° < θ < 180° Short way	
4: mcCWLongWay	CW Long way	180° ≤ θ < 360° Long way	
5: mcCCWLongWay	CCW Long way	180° ≤ θ < 360° Long way	

• Absolute value circular interpolation control operation with radius designation

In absolute value circular interpolation control operation with radius designation, positioning is carried out from the current position at start (start point address) to the address set to EndPoint (end address) in an arc path having the radius set in AuxPoint.

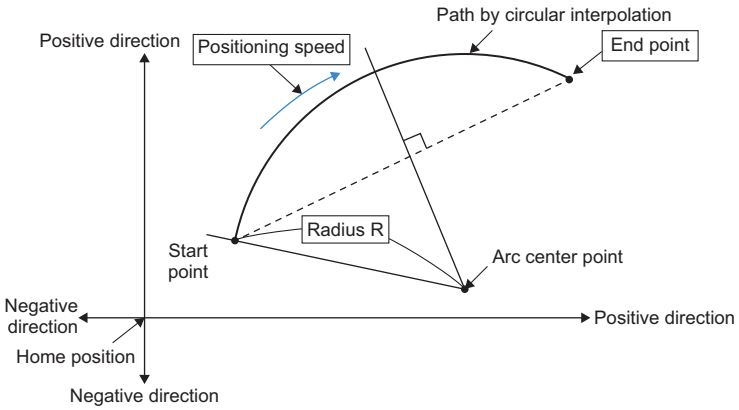
The resulting control path is an arc with the intersection of the perpendicular bisector of the current position at start and the end point address, and the specified radius as the center point. (The end point, positioning speed, and radius R shown in the following figure indicate the data to be set.)



• Relative value circular interpolation control operation with radius designation

In relative value circular interpolation control operation with radius designation, positioning is carried out from the current position at start (start point address) to the address of the movement amount set to EndPoint (end point address) in an arc path having the radius set in 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. (The end point, positioning speed, and radius R shown in the following figure indicate the data to be set.)



Restriction

2-axis circular interpolation control 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 is "XXXX"): The error "Out of Radius Range" (error code: 1A6CH) will occur at positioning start.
- When the end point address exceeds positioning range: The error "Out of End Point Address Range" (error code: 1A6DH) will occur.
- When the start point address is the same as the end point address: The error "Start Point - End Point Address Same Value" (error code: 1A66H) will occur.
- When the distance between the start point address and the end point address is larger than the radius: Since an arc cannot be drawn, the error "Radius Setting Error" (error code: 1A6EH) will occur at positioning start.

■AuxPoint (Sub point)

Set the sub point position of the absolute position or the movement amount from the current position at start to the sub point by the AuxPoint input. AuxPoint has 16 array elements. Setting details of AuxPoint differ depending on the circular interpolation mode as shown below.

Setting value	Circular interpolation mode name	AuxPoint (sub point) input setting
0: mcBorder	Border point designation	AuxPoint[0..N] indicates the sub point position of the configuration axis 1 to N. • AuxPoint inputs for the configuration axes which are not set to the circular interpolation axis are ignored. • AuxPoint inputs after all of the configuration axes which are set to the circular interpolation axis can be omitted.
1: mcCenter	Center point designation	
2: mcRadius	Radius designation	AuxPoint[0] indicates the radius of the arc. • Inputs after AuxPoint[1] are ignored, and these can be omitted.

Ex.

When setting configuration axis 2, 3, 4 to the circular interpolation axes, and the absolute position of the sub point of the configuration axis 2, 3 is 2000, 3000 respectively.

CircAxes: [2 3]

CircMode: Border point designation

AuxPoint: [0 2000 3000 0 0 0 0 0 0 0 0 0 0 0 0 0]

or

AuxPoint: [0 2000 3000]

■EndPoint (End point)

Set the end point position of the absolute position or the movement amount from the current position at start to the end point by the EndPoint input. EndPoint has 16 array elements.

EndPoint[0..N] indicates the end point of the configuration axis 1 to N.

- EndPoint inputs for the configuration axes which are not set to the circular interpolation axis are ignored.
- EndPoint inputs after all of the configuration axes which are set to the circular interpolation axis can be omitted.

■PathChoice (Path selection)

Set rotation direction in circular interpolation. For rotation direction, the first element of the array set in CircAxes (circular interpolation axis) is regarded as the reference axis.

■Velocity (Velocity)

Specify the maximum speed of the way. For details, refer to the following.

☞ Page 227 Positioning speed in multiple axes positioning control

■Acceleration (Acceleration)

Specify the acceleration. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■Deceleration (Deceleration)

Specify the deceleration. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

■Jerk (Jerk)

Specify the jerk. The setting details differ depending on the acceleration/deceleration method. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

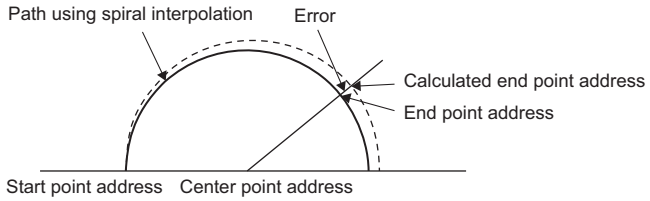
■CircularErrorTolerance (Circular interpolation error tolerance)

In circular interpolation control with center point designation, the arc path calculated from the start position and center position may deviate from the end position set in EndPoint.

CircularErrorTolerance sets allowable width of an error between the calculated arc path and the end position.

- Calculated error ≤ 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 > CircularErrorTolerance

At the positioning start, the error "Circular Interpolation Error Allowable Value Over" (error code: 1A71H) will occur and the control will not start. The machine will immediately stop if the error is detected during positioning control.

■BufferMode (Buffer mode)

Select the buffer mode. Aborting, Buffered, BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh can be set. For details, refer to the following.

☞ Page 125 Buffer mode type

■Options (Options)

Set a function option with bit specification.

Bit details and the function are as the following table. For details, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec Acceleration/deceleration specification method 1: mcFixedTime Acceleration/deceleration time-fixed method Refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3	Position selection during buffer mode It is valid only when relative value circular interpolation control. Set "0" for absolute value circular interpolation control. FALSE: Set position TRUE: Actual position For details, refer to the following. ☞ Page 125 Multiple Start (Buffer Mode)
4 to 31	Empty (Reserved)

Precautions

- Circular interpolation including an axis whose stroke limit is set to invalid cannot be carried out. The error "Stroke Limit Invalid at Circular Interpolation" (error code: 1A72H) will occur, and the operation does not start.
- When the interpolation path exceeds the stroke limit range during interpolation operation, the error "Software Stroke Limit Over (Forward Direction)" (error code: 1A03H) or the error "Software Stroke Limit Over (Reverse Direction)" (error code: 1A04H) will occur, and the operation will decelerate to a stop.

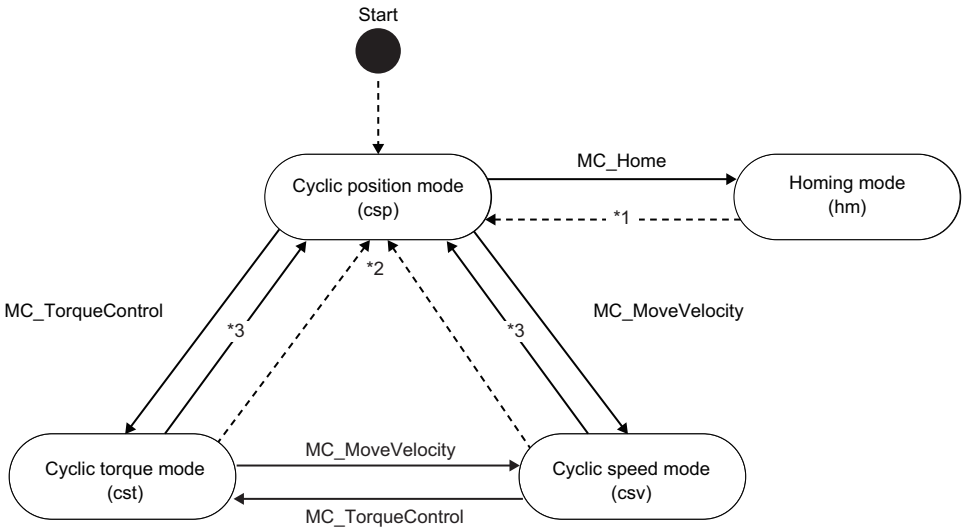
7 DIRECT CONTROL

Direct control includes velocity control and torque control. The operation details of each control is as shown below.

Control Name	Driver control mode	Applicable instruction	Operation details
Velocity control	Position control (csp)	MCv_SpeedControl	This function outputs the commanded position based on the set velocity for each control cycle.
	Velocity control (csv)	MC_MoveVelocity	This function outputs the set velocity for each control cycle. (Excluding the position loop.)
Torque control	Torque control (cst)	MC_TorqueControl	This function outputs the commanded torque for each control cycle. (Excluding the position loop.)

The driver side control mode must be csp at connection.

Switching the driver control mode is simultaneously executed when a motion control FB is executed. The following shows the state transition.



*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 an instruction other than MC_MoveVelocity and MC_TorqueControl.

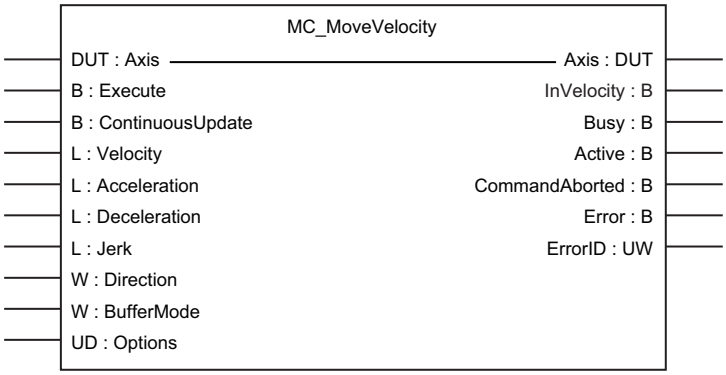
7.1 Velocity Control

In velocity control, the driver control mode is switched to csv, and the control excluding the position loop is executed.

Relevant variables/FB

Variable/Structure name	Name	Details
AxisName.Md.		
SetVelocity	Set velocity	A value set in TargetVelocity (set velocity during velocity control mode)
TargetVelocity	Target velocity	A value set in target velocity (Velocity)
ActualVelocity	Actual velocity	Actual velocity (same as positioning control)

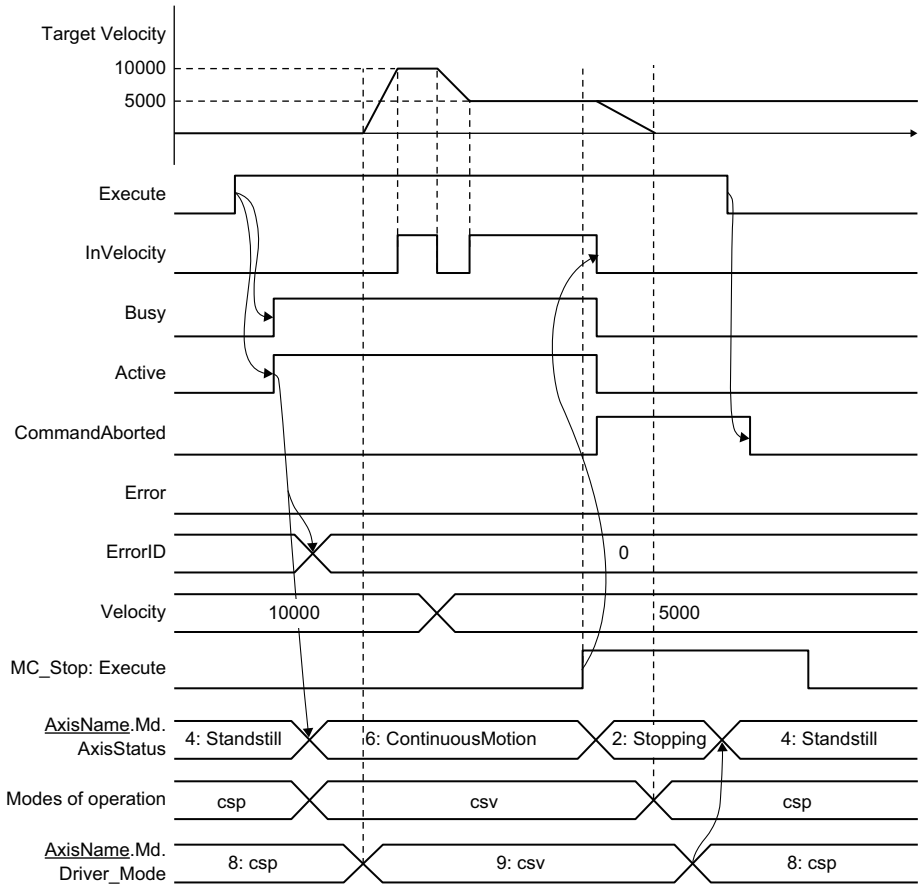
MC_MoveVelocity

Item	Description
Function overview	The driver is switched to the csp mode, and the velocity control is executed based on the specified target velocity.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
56	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the target velocity, the acceleration, and the deceleration.
Target velocity	Velocity	LREAL	↑/R/C	☞ Page 83 Velocity set range	0	Sets the target velocity. When the velocity is negative, the axis moves to the negative direction. When 0 is set, the axis does not operate, however, the axis status (AxisName.Md.AxisStatus) changes to "6: ContinuousMotion".
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the acceleration.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the deceleration.
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the jerk.
Direction selection	Direction	MC_DIRECTION	↑	1 to 2	0	Sets the direction selection. MC_DIRECTION definition can be used. 1: mcPositiveDirection (Positive direction) 2: mcNegativeDirection (Negative direction) When selecting "2: mcNegativeDirection" and Velocity is negative, the movement direction of the motor will be positive.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 1	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec Acceleration/deceleration specification method 1: mcFixedTime Acceleration/deceleration time-fixed method For details, refer to the following. ☞ Page 312 Acceleration/deceleration method
3 to 15	Empty (Reserved)
16, 17	Velocity initial value selection 0: Set velocity 1: Actual velocity 2: Automatic selection
18 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Target velocity reached	InVelocity	BOOL	FALSE	Indicates that the set velocity that is calculated by the motion system has reached the target velocity. After reaching, the speed is maintained until Execute turns FALSE or the control is interrupted. When the target velocity has been changed due to change at ContinuousUpdate TRUE, it turns FALSE until the set velocity reaches changed target velocity.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. Turns TRUE when this FB is stopped by an error or this FB is started during an error occurence. Turns FALSE when Execute is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Control details

MC_MoveVelocity switches the driver control mode to csv and executes control. This function controls the set velocity based on the specified acceleration, deceleration, and jerk. To finish this FB, start MC_Stop.

Velocity initial value selection

Set the "velocity initial value selection (options bit16, 17)" when switching the following control mode.

- Position control→Velocity control

Setting value	Description
0: Set velocity	The velocity during command is used as the velocity commanded to the drive unit immediately after switching.
1: Actual velocity	Motor speed received from the drive unit at switching is used.*1
2: Automatic selection	The lower velocity between "0: Set velocity" and "1: Actual velocity" is used as the velocity commanded to the drive unit immediately after switching.*2

*1 When Velocity actual value is not mapped, motor speed received from the drive unit at switching is not used. (Speed initial value selection becomes "0".)

*2 When Velocity actual value is not mapped, velocity commanded to the drive unit immediately after switching becomes "0: Set velocity".

Operation at stop cause occurrence

The following shows stop causes during the velocity control mode and the process when each cause occurs.

Cause No.	Stop cause	Axis status (AxisName.Md.AxisStatus)		Stop process
		During deceleration stop	After stop	
1	"Forced stop input" is FALSE	—	1: ErrorStop	Immediate stop*1
2	Drive unit power supply is FALSE	—	1: ErrorStop	Immediate stop*1
	Drive unit network disconnection detection			
	Drive unit			
	Forced stop input to the drive unit			
	Enable of MC_Power is FALSE			
	ServoON of MC_Power is FALSE (When AxisName.Pr.StopMode_ServoOff is "4:ServoOffAfterImmediateStop")*2			
3	Hardware stroke limit upper/lower limit error occurrence	1: ErrorStop	1: ErrorStop	Deceleration stop/Immediate stop*5 (Follows AxisName.Pr.StopMode_HwStrokeLimit)
4	CPU module error occurrence	1: ErrorStop	1: ErrorStop	Deceleration stop/Immediate stop*5 (Follows System.Pr.StopMode_All)
	PLC READY [Y0] is OFF			
5	Software stroke limit upper/lower limit error occurrence	1: ErrorStop	1: ErrorStop	Deceleration stop/Immediate stop*5 (Follows AxisName.Pr.StopMode_SwStrokeLimit)
6	Axis error detection*3	1: ErrorStop	1: ErrorStop	Deceleration stop/Immediate stop*5 (Follows AxisName.Pr.StopMode_General)
7	Execute of MC_Stop is TRUE	2: Stopping	2: Stopping*4	Deceleration stop*5 (Follows the deceleration speed set in the FB)
8	"Stop signal" of external input signal is TRUE	No change	4: Standstill	Deceleration stop/Immediate stop*5 (Follows AxisName.Pr.StopMode_General)

*1 The servo turns OFF in the driver side and immediate stop is performed, and also the motion side command is stopped.

*2 Operation differs depending on the setting value selected in AxisName.Pr.StopMode_ServoOff. For details, refer to the following.
☞ Page 149 Relevant variables/FB

*3 If an axis error (the error that transits the state into the "1: ErrorStop" status) occurs in the FB which can be linked by the buffer mode, deceleration stop will be performed from the error occurrence.

*4 When Execute of MC_Stop is FALSE at stop completion, the axis status (AxisName.Md.AxisStatus) after stop will be "4: Standstill".

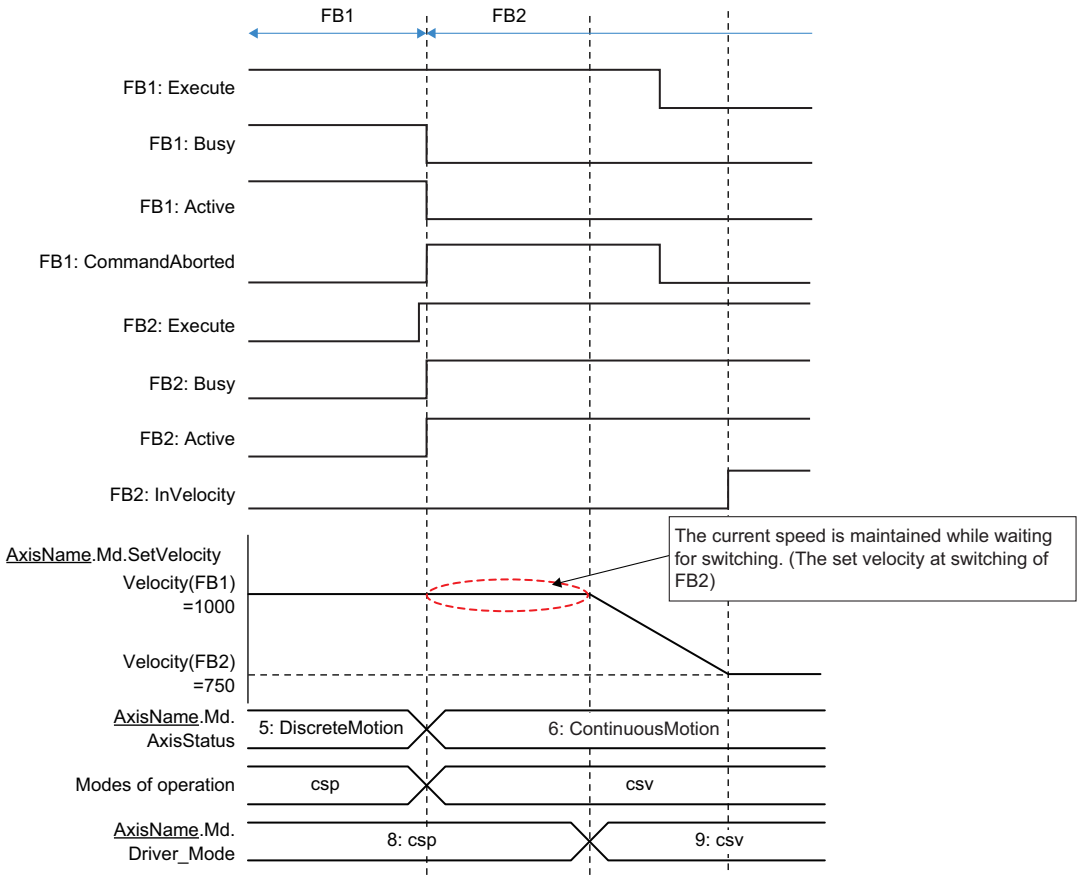
*5 After the stop, the control returns to csp.

When starting this FB during another instruction execution

■Single axis position control (FB1) → Velocity control (FB2)

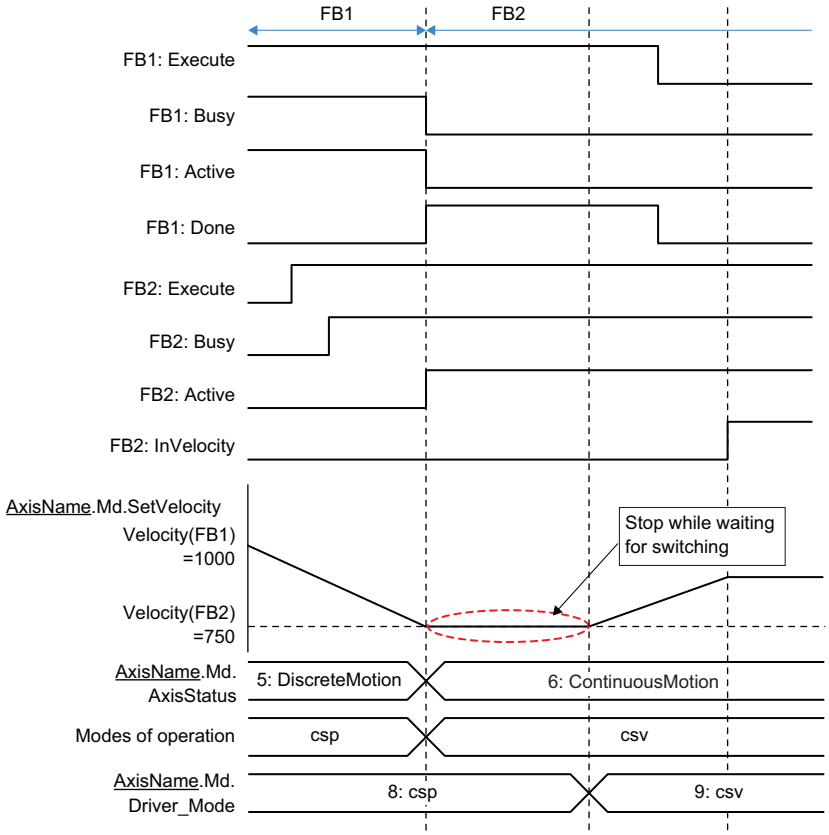
- 0: mcAborting

1. Input variables are analyzed, and a switching request to csv is issued to the driver.
2. Until the driver is switched, the axis is operated at the previous velocity with the velocity control including the position loop.
3. When the driver switches to csv, TargetVelocity is obtained based on the actual velocity and the acceleration/deceleration process is started again.



• 1: 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 csv is issued to the driver.
3. When the driver switches to 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 csp is issued to the driver.
2. Started positioning instruction is analyzed, and the axis waits until the driver switches to csp. (Even if the axis issues the switching request to csp during operation, switching may not be carried out depending on the driver specifications. If switching to csp is not completed within 1 second, an axis error will occur for the timeout, and the axis will stop.)
3. While waiting, csv is continued with the set velocity when Execute of FB2 is TRUE.
4. When the driver switches to 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 csv mode to the csp mode. In this case, the axis operates based on AxisName.Pr.OverrunOperation.

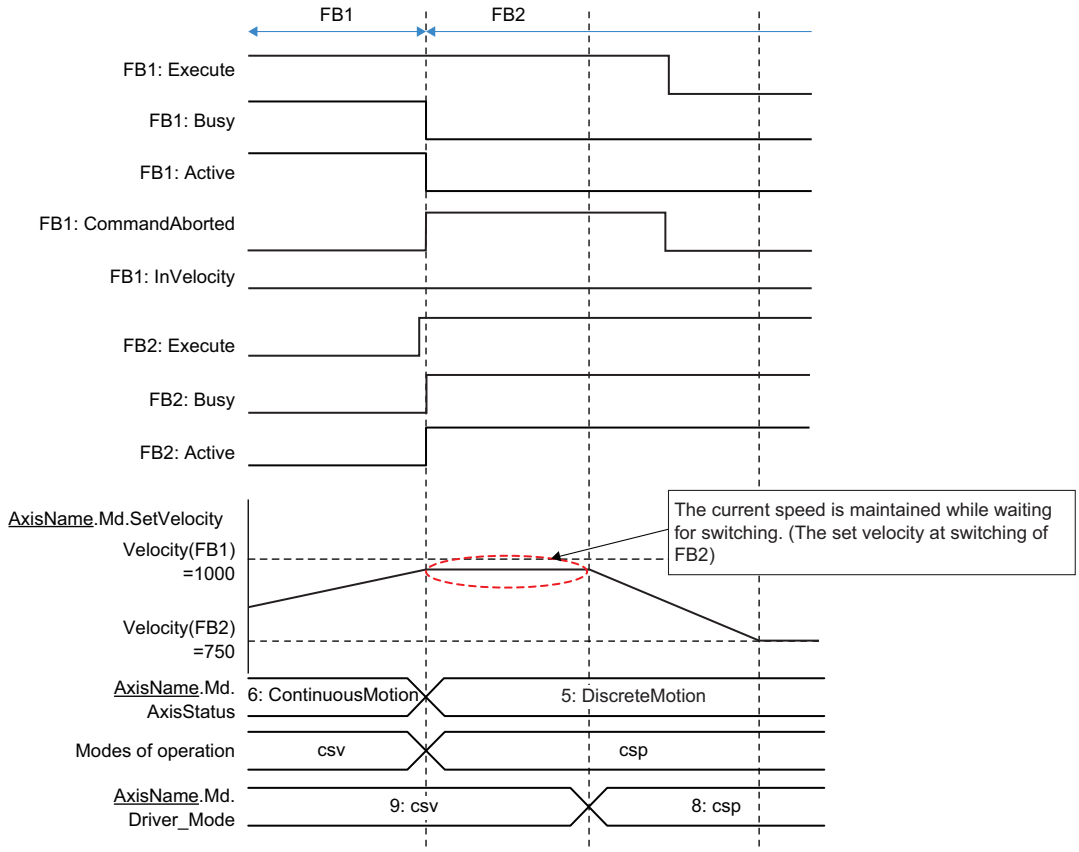
For operation at the overrun occurrence, refer to the following.

☞ Page 125 Multiple Start (Buffer Mode)

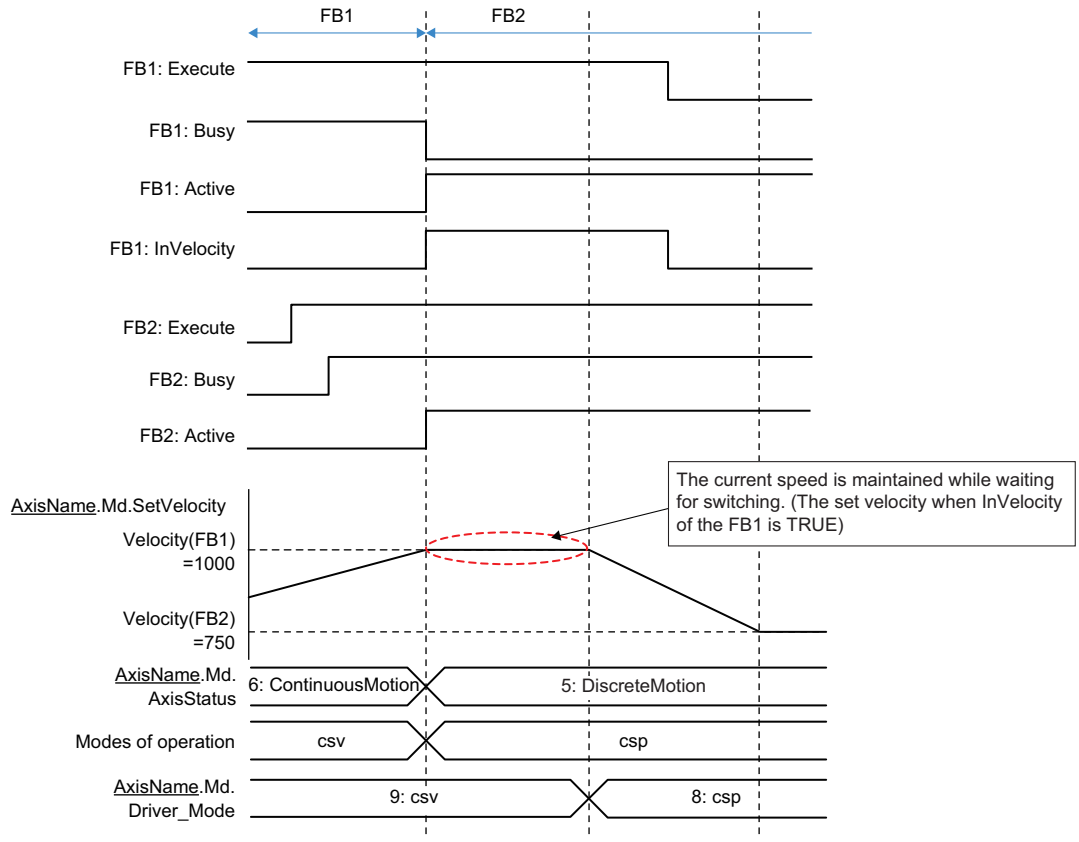
Precautions

If the axis overruns while waiting for switching, it will stop immediately after switching to csp.

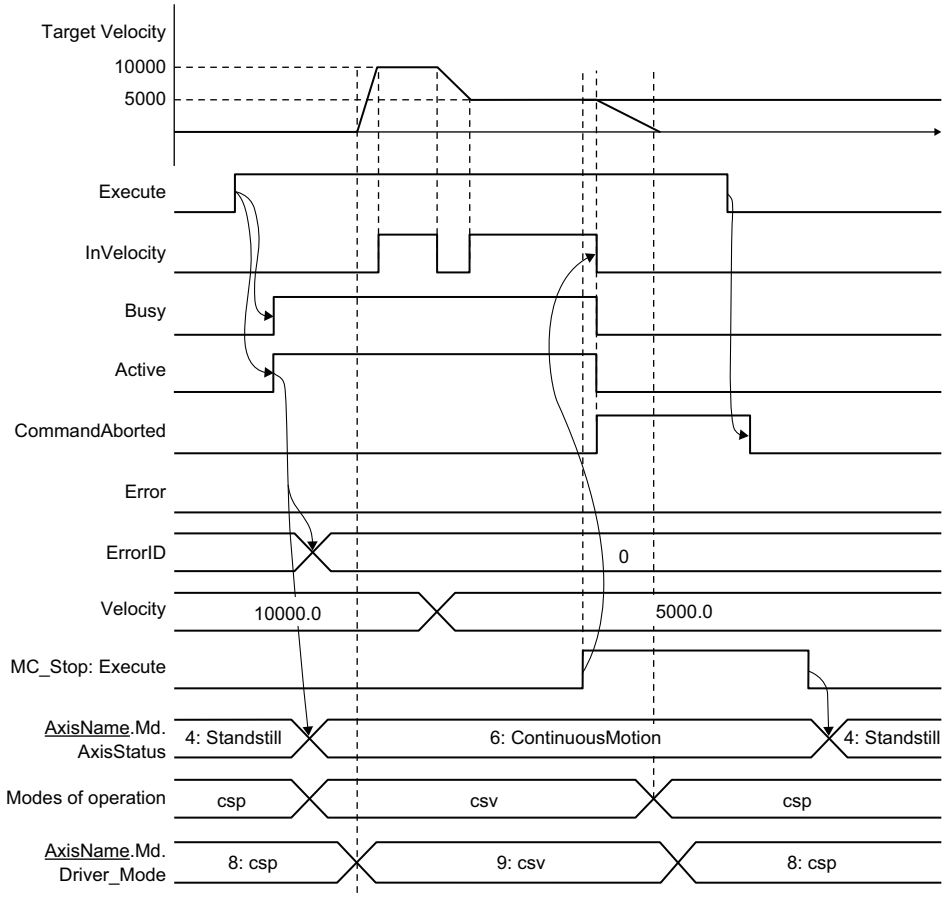
[For Aborting]



[For Buffered]



■Velocity control → Stop instruction (MC_Stop)

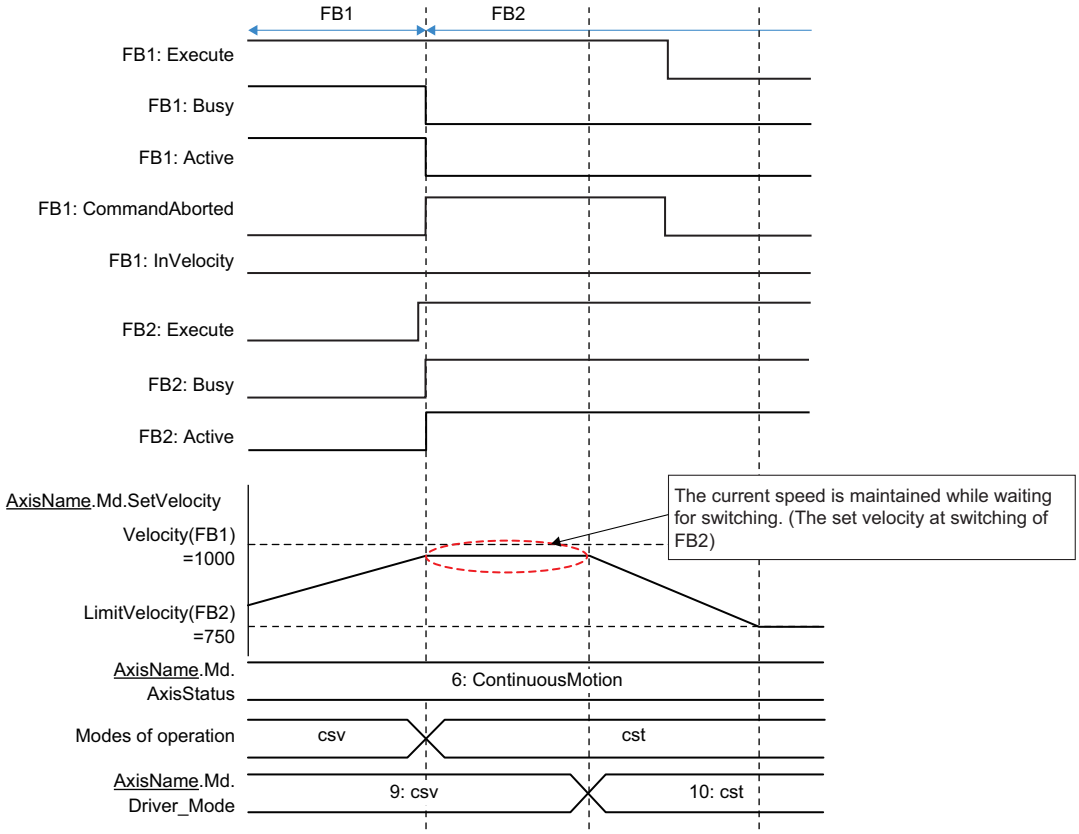


■Velocity control → Torque control

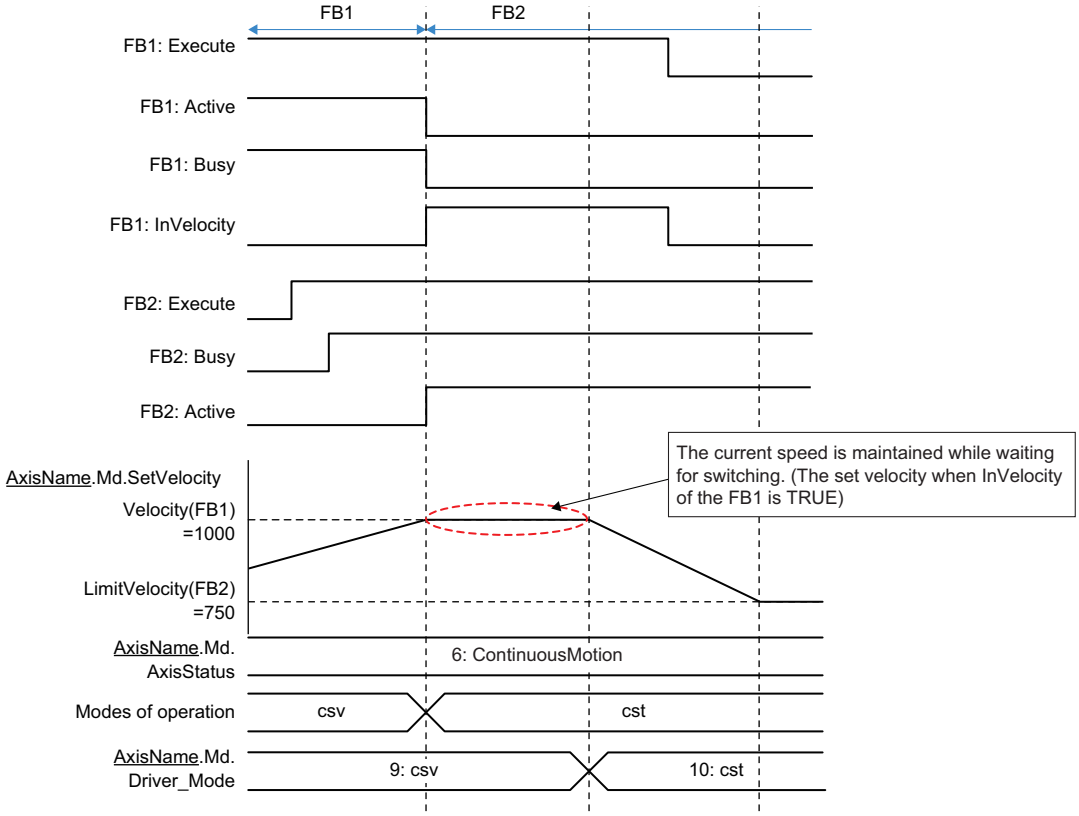
1. The torque control mode switching request is executed to the driver.

2. Started torque control is analyzed, and the axis waits until the driver switches to the torque control.

[For Aborting]



[For Buffered]



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 to the changed direction.

Precautions

- AxisName.Cd.VelocityOverride and AxisName.Cd.AccelerationOverride are valid.
- The set position and the feed machine position are updated by follow up.
- Switching time to the control mode depends on the specifications of the driver.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.

When using the MR-J5(W)-G

When switching from the position control mode to the speed control mode or from the speed control mode to the position control mode without waiting for stop of the motor, note the followings.

- Set "ZSP disabled selection at control switching" (PC76.1) of the servo parameter (extension setting) to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
- Set the servo parameter "Electronic gear numerator" (PA06) and "Electronic gear denominator" (PA07) as 1:1. The command value from the controller may be error at the control mode switching. When switching the control mode after the motor stops, the operation is possible other than the setting of 1:1.

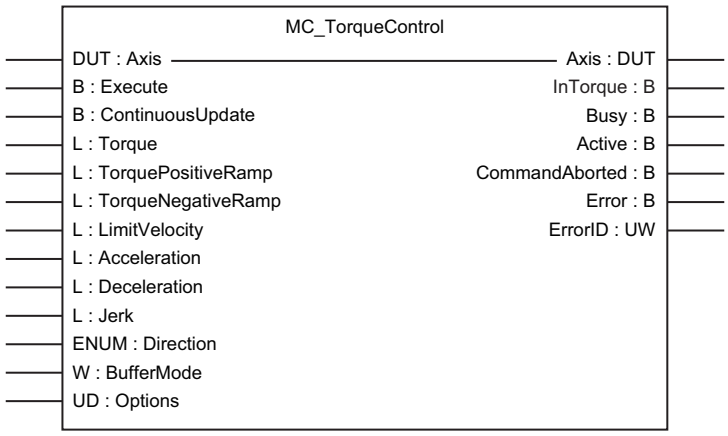
7.2 Torque Control

In torque control, the driver control mode is switched to cst and the control is carried out.

Relevant variables/FB

Variable/Structure name	Name	details
AxisName.Md		
SetVelocity	Set velocity	Stores velocity specified value by adding acceleration/deceleration
TargetVelocity	Target velocity	Stores value set to the limit velocity (LimitVelocity)
ActualVelocity	Actual velocity	Actural velecity (same as positioning control)
Cst_SetTorque	Set torque at torque control	Stores set torque at torque control mode
Cst_TargetTorque	Target torque at torque control	Stores target torque at torque control mode

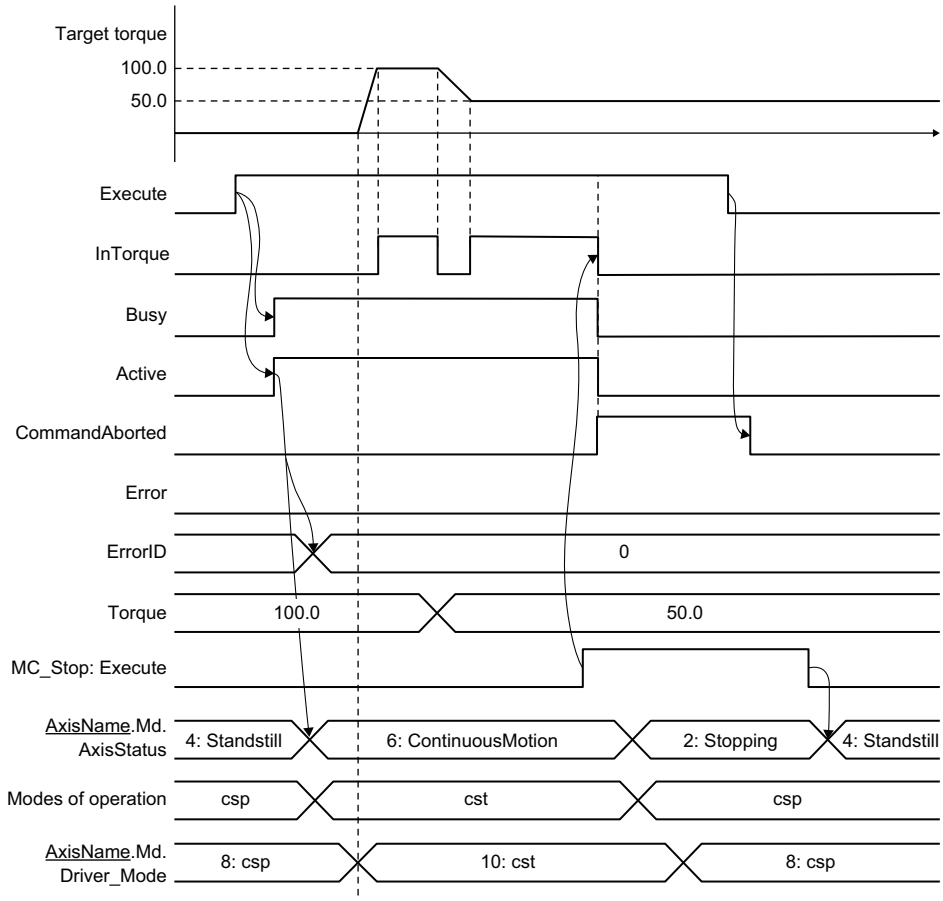
MC_TorqueControl

Item	Description
Function overview	The driver is switched to the csp mode, and the torque control is executed based on the specified target torque.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
80	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous Update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the target torque, the limit velocity, the torque positive direction ramp, the torque negative ramp, the acceleration and the deceleration.
Target torque	Torque	LREAL	↑/R/C	-1000.00 to 1000.00 [%]	0	Sets the target torque. Sets the ratio to the rated torque of the servo motor used in percentage. The number of significant digits after the decimal point differs depending on the ID assigned to the slave object map. Values less than the number of significant digits are truncated. To output the target torque in the positive direction (address increasing direction), set the positive value. To output the target torque in the negative direction (address decreasing direction), set the negative value.
Torque positive direction ramp	TorquePositiveRamp	LREAL	↑/R/C	☞ Page 274 Control details	0	☞ Page 274 Control details
Torque negative ramp	TorqueNegativeRamp	LREAL	↑/R/C		0	
Limit velocity	LimitVelocity	LREAL	↑/R/C	☞ Page 337 Speed Limit	0	Sets the velocity limit value at the torque control mode. For the velocity limit value, refer to the driver manual. [For using MR-J5(W)-G] Uses Velocity limit value as velocity limit value. When the Velocity limit value is not mapped, the velocity command of the controller will not be enabled.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the acceleration and acceleration/deceleration time until the limit velocity is reached. For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	Sets the deceleration until the limit velocity is reached. For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	Sets the jerk until the limit velocity is reached. For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function When 0 is set or the setting is omitted, the jerk is not applied.
Direction selection	Direction	MC_DIRECTION	↑	0	0	Set 0. (If a value other than "0" is set, an error will occur.)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 1	0	Selects the buffer mode. 0: mcAborting (Aborting) 1: mcBuffered (Buffered) For "0: mcAborting", the control mode is immediately switched to the torque control. For "1: mcBuffered", the control mode is switched to the torque control after the previous FB is completed. If the previous FB is MC_TorqueControl, the control mode is switched when InTorque is TRUE.
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 15	Empty (Reserved)
16, 17	Torque ramp fuction selection 0: Ramp method 1: Time constant method 2: Fixed time method
18	Torque initial value selection 0: Target torque 1: Actual torque
19 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Target torque reached	InTorque	BOOL	FALSE	Indicates that the set torque has reached the specified value.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. Turns TRUE when this FB is stopped by an error or this FB is started during an error occurence. Turns FALSE when Execute is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

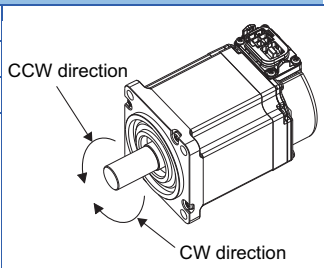
Control details

MC_TorqueControl switches the driver control mode to cst and executes control. This function controls the set torque based on the specified TorquePositiveRamp and TorqueNegativeRamp. To finish this FB, start MC_Stop.

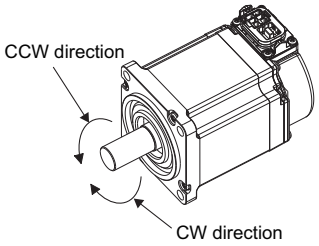
Relation between torque generation direction of servomotor and set torque

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 "Movement direction selection" (PA14)	Set torque	Torque generation direction of servomotor	
0: Forward rotation (CCW) with the increase of the positioning address	Positive value (positive direction)	CCW direction	
	Negative value (negative direction)	CW direction	
1: Reverse rotation (CW) with the increase of the positioning address	Positive value (positive direction)	CW direction	
	Negative value (negative direction)	CCW direction	

• When the servo parameter (extension setting) "Torque POL reflection selection" (PC29.3) is set to "1: Disabled"

Setting value of "Movement direction selection" (PA14)	Set torque	Torque generation direction of servomotor	
0: Forward rotation (CCW) with the increase of the positioning address	Positive value (positive direction)	CCW direction	
	Negative value (negative direction)	CW direction	
1: Reverse rotation (CW) with the increase of the positioning address	Positive value (positive direction)	CCW direction	
	Negative value (negative direction)	CW direction	

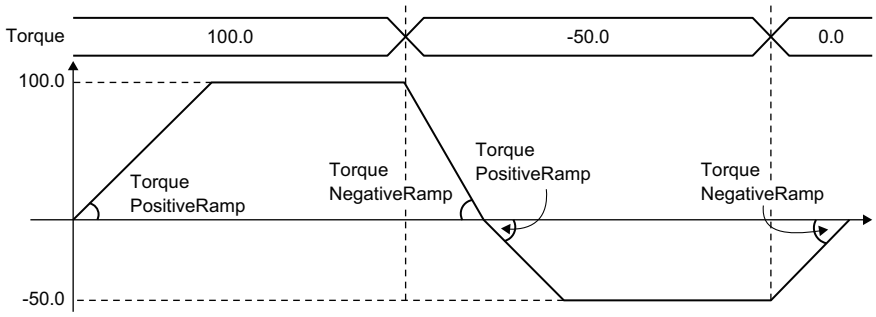
Torque ramp function selection (Options bit16, 17)

TorquePositiveRamp/TorqueNegativeRamp differs depending on the setting values.

• For "0: Ramp method"

Specify the ramp from the current set torque until the target torque is reached.

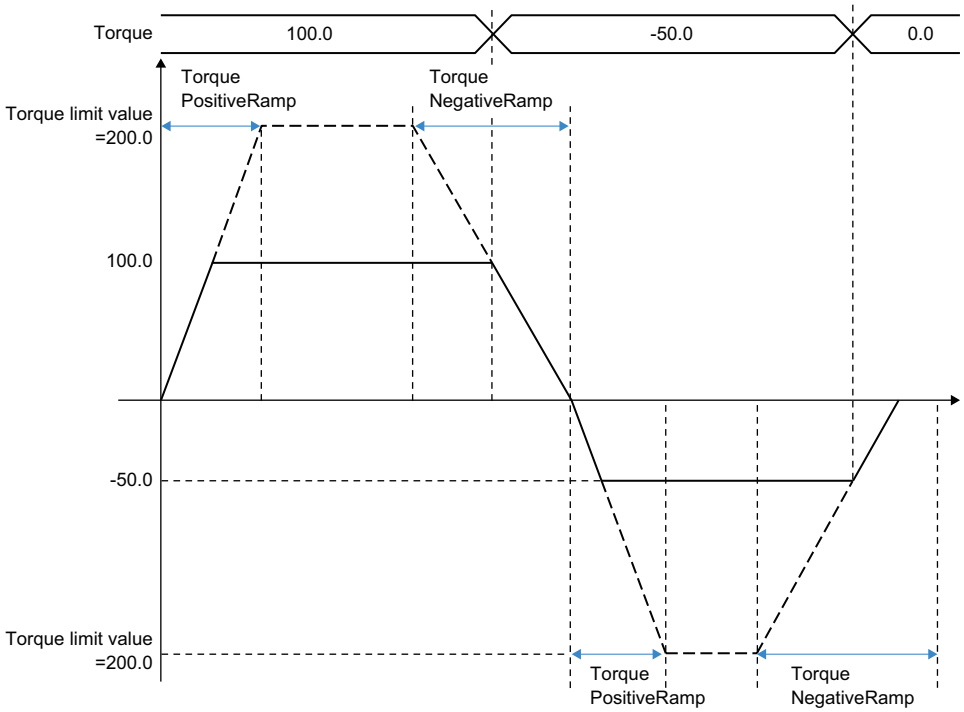
Setting range: 0 to 1000.00 [%/s]



• For "1: Time constant method"

Set the time that the set torque reaches from 0 until the positive/negative torque limit value.

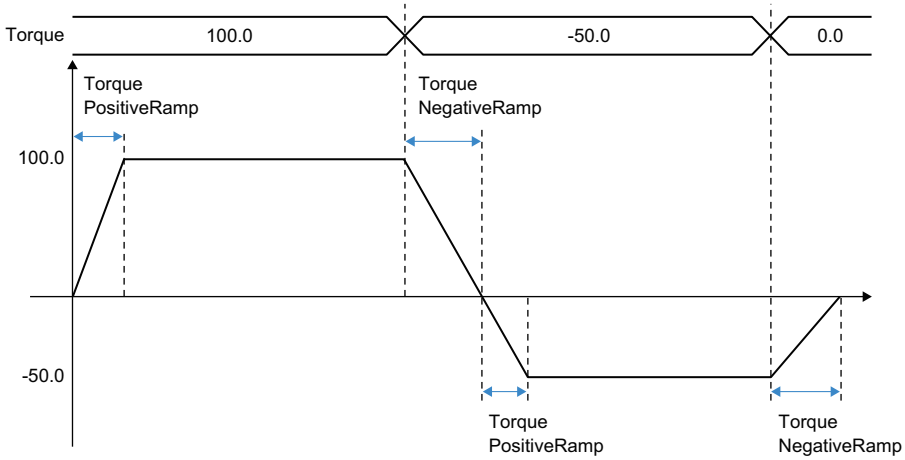
Setting range: 0 to 8400.0 [s]



• For "2: Fixed time method"

Set the time from the current set torque until the target torque is reached.

Setting range: 0 to 8400.0 [s]



When the output torque direction is changed due to the target torque change, the set torque becomes 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.

When the torque positive direction ramp and the torque negative direction ramp are specified to 0, the value reaches to the target torque in 1 operation cycle.

Torque initial value selection (Options bit18)

Set the torque initial value when switching to the torque control mode.

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.

Point

Normally set "0: Target torque". Set "1: Actual torque" only when switching the control mode without waiting for the servo motor to stop immediately after the command to the motor is completed.

Operation at stop cause occurrence

The following shows stop causes during the torque control mode and the process when each cause occurs.

Cause No.	Stop cause	Axis status (AxisName.Md.AxisStatus)	Stop process
		After stop	
1	"Forced stop input" is FALSE	1: ErrorStop	Immediate stop[*1]
2	Drive unit power supply is FALSE	1: ErrorStop	Immediate stop[*1]
	Drive unit network disconnection detection		
	Drive unit		
	Forced stop input to the drive unit		
	Enable of MC_Power is FALSE		
	ServoON of MC_Power is FALSE (When AxisName.Pr.StopMode_ServoOff is "4:ServoOffAfterImmediateStop", "5: ServoOffAfterDecelStop")[*2]		
3	Hardware stroke limit upper/lower limit error occurrence	1: ErrorStop	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After the stop, the control mode is changed to csp.
4	CPU module error occurrence	1: ErrorStop	
	PLC READY [Y0] is OFF		
5	Software stroke limit upper/lower limit error occurrence	1: ErrorStop	
6	Axis error detection[*3]	1: ErrorStop	
7	Execute of MC_Stop is TRUE	2: Stopping[*4]	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After the stop, the control mode is changed to csp. (Not based on the deceleration of MC_Stop)
8	"Stop signal" of external input signal is TRUE	4: Standstill	The limit velocity is changed to 0, and an immediate stop is performed.[*5] After the stop, the control mode is changed to csp.

*1 The servo turns OFF in the driver side and immediate stop is performed, and also the motion side command is stopped.

*2 Operation differs depending on the setting value selected in AxisName.Pr.StopMode_ServoOff. For details, refer to the following.
☞ Page 149 Relevant variables/FB

*3 If an axis error (the error that transits the state into the "1: ErrorStop" status) occurs in the FB which can be linked by the buffer mode, deceleration stop will be performed from the error occurrence.

*4 When "Execute" of MC_Stop is FALSE at stop completion, the axis status (AxisName.Md.AxisStatus) after stop will be "4: 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 Velocity limit value is not mapped, changes set torque to "0".)

BufferMode

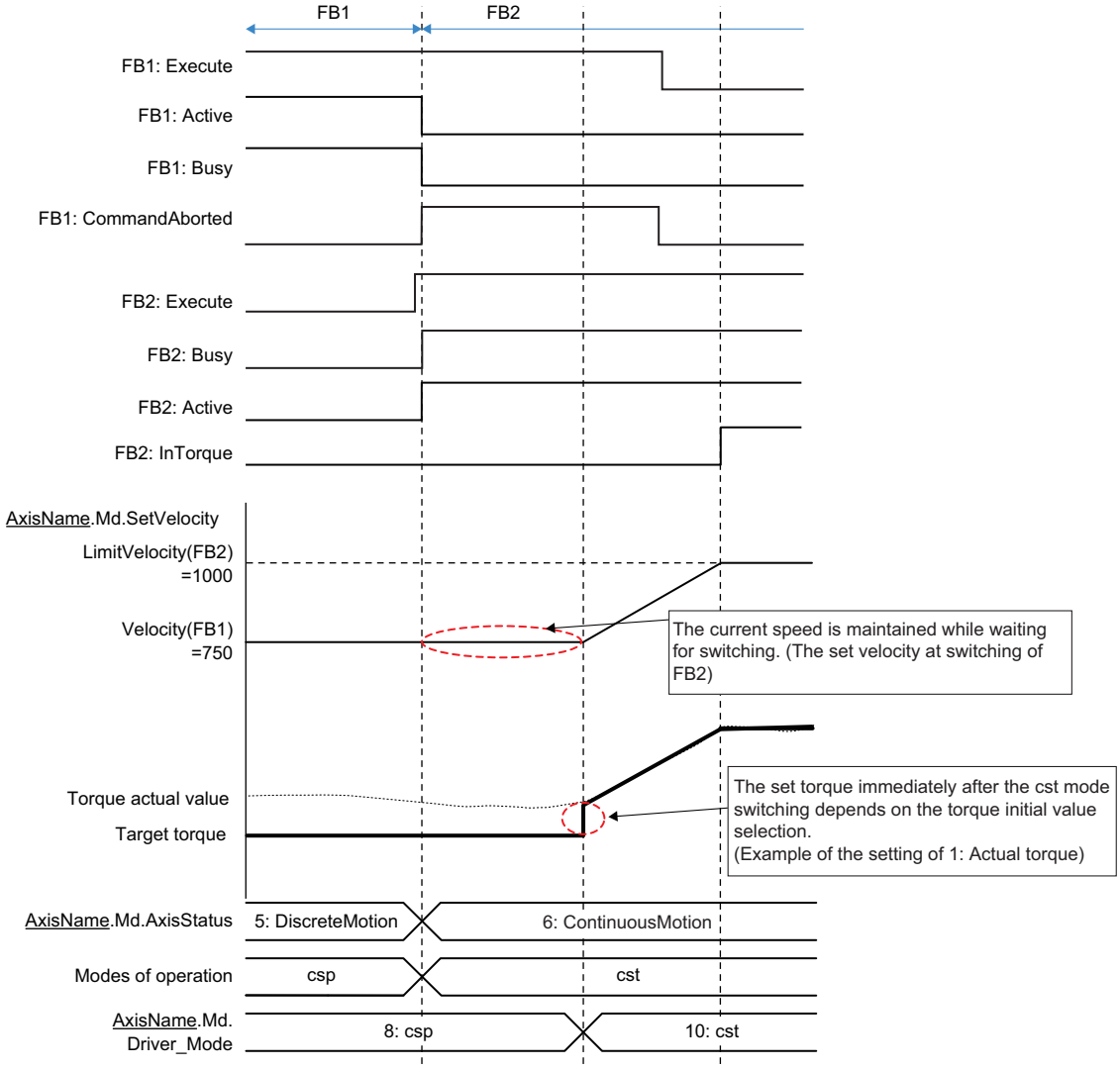
When starting this FB during another instruction execution

While this FB is executed, only Aborting and Buffered are supported.

■Position control(FB1) → Torque control(FB2)

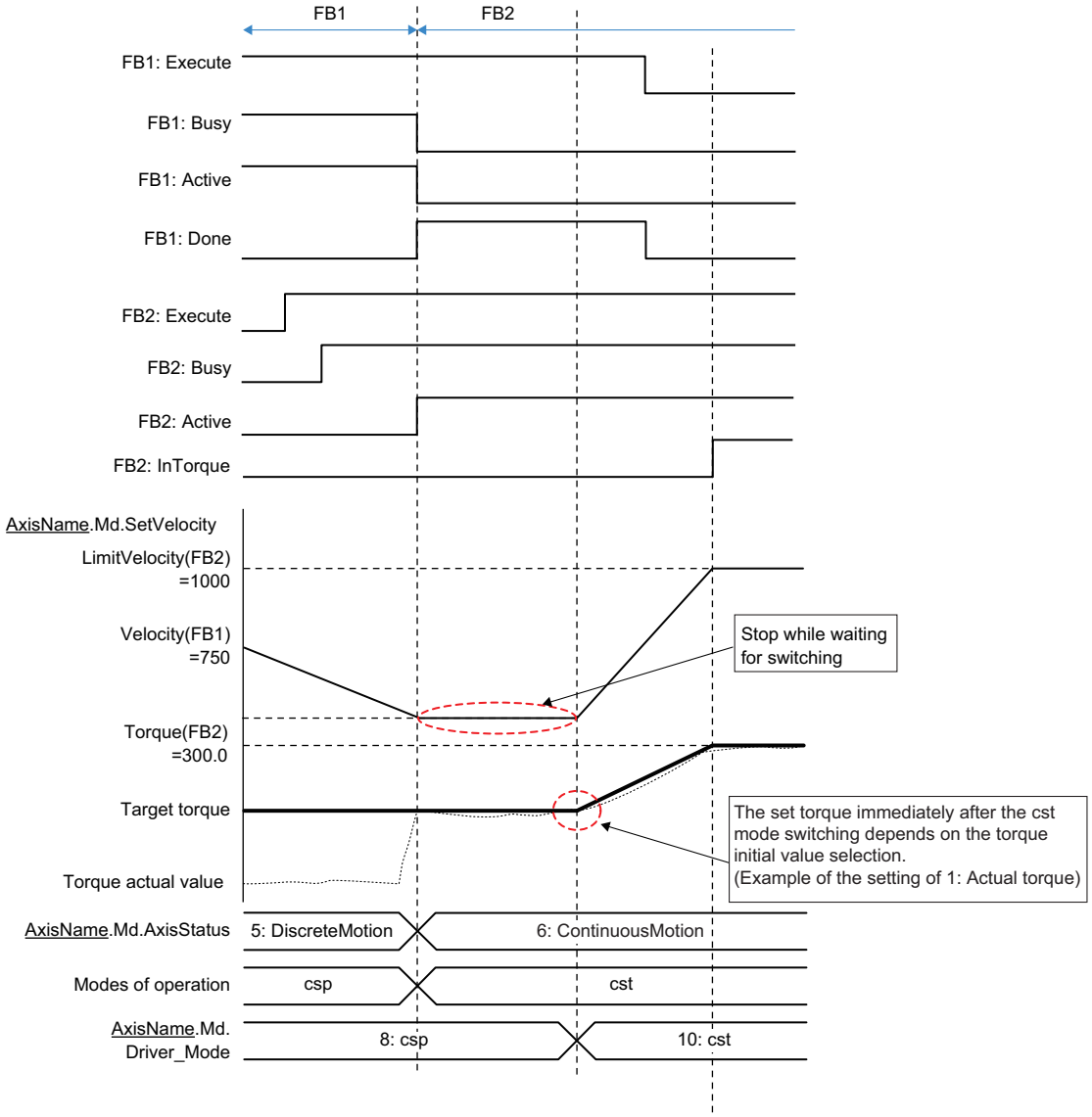
- 0: mcAborting

1. A switching request to cst is issued to the driver.
2. Until the driver is switched, the axis is operated at the previous velocity with the velocity control including the position loop.
3. When the driver switches to csv, the torque increase/decrease from the current actual torque starts and the acceleration/deceleration process of speed limit value from the current set velocity starts.



- 1: mcBuffered

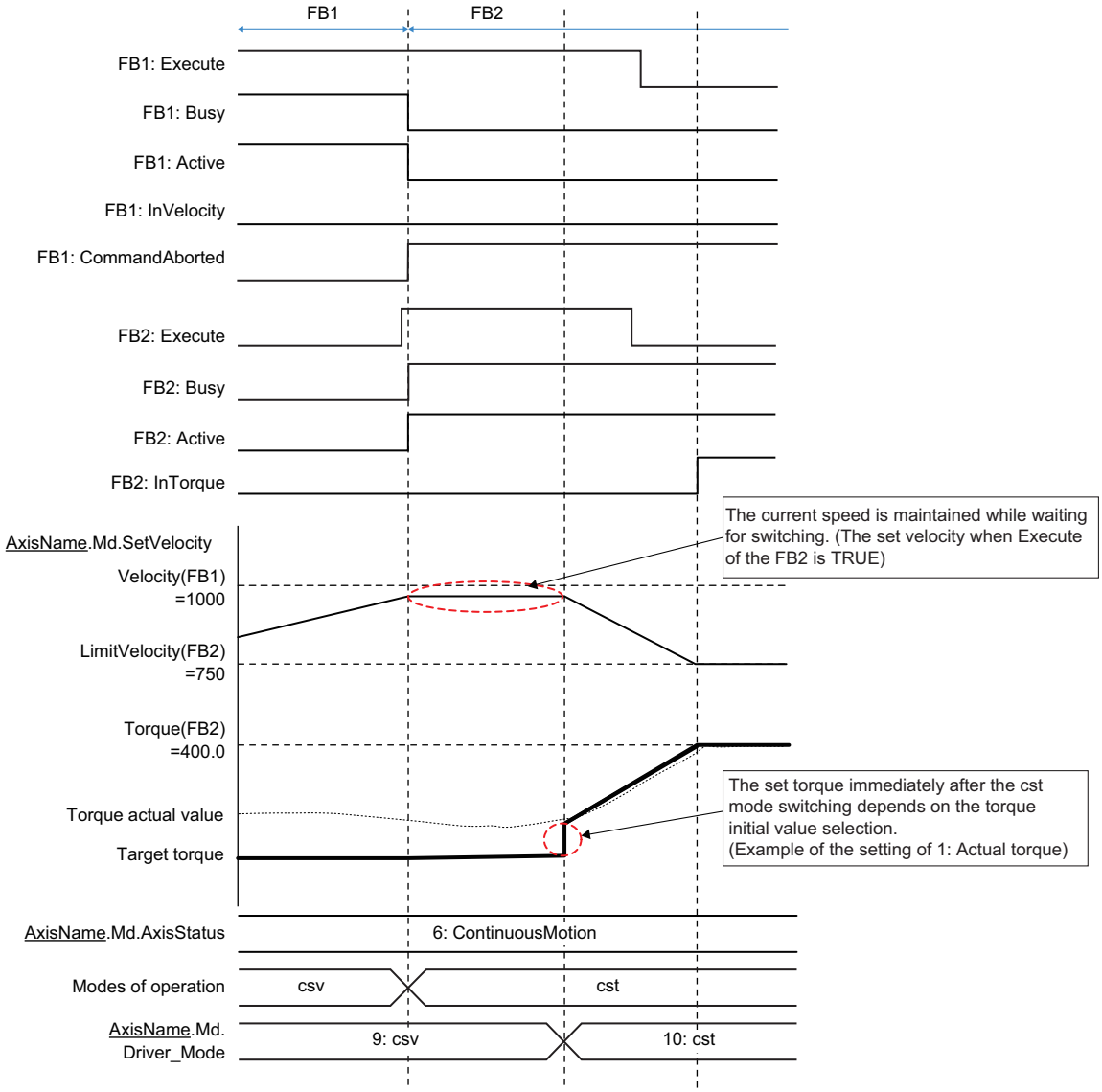
1. When the first instruction is completed, a cst change request is issued to the driver.
2. When the driver mode turns to the cst, the acceleration/deceleration process of the torque and the velocity is started from the current actual torque and the set velocity.



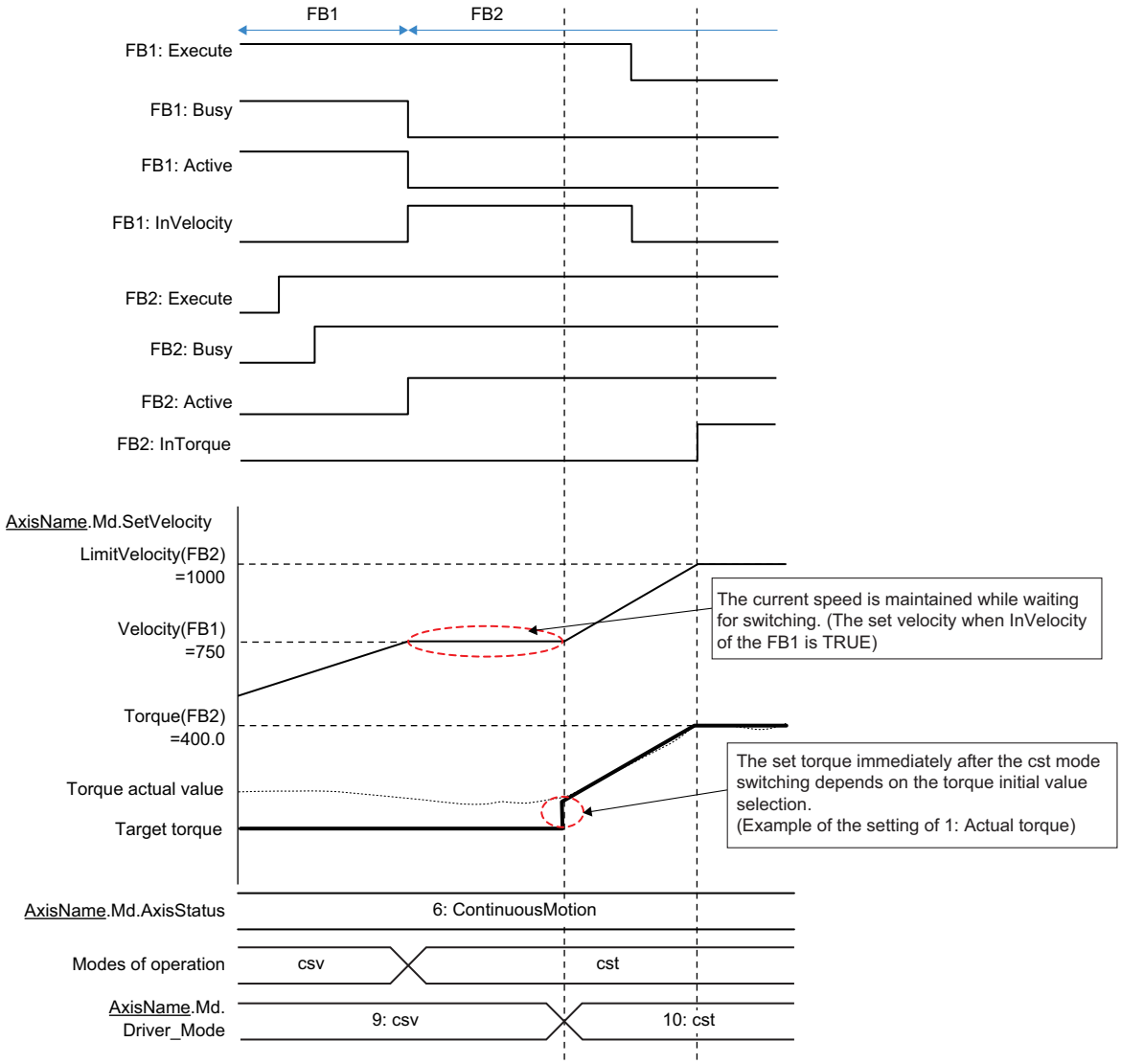
■Velocity control(FB1) → Torque control (FB2)

- 0: mcAborting

1. A cst change request is issued to the driver.
2. While waiting for change, csv is continued.
3. When the driver mode turns cst, the torque increase/decrease is started from the current actual torque, and the acceleration/deceleration process of the velocity from the set velocity is started.

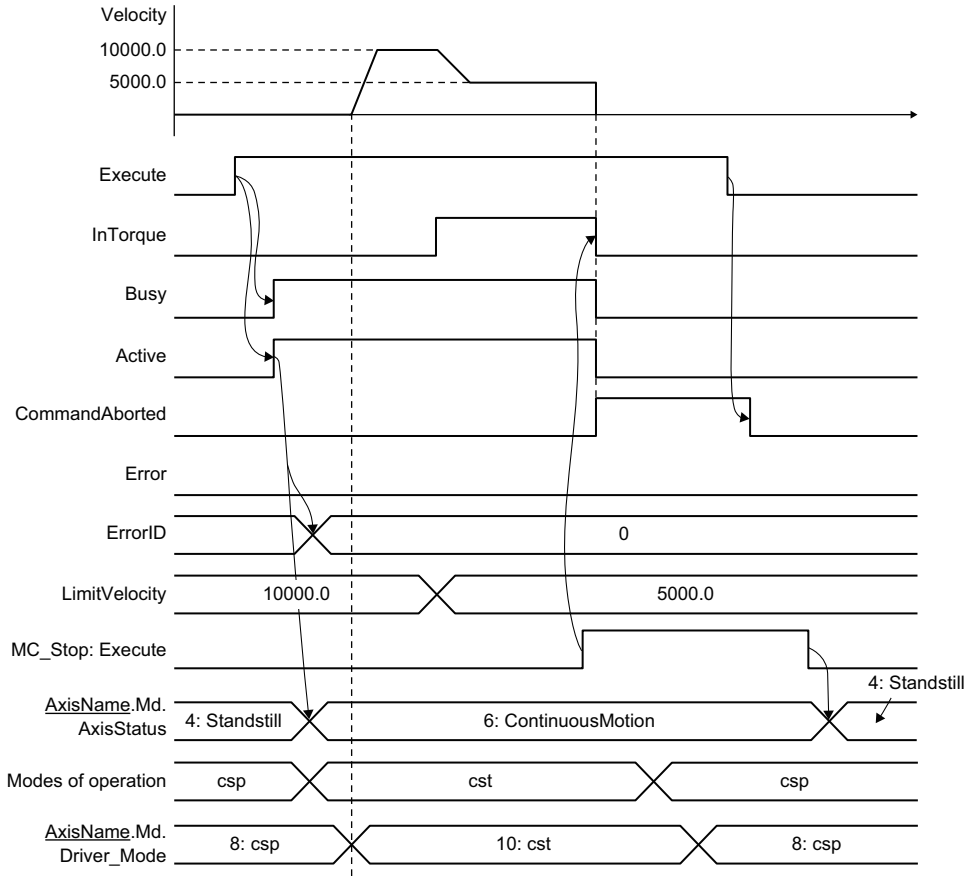


• 1: mcBuffered



When starting another instruction during this FB execution

■Torque control → Stop instruction (MC_Stop)



■Torque control → Positioning (Absolute value/Relative value positioning)

Aborting/Buffered

1. A csp change request is issued to the driver.
2. Started positioning instruction is analyzed, and the axis waits until the driver switches to the csp. (Even if the axis issues the switching request to the csp during operation, switching may not be carried out depending on the driver specifications. If switching to the csp is not completed within 1 second, a timeout will occur and the csp will be continued.)
3. While waiting for switching, torque control is continued with the torque and the limit velocity at switching.
4. When the driver switches to the 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 csv mode to the csp mode. In this case, the axis operates based on AxisName.Pr.OverrunOperation.

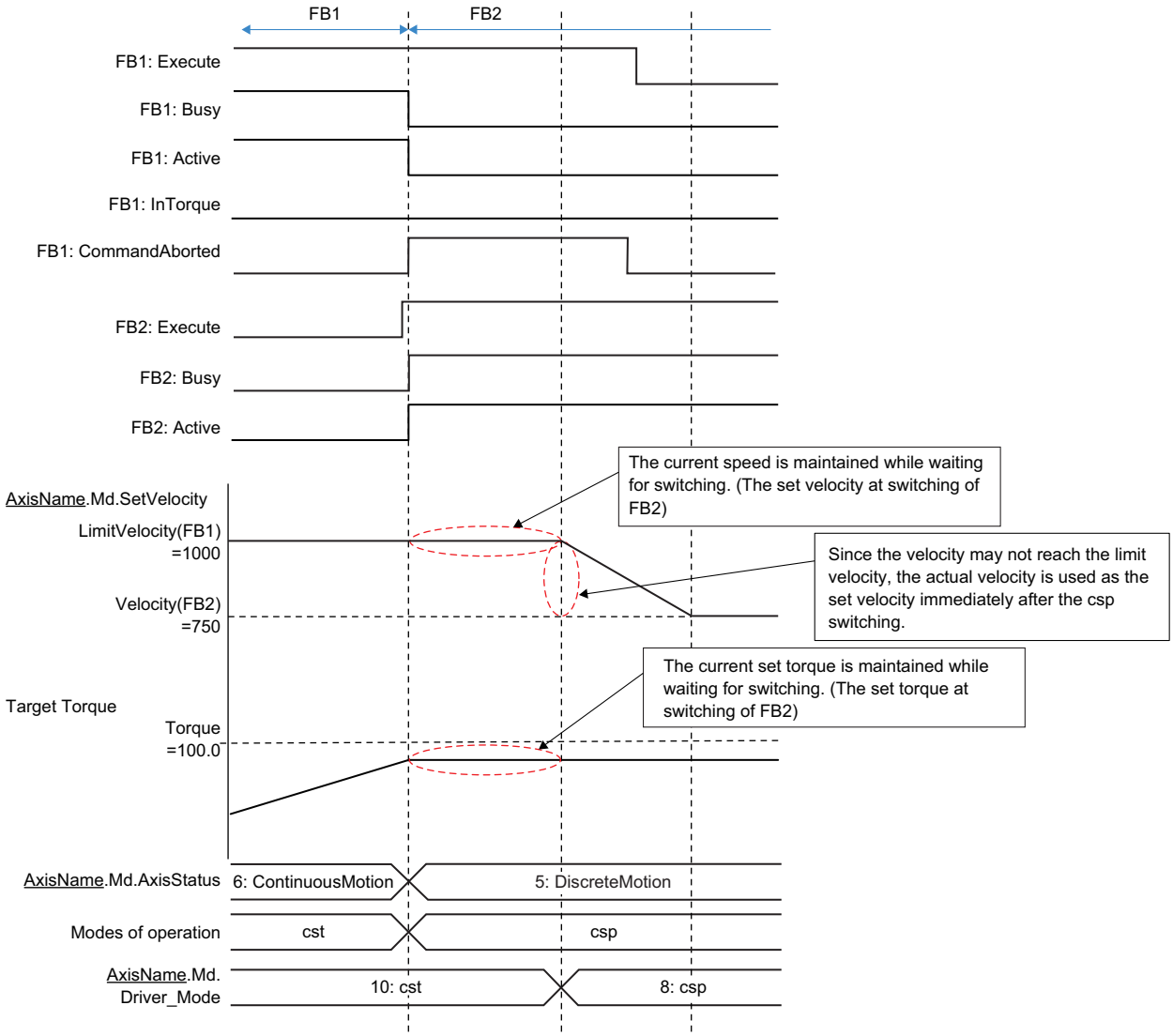
For operation at the overrun occurrence, refer to the following.

☞ Page 125 Multiple Start (Buffer Mode)

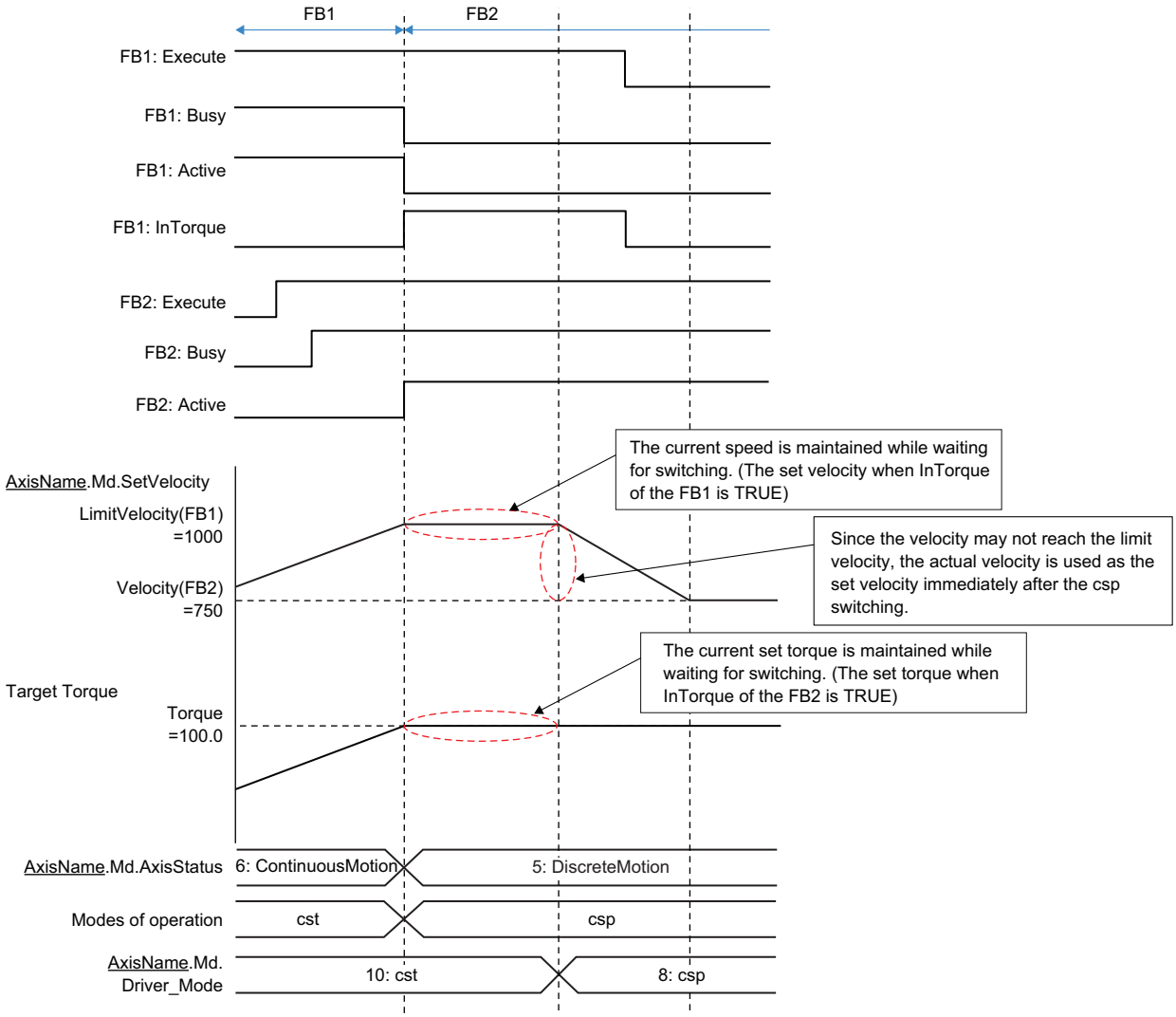
Precautions

If the axis overruns while waiting for switching, it will stop immediately after switching to csp.

• 0: mcAborting



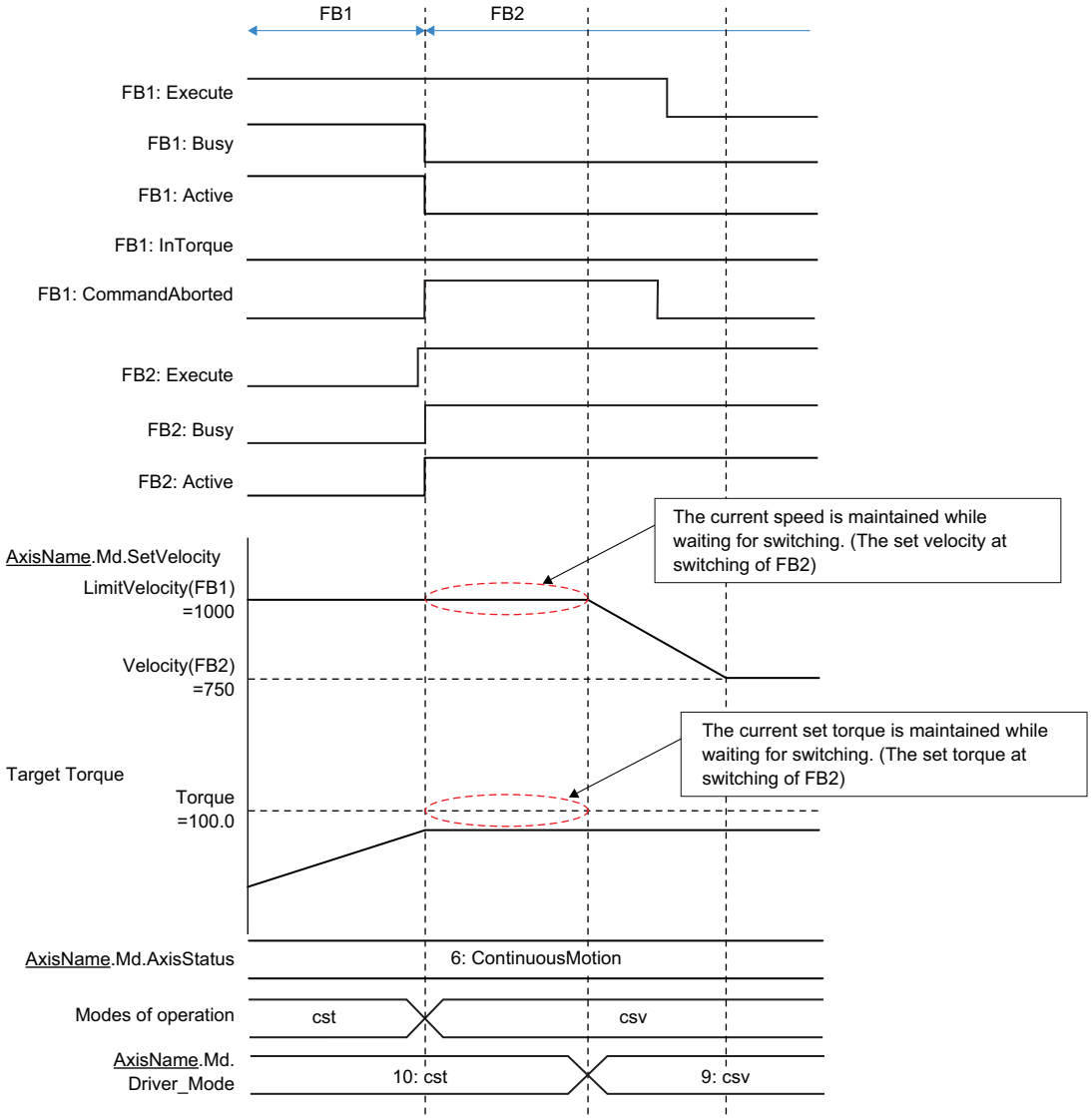
• 1: mcBuffered



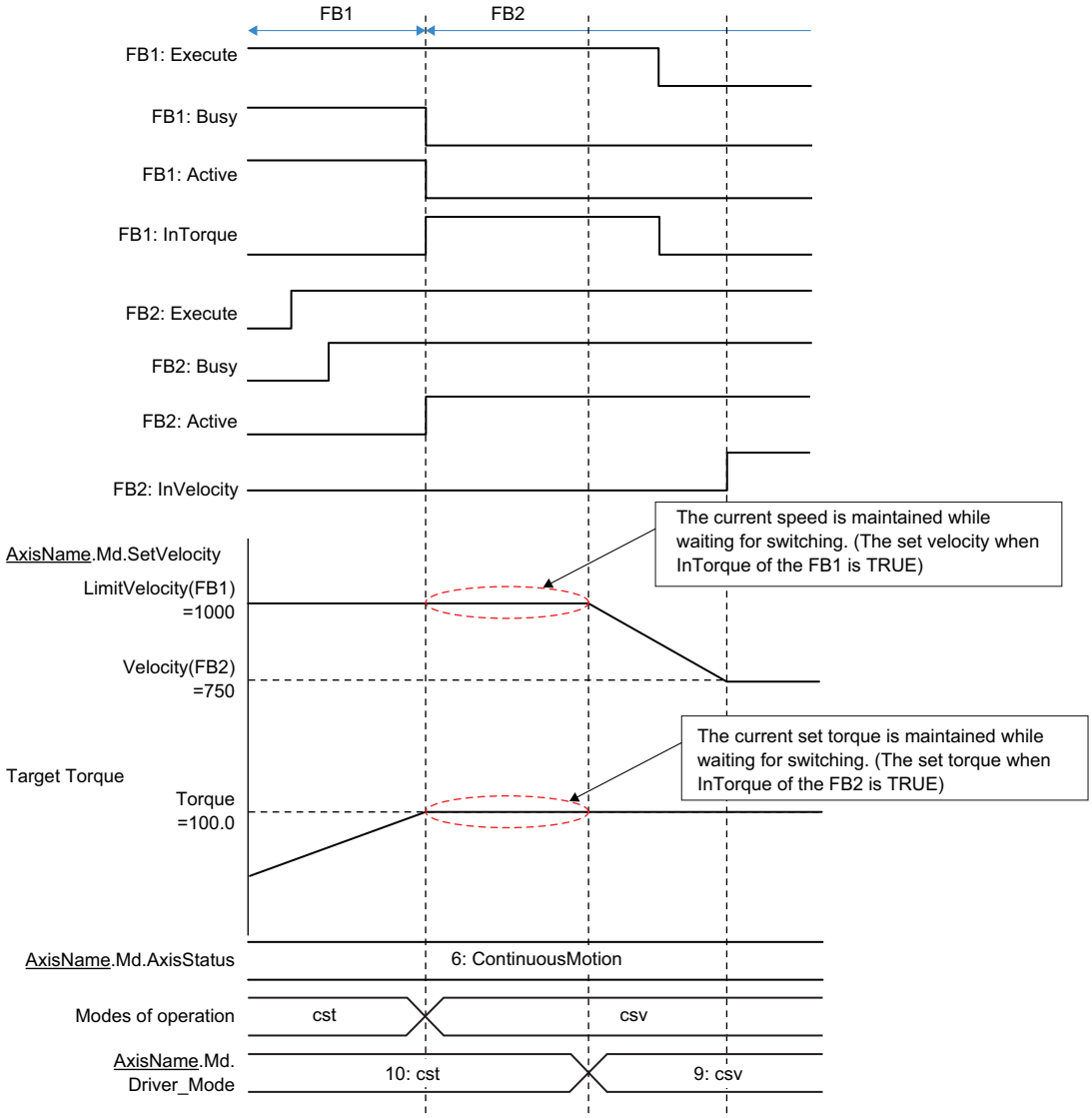
■Torque control (FB1) → Velocity control (FB2)

1. A csv switching request is issued to the driver.
2. Started positioning instruction is analyzed, and the axis waits until the driver switches to the csv. (Even if the axis issues the switching request to the csv during operation, switching may not be carried out depending on the driver specifications. If switching to the csv is not completed within 1 second, an axis error will occur for the timeout, and the axis will stop.)
3. While waiting for switching, torque control is continued with the torque and the limit velocity at switching.
4. When the driver switches to the csv, velocity control is started.

• 0: mcAborting



• 1: 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 FB operated in csp mode and operation direction is reversed during this instruction execution, set velocity at csp mode switching is set to 0. After that the operation starts to the changed direction.

Precautions

- AxisName.Cd.VelocityOverride and AxisName.Cd.AccelerationOverride are valid.
- The set position and the feed machine position are updated by follow up.
- Time until the control mode is switched depends on the specifications of the driver.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.

When using the MR-J5(W)-G

When switching from the position control mode to the torque control mode or from the torque control mode to the position control mode without waiting for stop of the motor, note the followings.

- Set "ZSP disabled selection at control switching" (PC76.1) of the servo parameter (extension setting) to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
- Set the servo parameter "Electronic gear numerator" (PA06) and "Electronic gear denominator" (PA07) as 1:1. The command value from the controller may be error at the control mode switching. When switching the control mode after the motor stops, the operation is possible other than the setting of 1:1.

Torque limit change during torque control

At restart or continuous update, if the target torque is changed to a value bigger than the torque limit value (AxisName.Md.TorqueLimit_Positive, AxisName.Md.TorqueLimit_Negative), the warning "Torque Limit Value Over Warning" (warning code: 0D12H) will occur and the axis operates at the value before change.

During torque control, if AxisName.Cd.TorqueLimit_Positive and 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 1 cycle.

8 RELEVANT FUNCTIONS to POSITION

8.1 Current Position Change Function

- This function executes control to change the set position to an arbitrary address. The current position change method includes a method of changing the set position at control execution (MC_SetPosition) and a method of changing to the set position corrected at the trigger input signal detection timing (MCv_SetPositionTriggered). (The feed machine position is not changed.)
- The "absolute position set" and the "relative position set" can be specified in the address to change.
- A method of changing the set position at control execution can be performed even though the axis is in operation. However, it cannot be performed during group control.
- 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 470 SYNCHRONOUS CONTROL

Point

When a current position change is completed, that "the current position change is executed" is recorded in the event history.

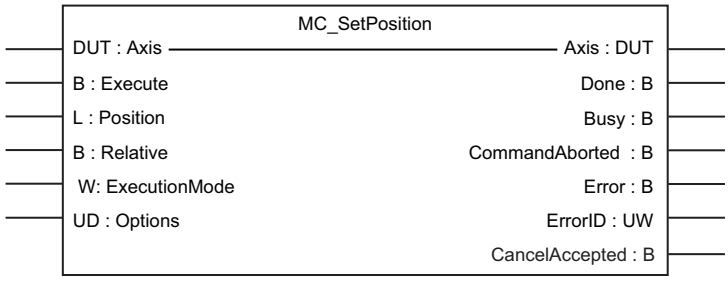
Targets to be changed and corresponding FBs

Target to be changed			Corresponding FB
Position	Current value		MC_SetPosition
			MCv_SetPositionTriggered
	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. However, it cannot be changed during control.
*2 The maximum value of the limit value can not be changed.

Relevant FBs

MC_SetPosition

Item	Description
Function overview	Changes the current position of the specified axis (set position, actual position).
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
32	7	Subroutine type	Real-time execution

■Function description

This FB changes the current position of the specified axis.

- When Relative is TRUE, the current position is changed to the position obtained by the addition of the target position (relative distance) and the current position.
- When Relative is FALSE, the current position is changed to the target position (absolute position).
- This FB is executed when Execute turns TRUE, and Busy turns TRUE when the processing is normally started.
- When the processing is completed and the current position is changed, Done turns TRUE.
- After starting this FB when ExecutionMode turned "1: mcQueued", if the axis status (AxisName.Md.AxisStatus) turns "0: Disabled" / "1: ErrorStop" before processing completion, an error will occur.
- When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID.
- For details of error codes, refer to the following.

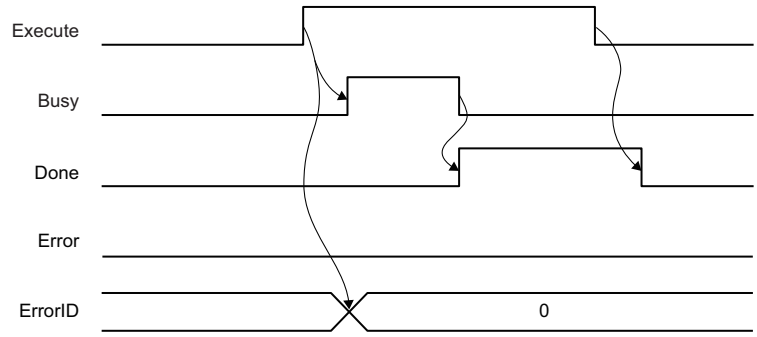
☞ Page 606 List of Error Codes

Precautions

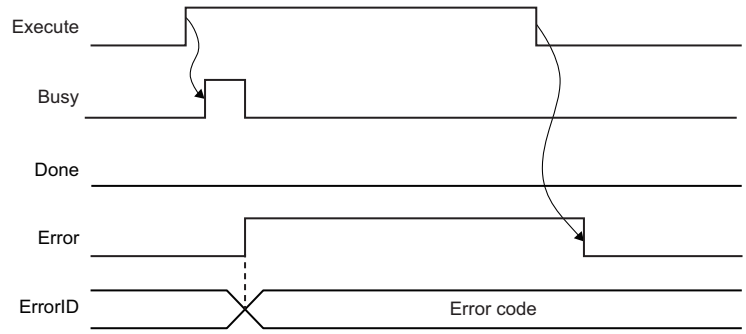
A current position change can be executed during axis operation. If the current position is changed during axis operation, the target position of the on-going FB will not change, but since the current position is changed, the operation to the target value will be changed.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Target position	Position	LREAL	↑	☞ Page 79 Positioning Range	0	Sets the target position value.
Relative position selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	The current position change with relative distance is set when Relative turns TRUE. The current position change with absolute position is set when Relative is FALSE.
Execution mode	ExecutionMode	MC_EXECUTION_MODE	↑	1 to 3	3	1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively) When "1: mcQueued", it executes after the previous FB is completed. When "3: mcSpeculatively", it can execute only when there is no on-going FB on the specified axis.
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

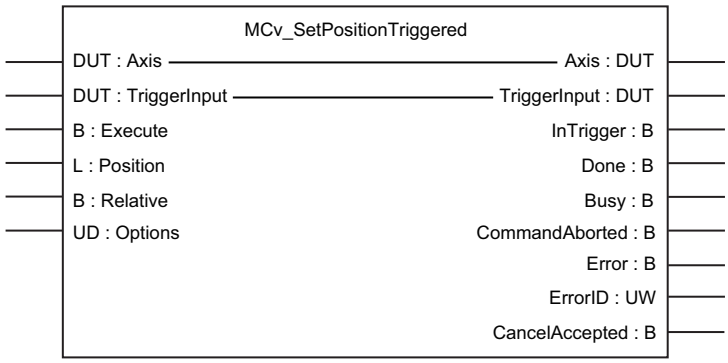
*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 15	Empty (Reserved)
16	Specifies whether cancel is allowed or not after FB is started. FALSE: Not allow TRUE: Allow
17 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that the current position change is completed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	When TRUE, it indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

MCv_SetPositionTriggered

Item	Description
Function overview	Changes the current position of specified axis (set position, actual position) to the position compensated at the trigger input signal detection timing.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Input area points(byte)	Output area points(byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■Function description

This FB changes the current position of the specified axis.

- The current position is changed when the TriggerInput signal is detected. When the processing is completed, Done turns TRUE.
- When Relative is TRUE, the current position is changed to the position obtained by the addition of the target position (relative distance) and the current position.
- When Relative is FALSE, the current position is changed to the target position (absolute position).
- This FB is executed when Execute turns TRUE, and Busy turns TRUE when the processing is normally started.
- When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID.
- For details of error codes, refer to the following.

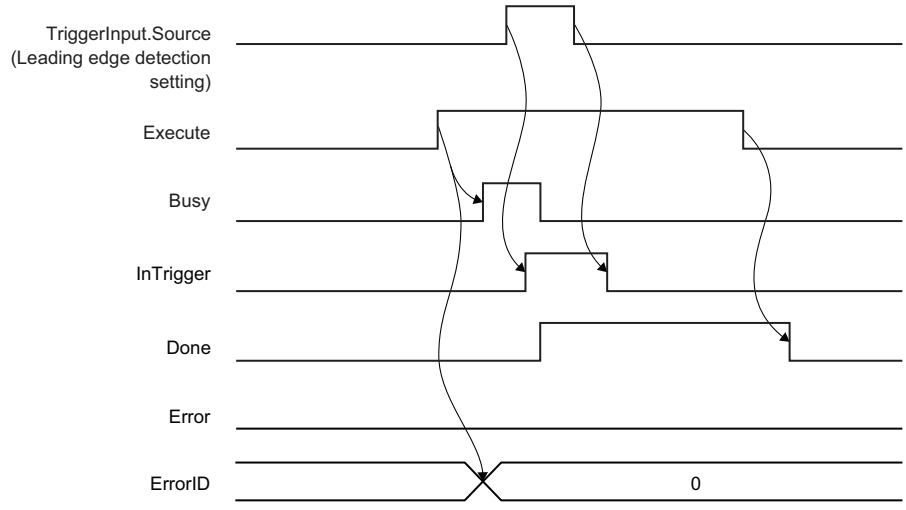
☞ Page 606 List of Error Codes

Precautions

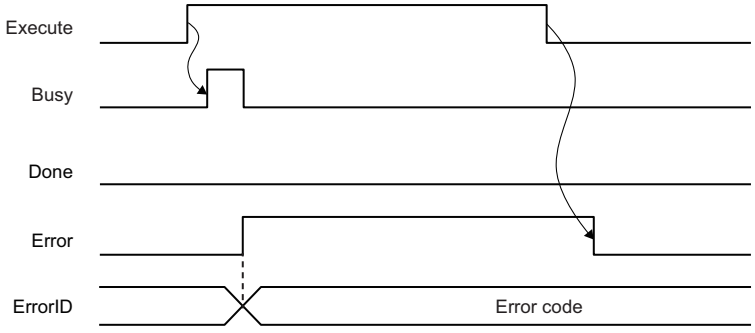
This FB can be executed only when the axis status (AxisName.Md.AxisStatus) is "4: Standstill". If it is other than "4: Standstill", an error occurs and it cannot be executed.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission not possible	☞ Page 398 External Signal Selection Only "RisingEdge", "FallingEdge", and "BothEdges" can be selected for Detection (signal detection method). A value within the range of "-5.0 to 5.0" can be specified to CompensationTime (compensation time [s]) when Relative is FALSE. Set "0.0" when Relative is TRUE. If the setting value is not within the valid range, an error will occur.

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Target position	Position	LREAL	↑	☞ Page 79 Positioning Range	0	Sets the target position value.
Relative position selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it sets the current position change by relative distance. When FALSE, it sets the current position change by absolute distance.
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets a function option with bit specification.

*1 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 15	Empty (Reserved)
16	Specifies whether cancel is allowed or not after FB is started. FALSE: Not allow TRUE: Allow
17 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Detecting signal	InTrigger	BOOL	FALSE	Indicates the detection status of the trigger input signal. The signal detection status is output as it is regardless of the correction time set in the trigger input signal.
Execution completion	Done	BOOL	FALSE	Indicates that the current position change is completed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	When TRUE, it indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

Position setting range

Values that can be specified in Position differs depending on whether Relative is FALSE or TRUE. Specify within each of the following range.

Relative	Position setting range
FALSE	Ring counter lower limit value ≤ Setting value < Ring counter upper limit value
TRUE	-(Ring counter upper limit value - Ring counter lower limit value) / 2 ≤ Setting value ≤ (Ring counter upper limit value - Ring counter lower limit value) /2

Even if a value outside the setting range is set, an error will occur and Position will not be executed when the set position after a current position change is outside the software stroke limit range.

Current position change

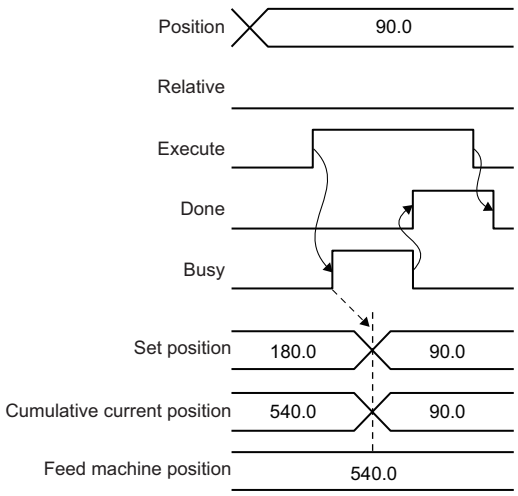
This section describes control details of MC_SetPosition.

Execution when the axis stops

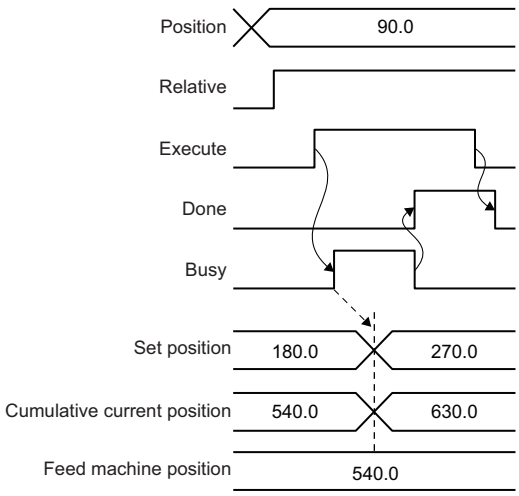
The current position change operation starts at rising edge detection of Execute.
In the current position change, the set position and the cumulative current position are changed to the position specified in Position.
Position is "Relative position set" when Relative is TRUE, and it is "Absolute position set" when 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 is FALSE>



<When Relative is TRUE>



Execution during axis operation

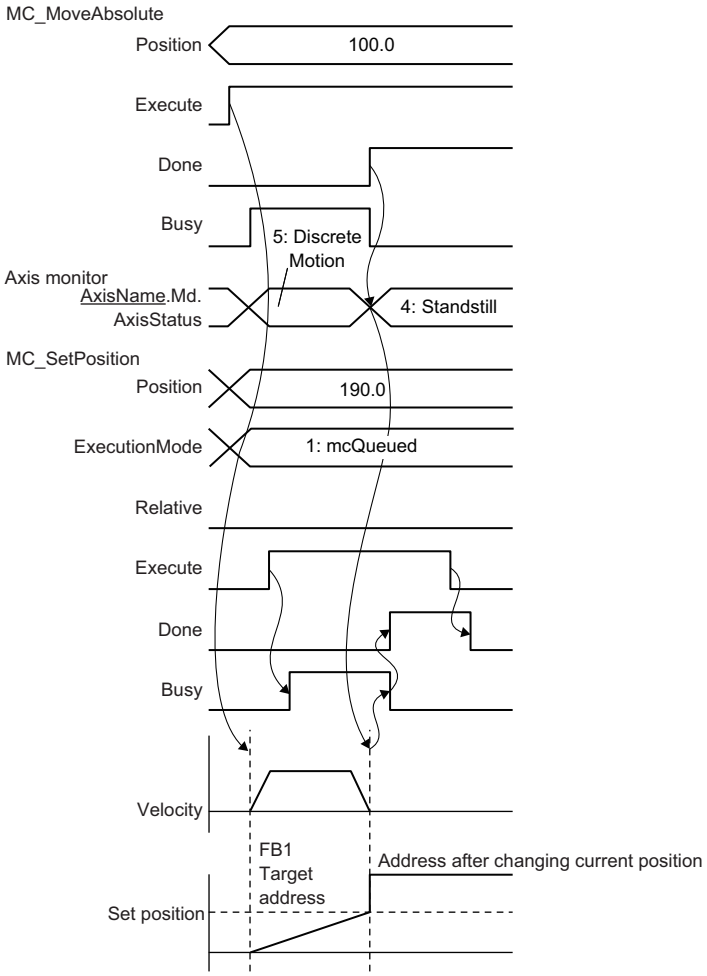
■Execute at completion

When "1: mcQueued" is set in ExecutionMode, this FB is executed after the on-going FB is completed.

Busy turns TURE by rising edge detection of Execute, and this FB waits until the axis status (AxisName.Md.AxisStatus) turns "4: Standstill".

As soon as the axis status (AxisName.Md.AxisStatus) turns "4: Standstill", the current position change operation will start.

Ex.



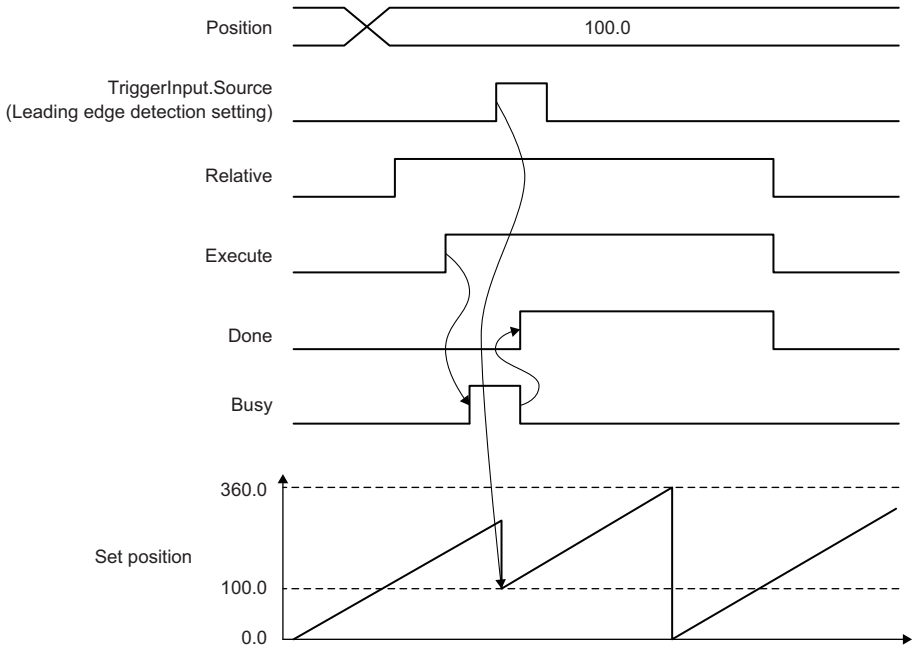
■Speculative execution

When specifying "3: mcSpeculatively" to ExecutionMode, if detecting the rising edge pf Execute when the axis status (AxisName.Md.AxisStatus) is not "4: Standstill" or when there is an on-going FB, the error "Axis Status Incorrect Start" (error code: 1A26H) will occur.

Trigger current position change

After rising edge detection of Execute, the current position change operation starts at signal detection of TriggerInput.
When the correction time of TriggerInput is a positive value, a current position change is immediately executed.
When the correction time of TriggerInput is a negative value, this FB waits for operation to start until the correction time has elapsed, and a current position change is executed.
In the current position change, the set position and the cumulative current position are estimated and changed so that the position will be a position set in Position at the signal detection timing of TriggerInput.
Position is "Relative position set" when Relative is TRUE, and it is "Absolute position set" when Relative is FALSE.

Ex.
When a current position change to 100.0 is executed in the real encoder axis during a follow up (during a counter enable) with the ring counter lower limit value of 0.0, the ring counter upper limit value of 360.0, and the axis status (AxisName.Md.AxisStatus) "4: Standstill".



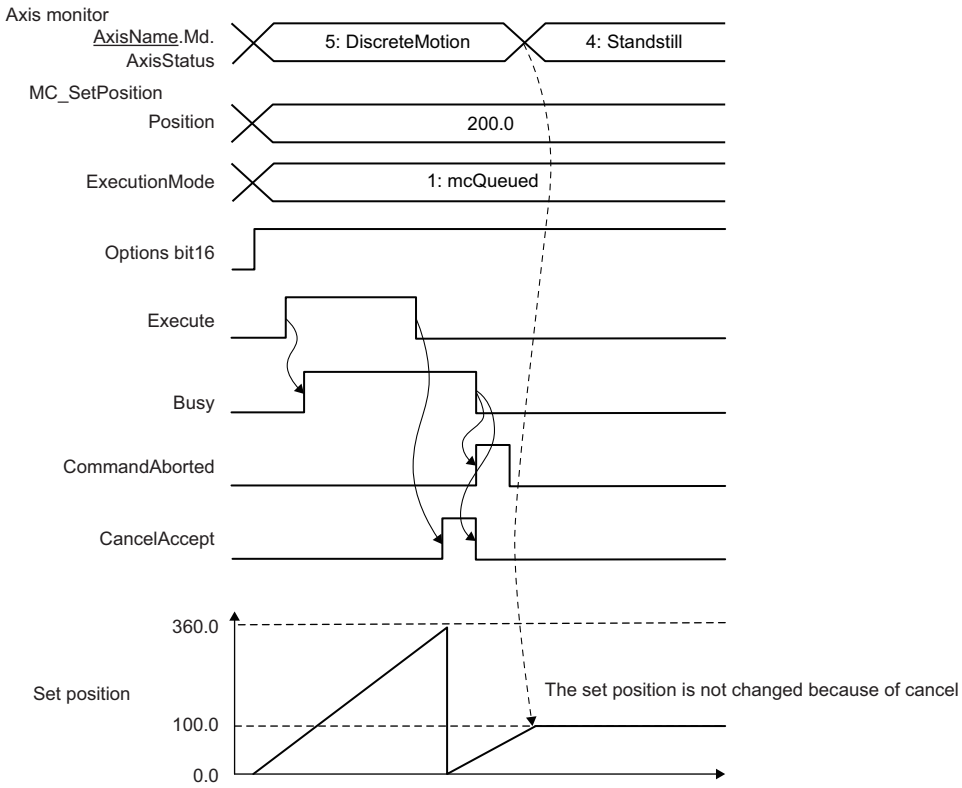
Cancel

Current position change that is in the standby status can be canceled after FB execution.

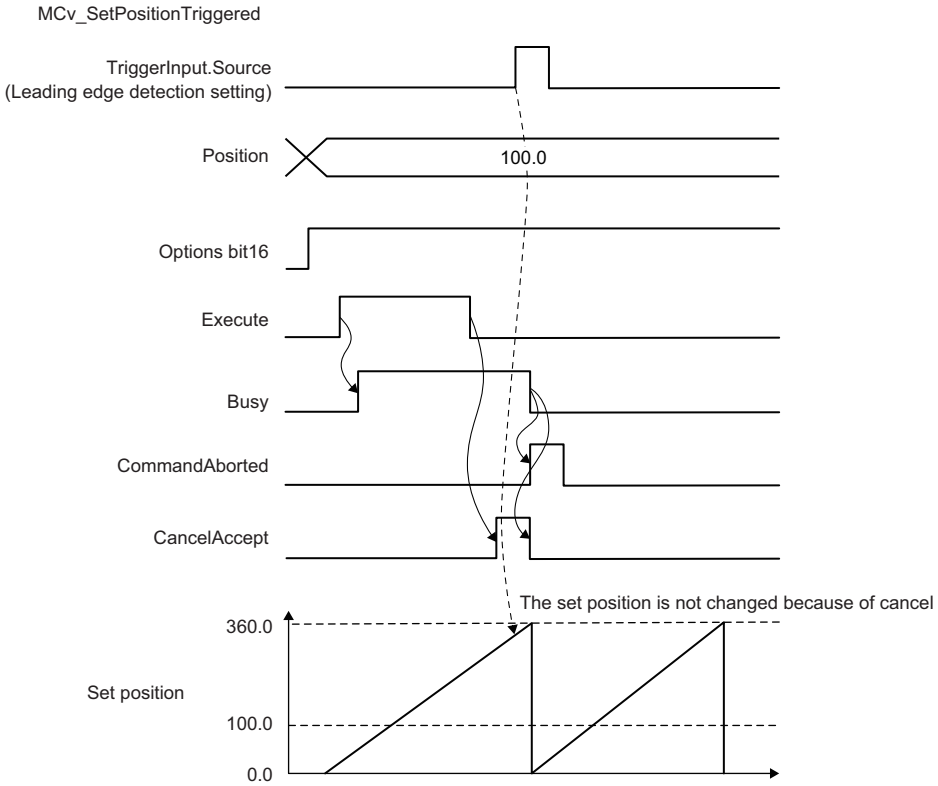
- To enable cancel, execute the FB with the status of "Cancel accepted after FB start" (Options bit16) set to "TRUE: Allowed".
- Cancel is started at rising edge detection of Execute.
- Cancel is accepted only when Busy of the output pin is TRUE.
- When FB accepts cancel, CancelAccepted of the output pin turns TRUE.
- When cancel is completed, CommandAborted of the output pin turns TRUE.
- When cancel was carried out, the set position is not changed.

Ex.

When canceling while the axis status (AxisName.Md.AxisStatus) is waiting for switching to "4: Standstill" after starting MC_SetPosition with "1: mcQueued" in ExecutionMode



When canceling while the axis status is waiting for detecting a trigger signal after starting MCv_SetPositionTriggered



8.2 Command In-position

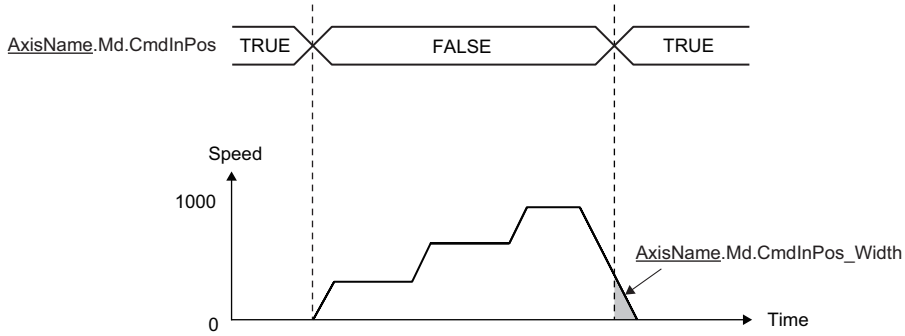
The command in-position function checks the remaining distance to the target position, and turns the flag to TRUE.
This flag is called the "command in-position flag". The command in-position flag is used as a front-loading signal indicating beforehand the completion of the control.
The command in-position function is valid to all control that requires commanded address specification.
It turns AxisName.Md.CmdInPos to TRUE when the remaining distance to the target position became AxisName.Md.CmdInPos_Width or less.
It turns AxisName.Md.CmdInPos to FALSE when the axis starts and when the FB is switched by multiple start.

Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
CmdInPos_Width	Command in-position width	Sets the command in-position width.
AxisName.Md.		
CmdInPos_Width	Command in-position width	Displays the command in-position width. • The value imports the setting value of AxisName.Pr.CmdInPos_Width. • When AxisName.Md.CmdInPos_Width is "0.0", the command in-position function of the axis is disabled.
CmdInPos	Command in-position	Indicates whether the remaining distance to the target position is AxisName.Md.CmdInPos_Width or less.
AxesGroupName.Pr.		
CmdInPos_Width	Command in-position width	Sets the command in-position width on the composite axis of the axes group.
AxesGroupName.Md.		
CmdInPos_Width	Command in-position width	Displays the command in-position width on the composite axis of the axes group. • The value imports the setting value of AxesGroupName.Pr.CmdInPos_Width. • When AxesGroupName.Md.CmdInPos_Width is "0.0", the command in-position function of the axes group is disabled.
CmdInPos	Command in-position	Indicates whether the remaining distance to the target position on the composite axis is AxesGroupName.Pr.CmdInPos_Width or less.

Command in-position width check

(Remaining distance) ≤ (AxisName.Md.CmdInPos_Width)



A command in-position width check is carried out every operation cycle.
However, while the axis stops, AxisName.Md.CmdInPos is not refreshed.
When AxisName.Md.CmdInPos_Width is 0.0, a command in-position width check is not carried out.
For an axes group, the remaining distance on the composite axis (line/arc) is checked based on AxesGroupName.Md.CmdInPos_Width.
The flag is stored in AxesGroupName.Md.CmdInPos.
During axes group operation, the command in-position function of the configuration axes is disabled.
AxisName.Md.CmdInPos of the configuration axes is not turned TRUE during axes group operation. (It turned FALSE when the axes group is started.)

8.3 Software Stroke Limit

In the "software stroke limit function", an address is set 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 "feed machine position" are used as the addresses indicating the current value. However, in the "software stroke limit function", which address is used to carry out the limit check is designated in AxisName.Pr.SwStrokeLimit_Target.

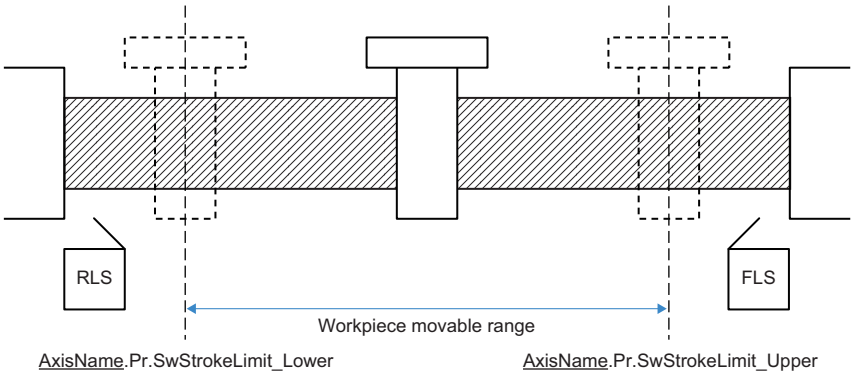
Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
SwStrokeLimit_Upper	Software stroke limit upper value	Sets the software stroke limit upper value.
SwStrokeLimit_Lower	Software stroke limit lower value	Sets the software stroke limit lower value.
SwStrokeLimit_Target	Software stroke limit target	Sets the software stroke limit target.
AxisName.Md.		
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 target.
SwStrokeLimit_Override	Software stroke limit override	Displays the software stroke limit valid/invalid status.
AxisName.Cd.		
SwStrokeLimit_Override	Software stroke limit override	Temporarily switches enabled/disabled of the software stroke limit.

Definition of movable range

Movable range differences by selection of set position and feed machine position

The following drawing shows the movable range of the workpiece when the software stroke limit function is used.

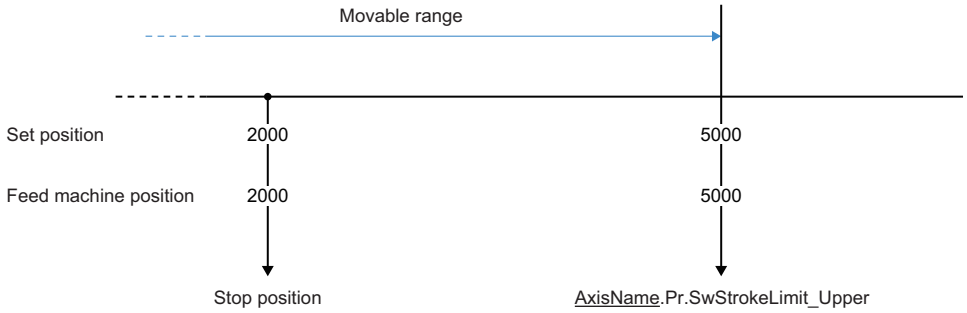


The set position or the feed machine position can be specified in the software stroke limit. (The cumulative current position cannot be specified.)

The following drawing shows the differences in the operation when the set position is used or when the feed machine position is used in the movable range limit check.

• Conditions

Assume the current value is 2000, and AxisName.Pr.SwStrokeLimit_Upper is set to 5000.

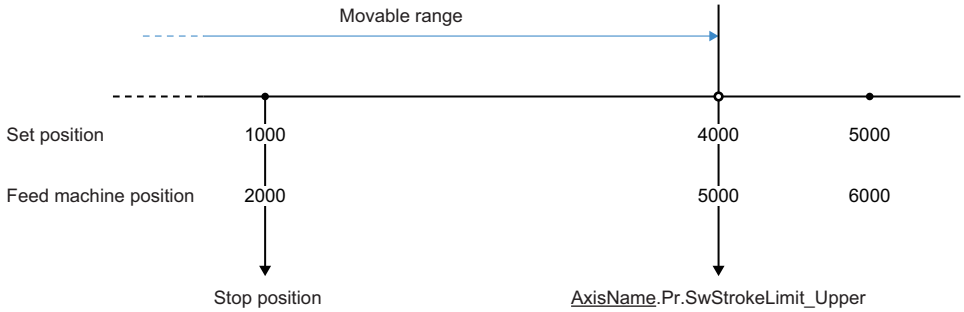


• Current value changing

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 feed machine position will stay the same at 2000.

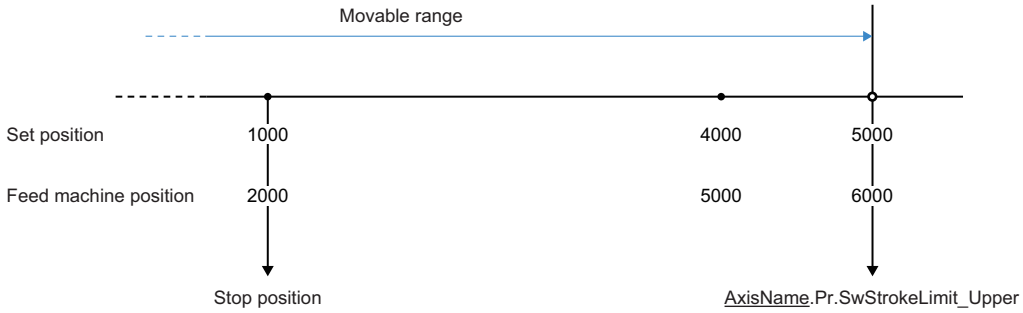
[When the feed machine position is set at the limit]

The set position of 4000 (feed machine position: 5000) becomes the upper stroke limit.



[When the set position is set at the limit]

The set position of 5000 (feed machine position: 6000) becomes the upper stroke limit.



Point

When "3: FeedMachinePosition" is set in AxisName.Pr.SwStrokeLimit_Target, the movable range becomes an absolute range referenced on the home position. When "1: 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

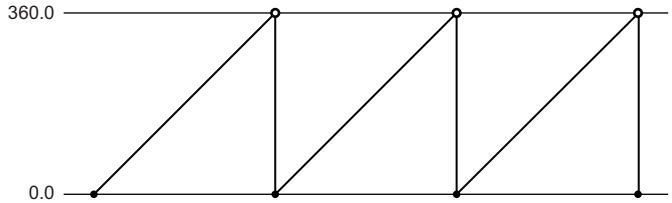
• Set position

The storing range of the set position upper/lower limit value is shown below.

Monitor data	Storing range
AxisName.Md.SetPosition	Ring counter lower value ≤ Set position < Ring counter upper 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.

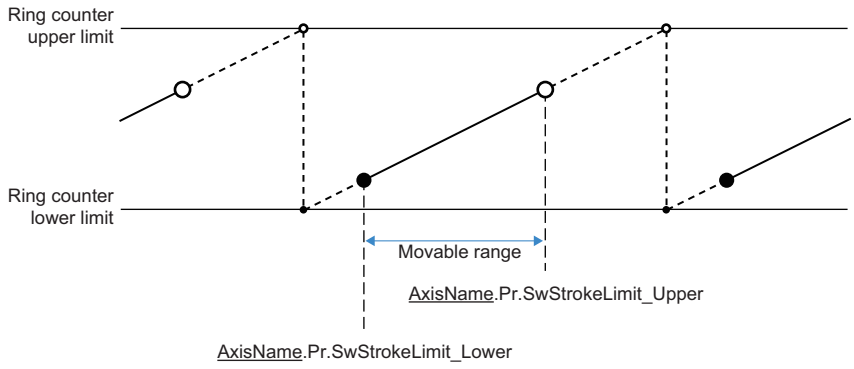
Parameter	Setting range
AxisName.Pr.SwStrokeLimit_Upper	Ring counter lower value < Setting value ≤ Ring counter upper value
AxisName.Pr.SwStrokeLimit_Lower	Ring counter lower value ≤ Setting value < Ring counter upper value

Movable range: AxisName.Pr.SwStrokeLimit_Lower ≤ Set position < AxisName.Pr.SwStrokeLimit_Upper

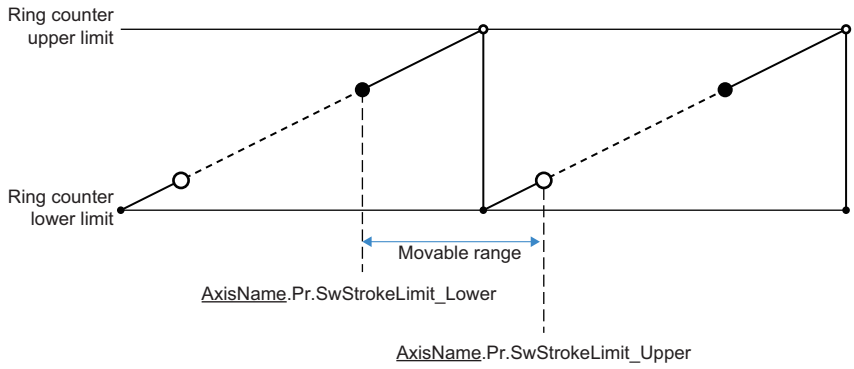
• Details of the movable range

The movable range varies as shown below depending on the relationship between AxisName.Pr.SwStrokeLimit_Upper and AxisName.Pr.SwStrokeLimit_Lower.

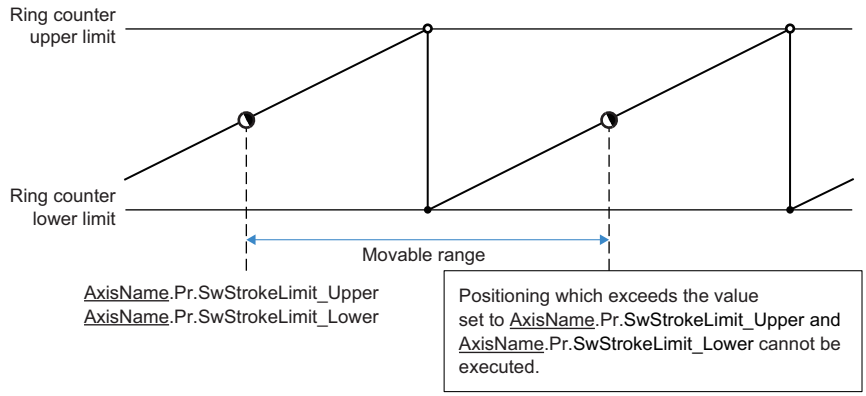
[AxisName.Pr.SwStrokeLimit_Upper > AxisName.Pr.SwStrokeLimit_Lower]



[AxisName.Pr.SwStrokeLimit_Upper < AxisName.Pr.SwStrokeLimit_Lower]



[AxisName.Pr.SwStrokeLimit_Upper = AxisName.Pr.SwStrokeLimit_Lower]



■When selecting the set position or the feed machine position when the ring counter is invalid

• Feed machine position

The storing range of the feed machine position upper/lower limit value are shown below.

Monitor data	Stroring range
AxisName.Md.FeedMachinePosition	10000000000.0 ≤ Feed machine position < 10000000000.0

• Setting the software stroke limit

The setting range of the software stroke limit upper/lower value is shown below.

Parameter	Setting range
AxisName.Pr.SwStrokeLimit_Upper	AxisName.Pr.SwStrokeLimit_Lower < Setting range ≤ 10000000000.0
AxisName.Pr.SwStrokeLimit_Lower	-10000000000.0 ≤ Setting range < AxisName.Pr.SwStrokeLimit_Upper

Movable range: AxisName.Pr.SwStrokeLimit_Lower ≤ Feed machine position < AxisName.Pr.SwStrokeLimit_Upper

Invalidating the software stroke limit

To invalidate the software stroke limit, set "-1: Invalid" in AxisName.Pr.SwStrokeLimit_Target. By setting "-1: Invalid", the software stroke limit check is not executed in all controls regardless of the setting values of AxisName.Pr.SwStrokeLimit_Upper and 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 or DISABLE in AxisName.Cd.SwStrokeLimit_Override, execute the axis operation to return to the movable range.

Point

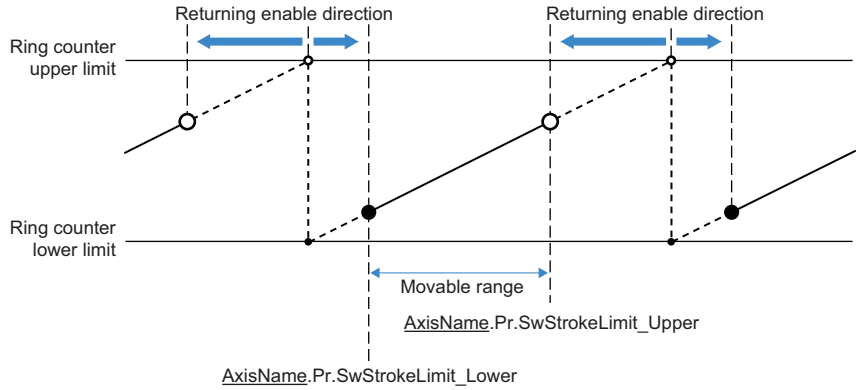
- In AxisName.Cd.SwStrokeLimit_Override, the software stroke limit can be temporarily disabled without changing the settings of AxisName.Pr.SwStrokeLimit_Upper and AxisName.Pr.SwStrokeLimit_Lower.
- In AxisName.Cd.SwStrokeLimit_Override, only the check in the returning enable direction can be disabled from outside the software stroke limit range. By disabling it only in the returning enable direction to the movable range, a motion to unexpected directions can be prevented.
- If the axis operation is started while the software stroke limit is disabled by AxisName.Cd.SwStrokeLimit_Override, that "the axis operation is started while the software stroke limit is disabled by AxisName.Cd.SwStrokeLimit_Override" is recorded in the event history.

■Returning enable direction to the movable range

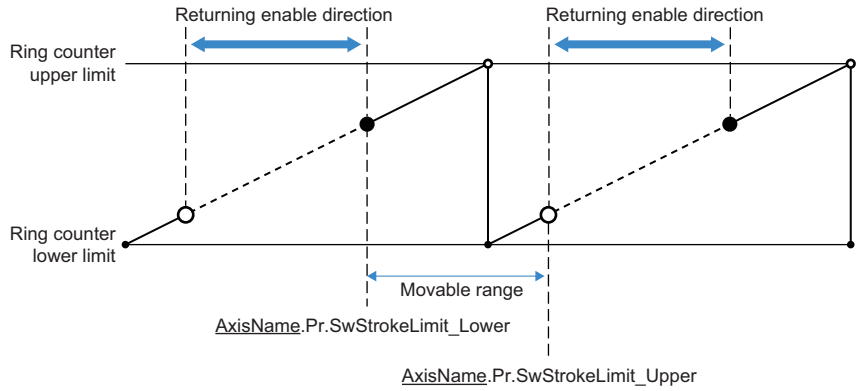
- When setting ONLY_INSIDE in AxisName.Cd.SwStrokeLimit_Override, movement in the returning enable direction from outside the software stroke limit range to the movable range is allowed.
- The returning enable direction from outside the software stroke limit range means the direction in which the axis can return to the movable range without exceeding the ring counter value.
- If the axis operates to the direction to exceed the ring counter value from outside the software stroke limit range, the error "Software Stroke Limit Over (start Position)" (error code: 1A01H) will be detected, and the axis will not start.
- Also, even if it is the returning enable direction, when an address which is outside the software stroke limit range exceeding the movable range is specified as the target position, the error "Software Stroke Limit Over (Target Position)" (error code: 1A00H) will be detected, and the axis will not start.
- To return to the movable range ignoring the returning enable direction, set DISABLE in AxisName.Cd.SwStrokeLimit_Override and carry out a move to the movable range.

■Returning enable direction when setting ONLY_INSIDE in AxisName.Cd.SwStrokeLimit_Override

- AxisName.Pr.SwStrokeLimit_Upper > AxisName.Pr.SwStrokeLimit_Lower



- AxisName.Pr.SwStrokeLimit_Upper < AxisName.Pr.SwStrokeLimit_Lower



Checking the software stroke limit enabled status

- In the monitor AxisName.Md.SwStrokeLimit_Override, the software stroke limit enabled/disabled status can be checked.
- AxisName.Md.SwStrokeLimit_Override is updated when turning the PLC READY[Y0] from OFF to ON and when starting the axis operation.
- Since AxisName.Cd.SwStrokeLimit_Override is restricted by switching of the software stroke limit enabled/disabled status, it performs import at start and updates AxisName.Md.SwStrokeLimit_Override.

AxisName.Pr.SwStrokeLimit_Target	AxisName.Cd.SwStrokeLimit_Override	AxisName.Md.SwStrokeLimit_Override
1: Invalid (Disabled)	—	DISABLE: Check disabled
1: SetPosition (Set position) 3: FeedMachinePosition (Feed machine position)	Other than the following: No disable request DISABLE: Check disabled ONLY_INSIDE: Check disabled only to inside the range direction	" ": No disable request DISABLE: Check disabled ONLY_INSIDE: Check disabled only to inside the range direction

Specifications of the software stroke limit check

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 address is outside the software stroke limit range.	When starting axis operation which has the "target address"	The error "Software Stroke Limit Over (Target Position)" (error code: 1A00H) is output and the axis does not start.
An error shall occur if the start address is outside the software stroke limit range.	When starting axis operation	The error "Software Stroke Limit Over (Start Position)" (error code: 1A01H) 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	The error "Software Stroke Limit Over (Forward Direction)" (error code: 1A03H) or the error "Software Stroke Limit Over (Reverse Direction)" (error code: 1A04H) is output and the stop processing is executed.*1

*1 The error occurs when detecting a command to the address outside the software stroke limit range, and the stop processing is executed. To stop within the software stroke limit range, set to immediately stop.

Precautions

- Homing must be executed beforehand for the software stroke limit function to function properly.
- If AxisName.Pr.SwStrokeLimit_Upper or AxisName.Pr.SwStrokeLimit_Lower is outside the setting range, the error "Out of Parameter Range" (error code: 1D80H) will be detected.
- During interpolation control, the software stroke limit check is executed to all current values of the interpolation axes. When an error occurs in any axis, all axes will not start.
- When the feed machine position is set as the setting value of AxisName.Pr.SwStrokeLimit_Target to the axis type in which the feed machine position is disabled, the error "Out of Parameter Range" (error code: 1D80H) will be detected.

8.4 Hardware Stroke Limit

In the "hardware stroke limit function", 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.

⚠WARNING

The negative logic (b-contact) is recommended for wiring the hardware stroke limit. If the positive logic (a-contact) is used, a serious accident may occur when disconnection or sensor failure occurs.

For details of the signals that can be used in the hardware stroke limit, refer to the following.
☞ Page 398 External Signal Selection

Relevant variables

Variable/Structure name	Name	Details
AxisName.PrConst.		
HwStrokeLimit_FlsSignal	Upper limit signal	Sets a signal using the upper limit signal (FLS). HwStrokeLimit_FlsSignal is the structure of SIGNAL_SELECT type. For details of SIGNAL_SELECT type, refer to the following. ☞ Page 398 SIGNAL_SELECT structure The specific setting and the operation of this signal are shown below. • IO No. Ignores the input value. • Target When the specification is not set, signal disabled is determined and the signal undetection status is always set. When unavailable data is set, the error "Target of FLS Signal Incorrect" (error code: 1AC4H) is output. • Signal detection method The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Signal Logical Setting of FLS Signal Range" (error code: 1AD1H) is output. 0: HighLevel Detection at TRUE 1: LowLevel Detection at FALSE • Compensation time Ignores the input value. • Filter time Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting of FLS Signal Range Warning" (warning code: 0D24H) is output. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle.

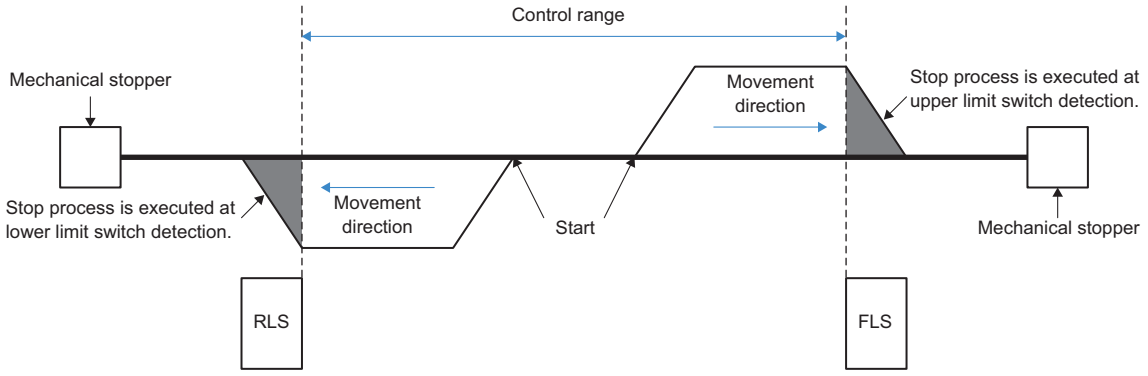
Variable/Structure name		Name	Details
	HwStrokeLimit_RlsSignal	Lower limit signal	Sets a signal using the lower limit signal (RLS). HwStrokeLimit_RlsSignal is the structure of SIGNAL_SELECT type. For details of SIGNAL_SELECT type, refer to the following. ☞Page 398 SIGNAL_SELECT structure The specific setting and the operation of this signal are shown below. • IO No. Ignores the input value. • Target When the specification is not set, signal disabled is determined and the signal undetection status is always set. When unavailable data is set, the error "Target of RLS Signal Incorrect" (error code: 1AC5H) is output. • Signal detection method The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Signal Logical Setting of RLS Signal Range" (error code: 1AD2H) is output. 0: HighLevel Detection at TRUE 1: LowLevel Detection at FALSE • Compensation time Ignores the input value. • Filter time Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting of RLS Signal Range Warning" (warning code: 0D25H) is output. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle.
AxisName.Md.			
	HwStrokeLimit_FlsStatus	Upper limit signal status	Displays the input status of the FLS signal.
	HwStrokeLimit_RlsStatus	Lower limit signal status	Displays the input status of the RLS signal.
	HwStrokeLimit_Override	Hardware stroke limit override	Displays the acceptance status of the enabled/disabled switching command of the hardware stroke limit.
AxisName.Cd.			
	HwStrokeLimit_Override	Hardware stroke limit override	Switches the enabled/disabled of the hardware stroke limit.

Hardware stroke limit check details

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 FLS signal is detected at start.	At start	The error "FLS Signal Detection (at Start)" (error code: 1A2DH) is output and the axis does not start.
Signal input from the RLS signal is detected at start.	At start	The error "RLS Signal Detection (at Start)" (error code: 1A2EH) is output and the axis does not start.
Signal input from the FLS signal is detected during control.	During control	The error "FLS Signal Detection (Controlling)" (error code: 1A2FH) is output and the axis stops.*1
Signal input from the RLS signal is detected during control	During control	The error "RLS Signal Detection (Controlling)" (error code: 1A30H) is output 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

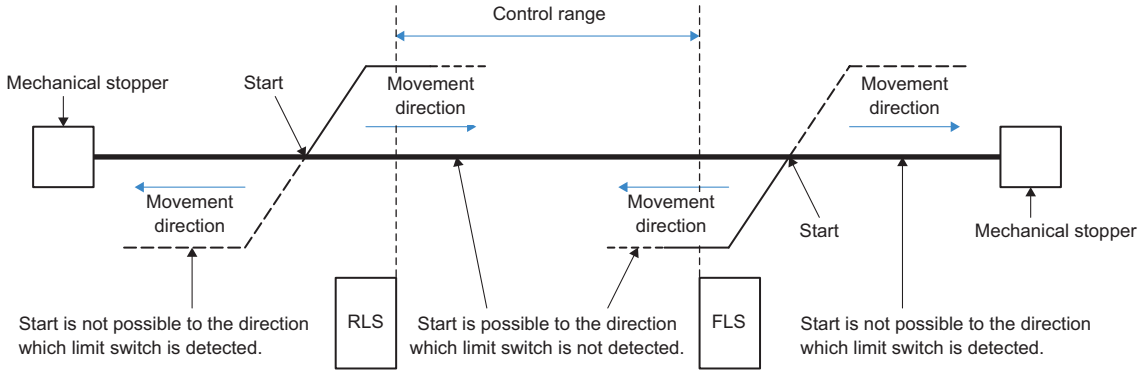
While the limit switch is detected, the operation cannot be performed regardless of the detection direction.
After setting ONLY_INSIDE or DISABLE in AxisName.Cd.HwStrokeLimit_Override, execute the axis operation to return to the controllable range.

Point

- When setting an item other than ONLY_INSIDE and DISABLE in AxisName.Cd.HwStrokeLimit_Override, the axis operates with "No disable request".
- If the axis operation is started while the hardware stroke limit is disabled by AxisName.Cd.HwStrokeLimit_Override, that "the axis operation is started while the hardware stroke limit is disabled by AxisName.Cd.HwStrokeLimit_Override" is recorded in the event history.

When setting ONLY_INSIDE

The axis can start to the direction in which the limit switch has not been detected.



When setting DISABLE

The axis can start regardless of the limit switch detection status.

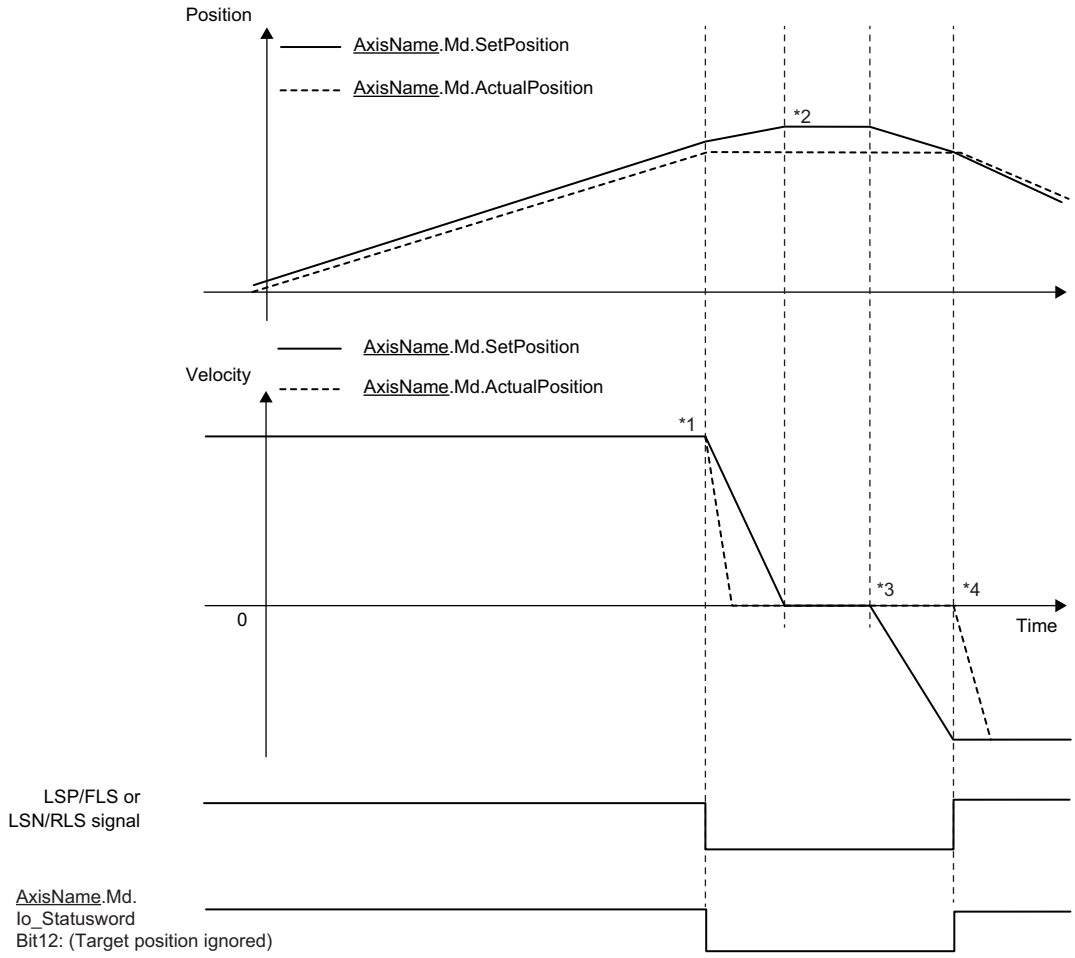
Precautions

- Install the FLS in the direction in which the set position increases, and install the RLS in the direction in which the set position decreases. If inverting the install positions of the FLS/RLS, hardware stroke limit function cannot be operated properly.
- The LSP/LSN signal input to the servo amplifier when connecting to MR-J5(W)-G can be set as the hardware stroke limit signal. For details of the setting method, refer to the following.
  ☞ Page 681 Using methods
- Depending on the setting of "Limit switch enabled status selection"(PD41.2) of the servo parameter "Function selection D-4"(PD41) when connecting to MR-J5(W)-G, the operation differs at LSP/FLS or LSN/RLS signal detection.
- 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 AxisName.Pr.StopOption_DriverTargetIgnored.
- When "1: Enabled only for homing mode" or the driver is in the Homing mode, the drive unit side will execute the stop processing. When the driver is in other than the Homing mode, the signal will be ignored so set it to stop by motion system using 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. So when using MR-J5(W)-G, it is recommended toset "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 Motion module side needs to be stopped, be sure to enable AxisName.Pr.StopOption_DriverTargetIgnored. The following shows an operation example.

Ex.

Operation example 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 AxisName.Pr.StopOption_DriverTargetIgnored is enabled, the motion system will detect the error "Driver Command Discard Detection" (error code: 1AE6H) and execute the command stop. For details of the setting, refer to the following.
☞ Page 148 Stop

*2 After completion of the stop process on the motion system side, it stops with the status where AxisName.Md.ActualPosition deviates from 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 stopped and when axis control is performed to the direction toward the inside of the stroke limit, the position command (the set position and feed machine position) and set 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 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 command position of the motion system stops at the stroke limit side closer than the actual position by the stroke limit detection of the driver unit and the axis control is performed to the inside of the stroke limit, the operation of the actual position follows the command position from the motion system.

9 RELEVANT FUNCTIONS TO VELOCITY

9.1 Acceleration/deceleration Processing Function

The acceleration/deceleration processing function adjusts the acceleration/deceleration of each motion control to the acceleration/deceleration curve suitable for device.

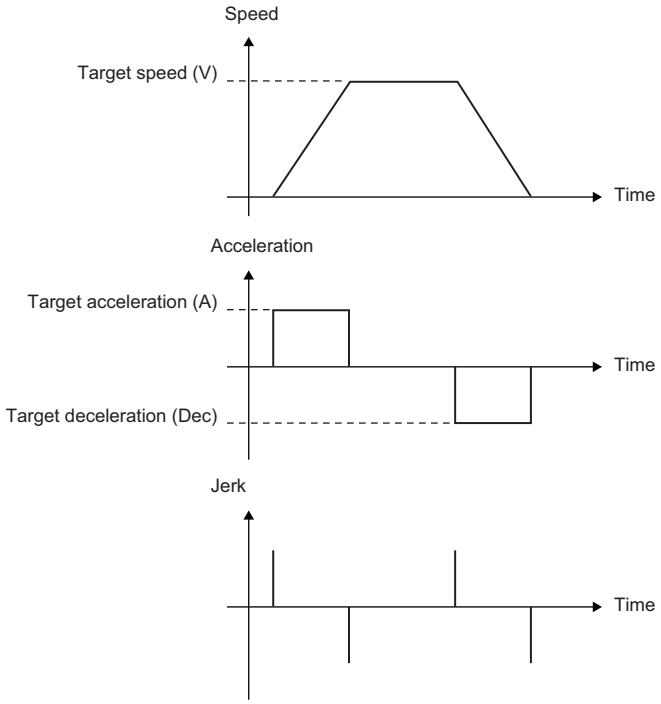
Acceleration/deceleration method

The following methods can be selected for the acceleration/deceleration method. When a value outside the range is set in the acceleration/deceleration method, the error "Out of Acceleration/Deceleration Method Range" (error code: 1AA9H) will occur and the axis will not start.

Acceleration/deceleration method	Description
Acceleration/deceleration specification method (Default)	An acceleration/deceleration method using the acceleration, the deceleration, and the 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 speed.

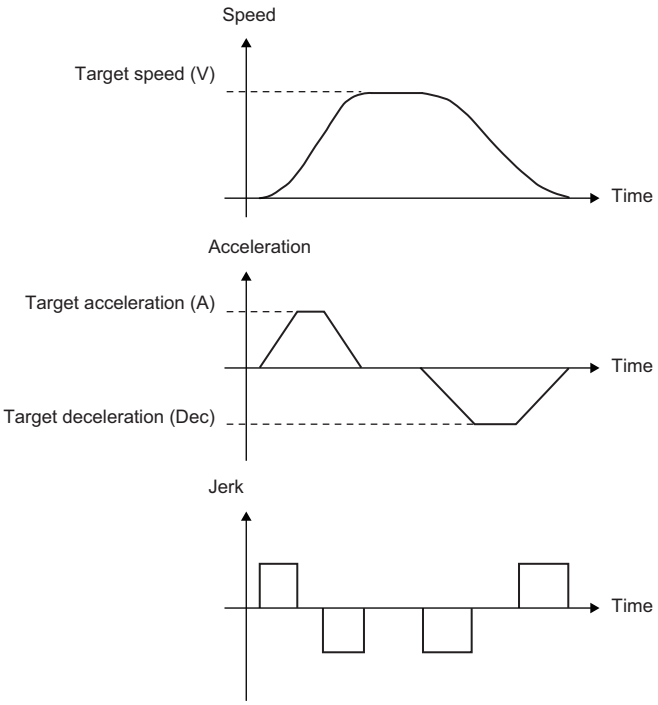
■Trapezoidal acceleration/deceleration

When "0.0" is set in the jerk, the curve is called the trapezoidal acceleration/deceleration. The speed shows a trapezoidal waveform.



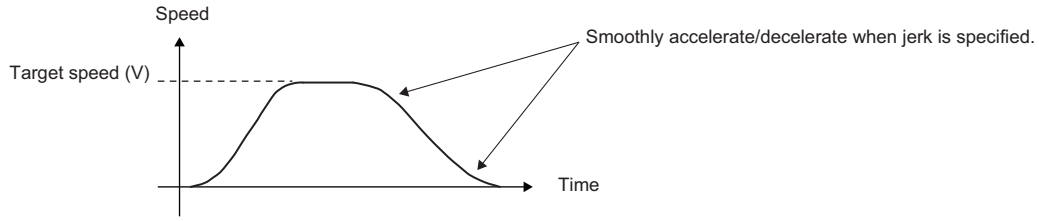
■Jerk acceleration/deceleration

When a value other than "0.0" is set in the jerk, the curve is called the jerk acceleration/deceleration. The speed shows a 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 speed 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.



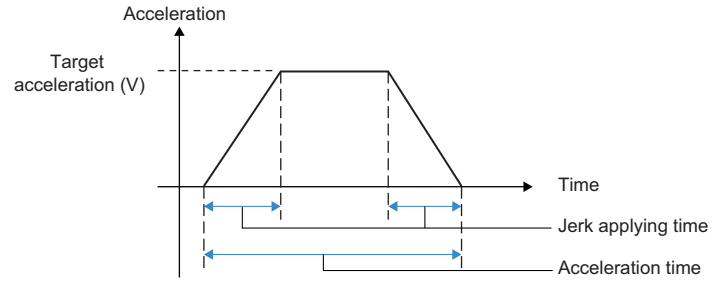
• Jerk applying time/Jerk applying ratio

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.

Jerk applying time = 2 × Target acceleration ÷ Jerk

Jerk applying ratio = (Jerk applying time ÷ Acceleration time) × 100 [%]



Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
VelocityLimit_Positive	Positive direction speed limit value	Sets the positive direction speed limit value. For details, refer to the following. ☞ Page 337 Speed Limit
VelocityLimit_Negative	Negative direction speed limit value	Sets the negative direction speed limit value. For details, refer to the following. ☞ Page 337 Speed Limit
VelocityLimit_OverOperation	Operation setting at speed limit value exceeded	Sets the operation at speed limit value exceeded. For details, refer to the following. ☞ Page 337 Speed Limit
AccelerationLimit	Acceleration limit value	Sets the acceleration limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, it doesn't limit the acceleration. • When "0.0000" is set, it does not limit the acceleration.
DecelerationLimit	Deceleration limit value	Sets the deceleration limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, it doesn't limit the 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, positive numbers from 0.0001 to 2147483647.0 U/s^3 • When "0.0000" is set, it does not limit the jerk.
AccelerationZeroBehavior	Operation selection at start acceleration/deceleration 0	Selects behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start. -1: ACCError (Error (Not started)) 1: MaximumAcceleration (Maximum acceleration/deceleration)
OverrunOperation	Operation setting at overrun	Automatically adjusts the deceleration to stop at the target position. 1: ImmediateStop (Immediately stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration)
AxesGroupName.Pr.		
VelocityLimit	Speed limit value	Sets the speed limit value. For details, refer to the following. ☞ Page 337 Speed Limit
AccelerationLimit	Acceleration limit value	Sets the acceleration limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, 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. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When "1: 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. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^3 • When "0.0000" is set, it does not limit the acceleration.
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: ACCError (Error (Not started)) 1: MaximumAcceleration (Maximum acceleration/deceleration)
OverrunOperation	Operation setting at overrun	Automatically adjusts the deceleration to stop at the target position. 1: ImmediateStop (Immediately stop) 2: KeepCurrentAcc (Keep current acceleration/deceleration)
AxisName.Md.		

Variable/Structure name	Name	Details
CommandedAcceleration	Commanded acceleration	Stores the acceleration specified by users. Unit: U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, it stores the specified acceleration/deceleration time. Unit: s • During axes group operation, stores "0.0" in AxisName.Md.CommandedAcceleration of the configuration axis.
CommandedDeceleration	Commanded deceleration	Stores the deceleration specified by users. Unit: U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, it is an illegal value. • During axes group operation, stores "0.0" in 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, stores "0.0" in 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, stores "0.0" in AxisName.Md.TargetDeceleration of the configuration axis.
SetAcceleration	Set acceleration	• Stores the command output acceleration. It is the acceleration/deceleration speed calculated from the difference of set velocity.[*1] Unit: U/s^2 • It indicates accelerating or decelerating by a sign. 0.0: During stop or fixed-speed. "0.0" is stored when the target velocity is reached. Plus sign: During acceleration Minus sign: During deceleration • During axes group operation, 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, stores "0.0" in AxisName.Md.CommandedJerk of the configuration axis.
InVelocity	Target velocity reached	TRUE: Reached FALSE: Not reached • During axes group operation, stores FALSE in AxisName.Md.InVelocity of the configuration axis.
AutoDeceleration	Automatically decelerating	TRUE: During auto deceleration FALSE: Not during auto deceleration • "1" is stored while the auto deceleration processing is executed. • When the multple 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, stores FALSE in AxisName.Md.AutoDeceleration of the configuration axis.
AxesGroupName.Md.		
CommandedAcceleration	Commanded acceleration	Stores the acceleration specified by users. Unit: U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, it stores the acceleration/deceleration time.
CommandedDeceleration	Commanded deceleration	Stores the deceleration specified by users. Unit: U/s^2 • When "1: mcFixedTime" is set in the acceleration/deceleration method, 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

Variable/Structure name		Name	Details
	SetAcceleration	Set current acceleration	• Stores the command output acceleration. It is the acceleration/deceleration speed calculated from the difference of set velocity.*1 Unit: U/s^2 • It indicates accelerating or decelerating by a sign. 0.0: During stop or fixed-speed. "0.0" is stored when the target velocity is reached. Plus sign: During acceleration Minus sign: During deceleration
	CommandedJerk	Commanded jerk	Stores the jerk specified by users. Unit: U/s^3
	InVelocity	Target velocity reached	TRUE: Reached FALSE: Not reached
	AutoDeceleration	Automatically decelerating	TRUE: Automatically decelerating FALSE: Not automatically decelerating • "TRUE" is stored while the auto deceleration processing is executed. • When the multple 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.

*1 The Values to be stored include the error, because the floating point type error occurs.

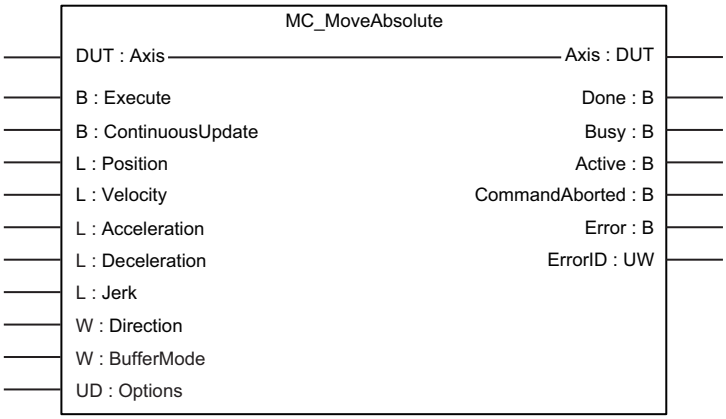
Settings of motion FB

The acceleration/deceleration method can be selected in the UD: Options input of the motion FB.

Set the function options by specifying the bit. The details of bit and the functions are shown below.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: mcAccDec (Acceleration/deceleration specification method) 1: mcFixedTime (Acceleration/deceleration time-fixed method) For details, refer to the following. ☞ Page 312 Acceleration/deceleration Processing Function
3 to 15	Empty
16 to 31	The function differs depending on the FB.

Whether a method can be selected or not differs depending on the FB. For details, refer to the speifications of each FB.



- Input variables to use

Variable/Structure name	Name	Details
Velocity	Velocity	Specifies the target velocity in the FB. Unit: For details, refer to the following. ☞ Page 74 Technical Units Range: For details, refer to the following. ☞ Page 83 Velocity set range
Acceleration	Acceleration and acceleration/ deceleration time	Specifies the acceleration and the acceleration/deceleration time in the FB. • When the acceleration/deceleration method is "0: mcAccDec" Unit: Specify with U/s^2 Range: 0.0000*1, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When the acceleration/deceleration method is "1: mcFixedTime" Unit: Specify with s Range: 0.000000*1, positive numbers from 0.000001 to 8400.0 s
Deceleration	Deceleration	Specifies the deceleration in the FB. • When the acceleration/deceleration method is "0: mcAccDec" Unit: Specify with U/s^2 Range: 0.0000*1, positive numbers from 0.0001 to 2147483647.0 U/s^2 • When the acceleration/deceleration method is "1: mcFixedTime" Not used.
Jerk	Jerk/Jerk ratio	Specifies the jerk in the FB. • When the acceleration/deceleration method is "0: mcAccDec" Unit: Specify with U/s^3 Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s^3 • When the acceleration/deceleration method is "1: mcFixedTime" Not used.
Options	Options	Specifies the option information in the FB.

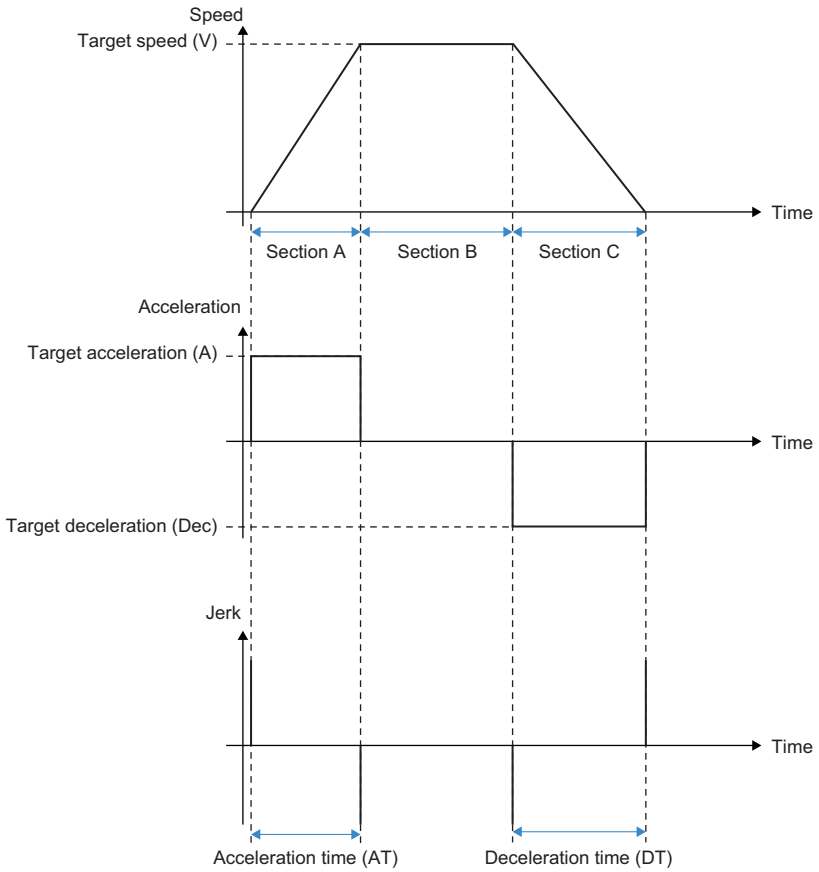
*1 Operation varies according to AxisName.Pr.AccelerationZeroBehavior at start. A change is not accepted during a acceleration change and a deceleration change.

Acceleration/deceleration method

Acceleration/deceleration specification method

When "0: mcAccDec" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, the acceleration, the deceleration, and the jerk can be set.

■Trapezoidal acceleration/deceleration



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section	Accelerates at the target acceleration.	○	×
B	Fixed speed section	Controls at the target velocity. (Acceleration = 0.0)	×	×
C	Deceleration section	Decelerates at the target deceleration.	×	○

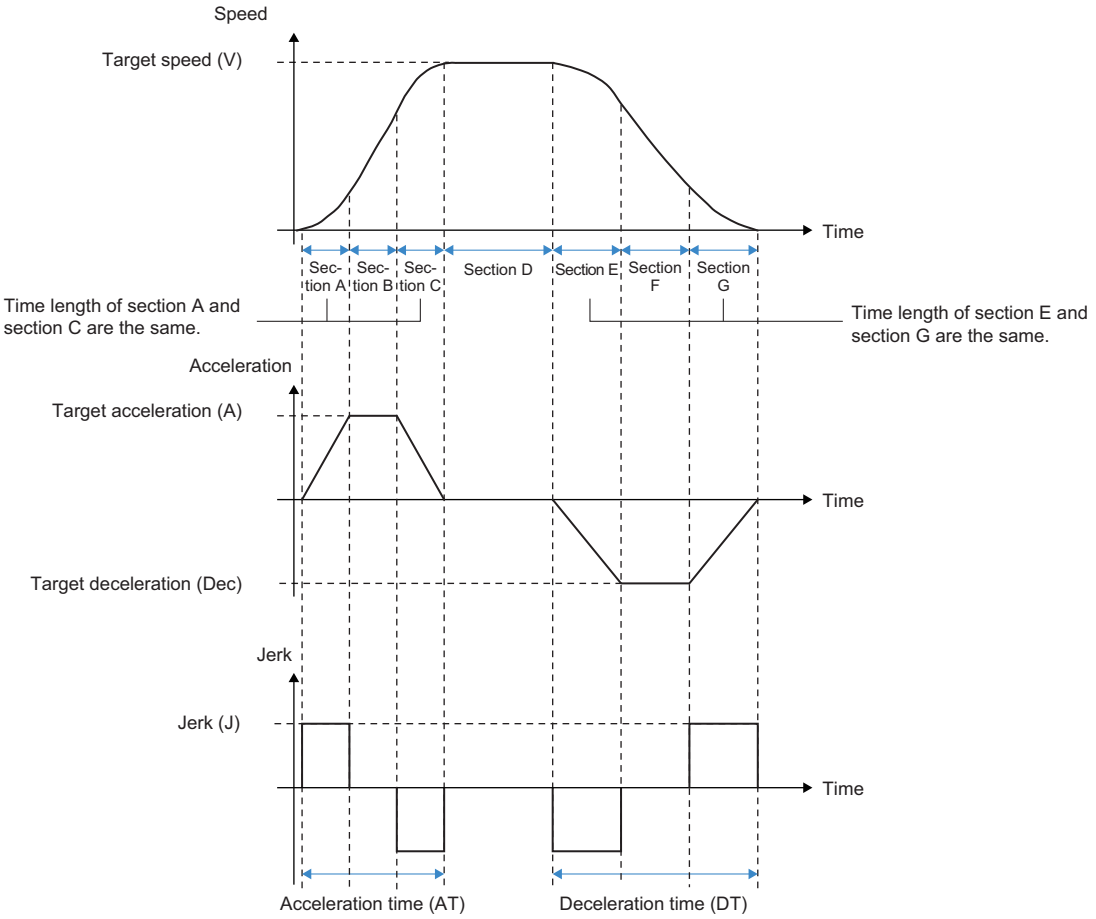
• Acceleration/deceleration time parameter calculation

○: 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	—	—	×	○
Calculated value	Acceleration section time	AT	Time from the speed 0.0 to the target velocity	V ÷ A*1	○	×
	Deceleration section time	DT	Time to decelerate from the target velocity to the speed 0.0	V ÷ Dec*1	×	○

*1 This is the calculation formula when unit of V is [U/s]. When other than [U/s], calculate by converting into [U/s].

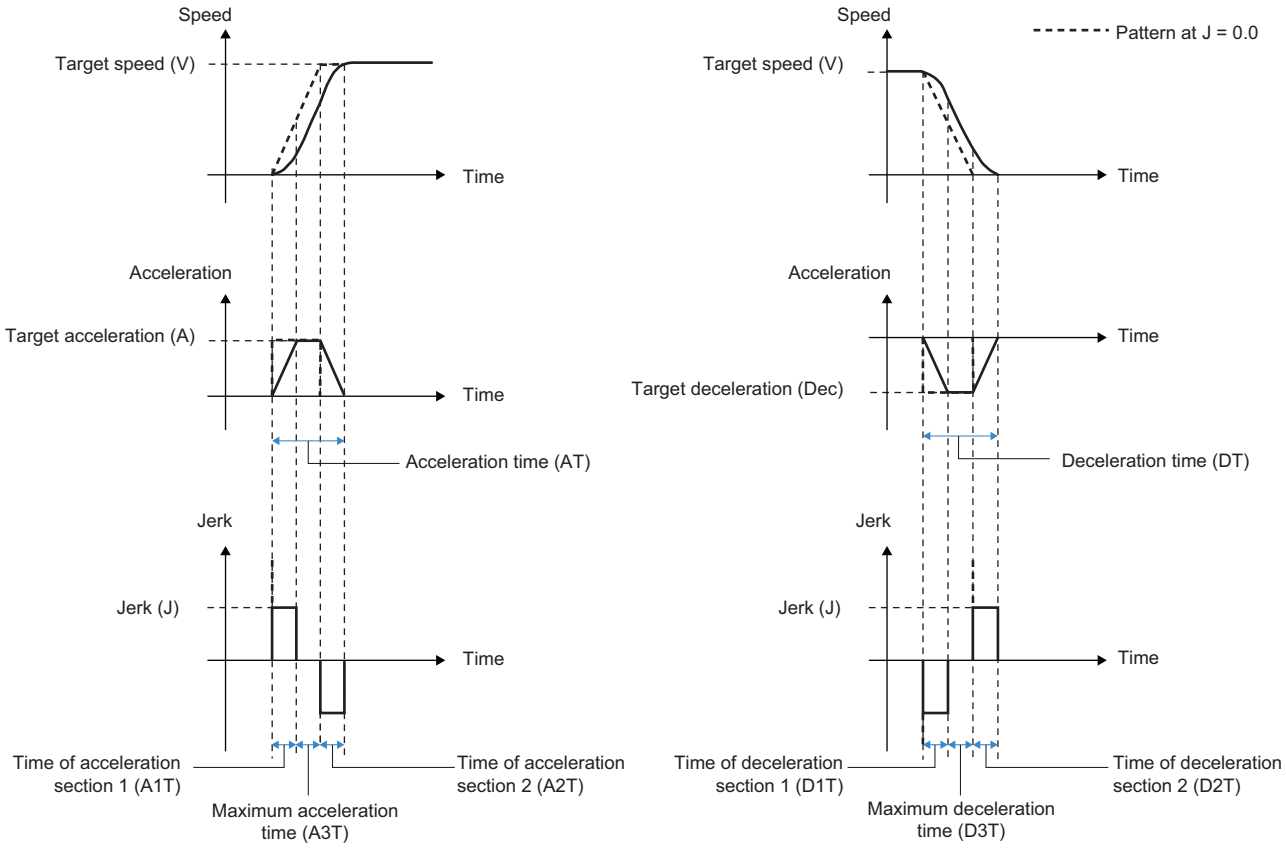
■Jerk acceleration/deceleration



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section 1	Accelerates by changing (increasing) the acceleration with the specified jerk from acceleration start to target acceleration.	○	×
B	Maximum acceleration section	Accelerates at the target acceleration.	○	×
C	Acceleration section 2	At the end of acceleration, accelerates by changing (decreasing) the acceleration by jerk specified from the target acceleration to acceleration 0.	○	×
D	Fixed speed section	Controls at the target velocity. (Acceleration = 0.0)	×	×
E	Deceleration section 1	Decelerates by changing (increasing) the deceleration with the specified jerk from deceleration start to the target deceleration.	×	○
F	Maximum deceleration section	Decelerates at the target deceleration.	×	○
G	Deceleration section 2	At the end of deceleration, decelerates by changing (decreasing) the deceleration by jerk specified from the target deceleration to deceleration 0.	×	○

• Acceleration/deceleration time parameter calculation



○: Operation possible, ×: Operation not possible

Section	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Target acceleration*3	A	—	—	○	×
	Target deceleration*3	Dec	—	—	×	○
	Jerk	J	—	—	○	○
Calculated 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)*2	○	×
	Acceleration time*1	AT	Time from speed 0.0 to the target velocity	A1T + A2T + A3T = (V ÷ A) + (A ÷ J) *2	○	×
	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)*2	×	○
	Deceleration time*1	DT	Time to decelerate from the target velocity to speed 0.0	D1T + D2T + D3T = (V ÷ Dec) + (Dec ÷ J)*2	×	○

*1 Acceleration time and deceleration time may be limited. For details, refer to the following.
☞ Page 329 Limit of acceleration time/deceleration time

*2 This is the calculation formula when unit of V is [/s]. When other than [U/s], calculate by converting into [U/s].

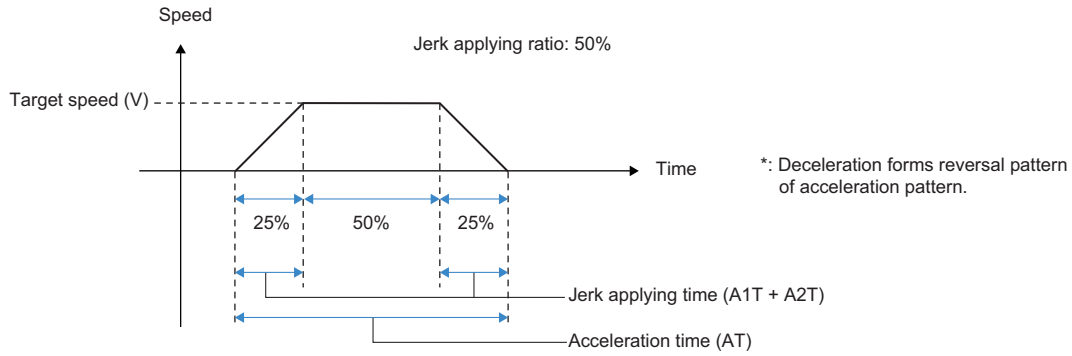
*3 Target acceleration/target deceleration may be adjusted by acceleration/deceleration waveform adjustment. For details, refer to the following.
☞ Page 325 Acceleration/deceleration waveform adjustment when specifying jerk

• Jerk calculation

When the speed and the acceleration of operation are fixed, the jerk can be calculated with the following formula by specifying the jerk applying ratio.

$$\text{Jerk (J)} = \frac{(2 - \text{Jerk applying ratio}) \times (\text{the square of acceleration (A)})}{\text{Jerk applying ratio} \times \text{Speed (V)}}$$

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.

A calculation example of jerk is shown below.

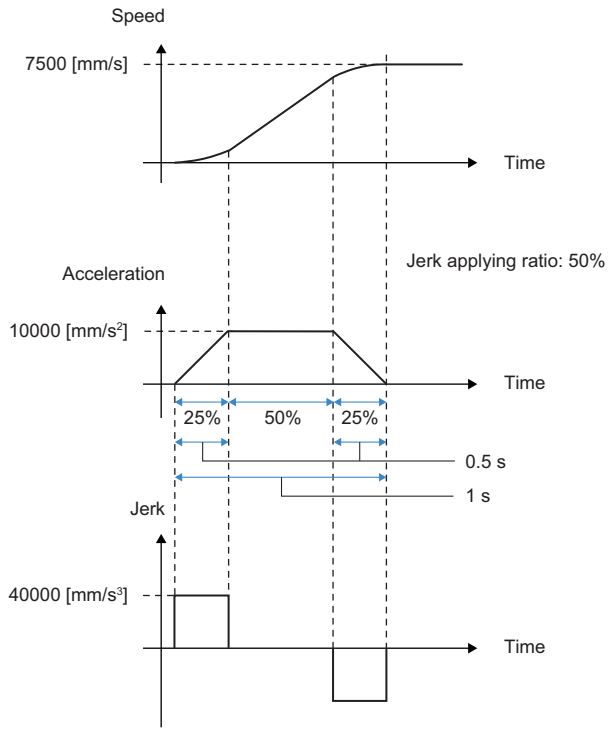
The jerk when the speed is 7500 mm/s, the acceleration is 10000 mm/s^2, and the jerk applying ratio is 0.5 (50%) can be calculated with the following formula.

$$\text{Jerk (J)} = \frac{(2 - 0.5) \times 10000^2}{0.5 \times 7500} = 40000\ [\text{mm/s}^3]$$

The acceleration time can be calculated when the speed, the acceleration, and the jerk are fixed. For details, refer to the following.

☞ Page 319 Jerk acceleration/deceleration

$$\text{Acceleration time (AT)} = \frac{\text{Speed (V)}}{\text{Acceleration time (AT)}} + \frac{\text{Acceleration time (AT)}}{\text{Jerk (J)}} = \frac{7500}{10000} + \frac{10000}{40000} = 1\ [\text{s}]$$



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 speed calculation is based on a given jerk, when the acceleration (deceleration) at FB execution and the target velocity 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 speed may be reached before the target acceleration is reached.

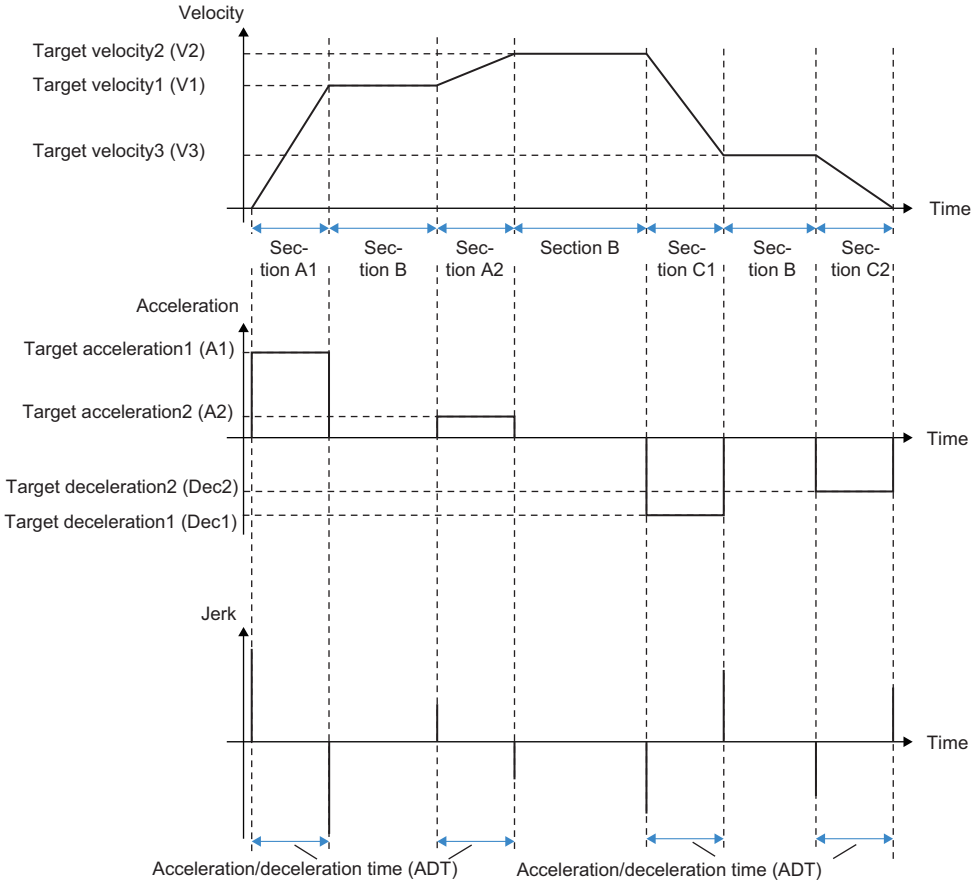
For details, refer to the following.

☞ Page 325 Acceleration/deceleration waveform adjustment when specifying jerk

Acceleration/deceleration time-fixed method

When "1: mcFixedTime" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, the acceleration/deceleration time can be set in Acceleration. Deceleration and jerk is 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 within one operation cycle.



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Acceleration	Deceleration
A	Acceleration section	Accelerates the acceleration time from the set velocity to the target velocity to be the acceleration/deceleration time.	○	×
B	Fixed speed section	Controls at the target velocity. (Acceleration = 0.0)	×	×
C	Deceleration section	Decelerates the deceleration time from the set velocity to the target velocity to be the acceleration/deceleration time.	×	○

• Acceleration/deceleration time parameter calculation

○: Operation possible, ×: Operation impossible

Section	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Acceleration/deceleration time	ADT	—	—	○	○
Calculated value	Current velocity	Vnow	The set velocity at target acceleration and target deceleration calculation	—	○	○
	Target acceleration*1	A	Acceleration from the currentvelocity to the target velocity*2	(V - Vnow)÷ ADT*3	○	×
	Target deceleration*1	Dec	Deceleration to decelerate from the current velocity to the target velocity*2	(V - Vnow)÷ ADT*3	×	○

*1 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.

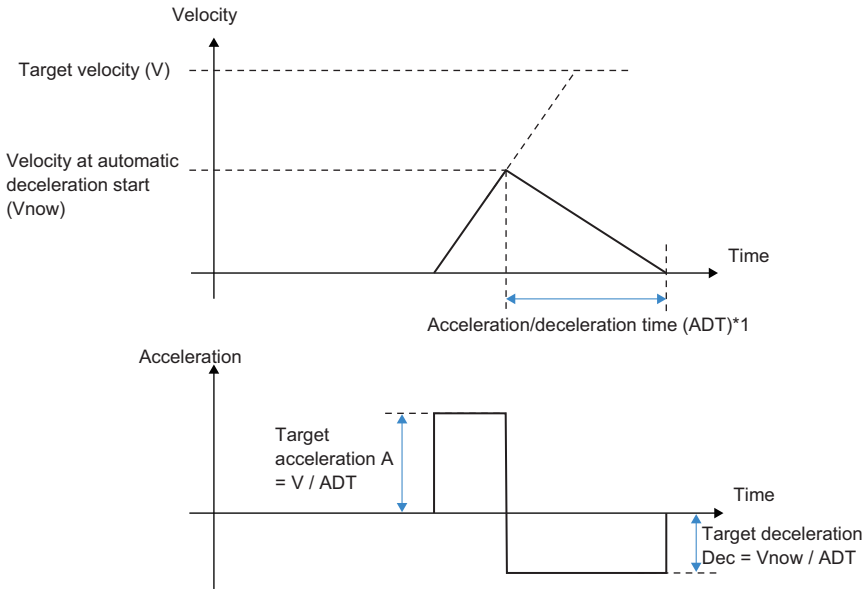
☞ Page 328 Acceleration limit value/deceleration limit value

*2 The target velocity will be 0 at stop.

*3 This is the calculation formula when unit of V is [/s]. When other than [U/s], calculate by converting into [U/s].

When the movement amount which cannot be accelerated up to the target velocity is specified at positioning operation, deceleration stop starts to the target position during acceleration by automatic deceleration. 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.



*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.

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.

For acceleration: $V \geq \frac{A^2}{J}$, For deceleration: $V \geq \frac{Dec^2}{J}$

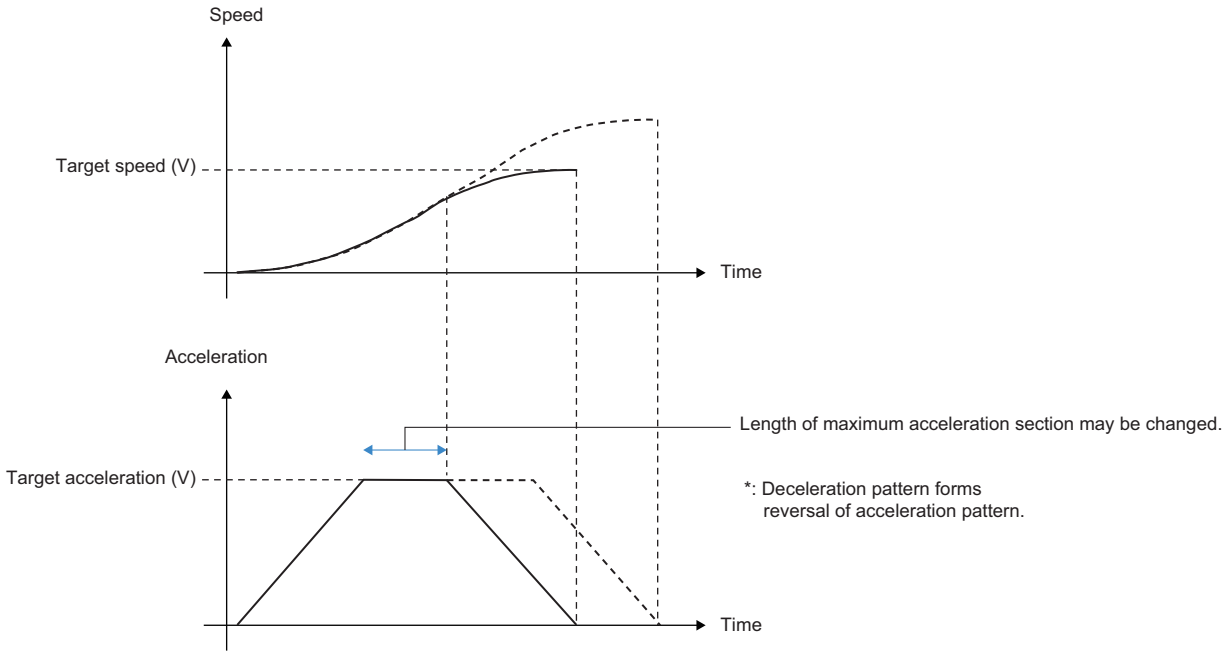
When the condition is satisfied

The target acceleration (deceleration) can be reached.

The maximum acceleration section time and the maximum deceleration section time are adjusted by the speed, 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 318 Acceleration/deceleration method

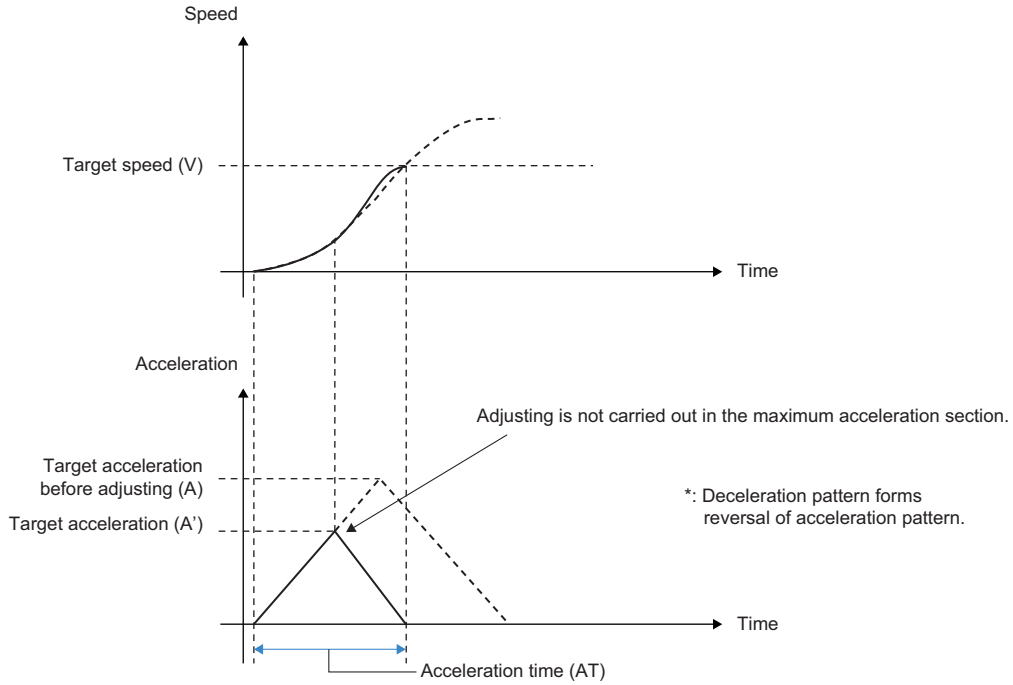


When the condition is not satisfied

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: mcFixedTime" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, the operation is the operation 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

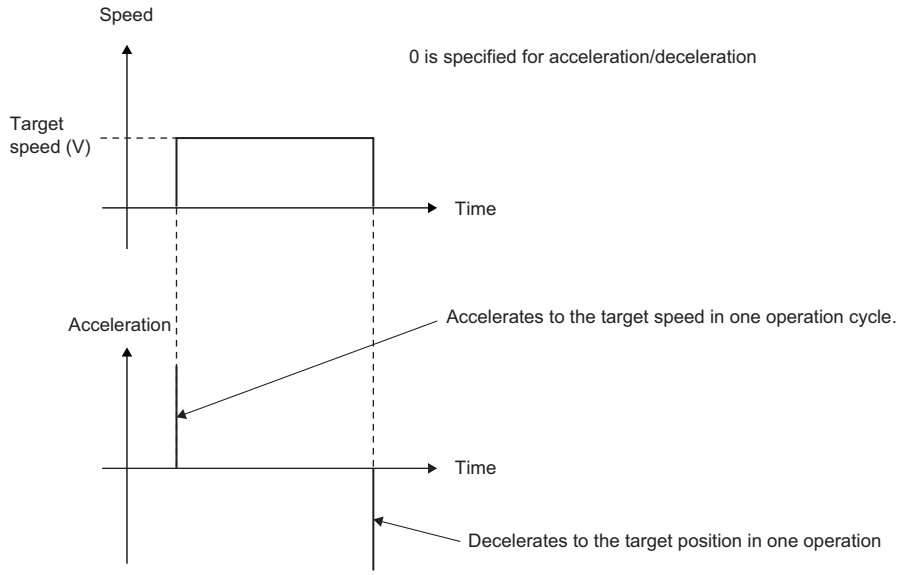
Select the operation when "0.0" is specified for the acceleration and the deceleration in AxisName.Pr.AccelerationZeroBehavior.

■When selecting "-1: ACCError"

The error "Acceleration/Deceleration 0 Specified Operation Error at Start" (error code: 1A0CH) occurs, and the axis does not start.

■When selecting "1: 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/deceleratio is performed in one operation cycle. In these case, acceleration/deceleration is performed exceeding the acceleration limit value and deceleration limit value.



Precautions

Pay full attention when setting "1: MaximumAcceleration", because operation is rapid motion.

Specifying 0.0 other than at start

■At the acceleration change/At the deceleration change

When "0.0" is specified at the acceleration change or the deceleration change, the change will not be accepted, and the operation is continued at the target acceleration or the target deceleration before change.

■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/MC_GroupStop 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: mcAccDec" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, the acceleration and the deceleration are limited by the acceleration limit value and the deceleration limit value.
When "1: mcFixedTime" is selected in Options of the FB, these are not limited. When "0.0" is specified for the acceleration limit value and the deceleration limit value, these are not limited as well.
The acceleration and the deceleration are limited at start, acceleration change, and deceleration change.
Applicable range of the acceleration limit value/deceleration limit value for single axis control and multiple axes control is set same as the velocity limit. For details, refer to the following.
☞ Page 337 Speed Limit

Operation

■At start

If the speed exceeds the acceleration limit value or the deceleration limit value, the error "Acceleration Limit Value Over" (error code: 1A38H) or the "Deceleration Limit Value Over" (error code: 1A39H) will occur, and the axis will not start.

■At acceleration change/At deceleration change

If the speed exceeds the acceleration limit value or the deceleration limit value by changing the acceleration or the deceleration, the warning "Acceleration Limit Value Over Warning" (warning code: 0D06H) or the warning "Deceleration Limit Value Over Warning" (warning code: 0D07H) 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 the deceleration of the multiple started FB has exceeded the acceleration limit value or the deceleration limit value, the error "Acceleration Limit Value Over" (error code: 1A38H) or the error "Deceleration Limit Value Over" (error code: 1A39H) will occur, and the instruction in execution will be interrupted and stopped. For details, refer to the following.
☞ Page 144 Precautions

Jerk limit value

Jerk is limited by a value specified in JerkLimit. When "0.0" is specified for the jerk limit value, the jerk is not limited.
Applicable range and operation of the jerk limit value for single axis control and multiple axes control are set same as the velocity limit. For details, refer to the following.
☞ Page 337 Speed Limit

Operation

■At start

If the specified jerk at start exceed the jerk limit value, the error "Jerk Limit Value Over" (error code: 1A3AH) 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, the error "Jerk Limit Value Over" (error code: 1A3AH) will occur, and the instruction in execution will be interrupted and the axis will stop. For details, refer to the following.
☞ Page 144 Precautions

Limit of acceleration time/deceleration time

The acceleration time and the deceleration time are limited by 8400 [s].
When "0: mcAccDec" is selected in the "acceleration/deceleration method setting" (Options bit 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 318 Acceleration/deceleration specification method

Operation

■At start

If the acceleration time or the deceleration time exceeds 8400 [s], the error "Acceleration Time Over at Start" (error code: 1A0FH) or the error "Deceleration Time Over at Start" (error code: 1A10H) will occur, and the axis will not startup.

■At control change

Limit of the acceleration time or the deceleration time may be exceeded when a velocity change, an acceleration change, or a deceleration change is carried out. In this case, the warning "Acceleration Time Limit Over Warning" (warning code: 0D04H) or the warning "Deceleration Time Limit Over Warning" (warning code: 0D05H) occurs, and the control change is not accepted. The acceleration/deceleration operation before change is continued. When a control change is carried out during acceleration or deceleration, time from the issuance of the control change instruction to the end of acceleration or deceleration is limited.

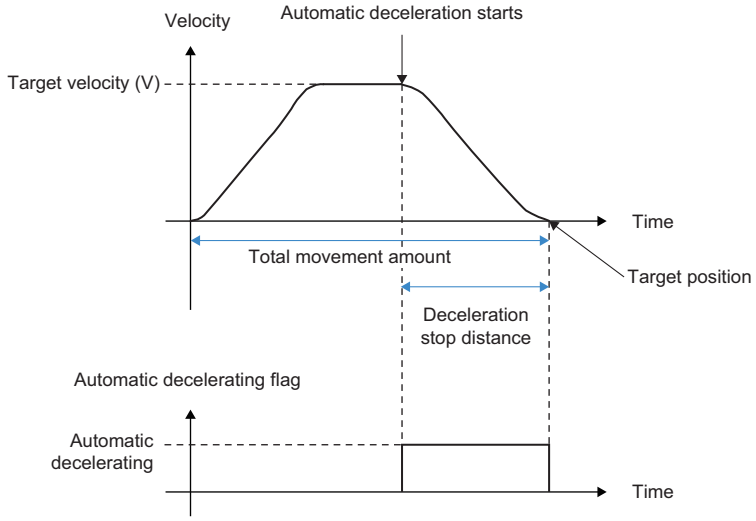
■When the acceleration time/deceleration time is within one operation cycle

When the acceleration time or the deceleration time is less than one operation cycle due to the specified velocity, acceleration, deceleration, and jerk, the speed reaches the target velocity within one operation cycle regardless of the jerk.

Automatic deceleration

Decelerating to a speed of "0.0" to stop at the specified target position is called automatic deceleration.
During automatic deceleration, AxisName.Md.AutoDeceleration is TRUE.
When automatic deceleration is performed, the deceleration may go ahead or behind the target deceleration. Therefore, AxisName.Md.SetAcceleration may exceed AxisName.Md.TargetDeceleration.
Besides, the current speed may be continued due to the compensation of the remaining distance during automatic deceleration of the trapezoidal acceleration/deceleration and at acceleration/deceleration time-fixed method. In this case, SetAcceleration will be 0.

Term	Description
Deceleration stop distance	Distance required to a deceleration stop to 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

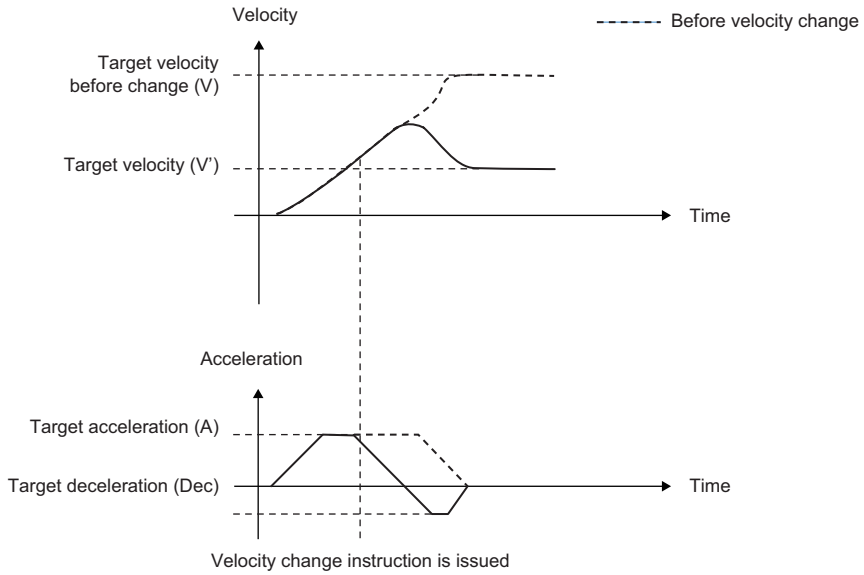


Automatic deceleration starts when the following condition is satisfied.
Deceleration stop distance > Total movement amount - Cumulative movement amount - Next Δ movement amount

- 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.



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.

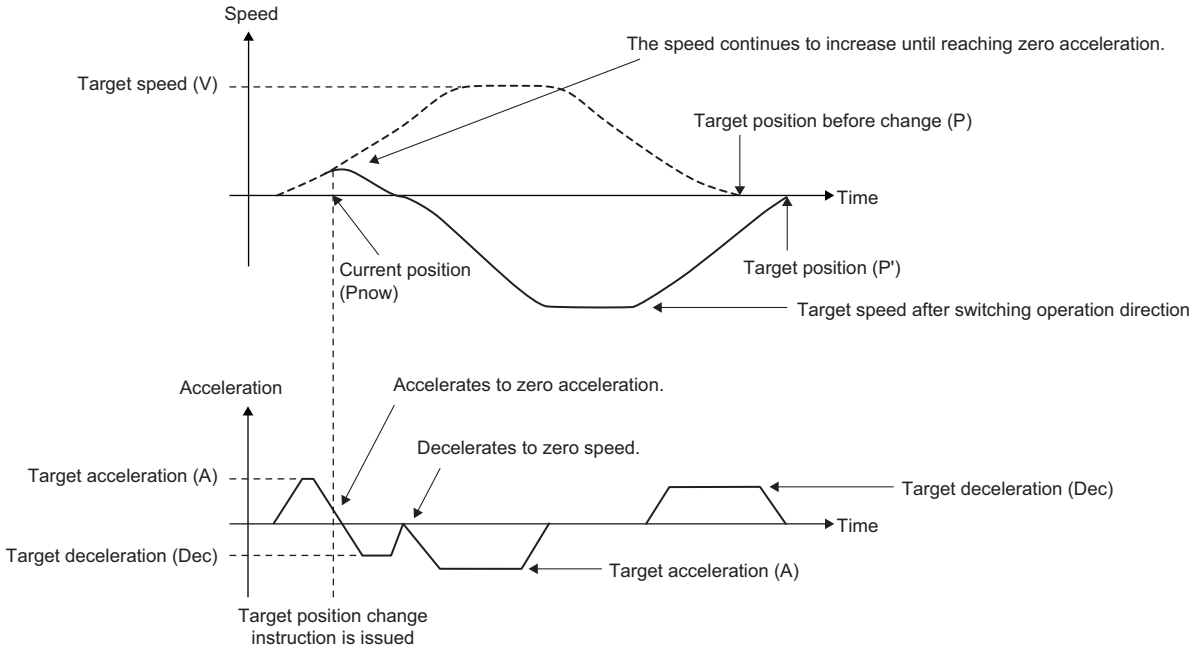
☞ Page 393 Target position/movement distance change

Term	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 speed 0. When the speed 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 396 Set velocity change

Term	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, in order to smooth acceleration at velocity change, velocity change is carried out 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.

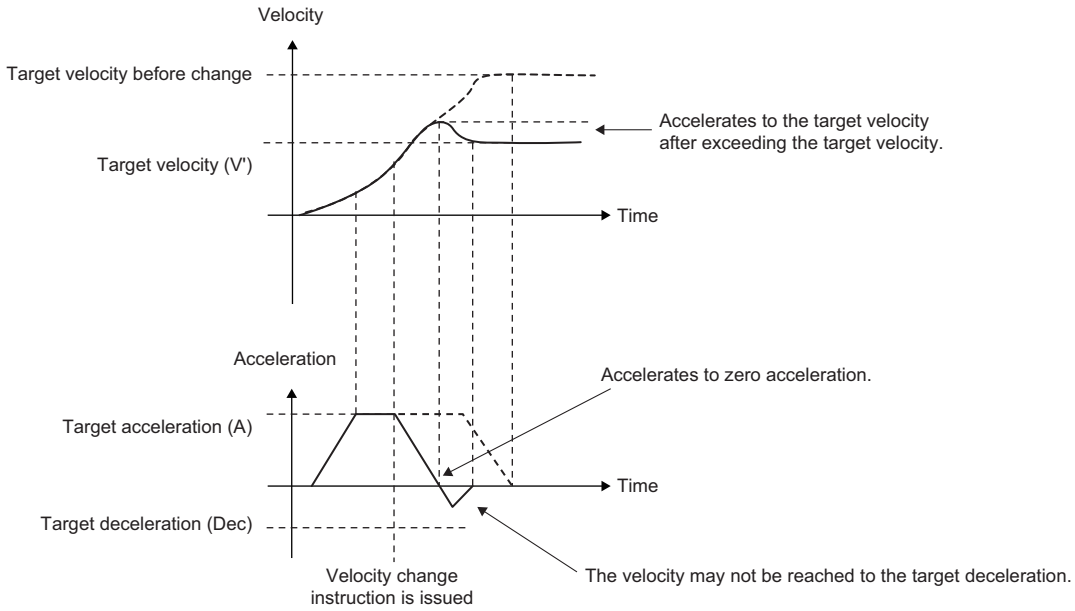
☞ Page 325 Acceleration/deceleration waveform adjustment when specifying jerk

■When exceeding the target acceleration

If speed 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 overrides 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 and acceleration/deceleration time change

When "0: mcAccDec" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, acceleration change is performed.

When selecting "1: mcFixedTime", acceleration/deceleration time change is performed. The operation when acceleration/deceleration time change is performed is the same as acceleration change to the acceleration calculated from the acceleration/deceleration time.

Term	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 the target velocity is not reached

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 325 Acceleration/deceleration waveform adjustment when specifying jerk

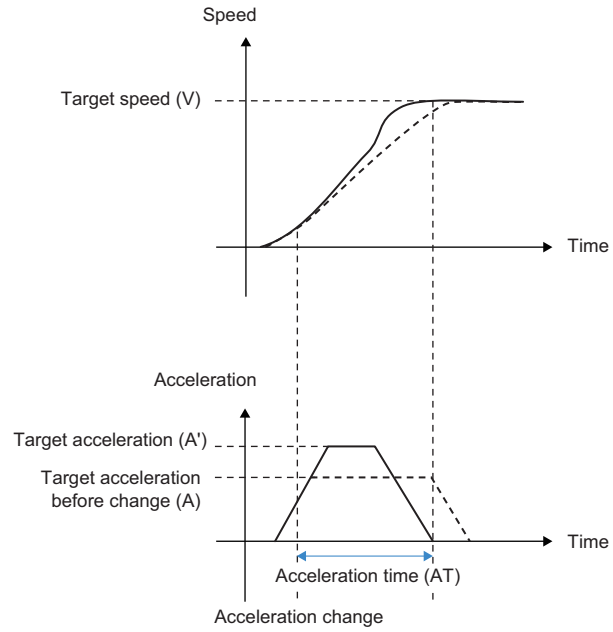
Also, when velocity change and acceleration change are simultaneously performed, the target acceleration may not be reached because the target velocity is given priority.

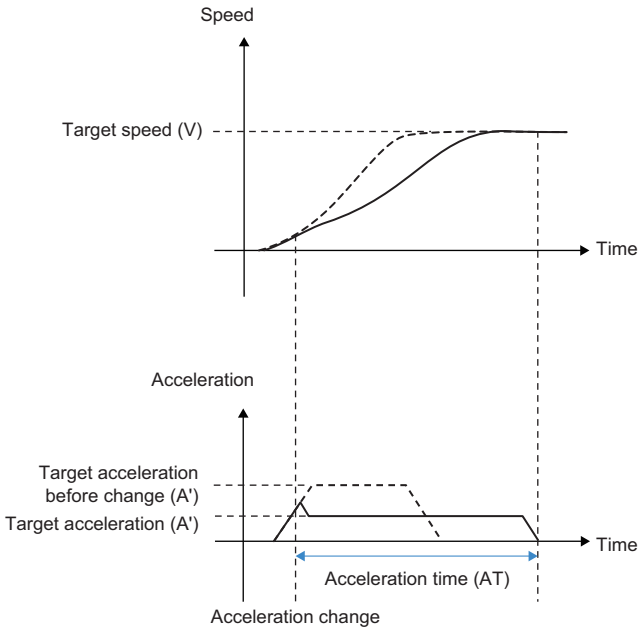
■Acceleration change

The acceleration change pattern can be classified based on the operation status when acceleration change is performed.

[When executing acceleration change in the acceleration section 1.]

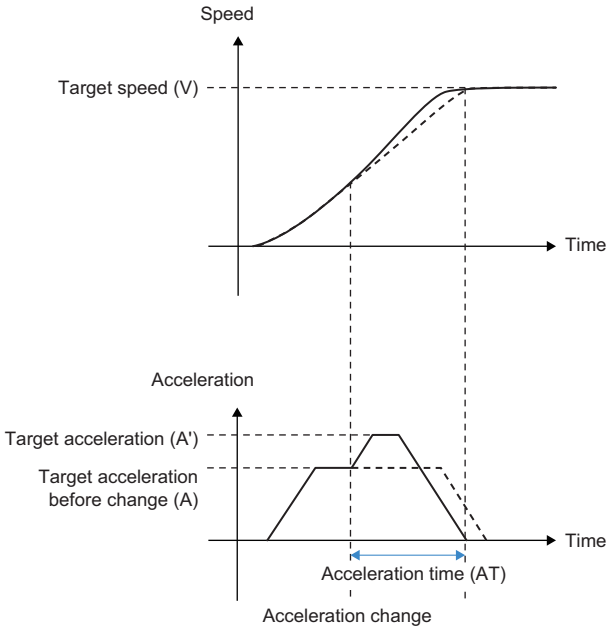
Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the speed and the acceleration immediately before the acceleration change.

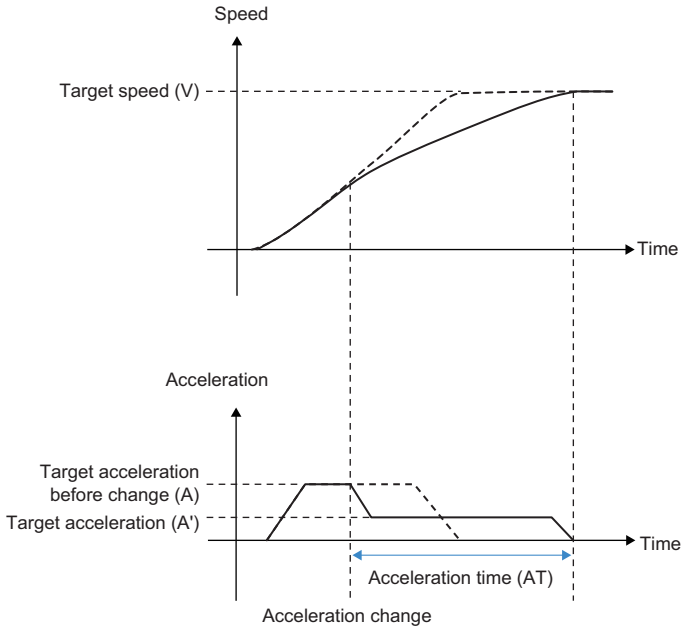




[When executing acceleration change in the maximum acceleration section]

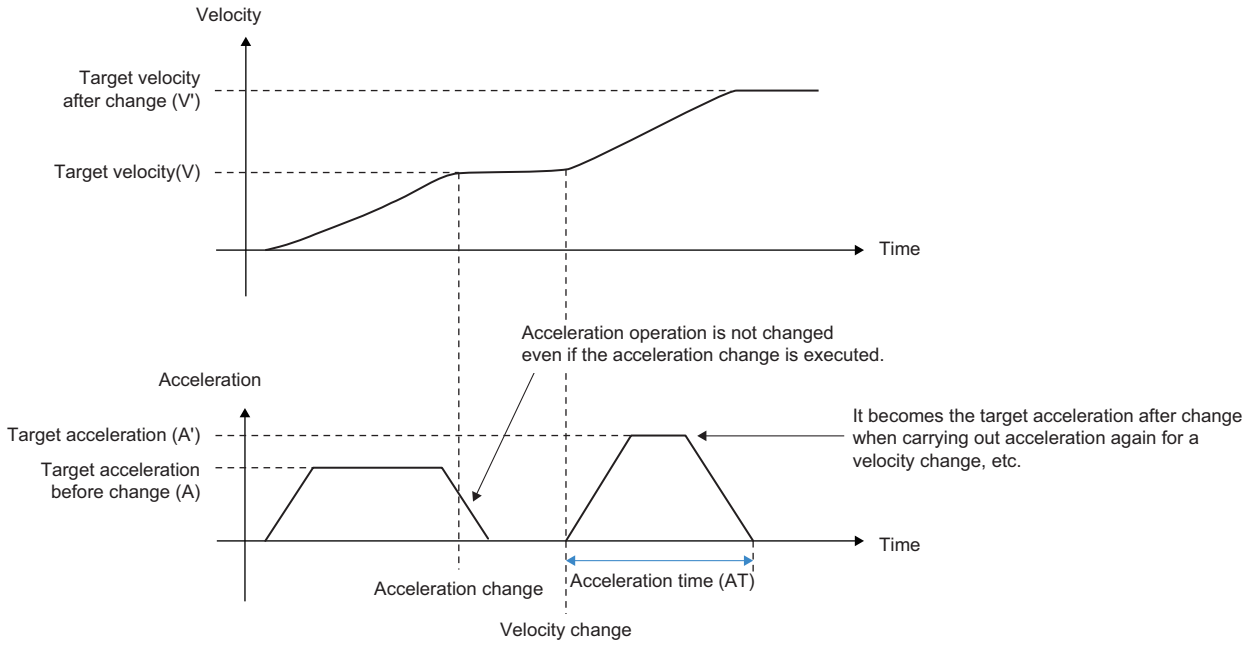
Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the speed and the acceleration immediately before the acceleration change.





[When executing acceleration change in the acceleration section 2 or during fixed-speed, deceleration, and automatic deceleration]

When acceleration change is executed in the acceleration section 2, the acceleration change is accepted, however acceleration operation during execution does not change. When re-acceleration is performed by velocity change etc, the axis accelerates with the acceleration after change.



Deceleration change

When "0: mcAccDec" is selected in the "acceleration/deceleration method setting" (Options bit 0 to 2) of the FB, deceleration change can be performed.

The following terms are used in deceleration change.

Term	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 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 and the acceleration/deceleration time change. Refer to the following.

☞ Page 333 Acceleration change and acceleration/deceleration time 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 the axis re-accelerates by target velocity change, the axis decelerates with the deceleration after change.

Multiple start of the jerk acceleration/deceleration

This section describes the acceleration/deceleration operation specific to the jerk acceleration/deceleration. For the basic operation of the buffer mode, refer to the following.

☞ Page 125 Multiple Start (Buffer Mode)

Term	Description
Switching point	The point where FBs are switched
On-going FB	FB that is in execution 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

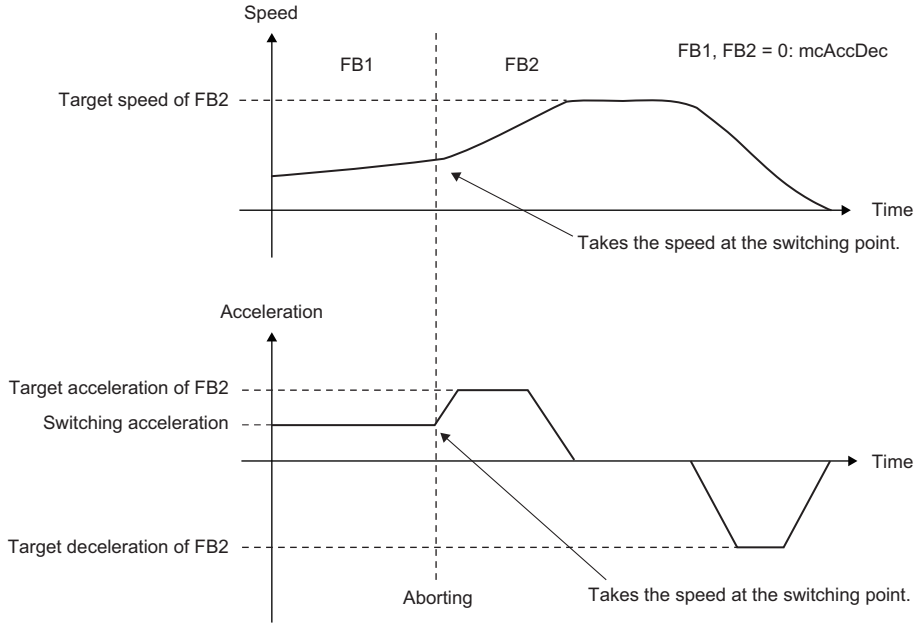
■When the acceleration/deceleration methods are different between the on-going FB and the next FB

The error "Acceleration/Deceleration Method Mismatched" (error code: 1A0EH) occurs and the axis stops. Specify the same acceleration/deceleration method in the FBs.

■When the acceleration/deceleration methods are the same between the on-going FB and the next FB

• When the on-going FB is jerk acceleration/deceleration and when the next FB is jerk acceleration/deceleration

The axis accelerates/decelerates taking over the speed and the acceleration (deceleration) at the switching point.



• When the on-going FB is trapezoidal acceleration/deceleration and when the next FB is jerk acceleration/deceleration

The axis accelerates/decelerates not taking over the speed and the acceleration (deceleration) at the switching point. The jerk acceleration/deceleration is executed by the acceleration (deceleration) 0.

After reaching the switching point during acceleration (deceleration), the speed waveform in execution is continued when all of the target velocity, the acceleration, the deceleration, and the jerk are the same between the on-going FB and the next FB. If there is a different setting for any one, velocity change is made for the target speed of the next FB.

9.2 Speed Limit

The "speed limit function" limits the set velocity to a value within the speed limit value setting range when the set velocity during control exceeds the speed limit value. By limiting the set velocity within the preset speed limit value setting range, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.

Relevant variables

Variable/Structure name		Name	Details
AxisName.Pr.			
	VelocityLimit_Positive	Positive direction speed limit value	Sets the address increasing direction speed limit value for each axis.
	VelocityLimit_Negative	Negative direction speed limit value	Sets the address decreasing direction speed limit value for each axis.
	VelocityLimit_OverOperation	Speed limit value over operation setting	Sets the operation when the speed limit value during control is exceeded. 0: Ignore (Ignore) 3: ImmediateStop (Immediate stop)
AxesGroupName.Pr.			
	VelocityLimit	Speed limit value	Sets the speed limit value of the axes group.

How to set the speed limit function

Speed limit value for each axis

Set the parameters, AxisName.Pr.VelocityLimit_Positive and AxisName.Pr.VelocityLimit_Negative, for each axis. If a value which is outside the setting range is input, the error "Out of Positive Direction Speed Limit Value Setting Range" (error code: 1A08H) or the error "Out of Reverse Direction Speed Limit Value Setting Range" (error code: 1A09H) will occur.

Setting item	Setting range	Setting details
VelocityLimit_Positive	0.0001 ≤ Setting value ≤ 2500000000.0	Sets the speed limit value (the maximum speed during control) for the positive direction operation.
VelocityLimit_Negative		Sets the speed limit value (the maximum speed during control) for the negative direction operation.

Speed limit value for each axes group

Set the parameter, AxesGroupName.Pr.VelocityLimit, for each axes group.

Setting item	Setting range	Setting details
VelocityLimit	0.0001 ≤ Setting value ≤ 2500000000.0	Sets the speed limit value (the maximum speed during control) of the axes group.

Point

When the speed after override becomes the value within 0 to the speed limit lower value (0.0001), the speed will be 0.

Operation when the speed limit value is exceeded

The operation when specifying the speed exceeding the speed limit value differs depending on single axis control, single axis synchronous control and interpolation control.

For single axis operation

Executes the speed limit to the actual target velocity which the override, etc. are considered for the commanded velocity.

• At start

If the target velocity at start exceeds the speed limit value (AxisName.Pr.VelocityLimit_Positive for the positive direction and AxisName.Pr.VelocityLimit_Negative for the negative direction) of each axis, the error "Speed Limit Value Over" (error code: 1A07H) will occur, and the axis will not start.

• During control

The speed limit is not executed.

• During control (At speed change)

If the speed exceeding the speed limit value of each axis is specified by the override function and input label change in execution, the warning "Speed Limit Value Over Warning" (warning code: 0D03H) will occur, and the operation continues at the speed before change.

For details of the override function and input label change in execution, refer to the following.

☞ Page 340 Override Function, ☞ Page 392 Input Variable Change in Execution

For single axis synchronous control

Executes the speed limit to the set velocity of the slave axis.

• At start

The speed limit is not executed.

• During control

If the set velocity exceeds the speed limit value (AxisName.Pr.VelocityLimit_Positive for the positive direction and AxisName.Pr.VelocityLimit_Negative for the negative direction) of each axis, follow AxisName.Pr.VelocityLimit_OverOperation.

If the absolute value of the set velocity exceeds the maximum speed, the error "Speed Range Over during Controlling" (error code: 1AE8H) will occur and stop the operation.

For interpolation control

For the speed limit at the interpolation control, AxisName.Pr.VelocityLimit_Positive, AxisName.Pr.VelocityLimit_Negative, AxesGroupName.Pr.VelocityLimit are used.

The operation when the target velocity exceeds the speed limit value is as follows.

• At start

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector speed specification	Long axis speed specification	Reference axis speed specification	
AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative[*1]	Speed is not restricted.	Long axis speed is restricted by speed limit value of long axis.[*2]	Reference axis speed is restricted by speed limit value of reference axis.[*2]	Speed is not restricted.
AxesGroupName.Pr.VelocityLimit	Speed is restricted for vector speed.[*2]	Speed is not restricted.	Speed is not restricted.	Speed is restricted for vector speed.[*2]

• During control

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector speed specification	Long axis speed specification	Reference axis speed specification	
AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative*1	Speed is restricted for set velocity of each configuration axis. When the speed limit value is exceeded, it follows AxisName.Pr.VelocityLimit_OverOperation.			
AxesGroupName.Pr.VelocityLimit	Speed is not restricted.			

• During control (At speed change)

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector speed specification	Long axis speed specification	Reference axis speed specification	
AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative*1	Speed is not restricted.	Long axis speed is restricted by speed limit value of long axis.*3	Reference axis speed is restricted by speed limit value of reference axis. *3	Speed is not restricted.
AxesGroupName.Pr.VelocityLimit	*3	Speed is not restricted.	Speed is not restricted.	*3

*1 About either AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative is restricted according to the movement direction at the limit value check.
*2 When the speed limit value is exceeded, it will not start. The error "Speed Limit Value Over" (error code: 1A07H) is output.
*3 When the speed limit value is exceeded, the speed change will not accepted. The warning "Speed Limit Value Over Warning" (warning code: 0D03H) warning is output.

Operation setting when the speed limit value is exceeded

The operation when the speed of any axis exceeds the speed limit value during control can be specified in AxisName.Pr.VelocityLimit_OverOperation.

The following two types can be selected for the operation when the speed exceeds the speed limit value.

• 0: Ignore (Ignore)
• 3: ImmediateStop (Immediate stop)

When the multiple axes exceed the limit value, the priority is "3: ImmediateStop" > "0: Ignore".

Control continuation

When "0: Ignore" is specified in AxisName.Pr.VelocityLimit_OverOperation, the warning "Speed Limit Value Over Warning" (warning code: 0D03) occurs at the time of detecting the set velocity exceeding the speed limit value, and the command exceeding the speed limit value is output as it is.

Control stop

When "3: ImmediateStop" is specified in AxisName.Pr.VelocityLimit_OverOperation, the error "Speed Limit Value Over during Controlling" (error code: 1A36H) occurs at the time of detecting the set velocity exceeding the speed limit value, and the positioning control in execution stops.

9.3 Override Function

- 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. (Ex. 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.
- To change the override factor, there are a method of using the dedicated FB and a method of using control data.

Change method	Description
Change using a dedicated FB	MC_SetOverride, MC_GroupSetOverride
Change using control data	AxisName.Cd.VelocityOverride, AxesGroupName.Cd.VelocityOverride, etc.

- The override factor can be set in the axis control data and the axes group control data respectively. 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

Targets to be changed and corresponding FBs, control data

Targets to be changed			Corresponding FB	Corresponding control data
Velocity	Current value		MC_MoveVelocity MC_SetOverride MC_GroupSetOverride	AxisName.Cd.VelocityOverride, AxesGroupName.Cd.VelocityOverride
	Limit value		—*1	—*1
	Limit value	Maximum value of the limit value	—*2	—*2

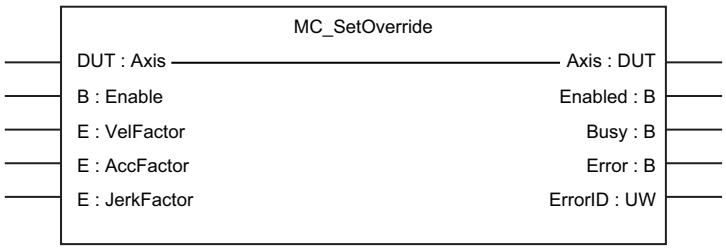
*1 Axis parameters can be changed by MC_WriteParameter. However, it cannot be changed during control.
*2 The maximum value of the limit value cannot be changed.

Relevant variables/FBs

Variable/Structure name		Name	Details
AxisName.Cd. AxesGroupName.Cd.			
	VelocityOverride	Velocity override factor	Sets the velocity override factor.
	AccelerationOverride	Acceleration override factor	Sets the acceleration override factor.
AxisName.Md. AxesGroupName.Md.			
	VelocityOverride	Velocity override factor	Sets the velocity override factor.
	AccelerationOverride	Acceleration override factor	Sets the acceleration override factor.

The override factor can be changed by using MC_SetOverride and MC_GroupSetOverride.

MC_SetOverride

Item	Description
Function overview	Changes the target velocity and the acceleration/deceleration of the specified axis.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
40	6	Subroutine type	Real-time execution

■Function description

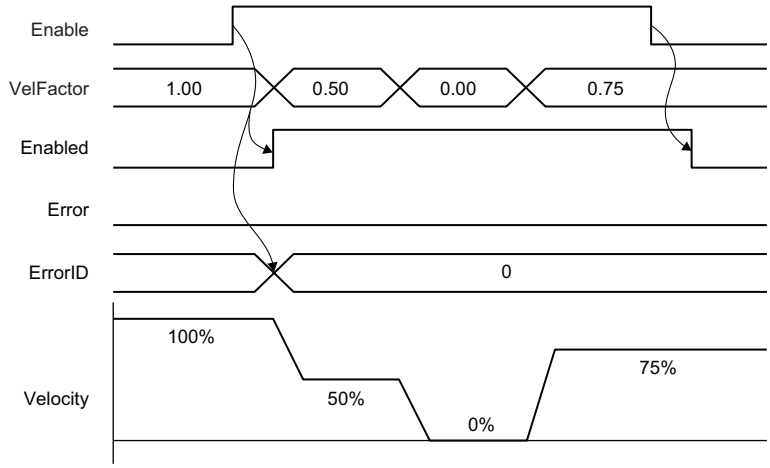
- This FB changes the target velocity and the acceleration/deceleration of the specified axis.
- The target velocity and the acceleration/deceleration are changed to the value obtained by the multiplication of the velocity in operation by the override factor.
- The FB is executed when Enable is TRUE. Enabled turns TRUE while the override factor is valid.
- If the override factor value is changed while Enable is TRUE, the new override factor is reflected.
- When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID. For details of error codes, refer to the following.
  ☞ Page 606 List of Error Codes
- When 0.00 is set to the velocity override factor, the axis stops without changing the axis status to "4: Standstill".
- When 0.00 is set to the acceleration override factor, the acceleration override factor is not changed, and the previous acceleration override factor is maintained.

Precautions

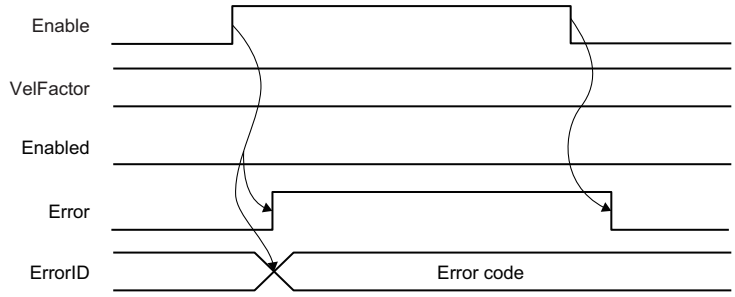
This FB changes AxisName.Cd.VelocityOverride and AxisName.Cd.AccelerationOverride.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

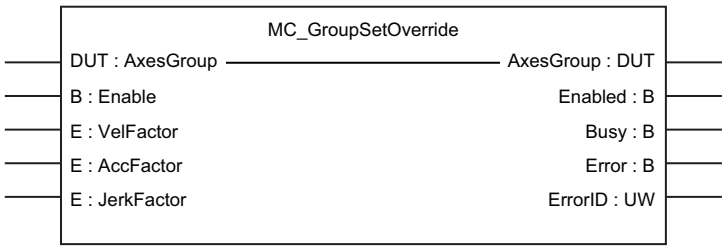
Import ⎍: Always

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Velocity override factor	VelFactor	LREAL	⎍	0.00 to 10.00	0	While Enable is TRUE, values are always imported. Sets the velocity override factor.
Acceleration/ deceleration override factor	AccFactor	LREAL	⎍	0, 0.01 to 10.00	0	While Enable is TRUE, values are always imported. Sets the acceleration/deceleration override factor. When "0" is set, the acceleration/deceleration override factor is not changed, and the control is performed with the previous value.
Jerk override factor (Reserved)	JerkFactor	LREAL	⎍	0	0	Set "0". (A value other than "0" causes an error.)

■Output variables

Name	Variable name	Data type	Default value	Description
Enabled	Enabled	BOOL	FALSE	Turns TRUE when the set override value is correct.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

MC_GroupSetOverride

Item	Description
Function overview	Changes the target velocity and the acceleration/deceleration of the specified axes group.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
40	6	Subroutine type	Real-time execution

■Function description

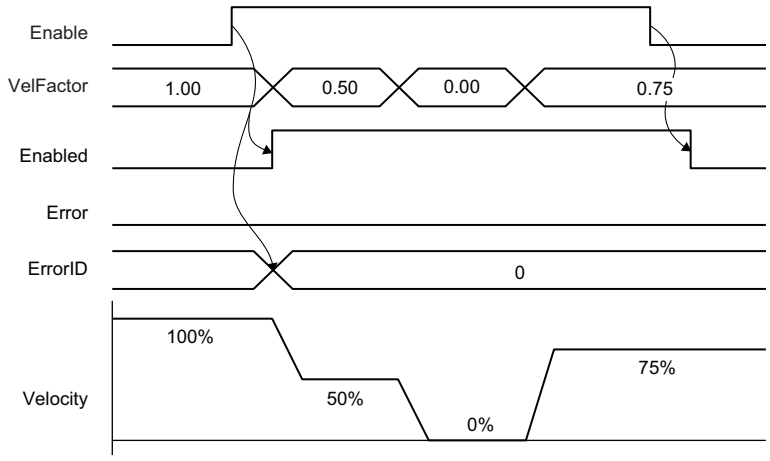
- This FB changes the target velocity and the acceleration/deceleration of the specified axes group.
- The target velocity and the acceleration/deceleration are changed to the value obtained by the multiplication of the velocity in operation by the override factor.
- The FB is executed when Enable is TRUE. Enabled turns TRUE while the override factor is valid.
- If the override factor value is changed while Enable is TRUE, the new override factor is reflected.
- When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID. For details of error codes, refer to the following.
  ☞ Page 606 List of Error Codes
- When 0.00 is set to the velocity override factor, the axis stops without changing the axis status to "4: Standstill".
- When 0.00 is set to the acceleration override factor, the acceleration override factor is not changed, and the previous acceleration override factor is maintained.

Precautions

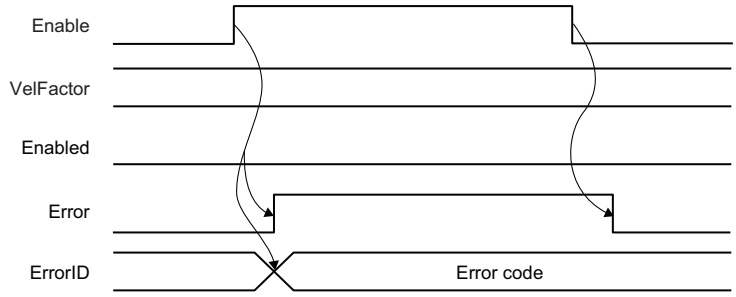
This FB changes AxesGroupName.Cd.VelocityOverride and AxesGroupName.Cd.AccelerationOverride.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import ⎍: Always

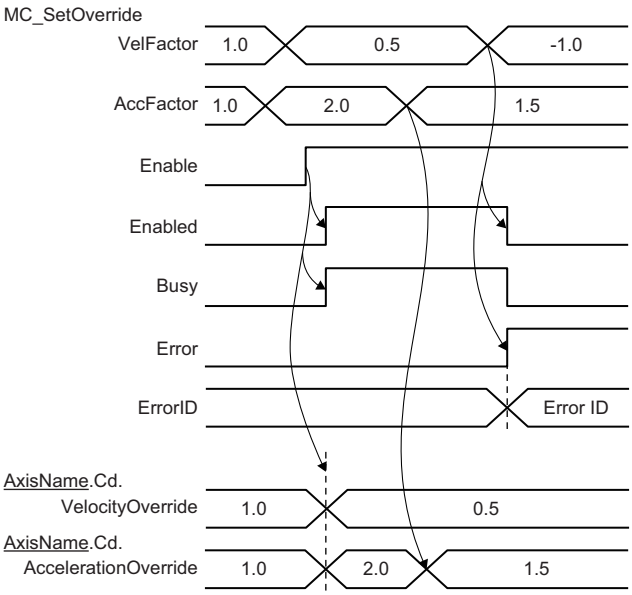
Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Velocity override factor	VelFactor	LREAL	⎍	0.00 to 10.00	0	While Enable is TRUE, values are always imported. Sets the velocity override factor.
Acceleration/ deceleration override factor	AccFactor	LREAL	⎍	0, 0.01 to 10.00	0	While Enable is TRUE, values are always imported. Sets the acceleration/deceleration override factor. When "0" is set, the acceleration/deceleration override factor is not changed, and the control is performed with the previous value.
Jerk override factor (Reserved)	JerkFactor	LREAL	⎍	0	0	Set "0". (A value other than "0" causes an error.)

■Output variables

Name	Variable name	Data type	Default value	Description
Enabled	Enabled	BOOL	FALSE	Turns TRUE when the set override value is correct.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Operation overview

In MC_SetOverride and MC_GroupSetOverride, AxisName(AxesGroupName).Cd.VelocityOverride and AxisName(AxesGroupName).Cd.AccelerationOverride of the axis or the axes group can be changed.



If a value outside the range is set as the override factor, an error will occur in the FB, and subsequent values will not be imported. To import values again, start up Enable again.

Precautions

- Do not arrange two or more MC_SetOverride and MC_GroupSetOverride 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 affects. In the axes group control, only the override factor set with the axes group control data affects.

How to change control data

Override factor setting range

The following shows each override factor setting range.

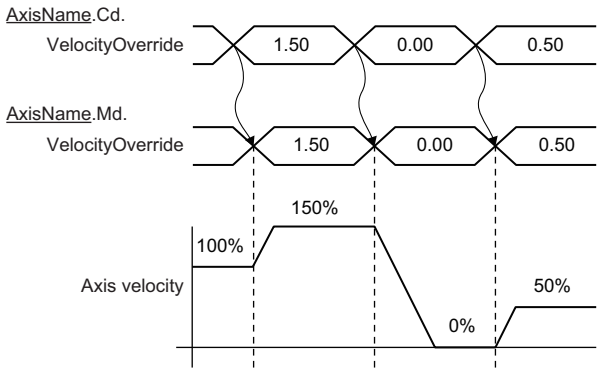
Variable/Structure name		Name	Setting range
AxisName.Cd. AxesGroupName.Cd.			
	VelocityOverride	Velocity override factor	0.00 (0%) ≤ Setting value ≤ 10.00 (1000%)
	AccelerationOverride*1	Acceleration override factor	0.01 (1%) ≤ Setting value ≤ 10.00 (1000%)
	JerkOverride (Reserved)	Jerk override factor	1

*1 Even if the acceleration/deceleration method specifying the acceleration/deceleration time, the override factor will be used to the acceleration/deceleration.

Operation when the velocity override factor is changed

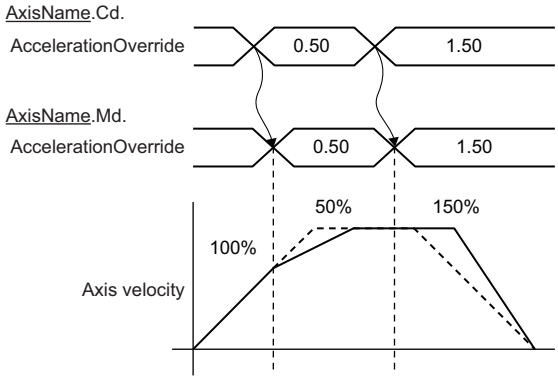
Change the velocity by changing AxisName(AxesGroupName).Cd.VelocityOverride.

When "0" is set in AxisName(AxesGroupName).Cd.VelocityOverride, the axis is stopped without moving to the "4: Standstill" status.



Operation when the acceleration override factor is changed

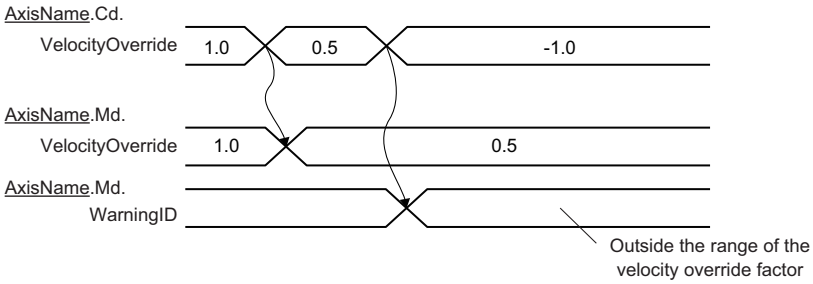
Change the acceleration by changing AxisName(AxesGroupName).Cd.AccelerationOverride.



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.

- The warning "Out of Speed Override Coefficient Range Warning" (warning code: 0D0BH)
- The warning "Out of Acceleration Override Coefficient Range Warning" (warning code: 0D0CH)

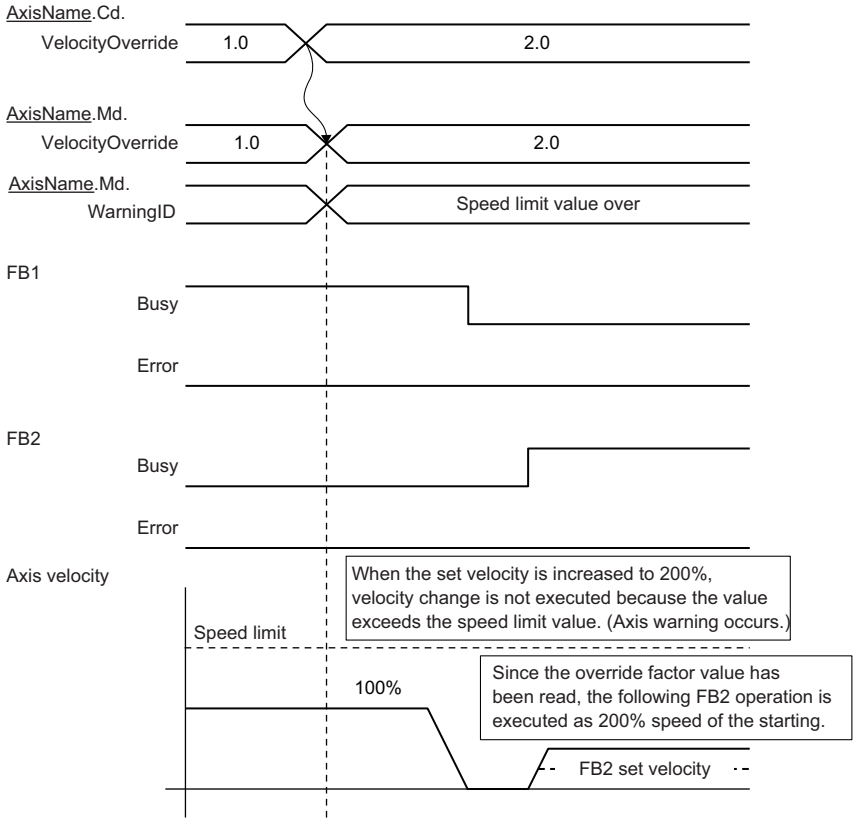


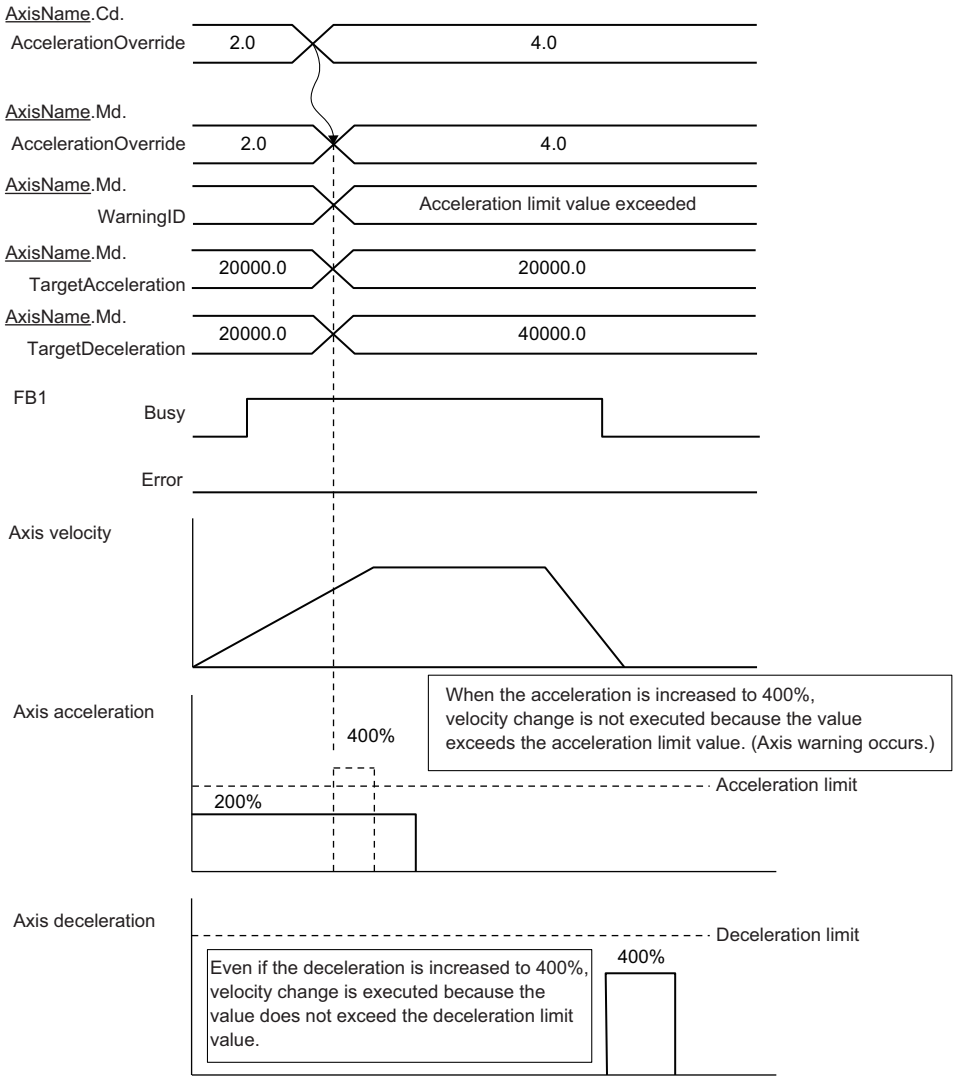
Operation at velocity/acceleration/deceleration limit value over by override

■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 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.)



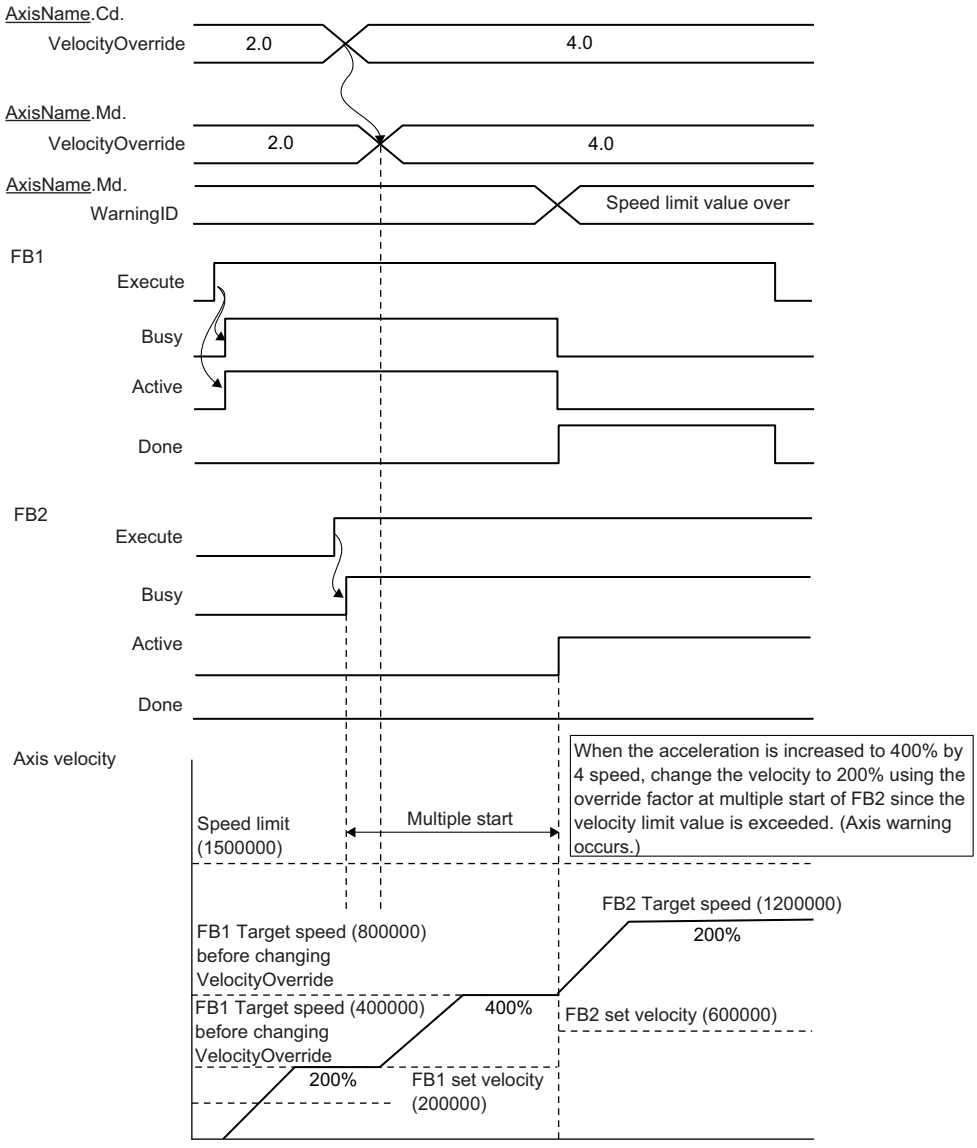

AxisName.Cd.
AccelerationOverride
2.0
4.0
AxisName.Md.
AccelerationOverride
2.0
4.0
AxisName.Md.
WarningID
Acceleration limit value exceeded
AxisName.Md.
TargetAcceleration
20000.0
20000.0
AxisName.Md.
TargetDeceleration
20000.0
40000.0
FB1
Busy
Error
Axis velocity
Axis acceleration
400%
When the acceleration is increased to 400%, velocity change is not executed because the value exceeds the acceleration limit value. (Axis warning occurs.)
Acceleration limit
200%
Axis deceleration
Deceleration limit
400%
Even if the deceleration is increased to 400%, velocity change is executed because the value does not exceed the deceleration limit value.

■When velocity/acceleration/deceleration limit value over occurs at switching of FB by buffer mode

The control change of buffering FB is executed at swiching 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 start are used to control.

Also when velocity/acceleration/deceleration limit value over occurs at swiching of FB, 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 operated.



MEMO

10 RELEVANT FUNCTIONS TO TORQUE

10.1 Torque limit

The "torque limit function" 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.

- Set the positive direction (address increment direction) torque limit value and the negative direction (address decrement direction) torque limit value for each axis.
- The torque limit value is used in the "setting of the torque limit value used in the driver" and the "control to suppress the command torque in MC_TorqueControl, etc.".
- The torque limit value can be changed by changing the values of AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative. When changing the torque limit value, specifies a value less than or equal to the AxisName.PrConst.TorqueLimit_Max setting value. For details, refer to the following.
  ☞ Page 353 Torque Limit Value Change Function
- The torque limit value that is currently valid can be checked with AxisName.Md.TorqueLimit_Positive and AxisName.Md.TorqueLimit_Negative.
- The torque limit value when connecting a driver, AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are set.

Relevant variables

Variable/Structure name		Name	Details
AxisName.PrConst.			
	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 AxisName.Cd.TorqueLimit_Positive.
	TorqueLimit_NegativeInitial	Negative direction torque limit initial value	Sets the initial value of AxisName.Cd.TorqueLimit_Negative.
AxisName.Cd.			
	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.
AxisName.Md.			
	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.

Slave object map

When using the torque limit function in the "setting of the torque limit value used in the driver", assign the torque limit object to the slave object setting. For details, refer to the following.

☞ Page 52 Axis Assignment

Point

- The number of significant digits after the decimal point differs depending on the ID assigned to the slave object map. Values less than the number of significant digits are truncated.
- If the torque limit object has not been assigned to the slave object map, 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, etc.". Since the torque limit value will not be sent to the driver, refer to each drive unit manual for the torque limit value used by the driver.

Torque limit value setting range

Set the settings of AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative for each axis.

The setting values are used in the "setting of the torque limit value used in the driver" and the "control to suppress the command torque in MC_TorqueControl, etc.".

The torque limit value can be changed by changing the setting values. For details, refer to the following.

☞ Page 353 Torque Limit Value Change Function

When the power supply turns ON, the setting values of AxisName.PrConst.TorqueLimit_PositiveInitial and AxisName.PrConst.TorqueLimit_NegativeInitial are stored. In this time, if AxisName.PrConst.TorqueLimit_PositiveInitial and AxisName.PrConst.TorqueLimit_NegativeInitial are set with the larger value than AxisName.PrConst.TorqueLimit_Max, the error "Out of Forward Direction Torque Limit Value Specification Range" (error code: 1A79H) or the error "Out of Reverse Direction Torque Limit Value Specification Range" (error code: 1A7AH) will occur.

If a value outside the range is set during control execution, the warning "Out of Forward Direction Torque Limit Value Specification Range Warning" (warning code: 0D09H) or the warning "Out of Reverse Direction Torque Limit Value Specification Range Warning" (warning code: 0D0AH) will occur.

Control data	Setting range
AxisName.Cd.TorqueLimit_Positive	0.0 (0%) ≤ Setting value ≤ AxisName.PrConst.TorqueLimit_Max
AxisName.Cd.TorqueLimit_Negative	

Torque limit maximum value setting range

Set the settings of 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 big value is input erroneously when changing the torque limit value, the change will not be accepted, and erroneous input is prevented. If a value outside the range is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) will occur.

Parameter	Setting range
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 driver as the torque limit maximum value.

Both the positive direction torque limit value and the negative direction torque limit value are limited by 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 carried out. Note that the movement might start rapidly as soon as the load torque is eliminated.

10.2 Torque Limit Value Change Function

- To change a torque limit value, there are a method of using the dedicated FB and a method of using control data.

Change method	Description
Change using a dedicated FB	MCv_SetTorqueLimit
Change using control data	AxisName.Cd.TorqueLimit_Positive, AxisName.Cd.TorqueLimit_Negative

- The number of significant digits after the decimal point differs depending on the ID assigned to the slave object map.
- In a torque limit value change, a value cannot be changed to a torque limit value that exceeds 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		MC_TorqueControl	—
	Limit value		MCv_SetTorqueLimit	AxisName.Cd.TorqueLimit_Positive AxisName.Cd.TorqueLimit_Negative
	Limit value	Maximum value of the limit value	—*1	—

*1 Axis parameters can be changed by MC_WriteParameter. However, it cannot be changed during control.

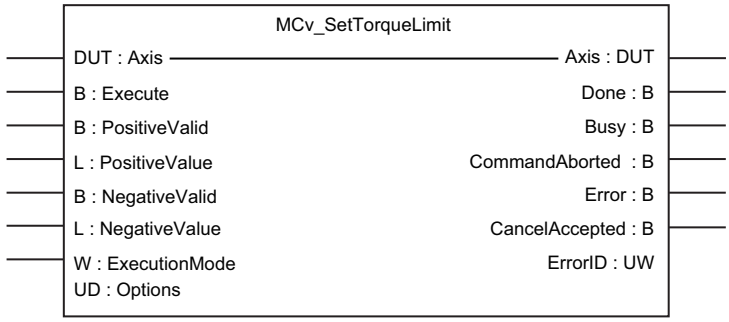
Relevant variables/FB

For variables used in a method of changing control data, refer to the following.

☞ Page 351 Relevant variables

MCv_SetTorqueLimit

To simultaneously change a positive/negative direction torque limit value, use the torque limit value change FB "MCv_SetTorqueLimit".

Item	Description
Function overview	Executes a torque limit value change.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
48	8	Subroutine type	Real-time execution

■Function description

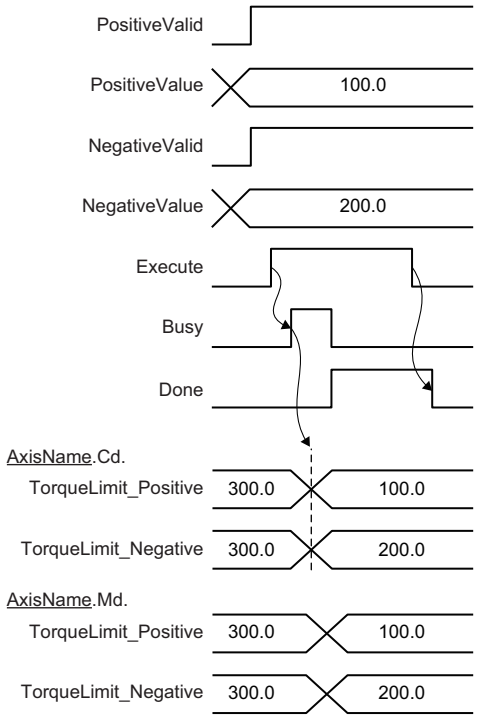
- This FB changes a positive/negative direction torque limit value.
- When PositiveValid is TRUE, a positive direction torque limit value is changed to PositiveValue.
- When NegativeValid is TRUE, a negative direction torque limit value is changed to NegativeValue.
- This FB is executed when Execute is TRUE, and Busy turns TRUE when the processing is normally started.
- The torque limit value change timing is set in ExecutionMode.
- When the process is completed and the torque limit value is changed, Done turns TRUE.
- After this FB is started with Execute = "1: mcQueued", if the axis status (AxisName.Md.AxisStatus) turns "0: Disabled"/"1: ErrorStop" before processing completion, the processing will be interrupted and CommandAborted will turn TRUE.
- When an error has occurred in the FB, this FB turns Error to TRUE and stores an error code in ErrorID. For details of error codes, refer to the following.
  ☞ Page 606 List of Error Codes
- When both of PositiveValid and NegativeValid are FALSE, the torque limit value will not change and Done will be TRUE.

Precautions

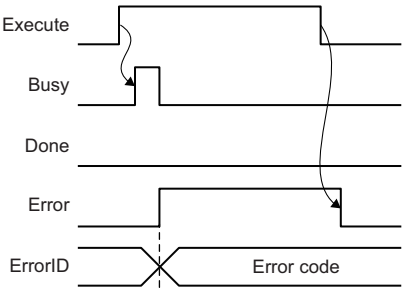
This FB changes AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Positive direction torque limit valid	PositiveValid	BOOL	↑/R	TRUE, FALSE	FALSE	When TRUE, the positive direction torque limit setting value is changed.
Positive direction torque limit value	PositiveValue	LREAL	↑/R	☞ Page 360 Positive/Negative direction torque limit value setting range	0	Imports when PositiveValid is TRUE. Sets the positive direction torque limit value.
Negative direction torque limit valid	NegativeValid	BOOL	↑/R	TRUE, FALSE	FALSE	When TRUE, the negative direction torque limit setting value is changed.
Negative direction torque limit value	NegativeValue	LREAL	↑/R	☞ Page 360 Positive/Negative direction torque limit value setting range	0	Imports when NegativeValid is TRUE. Sets the negative direction torque limit value.
Execution mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: mcImmediately (Execute immediately) 1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Sets function options with bit designation.

*1 For a bit and the function description, refer to the following table.

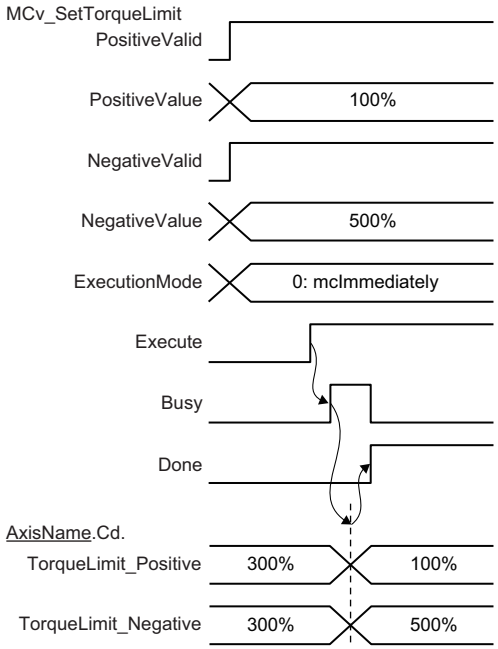
Bit	Function description
0 to 15	Empty (Reserved)
16	Specifies whether cancel is allowed or not after FB is started. FALSE: Not allow TRUE: Allow
17 to 31	Empty (Reserved)

■Output variables

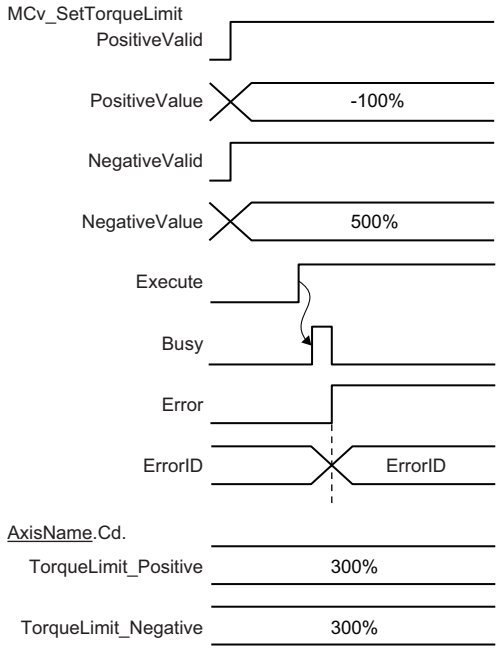
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that a torque limit value change is normally completed.
Executing	Busy	BOOL	FALSE	When TRUE, it indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	When TRUE, it indicates that execution is interrupted.
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

■Operation overview

In MCv_SetTorqueLimit, AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are changed.



If a value outside the range is set in PositiveValue or NegativeValue and Execute is turned to TRUE, an error will occur in the FB, and AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative will not be changed.



■Details of ExecutionMode

When the torque limit value change FB is executed during axis operation, the change timing differs depending on the ExecutionMode setting value of the input variable.

- Immediate execution

  "0: mcImmediately"

The change is immediately executed regardless of the axis status (AxisName.Md.AxisStatus).

AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are changed at rising edge of Execute.

- Execution after stop

  "1: mcQueued"

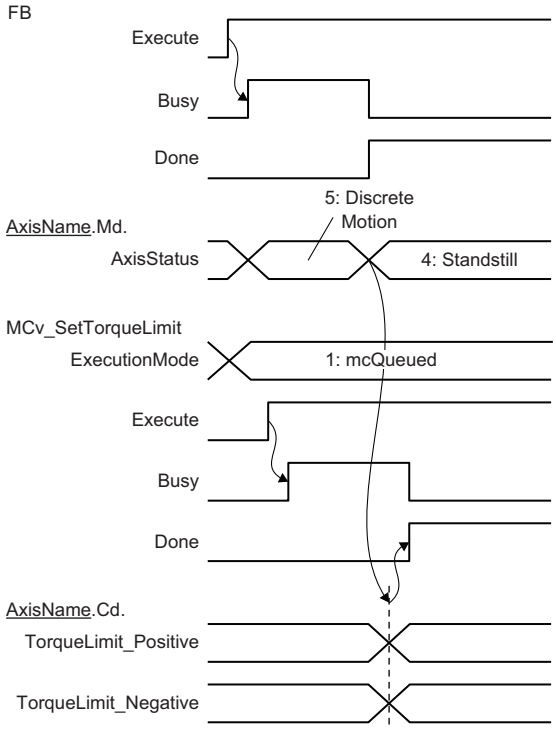
The change is executed after the on-going FB is completed.

Busy turns TRUE at rising edge detection of Execute, and the FB waits until the axis status (AxisName.Md.AxisStatus) turns "4: Standstill".

As soon as the axis status (AxisName.Md.AxisStatus) turns "4: Standstill", AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are changed.

When the axis status (AxisName.Md.AxisStatus) is "4: Standstill" at rising edge detection of Execute, the FB is immediately executed.

If the axis status (AxisName.Md.AxisStatus) turns "0: Disabled"/"1: ErrorStop" before processing is completed, the processing will be interrupted and CommandAborted will turn TRUE.



- Execute speculatively

  "3: mcSpeculatively"

If the axis status (AxisName.Md.AxisStatus) is not "4: Standstill" or if the rising edge of Execute is detected at execution of FB instruction, the error "MCv_SetTorqueLimit Instruction Error" (error code: 3450H) will occur.

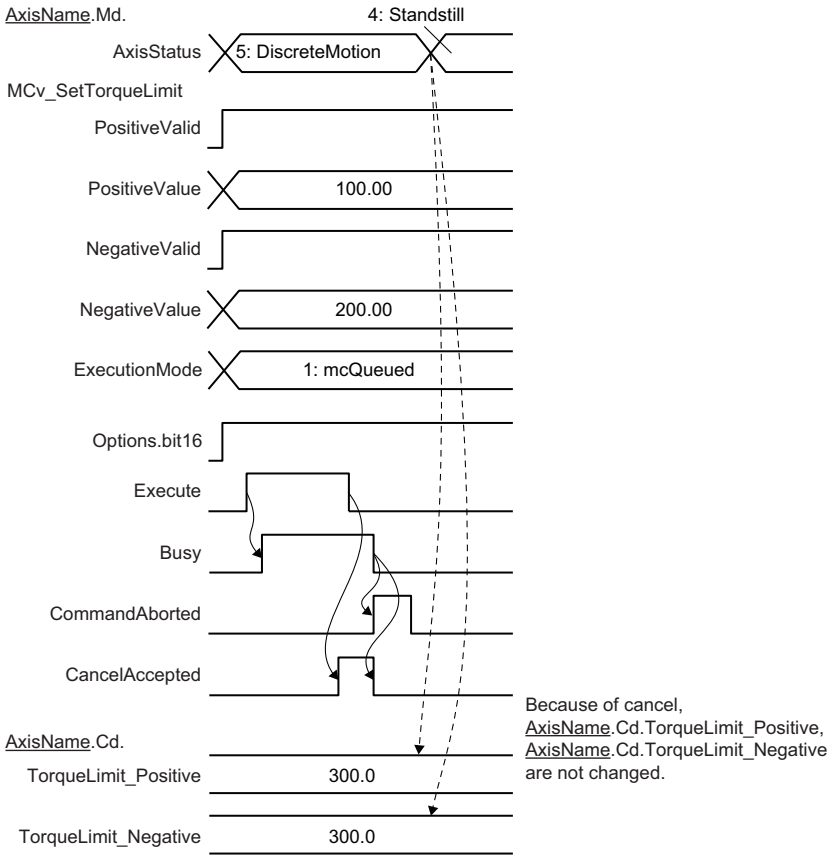
■Cancel

Torque limit value change that is in the standby status after FB execution can be canceled.

- To enable cancel, execute the FB with the status of "Cancel accepted after FB start" (Options bit16) set to "TRUE: Allowed".
- Cancel is started at falling edge detection of Execute.
- Cancel is accepted only while Busy of the output pin is TRUE.
- When FB accepts cancel, CancelAccepted of the output pin will be TRUE.
- When cancel is completed, CommandAborted of the output pin will be TRUE.
- When cancel was carried out, AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are not changed.

Ex.

When canceling while the axis status (AxisName.Md.AxisStatus) is waiting for switching to "4: Standstill" after starting MCv_SetTorqueLimit with "1: mcQueued" of ExecutionMode



How to change control data

Positive/Negative direction torque limit value setting range

The setting range of AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative is as the following table.

Control data	Setting range
AxisName.Cd.TorqueLimit_Positive	0.0 (0%) ≤ Setting value ≤ AxisName.PrConst.TorqueLimit_Max
AxisName.Cd.TorqueLimit_Negative	

Torque limit value change timing

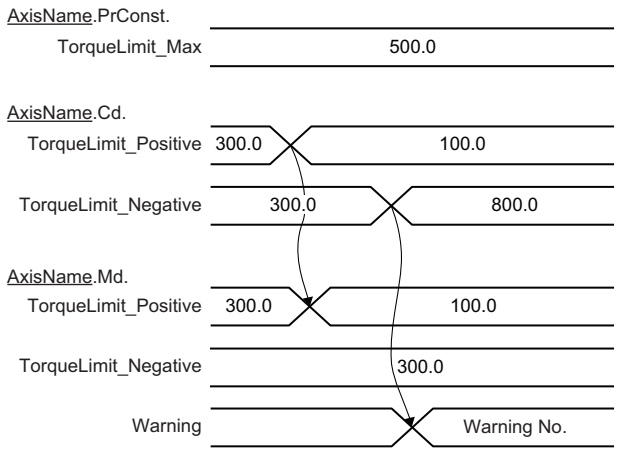
A torque limit value can be changed by changing AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative.

If a value outside the setting range is set, the warning "Out of Forward Direction Torque Limit Value Specification Range Warning" (warning code: 0D09H) or "Out of Reverse Direction Torque Limit Value Specification Range Warning" (warning code: 0D0AH) will occur, and the torque limit value will remain unchanged from the previous value.

When the real drive axis is not connected, the warning "Warning Changing Torque Limit Value to Axis not yet Started" (warning code: 0D23H) will occur. At this time, the torque limit value changed when connecting the real drive axis will be enabled because AxisName.Cd.TorqueLimit_Positive and AxisName.Cd.TorqueLimit_Negative are changed.

Ex.

When a warning occurs after AxisName.Cd.TorqueLimit_Negative changes 300.0→800.0 in the status where AxisName.PrConst.TorqueLimit_Max=500.0 is set



11 CONTROL SUB FUNCTIONS

11.1 Compensation Function

Compensation function includes the driver unit conversion function, which can be executed by the parameter settings.

Relevant variables

Variable/Structure name		Name	Details
AxisName.Pr.			
	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.
	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.

Driver unit conversion function

• Real drive axis

"Driver unit conversion function" converts the feed machine position to the driver command value and pass it to the target position (Target position). Also, it converts the current position (Position actual value) of the driver and calculates the actual position.

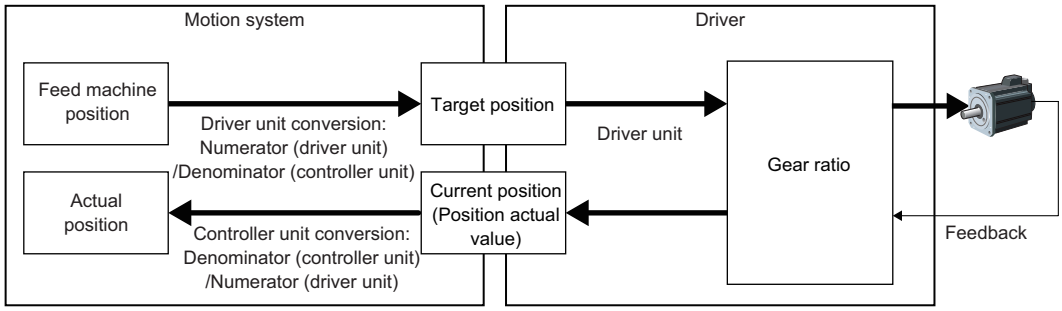
The conversion formulas are shown below.

Target position = Feed machine position (Motion system command value) × Driver unit conversion numerator / Denominator

Actual position = Current position × Driver unit conversion denominator / Numerator

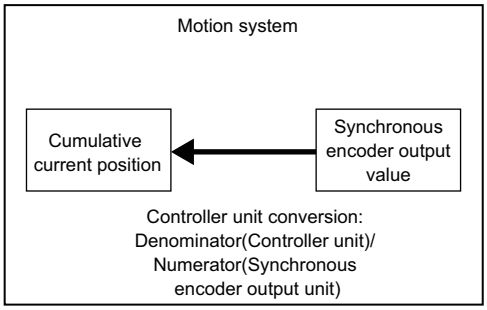
Point

When a value other than "1 : 1" is set in Gear ratio(6091H) of the driver side, conversion is performed in both motion system side and driver side.



• 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 AxisName.Pr.Drive_UnitConvRatioNum and AxisName.Pr.Drive_UnitConvRatioDen in order to output the command value to the driver according to the specified movement amount.
The setting examples are shown below.

■For a ball screw

Ex.

When the ball screw pitch is 20 [mm], the controller command unit is [mm], the driver command unit is [pulse], and the motor encoder resolution is 4194304 pulse/rev

Set the number of pulses required to rotate a motor once (the encoder resolution) in AxisName.Pr.Drive_UnitConvRatioNum, and set the transfer distance of the machine per motor rotation in AxisName.Pr.Drive_UnitConvRatioDen.

AxisName.Pr.Drive_UnitConvRatioNum = 4194304 [pulses]

AxisName.Pr.Drive_UnitConvRatioDen = 20 [mm]

In this example, the movement amount per pulse is 0.00000238 [mm]. For instance, when the movement amount of 22 [mm] is set, the command will be 4613734.4 [pulses] and a fraction of 0.4 [pulses] will appear. In this case, the movement amount of 4613734 [pulses] is output to the driver, 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 a linear servo motor

Ex.

When the controller command unit is [μm] and the driver 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]

$$\frac{\text{Number of pulses [pulse]}}{\text{Movement amount [μm]}} = \frac{1}{0.05} = \frac{20}{1.0}$$

AxisName.Pr.Drive_UnitConvRatioNum = 20 [pulses]

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 79 Positioning Range
  If setting a value outside the range, the error "Driver Unit Change Magnification Upper Over" (error code: 1AA4H) will occur.
- A change of the driver unit conversion parameter is also imported when the PLC READY [Y0] is turned ON. Turning ON it in the following status, otherwise, the error "Driver Unit Change Numerator/Denominator Change Timing Incorrect" (error code: 1AA5H) will be output, and the system will be operated with the set value before turning ON the PLC READY [Y0].
  · AxisName.Md.AxisStatus is "0: 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 pulse or more.
- When machine homing is completed, the function clears to "0" the cumulative values of less than one pulse which could not be output.
- When the driver unit conversion numerator/denominator is changed, the homing request flag turns 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 driver. Therefore, values that can not 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.
  Since the target position send a value which is obtained by truncating the fractional part of the operation result, errors due to rounding processing is truncated when it is less than or equal to the decimal point. However, when 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, change the following setting.
  · Reduce the multiplying factor of "driver unit conversion numerator / driver unit conversion denominator".
  For example, when setting 20 [mm] to the machine movement amount per motor rotation, set "20000" in AxisName.Pr.Drive_UnitConvRatioDen, and set [μm] in AxisName.Pr.Unit_Position. (20.0 [mm] → 20000.0 [μm])

11.2 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 input of the virtual drive axis can be output to the real drive axis.
Command filter includes the following.

Filter type	Overview
Smoothing filter	• Filter function that is used to suppress load-side vibration, such as work-side vibration and base shake. • Frequencies higher than the set frequency can be removed.
Travel direction limit filter	• Filter function that is used to limit the travel direction of the axis. • The input travel value from the master axis can be restricted to one direction. • This helps to avoid reverse operation caused by machine vibration, etc.
Speed limit filter	• Filter function that is used to limit the speed of the axis. • The speed input by the master axis can be limited to the specific speed and output.
Backlash compensation filter	• Filter function that is used to compensate for the backlash amount in the machine system. • Whenever the travel direction changes, outputs the extra commands equivalent to the set up backlash compensation amount.

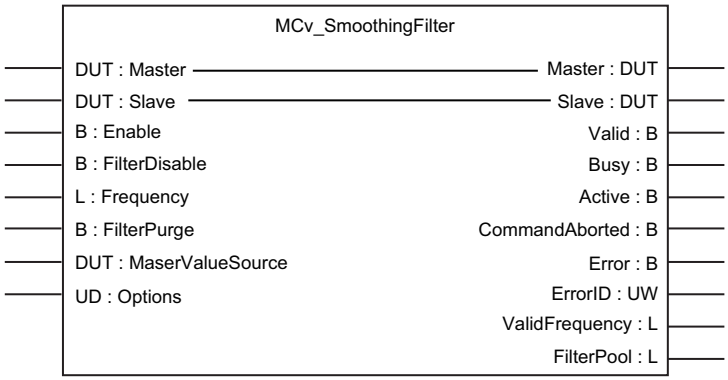
Operation of this function for each system status

○: Possible, ×: Not possible

System status	Function operation
STOP	×
RUN	○
Major error	×
Moderate error	×

Relevant FBs

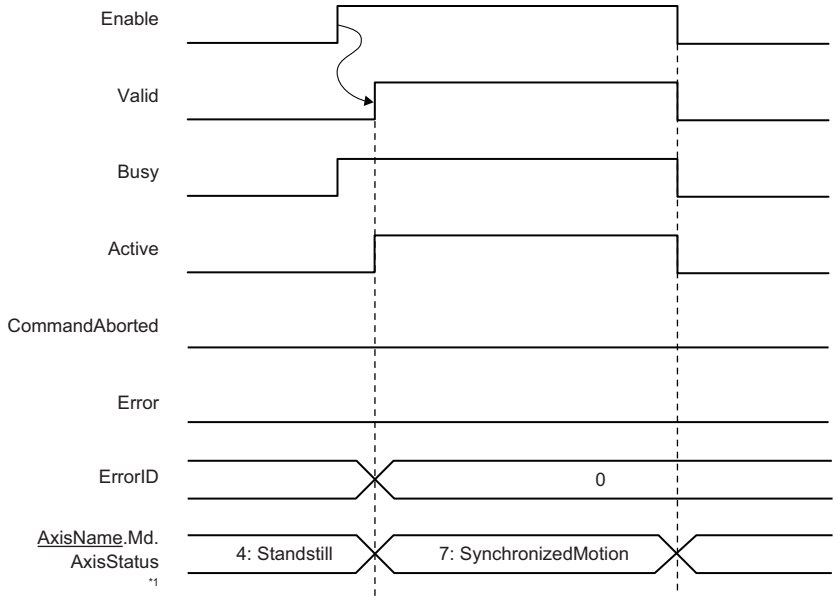
MCv_SmoothingFilter

Item	Description
Function overview	Executes filter processing based on the specified frequency.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
40	24	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 Indicates the axis status of the slave axis.

[When an error occurs]

For details upon completion with an error, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always, ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Filter disable	FilterDisable	BOOL	⎍	TRUE, FALSE	FALSE	Disables the filter during TRUE, and the master axis input is transmitted to the slave axis as it is.
Frequency	Frequency	LREAL	⎍	0.20 to 250.00 [Hz]	10.00	Sets a frequency that suppresses vibration.
Filter purge	FilterPurge	BOOL	↑	TRUE, FALSE	FALSE	Specifies the end operation with the filter cumulative value.
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	For details, refer to the following. ☞ Page 471 Master Axis Data Source Selection
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (A value other than "0" causes an error.)

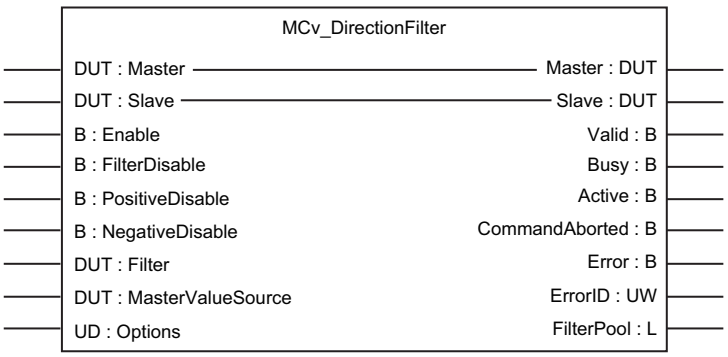
■Output variables

Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	During TRUE, the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Valid frequency	ValidFrequency	LREAL	0	Indicates valid frequencies.
Filter cumulated value	FilterPool	LREAL	0	Indicates the movement amount cumulated at filter processing.

■Public variables

Name	Variable	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0	Stores disposed FilterPool by turning FilterDisable to TRUE.

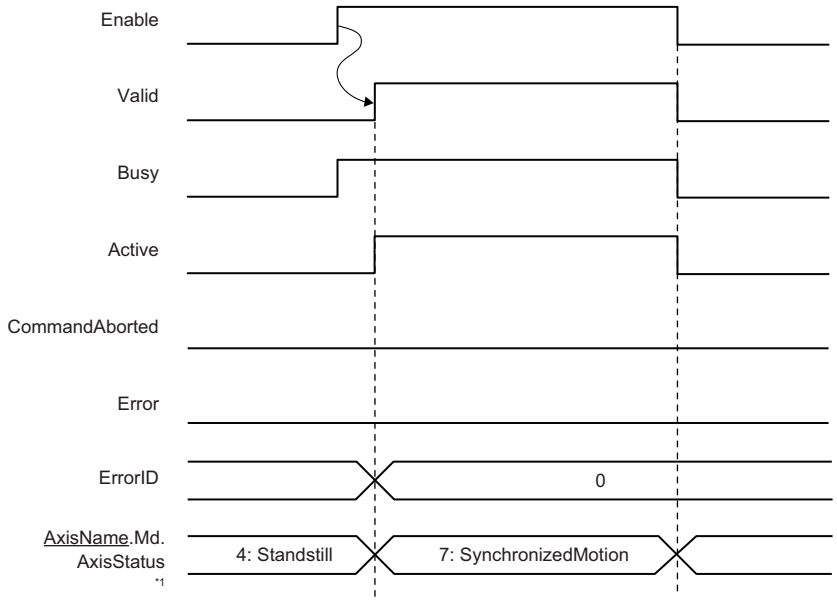
MCv_DirectionFilter

Item	Description
Function overview	Executes filter processing to the travel direction set up to restrict traveling.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
28	28	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 Axis status of the slave axis.

[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always,↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	During TRUE, it executes the FB.
Filter disable	FilterDisable	BOOL	⎍	TRUE, FALSE	FALSE	Disables the filter during TRUE, and the master axis input is transmitted to the slave axis as it is.
Positive direction limit	PositiveDisable	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, limit the axis operation to the positive direction.
Negative direction limit	NegativeDisable	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, limit the axis operation to the negative direction.
Filter operation	Filter	MC_VELOCITY_LIMIT_MODE	↑	0 to 4	2	Specify the filter operation.
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	For details, refer to the following. ☞ Page 471 Master Axis Data Source Selection
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (A value other than "0" causes an error.)

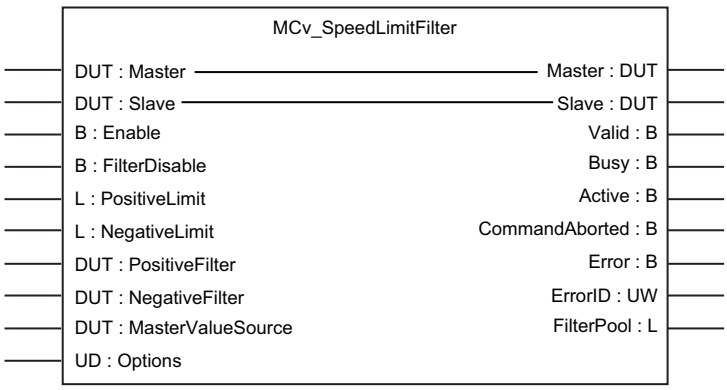
■Output variables

Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	During TRUE, indicates the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in theFB is returned.For details, refer to the following. ☞ Page 606 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0	Indicates the movement amount cumulated at filter processing.

■Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0	Stores disposed FilterPool by turning FilterDisable to TRUE.

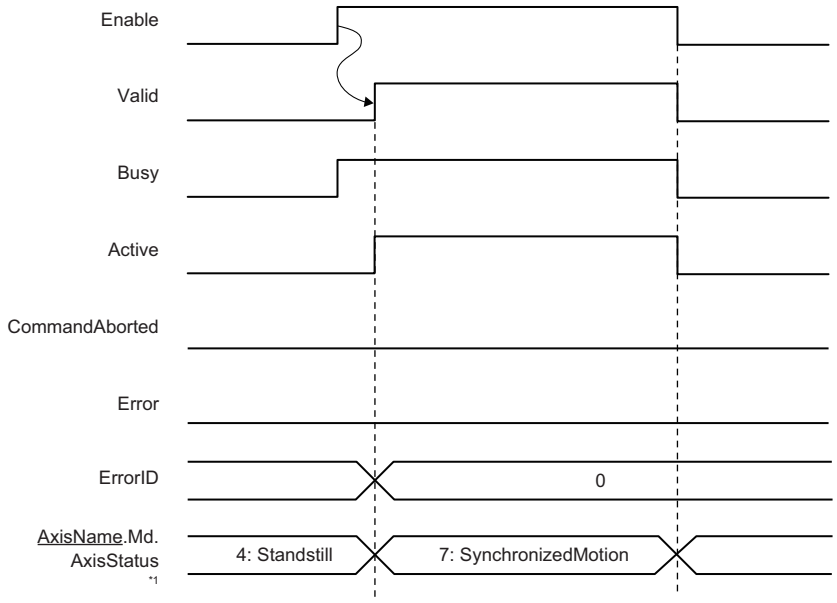
MCv_SpeedLimitFilter

Item	Description
Function overview	Executes filter processing to restrict to the speed of set up limit value.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
52	28	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 Axis status of the slave axis.

[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always,↑: At start

Name	Variable name	Data type	Imput import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	During TRUE, it executes the FB.
Filter disable	FilterDisable	BOOL	⎍	TRUE, FALSE	FALSE	Disables the filter during TRUE, and the master axis input is transmitted to the slave axis as it is.
Positive direction limit value	PositiveLimit	LREAL	↑	0, 0.0001to 2500000000.0	0	Sets the speed limit value for the positive direction.
Negative direction limit value	NegativeLimit	LREAL	↑	0, 0.0001to 2500000000.0	0	Sets the speed limit value for the negative direction.
Positive direction filter operation	PositiveFilter	MC_VELOCITY_LIMIT_MODE	↑	0 to 4	2	Sets the filter operation for the direction exceeds the positive direction limit.
Negative direction filter operation	NegativeFilter	MC_VELOCITY_LIMIT_MODE	↑	0 to 4	2	Sets the filter operation for the direction exceeds the negative direction limit.
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	For details, refer to the following. ☞ Page 471 Master Axis Data Source Selection
Options	Options	DWORD(HEX)	↑	0	00000000H	Set "0". (If a value other than "0" is set, an error will occur.)

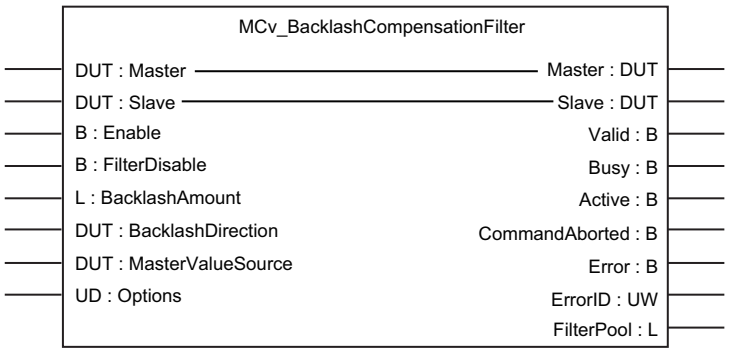
■Output variables

Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	During TRUE, it indicates thatthe output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0	Indicates the movement amount cumulated at filter processing.

■Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0	Stores disposed FilterPool by turning FilterDisable to TRUE.

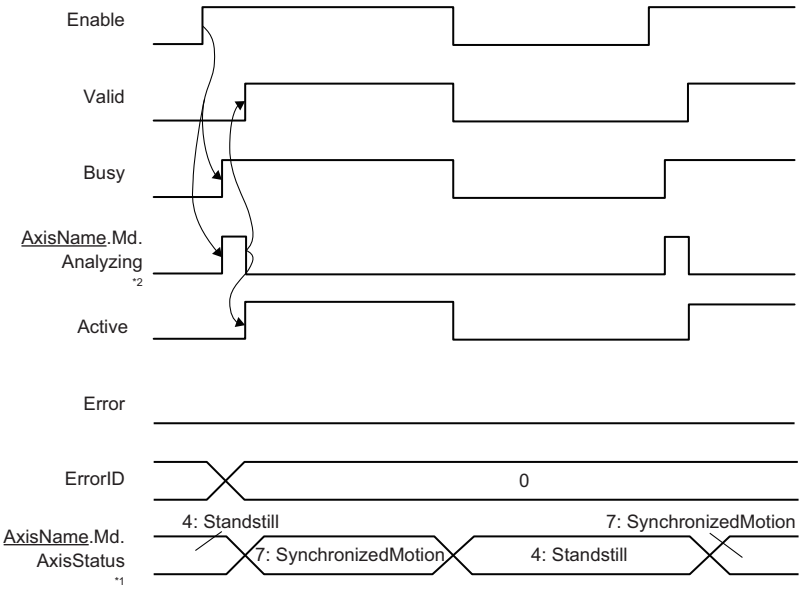
MCv_BacklashCompensationFilter

Item	Description
Function overview	Following the movement direction, executes filter processing to compensate the backlash amount in the machine system.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
40	24	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 Axis status of the slave axis.

*2 Analyzing the slave axis.

[When an error occurs]

For details when an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variables

Input import↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always,↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	TRUE, FALSE	FALSE	During TRUE, it executes the FB.
Filter disable	FilterDisable	BOOL	⎍	TRUE, FALSE	FALSE	Disables the filter during TRUE, and the master axis input is transmitted to the slave axis as it is.
Backlash amount	BacklashAmount	LREAL	↑	0.0 to 2500000000.0 [U]	0.0	Sets the backlash amount.
Backlash compensation direction	BacklashDirection	MC_DIRECTION	↑	1, 2	0	Sets the backlash compensation direction.
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 101	1	For details, refer to the following. ☞ Page 471 Master Axis Data Source Selection
Options	Options	DWORD(HEX)	↑	0	00000000H	Sets a function option. Set "0". (If a value other than "0" is set, an error will occur.)

■Output variables

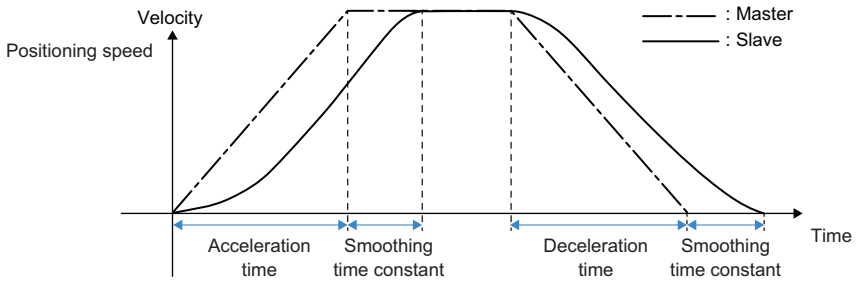
Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	During TRUE, it indicates thatthe output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution is interrupted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0000H	Returns the error code generated in the FB. For details, refer to the following. ☞ Page 606 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0	Indicates the movement amount cumulated at filter processing.

■Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0	Stores disposed FilterPool by turning FilterDisable to TRUE.

Smoothing filter

- Smoothing filter removes frequencies higher than the set Frequency, and the entire waveform higher than the setting value becomes a smooth acceleration/deceleration waveform.
- Smoothing filter outputs the result of filter processing that executed to the Master value set in MasterValueSource to Slave.
- The slave axis status (AxisName.Md.AxisStatus) is "7: SynchronizedMotion" during smoothing filter execution.
- The time constant of smoothing is 1/Frequency [s], and the acceleration time and deceleration time become longer by the smoothing time constant. When Frequency is 10 [Hz], the smoothing time constant is 0.1 [s] = 100 [ms].

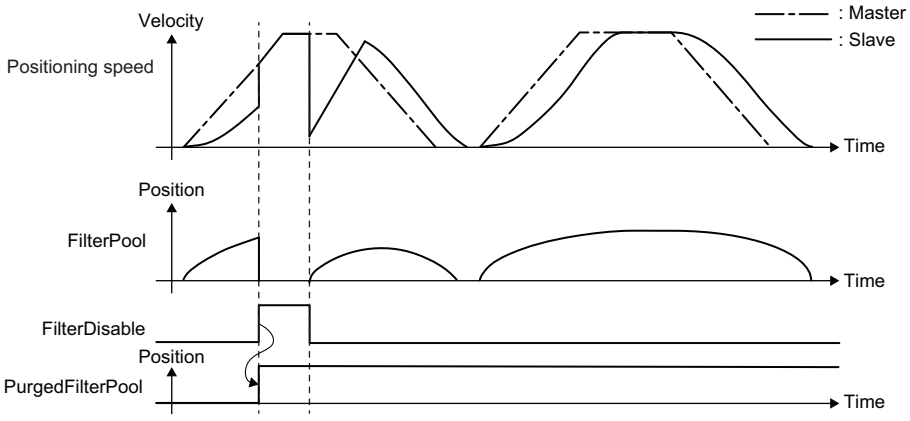


- If a smoothing filter is started while the slave axis is in another operation instruction, the start request will be ignored, and the error "Start Not Possible" (error code: 1AADH) will occur. Start it when the slave axis status (AxisName.Md.AxisStatus) is "4: Standstill".
- MC_Stop is the only function block that can be multiple started during smoothing filter execution.

Details of setting items

■FilterDisable (Filter disable)

- When FilterDisable is FALSE, the axis operates according to the filter setting.
- When FilterDisable is TRUE, the filter is disabled, and Master input is transmitted to Slave.
- When FilterDisable is turned TRUE, FilterPool becomes "0", and stores the disposed FilterPool to the PurgedFilterPool.



■Frequency (Frequency)

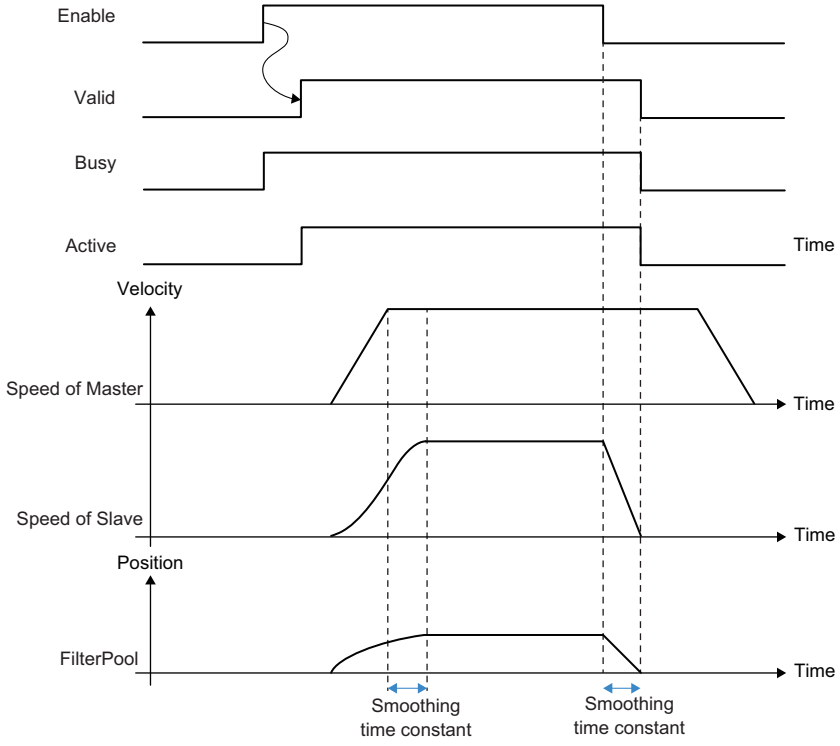
- The following shows the range that can be set in Frequency.

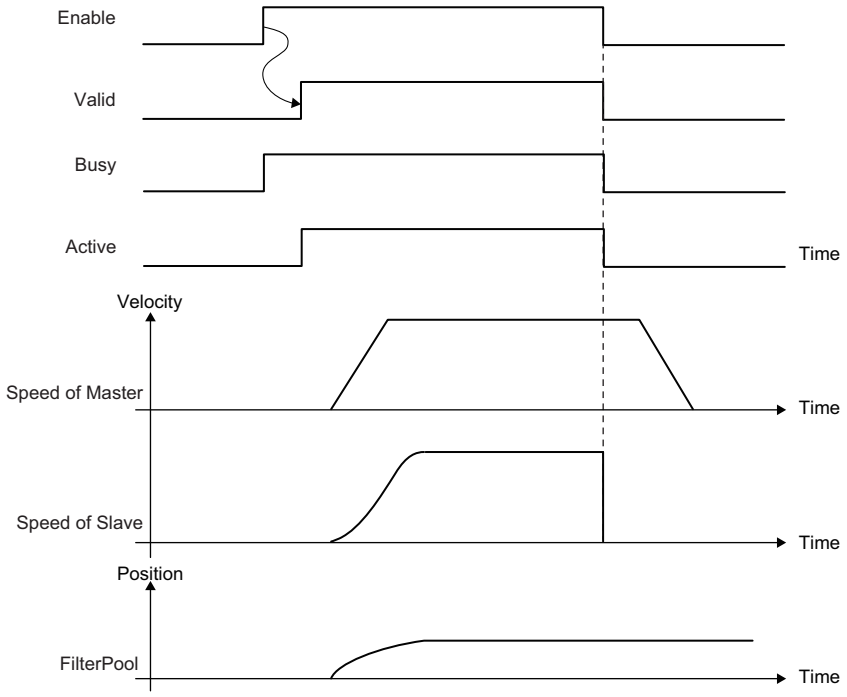
1/Slave axis operation cycle [s]	Setting range
250.00 [Hz] or more	0.20 to 250.00 [Hz]
Less than 250.00 [Hz]	0.20 to (1/Slave axis operation cycle [s]) [Hz]

- If a value outside the range is set in Frequency, the error "Out of Frequency Specification Range" (error code: 1A85H) will occur.
- Valid frequencies can be checked in ValidFrequency.
- To change Frequency, change Frequency when FilterPool is "0". Even if it is changed in a status other than "0", the change will not reflected until FilterPool becomes "0".
- Frequency cannot be changed to a frequency lower than ValidFrequency. If it is set, the error "Out of Frequency Specification Range" (error code: 1A85H) will be output.
- FilterPool may become "0" while the master axis operates with the operation pattern which repeats positive/reverse rotation. When the value of Frequency is changed while the filter operation is not settled, the filter operation will be stopped in the middle. Thus, it causes the deviation between the master axis and the slave axis. To change Frequency, confirm the master axis stop and wait for the filter time constant before changing.

■FilterPurge (Filter purge)

- By FilterPurge setting, operation when Enable turns FALSE can be specified with FilterPool other than "0".

FilterPurge	Operation overview
TRUE	When Enable turns FALSE, the axis operates until FilterPool becomes "0" and stops. 

FilterPurge	Operation overview
FALSE	When Enable turns FALSE, the slave axis immediately stops regardless of the FilterPool status. 

■ValidFrequency (Valid frequency)

- It indicates frequencies which are valid in filter processing.

■FilterPool (Filter cumulated value)

- FilterPool indicates the slave axis movement amount cumulated by filter processing.
- FilterPool is cleared when turning Enable TRUE.
- If the FilterPool value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) will occur. For values of the positioning range, refer to the following.
  ☞ Page 79 Positioning Range

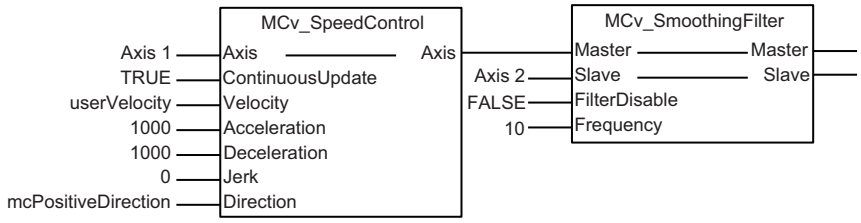
■PurgedFilterPool (Disposed filter cumulated value)

- PurgedFilterPool, when turns FilterDisable to TRUE, displays the disposed FilterPool.
- PurgedFilterPool does not cumulate.
- PurgedFilterPool is 0 cleared at FB start.

Program examples

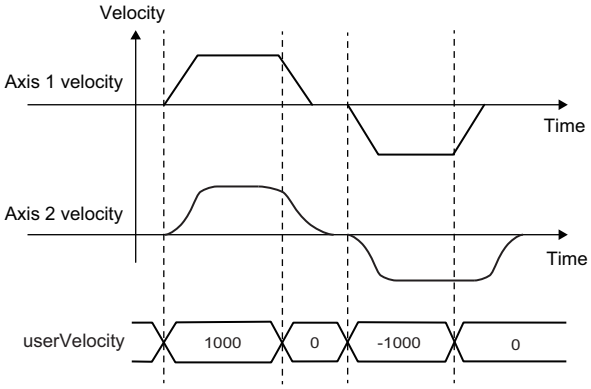
To turn the trapezoidal acceleration/deceleration into smooth acceleration/deceleration waveform

[Program]



[Operation]

As Frequency is set to 10.0, the smoothing time constant will be 0.1 [s].



Precautions

- When the master axis operates in the positive and negative direction alternately every operation cycle, underflow occurs and the position error of the master axis and the slave axis may cause.
- An operation load increases in smoothing filter by increasing the filter level. (Filter level: approximately 300μs for 5000)
  Filter level can be calculated using the following formula.
  Filter delay level = ((1 / frequency) x 1000) / operation cycle [ms]

Required objects

For details, refer to the following.

☞ Page 473 Required Slave Object

Movement direction limit filter

- The movement direction limit filter, to the master axis movement, restricts the movement of the slave axis to one direction.
- The movement direction limit filter, outputs the result of filter processing that executed to the Master value set in MasterValueSource to Slave.
- The slave axis status (AxisName.Md.AxisStatus) will be "7: SynchronizedMotion" during movement direction limit filter execution.
- If a movement direction limit filter is started while the slave axis is in another operation instruction, the start request will be ignored, and the error "Start Not Possible" (error code: 1AADH) will occur. Start when the slave axis status (AxisName.Md.AxisStatus) is "4: Standstill".
- MC_Stop is the only function block that can be multiple started during movement direction limit filter execution.
- When turning Enable to FALSE, execute while the slave axis is in stop status. If Enable is turned to FALSE during the slave axis in operation, the slave axis will stop immediately.

Details of setting items

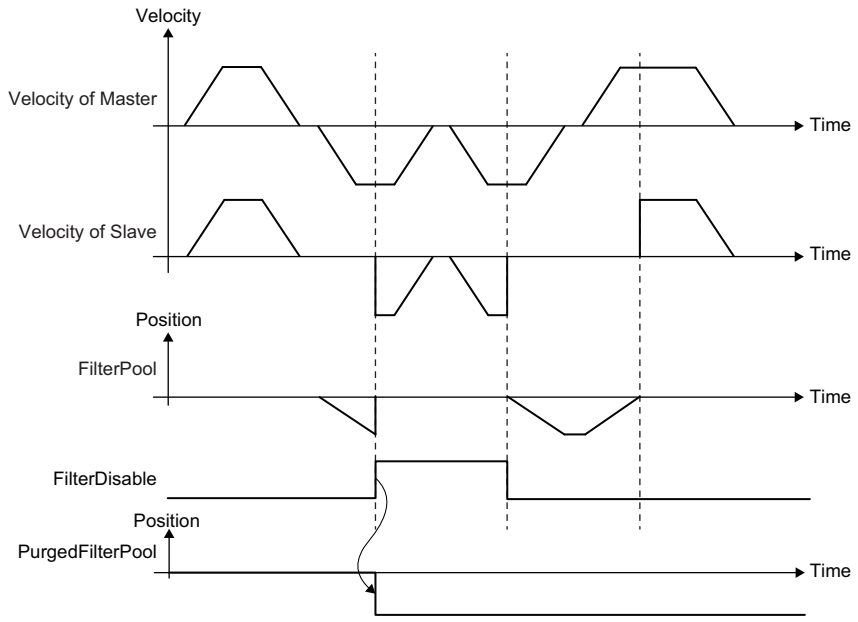
■FilterDisable (Filter disable)

- When FilterDisable is FALSE, the axis operates according to the filter setting.
- When FilterDisable is TRUE, the filter becomes disabled, and Master input is transmitted to Slave as it is.
- When FilterDisable is turned TRUE, FilterPool becomes "0", and stores the disposed FilterPool to the PurgedFilterPool.

Ex.

Examples of the following setting:

Input pin	Setting value
Filter	4: ClampWithoutRamp clamp (Without Ramp at Deceleration)
PositiveDisable	FALSE
NegativeDisable	TRUE

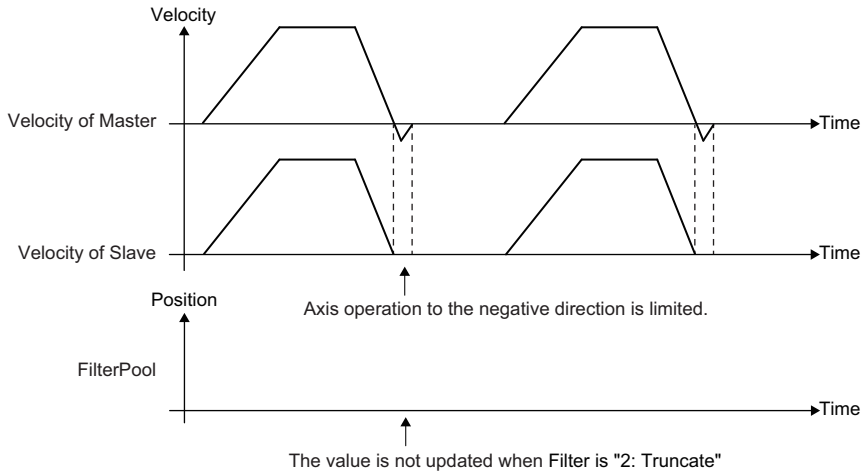
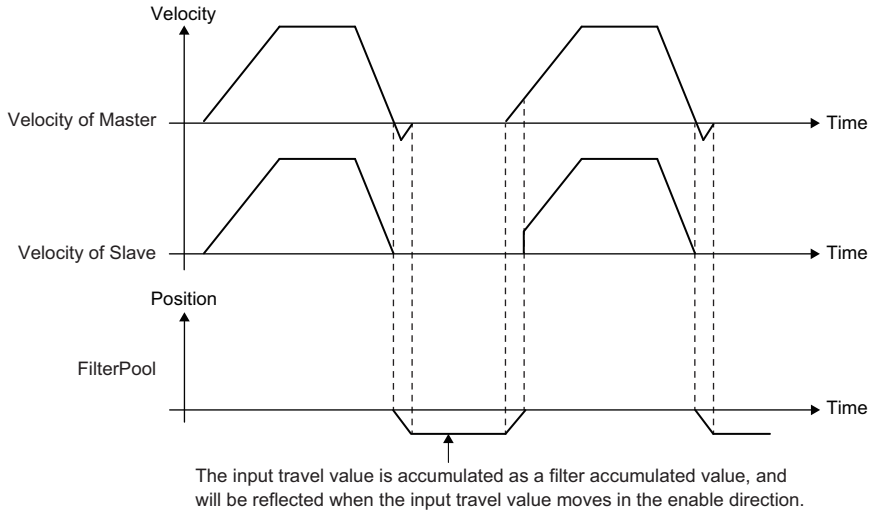


■PositiveDisable (Positive direction limit)/NegativeDisable (Negative direction limit)

- When PositiveDisable is TRUE, the Slave does not operate at Master forward rotation operation.
- When NegativeDisable is TRUE, the Slave does not operate at Master reverse rotation operation.
- When both PositiveDisable and NegativeDisable are set TRUE, the Slave will not operate even if the Master is operated.

■Filter (Filter operation)

• Depending on the Filter setting, set the slave axis operation at control.

Filter	Operation overview
0: Ignore (Ignore)	• Travel direction is not restricted. • FilterPool is not updated
2: Truncate (Truncate)	• The movement amount to the restricted direction is ignored, and not added to FilterPool. • The movement amount to the restricted direction will be truncated, and the position relation between the master axis and the slave axis equivalent of movement amount to the restricted direction will deviate. (Ex.) When PositiveDisable is FALSE, and NegativeDisable is TRUE 
4: ClampWithoutRamp Clamp (Without Ramp at Deceleration)	• Adds movement amount of the restricted direction to FilterPool. • FilterPool, reflects to the reverse direction movement. Thus, even the operation to the restricted direction is repeated, the position relation between the master axis and the slave axis with FilterPool "0" will not deviate. (Ex.) When PositiveDisable is FALSE, and NegativeDisable is TRUE 

• When setting the out of range value to Filter, the error "Out of Filter Operation Specification Range" (error code: 1A86H) is output.

■FilterPool (Filter cumulated value)

• FilterPool indicates the slave axis movement amount cumulated by filter processing.

• When FilterPool status is other than "0", and turns Enable FALSE, FilterPool holds the status at FALSE set. FilterPool, is cleared when turning Enable TRUE next time.

• If FilterPool value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) is output. For values of the positioning range, refer to the following.

☞ Page 79 Positioning Range

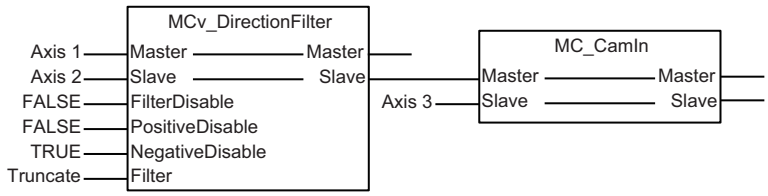
■PurgedFilterPool (Disposed Filter cumulated value)

- PurgedFilterPool, when turns FilterDisable TRUE, displays the disposed FilterPool.
- PurgedFilterPool does not cumulate.
- PurgedFilterPool is 0 cleared at FB start.

Program examples

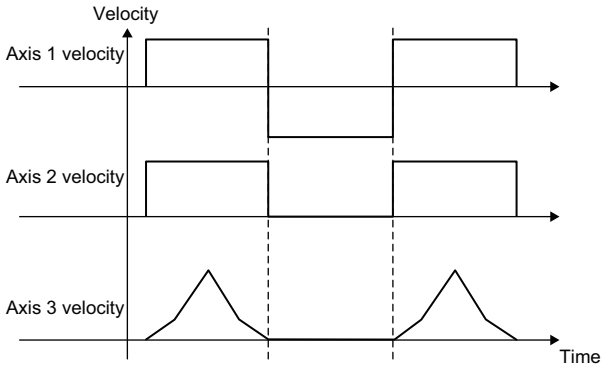
Cam operation direction restriction

[Program]



[Operation]

When MCv_DirectionFilter Master moves to the negative direction, Slave does not move to the negative direction.



Required objects

For details, refer to the following.

☞ Page 473 Required Slave Object

Speed limit filter

- The speed limit filter, to the input velocity of the master axis, sets a specified control value, and outputs the speed of the set control value to the slave axis.
- The speed limit filter, outputs the result of filter processing that executed to the Master value set in MasterValueSource to Slave.
- The slave axis status (AxisName.Md.AxisStatus) will be "7: 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 the error "Start Not Possible" (error code: 1AADH) will occur. Start when the slave axis status (AxisName.Md.AxisStatus is "4: Standstill".
- MC_Stop is the only function block that can be multiple started during speed limit filter execution.
- When turning Enable to FALSE, execute while the slave axis is in stop status. If Enable is turned to FALSE during the slave axis in operation, the slave axis will stop immediately.

Details of setting items

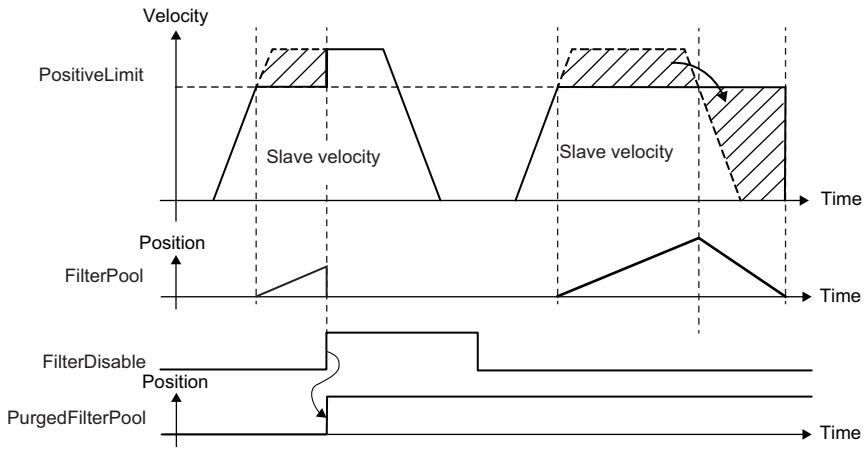
■FilterDisable (Filter disable)

- When FilterDisable is FALSE, the axis operates according to the filter setting.
- When FilterDisable is TRUE, the filter becomes disabled, and Master input is transmitted to Slave.
- When FilterDisable is turned TRUE, FilterPool becomes "0", and stores the disposed FilterPool to PurgedFilterPool.

Ex.

Examples of the following setting:

Input pin	Setting value
PositiveFilter	4: ClampWithoutRamp clamp (Without Ramp at Deceleration)

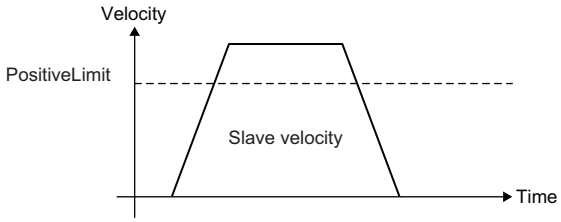
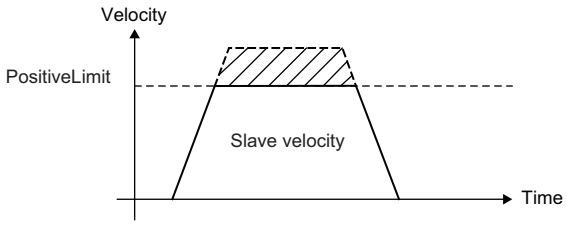
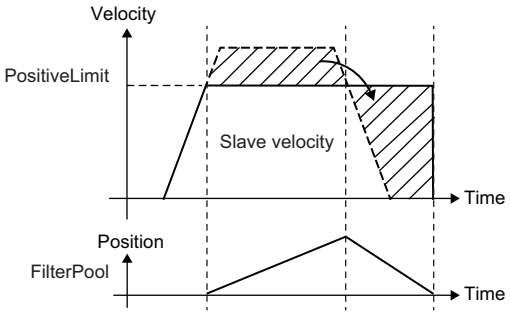
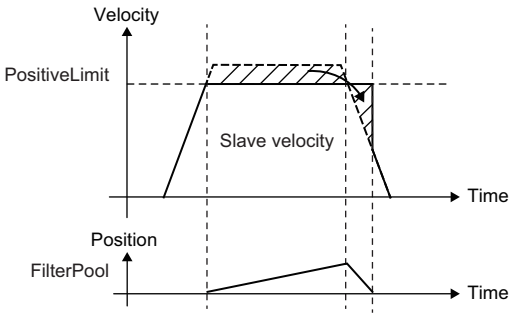


■PositiveLimit (Positive direction limit)/NegativeLimit (Negative direction limit)

- PositiveLimit, to the Master positive direction input speed, sets the upper limit value of the speed output to the Slave.
- NegativeLimit, to the Master negative direction input speed, sets the upper limit value of the speed output to the Slave.
- When "0" is set to the control value, the slave axis does not operate to the applicable direction.
- When out of range value is specified to PositiveLimit/NegativeLimit, the error "Out of Direction Limit Value Specification Range" (error code: 1A87H) is output.

■PositiveFilter (Positive direction filter operation)/NegativeFilter (Negative direction filter operation)

- Depending on PositiveFilter and NegativeFilter setting, set the slave axis operation at control.

Filter operation	Operation overview
0: Ignore (Ignore)	• Speed is not limited. • FilterPool is not updated. 
2: Truncate (Truncate)	• The exceeded control value, is not output to the Slave. • The restricted movement amount will be truncated, and that amount, the position relation between the master axis and the slave axis will deviate. 
4: ClampWithoutRamp (Clamp) (Without Ramp at Deceleration)	• The exceeded control value is cumulated as FilterPool, and output later. FilterPool output does not operates deceleration. • When 0 is set to the control value, all the master axis input to the applicable direction will be cumulated as FilterPool, and will not output later to the slave axis. The cumulated amount will be subtracted by the reverse direction master axis input, and will not operate until FilterPool is 0. [When Filter cumulated value is greater than the decelerated distance]  [When Filter cumulated value is smaller than the decelerated distance] 

- When out of range value is set to PositiveFilter or NegativeFilter, the error "Out of Filter Operation Specification Range" (error code: 1A86H) is output.

■FilterPool (Filter cumulated value)

- FilterPool indicates the slave axis movement amount cumulated by filter processing.
- When FilterPool status is other than "0", and turns Enable FALSE, FilterPool holds the status at FALSE set. FilterPool, is cleared when turning Enable TRUE next time.
- If the FilterPool value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) will occur. For values of the positioning range, refer to the following.

☞ Page 79 Positioning Range

■PurgedFilterPool (Disposed filter cumulated value)

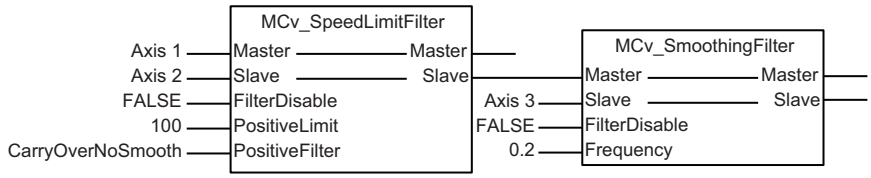
- PurgedFilterPool, when turns FilterDisable TRUE, displays the disposed FilterPool.
- PurgedFilterPool does not cumulate.
- PurgedFilterPool, is 0 cleared at FB start.

Program examples

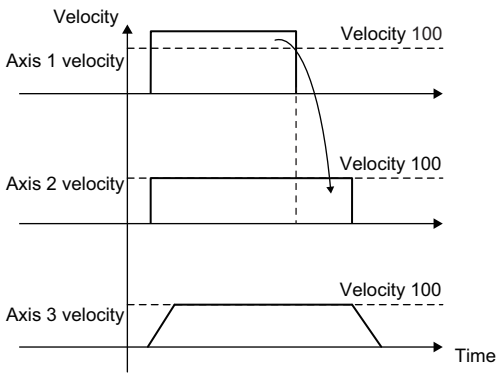
Synchronous encoder speed limit

[Program]

The axis 1 sets the synchronous encoder.



[Operation]



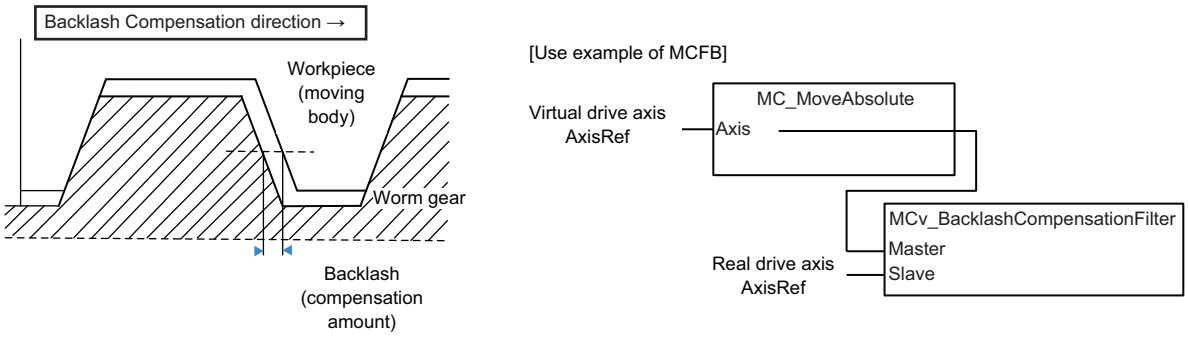
Required objects

For details, refer to the following.

☞ Page 473 Required Slave Object

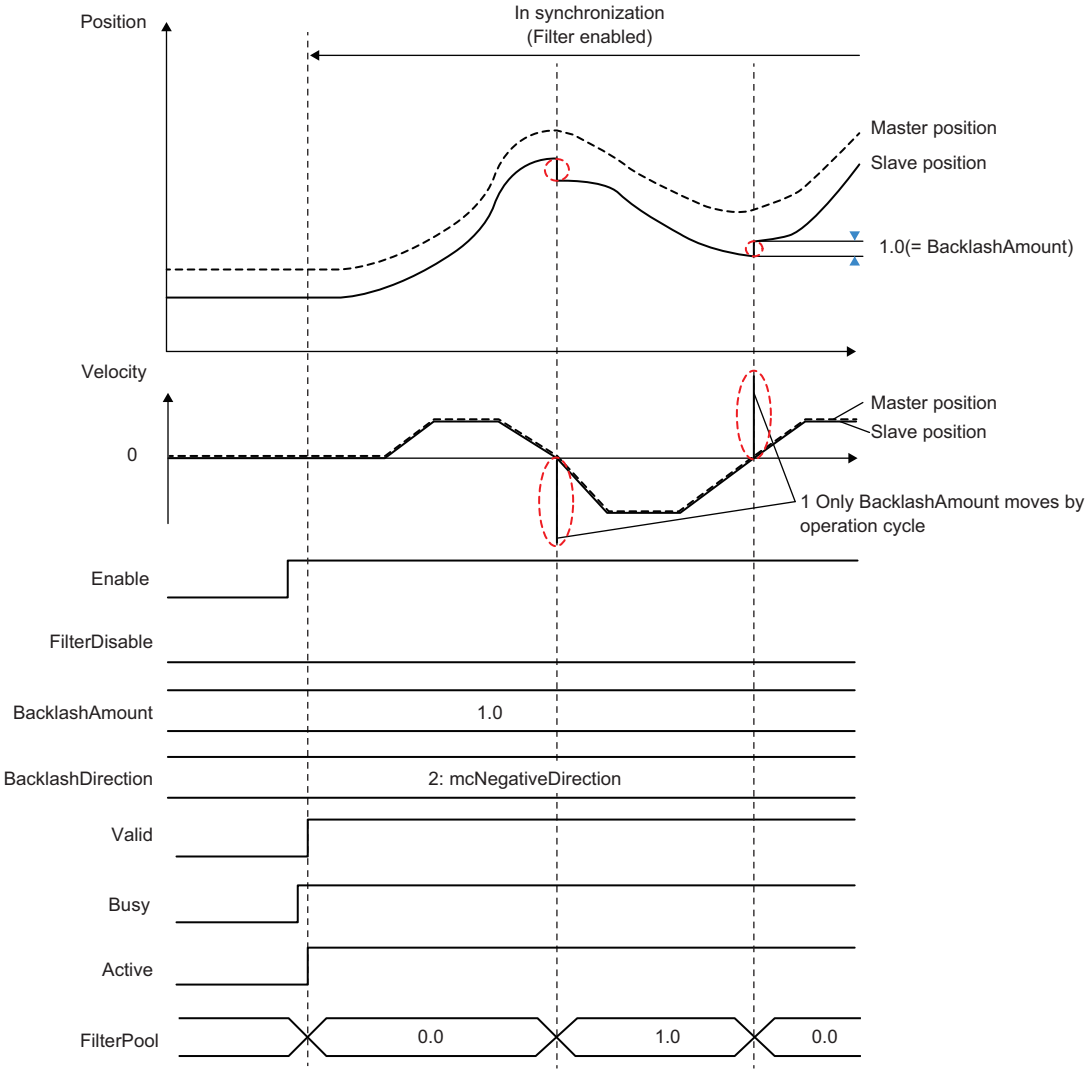
Backlash compensation filter

Backlash compensation filter, is used to compensate the backlash amount in the machine system.



When the travel direction of Master and BacklashDirection are same, Slave synchronizes to Master current direction shifts to the position equivalent to BacklashAmount amount to the BacklashDirection direction. When the travel direction of Mater and BacklashDirection are in reverse, Slave synchronizes to the Master current position.

Whenever Master travel direction changes, extra Slave movement amount occurs only to BacklashAmount, and executes the backlash compensation.



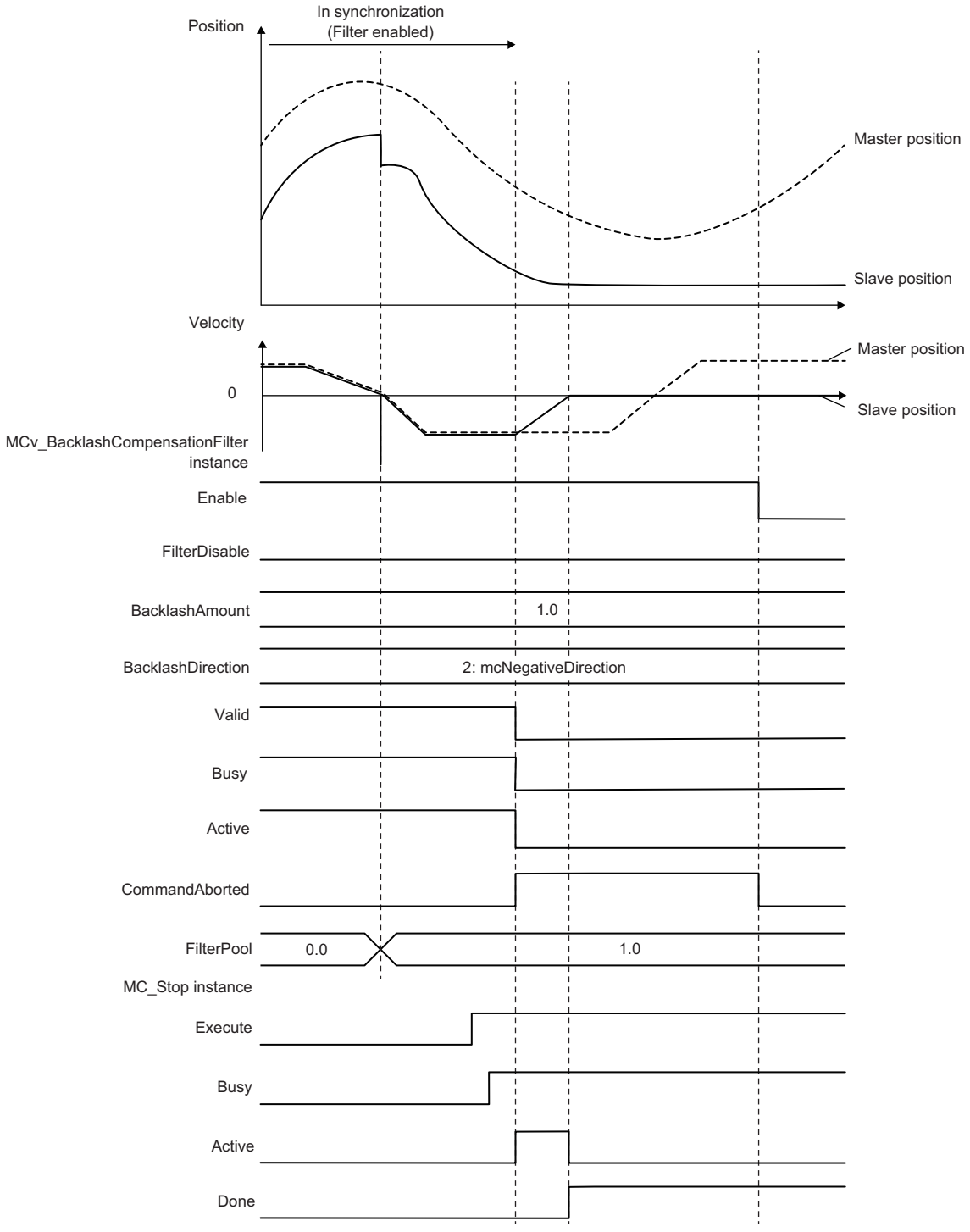
• Stop operation

For details, refer to the following.

☞ Page 472 Start and Stop Operation

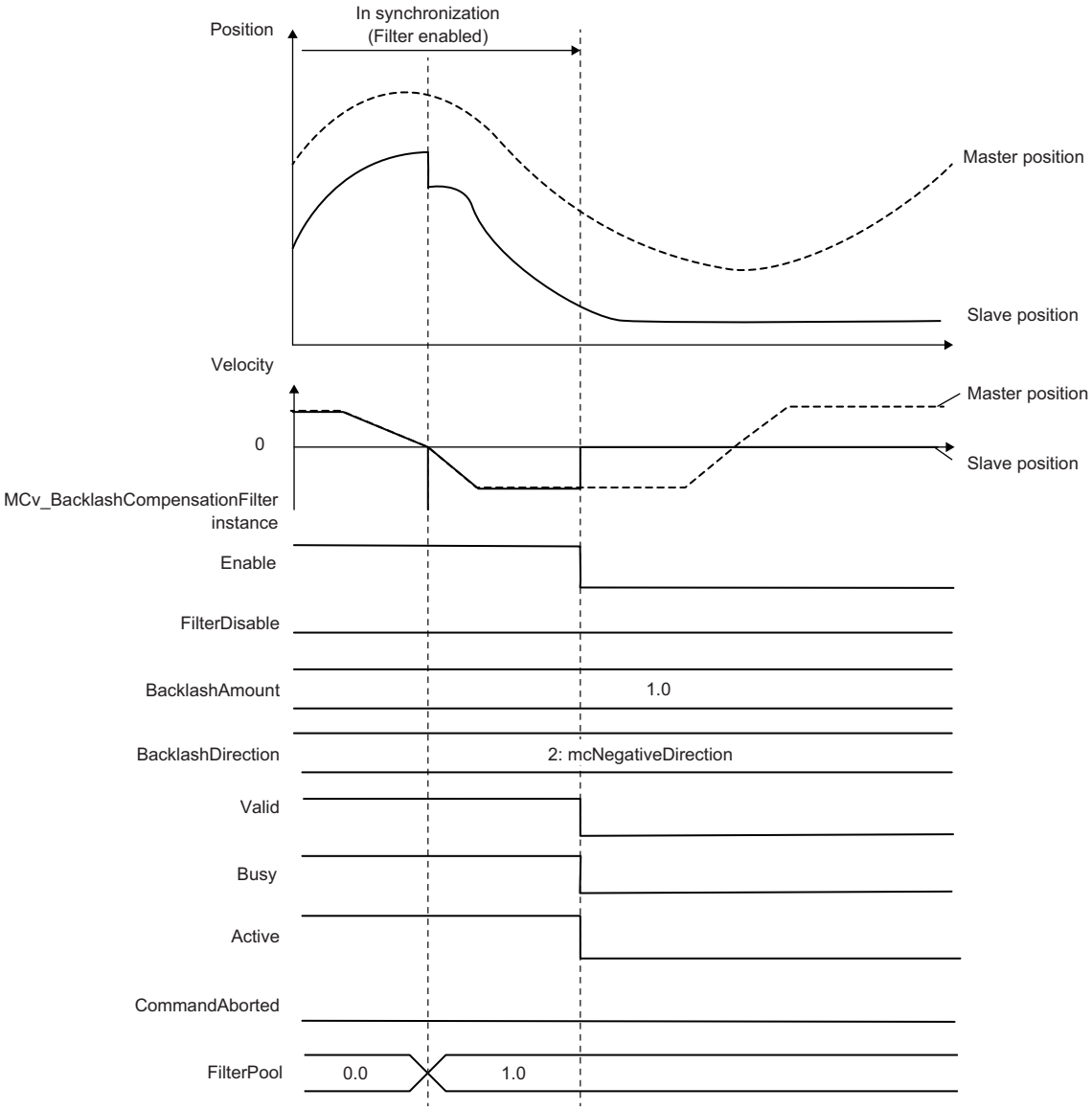
This section describes the spcific operation of the backlash compensation filter.

When stop factor occurs to Slave, Slave starts the stop operation from the synchronous position. The movement amount (FilterPool value) by the compensation will not be restored.



• Operation at Filter disabled (At Enable trailing edge)

Slave stops immediately at the synchronous position when Enable trail edged. The travel amount (FilterPool value) by the compensation will not be restored.



Details of setting items

■FilterDisable (Filter disable)

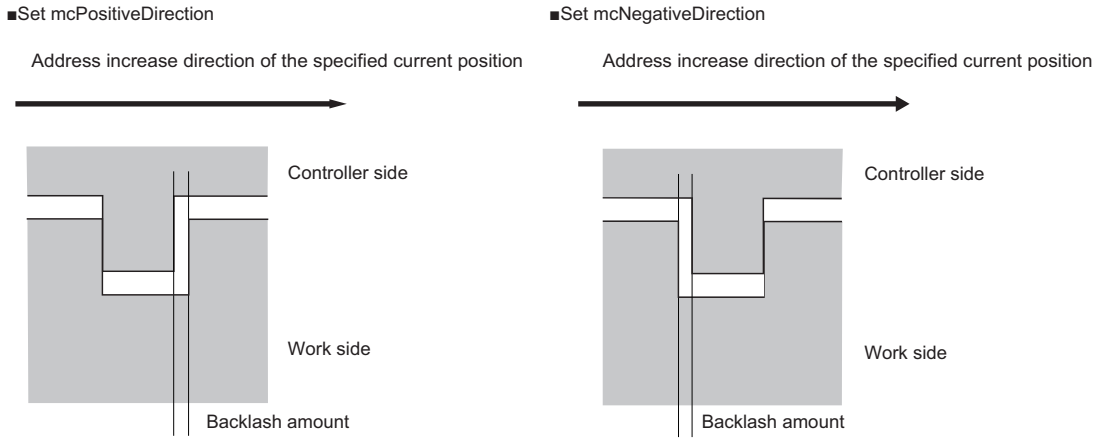
- When FilterDisable is FALSE, the axis operates according to the filter setting.
- When FilterDisable is TRUE, the filter becomes disabled, and Master input is transmitted to Slave.
- When FilterDisable is turned TRUE, FilterPool becomes "0", and stores the disposed FilterPool to the PurgedFilterPool.

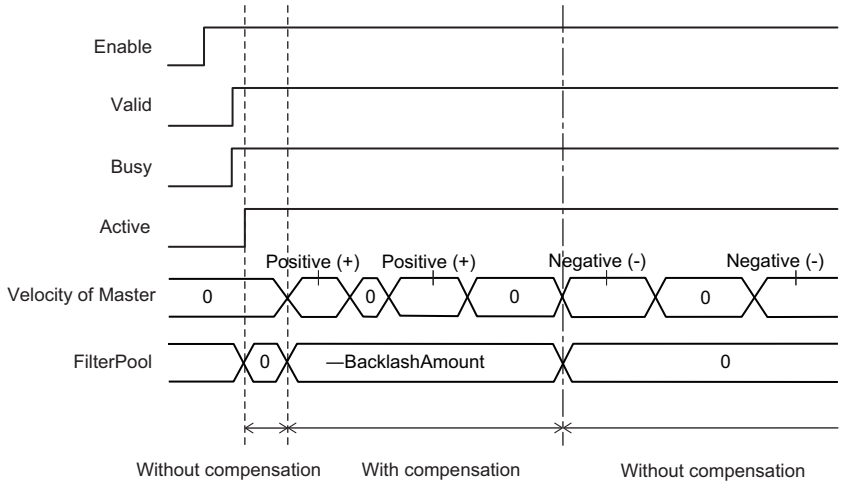
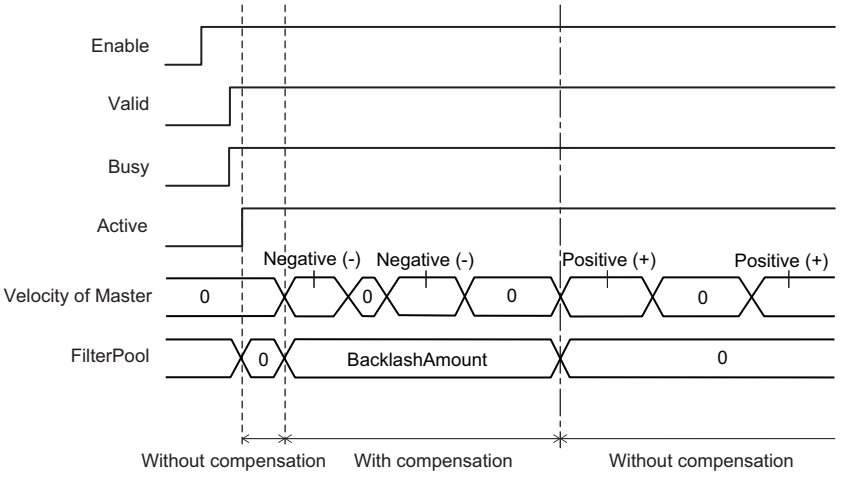
■BacklashAmount (Backlash amount)

- Sets the backlash amount of the machine system.

■BacklashDirection (Backlash compensation direction)

- Specifies the backlash compensation direction. Outputs the compensation amount to Slave when Master movement direction is BacklashDirection. When backlash compensation filter is enabled (Started with FilterDisable FALSE, or trail edged FilterDisable during execution), compensates to the address increase direction of the Master command current position that the backlash status of the machine system is in the following relation.



BacklashDirection	Operation overview
1: mcPositiveDirection (Positive direction)	• When the travel direction of Master is positive direction, Slave synchronizes to Master current direction shifts to the positive direction position equivalent to BacklashAmount. 
2: mcNegativeDirection (Negative direction)	• When the travel direction of Master is negative direction, Slave synchronizes to Master current direction shifts to the negative direction position equivalent to BacklashAmount. 

■FilterPool (Filter cumulate value)

- FilterPool, describes the movement amount of the slave axis cumulated by the filter processing.
  For backlash filter, the reversed value of FilterPool positive/negative will be the compensation amount transmitted to the slave axis.

■Options (Option)

Sets the function option to be used by specifying bit.

For bit and function description, refer to the following.

Bit	Function description
0 to15	Empty (Set 0.)*1
16	Enable filter initial status selection Selects the initial status of the backlash compensation filter at enable. 0: First compensation
17 to 31	Empty (Set 0.)*1

*1 When other than "0" is specified, the error "Out of Options Range" (error code: 1A4EH) will occur and will not start.

- Enable filter initial status selection

Selects the initial status of the backlash compensation filter at enable(When started with FilterDisable FALSE, or trail edged FilterDisable during execution).

Setting value	Description
0: First compensation	Despite Master current direction at filter enable, the filter operation starts following the position relation of Master and Slave current position do not add the backlash compensation.

■PurgedFilterPool (Disposed filter cumulated value)

- PurgedFilterPool, when turns FilterDisable TRUE, displays the disposed FilterPool.
- PurgedFilterPool does not cumulate.
- PurgedFilterPool, is 0 cleared at FB start.

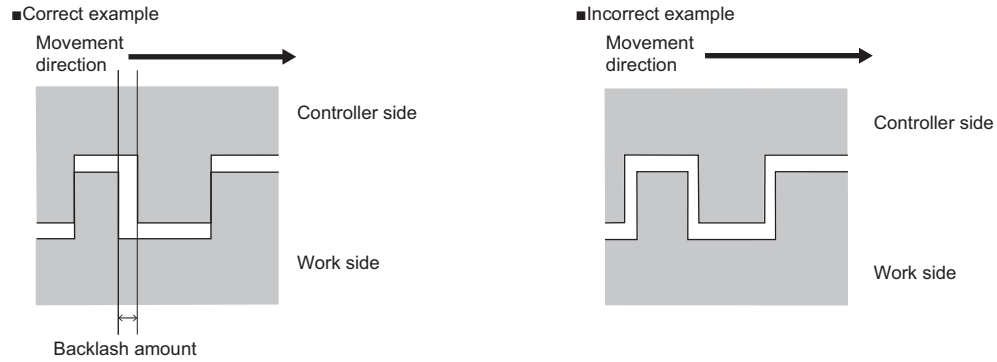
Backlash compensation filter enable procedure

Execute after the machine position is established by homing, or restart the backlash compensation filter after cancelling midway.

Ex.

The example is shown below.

1. Move the real drive axis by homing or JOG operation etc., and keep the status as backlash of the machine system has generated to one direction as an correct example shown below.

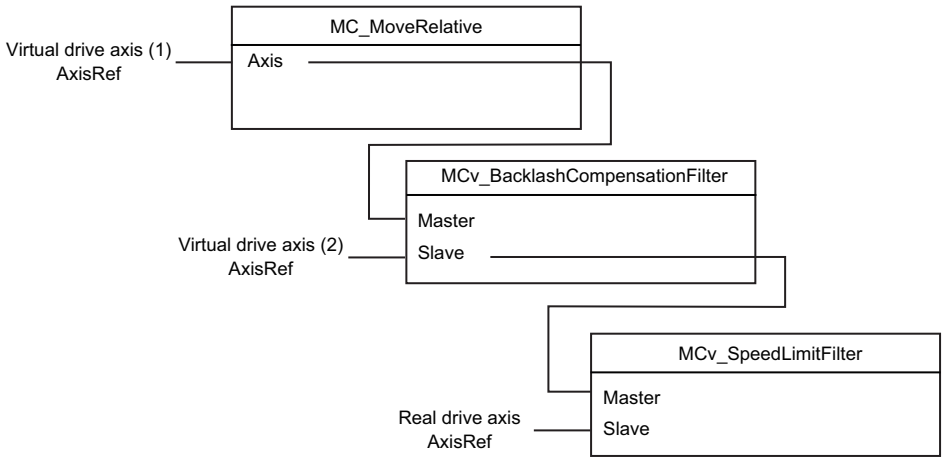


2. Due to the current position change etc., set Master command current position corresponds to the real drive axis command current position.
3. Set the reverse direction of the direction that the real drive axis in Ex1. has moved to, and start the backlash compensation filter. Also start the back part function block if any.

Program example

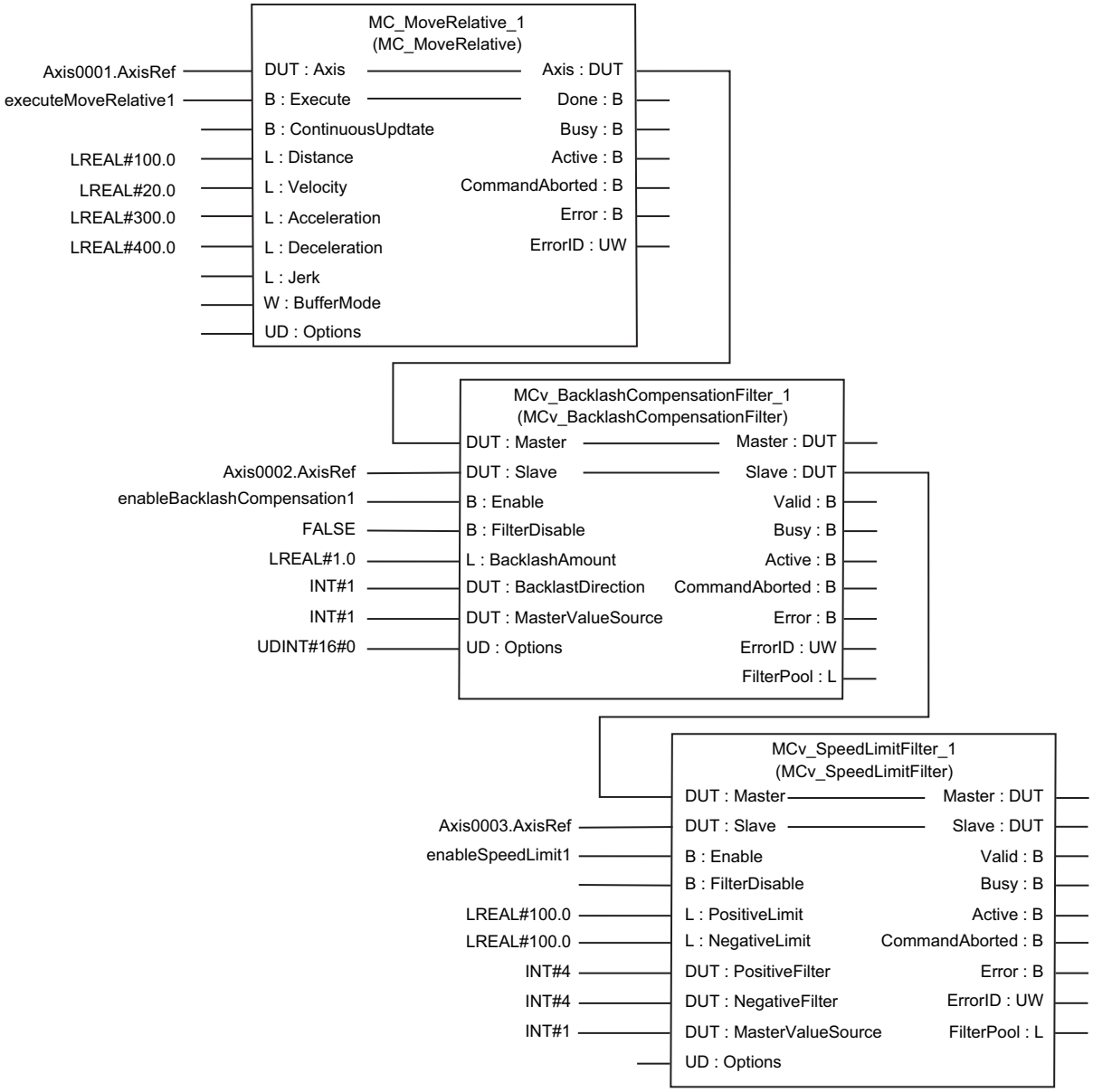
The usage examples of the backlash compensation filter in the program is shown below.

In the example the backlash compensation filter back part is connected with the speed limit filter as configured below.



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

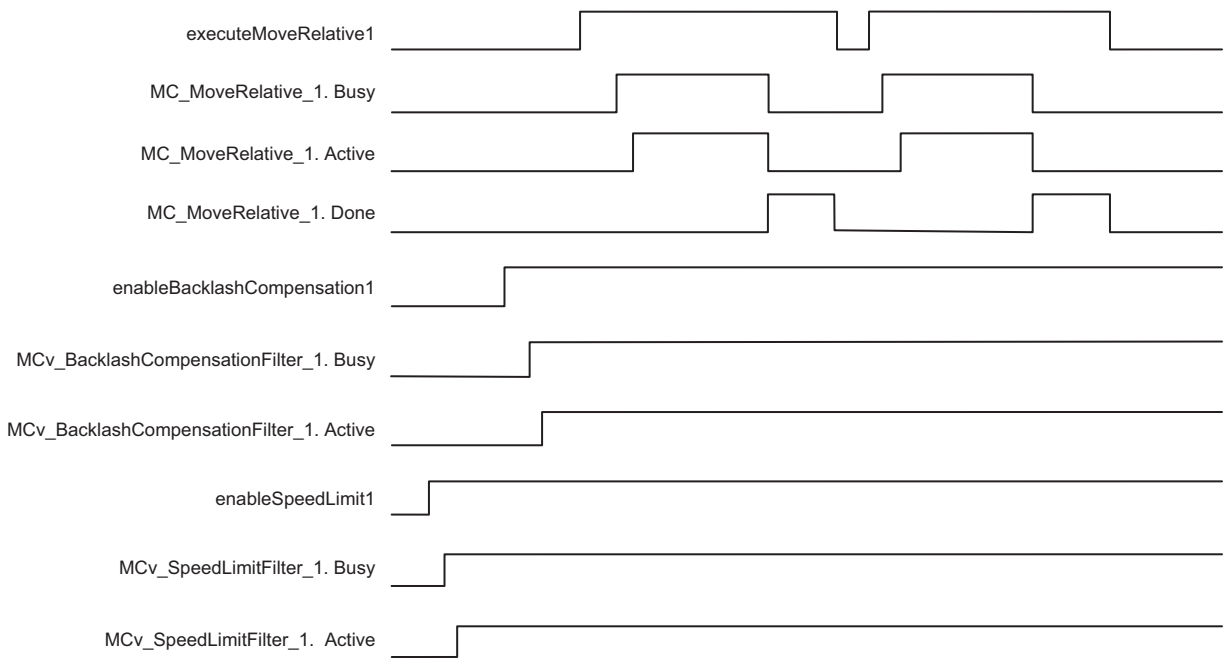
■Structured text (ST language)

```
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

- The backlash compensation is a function which the command direction and the backlash status should not change from the external force etc. The correct compensation will not be executed when used such as below.
  A machine which always weighed by external force unidirectionally such as upper and lower axis.
  A machanism (such as rack and pinion mechanism) which the backlash amount changes depending on the machine position.
- Only Slave BacklashAmount moves by one operation cycle at the time of Master movement direction changes. Depending on the value, it may exceed the command frequency that the speed limit value and the driver unit can accept, connect the speed limit filter or the smoothing filter to the backlash compensation filter back part.
- Slave current position (such as command current position, machine feed position etc.) will be the position that BacklashAmount compensation is added. BacklashAmount compensation will not be added to the Master current position.

Required objects

For details, refer to the following.

☞ Page 473 Required Slave Object

Precautions

- Note that if FilterDisable is switched during operation, Slave velocity may change rapidly.
- After enabling the command filter, when Master command is not transmitted to Slave or the back part synchronous control function block by stop factor occurs to Slave etc., the synchronous position relation deviates. Before enabling the command filter again, execute the synchronous positioning as needed.

11.3 Input Variable Change in Execution

- In the control whose start condition is Execute, data such as Position and Velocity can be re-imported without interrupting the operation by Execute retrigger.
- When ContinuousUpdate is TRUE at start, data such as Position and Velocity are imported at each execution cycle during operation.

This section describes the operation when changing the following input variables as a typical example of input variable change.

- Target position/movement distance
- Set velocity
- Acceleration/deceleration, Acceleration/deceleration time

For details of input variables that can be changed and the operation when changing input variables other than the above, refer to details of each FB.

Relevant variables

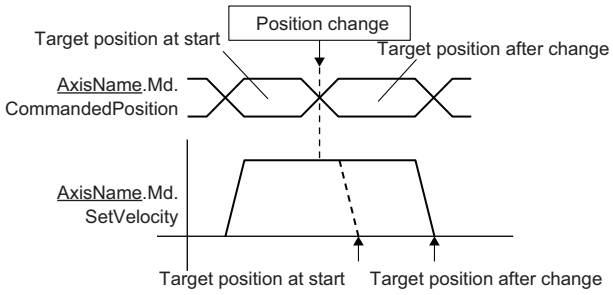
Variable/Structure name	Name	Details
AxisName.Pr.		
OverrunOperation	Operation setting at overrun	Sets operation when an overrun occurs during operation. 1: ImmediateStop (Immediate Stop) 2: KeepCurrentAcc (Keep Current Acceleration/Deceleration)
AxesGroupName.Pr.		
OverrunOperation	Operation setting at overrun	Sets operation when an overrun occurs during operation. 1: ImmediateStop (Immediate Stop) 2: KeepCurrentAcc (Keep Current Acceleration/Deceleration)

Target position/movement distance change

This function changes the target position and the movement distance.

Target position change

The target position is changed.

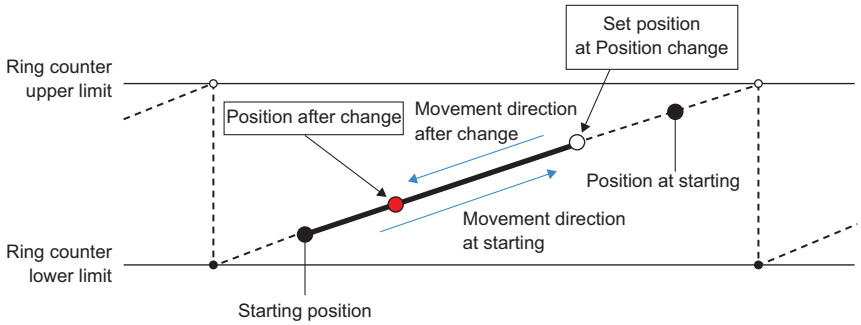


When Direction can be set, the operation when changing the target position differs depending on the setting value.

■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 set direction.

When the target position is changed to 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 bit5).



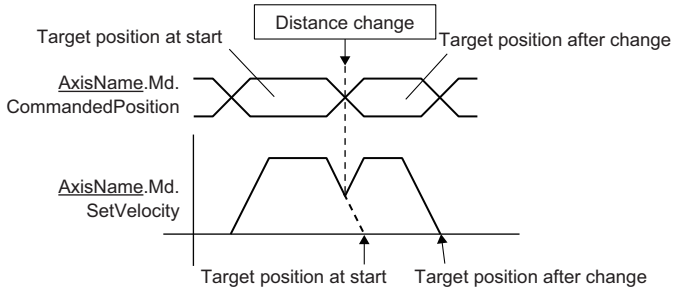
■For the shortest path

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.



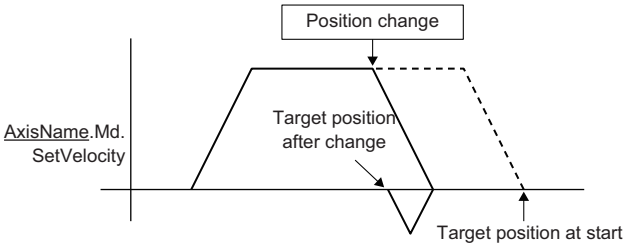
If the movement distance after change is shorter than the moved distance at movement distance change execution, the operation will be reversed, and the control will be performed according to the selection when having reverse rotation permission selection (Options bit5).

The deceleration distance is not kept by the target position/movement distance change

The control is performed according to the selection when having AxisName(AxesGroupName).Pr.OverrunOperation and reverse rotation permission selection (Options bit5).

■When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options bit5), a deceleration stop is performed once regardless of the AxisName.Pr.OverrunOperation setting. After the deceleration stop is completed, operation is started to the changed target position.

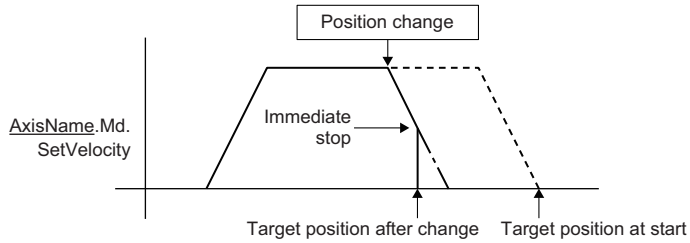


■When the reverse rotation is not allowed

When "1: Not allow" is set to the reverse rotation permission selection (Options bit5), the axis operates according to the AxisName.Pr.OverrunOperation setting.

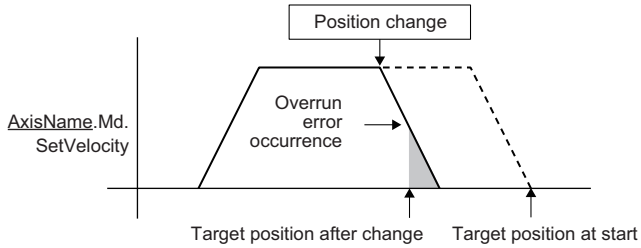
• When "1: ImmediateStop" is set

Deceleration is started, and the axis immediately stops after the warning "Overrun Warning" (warning code: 0D10H) is output when it reaches the stop address.



• When "2: KeepCurrentAcc" is set

The deceleration is started, and the axis exceeds the stop address and stops. When the axis exceeds the stop address, the error "Overrun Error" (error code: 1A7EH) is output.However, the operation stops according to the setting of AxisName.Pr.StopMode_General when the error occurs. To stop the operation with the address which exceeds the stop address, set "2: KeepCurrentAcc" in AxisName.Pr.StopMode_General.

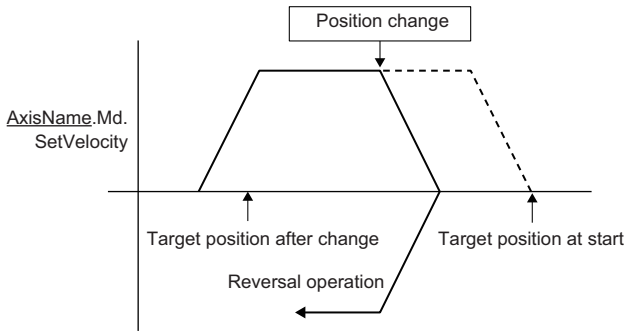


When an operation is reversed by changing the target position/movement distance

When 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 bit5).

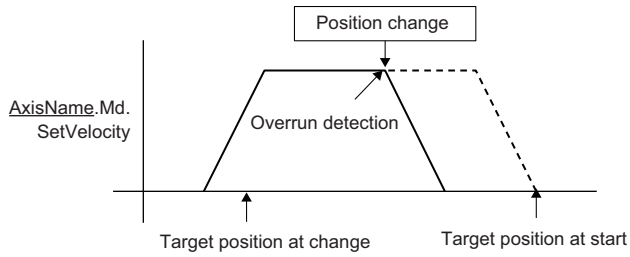
■When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options bit5), a deceleration stop is performed once. After the deceleration stop is completed, operation is started to the changed target position.



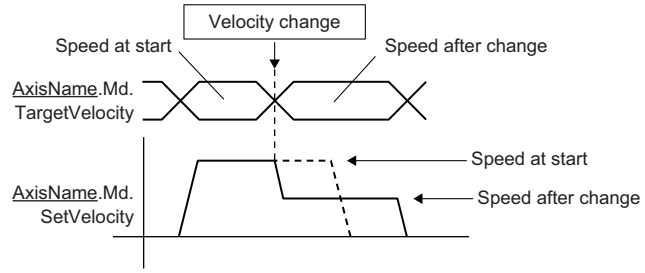
■When the reverse rotation is not allowed

When "1: Not allow" is set to the reverse rotation permission selection (Options bit5), a deceleration stop is performed regardless of the AxisName.Pr.OverrunOperation setting. When the target position/movement distance is changed, the error "Overrun Error" (error code: 1A7EH) is detected.



Set velocity change

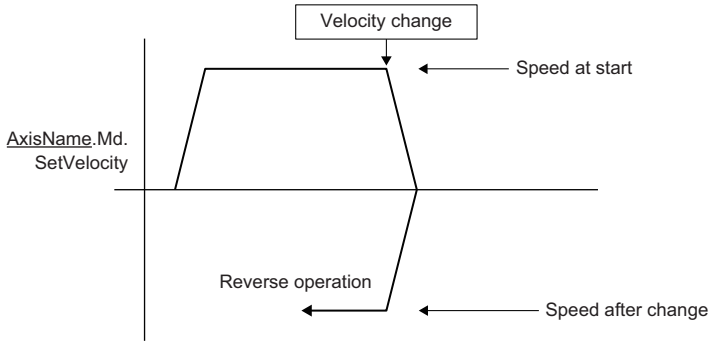
The set velocity is changed according to the acceleration/deceleration.



Set velocity sign inversion during speed control

The negative speed can be set in the speed control.

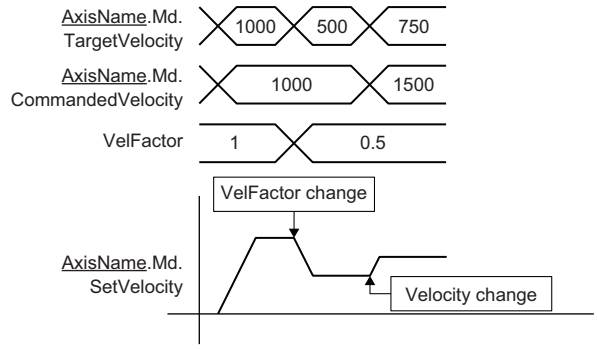
When the sign of set velocity is reversed, the reverse operation will start after a deceleration stop.



Combination with override

The velocity override factor also affects when the speed is changed.

The speed is changed to the speed obtained by adding the velocity override factor to the change speed.



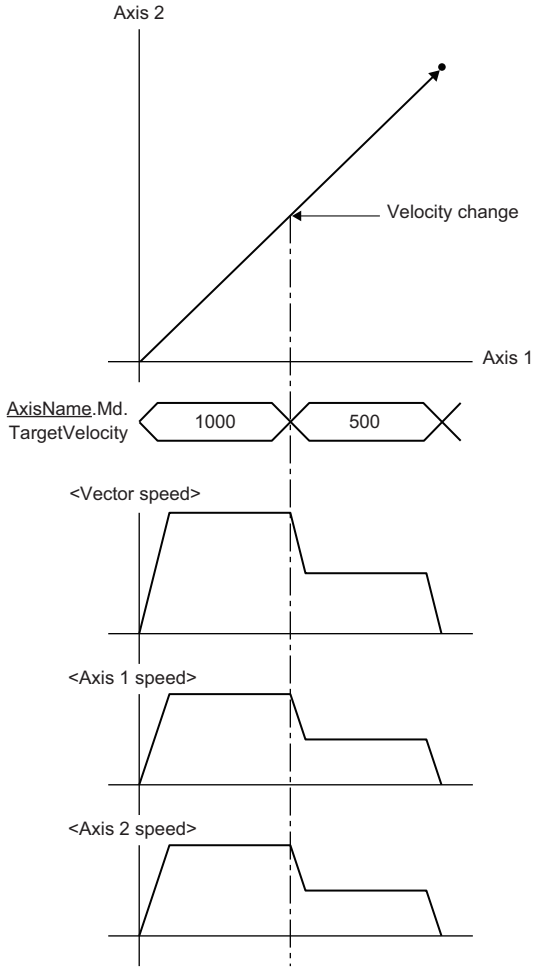
Operation during interpolation control

When the set velocity is changed during the interpolation control, the set velocity is changed according to the acceleration/deceleration method or the acceleration.

Each axis speed is changed according to the velocity mode.

Ex.

When the vector speed is set in the velocity mode



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 AxisName(AxesGroupName).Pr.OverrunOperation.

For operation when changing the acceleration/deceleration and the acceleration/deceleration time, refer to the following.

☞ Page 312 Acceleration/deceleration Processing Function

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 of each FB.

12 COMMON FUNCTIONS

12.1 External Signal Selection

This section describes a setting method of I/O signals which are used in each control.
The following indicates the functions that use external signal selection.
☞ Page 176 Forced Stop
☞ Page 306 Hardware Stroke Limit

Relevant variables

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.

Variable/Structure name		Name
MC_TRIGGER_REF		
	Signal (SIGNAL_SELECT structure)	Trigger signal
MC_INPUT_REF		
	Signal (SIGNAL_SELECT structure)	Input signal
MC_OUTPUT_REF		
	Signal (SIGNAL_SELECT structure)	Output signal

For the configuration of each structure, refer to the following.
☞ Page 640 List of Variables
The following shows specifications of structures common for each function, the SIGNAL_SELECT structure and the TARGET_REF structure.

SIGNAL_SELECT structure

This section describes SIGNAL_SELECT structure.

Variable/Structure name		Name
SIGNAL_SELECT		Signal select
	Source	Signal
	Detection	Signal detection method
	CompensationTime	Compensation time
	FilterTime	Filter time

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 shown below.

Signal name

- Specify BOOL type signals which are used in control with the TARGET_REF structure. Data types of [VAR], [DEV], [CONST] and [OBJ] can be used.
- For operation when a signal which cannot be used is set, refer to each function.

Signal Logic

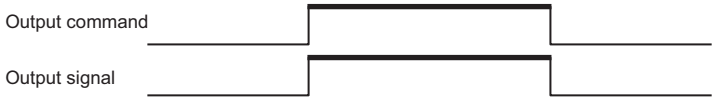
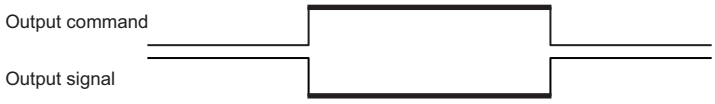
- Specify the signal logic with the MC_SIGNAL_LOGIC enumeration type. For details, refer to the following.

☞ Page 664 ENUM enumerator

■Bit input signals

Setting	Operation
0: HighLevel	When the corresponding signal is in the TRUE status, it operates as a signal input status.
1: LowLevel	When the corresponding signal is in the FALSE status, it operates as a signal input status.
2: RisingEdge	When the corresponding signal turns from FALSE to TRUE, it operates as a signal input timing.
3: FallingEdge	When the corresponding signal turns from TRUE to FALSE, it operates as a signal input timing.
4: BothEdges	When the corresponding signal turns from FALSE to TRUE and vice versa, it operates as a signal input timing.

■Bit output signals

Setting	Operation
0: HighLevel	When the output command is TRUE, the corresponding signal is turned to TRUE. 
1: LowLevel	When the output command is TRUE, the corresponding signal is turned to FALSE. 
2: RisingEdge	Must not be specified.
3: FallingEdge	Must not be specified.
4: BothEdges	Must not be specified.

- Selectable logics vary depending on the function. For details, refer to each function.

Compensation time

- Specify the compensation time in seconds.
- Set a positive value to compensate the delay of the input signal, and set a negative value to compensate the lead.
- Set a positive value to delay the output timing of the output signal, and set a negative value to hasten it. When compensated output timing is earlier than the current time, output is immediately carried out.
- Whether the compensation time can be used or not is depending on the function. For details, refer to each function.

Filter time

- Specifies the filter time in seconds to remove chattering of the input signal. During the time that the signal status specifies, it is reflected to the input/output only when the same value is continued. The timing of input/output is delayed for the filter time.
- The availability of the filter time differs according to functions. For details, refer to each function.

TARGET_REF structure

This section describes the TARGET_REF structure.

Variable/Structure name		Name
TARGET_REF		Input signal
	StartIO	IO No.
	Target	Target

Specify a signal which is used in the control in Target of the TARGET_REF structure with the following character string format.
[Classification](Type)Data name.Bit position@Target modification
or
[Classification](Type)WSTRING type label^

Point

Up to 643 characters can be stored in Target. When specifying more than 643 characters string format, 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 and data name

Specify the data type in [Classification] and the target data in Data name. The specifying method of the data name varies depending on the classification.

Classification	Target	Specifying method of data name	Example
[OBJ]	CANopen object of the slave device	[OBJ]0xXXXXYYZZ XXXX: Specify the object index. YY: Specify the object sub index. ZZ: Specify the object size (Number of bit). (Ex: For 4 byte object, ZZ = 20H) Specifying the target device may be required in @Target modification. Check the specification of the function.	[OBJ]0x607A0020
[VAR]	Label of the motion system	[VAR]Label name Specify a label in the motion system includes in Label name. When specifying the local label, specify the POU*1 name in @Target modification. For whether the local label can be set or not and the conditions that the setting is enabled, check the specification of the function.	[VAR]ADunit10.OutputEnable
[AXIS]	Axis data	[AXIS]MC_SOURCE Specify a MC_SOURCE enumeration type enumerator in MC_SOURCE. Specifying the target data may be required in @Target modification. Check the specification of the function. Only the data type "LREAL" can be specified. This data cannot be written.	[AXIS]mcSetValue
[DEV]	Device in the motion system (Including buffer memory and link device of the module itself)	[DEV]Device name Specify a device in the module itself in Device name. For devices that can be specified, refer to the following. ☞ Page 696 Variables @Target modification cannot be specified. (It is ignored.)	[DEV]RWr10.5 [DEV]G10000.1
[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. This data cannot be written.	[CONST]1000 [CONST]0x100

*1 POU: Program Organization Unit

■MC_SOURCE

MC_SOURCE enumeration type enumerators are shown below. Check the specifications of the function to be used for the enumerators that can be specified.

○: Can be specified, ×: Cannot be specified

Classification	Target	Modification	
		@Position	@CumulativePos
1: mcSetValue (Set value)	Set value of previous operation cycle	○	○
2: mcActualValue (Actual value)	Actual value of previous operation cycle	○	×
101: mcLatestSetValue (Latest set value)	Set value of latest operation cycle	○	○
102: mcLatestActualValue (Latest actual value)	Actual value of latest operation cycle	○	×

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.

The following types can be specified.

(BOOL)
(INT)
(DINT)
(WORD)
(DWORD)
(REAL)
(LREAL)

When the type of data by itself specified at [Classification] specifies (BOOL) to the data other than BOOL type, it will be handled as bit position .0 is omitted if it is not specifically specified in each function description.

Ex.
[DEV](BOOL)G10000, will be handled as [DEV](BOOL)G10000.0.

Bit position

When .Bit position is added to the data whose [Classification] is [OBJ], [VAR] (only WORD type, DWARD type, INT type, DINT type) and [DEV], the data is dealt with as BOOL type data. From 0 to F can be used for the bit position. When (Type) and .Bit position are simultaneously specified, (Type) is ignored and the data becomes BOOL type data.

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. When specifying the target modification for data types and function that do not require it, the specification will be ignored.

Classification	Target modification details		Setting example
[OBJ]	Specify the station address (address information to distinguish slave devices.)		
	IP address specifying	@XXX.XXX.XXX.XXX Write in decimal format.	@ 192.168.3.10
	Network No./station No. specifying	@Network No. - Station No. Write in decimal format.	@ 192-10
	Axis label specifying	@Axis label Write axis label.	@Roller
	Multidrop No.	#Multidrop No. Like multi-axis drive unit, when one station includes multiple logic axes, specify the No. in order to distinguish logic axes. Write in decimal format. 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.).	@ 192.168.3.10#2
[VAR]	@POU name*1 Use it when specifying the local label.		
[AXIS]	@Position @CumulativePos Specify the target data (position).		@Position @CumulativePos
[CONST]	@+adding value or @-subtracting value Each time referring the value, it is used to change the read value.		*2

*1 POU: Program Organization Unit
*2 The referred value set as [CONST] (INT) 0 @ -10 will be as 0, -10, -20, -30, ….
The referred value set as [CONST] (BOOL) 0 x 00.3 @ + 1 switch TRUE/FALSE every eight (23) cycle. (1 byte value +1 will be added in every cycle and retrieves bit 3 status)
Specifying [CONST] bit can be used from 0 to 7.

Common rule

- Capital letters and lower case letters are not distinguished.
- The space is ignored.

12.2 Touch Probe

This function records (latches) arbitrary data at trigger input signal detection.

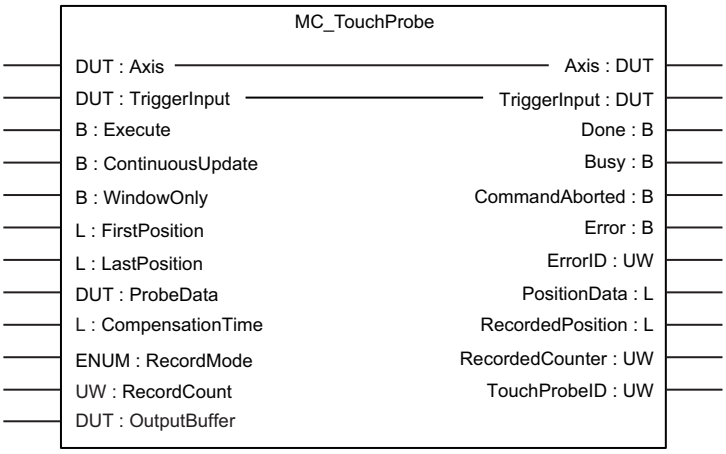
Operation of this function for each system status

○: Possible, ×: Not possible

System Status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant FBs

MC_TouchProbe

Item	Description
Function overview	Optional data will be recorded due to the trigger event occurence.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
480	28	Subroutine type	Real-time execution

■I/O variables

Input import: ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission not possible	☞ Page 398 External Signal Selection

■Input variables

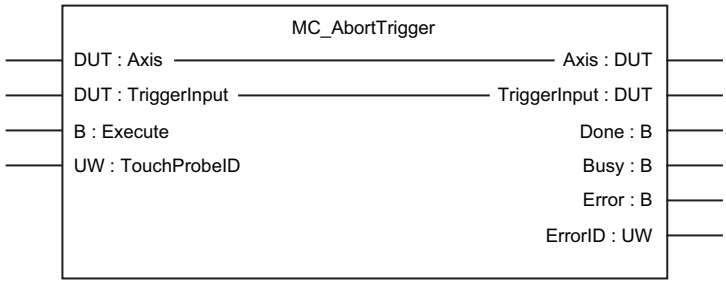
Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	—	FALSE	During TRUE, it can continuously change the enabled window, the first position, and the last position.
Enabled window	WindowOnly	BOOL	↑/R/C	—	FALSE	When it is TRUE, triggers are detected only in the defined area.
Lower limit position	FirstPosition	LREAL	↑/R/C	—	0.0	Specifies the lower limit position of the trigger event valid area. The valid area includes the lower limit position.
Upper limit position	LastPosition	LREAL	↑/R/C	—	0.0	Specifies the upper limit position of the trigger event valid area. The valid area includesthe upper position.
Probe data	ProbeData	TARGET_REF	↑	—	—	Sets the probe data. ☞ Page 400 TARGET_REF structure
Compensation time	CompensationTime	LREAL	↑	-5.0 to 5.0 [s]	0.0	Compensates the delay time of the touch probe process. Set a positive value to compensate for a delay.
Latch mode	RecordMode	MC_RECORD_MODE	↑	0 to 2	0	Sets the latch method of the data. 0: OneShot: One shot mode 1: RecordCount: Number of designation times mode 2: RingBuffer: Ring buffer mode
Number of latch times	RecordCount	WORD(UINT)	↑	1 to 65535	1	Sets the number of latch times.
Storage location of latch data	OutputBuffer	TARGET_REF	↑	—	—	Sets the storage location of latch data. When it is omitted, latch data is output only in RecordedPosition.

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	When TRUE, it indicates the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that an execution of FB is aborted by error and multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
The current value monitor data	PositionData	LREAL	0.0	Stores the current value of data to be latched.
Latch position	RecordedPosition	LREAL	0.0	Stores the current value when a trigger event is occurring. When latch is executed multiple times, the data is overwritten by the latest data.
Number of latch times	RecordedCounter	WORD(UINT)	0	Stores the number of times that latch is executed.
Probe ID	TouchProbeID	WORD(UINT)	0	Stores the ID unique to this FB.

MC_AbortTrigger

Item	Description
Function overview	Disables the latch in execution.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
172	6	Subroutine type	Real-time execution

■I/O variables

Input import: ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission possible	☞ Page 641 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission possible	☞ Page 398 External Signal Selection

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Touch probe ID	TouchProbeID	WORD(UINT)	↑	1 to 65535	0	Sets a proper ID of touch probe to invalidate.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	When TRUE, it indicates the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When ON, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Touch probe valid

This is a function that arbitrary data is recorded (latch) at the timing of detecting the trigger input signal.
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. To stop this function, execute MC_AbortTrigger.
When a trigger event occurs, the operation becomes as shown below.

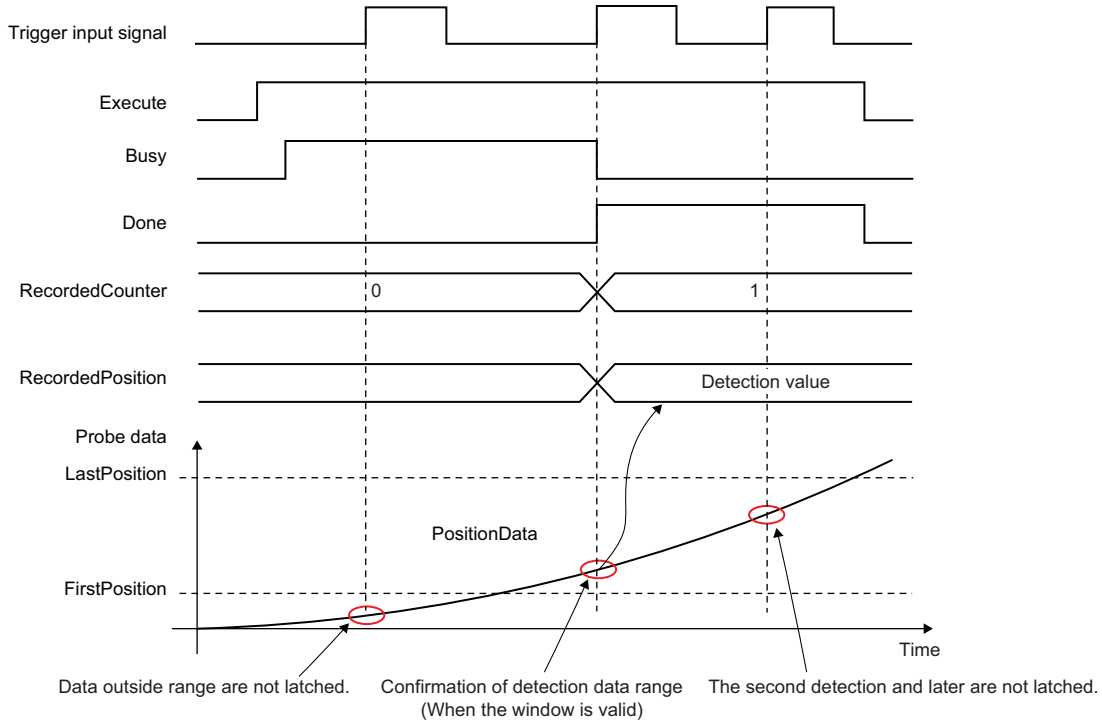
Operation

- Calculations for the latched data are estimated at rising edge/falling edge/both direction of the signal set in TriggerInput (indicate trigger input signal as follows).
- When it is WindowOnly = TRUE, whether the latch data at trigger event occurrence is within the range or not is confirmed. Data outside the range are not latched.
- The latch data is stored to the storage location specified RecordedPosition and OutputBuffer according to RecordMode, and RecordedCounter is updated.

■Timing chart

[When the FB is normally completed]
The following shows examples of latch operation by RecordMode.

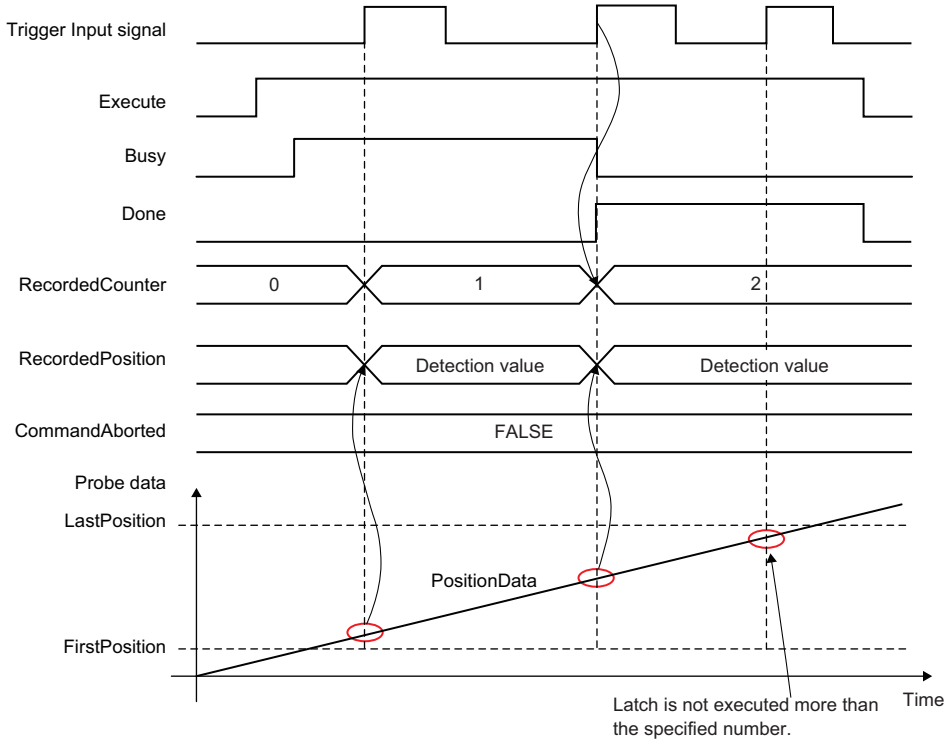
Ex.
For RecordMode = "0: OneShot"



Ex.

For RecordMode = "1: RecordCount"

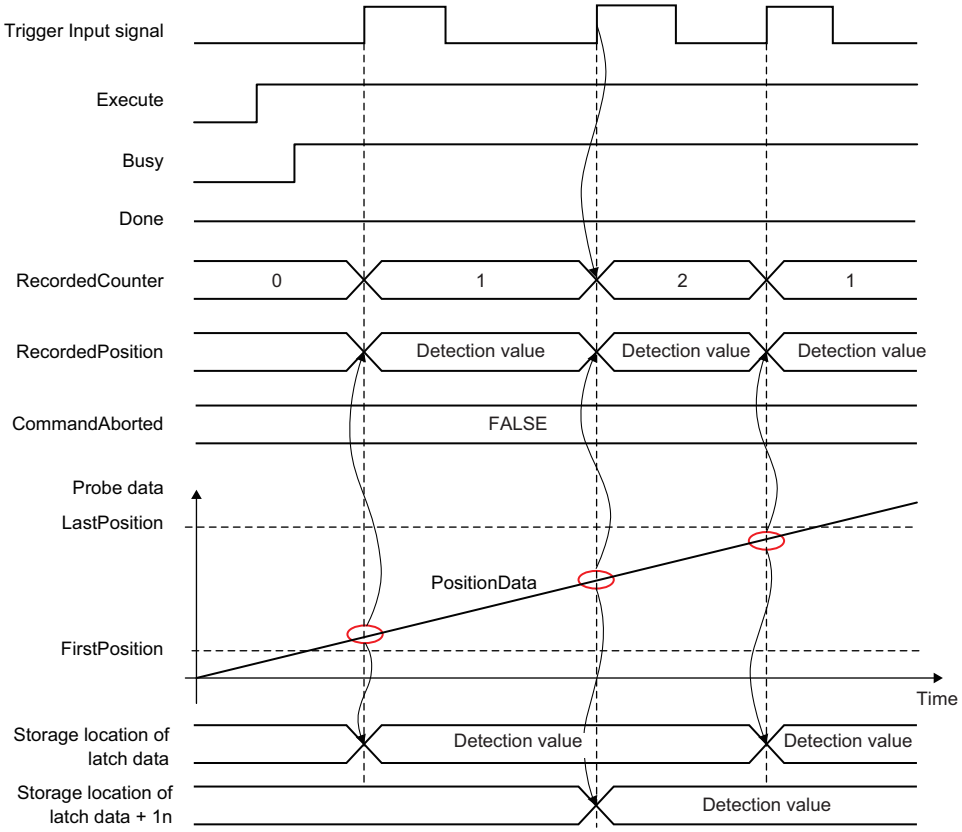
Number of latches: 2



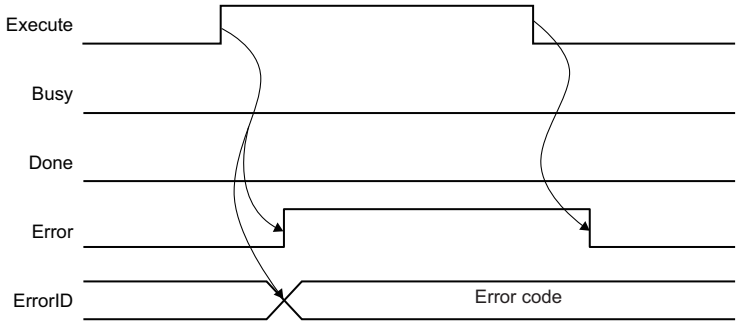
Ex.

For RecordMode = "2: RingBuffer"

Number of latches: 2



[When an error occurs]



Details of setting items

■TriggerInput (trigger input signal)

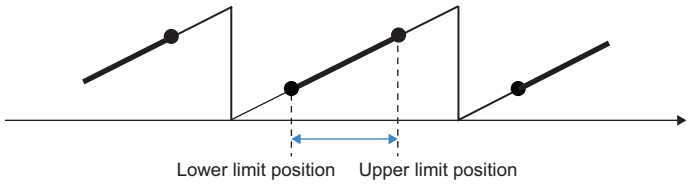
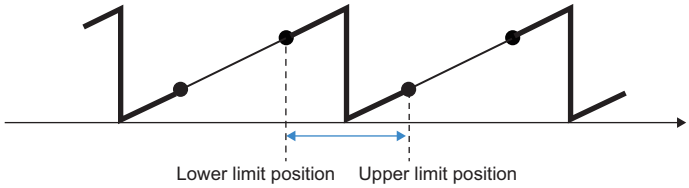
Trigger input signal is specified in MC_TRRIGER_REF structure.

Setting range of TriggerInput.Signal is shown below.

Item		Setting range
TriggerInput.Signal		
	Source	Type BOOL Data type [VAR] [DEV] [CONST] [OBJ]
	Detection	2: RisingEdge 3: FallingEdge 4: BothEdges
	CompensationTime	-5.0 to 5.0 [s]
	FilterTime	0 to 5.0 [s] When out of range value is set, operates as setting a value "0".

■WindowOnly (Enabled window)/FirstPosition (Lower limit)/LastPosition (Upper limit)

When WindowOnly is valid, triggers are detected only within the range between FirstPosition and LastPosition of the probe data. When it is invalid, the touch probe processing is executed to the all range.

LastPosition, FirstPosition relation	Touch probe processing
LastPosition > FirstPosition	The touch probe processing is executed when the probe data is more than FirstPosition and less than LastPosition. [Operation example] 
LastPosition < FirstPosition	The touch probe processing is executed when the probe data is less than LastPosition or more than FirstPosition. [Operation example] 

■ProbeData (Probe data)

Specify the data to latch by the TARGET_REF structure. The data types of [VAR], [AXIS], [DEV] and [OBJ] can be used.

When specifying [AXIS], the axis data of Axis input is referred. The Target modification of [AXIS] (@Position, etc.) needs to be specified.

When specifying [VAR] or [DEV], Axis is ignored. Specify "(LREAL)" when specifying the data other than LREAL type to TARGET_REF.Target

Ex.

Setting example of TARGET_REF.Target

[DEV](LREAL)G11500000

[VAR]OutputBufferData1(OutputBufferData1 is LREAL type instance)

[VAR](LREAL)OutputBufferData2(OutputBufferData2 is WORD type instance)

■CompensationTime (Compensation time)

Delay time of a touch probe processing is compensated.Set this item to compensate a proper delay of the touch prove process separately form the compensation time for the trigger input signal. Set the positive value to compensate the delay, and negative value to compensate the process.

Total compensation time is CompensationTime - TriggerInput.Signal.CompensationTime.[A-1]

Point

When compesating the delay time, the past value is used for latch data estimate calculation. Thus, at the time the compensation time from the Busy = TRUE timing is elapsed, the accuracy will be at the maximum.

■RecordMode (Latch mode)

Latch method of data is specified by RecordMode.

[RecordMode = "0: OneShot"]

- Latch data is stored only one shot.

[RecordMode = "1: RecordCount"]

- Latch data is stored for the setting value of RecordCount.
- Latch data is stored in the area shifted for the latch data size per latch, to the storage location set in OutputBuffer in front.
- To stop touch probe function before completing latch for RecordCount, execute MC_AbortTrigger.

[RecordMode = "2: RingBuffer"]

- Latch data is stored to the ring buffer for the setting value of RecordCount.The latch operation is always carried out.
- Latch data is stored to the ring buffer for RecordCount after shifted for latch data size per latch, to the storage location set in OutputBuffer in front.
- To stop touch probe function before completing latch for RecordCount, execute MC_AbortTrigger.

Following value is stored for RecordedCounter and RecordedPosition by RecordMode.

RecordMode	RecordedCounter	RecordedPosition
0: OneShot	1 by latch operation.	Stores latch data only one shot.
1: RecordCount	+ 1 by latch operation.	Stores latest latch data by latch operation.
2: RingBuffer	+ 1 by latch operation. Returned 0 when more than RecordCount.	Stores latest latch data by latch operation.

■RecordCount (Number of latch times)

Following value is specified for RecordCount by RecordMode.

RecordMode	RecordedCount
0: OneShot	Ignores.
1: RecordCount	Specifies number of latch times of data. When omitting, an error will occur.
2: RingBuffer	Specifies number of ring buffer times of data. When omitting, an error will occur.

■OutputBuffer (Storage location of latch data)

The storage location of latched data can be specified in TARGET_REF structure. Applicable data types are [VAR] and [DEV].

Specify "(LREAL)" when specifying the data other than LREAL type to TARGET_REF.Target LREAL.

RecordMode	storage location
0: OneShot	The area specified by OutputBuffer
1: RecordCount	Following area Area specified by OutputBuffer+ RecordedCounter × Latch data size
2: RingBuffer	

OutputBuffer can be ommitted. When ommitting, the latch data is stored only in RecordedPosition.

Ex.

Setting example of TARGET_REF.Target

- When RecordMode = OneShot or RecordMode = RecordCount, RingBuffer's RecordCount = 1
  [DEV] (LREAL) G11500000
  [VAR] OutputBufferData1 (OutputBufferData1 is LREAL type instance)
- When RecordMode = RecordCount, RingBuffer's RecordCount ≥ 2
  [DEV] (LREAL[1..100]) G11500000
  [VAR] OutputBufferData2 (OutputBufferData2 is LREAL [1..100] type instance)
  [VAR] (LREAL) OutputBufferData3 (OutputBufferData3 is WORD [1..100] type instance)

The relation of the setting value and operation of each item is shown below. For details, refer to the following.

☞ Page 406 Operation

RecordMode	RecordCount	OutputBuffer	Detection operation	Data storage location
0: OneShot	Omit/Set	Omit	One shot	RecordedPosition
		Set		RecordedPosition/Buffer
1: RecordCount	Omit	Omit/Set	Error	—
	Set	Omit	Number of setting	RecordedPosition
		Set		RecordedPosition/Buffer
2: RingBuffer	Omit	Omit/Set	Error	—
	Set	Omit	Always	RecordedPosition
		Set		RecordedPosition/Buffer

Touch probe invalid

Touch probe is invalidated.

Control details

MC_TouchProbe which is specified in TouchProbeID is invalidated..

When MC_AbortTrigger is executed, if the specified MC_TouchProbe specified TouchProbeID is not running, the FB will immediately become Done = TRUE.

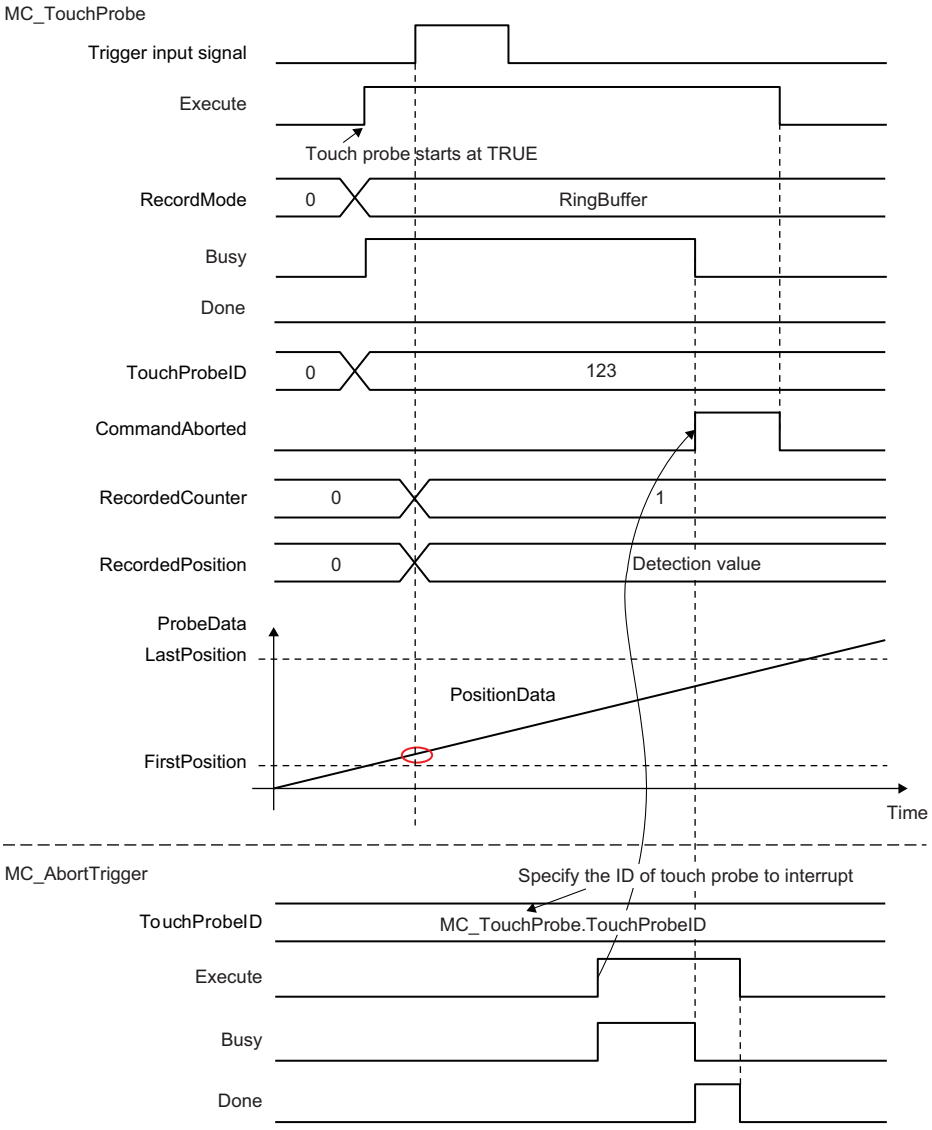
Axis and TriggerInput can be omitted, because those are ignored.

■Timing chart

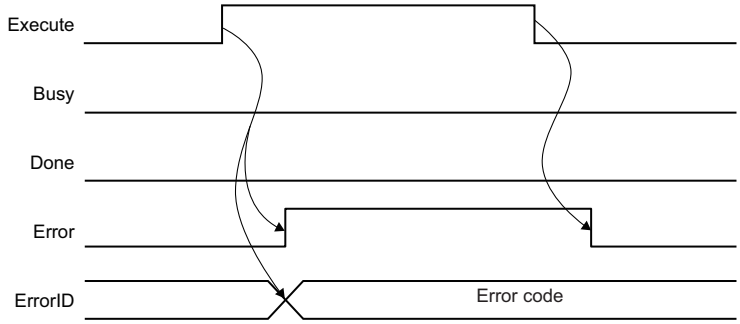
[When the FB is normally completed]

Ex.

For RecordMode ="2: RingBuffer"



[When an error occurs]



Details of setting item

■TouchProbeID (Touch probe ID)

Sets the proper ID of the touch probe to invalidate. Sets MC_TouchProbe.TouchProbeID after MC_TouchProbe.Execute rising of MC_TouchProbe to invalidate.

Precautions

- The execution timing is according to the operation cycle setting of AXIS_REF.
- Even if the target axis is not connected or an error occurs, this FB will be executed.

12.3 Slave Emulate

Slave emulate function controls axes on the real axis without connecting to the slave station.
When using emulate function, even if the slave 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.
Emulate function can be used on real axes (regardless of the axis type).
Emulate function simulates the cyclic communication and the transient communication of the slave device. The operations unique to the slave device can be simulated by installing emulate models corresponding to each slave device as add-ons.
Emulate function can be used according to the following table.
○: Operation possible, ×: Operation impossible

Module operation mode setting	Emulate function Switches valid/invalid	Start up as an emulate axis
Online mode*1	○	○

*1 For details, refer to the following.
MELSEC iQ-R Motion Module User's Manual (Network)

Relevant variables

Variable/Structure name	Name	Details
AxisName.PrConst.		
SlaveEmulate_Enable	Slave Emulation Enabled	Sets whether the axis is used as an emulate axis. FALSE: Invalid TRUE: Valid
AxisName.Md.		
SlaveEmulate_Enable	Slave Emulating	Becomes TRUE when driver emulate operation is in execution. FALSE: Invalid TRUE: Valid

Setting procedures

This section explains the procedures to carry out 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.

Operation during emulate function

The emulate function operation follows the axis parameter setting. The values of the set position and the feed machine position at connection are as shown below.

- When "AxisName.PrConst.PosRestoration_AbsPosEnable" is "-1: Auto" or "0: ABSDisabled"

Both the cumulative current position and the feed machine position are "0". (The set position is according to the ring counter setting)

- When "AxisName.PrConst.PosRestoration_AbsPosEnable" is "1: Enabled"

When the home position has been established, those are the address when the module power was disconnected most recently.
When the home position has not been established, both the cumulative current position and the feed machine position are "0". (The set position is according to the ring counter setting)

Precaution

When executing the all axes emulate switching, it takes time to complete.

PART 3 MOTION CONTROL2

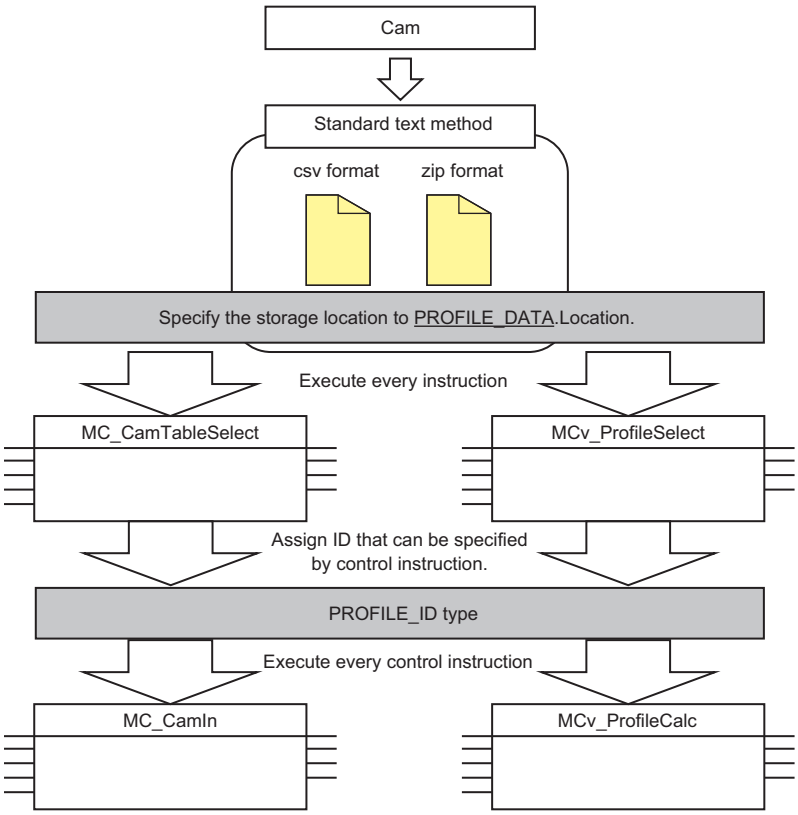
13 OPERATION PROFILE FUNCTION

14 SYNCHRONOUS CONTROL

13 OPERATION PROFILE FUNCTION

13.1 Operation Profile Data

Waveform data used for control is collectively called operation profile data.
This section describes creating and using methods of operation profile data.
Operation profile data not only can be used in various functions (ex. cam of the single axis synchronous control), but also can perform opening profile for the cam and reading/writing for the cam.



Operation of this function for each system status

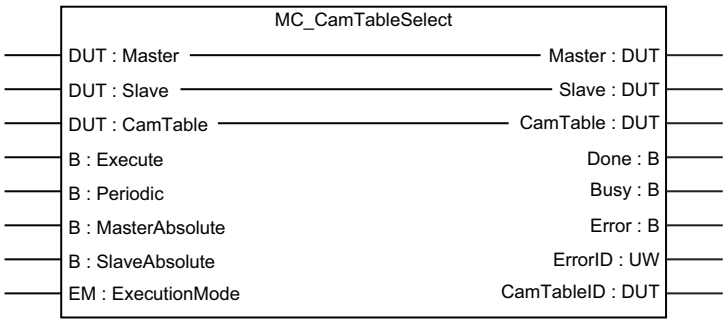
○: Possible, ×: Not possible

System status	Operation availability
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant variables/FB

Variable/Structure name	Name	Details
AXIS.Md.		
ProfileID	Execution profile ID No.	Stores the profile ID in execution.
PROFILE_DATA		
Location	Calculation profile data storage location	_FILE_LOCATION type
ID	Profile ID	_PROFILE_ID type
FILE_LOCATION		
FileName	File name	Specifies a file name (including the extension).
Path	Folder specification	Specifies the folder path in which the file is stored.
PROFILE_ID		
Number	Profile ID No.	Profile ID No. (0 to 60000)
INSTANCE_ID		
Number	Instance ID No.	Instance ID No.

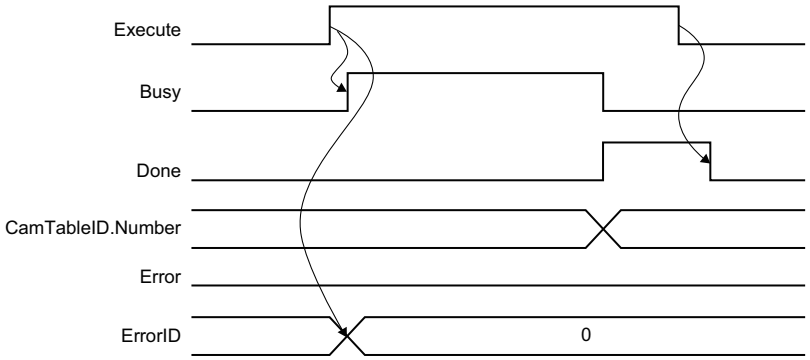
MC_CamTableSelect

Item	Description
Function overview	Stores specified operation profile data in the open area.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

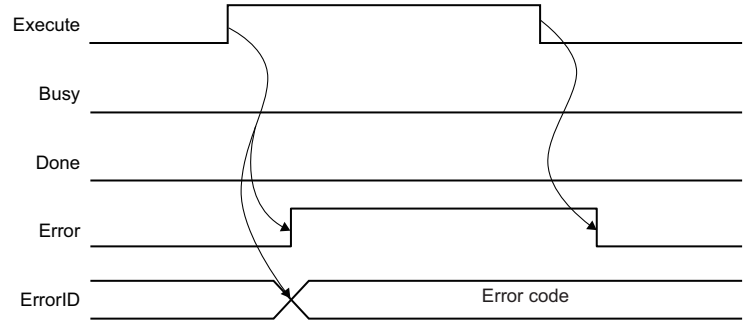
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
158	18	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	When FB is used on the CPU module side, Master.AxisNo can be omitted, but Master.StartIO cannot be omitted. Both can be omitted when FB is used on the motion module side.
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	When FB is used on the CPU module side, Slave.AxisNo can be omitted, but Slave.StartIO cannot be omitted. Both can be omitted when FB is used on the motion module side.
Cam table	CamTable	MC_CAM_REF	↑	—	Omission not possible	Specifies the operation profile data (cam data).

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Periodic	Periodic	BOOL	↑	—	FALSE	TRUE: Periodic FALSE: Non periodic
Input absolute coordinate	MasterAbsolute	BOOL	↑	—	FALSE	TRUE: Absolute coordinate FALSE: Relative coordinate
Output absolute coordinate	SlaveAbsolute	BOOL	↑	—	FALSE	TRUE: Absolute coordinate FALSE: Relative coordinate
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: mcImmediately (Execute immediately) 1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively) For details, refer to the following. ☞ Page 458 Start mode

■Output variables

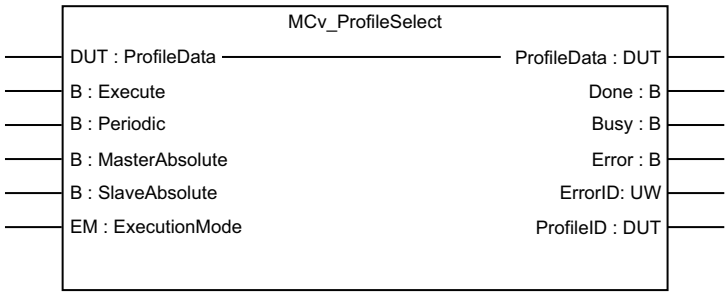
Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	It indicates the control is completed. When Execute is TRUE at the operation completion, it will be TRUE until Execute turns FALSE. When Execute is FALSE at the operation completion, it will be TRUE for only one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The generated error code is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cam table ID	CamTableID	MC_CAM_ID	0	Outputs the profile ID.

Point

When FB is used on the CPU module side, Master.StartIO and Slave.StartIO are used, but Master.AxisNo and Slave.AxisNoare not used.

When FB is used on the motion module side, even if specifying Master and Slave, axis information is not given to the cam data, and these are not used for the control.

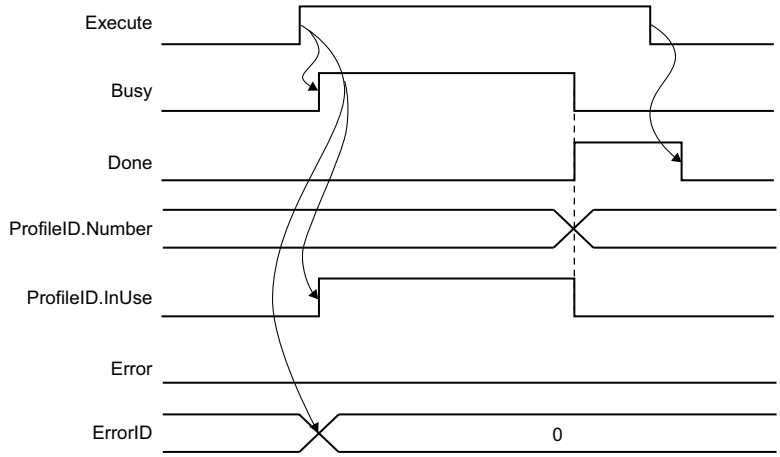
MCv_ProfileSelect

Item	Description
Function overview	Stores specified operation profile data in the open area.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

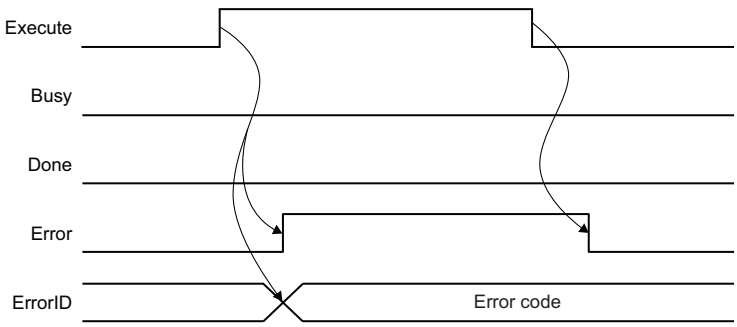
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Profile data	ProfileData	PROFILE_DATA	↑	—	Omission not possible	Specifies the operation profile data.

■Input variables

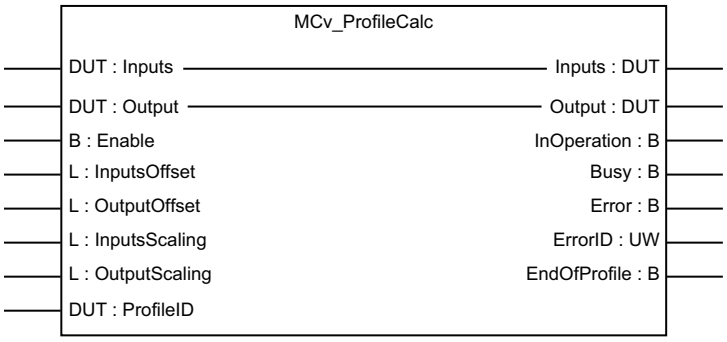
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Periodic	Periodic	BOOL	↑	—	FALSE	TRUE: Periodic FALSE: Non periodic
Input absolute coordinate	MasterAbsolute	BOOL	↑	—	FALSE	TRUE: Absolute coordinate FALSE: Relative coordinate
Output absolute coordinate	SlaveAbsolute	BOOL	↑	—	FALSE	TRUE: Absolute coordinate FALSE: Relative coordinate
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: mcImmediately (Execute immediately) 1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively) For details, refer to the following. ☞ Page 458 Start mode

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	It indicates the control is completed. When Execute is TRUE at the operation completion, it will be TRUE until Execute turns FALSE. When Execute is FALSE at the operation completion, it will be TRUE for only one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Profile ID	ProfileID	PROFILE_ID	0	Outputs the profile ID.

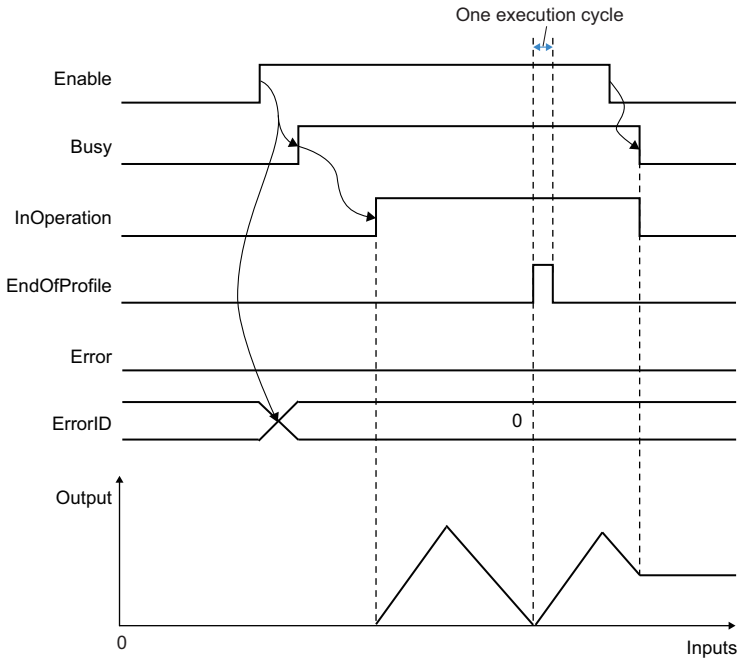
MCv_ProfileCalc

Item	Description
Function overview	Calculates the ouput data to the input data following the specified operation profile data.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

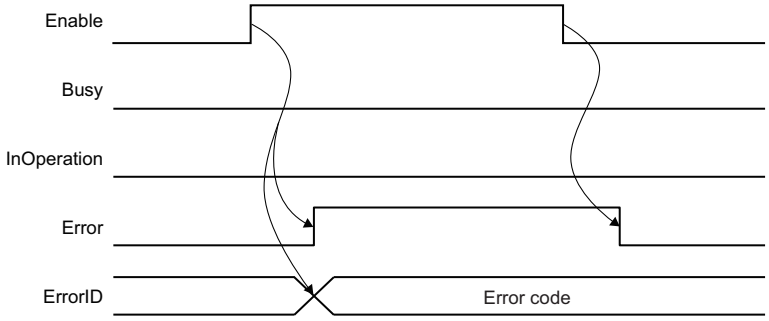
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Input data	Inputs	TARGET_REF[1..3]	⎍	—	Omission not possible	Specifies the reference of the input value.
Output data	Output	TARGET_REF	⎍	—	Omission not possible	Specifies the reference of the output value.

■Input variables

Import ⎍: Always

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	⎍	—	FALSE	During TRUE, it executes the FB.
Input offset	InputsOffset	LREAL[1..3]	⎍	☞ Page 79 Positioning Range	0.0	Shifts the phase of each input by the amount of offset. It can be specified for the number of Inputs elements. (The number exceeding the number of elements is ignored)
Output offset	OutputOffset	LREAL	⎍	☞ Page 79 Positioning Range	0.0	Shifts the phase of each output by the amount of offset.
Input coefficient	InputsScaling	LREAL[1..3]	⎍	0.01 to 10.0	1.0	Widens/narrows the phase of each input. It can be specified for the number of Inputs elements. (The number exceeding the number of elements is ignored)
Output coefficient	OutputScaling	LREAL	⎍	0.01 to 10.0	1.0	Widens/narrows the phase of each output.
Profile ID	ProfileID	PROFILE_ID	⎍	0 to 60000	0	Specifies the profile ID.

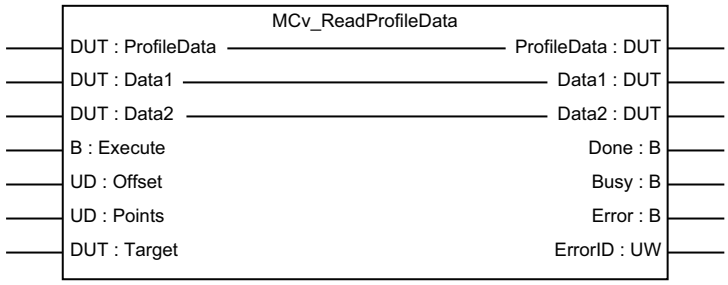
■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	InOperation	BOOL	FALSE	It indicates the output value is valid (refreshing).
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Profile cycle completion	EndOfProfile	BOOL	FALSE	When the end edge of the operation profile data is detected, only one execution cycle turns TRUE.

■Public variables

Name	Variable name	Data type	Default value	Description
Current value per cycle	InputsPerCycle	LREAL[1..3]	☞ Page 79 Positioning Range	Variable that the current value per cycle is stored.
Reference value	Reference	LREAL	☞ Page 79 Positioning Range	Variable that the reference value is stored.
Output value	Output	LREAL	☞ Page 79 Positioning Range	Variable that the output value is stored.
Instance ID	InstanceID	WORD(UINT)	0	It is the instance ID. It is automatically set by the system when creating an instance. It is used for inputs of FB, etc.

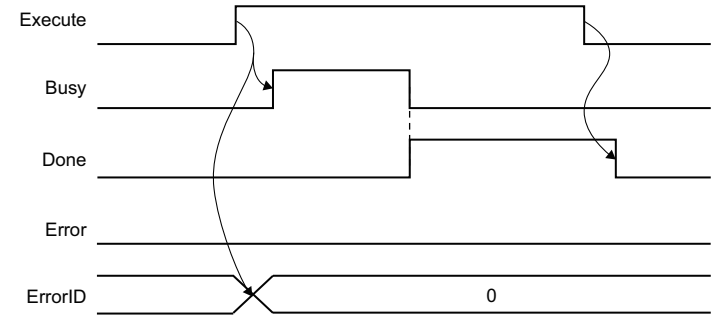
MCv_ReadProfileData

Item	Description
Function overview	Reads the specified operation profile data from the open area or the file.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

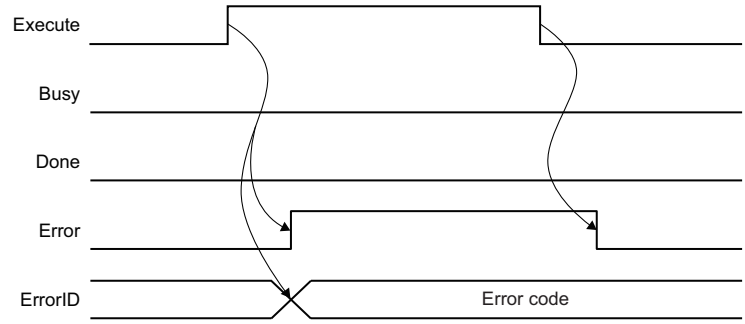
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
422	10	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Profile data	ProfileData	PROFILE_DATA	↑	—	Omission not possible	Specifies the operation profile data to read.
Read data 1	Data1	TARGET_REF	↑	—	Omission not possible	Specifies the structure of the data for reading according to the operation profile data format to read.
Read data 2	Data2	TARGET_REF	↑	—	Omission not possible	Specifies the structure of the data for reading according to the operation profile data format to read.

■Input variables

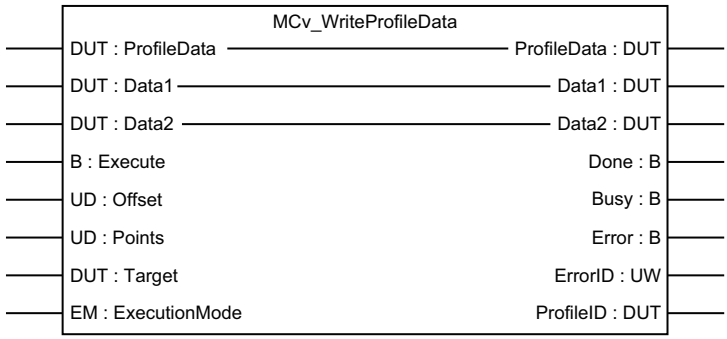
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Offset	Offset	DWORD(UDINT)	↑	—	0	Specifies offset from the top of the operation profile data. To specify a value other than 0 to Offset, also set a value other than 0 to Points. (If a value "0" is set to Points, an error will occur.)
Number of read data	Points	DWORD(UDINT)	↑	—	0	Specifies the number of data points to read. Set 0.
Read destination	Target	MC_PROFILE_STORAGE	↑	0 to 1	0	Specifies the read destination of the operation profile data. 0: OpenArea (Open Area) 1: File (File)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

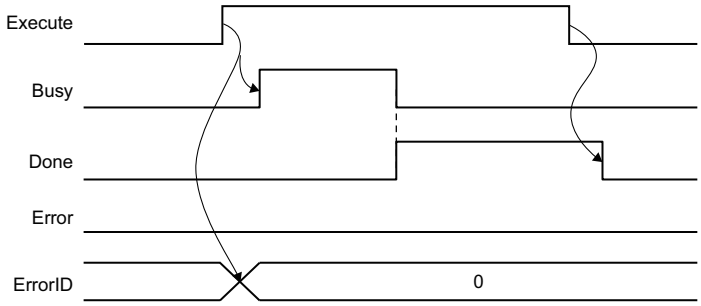
MCv_WriteProfileData

Item	Description
Function overview	Writes the specified operation profile data from the open area or the file.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

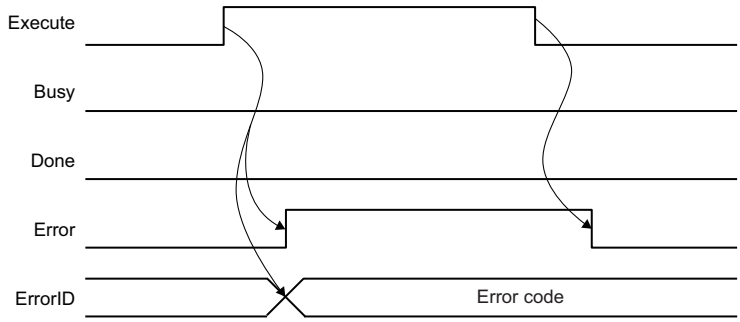
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation
424	16	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Profile data	ProfileData	PROFILE_DATA	↑	—	Omission not possible	Specifies the operation profile data to write.
Write data 1	Data1	TARGET_REF	↑	—	Omission not possible	Specifies the structure of the data for writing according to the operation profile data format to write.
Write data 2	Data2	TARGET_REF	↑	—	Omission not possible	Specifies the structure of the data for writing according to the operation profile data format to write.

■Input variables

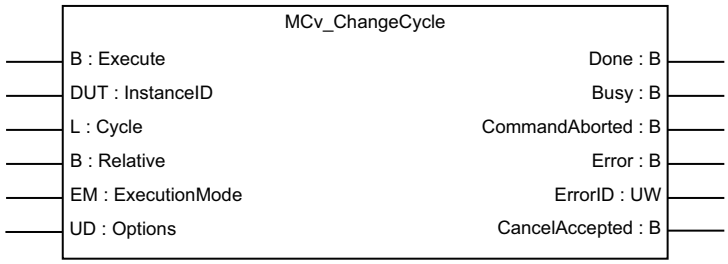
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Offset	Offset	DWORD(UDINT)	↑	—	0	Specifies offset from the top of the operation profile data. To specify a value other than 0 to Offset, also set a value other than 0 to Points. (If a value "0" is set to Points, an error will occur.)
Number of write data	Points	DWORD(UDINT)	↑	—	0	Specifies the number of data points to write.
Write destination	Target	MC_PROFILE_STORAGE	↑	0 to 1	0	Specifies the write destination of the operation profile data. 0: OpenArea (Open Area) 1: File (File) To specify File(file) to the write destination, set Offset and Points 0. (an error will occur for other than "0".)
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: mcImmediately (Execute immediately) 1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively) For details, refer to the following. ☞ Page 458 Start mode

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Profile ID	ProfileID	PROFILE_ID	0	Outputs profile ID.

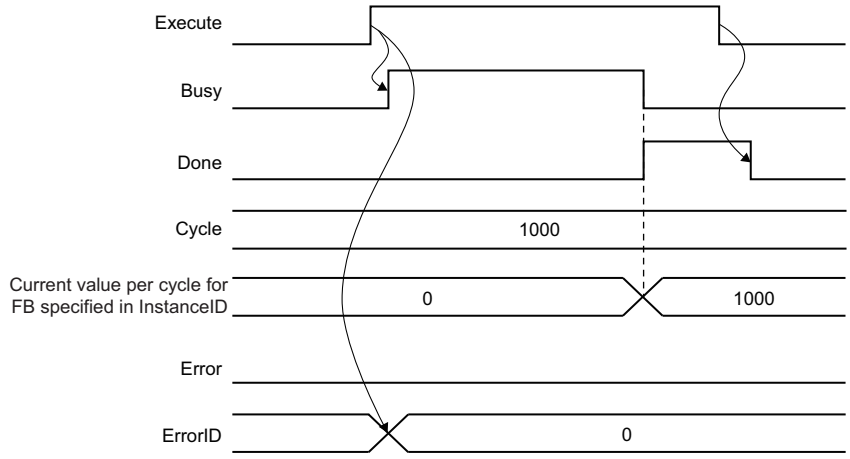
MCv_ChangeCycle

Item	Description
Function overview	Changes the current value per cycle of the specified operation profile data control FB.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

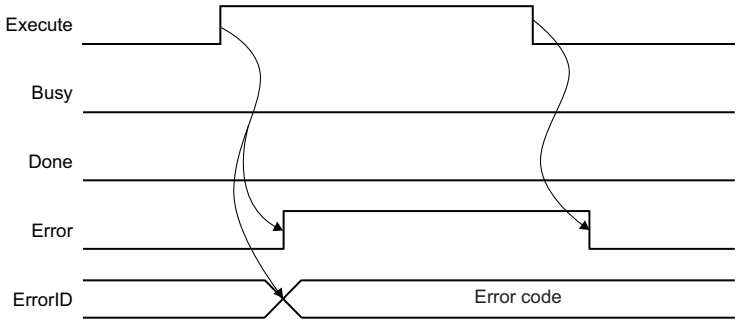
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
48	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Instance ID	InstanceID	INSTANCE_ID	↑	—	0	Specifies the instance ID of FB to change the current value per cycle.
Current value per cycle	Cycle	LREAL[1..3]	↑	—	0.0	Specifies the current value per cycle to change. Specifies the absolute position when Relative = FALSE. Specifies the relative position when Relative = TRUE.
Relative selection	Relative	BOOL	↑	—	FALSE	TRUE: Relative specification FALSE: Absolute specification
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: mcImmediately (Execute immediately) 1: mcQueued (Execute at completion) 3: mcSpeculatively (Execute speculatively)
Options	Options	DWORD(HEX)	↑	*1	00000000H	Set the function options by specifying the bit.

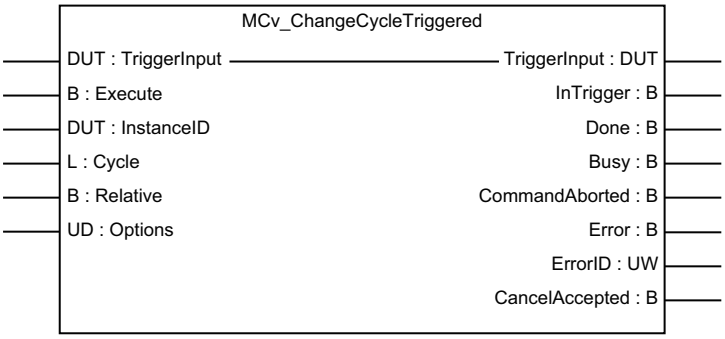
*1 For bit and function description, refer to the following.

Bit	Function description
0 to 15	Empty (Reserved)
16	Specifies whether cancel is allowed or not after FB is started. OFF: Not allowed ON: Allowed
17 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of the FB is interrupted by an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

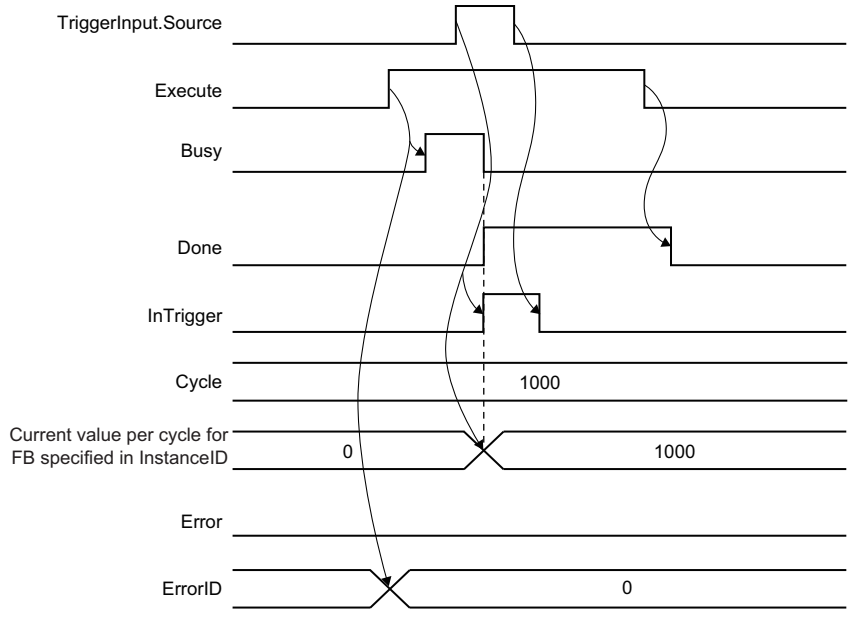
MCv_ChangeCycleTriggered

Item	Description
Function overview	Changes the current value per cycle of the specified operation profile data control FB to the value which is compensated at the detection timing of the trigger input signal.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

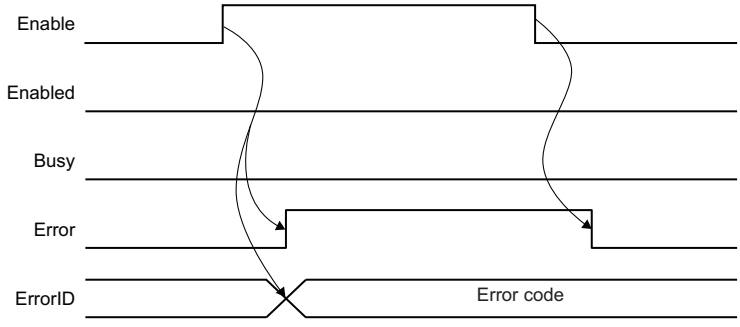
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission not possible	Specifies the trigger input signal.

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	—	FALSE	When TRUE, it executes the FB.
Instance ID	InstanceID	INSTANCE_ID	↑	—	0	Specifies the instance ID of the FB to change the current value per cycle.
Current value per cycle	Cycle	LREAL[1..3]	↑	—	0.0	Specifies the current value per cycle after change. Specifies the absolute position when Relative = FALSE. Specifies the relative position when Relative = TRUE.
Relative selection	Relative	BOOL	↑	—	FALSE	TRUE: Relative specification FALSE: Absolute specification
Options	Options	DWORD(HEX)	↑	*1	00000000H	Set the function options by specifying the bit.

*1 For bit and function description, refer to the following.

Bit	Function description
0 to 15	Empty (Reserved)
16	Specifies whether cancel is allowed or not after FB is started. OFF: Not allowed ON: Allowed
17 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Detecting signal	InTrigger	BOOL	FALSE	Indicates the detection status of the trigger input signal. Outputs the signal detection status as it is regardless of the compensation time that is set to the trigger input signal.
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute is TRUE at the operation completion, TRUE remains until Execute turns FALSE. When Execute is FALSE at the operation completion, it becomes TRUE only for one cycle.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of the FB is interrupted by an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepts cancel.

Creating operation profile data

This section describes storage format and creating method of the operation profile data.

Storage format

The standard text (csv) can be used as the operation profile data in the motion system.

Storage format	Details	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 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 a SD memory card.
2. Set the storage location in 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 using the engineering tool, it can be automatically opened to the motion system when the power turns ON and when the PLC READY [Y0] turns ON by explicitly specifying the profile ID. (When the profile ID is not explicitly specified, it will not be automatically opened.)
Automatically opened operation profile data can be used for control without executing the open FB.
Also, 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 initial value of the profile data type.

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 of the operation profile created by the engineering tool is %PROJECT_ROOT%/calc_profile/, and the storage location is set at PROFILE_DATA.Location.
Files within this folder (including the sub folders) may be overwritten or deleted by the engineering tool operation, so the operation profile created by the program, store in location other than the folder above (including the sub folder).

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 table shows operation profile data format and I/O data that can be used to each function.

Function	Operation profile data format	Input data	Output data
Cam	Cam data	Master axis position (selected with MC_SOURCE)	Slave axis position
Profile operation	Multidimensional profile data	Arbitrary data (1 to 3 dimension)	Arbitrary data (1 dimension)

Operation profile data format: Cam data

■Setting item

The relationship of output values to input values is generally defined as the cam data.

A necessary definition as the cam data differs depending on the format. Refer to the following table.

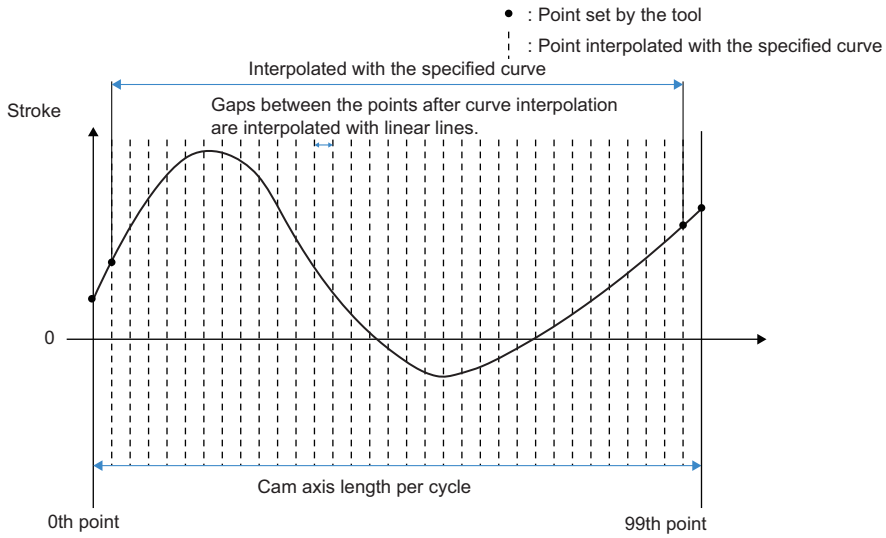
◎: Necessary, ○: Optional, —: Unnecessary

Setting items		Specifying interpolation method		
		0: Linear interpolation	1: Specifying for each section	2: Spline interpolation
Profile ID		○	○	○
Specifying interpolation method		◎	◎	◎
Resolution/coordinate number		◎	◎	◎
Input unit character string		○	○	○
Output unit character string		○	○	○
Start point		—	◎	—
Initial stroke amount		—	◎	—
Initial velocity		—	○	—
Initial acceleration		—	○	—
I/O data		◎	—	—
Parameter	Cam curve types	—	◎	—
	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		○	○	○

• Specifying interpolation method

[Specifying for each section]

When "1: Specifying for each section" is set for the specifying interpolation method of the cam data format, 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 is opened in the open area.



Point

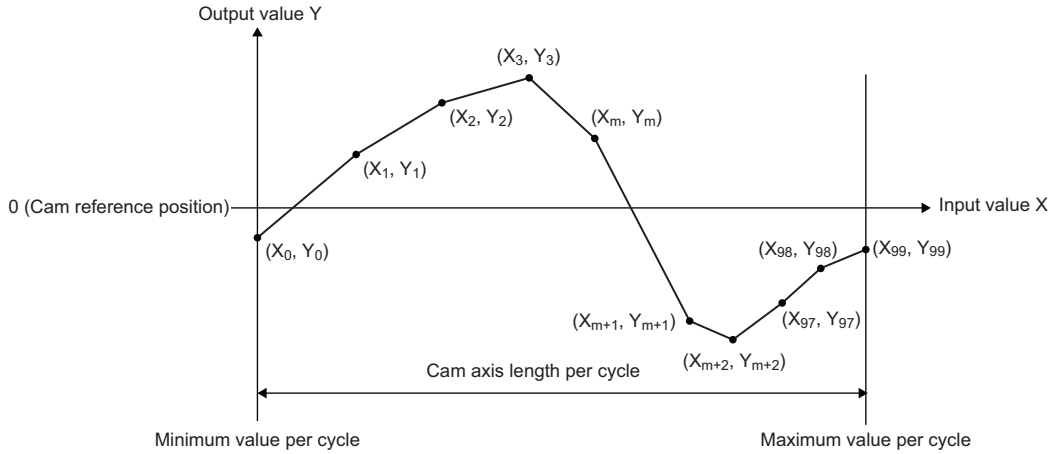
If the number of I/O data is not enough for the set resolution, cam data that is equally divided after interpolating the data in shortage according to the line set by the curve designation will be created.

[Spline interpolation]

When "2: Spline interpolation" is set for the specifying interpolation method of the cam data format, 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 is opened in the open area.

[Linear interpolation]

When "0: Linear interpolation" is set for the specifying interpolation method of the cam data format, the data that is defined for a cam curve per cycle with two or more points 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 can be used in the control instruction (MC_CamIn) as the MC_CAM_ID type. ID can be specified with an arbitrary No.

- Resolution/coordinate number

Set the number of divisions for one cam curve. 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 be used in the control. It is used only in monitoring.

- Start point

Set the start point. It should be set within the range of the length per cycle.

- 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

Set the velocity at the start point.

- Initial acceleration

Set the acceleration at the start point.

- Length per cycle

Set the input amount that is required for one cycle.

• Maximum value per cycle/Minimum value per cycle

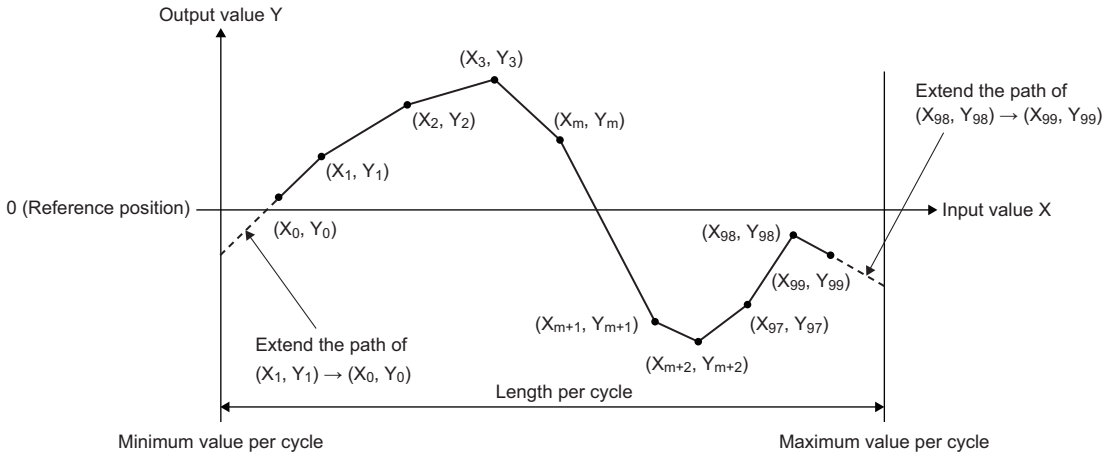
Set the maximum/minimum value per cycle. It is valid only when the specifying interpolation method is "0: linear interpolation".

When specifying interpolation method is "0: linear interpolation"

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.
"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

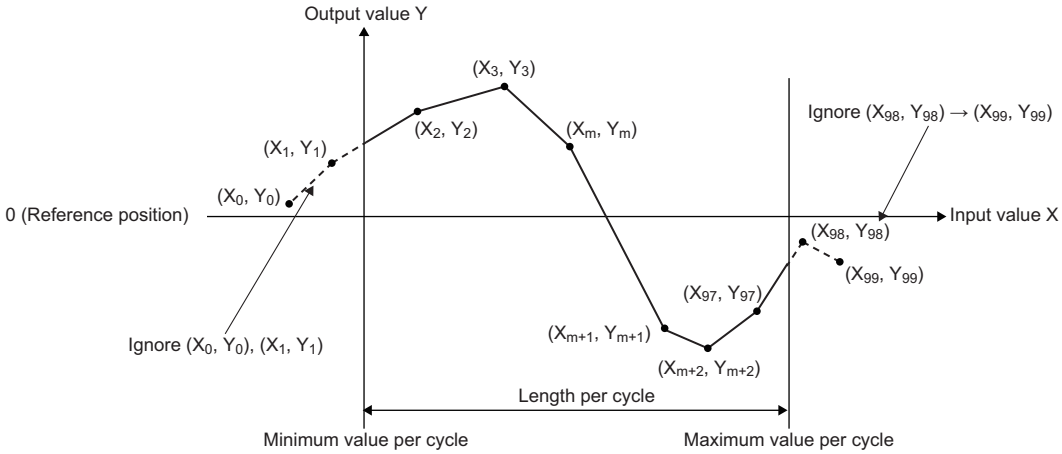
Ex.

For "Minimum value per cycle < Minimum value of input" and "Maximum value of input < Maximum value per cycle", and when resolution is "100"



Ex.

For "Minimum value of input < Minimum value per cycle" or "Maximum value per cycle < Maximum value of input", and when the number of point data is "100"



• Time per cycle

Set time that is required for one cycle.

• 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.

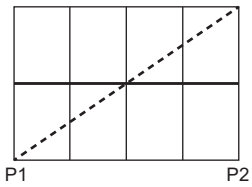
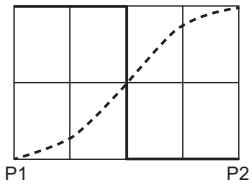
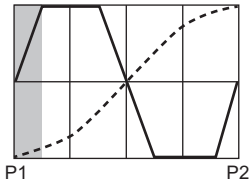
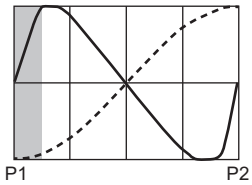
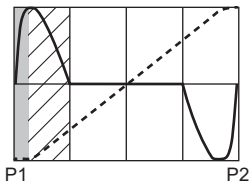
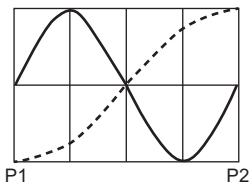
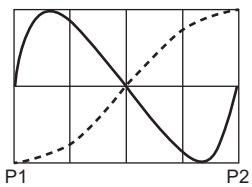
• I/O data

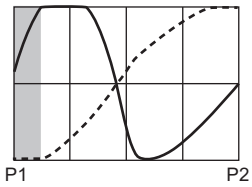
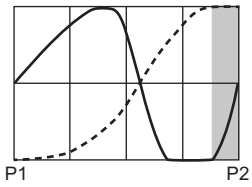
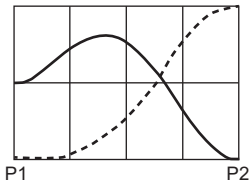
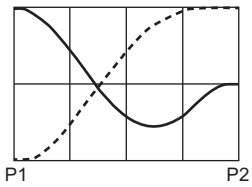
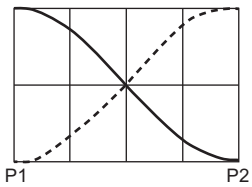
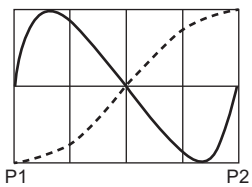
Set the I/O data. The input data should be set in ascending order.

• Cam curve types

A cam curve can be selected from the following curves.

- - - - : Stroke ratio ——— : Acceleration : Range L1 : Range L2

Cam curve type (MC_CAM_CURVE_TYPE)			Acceleration curve shape	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 speed	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)	—	—	—
DistortedConstantSpeed(4)	Distorted constant speed			0.0 to 1.0	0.0001 < L1 < 0.1250 (0.0625)	0.0001 < L1 < 0.5000 (0.25)	—	—
Cycloid(5)	Cycloid			0.0 to 1.0	—	—	—	—
FifthCurve(6)	5th curve			0.0 to 1.0	—	—	—	—

Cam curve type (MC_CAM_CURVE_TYPE)			Acceleration curve shape	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		
Trapecloid(7)	Trapecloid	Two-dwelling asymmetrical		0.0 to 1.0	0.0001 < L1 < 0.2500 (0.125)	—	—	—
Reverse Trapecloid(8)	Reverse trapecloid			0.0 to 1.0	0.0001 < L1 < 0.2500 (0.125)	—	—	—
DoubleHypotenuse(9)	Double hypotenuse	One-dwelling		0.0 to 1.0	—	—	—	—
Reverse DoubleHypotenuse(10)	Reverse double hypotenuse			0.0 to 1.0	—	—	—	—
Single Hypotenuse(11)	Single hypotenuse	Non-dwelling curve		0.0 to 1.0	—	—	—	—
FifthCurve_SpeedDesignation(12)	5th curve (Speed designation)	Two-dwelling symmetrical		0.0 to 1.0	—	—	-2500000000 to 2500000000	-2147483647 to 2147483647

■Read/write data structure

Specify the following structures for Data1, Data2 of MCv_ReadProfileData/MCv_WriteProfileData.

• Data1

Specify the PROFILE_CAM_DATA type structure.

PROFILE_CAM_DATA			Device offset	Description
Interpolate	Specifying interpolation method	INT	+0	Set the specifying interpolation method of the cam data. 0: Linear interpolation 1: Specifying for each section 2: Spline interpolation
Resolution	Resolution/number of coordinates	DWORD(UDINT)	+2	Set the resolution. Linear interpolation/specifying for each section/spline interpolation 2 to 65535
InputUnitString	Input unit character string	WSTRING[0..31]	+4	—
OutputUnitString	Output unit character string	WSTRING[0..31]	+36	—
StartPoint	Start point*1	LREAL	+68	Set the start point. (0 ≤ StartPoint < The positive positioning range)
StartStroke	Initial stroke amount*1	LREAL	+72	Set the stroke amount for the start point. (0 ≤ StartStroke < The positive positioning range)
StartVelocity	Initial velocity*3	LREAL	76	Set the velocity for the start point. (-2500000000 < StarVelocity < 2500000000)
StartAcceleration	Initial acceleration*3	LREAL	80	Set the acceleration for the start point. (-2147483647 < StartAcceleration < 2147483647)
CycleLength	Length per cycle*1	LREAL	+84	Set the input amount that is required for one cycle. (0 < CycleLength < The positive positioning range)
CycleMin	Minimum value per cycle	LREAL	+88	Set the minimum value per cycle. (0 ≤ CycleMin < CycleMax)
CycleMax	Maximum value per cycle	LREAL	+92	Set the maximum value per cycle. (CycleMin < CycleMax < The positive positioning range)
CycleTime	Time per cycle*3	LREAL	+96	Set time per cycle. (0 < CycleTime < 100000.0)
Stroke	Stroke amount	LREAL	+100	Set the stroke amount. (0 < Stroke < The positive positioning range)
NumberOfSections	Number of sections*1	DWORD(UDINT)	+104	Specifying for each section 1 to 360 Spline interpolation 3 to 360
Options	Options*2	DWORD(HEX)	+106	—
			Total size: 108 points	

*1 It is not used in the cam data format (Specifying interpolation method is "0: Linear interpolation"). (It is ignored.)

*2 Specify "0".

*3 Used only when cam curve is 5th Curve (Speed Specification). (Ignore for other curve)

Ex.

Setting example of TARGET_REF.Target

[DEV] (PROFILE_CAM_DATA) G11500000

[VAR]CamData1 (CamData1 is PROFILE_CAM_DATA type instance)

• Data2

For MCv_ReadProfileData, a structure specified in Data2 differs depending on the Target. For MCv_WriteProfileData, it can be executed despite the Target.

○: Supported, —: Not supported

FB	Target	Structure specified in Data2	Specifying interpolation method		
			Linear interpolation	Specifying for each section	Spline interpolation
MCv_ReadProfileData	0: OpenArea	LREAL[]	○	○*2	○*2
	1: File	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1
MCv_WriteProfileData	0: OpenArea	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1
	1: File	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1

*1 Used only by end point and Stroke

*2 Reads out by interpolation method: Read by Linear interpolation (Resolution + 1 point of coordinate value)

[LREAL type two-dimensional array]

LREAL [m..n, o..p] Coordinate value [x, y]

The number of elements (n - m + 1), is required as many as the Points arguments of FB. When reading or writing all of the operation profile data (Points = 0), set the same number as PROFILE_CAM_DATA.Resolution.

Set the number of dimensions (p - o + 1) to 2.

To read/write 2 points of LREAL type data equivalent to the number of elements, prepare the device/label areas in same size.

If the number of elements and the number of dimensions are mismatched, an error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.

When interpolation method specification of the cam data format is Linear interpolation, a pair of input value and output value will be read/write.

When interpolation method specification of the cam data format is specifying for each section, spline interpolation and cam data format for rotary cutter (Specifying a double-precision real number), a pair of current value and stroke position per cycle will be read/write.

Point

When executing MCv_WriteProfileData whose Target is File in the LREAL type array, the interpolation designation method of the cam data format is output to the file as "0: linear interpolation".

Ex.

Setting example of TARGET_REF.Target

[DEV] (LREAL [1..100,1..2]) G11500000

[VAR] CamData2 (CamData2 is LREAL [1..100,1..2type instance)

[PROFILE_CAM_ELEMENT type structure array]

PROFILE_CAM_ELEMENT[m..n]*1			Device offset	Description
CurveType	Cam curve type	MC_CAM_CURVE_TYPE	+0	Set the cam curve. (When EndPoint is 0, it is invalid.)
EndPoint	End point	LREAL	+4	Set the position to the length per cycle (the current value per cycle). (0 < EndPoint ≤ Length per cycle)
Stroke	Stroke	LREAL	+8	Set the stroke position. (The absolute value of 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	LREAL	+28	Set the end point velocity of the cam curve. (-2500000000 < EndVelocity < 2500000000)
EndAcceleration	End point acceleration	LREAL	+32	Set the end point acceleration of the cam curve. (2147483647 < EndAcceleration < 2147483647)
			Total size: 36 points	

*1 The number of elements (n - m + 1), is required as many as the Points arguments of FB. When reading or writing all of the operation profile data (Points = 0), set the same number as PROFILE_CAM_DATA.NumberOfSections. If the number of elements are mismatched, an error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.

Ex.

Setting example of TARGET_REF.Target

[DEV] (PROFILE_CAM_ELEMENT [1..10]) G11500000

[VAR] CamData2 (CamData2 is dPROFILE_CAM_ELEMENT [1..10] type instance.)

Operation profile data format: Cam data for rotary cutter

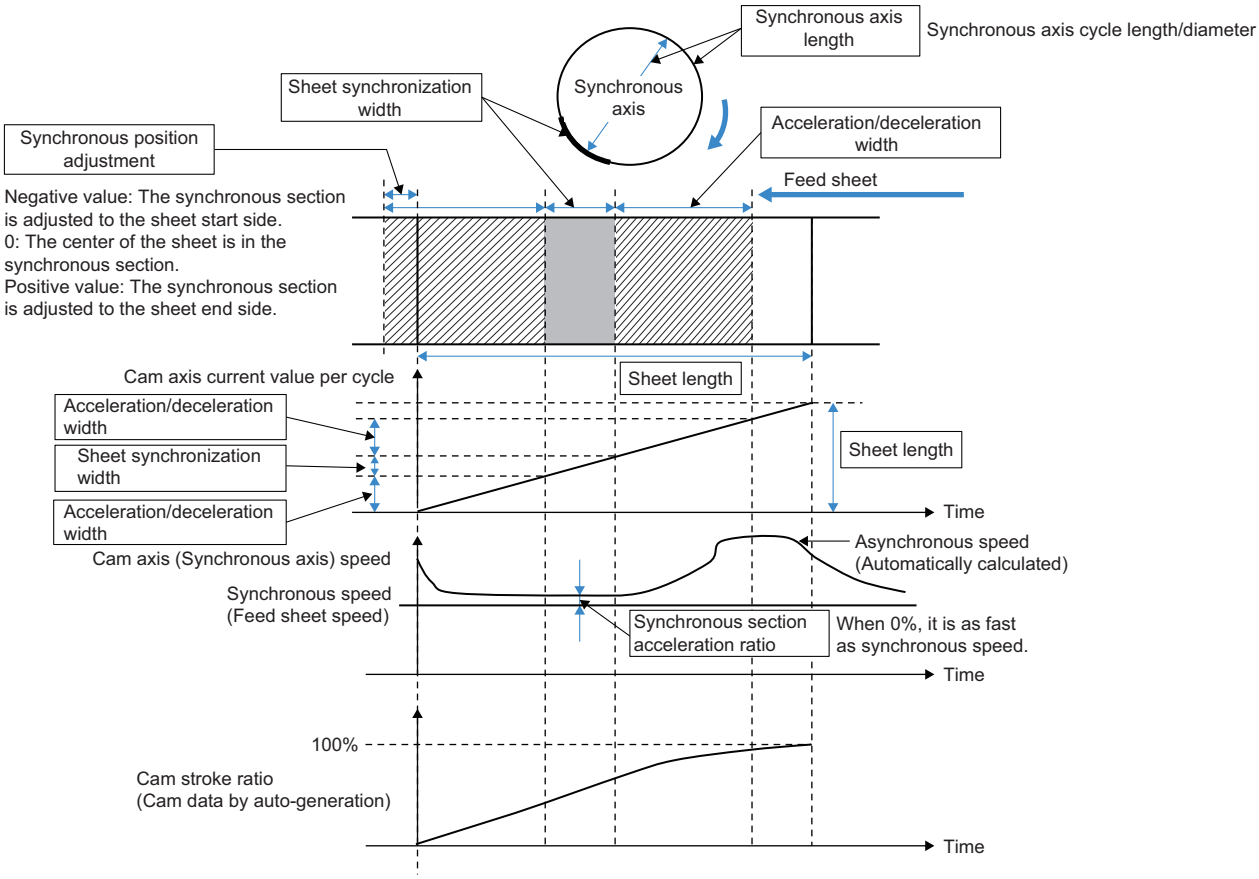
■Setting item

Generate cam data for the rotary cutter. The stroke data that is defined after equally dividing a cam pattern per cycle for rotary cutter by points of the resolution is opened in the open area.

For a necessary definition as cam data for the rotary cutter, refer to the following table.

◎: Necessary, ○: Optional, —: Unnecessary

Setting item		Cam data for rotary cutter
Profile ID		○
Interpolation method specification		—
Resolution/coordinate number		◎
Input unit character string		○
Output unit character string		—
Start point		—
Initial stroke amount		—
Initial velocity		—
Initial acceleration		—
Parameter	Auto-generation option	◎
	Synchronous section acceleration ratio	◎
	Sheet length	◎
	Sheet synchronization width	◎
	Synchronous axis length	◎
	Synchronous position adjustment	◎
	Acceleration/ deceleration width	◎
	Number of cutter	◎
Length per cycle		—
Minimum value per cycle		—
Maximum value per cycle		—
Time per cycle		—
Stroke amount		— (Fixed with 360)


Synchronous axis length
Synchronous axis cycle length/diameter
Sheet synchronization width
Synchronous axis
Acceleration/deceleration width
Synchronous position adjustment
Feed sheet
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.
Sheet length
Cam axis current value per cycle
Acceleration/deceleration width
Sheet synchronization width
Acceleration/deceleration width
Sheet length
Time
Cam axis (Synchronous axis) speed
Asynchronous speed (Automatically calculated)
Synchronous speed (Feed sheet speed)
Synchronous section acceleration ratio
When 0%, it is as fast as synchronous speed.
Time
100%
Cam stroke ratio (Cam data by auto-generation)
Time

■Read/write data structure

Specify the following structures for Data1 of MCv_ReadProfileData/MCv_WriteProfileData. However, when reading the cam data opened by using the cam data for the rotary cutter from the open area again, it becomes the cam data format. Therefore, use a read/write data structure of the cam data format. For details, refer to the following.

☞ Page 433 Setting item

■Cam for rotary cutter (Specifying a double-precision real number)

• Data1

Specify the PROFILE_ROTARY_CUTTER type structure.

PROFILE_ROTARY_CUTTER			Device offset	Description
Resolution	Resolution	DWORD(UDINT)	+0	Set the resolution for generating the cam. (2 to 32768)
InputUnitString	Input unit character string	WSTRING[0..31]	+2	—
Options	Options	DWORD(HEX)	+34	Specify "0".
AutoGeneration Options	Auto-generation options	WORD(HEX)	+36	• Bit 0: Acceleration/deceleration method 0: Trapezoidal acceleration/deceleration 1: S-curve acceleration/deceleration • Bit 1: Synchronous axis length setting 0: Diameter 1: Cycle length • Set "0" for bit 2 to 15.
NumberOfCutter	Number of cutter	WORD(UINT)	+37	Set the number of cutter. (1 to 256)
SyncSectionAcc Ratio	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. (-50.0 to 50.0)
SheetLength	Sheet length	LREAL	+44	Set the sheet length. (0 < SheetLength < The positive positioning range)
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 < SheetSyncWidth < SheetLength) (0 < SheetSyncWidth < Cycle length /NumberOfCutter)
SyncAxisLength	Synchronous axis length	LREAL	+52	• Set the rotary cutter axis length. • When the auto-generation option is set to the diameter, it is calculated as "Cycle length = setting value × π ". • When the auto-generation option is set to the cycle length, it is calculated as "Cycle length = setting value". (0 < Cycle length < The positive positioning range)
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 SyncPositionAdjustment < 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 × AccDecWidth ≤ SheetLength - SheetSyncWidth)
AsyncSpd	Asynchronous speed result	LREAL	+64	When the auto-generation is successfully completed, the asynchronous speed is stored as the ratio of the synchronous speed.
			Total size: 68 points	

• Data2

Specifying is not required. (It is ignored.)

Multidimensional profile data

■Setting item

Multidimensional profile data whose number of input dimensions is two to three can be used.

When using multidimensional profile data, create a csv file according to the operation profile data format, open with the MCv_ProfileSelect, and use the MCv_ProfileCalc.

For a necessary definition as the multidimensional profile data, refer to the following table.

◎: Necessary, ○: Optional, —: Unnecessary

Setting item	Multidimensional profile
Number of input dimensions	◎
Number of output dimensions	—
Profile ID	○
Resolution/coordinate number	◎
Input unit character string	○
Output unit character string	○
I/O data	◎
Length per cycle	◎
Minimum value per cycle	—
Maximum value per cycle	—
Stroke amount	◎
Curve designation	—

- Number of input/output dimensions

Specify the number of input/output dimensions. From two to three can be set for input, and one is fixed for output.

Specify "300: Multidimensional profile format (2 inputs 1 output)" or "310: Multidimensional profile format (3 inputs 1 output)" in the operation profile data format of csv file third line depending on the number of input dimensions.

- Profile ID

It is a unique ID assigned by an open instruction. The ID opened by the MC_CamTableSelect can be used in the control instruction (MC_CamIn) as the MC_CAM_ID type. ID can be specified with an arbitrary No.

- Resolution/coordinate number

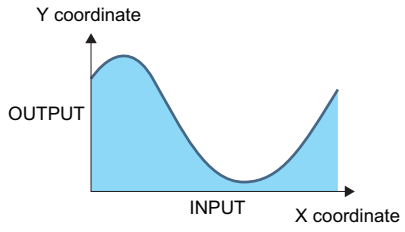
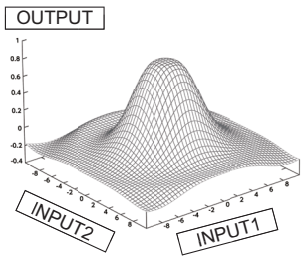
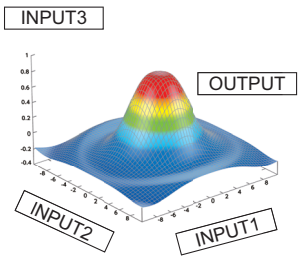
Specify the resolution/coordinate number of the number of input/output dimensions.

- Input/Output unit character string

It can be specified the number of input/output dimensions.

- I/O data

Define the output value to all combinations of the input value.

One-dimensional input — One-dimensional output	Two-dimensional input — One-dimensional output	Three-dimensional input — One-dimensional output
		
X coordinate input →Y coordinate output	X, Y coordinate input →Z coordinate output	X, Y, Z coordinate input → Output

For the operation profile data of one input and one output, define it in the cam data format.

• 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.

• The minimum/maximum value per cycle

The setting is not required.

• Length per cycle

Set the input amount that is required for one cycle.

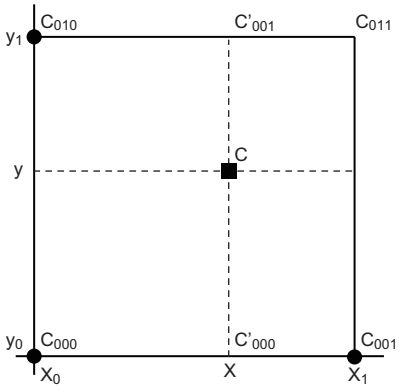
• Curve designation

It is fixed with the linear interpolation.

For the multidimensional profile data, the output value to the input value is calculated by repeating the linear interpolation (linear).

The following figure shows the case of the two-dimensional input.

C'_0 = linear (x, x_0, x_1, C_{000}, C_{001})
C'_1 = linear (x, x_0, x_1, C_{010}, C_{011})
C = linear (y, y_0, y_1, C'_0, C'_1)

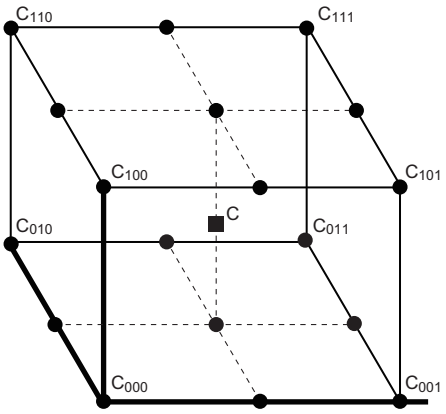


The following figure shows the case of the three-dimensional input.

C'_{00} = linear (x, x_0, x_1, C_{000}, C_{001})
C'_{01} = linear (x, x_0, x_1, C_{010}, C_{011})
C'_0 = linear (y, y_0, y_1, C'_{00}, C'_{01})

C'_{10} = linear (x, x_0, x_1, C_{100}, C_{101})
C'_{11} = linear (x, x_0, x_1, C_{110}, C_{111})
C'_1 = linear (y, y_0, y_1, C'_{10}, C'_{11})

C = linear (z, z_0, z_1, C'_0, C'_1)



Operating operation profile data

Operation profile data uses files and open areas, and performs operation profile data manipulation (open, read/write) 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 control		Performs control by using operation profile data of "Open area".

Data type of operation profile data

The profile data type structure and the profile ID type structure can be used as the data type to perform operation profile data manipulation/operation profile data controls.

• Files are managed as the profile data type labels.

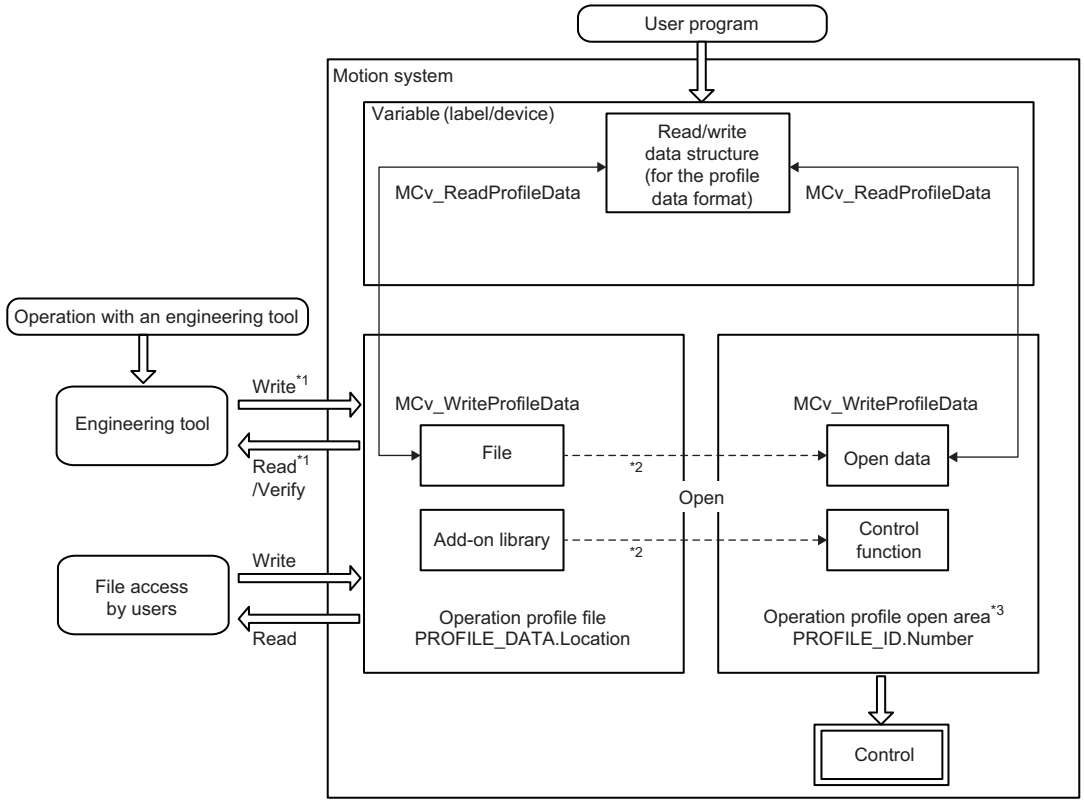
Specify the file path in PROFILE_DATA.Location.

• "Open area" is managed as 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 ID of the open area for PROFILE_ID.Number.

Control can be carried out by specifying the profile ID type labels at the operation profile data controls.

Entity of operation profile data	Description	Data type for operation/control	Remark
File	Written by the following operation. • Write from the engineering tool • Operation profile data write execution	Profile data type • General type (PROFILE_DATA type) • Function specific type (MC_CAM_REF type, etc.)	Data is preserved even when the power turns OFF.
Open area	Written by the following operation. • The power turns from OFF to ON • The PLC READY [Y0] turns from OFF to ON • Operation profile data open execution • Operation profile data write execution	Profile ID type • General type (PROFILE_ID type) • Function specific type (MC_CAM_ID type, etc.)	Data actually used in the control is stored. The data is deleted when the power turns OFF.



*1 Operation from the engineering tool is carried out to operation profile data file.

*2 When the power turns ON or when the PLC READY [Y0] turns ON, the operation profile data written by the engineering tool, etc. to which the ID is specified is automatically opened from the operation profile data file to the operation profile data open area.

*3 It is cleared when the system starts up.

Precautions

To hold the change, write file by MCv_WriteProfileData (file specification). Because the change is deleted when the power turns OFF, even if the data is changed in open area by MCv_WriteProfileData (open area specification) during operation.

■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. Create instances of variable corresponding to the FB argument type to use.

Type name	General-purpose type	Function specific type	Remark
Profile data type	PROFILE_DATA	• MC_CAM_REF	Indicates the operation profile data with the following configurations. • Operation profile data storage location (Location) • Profile ID (ID)
Profile ID type	PROFILE_ID	• MC_CAM_ID	Data type to specify the operation profile data to use in the operation profile data control FB (MC_CamIn, etc.). A unique No. is given by the operation profile data open FB (MC_CamTableSelect, etc.). • Profile ID No. (Number)

The following table shows open FBs and control FBs that can be used to each function type.

Function	Profile data type	Profile ID type	Open FB	Control FB
Cam	MC_CAM_REF	MC_CAM_ID	MC_CamTableSelect*1	MC_CamIn
Profile operation	PROFILE_DATA	PROFILE_ID	MCv_ProfileSelect	MCv_ProfileCalc

*1 It can be opened with MCv_ProfileSelect.

■Operation profile data operation in the engineering tool

When operating from the engineering tool, set operation profile data file reads/writes to files. Operation profile data file cannot read/write to 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 the interpolation method specification is "0: Linear interpolation": Management information (1kbyte) +Coordinate number × 8 × 2 (byte) • When the interpolation method specification is "1: Specifying for each section" and "2: Spline interpolation": Management information (1k byte) +Resolution × 8 (byte)
	Cam data for rotary cutter	Management information (1k byte) + Resolution × 8 (byte)
Create csv file directly	Multidimensional profile data	• For "2 input 1 output": Management information (1k byte) + X coordinate number × Y coordinate number × 8 × 3 (byte) • For "3 input 1 output": Management information (1k byte) +X coordinate number × Y coordinate number × Z coordinate number × 8 × 4 (byte)

In operation profile open processing, temporarily twice the data size memory of open area will be used for cam data (interpolation method specification is "1: Specifying for each section" and "2: Spline interpolation") and cam data for rotary cutter, and the same data size memory of open area will be used for other than the above.

Opening operation profile data

Performs open of operation profile data.

Open files specified with PROFILE_DATA.Location in the open area by using operation profile data open FB (MC_CamTableSelect, MCv_ProfileSelect).

- Data opened in the open area is assigned profile IDs expressed in the profile ID type.
- An operation profile data open FB that can be executed differs depending on the defined profile data type. For details, refer to the following.

  ☞ Page 433 Operation profile data types

MCv_ProfileSelect can be opened regardless of the profile data type.

Precautions

When rewriting the 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

- An open instruction is carried out with service processing. It may take time to open depending on the processing details and the operation profile data.
- When there are Periodic, MasterAbsolute, or SlaveAbsolute as an input argument of the open FB, the file setting values are ignored, and the open is carried out referring the setting of the input argument. (The file setting values do not overwrite.)

■Details of setting items

• Master (master axis)/Slave (slave axis)/AxesGroup (axes group)

Ignores them.

• CamTable (cam table)/ProfileData (profile data)

Set the operation profile data with PROFILE_DATA type structure.

The value of PROFILE_DATA.Location is referred, and open is carried out to the operation profile data that the file name and the path indicate.

The ID that PROFILE_DATA.ID indicates is assigned in the open area.

PROFILE_DATA.ID.Number	Operation
When specifying "0"	An available ID is assigned automatically, and the ID is stored in PROFILE_DATA.ID.Number. If an open FB whose PROFILE_DATA.ID.Number is "0" is executed multiple times to the same operation profile data, the data will be opened in multiple different open areas. When there is no available ID, error "Insufficient Calculation Profile ID" (error code: 3452H) will occur and open processing will not be carried out.
When expressly specifying other than "0"	The open is carried out without changing the ID. If specifying an ID that has been already opened, the open data will be overwritten.

The following table shows the relationship between the value of PROFILE_DATA.ID.Number at open and the open location area.

Value of PROFILE_DATA.ID.Number		Open location area
Before open FB execution	After open FB execution	
0	Stores other than 0	New
Other than 0		Overwrite if there exists, new otherwise

If there is no operation profile data specified with PROFILE_DATA.Location, the error "No Calculation Profile" (error code: 340FH) will occur, and the open processing will not be carried out.

If operation profile data specified with PROFILE_DATA.Location is broken or if there is a problem in the format, the error "Operation profile data error" (error code: 3412H) will occur, and the open processing will not be carried out.

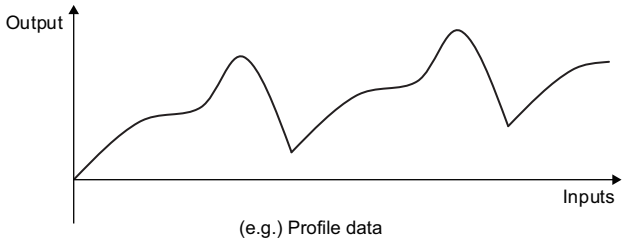
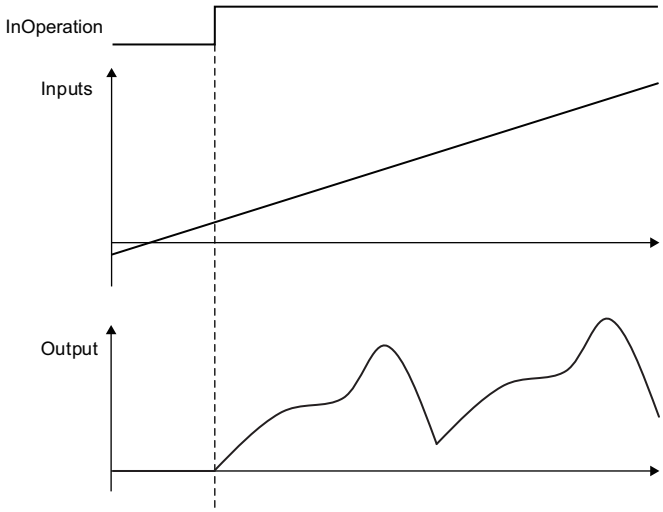
• Periodic (Periodic)

The following explains the operation at operation profile data control execution when periodic mode is set.

Periodic	Operation
When FALSE is set	The control ends when it executes until the end of operation profile data.
When TRUE is set	Repeats continuously operation profile data execution.

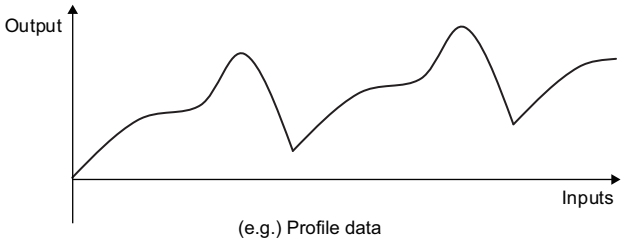
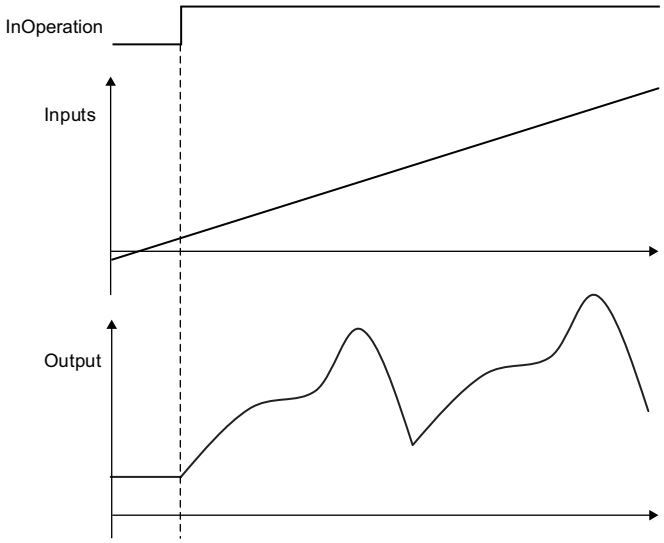
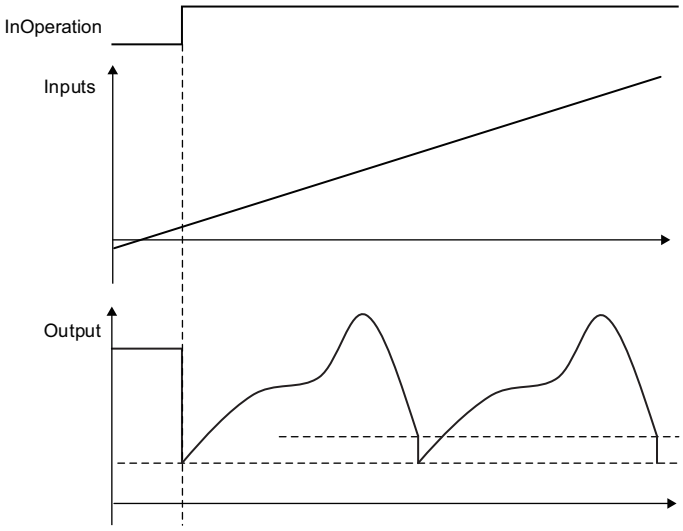
• MasterAbsolute (Input absolute coordinate)

The following explains the operation at operation profile data control execution when MasterAbsolute mode is set. (When the input unit is time specification, it is ignored. (Fixed with relative coordinates)

MasterAbsolute	Operation
When FALSE is set	The current Inputs value becomes the start point of the operation profile data. When InOperation turns TRUE, Output is calculated according to the relative movement amount of Inputs.  (e.g.) Profile data 

• SlaveAbsolute (Output absolute coordinate)

The following explains the operation at operation profile data control execution when SlaveAbsolute mode is set.

SlaveAbsolute	Operation
When FALSE is set	When InOperation turns TRUE, Output is calculated based on the current value.  (e.g.) Profile data 
When TRUE is set	Calculates so that Output at the time when InOperation turns TRUE always becomes the start point when one cycle of the operation profile data starts. When there is a limit on the Inputs value, such as the cam data length per cycle, of the operation profile data, and the start point and the end point of the operation profile data are different when Periodic=TRUE "Periodic", the command is output in one operation cycle in order to return to the first Output at the next one cycle start. 

Automatic open of operation profile data

Opens operation profile data automatically.

Operation profile data that satisfy all of the following conditions can be used for control without executing an open FB, because it is automatically opened when the power turns ON.

- Other than "0" is specified to the initial value of PROFILE_DATA.ID.Number.
- The operation profile data is stored in %PROJECT_ROOT%/calc_profile/auto_open, or %PROJECT_ROOT_DRIVE%/calc_profile/auto_open.

Read/write operation profile data

Operates data read/write of operation profile data.

Operates data read/write of file an operation profile data in open area by using MCv_ReadProfileData/MCv_WriteProfileData according to data structure for read/write.

Operation profile data format to which the data structure for read/write is defined can operates read/write operation. For details of the data structure for read/write of each operation profile data format, refer to the following.

☞ Page 433 Operation profile data format: Cam data

Point

The number of data points that can be read/written at the same time are limited. If read/write is not completed in one time FB execution, carry out it in several times.

■Read operation profile data

Operation profile data can be read by using the MCv_ReadProfileData.

- The file specified in ProfileData and Target, or the operation profile data in open area are read for the number of points specified in Points from data specified with Offset.
- To read the whole operation profile data, specify "0" in both Offset and Points.
- Read data is stored in variables specified in Data1 and Data2.

■Write operation profile data

Operation profile data can be written by using the MCv_WriteProfileData.

- The file specified in ProfileData and Target, or the operation profile data in open area are written for the number of points specified in Points from data specified with Offset.
- To write the whole operation profile data, specify "0" in both Offset and Points.

■Details of setting items

- ProfileData (Profile data)

Set operation profile data for read/write with PROFILE_DATA structure.

Operation profile data format to which the data structure for read/write is defined can operates read/write operation.

If specifying operation profile data that does not correspond to read/write operation, the error "Calculation Profile Read/Write Unsupported" (error code: 345EH) will occur.

- Data1 (Read data 1/Write data 1)/Data2 (Read data 2/Write data 2)

Set read data/write data of operation profile data with TARGET_REF structure.

Data types of [VAR] and [DEV] can be used.

Data type that can be used is the type of the data structure for read/write of each operation profile data. For details, refer to the following.

☞ Page 433 Operation profile data format: Cam data

Ex.

When reading operation profile data of the cam data format for 10 points of buffer memory (Data1 is G1000 or more and Data2 is G3000 or more)

Data1.Target…"[DEV](PROFILE_CAM_DATA)G1000"

Data2.Target…"[DEV](LREAL[1..10, 1..2])G3000"

If the type of the specified data structure for read/write does not match the type that is required for each operation profile data, the error "Read/Write Data Type Incorrect" (error code: 3462H) will occur.

• Offset (Offset)

Specifies offset from the top for operation profile data specified in ProfileData.

If Offset exceeds the range of operation profile data, the error "Out of Offset Range" (error code: 3413H) will occur, and read/write will not be performed.

When setting the value other than 0 to Offset, also set the value other than 0 to Points.(When "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

Set 0 to write operation profile when Target = 1 (File) (When other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

• Points (Number of read data/Number of write data)

Specifies the number of data points to read and the number of data points to write.

When Points exceeds the number of elements of the operation profile data, read/write is carried out within the number of elements of the operation profile data range.

When the interpolation method specification of operation profile is "0: Linear interpolation" and "2: Spline interpolation", set 0 (When other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

Set 0 to write operation profile when Target = 1 (File) (When other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

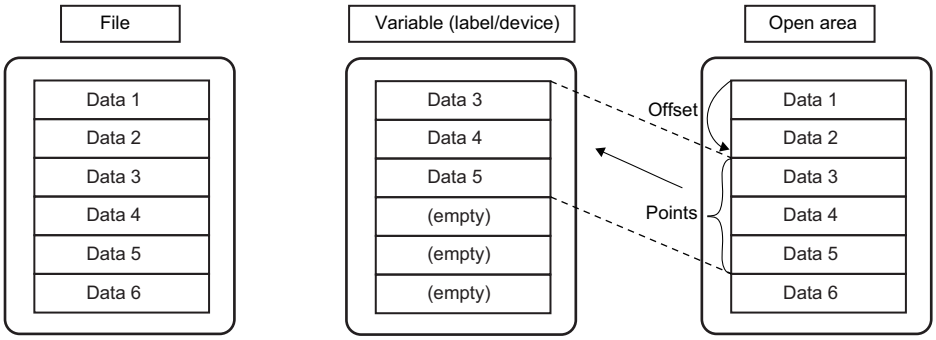
• Target (Read destination/write destination)

Specifies read destination and write destination of the operation profile data.

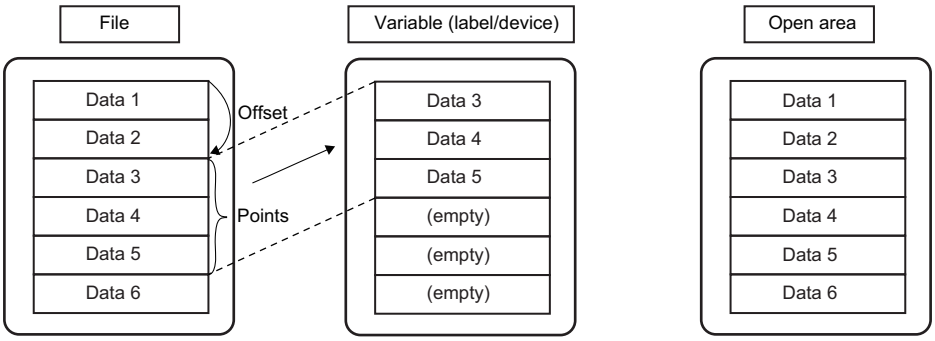
Target	Read operation	Write operation
0: OpenArea	• The value of PROFILE_DATA.ID is referred, and read is carried out to the operation profile data that the ID indicates in open area. • If operation profile data does not exist (unopened), the error "No Calculation Profile" (error code: 340FH) will occur.	• The value of PROFILE_DATA.ID is referred, and write is carried out to the operation profile data that the ID indicates in open area.
1: File	• The value of PROFILE_DATA.Location is referred, and read is carried out to the operation profile data that the file name and the path indicate. • If operation profile data does not exist, the error "No Calculation Profile" (error code: 340FH) will occur.	• The value of PROFILE_DATA.ID is referred, and write is carried out to the operation profile data that the ID indicates in open area. Then The value of PROFILE_DATA.Location is referred, and write is carried out to the operation profile data that the file name and the path indicate. • If the specified file exists, overwrite is carried out. • If the specified file does not exist, a new file will be created when both Offset and Points are "0". • When creating a new file, both Offset and Points must be "0", otherwise the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur. (Write to the open area is executed.)

Ex.

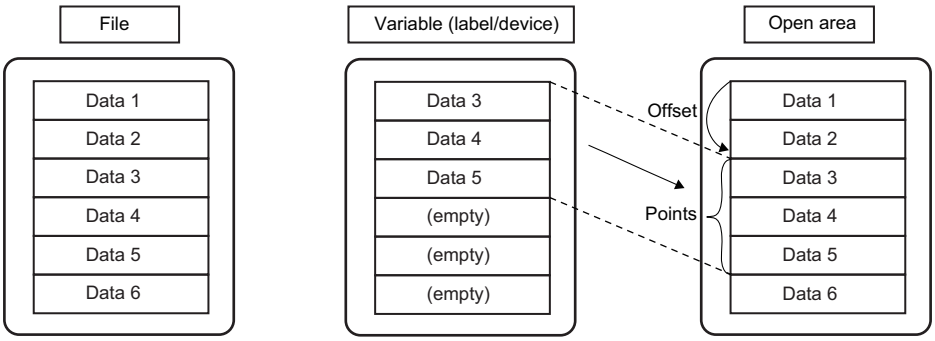
Read process when Target = 0 (OpenArea), Offset = 2 and Points = 3 are specified



Read process when Target = 1 (File), Offset = 2 and Points = 3 are specified



Read process when Target = 0 (OpenArea), Offset = 2 and Points = 3 are specified



Point

- When Target is "1: File", processing is carried out at a cycle with lower priority than the operation cycle. Therefore, it may take time to read/write depending on processing details and operation profile data.
- When Target is "0: OpenArea", read/write is carried out depending on the cycle of executed program.

Precautions

When the operation profile data is written in the file area using MCv_WriteProfileData, the setting value of periodic, input absolute coordinate and output absolute coordinate will be FALSE.

Control of operation profile data

Operation profile data is used to control.

Control details

Control is executed based on the operation profile data specified with PROFILE_DATA.ID by using operation profile data control FBs (MC_CamIn and MCv_ProfileCalc).
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.

■Profile operation

Output data for input data is calculated by using multidimensional profile data.
Inputs, Output, InputsOffset, OutputOffset, InputsScaling, OutputScaling and ProfileID are set by using MCv_ProfileCalc, and the control is executed based on multidimensional profile data.
Before using this function, open the multidimensional profile data in the open area of the operation profile data to enable this control.
Output to the signal set in Outputs (Output data indicated as follows) is controled based on the signal set in Inputs (Input data indicatd as follows) and the multidimensional profile data in ProfileID.

■Details of setting items

• Inputs (Input data)

Specify the input data with the array of the number of dimensions of the TARGET_REF structure of the input data.
The data type, [VAR] and [DEV] can be used.
Data type that can be used is LREAL.

• Output (Output data)

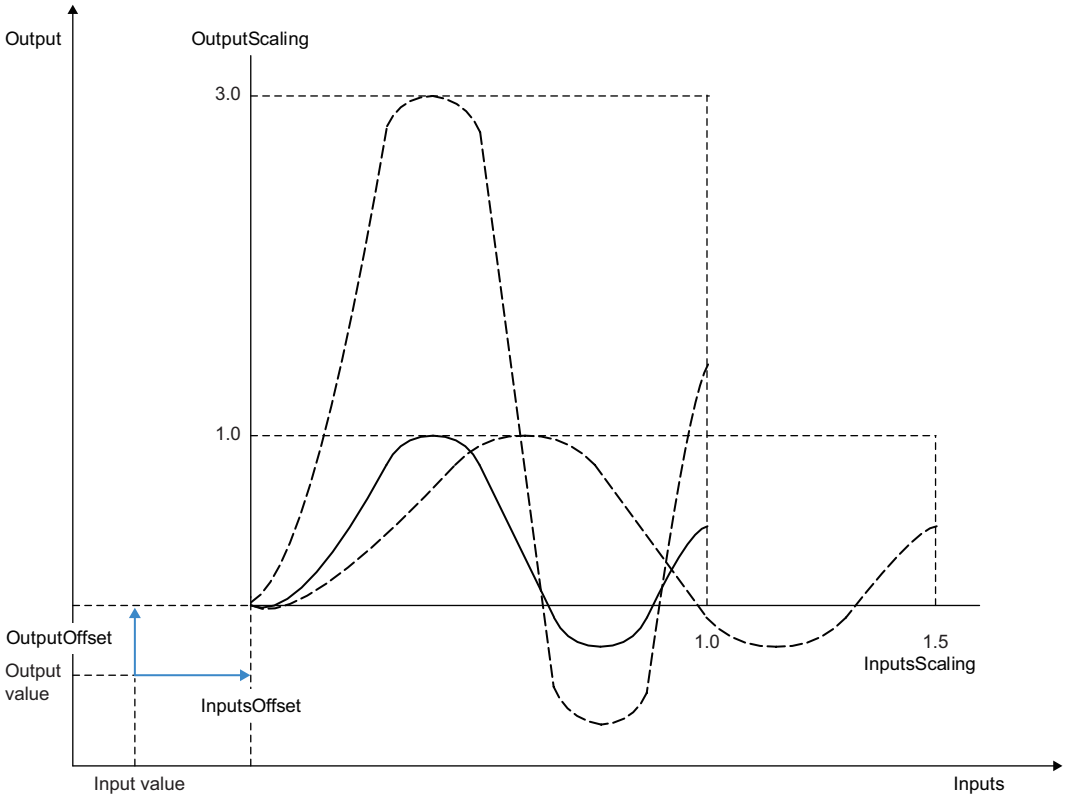
Specify the output data with the TARGET_REF structure.
The data type, [VAR] and [DEV] can be used.
Data type that can be used is LREAL.

• InputsOffset (Input offset)/OutputOffset (Output offset)

The phase/displacement Inputs/Output can be shifted by setting InputsOffset/OutputOffset.
The phase of input value can be shifted by InputsOffset.
InputsOffset can be specified as an array for each element of Inputs respectively.

• InputsScaling (InputScaling)/OutputScaling (OutputScaling)

The operation profile data can be enlarged or reduced by setting InputsScaling/OutputScaling (OutputScaling).
InputsScaling can be specified as an array for each element of Inputs respectively.



• ProfileID (Profile ID)

Specify the multidimensional profile data ID with the PROFILE_ID structure.

Start mode

The following table show the operation when simultaneously executing various operation profile data FBs (open, write, read, control) that access open areas to the same profile ID.

• ExecutionMode

For the operation profile data open FB and the operation profile data write FB, the operation for simultaneous execution can be specified with ExecutionMode.

○: Execution possible, ×: Error

On-going FB	FB to be executed			
	Open/Write			Read/Control
	mcImmediately	mcQueued	mcSpeculatively	
Open/Write	○	○	×	×
Read/Control	○	○	×	○

[0: 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 operation profile format and the resolution do not match when executing open/write during FB execution, the error "Operating operation profile data" (error code: 3411H) occurs.

[1: 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.

[3: mcSpeculatively]

The error "Operating operation profile data" (error code: 3411H) occurs, and the open area is not changed.

Point

When no FB is in execution, the FB is executed immediately regardless of specification of ExecutionMode. While the FB (open, write, read, control) that accesses open areas is in execution, Busy of various FBs are TRUE. Use this signal to the interlock as needed.

Sub function of operation profile data control

Current value per cycle change function

Change the current value per cycle of an operation profile data control FB to an arbitrary value.

- Set ProfileCalc.InstanceID of operation profile data control FB (Instance name indicates ProfileCalc as follows) in InstanceID. It is valid to FBs which have ProfileCalc.InputsPerCycle.
- Change ProfileCalc.InputsPerCycle to the value specified with Cycle.
- Change ProfileCalc.Reference, as to fix ProfileCalc.OutputData, to match the change of ProfileCalc.InputsPerCycle as well.
- There are two methods as follows for current value per cycle change.

Method	Description
MCv_ChangeCycle	Change it to the specified value at control execution.
MCv_ChangeCycleTriggered	Compensate the specified value at the trigger input signal detection timing. Change it to the compensated value.

- For specification of the current value per cycle to be changed, "absolute specification" or "relative specification" can be selected by Relative.

■Current value per cycle change

Uses MCv_ChangeCycle.

Changes the current value per cycle of the specified operation profile data control FB.

Executes current value per cycle change at rising edge detection of Execute.

Whether the change of the current value per cycle waits until the operation profile data control FB execution is completed can be selected by ExecutionMode.

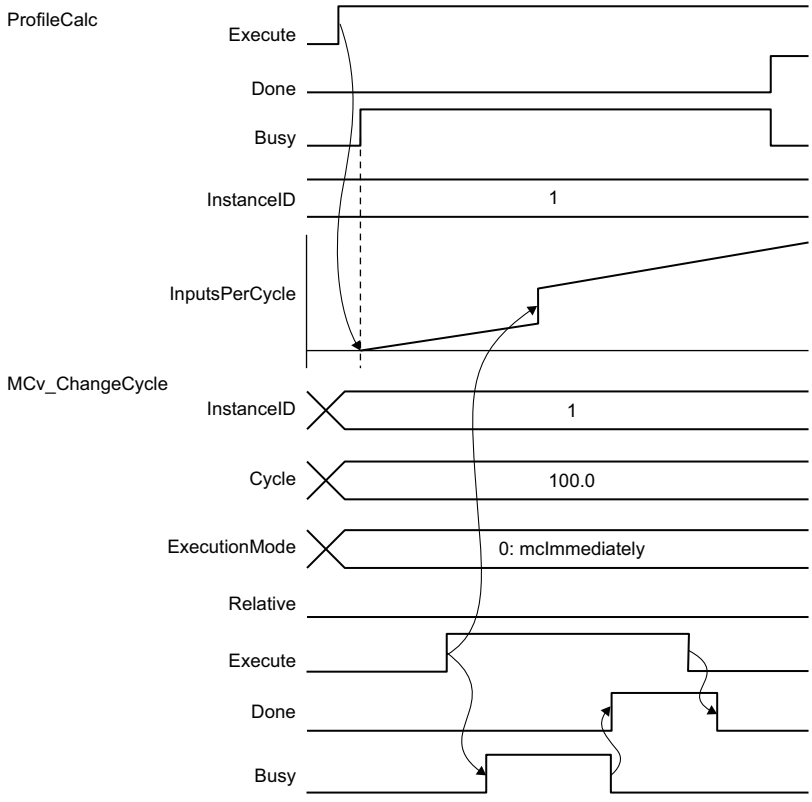
- ExcutionMode (Start mode)

[0: mcImmediately]

Executed immediately at rising edge detection of Execute with ProfileCalc.Busy = TRUE.

Ex.

Sets Cycle = 100.0 when ProfileCalc.Busy = TRUE, and when executing current value per cycle change.



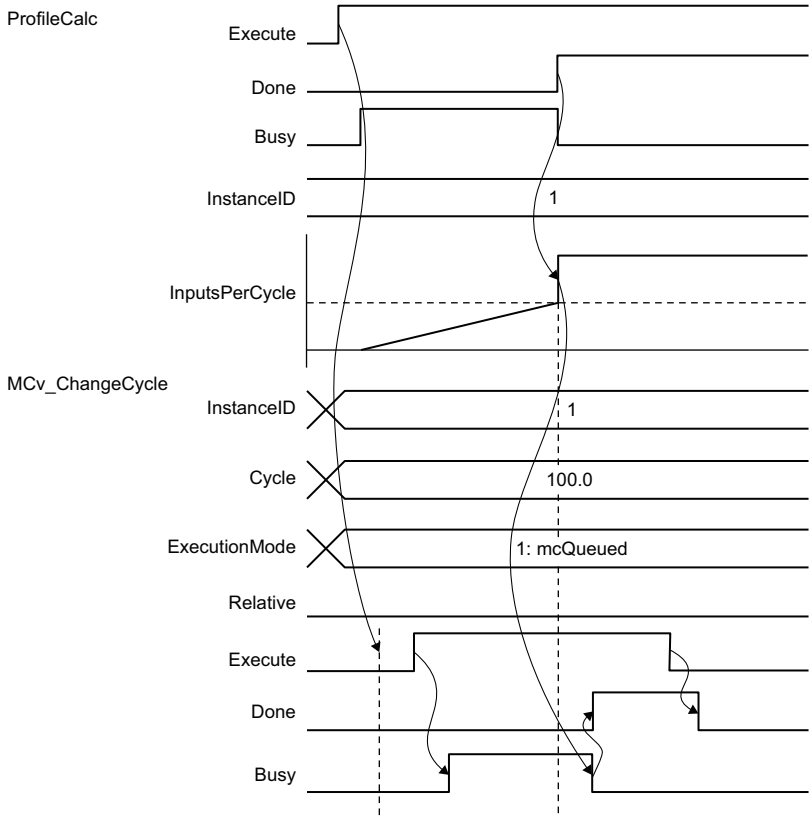
[1: mcQueued]

Becomes Busy = TRUE at rising edge detection of Execute.

Executed after waiting until ProfileCalc.Busy = TRUE turns FALSE.

Ex.

When setting Cycle = 100.0, and executing current value per cycle change.



[3: mcSpeculatively]

If detecting the rising edge pf Execute when it is not ProfileCalc.Busy = FALSE, the error "Axis Status Incorrect Start" (error code: 1A26H) will occur.

■Trigger current value per cycle change

Uses MCv_ChangeCycleTriggered.

Changes the current value per cycle of the specified operation profile data control FB to the value which is compensated at the detection timing of the trigger input signal.

Executes current value per cycle change when the trigger signal is detected after the rising edge detection of Execute.

When TriggerInput.Signal.CompensationTime is a positive value, it is executed immediately.

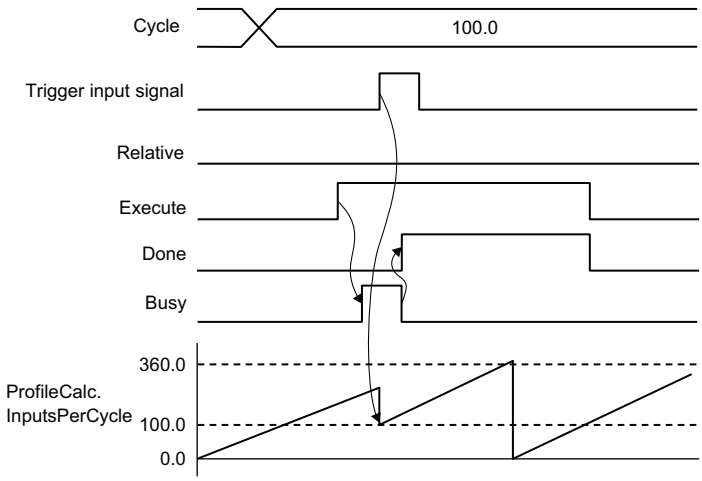
When TriggerInput.Signal.CompensationTime is a negative value, this FB waits for operation to start until the correction time has elapsed, and it is executed.

ProfileCalc.InputsPerCycle is estimated and changed so that the position will be a position set in Cycle at Trigger signal detection timing.

Ex.

Operation example by Trigger input signal

When setting Cycle = 100.0 during ProfileCalc operation, and executing current value per cycle change.



- TriggerInput (Trigger input signal)

Specifies Trigger input signal with the MC_TRIGGER_REF structure.

Setting range of TriggerInput.Signal is shown below.

Item		Setting range
TriggerInput.Signal		
	Source	Type BOOL Data type [VAR] [DEV] [CONST] [OBJ]
	Detection	2: RisingEdge 3: FallingEdge 4: BothEdges
	CompensationTime	When Relative = TURE: 0.0 When Relative = FALSE: -5.0 to 5.0 [s]

■Details of setting items

• InstanceID (Instance ID)

Specifies the instance ID of operation profile data control FB.

• Cycle (Current value per cycle)

Specifies the current value per cycle to be changed.

When Relative=TURE: ProfileCalc.InputsPerCycle is changed to the value added Cycle to the current ProfileCalc.InputsPerCycle.

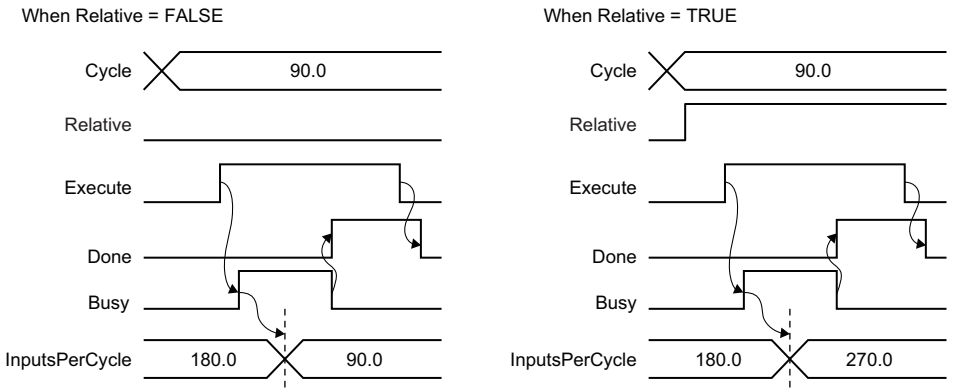
When Relative=FALSE: ProfileCalc.InputsPerCycle is changed to

Relative	Position setting range
FALSE	0 ≤ Setting value < Length per cycle
TRUE	-(Length per cycle) / 2 ≤ Setting value ≤ (Length per cycle) / 2

Ex.

Operation example by Relative

When executing the current value per cycle change of Cycle = 90.0 while it stops with ProfileCalc.InputsPerCycle = 180.0.



• Relative (Relative selection)

When Relative = TRUE, Cycle is "Relative specification", when Relative = FALSE, Cycle is "Absolute specification".

• Options (Options)

Specify the function options.

Bit	Function description
0 to 15	Empty (Specify "0".)
16	Cancel enabled setting of current value per cycle change 0: Not allow 1: Allow
17 to 31	Empty (Specify "0".)

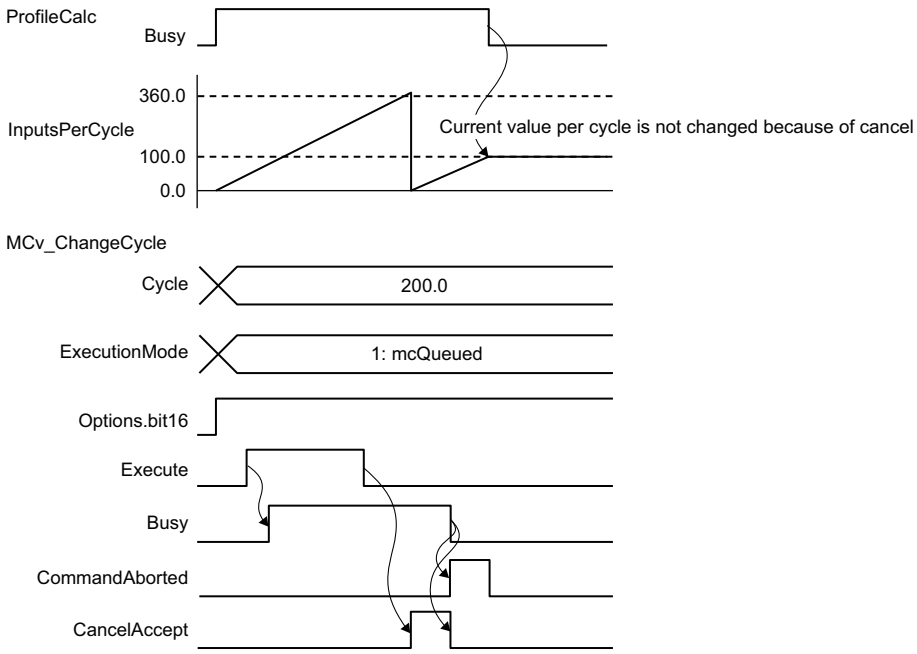
Current value per cycle change that is in the standby status can be canceled after FB execution by cancel enabled setting.

- Cancel is started at falling edge detection of Execute.
- Cancel is accepted only when Busy = TRUE.
- When FB accepts cancel, becomes CancelAccepted = TRUE.
- When cancel is completed, becomes CommandAborted = TRUE.
- When cancel was carried out, InputsCyclePerCycle is not changed.

Ex.

Cancel operation example by MCv_ChangeCycle

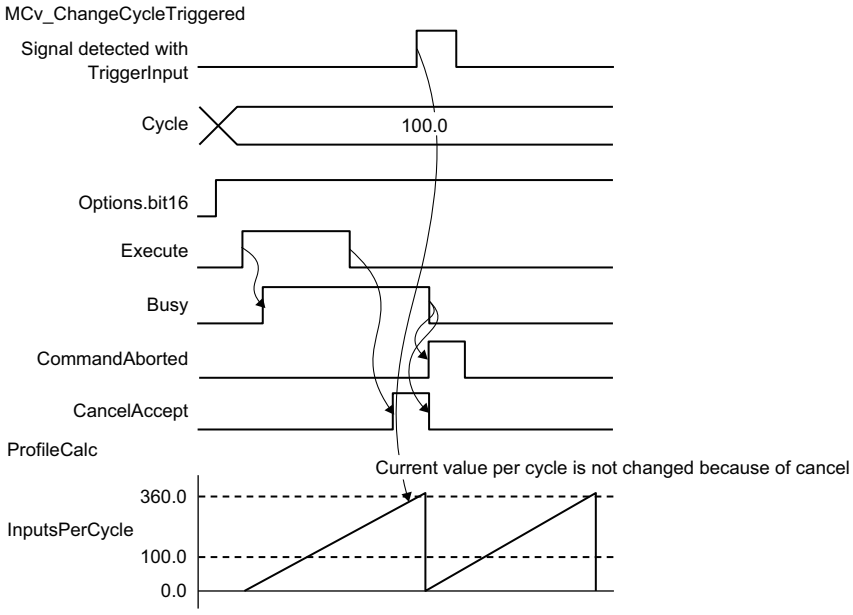
When canceling while ProfileCalc.Busy=TRUE is waiting for switching to FALSE after starting ExecutionMode with "1: mcQueued"



Ex.

Cancel operation example by MCv_SetPositionTriggered

When canceling while it is waiting for detecting a trigger input signal after starting



13.2 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 as the following table.

Line No.	Description
1	For system
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	Length per cycle
N-1	Stroke amount
N	Common footer (EOF)
N+1	Common footer (CRC)

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
2	1	Profile ID	×	☞ Page 416 Operation Profile Data Initial value: 0 (= automatic apply)	Unsigned integer	Specifies Profile ID. (Use only when carrying out automatic open when the power turns ON.)	0x0103
	2	Periodic	○	☞ Page 416 Operation Profile Data	Integer	Specifies periodic.	0x0103
	3	Input absolute coordinate	○	☞ Page 416 Operation Profile Data	Integer	Specifies input absolute coordinate.	0x0103
	4	Output absolute coordinate	○	☞ Page 416 Operation Profile Data	Integer	Specifies output absolute coordinate.	0x0103
3	1	Operation profile data format	×	99: Cam data format	Integer	Specifies operation profile data format.	0x0103
	2	Profile data type	○	0: General profile data 1: Cam data 6: Digital output data format Initial value: 0	Integer	Specifies the profile data type. ☞ Page 416 Operation Profile Data	0x0103
	3	Interpolation method specification	○	0: Linear interpolation 1: Specifying for each section 2: Spline interpolation Initial value: 0	Integer	Specifies the interpolation method between data.	0x0103
4	1	Resolution and number of coordinates	×	☞ Page 416 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 accrlrration	○	*1 99: Valid for the cam data format (specified for each section) Initial value: 0	Real number	Specifies the initial accrlrration	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*3	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 For settable units, refer to the following. ☞ Page 74 Technical Units	Unsigned integer	Specifies the unit of the length per cycle. Units that can be specified differ depending on the profile data type. ☞ Page 416 Operation Profile Data	0x0103
	3	Unit character string	○	Initial value: "" ☞ Page 74 Technical Units	Character string	Specifies an arbitrary character string when "an arbitrary unit" is set to the unit setting.	0x0103
	4	Minimum value per cycle	○	*4	Real number	Specifies the minimum value of length per cycle. Specify "0" for the data format that does not require it.	0x0103
	5	Maximum value per cycle	○	*4	Real number	Specifies the maximum value of length per cycle. Specify "0" for the data format that does not require it.	0x0103
	6	Time per cycle	○	0 or more*3	Real number	Specifies the time per cycle. Specify "0" for the data format that does not require it.	0x0103

*3 The maximum value differs depending on the data format.

*4 Differs depending on the data format.

• (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 For settable units, refer to the following. ☞ Page 74 Technical Units	Unsigned integer	Specifies the unit of stroke amount. Units that can be specified differ depending on the profile data type. ☞ Page 416 Operation Profile Data	0x0103
	3	Unit character string	○	Initial value: "" ☞ Page 74 Technical Units	Character string	Specifies an arbitrary character string when "an arbitrary unit" is set to the unit setting.	0x0103

*1 Differs depending on the data format.

Cam data format (Interpolation method specification: "0: Linear interpolation")

The following shows a case for specifying setting value below.

Line No.	Column No.	Item	Setting value
3	1	Operation profile data format	99: Cam data format
	3	Interpolation method specification	0: Linear interpolation

■7th line or later: I/O data

×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	Input value (0th point)	×	☞ Page 79 Positioning Range	Real number	☞ Page 416 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 79 Positioning Range	Real number	☞ Page 416 Operation Profile Data	0x0103

Cam data format (Interpolation method specification: "1: Specifying for each section")

The following shows a case for specifying setting value below.

Line No.	Column No.	Item	Setting value
3	3	Interpolation method specification	1: Specifying for each section

■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 416 Operation Profile Data	Integer	☞ Page 416 Operation Profile Data	0x0103
	2	End point	×	☞ Page 416 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)							

Cam data format (Interpolation method specification: "2: Spline interpolation")

The following shows a case for specifying setting value below.

Line No.	Column No.	Item	Setting value
3	3	Interpolation method specification	2: Spline interpolation

■6th line: Number of sections

Specify the number of sections.

■7th line or later: Parameter

×: Omission not possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
7	1	End point	×	☞ Page 416 Operation Profile Data	Real number	☞ Page 416 Operation Profile Data	0x0103
	2	Stroke	×		Real number		0x0103
8	1-2	Same as line No.7					
⋮ (For the number of sections)							

14 SYNCHRONOUS CONTROL

14.1 Outline of Single Axis Synchronization Function Blocks

Single axis synchronization function blocks enable to control mechanical systems such as gear, speed change gear, and cam with a software by transmitting the position information (command) of Slave that is synchronized with Master.

FB	Control details
MC_CamIn	Executes cam operation.
MC_GearIn	Sets the speed ratio between the master axis and the slave axis, and enters gear operation.
MC_CombineAxes	Combines operations of two axes by a selectable combination method, and outputs it to the third axis.
MCv_ChangeCycle MCv_ChangeCycleTriggered	Changes the cam current value per cycle to the specified value during MC_CamIn control. It is used to interpolate the cam current value per cycle into an arbitrary value.
MCv_******Filter	Carries out the specific filter processing to input of Master, and outputs the result to Slave. ☞ Page 364 Command Filter

14.2 Axis Configuration

The following shows axes that can be specified to Master and Slave in the single axis synchronization function block. Any of the following axis types can be used in the configuration of Master or Slave. For the specifications of each axis type, refer to the following.

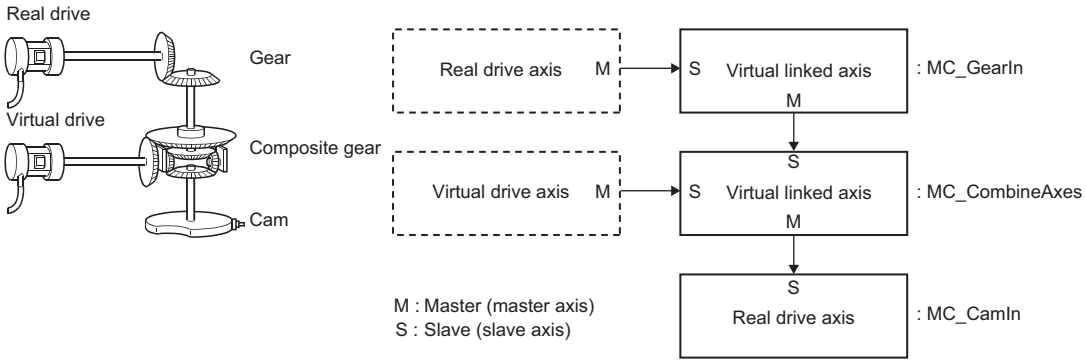
☞ Page 32 Axis, ☞ Page 52 Axis Assignment

Axis type	Remark
Real drive axis	When control for Motion FB is required, create a configuration that executes function blocks for each virtual linked axis and transmits the result (command) to the real drive axis.
Virtual drive axis	Cammands can be mainly created by positioning control, etc.
Virtual linked axis	It is used as an intermediate axis to transmit a command to the real drive axis. When using multiple function blocks (motion) such as gear, assign virtual linked axes.
Real encoder axis	It is used as Master. When it is used as Slave, the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs and it does not start.
virtual encoder axis	

A command can be transmitted between axes by linking the axes to the single axis synchronization function block. Also, to simultaneously execute controls such as gear and cam by executing multiple function blocks, like the following example, link the necessary number of axes and execute the single axis synchronization function block.

Ex.

When cam control is realized by linking axes with gear from the realdrive and adding a command from the virtual drive to the command



14.3 Master Axis Data Source Selection

In the single axis synchronization function block, a position type of the master axis whose the slave axis executes the single axis synchronous control can be selected by MasterValueSource of each FB.

mcLatest* uses 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. The operation may differ between mcLatest* and the others for the differences of the operation cycles between the master axis and the slave axis or for the execution order of FBs. For details, refer to the following.

☞ Page 105 Operation Cycle

Operates with the same value as set value when specifying actual value in the mastar axis data source selection by setting axis types other than real axis to the master axis.

Point

When mcSetValue and mcLatestSetValue are set to MasterValueSource and the master axis becomes servo OFF by the servo alarm or forced stop, the amount of value change may be large. This can be prevented by setting mcActualValue and mcLatestActualValue to MasterValueSource.

MasterValueSource	Description
1: mcSetValue (Set value)	Uses the commanded position of the master axis in the previous operation cycle.
2: mcActualValue (Actual value)	Uses the actual position of the master axis in the previous operation cycle.
101: mcLatestSetValue (Latest set value)	Uses the commanded position of the master axis in the current operation cycle.
102: mcLatestActualValue (Latest actual value)	Uses the actual position of the master axis in the current operation cycle.

14.4 Start and Stop Operation

Slave continues to control with the command transmitted by the master axis even if a stop cause occurs during execution of the synchronous control function blocks. The axis status of the slave axis does not change.

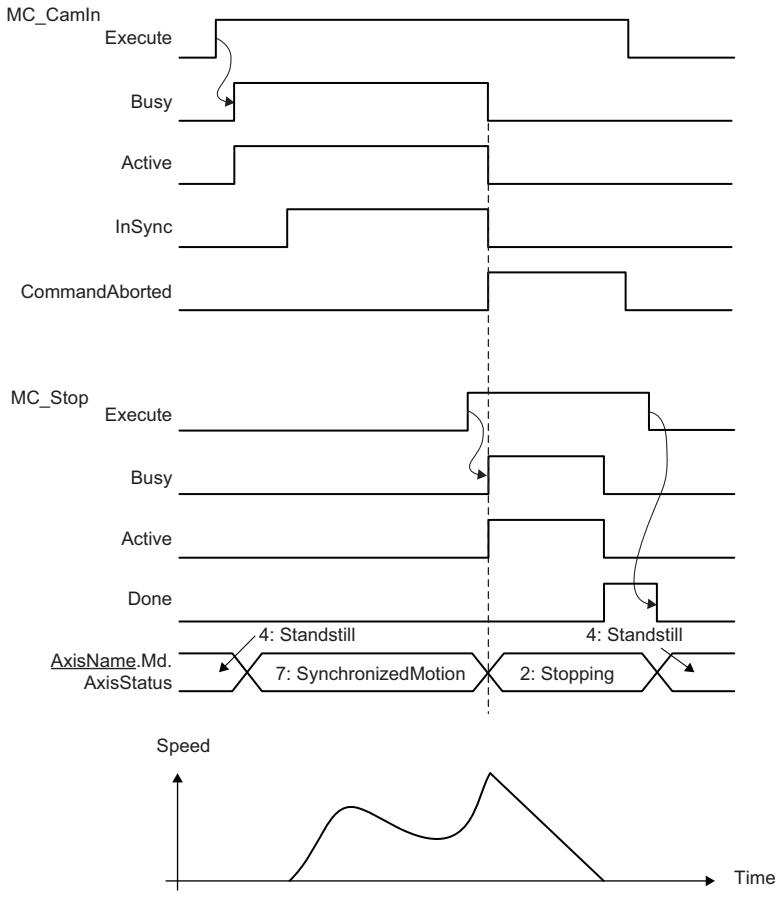
When a stop cause occurs to the slave axis, the axis status transits and the slave axis immediately stops or stops with deceleration according to the stop cause and its stop process. For axis control when a stop cause occurs, refer to the following.

☞ Page 156 Stop causes during axis operation

The master axis is not affected even when the stop cause occurs to the slave axis.

Ex.

When a stop cause (MC_Stop) occurs during execution of the synchronous control FB



Point

When the master axis becomes servo OFF by the servo alarm or forced stop, stop the operation of the synchronous control FB by using MC_Stop (Forced stop) command is recommended because the slave axis may cause unexpected operation.

14.5 Required Slave Object

The following shows the setting condition of the slave object when using it as Slave of the single axis synchronization function block.

Slave object 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 The error "Necessary Slave Object Unset" (error code: 1AA8H) occurs and it will not start.

14.6 Restrictions

- When Master and Slave are specified to the same axis, the error "Master Axis and Slave Axis No. Duplicated" (error code: 1A3EH) will occur.
- When connecting multiple axes in the single axis synchronization function block, if the master axis is specified to Slave of the latter function block or more than 257 single axis synchronization function blocks are linked, the error "Master Axis and Slave Axis Cyclic Reference" (error code: 1A3FH) will occur.

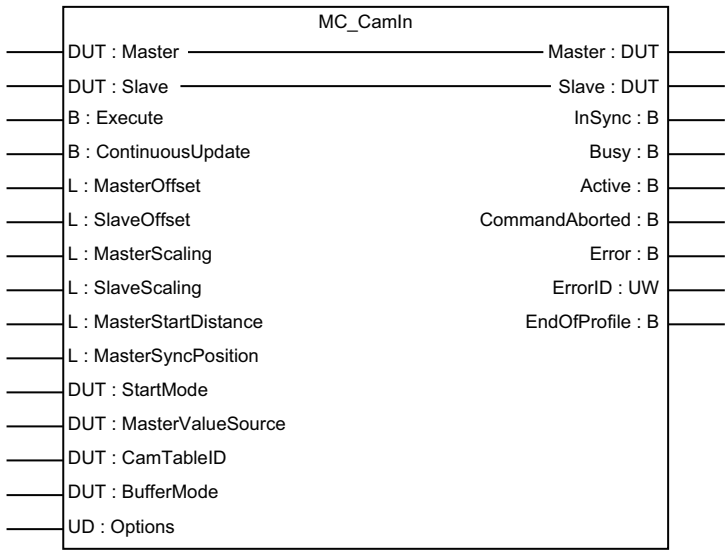
14.7 Cam Operation

This function operates by synchronizing the slave axis with the master axis based on cam table.
Before using this function, it is necessary to open the cam table to the cam open area and set to a state where it can be controlled. For the open method to the cam open area, and for cam data types that can be controlled in cam operation, refer to the following.

☞ Page 446 Operating operation profile data
☞ Page 433 Operation profile data types

Relevant FB

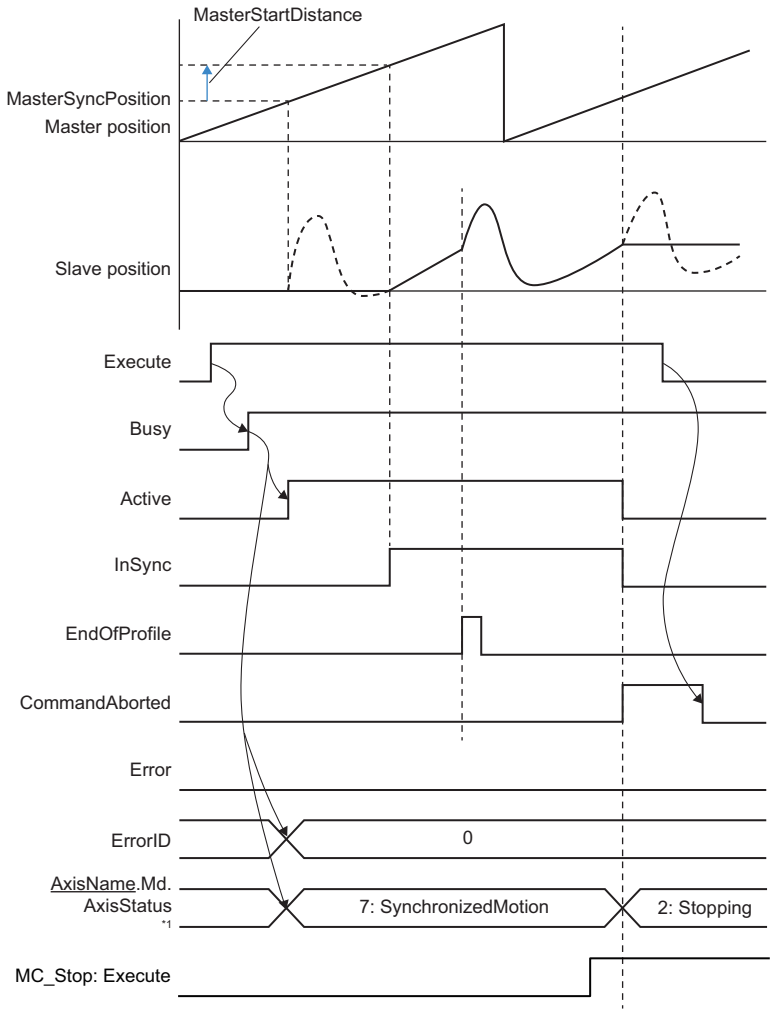
MC_CamIn

Item	Description
Function overview	Cam operation starts operation according to the specified cam data.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
96	48	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 This is the state of the Slave axis.

[When an error occurs]

When an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	
Master axis offset	MasterOffset	LREAL	↑/R/C	☞ Page 79 Positioning Range	0	☞ Page 484 MasterOffset (Master axis offset)
Slave axis offset	SlaveOffset	LREAL	↑/R/C	☞ Page 79 Positioning Range	0	☞ Page 484 SlaveOffset (Slave axis offset)
Master axis scaling	MasterScaling	LREAL	↑/R/C	0.01 to 10.00	1	☞ Page 484 MasterScaling (Master axis scaling)
Slave axis scaling	SlaveScaling	LREAL	↑/R/C	0.01 to 10.00	1	☞ Page 485 SlaveScaling (Slave axis scaling)
Master axis follow-up distance	MasterStartDistance	LREAL	↑	☞ Page 79 Positioning Range	0	☞ Page 485 MasterStartDistance (Master axis follow-up distance)
Master axis synchronization start position	MasterSyncPosition	LREAL	↑	☞ Page 79 Positioning Range	0	☞ Page 485 MasterSyncPosition (Master axis synchronization start position)
Start mode	StartMode	MC_START_MODE	↑	0 to 2	0	☞ Page 485 StartMode (Start mode)
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 485 MasterValueSource (Master axis data source selection)
Cam tableID	CamTableID	MC_CAM_ID	↑/R/C	1 to 6000	0	☞ Page 485 CamTableID (Cam table ID)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 486 BufferMode (Buffer mode)
Options	Options	DWORD(HEX)	↑	0	00000000H	Sets "0". (If a value other than "0" is set, an error will occur.)

■Output variables

Name	Variable name	Data type	Default value	Description
In synchronization	InSync	BOOL	FALSE	☞ Page 487 InSync (In synchronization)
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. When this FB is stopped by an error or when this FB is started up while an error occurs, it turns TRUE. Turns FALSE when Execute turns FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes
Cam cycle completion	EndOfProfile	BOOL	FALSE	☞ Page 487 EndOfProfile (Cam cycle completion)

■Public variables

Name	Variable name	Data type	Default value	Description
Current value per cycle	InputPerCycle	LREAL	☞ Page 79 Positioning Range	Stores the current value per cycle.
Reference value	Reference	LREAL	☞ Page 79 Positioning Range	Stores the reference value.
Output value	OutputData	LREAL	☞ Page 79 Positioning Range	Stores the output value.
Instance ID	InstanceID	WORD(UINT)	0	Instance ID that is automatically set when an instance is created. Used in FB input, etc.

Control details

MC_CamIn instruction sets MasterOffset, SlaveOffset, MasterScaling, SlaveScaling, MasterStartDistance, MasterSyncPosition, StartMode, MasterValueSource, CamTableID, BufferMode and executes the cam operation.
To stop the operation, execute MC_Stop.

Starting cam operation

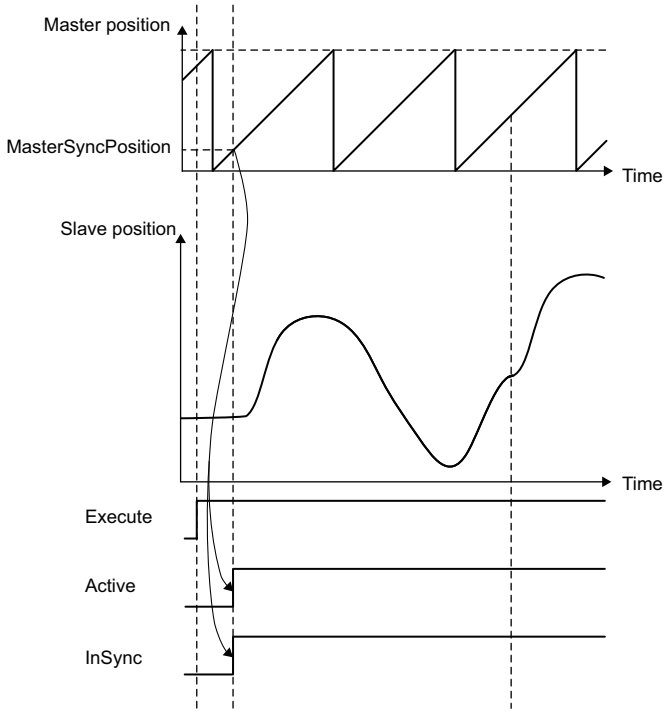
The following operation is executed by setting of StartMode.

■When setting "1: mcAbsolute", "2: mcRelative" to StartMode

MasterSyncPosition is set to the start position in the cam table. Slave control is started at the position per cycle in the cam table which is corresponding to the position specified in MasterStartDistance.
After MC_CamIn is started, Slave starts cam operation when Master passes MasterStartDistance in the cam table, and InSync turns TRUE.
When MasterStartDistance is not necessary, InSync turns TRUE when Master passes MasterSyncPosition.
The operations of MasterStartDistance are as shown below depending on StartMode settings.

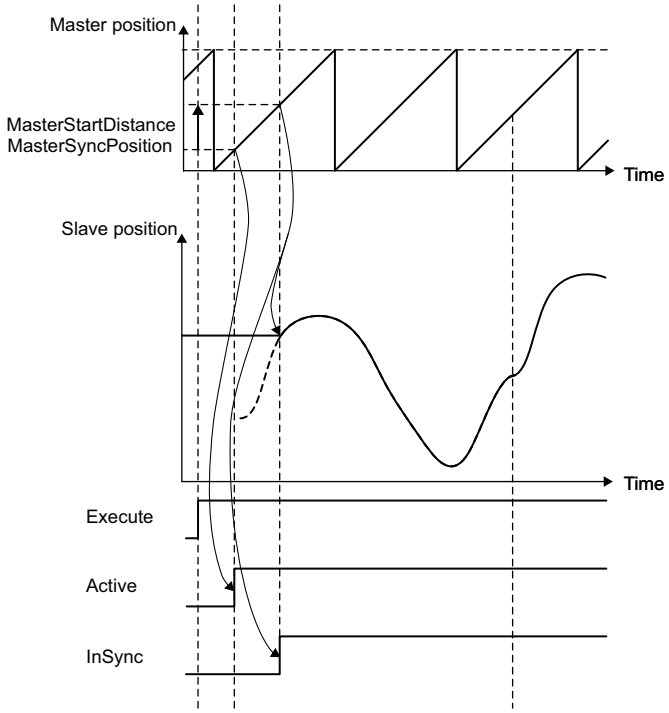
- When StartMode is set to "1: mcAbsolute"

When Master passes the position specified at MasterSyncPosition, Slave starts cam operation and InSync turns TRUE.



• When StartMode is set to "2: mcRelative"

When Master passes the position "MasterSyncPosition + MasterStartDistance", Slave starts cam operation and InSync turns TRUE.

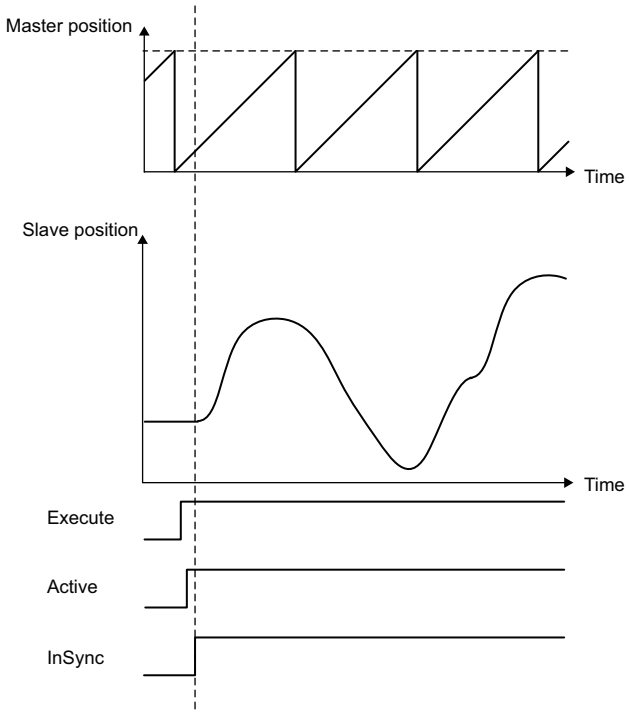


■When "0: mcImmediate" is selected for StartMode

Active turns TRUE at instruction execution, then Slave starts cam operation and InSync turns TRUE. Start position of the cam table will be the start point of the cam table or the start point set in the cam table.

☞ Page 433 Setting item

When "0: mcImmediate" is selected, MasterSyncPosition and MasterStartDistance are not used.



Cam table

The following explains cam operations at MC_CamIn execution when the periodic mode, master axis absolute coordinate, or slave axis absolute coordinate, is set as optional information at MC_CamTableSelect.

■Periodic mode

The following explains the operation at MC_CamIn execution when periodic mode is set.

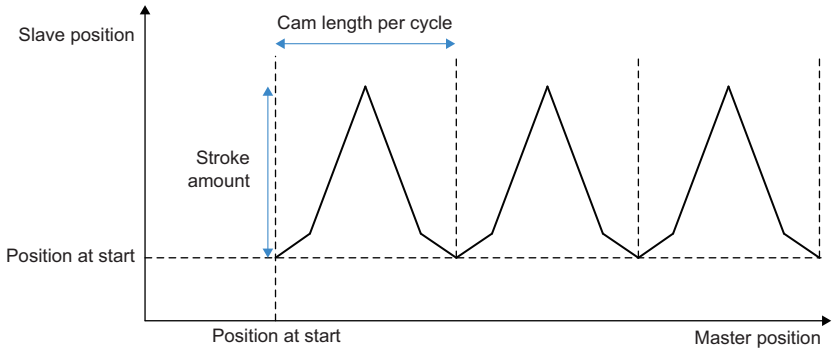
• Periodic mode (0: Non periodic) is specified

MC_CamIn stops when reaching to the end point of cam table. MC_CamIn (cam operation) does not restart even if Master is reversed to the end point of the cam table.

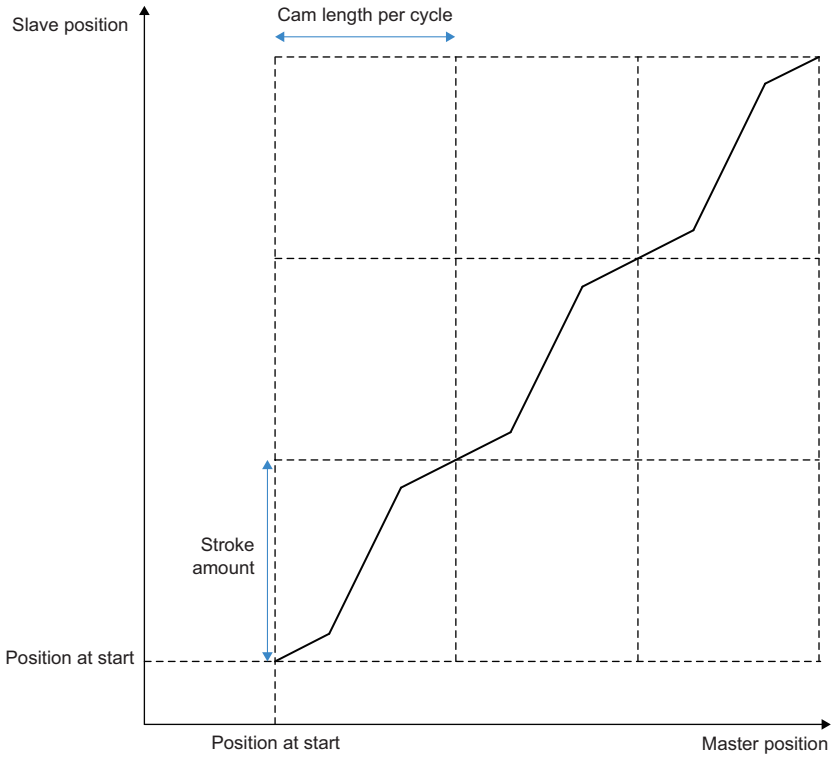
• Periodic mode (1: Periodic) is specified

Cam table execution is repeated continuously. When the positions of 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 points at the start point and the end point are different, cam is operated as a feed cam.

[Two-way cam operation]



[Feed cam operation]



■Master axis absolute coordinate

The following explains the operation at MasterAbsolute set by MC_CamTableSelect.

• [0: Relative coordinate] is specified to the master axis absolute coordinate

MasterSyncPosition becomes the start point of the cam data. When InSync turns TRUE, cam operation is executed corresponding to the relative movement amount of Master.

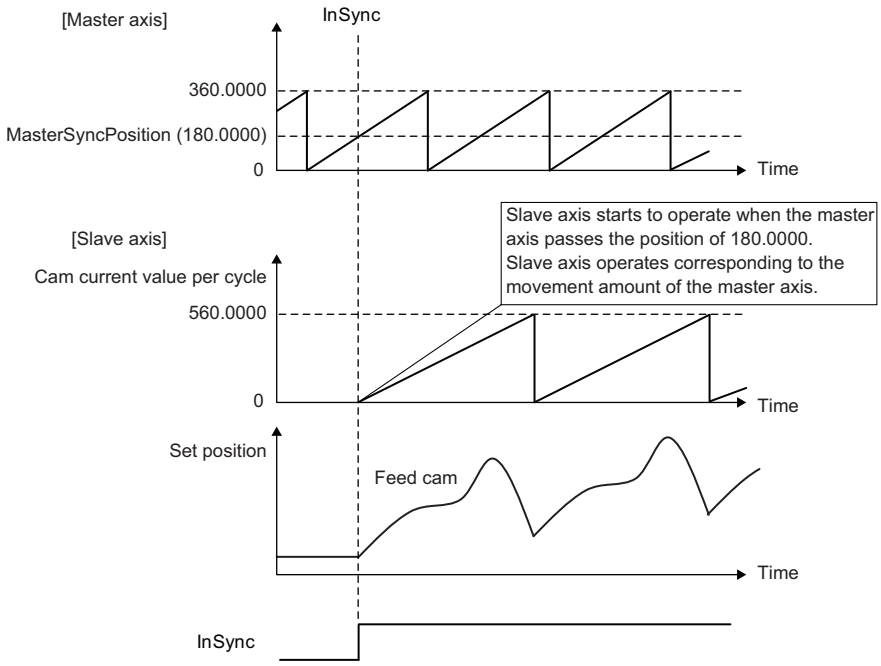
Cam operation is executed continuously, even when ring counters of Master and cam table are not matched.

Ex.

Master axis: Ring counter of the current value: 0 to 360.0000 [degree]

MasterSyncPosition: 180.0000 [degree]

Cam: Cam length per cycle: 540.0000 [degree]



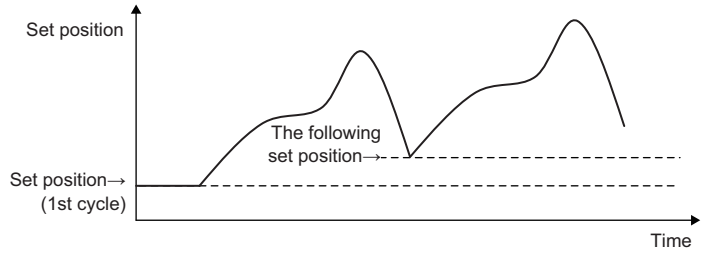
■Slave axis absolute coordinate

The following explains the operation at SlaveAbsolute set by MC_CamTableSelect.

• [0: relative coordinate] is specified to the slave axis absolute coordinate

When InSync turns TRUE, the slave axis starts the operation of the cam profile from the current position (set position).

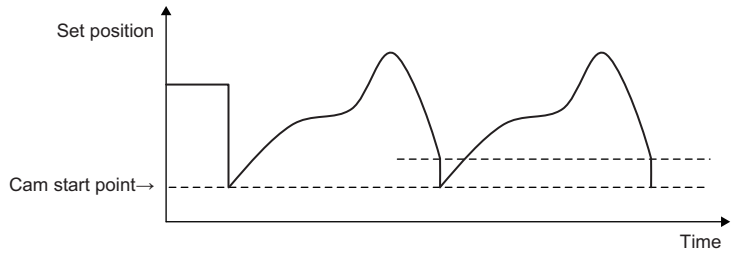
When the periodic mode of the cam profile is set to [1: Periodic], the next cycle starts from the stroke position (set position) where the last cycle completed.



• [1: absolute coordinate] is specified to the slave axis absolute coordinate

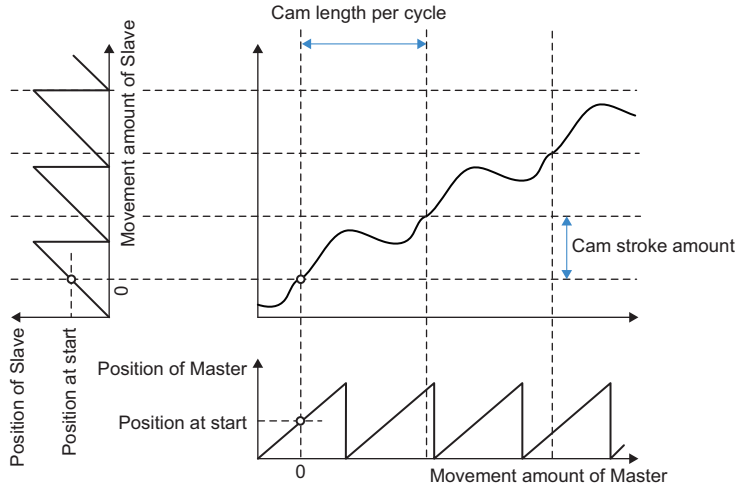
Cam is operated to control that the set position of Slave at the point where InSync turns TRUE is set to the start point of the cam profile when starting a cam.

When the periodic mode of the cam profile is set to [1: Periodic], when the stroke positions of the cam profile differ between the start point and the end point, command is output per operation cycle to return the stroke position back to the first set point when the next cycle starts. If the command current value at this time is large, the position command and speed command to the drive unit become large and that causes the servo error (AL. 035 Command frequency error) of the MR-J5(W)-G.

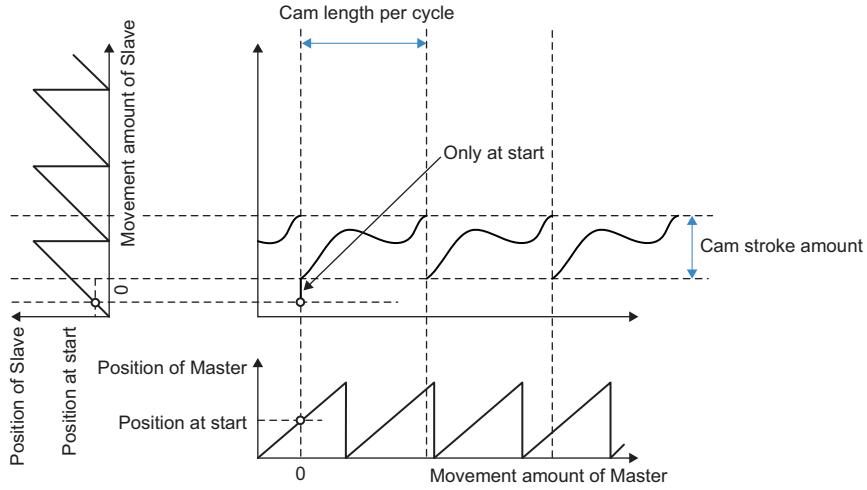


The following explains the relationships of the position between Master and Slave based on the combination of the master axis absolute coordinate and the slave axis absolute coordinate.

• When [0: relative coordinate] is specified to the master axis absolute coordinate, and [0: relative coordinate] is specified to the slave axis absolute coordinate



• When [0: relative coordinate] is specified to the master axis absolute coordinate, and [1: absolute coordinate] is specified to the slave axis absolute coordinate



Monitor data during cam operation

The position relationship of cam data can be checked by the data of MC_CamIn.InputsPerCycle, MC_CamIn.Reference, and MC_CamIn.OutputData.

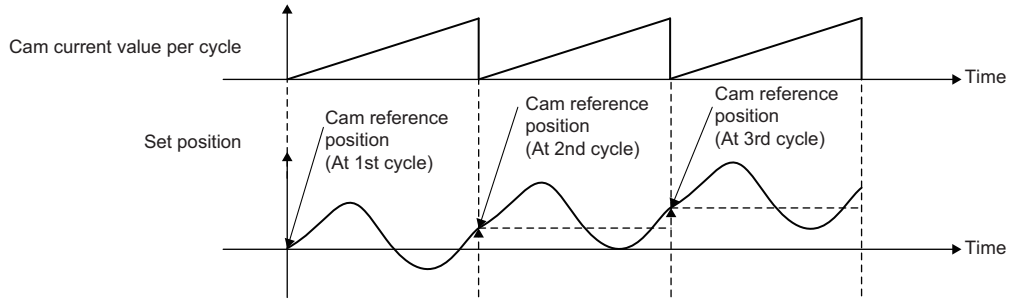
■MC_CamIn.InputsPerCycle (Cam current value per cycle)

Movement amount of Master is reflected as Cam data start point 0 of MasterSyncPosition. The monitor value range is the cam length per cycle range ("0 to (cam length per cycle - 1)") set in the cam data.

■MC_CamIn.Reference (Cam reference value)

When MC_CamIn is started to operate, cam reference value is calculated by the cam position for start (cam current value per cycle) based on set position where InSync becomes TRUE. The cam reference position is not updated in two-way cam operation. In a feed cam, the cam reference value is calculated as shown below.

Cam reference value = Original cam reference value + (Output value at the last point - Output value at the 1st point)

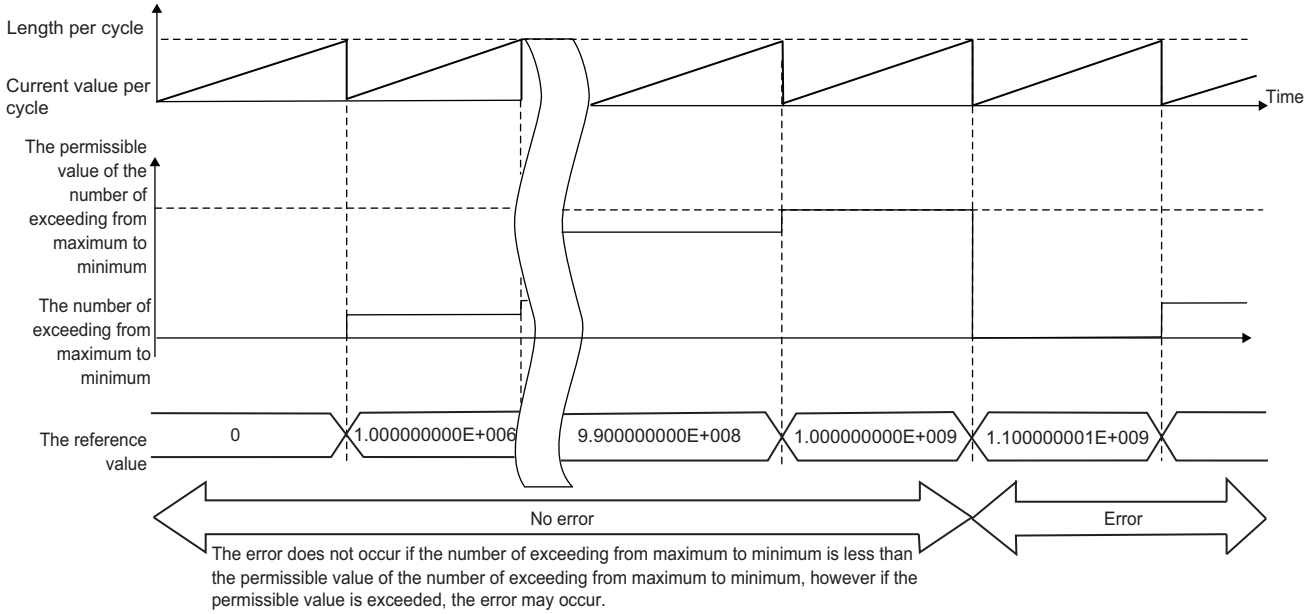


Restriction

For the reference value error

If the number of exceeding from maximum to minimum per cycle is more than the permissible value of the number of exceeding from maximum to minimum, the reference value errors may become large.

To decrease the errors, "output value at the last point - the differences of output value at the 1st point" and "output coefficient" must not be set decimal. Also, use a two-way cam to prevent the errors.



When the reference value error becomes 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 79 Positioning Range

The permissible value of the number of exceeding from maximum to minimum is a variable value calculated with the following formula.

The permissible value of the number of exceeding from maximum to minimum = the limit value of the number of exceeding from maximum to minimum / ((output value at the last point - output value at the 1st point) / output coefficient)

The limit value of the number of exceeding from maximum to minimum is 10000000000 as the upper limit value of the positioning range.

(e.g.) When the output value at the 1st point = 0, the output value at the last point = 1000000, and the output coefficient = 10, the permissible value of the number of exceeding from maximum to minimum becomes "100000".

■MC_CamIn.OutputData (Output value)

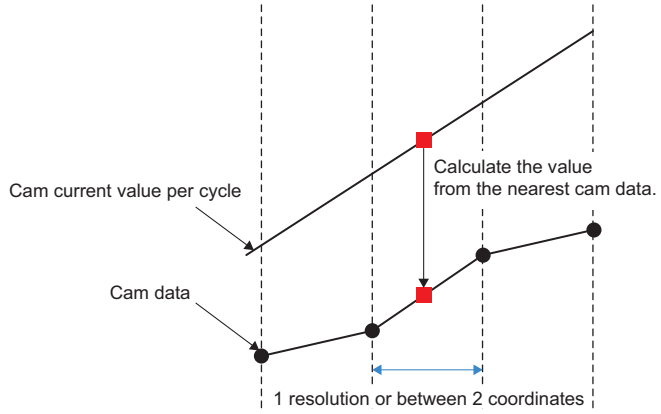
While InSync is TRUE, MC_CamIn.Output is calculated as shown below.

Output value = Cam reference position + (Cam stroke amount × Stroke ratio corresponding to cam current value per cycle)

or

Output value = Cam reference position + (Output value corresponding to cam current value per cycle)

When the cam current value per cycle is in between the cam data, the value is calculated from the nearest cam data.



Details of setting items

■MasterOffset (Master axis offset)

The phase of the master axis can be shifted for the amount of offset by setting MasterOffset. (This does not affect MasterStartDistance or MasterSyncPosition.)

When other than "0" is set at operation start, the phase of master axis is changed to the cam position per cycle which is added the amount of offset for position of the Master at rising edge of InSync. The operation is the same as when changing while InSync is TRUE.

■SlaveOffset (Slave axis offset)

The displacement of the Slave is shifted for amount of offset.

When other than "0" is set before starting up InSync, the command which is added the position of Slave for the amount of offset at rising edge of InSync is output. The operation is the same as when InSync is changed during TRUE.

■MasterScaling (Master axis scaling)

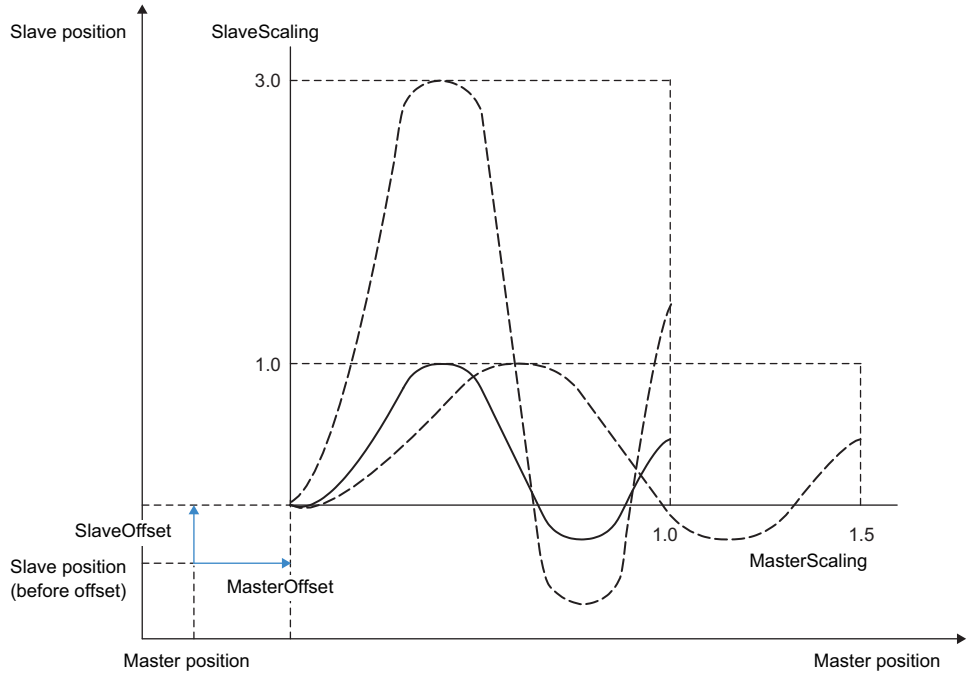
Expand/reduce the cam length per cycle of the cam table.

When changing during synchronization, a command for the moving amount is output to adjust the position of Slave to the position of the cam table.

■SlaveScaling (Slave axis scaling)

Expand/reduce the cam stroke amount of the cam table.

When changing during synchronization, a command for the moving amount is output to adjust the position of Slave to the position of the cam table.



■MasterStartDistance (Master axis follow-up distance)

Set the position of Master where Slave starts the cam operation. When passing the relative position from MasterSyncPosition shown below, InSync turns TRUE and the slave axis starts operation.

StartMode	Position
1: mcAbsolute	Absolute
2: mcRelative	Relative (Relative position from MasterSyncPostion)

This setting is not used when "0: mcImmediate" or "1: mcAbsolute" is set to StartMode.

■MasterSyncPosition (Master axis synchronization start position)

Set the position of Master during cam profile. For details, refer to the following.

☞ Page 477 Control details

This setting is not used when "0: mcImmediate" is set to StartMode.

■StartMode (Start mode)

Select "0: mcImmediate", "1: mcAbsolute", "2: mcRelative". For details, refer to the following.

☞ Page 477 Control details

When "2: mcRelative" is specified, the error "Out of Start Mode Range" (error code: 1A47H) occurs.

■MasterValueSource (Master axis data source selection)

Select the data souse of Master. For details, refer to the following.

☞ Page 471 Master Axis Data Source Selection

■CamTableID (Cam table ID)

Set the ID for cam. Open the cam ID to the open area by MC_CamTableSelect or MCv_ProfileSelect before use.

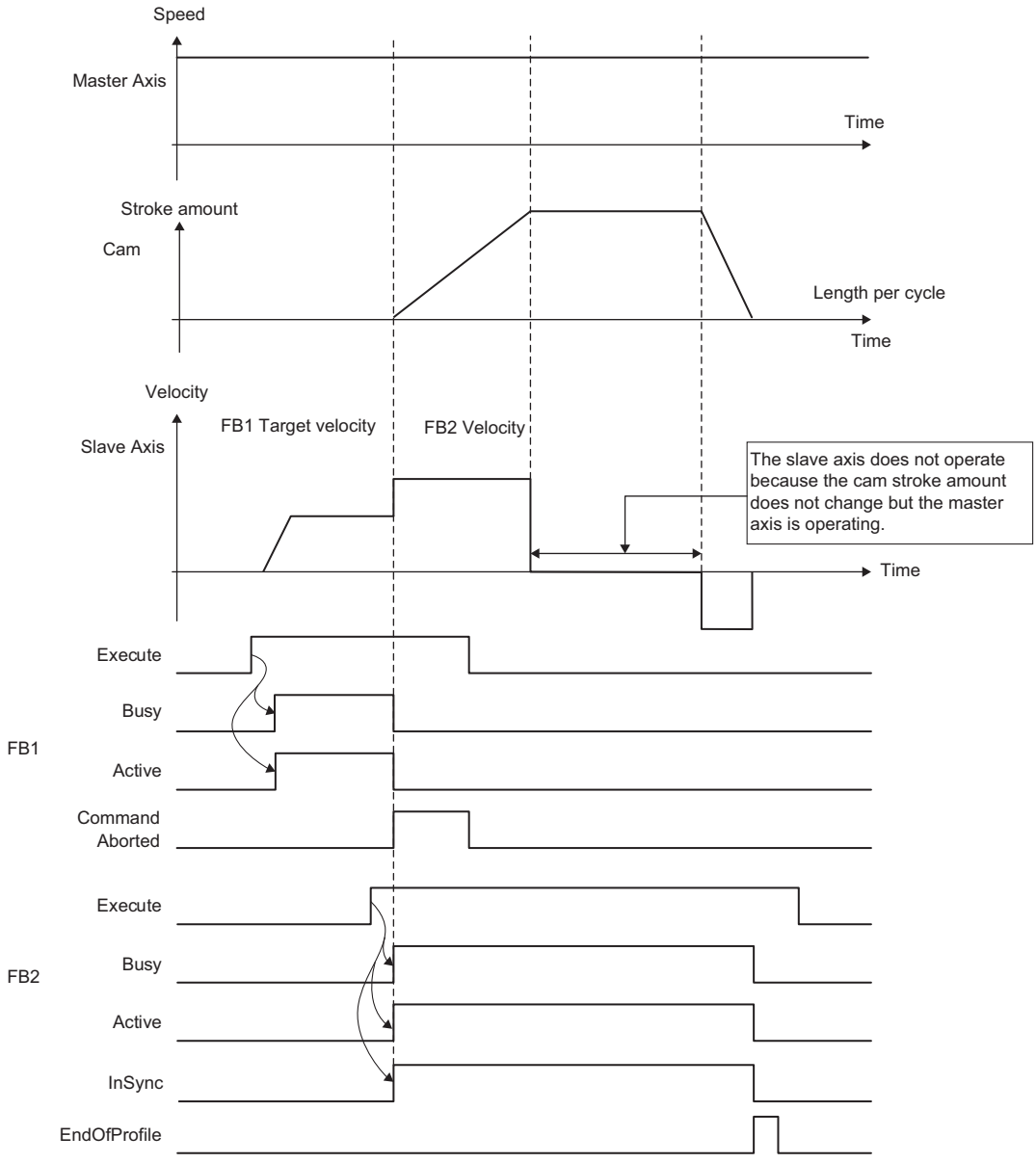
■BufferMode (Buffer mode)

Select the buffer mode. Aborting and Buffered can be set.

When the FB is switched, the speed changes immidiately based on the master axis speed and the set cam data as the speed of MC_CamIn follows the synchronizing FB (the master axis). The switching condition at each mode is shown below.

BufferMode	Switching condition
Aborting	Always
Buffered	EndOfProfile = TRUE

An operation example when Aborting is executed in StartMode = "0:mclmmdiate" to the on-going FB1 with the linked start FB2 (slave axis: MC_CamIn) is shown below.



The speed of FB2 occurs after InSync turns TRUE.

When StartMode is other than "0: mcImmediate", the speed becomes 0 until it turns from Busy = TRUE to InSync = TRUE because InSync does not turn TRUE immediately after it started.

For details of operation and the combination with the other FBs, refer to the following.

☞ Page 125 Buffer mode type

■InSync (In synchronization)
It turns TRUE while Slave is in cam operation.

■Busy (Executing)
It turns TRUE during execution of instruction.

■Active (Controlling)
It turns TRUE during controlling Slave.

■CommandAborted (Abortion of execution)
It turns TRUE if other instructions are started during execution of this FB.

■Error (Error)
It turns TRUE if an error occurs in this FB.

■ErrorID (Error code)
It returns an error code occurred in this FB.

■EndOfProfile (Cam cycle completion)
It turns TRUE if the last point of the cam is detected.

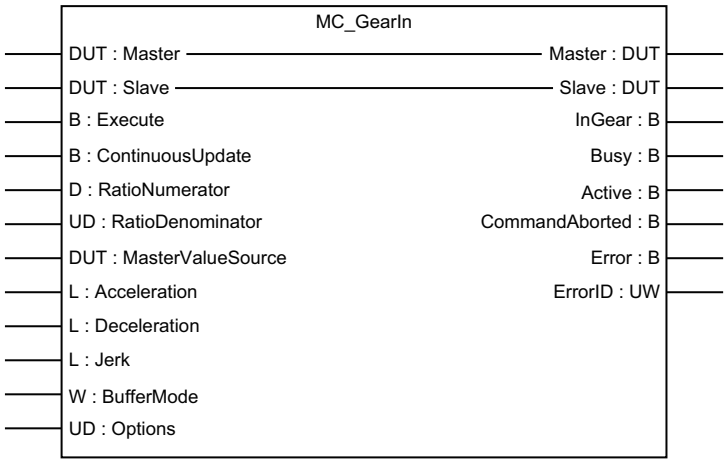
Precautions
When other than "0" is set to MasterOffset or SlaveOffset before the rising edge of InSync, the set position of Slave is changed directly at the rising edge of InSync. When changing MasterOffset or SlaveOffset while InSync is TRUE, the set position of Slave is immediately changed directly. To execute a smoothing process for the movement amount change, use it with MCv_SmoothingFilter.

14.8 Gear Operation

This function sets the speed ratio between the master axis and the slave axis, and starts gear operation.

Relevant FB

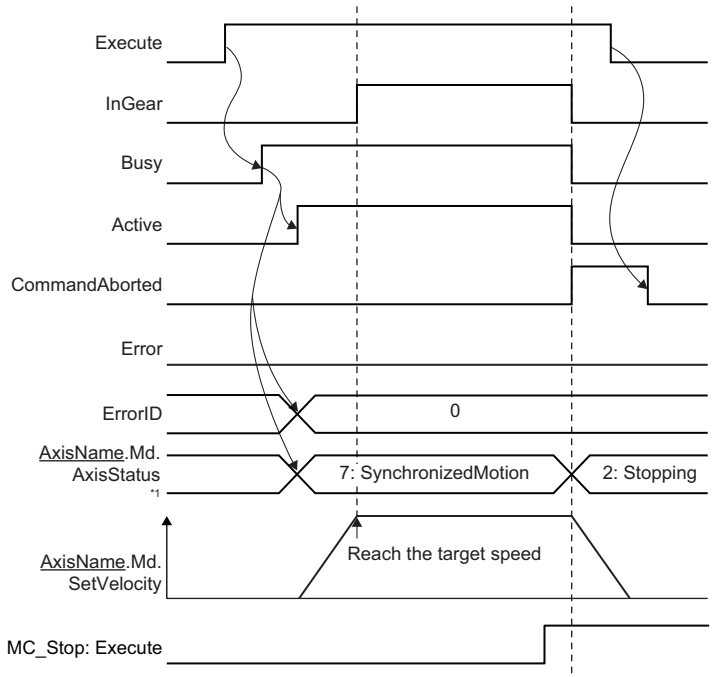
MC_GearIn

Item	Description
Function overview	Gear operation starts operation according to the specified gear ratio.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
64	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



*1 This is axis state of Slave axis.

[When an error occurs]

When an error occurs, refer to the following.

☞ Page 25 Execute type/Enable type

■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the gear ratio numerator, the gear ratio denominator, the acceleration, and the deceleration.
Gear ratio numerator	RatioNumerator	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 492 RatioNumerator (Gear ratio numerator)
Gear ratio denominator	RatioDenominator	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 492 RatioDenominator (Gear ratio denominator)
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 492 MasterValueSource (Master axis data source selection)
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	☞ Page 492 Acceleration (Acceleration)
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 314 Relevant variables	0	☞ Page 493 Deceleration (Deceleration)
Jerk	Jerk	LREAL	↑	☞ Page 314 Relevant variables	0	☞ Page 493 Jerk (Jerk)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 493 BufferMode (Buffer mode)
Options	Options	DWORD(HEX)	↑	0	00000000H	Sets "0". (If a value other than "0" is set, an error will occur.)

■Output variables

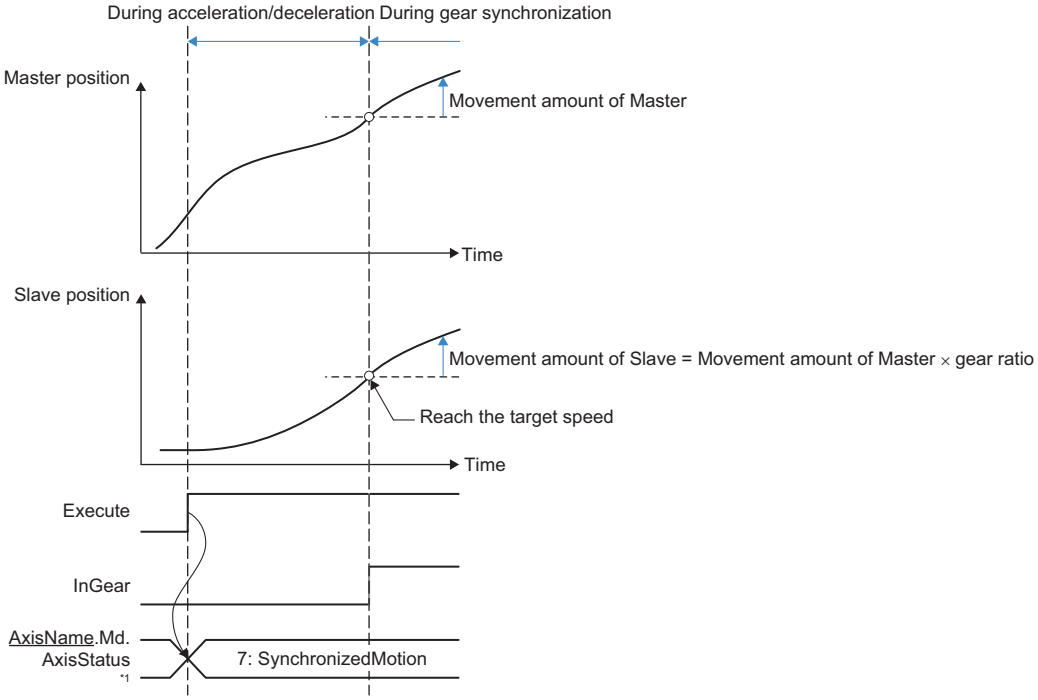
Name	Variable name	Data type	Default value	Description
Gear ratio reached	InGear	BOOL	FALSE	Indicates that the target velocity is reached.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. When this FB is stopped by an error or when this FB is started up while an error occurs, it turns TRUE. Turns FALSE when Execute turns FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Control details

In the MC_GearIn, RatioNumerator, RatioDenominator, MasterValueSource, Acceleration, Deceleration, Jerk, and BufferMode are set and the gear operation starts.

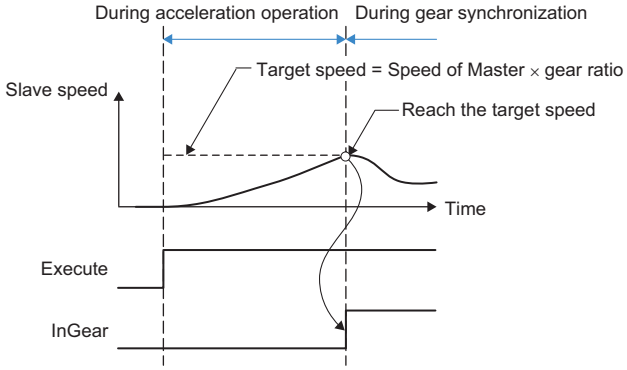
To stop the operation, execute the MC_Stop.

After executing the instruction, Slave continues acceleration/deceleration until reaching the target velocity which is a value converted the speed of Master by the gear ratio. After reaching the target velocity, InGear turns TRUE, and Slave is controlled with the speed converted the speed of Master by gear ratio.

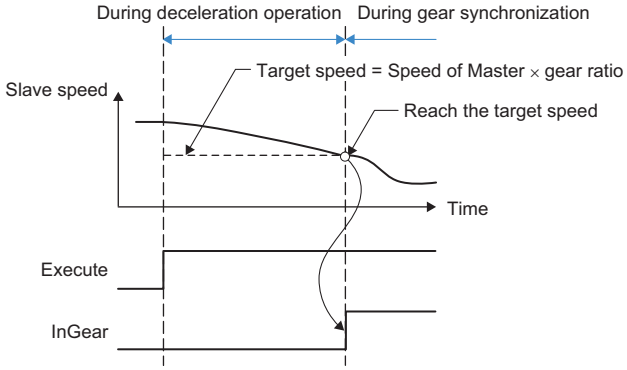


*1 This is axis state of Slave axis.

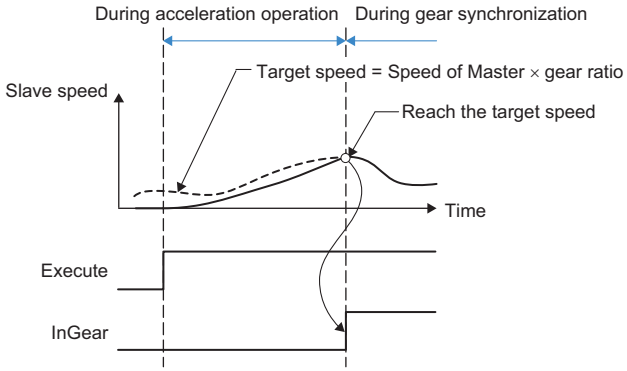
- Accelerate when the speed of Slave is smaller than the target velocity at operation start.



- Decelerate when the speed of Slave is larger than the target velocity at operation start.



- When the speed of Master is changed during acceleration/deceleration, the target velocity is updated.



Details of setting items

■RatioNumerator (Gear ratio numerator)

Set the numerator value for converting the speed of Master and transmitting.

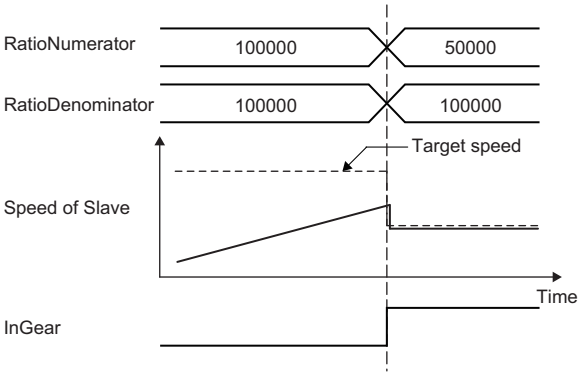
The speed is converted as shown below.

$$\text{Master speed after conversion} = \text{Master speed before conversion} \times \frac{\text{RatioNumerator}}{\text{RatioDenominator}}$$

The speed direction can be reversed and transmitted by setting a negative value in RatioNumerator.

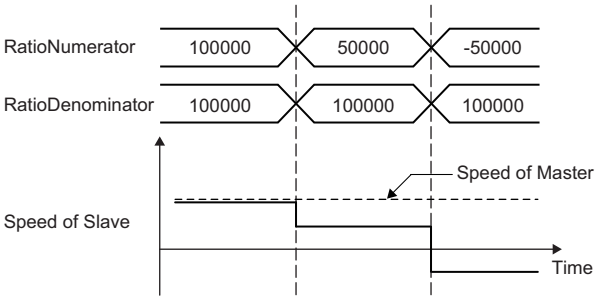
The target velocity is changed if the gear ratio is changed during acceleration/deceleration. Therefore, the speed of Slave is changed directly and the gear operation may be started depends on the change of the target velocity.

- Changing gear ratio during acceleration/deceleration



When the gear ratio is changed during gear synchronization, the speed of Slave is changed directly.

- Changing gear ratio during gear synchronization



■RatioDenominator (Gear ratio denominator)

Set the denominator for converting the movement amount of Master and composing.

Set together with RatioNumerator.

Set a positive value in RatioDenominator.

■MasterValueSource (Master axis data source selection)

Select the data souse of Master for transmitting the speed of Master. For details, refer to the following.

☞ Page 471 Master Axis Data Source Selection

■Acceleration (Acceleration)

Set the acceleration for accelerating.

When reaching the target velocity, InGear turns TRUE and Slave is controlled with the speed which converted the speed of Master by the gear ratio.

■Deceleration (Deceleration)
Set the deceleration for decelerating.
When reaching the target velocity, InGear turns TRUE and Slave is controlled with the speed which converted the speed of Master by the gear ratio.

■Jerk (Jerk)
Set Jerk at acceleration/deceleration start.

■BufferMode (Buffer mode)
Select the buffer mode. Aborting and Buffered can be set. For details of operation, refer to the following.
☞Page 125 Buffer mode type

■InGear (Gear ratio reached)
It turns TRUE when reaching the target velocity.

■Busy (Executing)
It turns TRUE during execution of instruction.

■Active (Controlling)
It turns TRUE during controlling Slave.

■CommandAborted (Abortion of execution)
It turns TRUE if other instructions are started during execution of this FB.

■Error (Error)
It turns TRUE if an error occurs in this FB.

■Error ID (Error code)
It returns an error code occurred in this instruction.

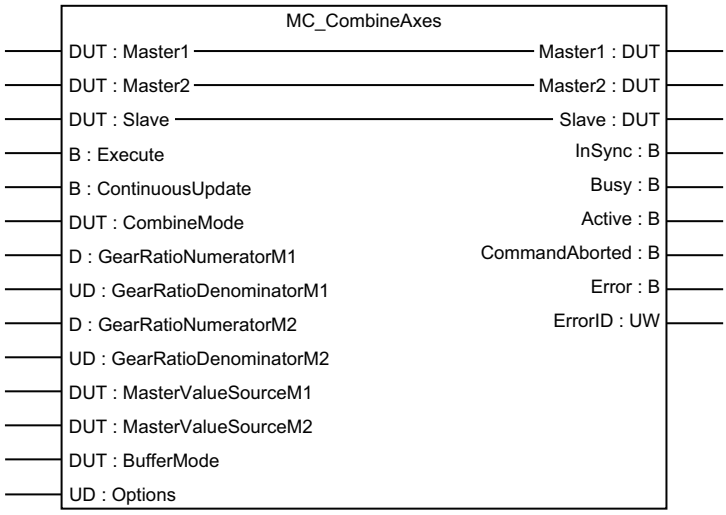
Precautions
- When gear ratio is changed, the speed of slave axis is changed directly. To smooth the speed change, use with MCv_SmoothingFilter.
- When Master speed after conversion exceeds the acceleration/deceleration upper limit value during acceleration/deceleration operation, the warning "Acceleration Time Limit Over Warning" (warning code: 0D04H) or the warning "Deceleration Time Limit Over Warning" (warning code: 0D05H) will occur and stops the acceleration/deceleration operation, and continues the operation with the speed when the warning was detected.
  When the above warning occured, adjust and set Master speed after conversion, Acceleration or Deceleration to not exceed the acceleration/deceleration upper limit value, and restart the acceleration/deceleration operation.

14.9 Addition/Subtraction Positioning

This function combines the movement amount of 2 axes and transmits.

Relevant FB

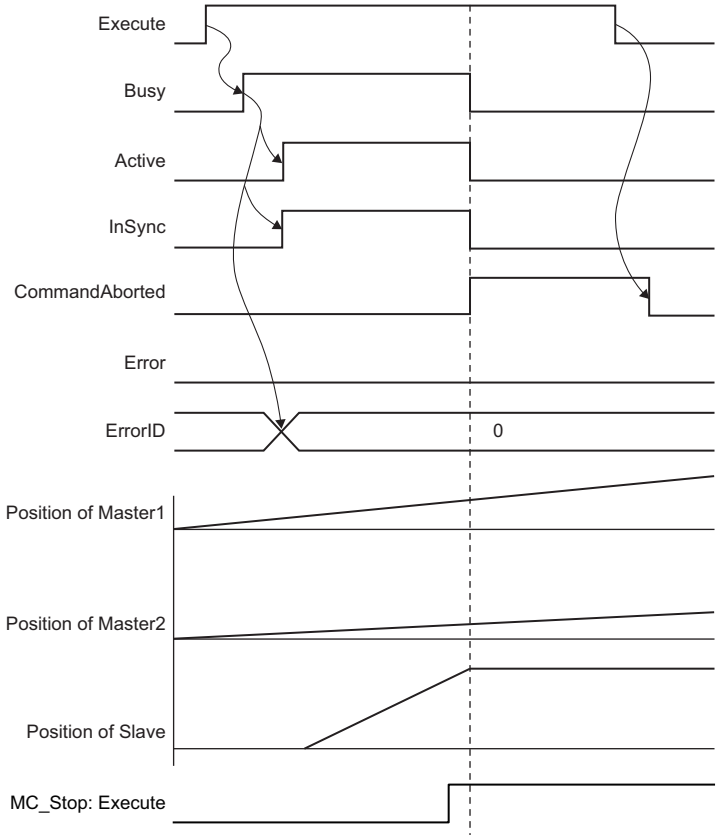
MC_CombineAxes

Item	Description
Function overview	Added or subtracted value which the movement amout of the specified mastar axis 2-axis is set as the commanded position, and the positioning is executed.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

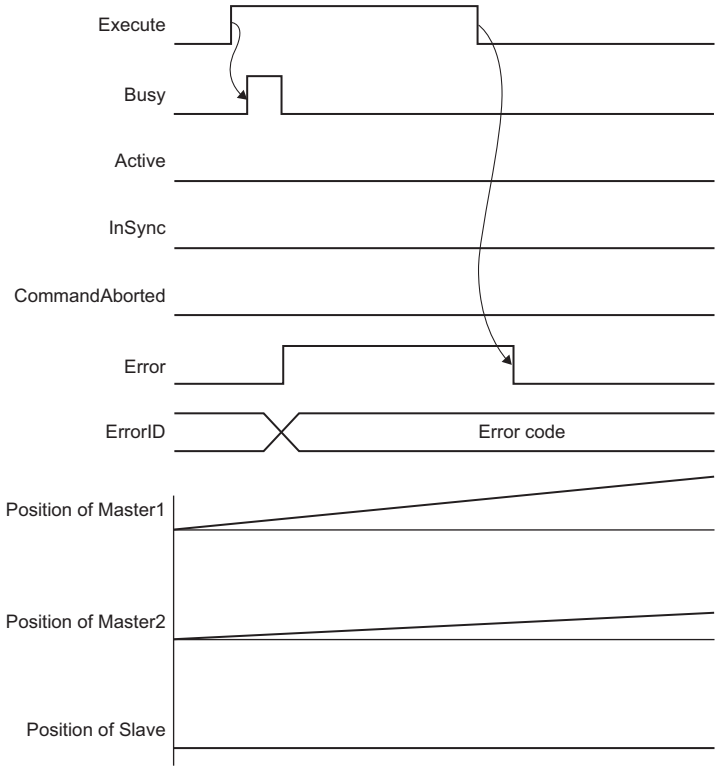
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
56	8	Subroutine type	Real-time execution

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis 1	Master1	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Master axis 2	Master2	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start, R: Retrigger possible, C: Continuous update possible

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change the addition/subtraction method selection, the master axis 1 gear ratio numerator, the master axis 1 gear ratio denominator, the master axis 2 gear ratio numerator, and the master axis 2 gear ratio denominator.
Addition/ subtraction method selection	CombineMode	MC_COMBINE_MODE	↑/R/C	0, 1	1	☞ Page 498 CombineMode (Addition/ subtraction method selection)
Master axis 1 gear ratio numerator	GearRatioNumeratorM1	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 498 GearRatioNumeratorM1 (Master axis 1 gear ratio numerator)
Master axis 1 gear ratio denominator	GearRatioDenominatorM1	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 498 GearRatioDenominatorM1 (Master axis 1 gear ratio denominator)
Master axis 2 gear ratio numerator	GearRatioNumeratorM2	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 498 GearRatioNumeratorM2 (Master axis 2 gear ratio numerator)
Master axis 2 gear ratio denominator	GearRatioDenominatorM2	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 498 GearRatioDenominatorM2 (Master axis 2 gear ratio denominator)
Master axis 1 data source	MasterValueSourceM1	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 499 MasterValueSourceM1 (Master axis 1 data source selection)
Master axis 2 data source	MasterValueSourceM2	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 499 MasterValueSourceM2 (Master axis 2 data source selection)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 499 BufferMode (Buffer mode)
Options	Options	DWORD(HEX)	↑	0	00000000H	Sets "0". (If a value other than "0" is set, an error will occur.)

■Output variables

Name	Variable name	Data type	Default value	Description
In synchronization	InSync	BOOL	FALSE	☞ Page 499 InSync (In synchronization)
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that another FB has aborted the execution of the FB. When this FB is stopped by an error or when this FB is started up while an error occurs, it turns TRUE. Turns FALSE when Execute turns FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 606 List of Error Codes

Control details

In MC_CombineAxes, CombineMode, GearRatioNumeratorM1, GearRatioDenominatorM1, GearRatioNumeratorM2, GearRatioDenominatorM2, MasterValueSourceM1, MasterValueSourceM2 and BufferMode are set and the addition/subtraction positioning is executed.

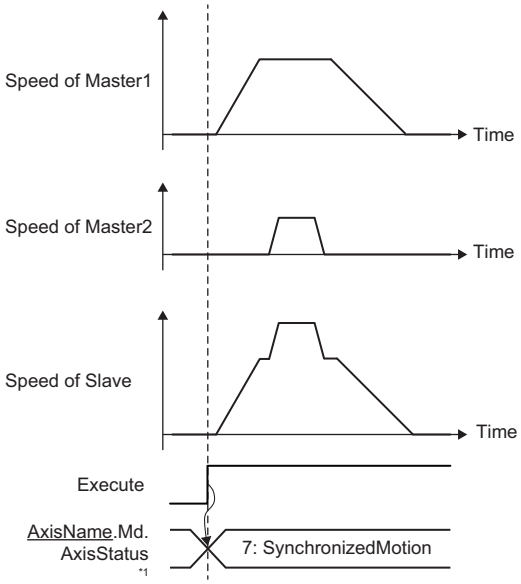
To stop the operation, execute MC_Stop.

The movement amount of Master1 and Master2 are combined. Also, gear ratio can be set to each master axis.

Combining the movement amount calculates adding/subtracting regardless of the unit of Master1 and Master2.

When "0: mcAddAxes" is set to CombineMode

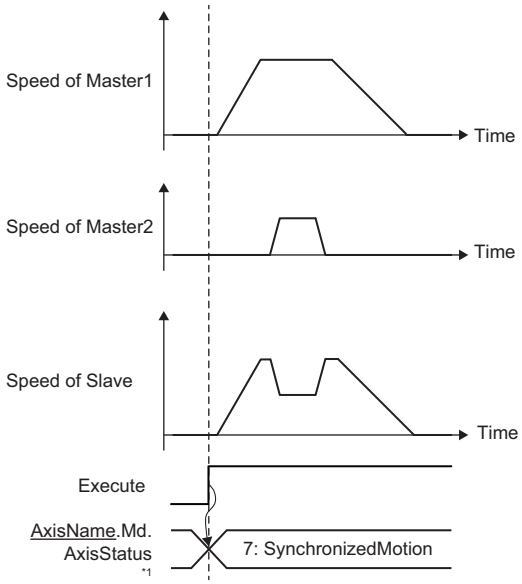
Movement amount of Slave = Master1 + Movement amount of Master2



*1 This is axis state of Slave axis.

When "1: mcSubAxes" is set to CombineMode

Movement amount of Slave = Master1 - Movement amount of Master2



*1 This is axis state of Slave axis.

Details of setting items

■CombineMode (Addition/subtraction method selection)

Set the method to combine the movement amount of Master1 and Master2.

- 0: mcAddAxes

It adds the movement amount of Master1 and Master2 and outputs.

- 1: mcSubAxes

It subtracts the movement amount of Master2 from the movement amount of Master1 and outputs.

■GearRatioNumeratorM1 (Master axis 1 gear ratio numerator)

Set the value of numerator for when converting the movement amount of Master1 and combining.

The movement amount is converted as shown below.

$$\text{Master1 movement amount after conversion} = \text{Master1 movement amount before conversion} \times \frac{\text{GearRatioNumeratorM1}}{\text{GearRatioDenominatorM1}}$$

The movement amount can be reversed and combined by setting a negative value to GearRatioNumeratorM1.

■GearRatioDenominatorM1 (Master axis 1 gear ratio denominator)

Set the value of denominator for when converting the movement amount of Master1 and combining.

It is set with GearRatioNumeratorM1.

Set a positive value to GearRatioDenominatorM1.

■GearRatioNumeratorM2 (Master axis 2 gear ratio numerator)

Set the value of numerator for when converting the movement amount of Master2 and combining.

The movement amount is converted as shown below.

$$\text{Master2 movement amount after conversion} = \text{Master2 movement amount before conversion} \times \frac{\text{GearRatioNumeratorM2}}{\text{GearRatioDenominatorM2}}$$

The movement amount can be reversed and combined by setting a negative value to GearRatioNumeratorM2 (master axis 2 gear ratio numerator).

■GearRatioDenominatorM2 (Master axis 2 gear ratio denominator)

Set the value of denominator for when converting the movement amount of Master2 and combining.

It is set with GearRatioNumeratorM2.

Set a positive value to GearRatioDenominatorM2.

■MasterValueSourceM1 (Master axis 1 data source selection)

Select the data souse of Master1 which is for the movement amount of Master1 to transmit. For details, refer to the following.

☞ Page 471 Master Axis Data Source Selection

■MasterValueSourceM2 (Master axis 2 data source selection)

Select the data souse of Master2 which is for the movement amount of Master2 to transmit. For details, refer to the following.

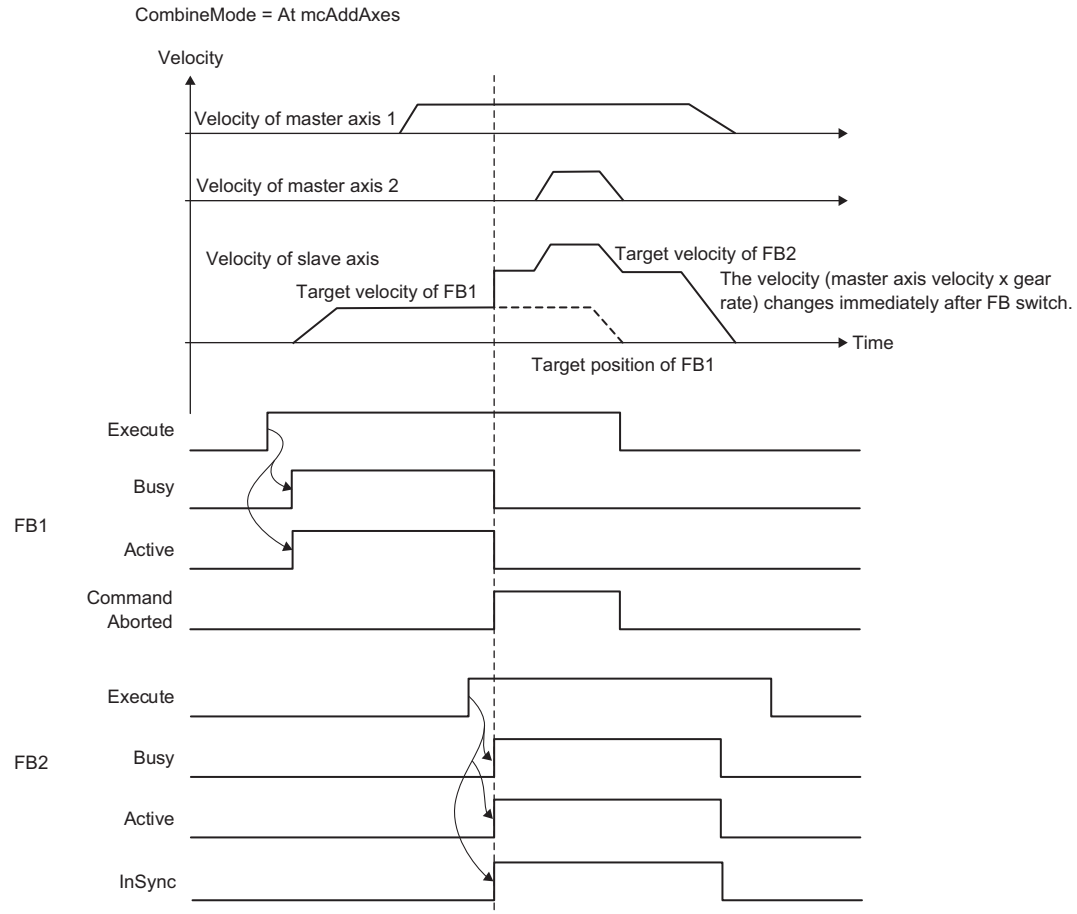
☞ Page 471 Master Axis Data Source Selection

■BufferMode (Buffer mode)

Select the buffer mode. Aborting and Buffered can be set.

When the FB is switched, the speed changes immediately based on the master axis speed and the set gear data as the speed of MC_CombineAxes follows the synchronizing FB (master axis).

An operation example when Aborting is executed to the on-going FB1 with the linked start FB2 (slave axis: MC_CambineAxes) is shown below.



The speed of FB2 occurs when InSync turns TRUE.

For details of operation, refer to the following.

☞ Page 125 Buffer mode type

■InSync (In synchronization)

It turns TRUE when Slave starts synchronizing.

■Busy (Executing)

It turns TRUE during execution of instruction.

■Active (Controlling)

It turns TRUE during controlling Slave.

■CommandAborted (Abortion of execution)

It turns TRUE if other instructions are started during execution of this FB.

■Error (Error)

It turns TRUE if an error occurs in this FB.

■ErrorID (Error code)

It returns an error code occurred in this FB.

PART 4 CONTROL/OPERATION/ MAINTENANCE

15 LOGGING

16 RAS FUNCTIONS

17 MOTION SERVICE PROCESSING

18 HOW TO CONTROL FROM CPU MODULE

19 FILE CONTROL

20 SECURITY

21 MODULE SOFTWARE INSTALLATION

22 TROUBLESHOOTING

15 LOGGING

"Logging" is used as a generic term for "Data logging" and "Real-time monitor". This chapter describes how to use data logging and real-time monitor.

15.1 Data Logging/Real-Time Monitor

Operation of this function at each status of system

○: Possible, ×: Not possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

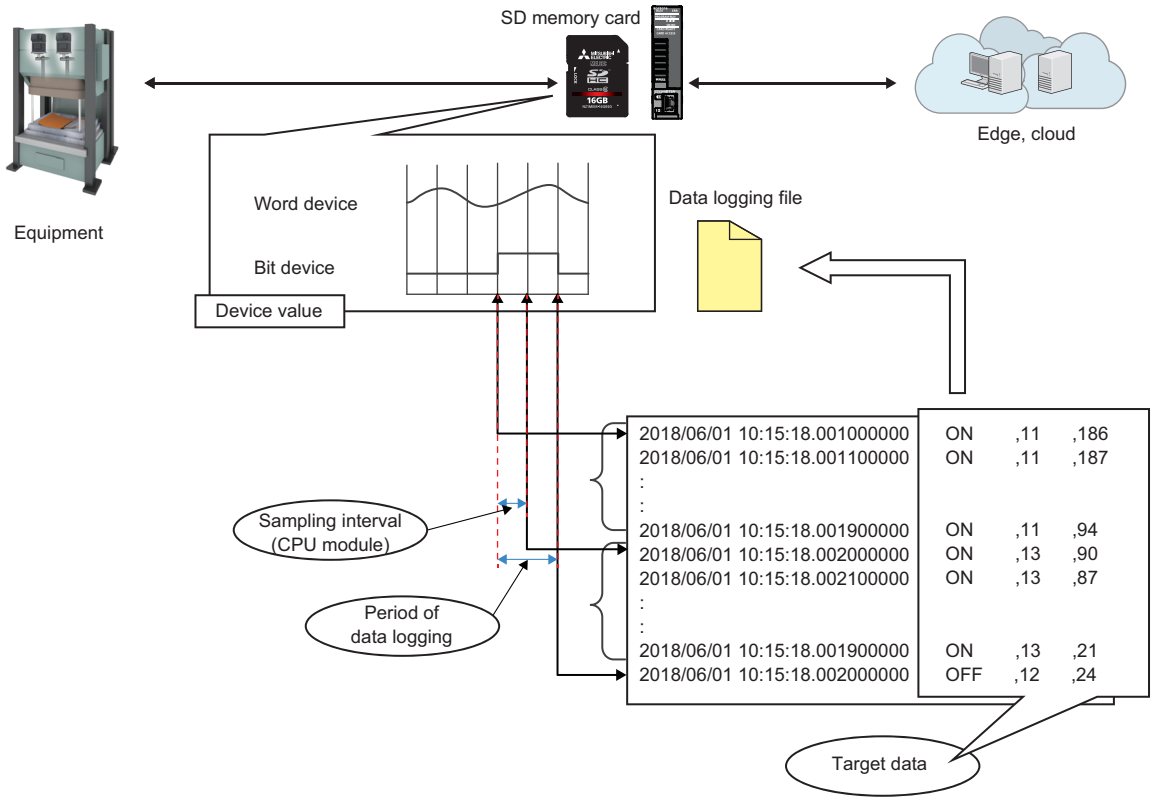
Relevant variables

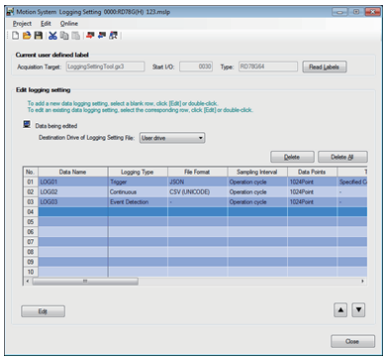
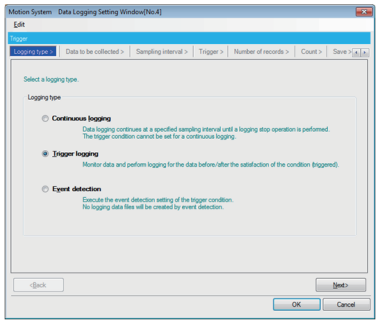
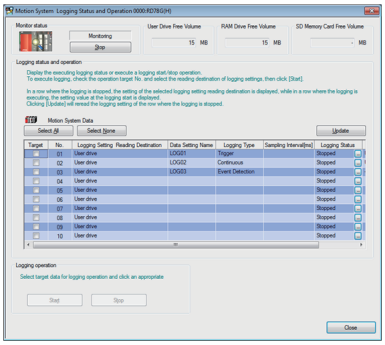
Variable/Structure name		Name	Details
System.LoggingRef[1..10].Cd.*1			
	SettingPath	Logging setting path	Sets the storage location path (folder name/file name) of logging setting.
	StartLog	Logging request	Requests the execution of logging. FALSE: STOP TRUE: RUN
	Trigger	Trigger request	Requests the trigger when "Trigger command" is set for a trigger condition. FALSE: No request TRUE: Request
System.LoggingRef[1..10].Md.*1			
	SettingPath	Logging setting file	Indicates the path (file name) of the logging setting file during the logging.
	LogDataPath	Logging data file path	Indicates the path (file name) of the logging data file.
	LoggingStatus	Logging status	Indicates the logging execution status. FALSE: Stop TRUE: Executing
	Triggered	Triggered	Indicates the triggered status.
	TriggerCount	Trigger detection count	Indicates the trigger detection count.
	TrigerCountIgnored	Trigger ignored count	A trigger occurs again during collecting data after trigger and it indicates the trigger ignored count.
	LogDataSavedCount	Number of saved files	Indicates the number of saved data logging files.
	TriggerStatus[1..32]	Trigger status	Indicates the status of each trigger condition. FALSE: Trigger condition not established TRUE: Trigger condition established
	SaveStatus	Save status	Indicates the save status to files of collected data. 0: UnSave (Unsaved) 1: Saving (Saving) 2: Saved (Saved) 3: FullySaved (Fully saved)
	LogType	Logging type	Indicates the logging type in progress.
	ErrStatus	Error status	Stores the error code related to logging.
	SamplingTime[0..1]	Data collection interval	Indicates the data collection interval in a unit of ns. [0] Sampling interval lower 32 bits [1] Sampling interval upper 32 bits
System.PrConst.			
	Logging_AutoLoggingEnable	Auto logging enabled	Enables auto logging function. Auto logging can be executed only when the logging setting file is stored in the SD memory card. FALSE: Disabled TRUE: Enabled

*1 The array elements [1] to [10] correspond to the logging setting 1 to 10.

Data logging function

Data logging function is used to collect the motion system data at a specified interval based on the logging setting (trigger condition or data collection condition) written by the engineering tool and save the result to the data logging file.
The collected data is saved as the logging file. The data logging setting up to 10 can be executed at the same time in the motion system.



Motion system logging setting window	Motion system setting window	Motion system logging state check and operation window
		

Real-time monitor

Real-time monitor is used to set the data collection and monitor the collected data (waveform display) in real time in the status where the engineering tool has been connected with the motion system.
For details, refer to Help of the engineering tool.

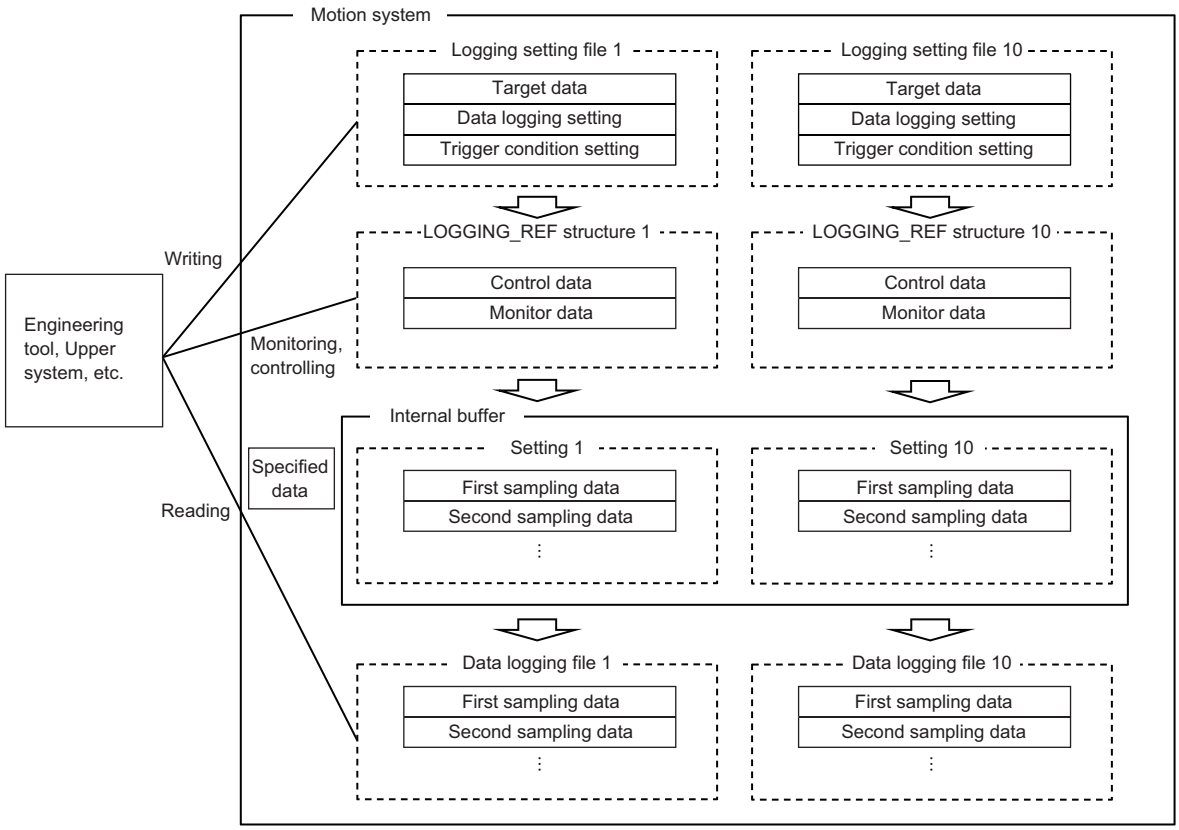
Steps until the collected data is saved

Data logging

The motion system executes data logging according to the description of logging setting files.

The control and monitor of data logging are executed by the LOGGING_REF structure.

The collected data is saved to the internal buffer in real-time processing and it is saved to the file in back-ground processing.

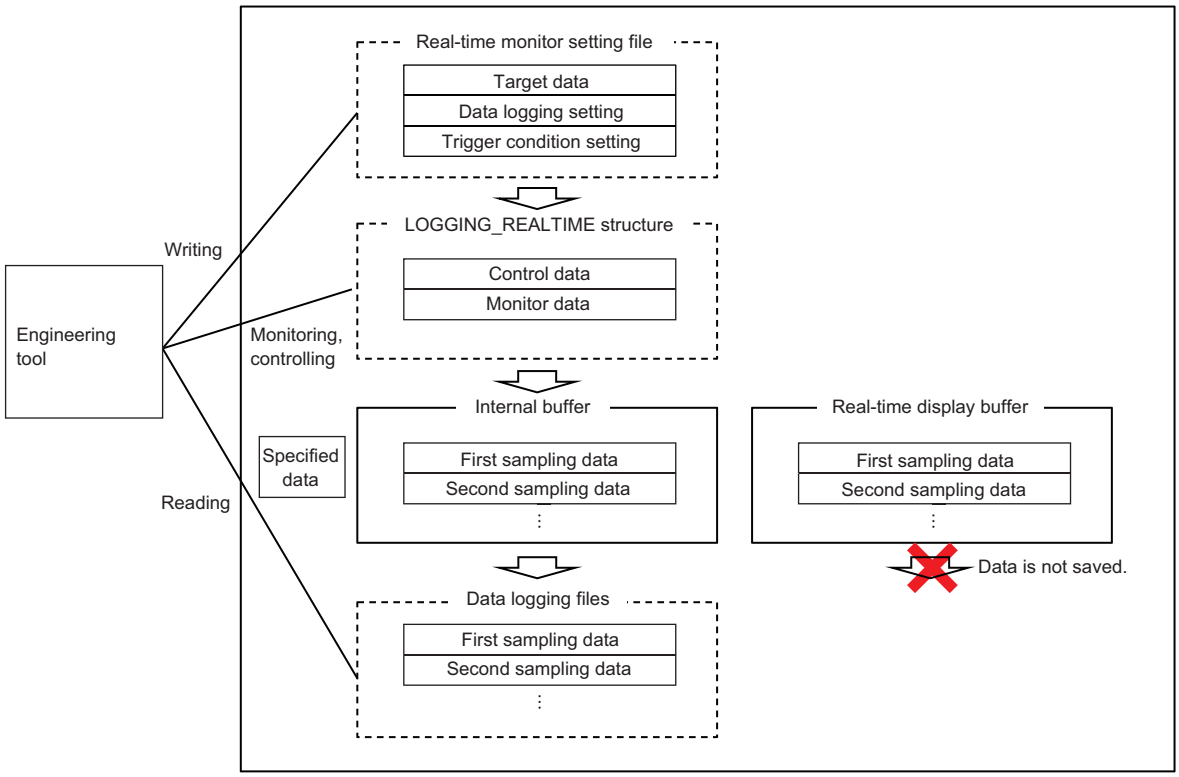


Real-time monitor

Real-time monitor is used in the status where the engineering tool has been connected with the motion system.
The motion system executes the followings according to the description of the real-time monitor setting file set in the engineering tool.

Execution details	Data	Maximum number of points
Data collection to the internal buffer	All of the specified data	Max. 1024 points
Data output to the buffer for the real-time display	Data that are selected as the real-time waveform display target from the specified data	Max. 32 points

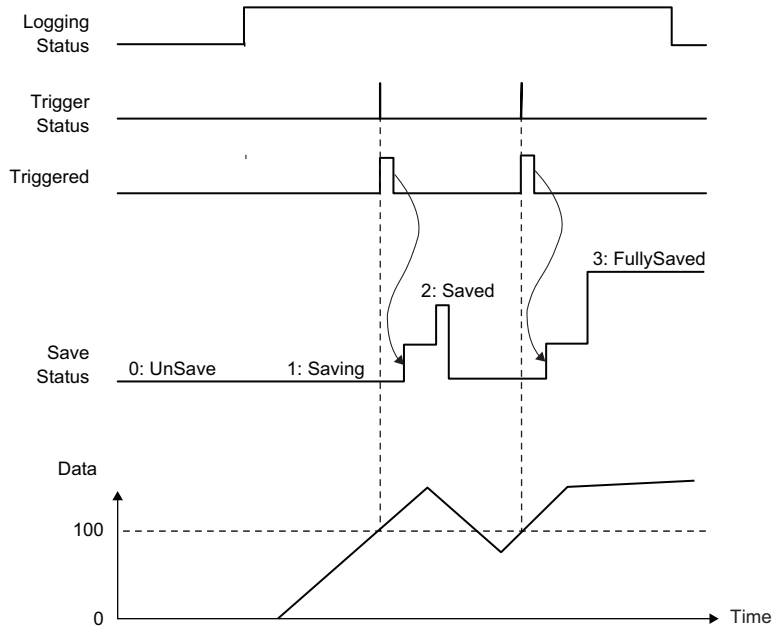
When the data collection is completed, the collected data in the internal buffer is saved and displayed in the engineering tool.
Real-time monitor can start with new setting independently from data logging. Also, it can start based on the setting of the data logging in progress.



Status of logging

The status of logging in progress can be checked by System.LoggingRef[1..10].Md.LoggingStatus, System.LoggingRef[1..10].Md.TriggerStatus[1..32], System.LoggingRef[1..10].Md.Triggered, and System.LoggingRef[1..10].Md.SaveStatus.

The following explains the operation at trigger logging when Data = 100 is set for a "Trigger condition", and 2 is set for a "Number of trigger logging".



It turns TRUE while trigger condition is processed for System.LoggingRef[1..10].Md.TriggerStatus[1..32], and after trigger condition is processed for System.LoggingRef[1..10].Md.Triggered. After the completion of collecting the number of records set to the "number of records after trigger", they both returns to FALSE.

After the completion of saving files, it turns the state of System.LoggingRef[1..10].Md.SaveStatus as follows.

3: FullySaved

- When the number of records specified during continuous logging "Number of file switching records" is all saved in a file.
- When the number of records specified during trigger logging "Number of records after trigger" is all saved in a file, and when the files are saved at the number of specified times at "Number of trigger logging".

2: Saved

- When the file is saved with the state that does not meet the condition of "3: FullySaved".

However, after the status becomes "2: Saved" or "3: FullySaved", the status moves to be "0: UnSave" immediately if the logging is in progress.

Internal buffer

The internal buffer which is used to temporarily store collected data frees up the memory capacity up to the capacity assigned to the logging function by "System memory setting". Adjust the system memory setting according to the number of logging settings and data.

The following shows a rough standard of the required amount of memory for logging.

Minimum required amount per setting (kB) = 100 + (The total number of the appropriative words for each data) × R × B

Item	Description
Minimum required amount per setting	It may increase more than the minimum required amount depending on the setting order of the data when different types of word data exist as the target data. For the internal buffer, the number of appropriative words of the smaller type may be rounded up to the number of the appropriative words of the next bigger type. Because the two-word data and the four-word data are set in the two-word border and the four-word border respectively. (Ex.) When setting the order of four-word data, one-word data, four word data, the number of the appropriative words is 12. (The number of the appropriative words for one word data is rounded up to 4.)
Total number of the appropriative words for each data	The number of the appropriative words per one for each data is shown below. Bit: 1 / 16 (one word for 16) Word (signed): 1 Double word (signed): 2 Word (unsigned): 1 Double word (unsigned): 2 Single-precision real number: 2 Double-precision real number: 4
R: Number of records	During continuous logging: R = Number of file switching records (SAVSWICTMNRECNUM) In trigger logging: R = Number of trigger records before trigger (LLNBEFOR) + Number of trigger records after trigger (LLNAFTER)
B: Number of buffer	When the specification of the number of buffer (NUMBUFF) is 2 to 10: B = NUMBUFF When the specification of the number of buffer (NUMBUFF) is 0, and when the number of records R × collection interval is within 1 [s]: B = 4 When within 1 [s] to 5 [s]: B = 3 Other than the above: B = 2

SD memory card replacement

When the storage location of the data logging files is set to an SD memory card, the SD memory card can be replaced by using the SD memory card forced disable function even while data logging is in progress. Only the data saving to the SD memory card is stopped. The data collection keeps working.

Precautions

If a new SD memory card is inserted before the next file saving is started, the logging result is saved to the new SD memory card. If a SD memory card is not inserted before the next file saving is started, the file saving is failure and an error occurs.

Logging setting

The following describes how to set data logging/real-time monitor.
The ( ) of the title indicates the object name of logging setting files (Json format) in this below.

Data to be collected (DATA)

Set data to be collected by logging. The number of data can be set is up to 1024.
Duplicate data records are counted as distinct.

Data name (NAME)

Set the data name to be collected (device, label). For the format specification, refer to the following.
☞ Page 400 TARGET_REF structure

Data type (TYPE)

The following shows data type that can be specified to the data name.

- Bit
- Word (signed)
- Double word (signed)
- Word (unsigned)
- Double word (unsigned)
- Single-precision real number
- Double-precision real number

When the device is specified to the data name, it is required to specify the data type as well. The data type also can be specified by the specification of the NAME object. When both NAME and TYPE are specified, the specification of NAME takes priority.
When the label is specified to the data name, the data type specification is ignored.

Logging setting (LOGGING)

Set the logging operation.

Logging start conditions (STARTCONDITION)

Set a logging start condition.

Logging start conditions	Description
Starts automatically	When the motion system starts*1, System.LoggingRef[1..10].Cd.StartLog becomes TRUE and logging starts automatically. Logging can start and stop after the system starts by System.LoggingRef[1..10].Cd.StartLog.
Stop disabled after automatically start	When the motion system starts*1,System.LoggingRef[1..10].Cd.StartLog becomes TRUE and logging starts automatically. Logging cannot stop manually (System.LoggingRef[1..10].Cd.StartLog changes to FALSE).
Starts by user operation	Logging can start and stop by System.LoggingRef[1..10].Cd.StartLog.

*1 When the system starts, the logging setting file exists as follows, and when the logging start condition is "Starts automatically", the logging starts.
/rom/LOGGING/LOG**/LOGGING.json (** corresponds to the logging setting No.01 to 10.)
When using the logging setting file on the SD memory card, refer to the following.
☞ Page 517 Auto logging

When the logging is stopped, the data in buffer at the time is output to the file.

Collection interval (SMPHSPDTYPE, SMPHSPDTIME)

Set the collection timing of the target data.

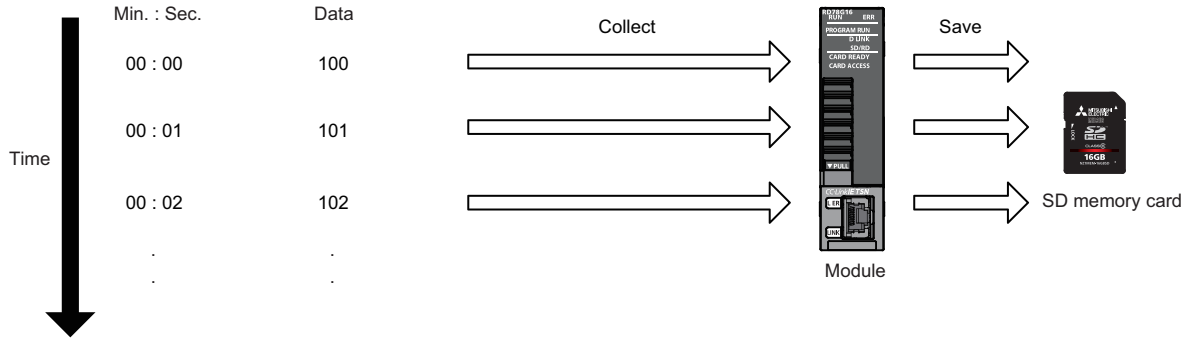
Data collection timing	Description
Operation cycle	Collects data in operation cycle interval. From the first to third operation cycles are available.
Time specification	Collects data at specified time interval (ms). The closest cycle among cycles obtained by multiplying the first to third operation cycles by an integer becomes the actual collection interval. (When there are multiple options of the cycle, the longer cycle is obtained) (Ex.) When the first operation is 4.0 ms, the second operation is nothing, and the third operation is nothing • When specifying 6.0ms, the actual collection interval is 8.0 ms (the first operation cycle × 2) (Ex.) When the first operation is 0.25 ms, the second operation is 1.0 ms, and the third operation is 4.0 ms • When specifying 1.8ms, the actual interval is 1.75 ms (the first operation cycle × 7) • When specifying 1.9ms, the actual interval is 2.0 ms (the second operation cycle × 2) • When specifying 8.0ms, the actual interval is 8.0 ms (the third operation cycle × 2)

Logging type (TFFLGTP)

Set the logging type to be executed. The following describes available methods of data collection.

■Continuous logging

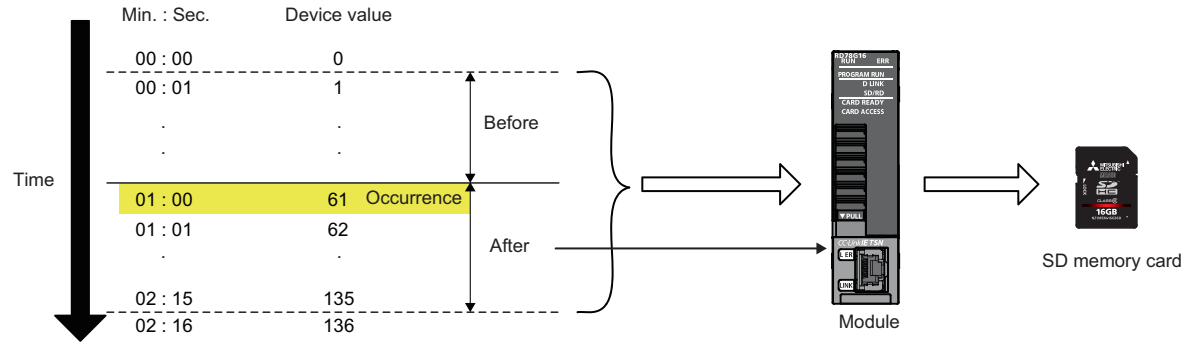
In continuous logging, the module collects specified data continuously and keeps saving the data logging file at file switching timing.



[Operating procedure for continuous logging]

1. Set the logging setting and start logging.
2. Collect data and save the file with the condition specified at "File switching timing".
3. Data collection finishes at the following cases: upon reaching the number of files to be saved specified as part of the "Stop" setting configured in "Operation when exceeds the number of files", or when System.LoggingRef[1..10].Cd.StartLog changes to FALSE.

■Trigger logging



In trigger logging, the module stores specified data in its internal buffer; 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. Note that data collection is performed not only at the specified collection interval or timing but also when a trigger condition is met.

[Operating procedure for trigger logging]

1. Set the logging setting and start logging.
2. Wait until the trigger condition is met. (The trigger condition status can be checked by System.LoggingRef[1..10].Md.Trggered and System.LoggingRef[1..10].Md.TrggerStatus[1..32].)
3. When the trigger condition is met, collect as much data as the number of records specified in the number of records after trigger and save the collected data to the file.
4. System.LoggingRef[1..10].Md.SaveStatus changes to "2: Saved" and "3: FullySaved" when the writing of the collected data to the file is completed.
5. Data collection is completed when the file is saved at the number of times set in "Number of trigger logging" or System.LoggingRef[1..10].Cd.StartLog is changed to FALSE.

Number of trigger logging (TRIGGERTIME)

Set the repeat number of trigger logging. A file is saved each time a trigger is executed once.

Number of trigger logging	Description
1 to 32767 (Number of times specification)	Executes repeatedly at the number of specified times. When exceeding the number of files that specified to the "Number of save files", the setting of "Operation when exceeding the number of files" will be ignored and "Overwrite" will be operated.
0 (Number of save files specification)	Executes repeatedly according to the "Number of save files" and the "Operation when exceeding the number of files". When the file save setting (SAVENABLE) is the "Not save", it executes repeatedly without the limit of number of times.

Number of records (LLNBEFOR, LLNAFTER)

Set the number of records before and after trigger condition occurrence.

Item	Description	Setting range
Number of records (before trigger)	Sets the number of records to be output as pre-trigger record.	0 to 999999
Number of records (after trigger)	Sets the number of records to be logged during and after a trigger occurrence.	1 to 1000000

Point

If there are many records, the capacity of the operation folder may be insufficient. The place of the operation folder can be changed. For details, refer to the following.

☞ Page 518 Precautions

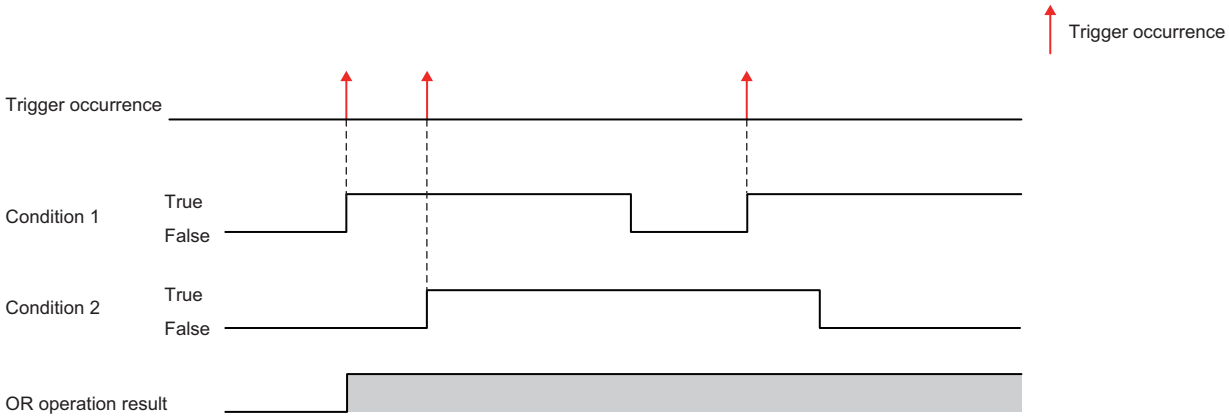
Trigger type (TRGCOMPTYPE)

Set the combination of multiple trigger conditions. One trigger type can be set for one setting.

Trigger type	Number of trigger conditions can be set	Trigger conditions can be specified
OR combine	Up to 32	[The following conditions are regarded as an AND/OR condition is satisfied when a condition is satisfied only.] • Data conditions (Comparison) • Data conditions (Value change) • Fixed cycle [The following conditions are regarded as an AND/OR condition is satisfied after a condition is satisfied once.] • System start • Trigger command • Event history
AND combine	Up to 32	

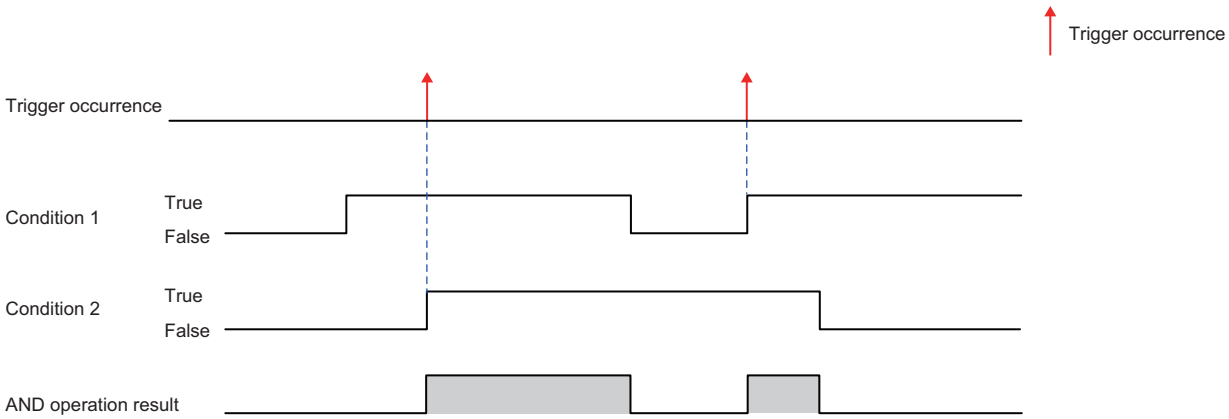
■OR combine

When any of the set conditions is satisfied, the trigger occurs.



■AND combine

When all the set trigger conditions are satisfied, the trigger occurs.



File save setting (SAVENABLE)

Set the saving enabled/disabled of a data logging file. When "Disabled" is set, the collected data file is not saved and only the trigger detection is executed.

File storage location (SAVFLDNAMEDETLFRMT)

Set a folder name of the data logging file storage location. When this setting is empty (""), the file is saved in the same folder as the logging setting file.

The file name is the date (YYYYMMDD)_time(hhmmss).extension.

File format (TFFFILE)

The following storage formats are available for data logging files. For details on the output format, format specifications, and output contents of each file, refer to the data output format.

☞ Page 521 Data Logging Format

File format	Description
CSV (Unicode)	This is a file format which can be opened in generic-purpose application programs such as table calculated software and GX LogViewer.
JSON	This is a file format which is appropriate for data operation on the host system. It can also be opened in GX LogViewer.

Number of files to be saved (SAVFNUM)

Set the maximum number of data logging files (Files of the extension specified with "File format") in the storage location folder.

The setting range of files is 0 to 65535.

When the setting value is greater than or equal to 1, the current number of files is stored in System.LoggingRef[1..10].Md.LogDataSavedCount. The operation when the number of files exceeds the setting value is specified by "Operation when exceeds the number of files".

When the setting value is 0, the maximum number of files is not checked. When the logging starts, System.LoggingRef[1..10].Md.LogDataSavedCount becomes 0, after this the saved number of files is stored.

Point

It may take time to save files if the number of maximum files is large.

Operation when exceeding number of files (SAVFNUMTYPE)

Set the operation when the number of files in the storage location folder exceeds the setting value of "Number of files to be saved".

Setting	Description
Overwrite	When creating the next storage file, the oldest file is deleted, and a new file is created and the logging is continued.
Stop	When trying to create the next save file, the error will occur, and the logging operation will be stopped.

Number of file switching records (SAVSWICTMNRECNUM)

Sets the number of records to switch a file to be saved during continuous logging.

In trigger logging, since a file to be saved is switched automatically when the trigger is satisfied, this setting is ignored.

Number of buffers (NUMBUFF)

Set the number of internal data collection buffers. When the creation interval of the data logging files is short, and the error BUSY occurs, increase this setting value. When the setting value is 0, the number of buffers is determined automatically according to the file creation interval.

For details, refer to the following.

☞ Page 508 Internal buffer

Trigger condition (TRIGGERCONDITION)

Sets a trigger condition. Conditions can be created up to 32 and combined by "Trigger type" setting.

Condition type (TYPE)

Condition		Description
Data condition	Comparison	Data is compared with data or constant and a trigger occurs when a condition is satisfied. (>, ≥, <, ≤, =, ≠)
	Value change	A trigger occurs when a value is changed.
Fixed cycle		A trigger occurs every specified cycle (ms).
System start		A trigger occurs at system start.
Trigger command		A trigger occurs when System.LoggingRef[1..10].Cd.Trigger is set to TRUE.
Event history		A trigger occurs when an event of the specified event history occurs.

■Data condition

A trigger occurs when the specified data meets the specified condition.

- =: When the current value of monitored data is equal to the comparison value
- ≠: When the current value of monitored data is not equal to the comparison value
- ≥: When the current value of monitored data is greater than or equal to the comparison value
- >: When the current value of monitored data is greater than the comparison value
- ≤: When the current value of monitored data is less than or equal to the comparison value
- <: When the current value of monitored data is less than the comparison value
- ↑: When the monitored data turns FALSE to TRUE
- ↓: When the monitored data turns TRUE to FALSE
- At change: When the current value of the monitored data changes

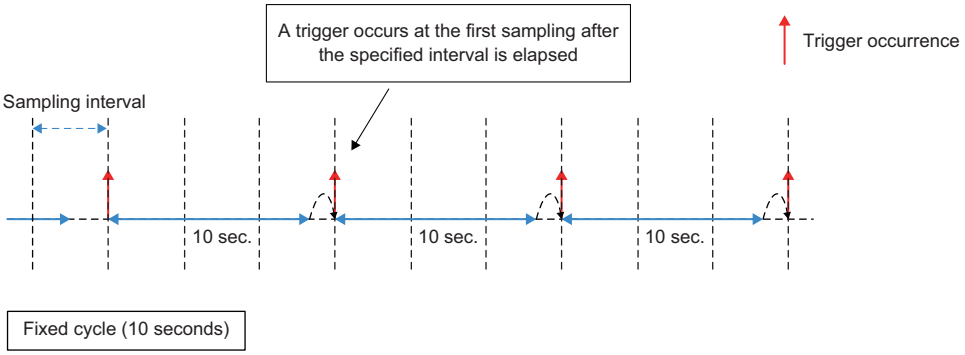
■Fixed Cycle

A trigger occurs in the specified interval after logging starts.

However, when the specified interval in the fixed cycle and the collection timing are not matched, a trigger occurs at the first sampling after the specified fixed cycle interval is elapsed.

The cycle can be specified is 1 to 86400000 [ms].

- When the fixed cycle is specified to 10 seconds



■System start

A trigger occurs at system start (at completion of initialization processing) automatically. When this condition is used, set the start condition of logging setting to "Starts automatically".

■Trigger command

A trigger occurs when System.LoggingRef[1..10].Cd.Trigger is set to TRUE.

■Event history

A trigger occurs when an event of the specified event history occurs.

- Set an event code to be triggered.
- Multiple event codes can be specified using "-" (hyphen) and "," (comma).

Ex.

[When setting event codes from 0x80001000 to 0x80001010 as a trigger condition]

0x80001000-0x80001010

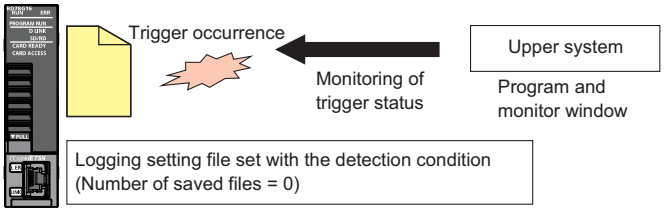
[When setting all event codes as a trigger condition]

0x00000000-0xFFFFFFFF

Event detection

When File save setting is set to "Disabled" in the logging setting, only the trigger detection is executed without saving files. The following can be applied easily by using the trigger detection function of the logging function instead of description of the satisfied judgement processing of various signal conditions (event detection processing) by a user program.

- Set the complicated error condition or program execution status to the trigger condition and utilize it for preventive maintenance.
- Monitor whether the monitor value exceeds the threshold value from the upper system and utilize it for debugging of the program.



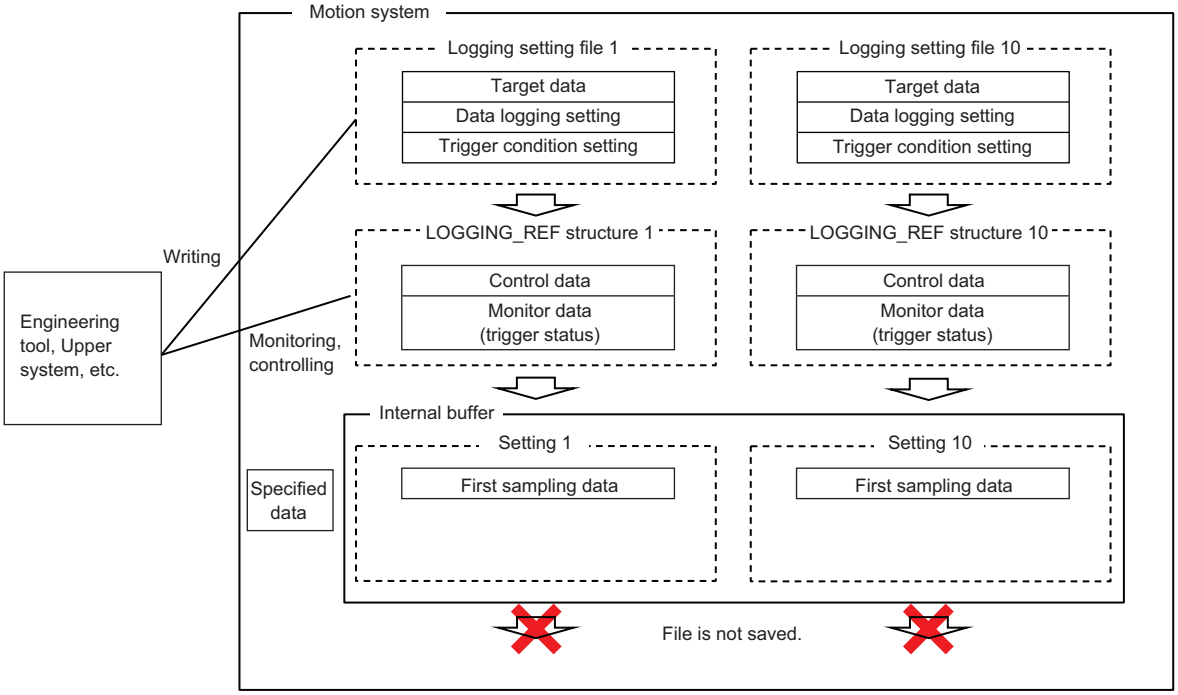
■Procedures of event detection

1. Set as follows in the logging setting and start logging.

- File save setting: Disabled
- Logging type: Trigger logging
- Number of trigger logging: 1 time
- Number of trigger records before trigger: 0
- Number of trigger records after trigger: 1

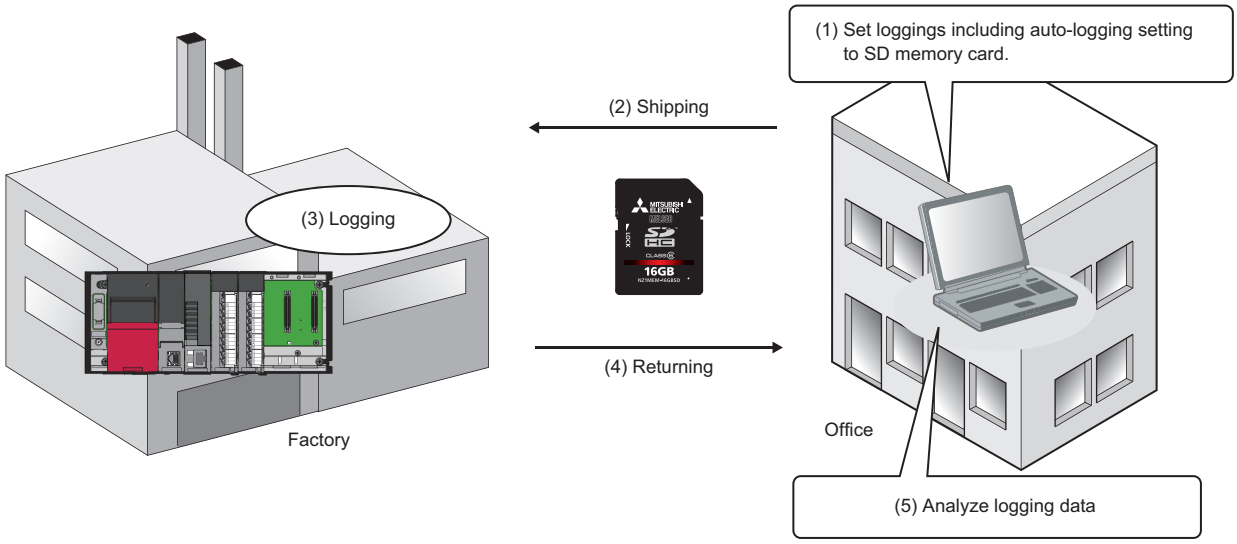
2. When the set trigger condition is detected, System.LoggingRef[1..10].Md.TriggerCount turns 1. This signal is used to control. (From the upper, used for monitoring, program execution condition, etc.)

3. To detect an event continuously, set System.LoggingRef[1..10].Cd.StartLog to FALSE once after a trigger is detected and set to TRUE again.



Auto logging

When inserting an SD memory card, which holds logging setting, into the motion system, the data logging automatically starts based on the logging setting information on the SD memory card.



■How to use auto logging

The following describes how to use auto logging.

1. Set System.PrConst.Logging_AutoLoggingEnable to TRUE in advance and allow the auto logging function.
2. Write the following logging setting file. Set /sdc/LOGGING□□.json or /sdc/LOGGING/LOG□□/LOGGING.json(□□ = 01 to 10) to the writing destination. (When there are both files, the priority is the former.)
   Logging start conditions is set as "Starts automatically".
3. Start the system by inserting the SD memory card prepared in step 2 into the Motion module or insert the Motion module while it is running.
4. System.LoggingRef[1..10].Cd.SettingPath which corresponds to the logging setting file stored in the SD memory card automatically becomes the path of the setting file, System.LoggingRef[1..10].Cd.StartLog becomes TRUE and logging starts. If the logging setting of that number already operates, a new logging does not start and an error occurs. (The logging which has already started is not affected.)

Precautions

The following describes precautions to take when using the logging function.

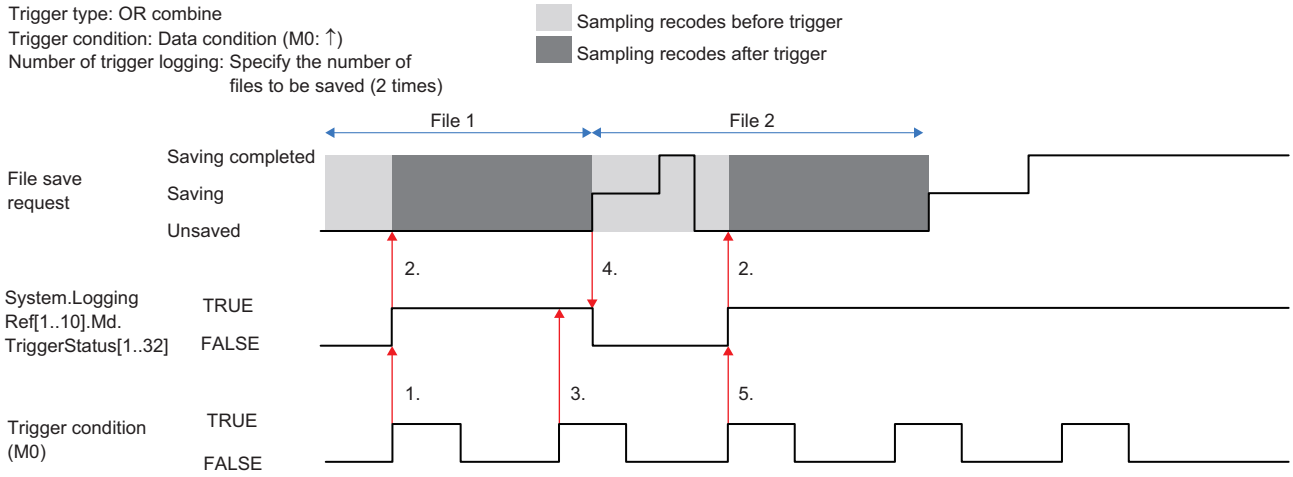
- When the AND condition is used, the condition at module start is satisfied only once. Therefore, the trigger occurs at the first time only even if the trigger count is set to other than 1.
- The judgement of data condition is executed by the collected data in each set collecting interval.
  When the data condition is specified to the trigger, data is not detected unless the data condition has been satisfied at collecting. Set the condition established time longer than the collecting interval.
- If the 2nd operation cycle is not set when the 2nd operation cycle is selected for the collection interval, the status will be logging error and the data collection will not be executed.
- The write for System.LoggingRef[1..10].Cd.** must not be carried out during the logging operation by the engineering tool.
- After the trigger condition is satisfied, if a new trigger occurs during sampling of records after trigger, a new trigger is ignored. When the sampling of records after trigger is completed and the file is started to be saved, a new trigger is allowed to be received.

The example is shown below.

Ex.

Indicates the operation below.

1. System.LoggingRef[1..10].Md.TriggerStatus[1..32] becomes TRUE when the trigger condition is satisfied. (File 1)
2. When the trigger condition is satisfied, sampling records after trigger is executed.
3. The trigger condition occurred during sampling of records after trigger is ignored.
4. When the file save is executed, System.LoggingRef[1..10].Md.TriggerStatus[1..32] becomes FALSE. (Preparation for the next logging operation)
5. System.LoggingRef[1..10].Md.TriggerStatus[1..32] becomes TRUE when the trigger condition is satisfied. (File 2)

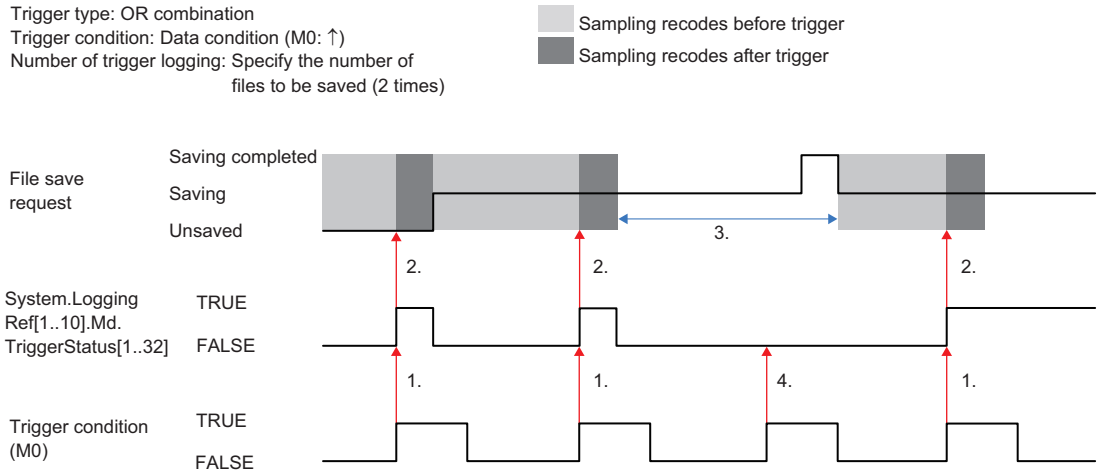


- Saving files can be carried out continuously up to the number specified in the number of buffers (NUMBUFF). If it takes time to save the file when the file size is large and a trigger is established during the time, the trigger is ignored.

Ex.

Indicates the operation for NUMBUFF = 2 below.

1. System.LoggingRef[1..10].Md.TriggerStatus[1..32] becomes TRUE when the trigger condition is satisfied.
2. When the trigger condition is satisfied, sampling records after trigger is executed.
3. The logging whose file size is large is continued 2 times and it takes time to save files.
4. The 3rd trigger established is ignored.



- In logging, the folder which the environmental variable %TEMP% indicates is used as the operation folder. (/ram/temp by default)If the drive capacity is insufficient due to many records, etc., consider changing the place of the operation folder. For details, refer to the following.

☞ Page 546 FILE CONTROL

Error

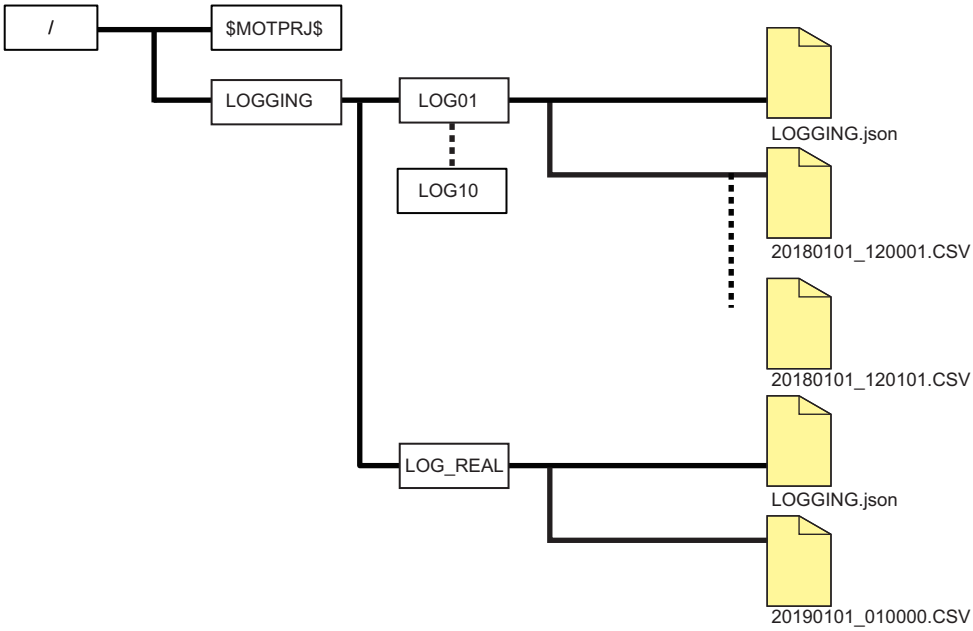
No diagnostic error occurs if an error occurs during logging, and the error event is not recorded in the error history. To check the error status, refer to System.LoggingRef[1..10].Md.ErrStatus.

For the list of logging error codes, refer to the following.

☞ Page 636 List of Logging Error Codes

Folder configuration

The following shows the default folder configuration of logging.



Folder	Data logging: Route of drive/LOGGING/LOG**/ (The ** corresponds to No.1 to 10 of logging setting) Real-time monitor: Route of drive/LOGGING/LOG_REAL/
Logging setting file	LOGGING.json
Data logging file	[SAVFLDNAMEDETLFRMT]/[YYYYMMDD]_[hhmmss].[TFFFILE]

15.2 Data Logging Format

This section describes file format of the data logging.

CSV file data specifications

File information row

Column No.	Column name	Description
1st column	File type	Fixed character "[LOGGING]"
2nd column	Type information_file version	Output file version "RD78G(H)_1" (Initial version)
3rd column	Data type information row number	Number which indicates data type information row: a
4th column	Data name row number	Number which indicates data name row: a + 1
5th column	Data start row number	Number for data starting row: a + 2
6th column	Device comment row number	Number indicates device comment row: a + 3 When the device comment does not exist, it can be omitted.

Setting data information row

The description of the setting file (json) is output. For data details, refer to the followings.

☞ Page 509 Logging setting, ☞ Page 523 JSON File Data Specifications

Data type information row

Data type information row is output in the format of "(Data type) [additional information]".

Column No.	Column name	Description
1st column	Date and time column	Indicates data type of date and time. Fixed character "DATETIME[YYYY/MM/DD hh:mm:ss.ssssssss]"*1
2nd column	Index column	Fixed character "INDEX" which indicates index column Index does not have additional information. [] is not output.
3rd column and later	Data column	Indicates data type of the sampled data.
Last column	Trigger generation information column	The following character string is output regardless of continuous logging/ trigger logging. "TRIGGER["trigger ON string"]*2 The character string with double quotation "" is fixed character.

*1 Regarding .ssssssss at the end, three digits for information of [ms], three digits for information of [μs], and two digits for information of [ns] are output.

2 "" is output for trigger ON string.

For details of data column are shown below.

Data type of data	Output character for the data type	Description
Bit	BIT	Outputs in the format of "BIT[1;0]".
Word [unsigned]	USHORT	Outputs in the format of "USHORT[DEC.0]".*2
Word [signed]	SHORT	Outputs in the format of "SHORT[DEC.0]".*2
Double word [unsigned]	ULONG	Outputs in the format of "ULONG[DEC.0]".*2
Double word [signed]	LONG	Outputs in the format of "LONG[DEC.0]".*2
Single-precision real number	FLOAT	Outputs in the format of "FLOAT[DEC.7]".*1*2
Double-precision real number	DOUBLE	Outputs in the format of "DOUBLE[DEC.14]".*1*2

*1 The number of digits after the decimal point is not always same as the specified one. (Example) For 1.2345, '1.2345000' is not output.

*2 [DEC.(Number)] shows the numerical value format and the maximum number of fractional part digit. (Example) For [DEC.7], the fractional part digit is seven with decimal notation.

Data name row

Data name row indicates the title character string of each column.

Column No.	Column name	Description
1st column	Date and time column	Indicates title of date and time. Fixed character "TIME[time zone]"
2nd column	Index column	Indicates title of index column. Fixed character "INDEX"
3rd column and later	Data column	Indicates title of data column. Device label (Example: FeedAxis.AxisMntr.Feedcurrent)
Last column	Trigger generation information column	Indicates title of trigger generation information column. Fixed character "Trigger"

Device comment row

The following description is output in the device comment row.

Column No.	Column name	Description
1st column	Date and time column	Blank
2nd column	Index column	Blank
3rd column and later	Data column	Outputs device comment.
Last column	Trigger generation information column	Blank

Data row

Data of each data name is output in the data row.

Column No.	Column name	Description
1st column	Date and time column	Indicates data of date and time. Output in the format of "YYYY/MM/DD hh:mm:ss:ssssssss" with the fixed format.
2nd column	Index column	Indicates data of index. Integer value of the index is output. (When missing, reassigns it from one.)
3rd column and later	Data column	Indicates value of data name. Value according to the data type of data type information row.
Last column	Trigger generation information column	Indicates data of trigger generation information. Character string at occurrence is output in trigger row.

JSON File Data Specifications

Common items (LOGGING)

Item name		Data type	Description
Data logging name	NAME	string	Arbitrary character string (Not used for the control)
Logging type*1	TFFLGTP	string	CONT: Continuous logging TRIGGER: Trigger logging
Number of file switching records*1	SAVSWICTMNRECNUM	number	100 to 100000
Storage location path*1	SAVFLDNAMEDETLFRMT	string	Path name. Blank is available. (Regarded as the same folder of the setting file.)
File format*1	TFFFILE	string	CSV_UTF16LE: CSV(Unicode)*2 CSV_UTF16LE_ZIP: ZIP compression CSV(Unicode)*2 JSON: JSON*2 JSON_ZIP: ZIP compression JSON*2
Collecting interval	SMPHSPDTYPE	string	EACHSCAN: Operation cycle TIME: Time specification
Time specification	SMPHSPDTIME	number	• When SMPHSPDTYPE = EACHSCAN 1 to 3: The nth operation cycle • When SMPHSPDTYPE = TIME 31250 to 86400000000[ns] Set an unit of ms (floating point) on display
Trigger type (complex condition)	TRGCOMPTYPE	string	OR AND
Number of trigger records before trigger*1	LLNBEFOR	number	0 to 999999
Number of trigger records after trigger*1	LLNAFTER	number	1 to 1000000
Total number of rows*1	LLNTOTAL	number	LLNBEFOR + LLNTOTAL
Number of save files*1	SAVFNUM	number	0: No upper limits 1 to 65535: Maximum number of files
Operation when exceeds the number of files*1	SAVFNUMTYPE	string	OVERWRITE: Overwrite STOP: Stop
Start condition*2	STARTCONDITION	string	AUTO: Starts automatically CONTINUE: Starts automatically (Stop disabled) MANUAL: Starts by user operation
File save*2	SAVENABLE	boolean	Saving enabled/disabled of a data logging file TRUE: Save FALSE: Not save
Number of trigger logging*2	TRIGGERTIME	number	0: Number of save files specification 1 to 32767: Number of times specification

*1 When SAVENABLE = FALSE, setting is not required.

*2 It is a unique setting item for the Motion module (Logger Module does not have this setting).

Trigger condition (TRIGGERCONDITION)

Item name		Data type	Description
No.	NO	number	1 to 32 (Serial number is not required)
Condition type	TYPE	string	DATACOMP: Data condition (Comparison) DATACHANGE: (Value change) CYCLE: Fixed cycle STARTMODULE: At module start EVENTHISTORY: Event history*1 LOGTRG: At trigger command execution*1
Data name	DATA1	number	1 to 1024
Condition	DATAOPE	string	EQUAL: = NOTEQUAL: ≠ GREATERTHANEQUAL: ≥ GREATERTHAN: > LESSTHANEQUAL: ≤ LESSTHAN: < RISINGEDGE: ↑*1 FALLINGEDGE: ↓*1
Data/constant	DATA2TYPE	string	DATA CONST
Data name (data name/ constant value)	DATA2	Number	1 to 1024
Constant value (data name/ constant value)	DATA2CONST	string	Constant value Set 0/1 for bit data
Fixed-cycle	CYCL	number	1000000 to 86400000000[ns] Set an unit of ms (floating point) on display
Event code*1	EVENTCODE	string	Event code (0xXXXXXXXX type, Settable in the range)

*1 It is a unique setting item for the Motion module (Logger Module does not have this setting).

Data(DATA)

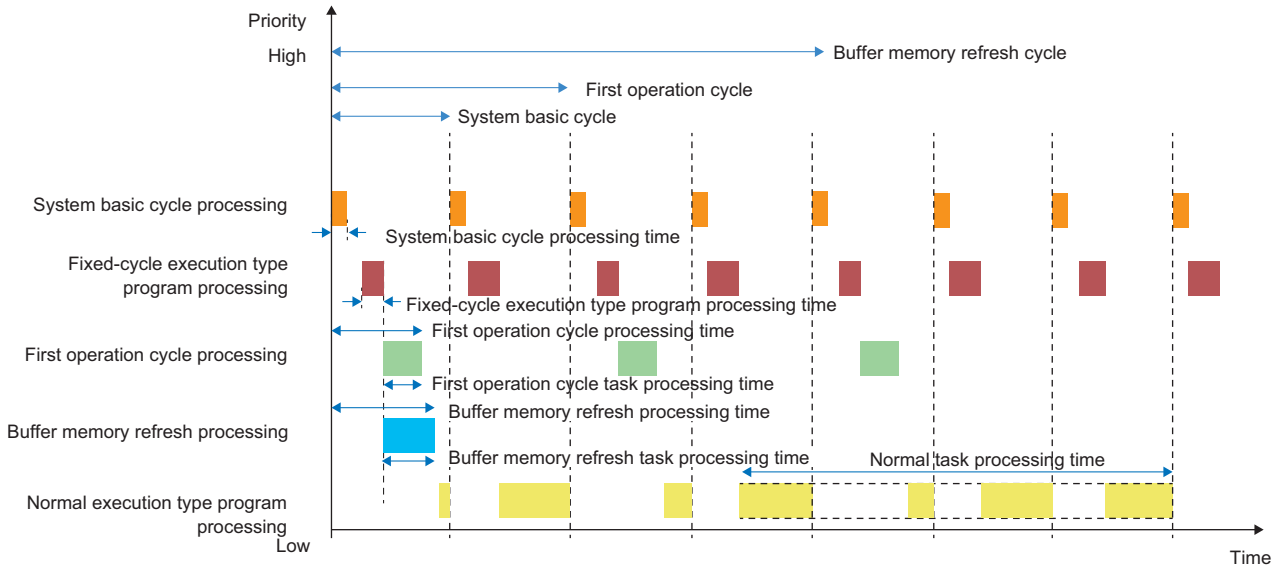
Item name		Data type	Description
No.	NO	number	1 to 1024 (Serial number is not required)
Name	NAME	string	Label/device character string
Data name	DATA1	number	1 to 1024
Data type	TYPE	string	Available only at device specification. (Ignores at label specification) BIT: Bit (BIT) SWORD: Word [signed] SDWORD: Double word [signed] UWORD: Word [unsigned]/Bit column (16 bits) UDWORD: Double word [unsigned]/Bit column (32 bits) FLOAT: Single-precision real number DFLOAT: Double-precision real number SQWORD: Long word [signed]*1 UQWORD: Long word [unsigned]*1
Input method	INPUTMETHOD	number	<For data name restoration by logging setting tool> 0: Directly input (No restoration) 1: Input from label input assistant display (Restores label name) No specification/value other than above: Directly input
Axis type	AXISTYPE	string	<For data name restoration by logging setting tool> • Available only at input method "1" "SYSTEM": System "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 "AXES_GROUP": Axes group No specification/value other than above: Regard as directly input data

*1 It is a unique setting item for the Motion module (Logger Module does not have this setting).

16 RAS FUNCTIONS

16.1 Execution Time Monitor

This function is used to monitor the operation cycle processing and the normal task execution time.



Relevant variables

Variable/Structure name		Name	Details
System.PrConst.			
	OperationCycle[1..1]	Operation cycle setting	Stores each setting value of first operation cycle. CYCLE_PARAM structure
	BuffermemoryRefreshCycle	Buffer memory refresh cycle setting	Stores each setting value of buffer memory refresh cycle. CYCLE_PARAM structure
System.Md.			
	SystemBaseCycle	System basic cycle monitor	Stores the monitor value of system basic cycle. CYCLE_MONI structure
	OperationCycle[1..1]	Operation cycle monitor	Stores the monitor value of first operation cycle. CYCLE_MONI structure
	BuffermemoryRefreshCycle	Buffer memory refresh cycle monitor	Stores each monitor value of buffer memory refresh cycle. CYCLE_MONI structure
	Program_NormalTaskCycle	Normal task processing time monitor	Stores the monitor value of normal task. CYCLE_MONI structure Limits Cycle: 0 is always stored because the cycle setting is not existed. CycleOver: FALSE is always set because the cycle over detection is not executed.
	WDTerror	WDT error	Becomes TRUE when WDT error is detected.
	SystemBaseCycle_Counter	System basic cycle counter	Stores the system basic cycle counter.
CYCLE_PARAM			
	Cycle	Cycle setting	For details, refer to the following. ☞ Page 105 Operation Cycle
	NumOfCycleOverWngDetectTimes	Number of cycle over warning detections	The number of cycles until the cycle over warning of each cycle is detected can be set. Warning is not detected when 0 is set.
	NumOfCycleOverErrDetectTimes	Number of cycle over error detections	The number of cycles until the cycle over error of each cycle is detected can be set.
	CycleOverErrorType	Cycle over error selection	An assignment for the over error of each cycle can be selected. 2: MinorError (Minor error) 3: ModerateError (Moderate error)
CYCLE_MONI			
	ProcessingTime	Processing time	Stores the processing time of each cycle in a unit of ns.
	MaximumProcessingTime	Maximum processing time	Stores the maximum processing time of each cycle in a unit of ns.
	Cycle	Setting cycle	Stores the cycle setting of each cycle in a unit of ns.
	CycleOver	Cycle over	Becomes TRUE when the cycle over of each cycle is detected.

Control details

System basic cycle

For details of system basic cycle, refer to the following.

☞ Page 105 Operation Cycle

■System basic cycle setting

Stores the system basic cycle setting in System.Md.SystemBaseCycle.Cycle with a unit of nanosecond [ns].

■System basic cycle processing time

Stores the system basic cycle processing time in System.Md.SystemBaseCycle.ProcessingTime with a unit of nanosecond [ns].

■Maximum processing time of system basic cycle

Stores the maximum value of system basic cycle processing time in System.Md.SystemBaseCycle.MaximumProcessingTime with a unit of nanosecond [ns].

■System basic cycle over

For details, refer to the following.

☞ Page 529 System basic cycle over check

Normal task

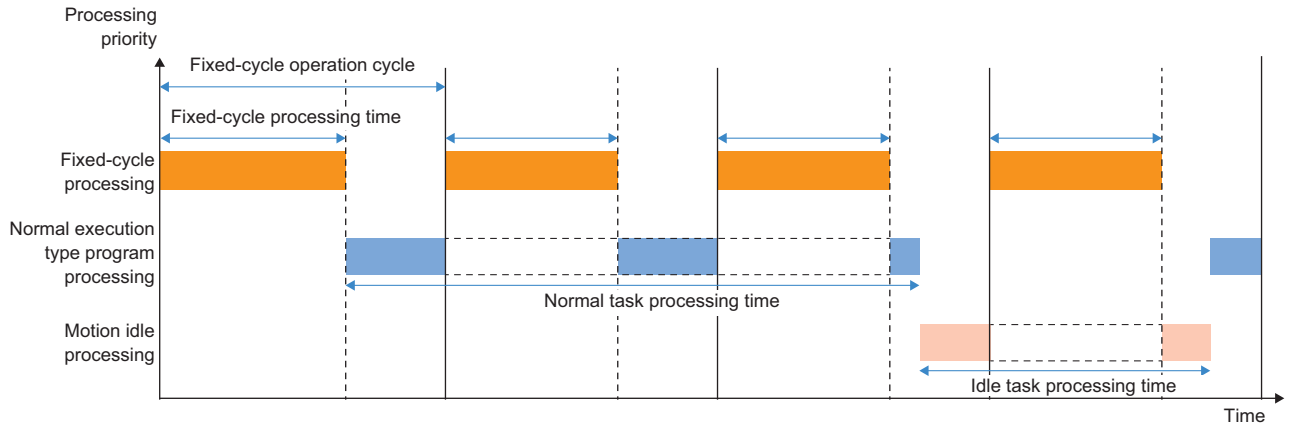
■Normal task processing time

Stores the normal task processing time in System.Md.Program_NormalTaskCycle.ProcessingTime with a unit of nanosecond [ns]. It includes the task processing time whose priority is higher than the normal task.

[Normal execution type program processing]

For details of the processing, refer to the following.

☞ Page 698 Normal execution type



■Maximum processing time of normal task

Stores the maximum value of the normal task processing time in System.Md.Program_NormalTaskCycle.MaximumProcessingTime with a unit of nanosecond [ns].

First operation cycle

For details, refer to the following.

☞ Page 105 Operation Cycle

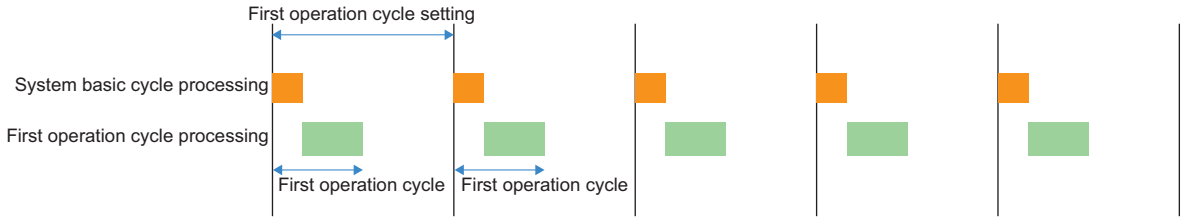
■First operation cycle setting

Stores the first operation cycle setting in System.Md.OperationCycle[1..1].Cycle with a unit of nanosecond [ns].

■First operation cycle processing time

Stores the first operation cycle processing time in System.Md.OperationCycle[1..1].ProcessingTime with a unit of nanosecond [ns].

It includes the task processing time whose priority is higher than the first operation cycle.



■Maximum processing time of first operation cycle

Stores the maximum value of the first operation cycle processing time in System.Md.OperationCycle[1..1].MaximumProcessingTime.

■First operation cycle over

For details, refer to the following.

☞ Page 529 Operation cycle over check

Buffer memory refresh

For details, refer to the following.

☞ Page 105 Operation Cycle

■Buffer memory refresh cycle setting

Stores the buffer memory refresh cycle setting in System.Md.BufferMemoryRefreshCycle.Cycle with a unit of nanosecond [ns].

■Buffer memory refresh cycle processing time

Stores the buffer memory refresh cycle processing time in System.Md.BufferMemoryRefreshCycle.ProcessingTime with a unit of nanosecond [ns]. It includes the task processing time whose priority is higher than the buffer memory refresh cycle.

■Maximum processing time of buffer memory refresh cycle

Stores the maximum value of the buffer memory refresh cycle processing time in System.Md.BufferMemoryRefreshCycle.MaximumProcessingTime with a unit of nanosecond [ns].

■Buffer memory refresh cycle over

For details, refer to the following.

☞ Page 530 Buffer memory refresh cycle over check

Processing time over check

System basic cycle over check

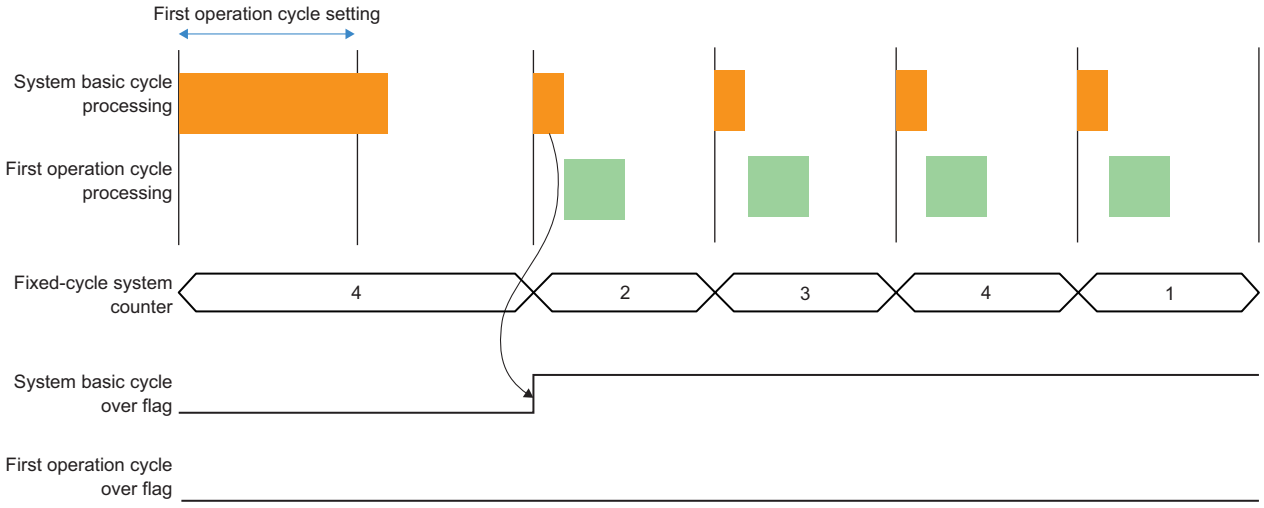
When the system basic cycle processing is not completed before the start of the next system basic cycle processing, the system basic cycle over flag becomes TRUE.

When the system basic cycle over is detected, the number of the fixed-cycle program should be reviewed.

If the system basic cycle exceeds the set cycle at the start of the first operation cycle, a new operation cycle is not executed in this cycle and it is executed in the start timing of the next cycle.

To set the system basic cycle over flag to FALSE, operate one of the followings.

- Power OFF→ON and reset
- Reset by user program

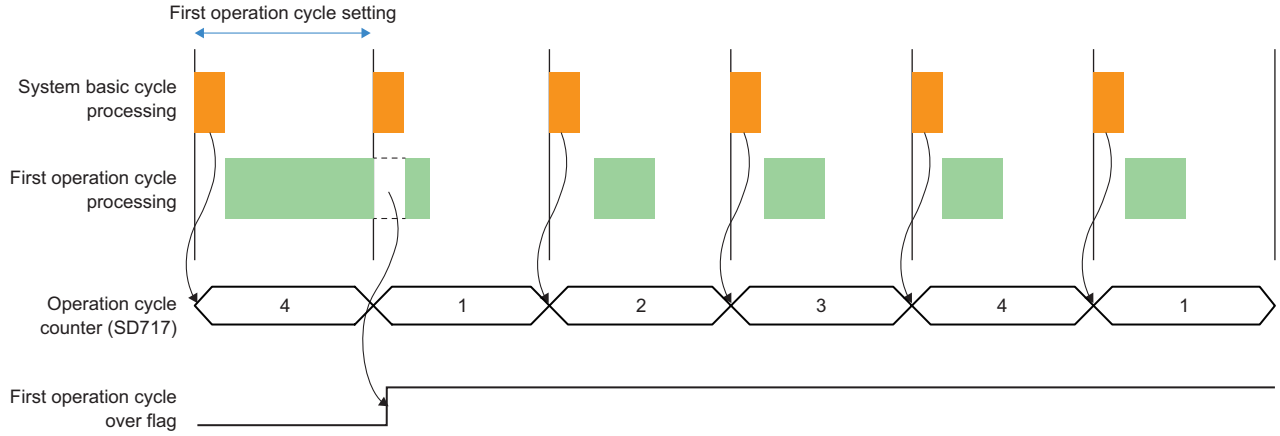


Operation cycle over check

When the first operation cycle has exceeded the set cycle, the first operation cycle over flag becomes TRUE. When the operation cycle over is detected, the number of the fixed-cycle program or the operation cycle setting should be reviewed, or set the greater value for the cycle over detection number or the operation cycle setting.

To set the operation cycle over flag to FALSE, operate the following.

- Power OFF → ON and reset



Point

- When the operation cycle over flag is detected, correct the positioning content or increase the operation cycle.

Buffer memory refresh cycle over check

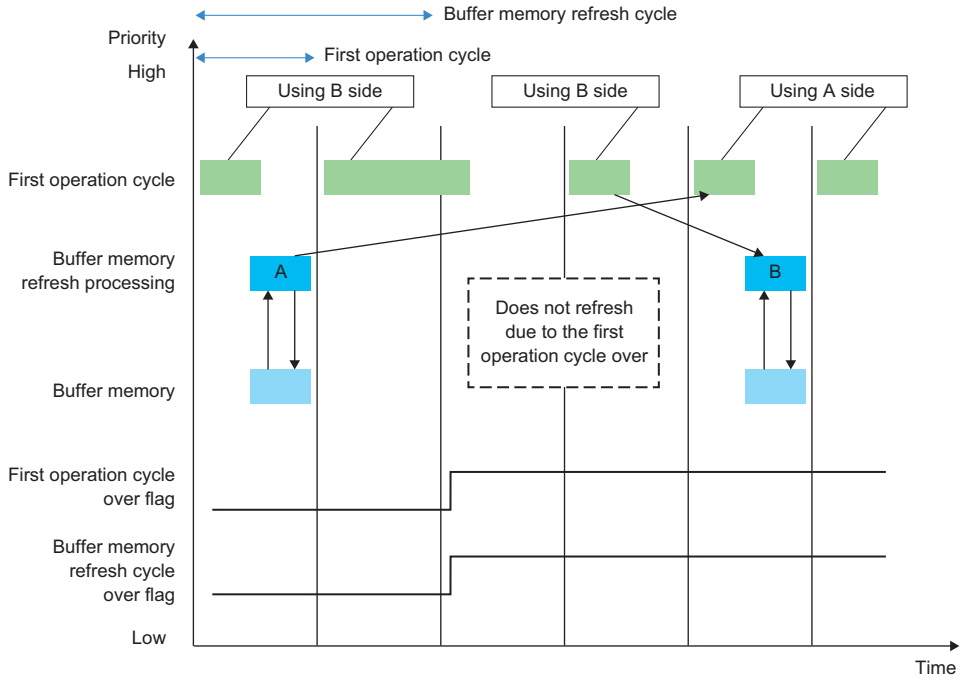
When the buffer memory refresh cycle is not completed before the start of the next cycle, the buffer memory refresh cycle over flag becomes TRUE.

When the buffer memory refresh cycle over is detected, correct the buffer memory refresh number or increase the buffer memory refresh cycle setting or the cycle over error detection number.

Unless one or more of the processing of system basic cycle, first operation cycle, second operation cycle or buffer memory refresh is completed, the processing of buffer memory refresh cycle is skipped in the cycle.

To let the buffer memory refresh cycle over flag be FALSE, perform the following operation.

- Power OFF → ON and reset



Precautions

WDT error detection

When the processing is stopped because the operation cycle or other processing is error, a WDT error occurs 1 second later.

When the WDT error is detected, the motion system stops all axes immediately and a moderate error occurs.

Cycle over warning and error detection

When the number of cycle over of each cycle reaches the set cycle over warning/error detection number, the cycle over warning/the error occur.

When the same values are set to cycle over warning detection number and cycle over error detection number, a warning does not occur. And, when 0 is set to the detection number of the cycle over warning, a warning does not occur.

The assignment of over error of each cycle can be selected.

When a minor error is selected, the deceleration stop is executed. When a moderate error is selected, the immediately stop is executed.

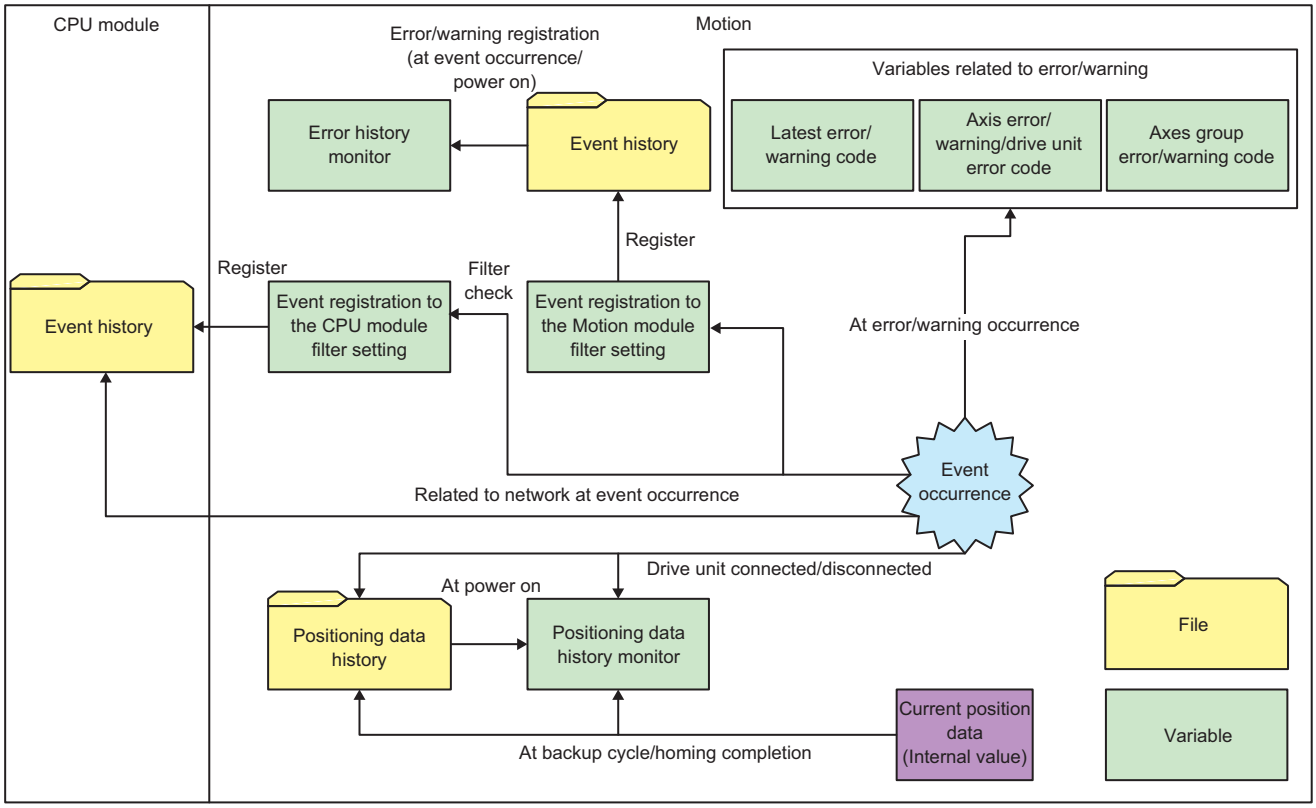
⚠CAUTION

When the deceleration stop cannot be executed because of such as system unstable or hang-ups, a moderate error occurs by WDT error detection. When a minor error is selected, the operation may keep until the WDT error detection. Ensure safety by a user.

16.2 History Data

- History data contains "Event history" and "Positioning data history".
- Positioning data history is used to save such as positioning data of each axis as history at event occurrence related to the absolute position control.
- Event history is used to save the error information and the operation for the module as an event in the CPU module and the Motion module. In each event, the records of the CPU module and Motion module can be set. The store destination of event records can be set according to event frequency or priority.

Figure related to history data



Relevant variables

Event history filter setting

Variable/Structure name		Name	Details
System.PrConst.			
	EventHistoryMotion_Exclude	Motion event history excluded event	Sets a event code which does not register an event to the motion system.
	EventHistoryMotion_Path	Motion event history path	Sets the store destination of event history file.
	EventHistoryMotion_Capacity	Motion event history capacity	Sets the size of event history file.
	EventHistoryCpu_Exclude	Event excluding CPU event history	Sets a event code which does not register an event to the CPU module.
System.Cd.			
	EventHistoryMotion_Clear	Motion event history clear execution request	Carries out execution requests of the event history clear.
System.Md.			
	EventHistoryMotion_Path	Motion event history path	Stores the store destination (absolute path) of event history file.
	EventHistoryMotion_ClearStatus	Motion event history clear execution status	Displays the execution status of the event history clear. 0: Ready (Waiting for the request) 1: Executing (Executing) 2: Done (Execution completed) -1: Error_ (Error occurrence)

Error history monitor

Variable/Structure name		Name	Details
System.Md.			
	ErrorHistory_Latest	Latest error history data No.	Displays the latest number of error data.
	ErrorHistory[0..64499]	Error history information	Displays error information.

Positioning data history monitor

There is no positioning data history monitor.

Event history function

- This function is used to save the data such as the error detected by the motion system, the operation executed to the module, the event related to the motion control of start and stop as event history.
- The occurrence history of the information such as the saved operation and error can be checked in chronological order.
- The data is saved as event history, so that the history can be checked even if the module turns OFF or resets.
- Using this function enables exploration of failure cause occurred in equipment and device, check of the control data update status of CPU module, and detection of illegal access.
- The event history is always collected regardless of the operation status of Motion module. However, it may not be collected in the cases such as major error of the module, base module error, or cable error.
- The event which occurred in the Motion module and is not set to be filtered is registered in the event history of the control CPU module. For event history of a CPU module, refer to the following.
  MELSEC iQ-R CPU Module User's Manual (Application)

Event occurred in the motion system

The items saved in the event history are shown below.

For details of the event, refer to the following.

☞ Page 637 List of Event Codes

Event type	Category	Details	Event item	Event code
System	Error	Not applicable	Not applicable	—
	Warning	Not applicable	Not applicable	—
	Information	An event on the right is detected in the Motion module.	☞ Page 637 System	00000H to 007FFH
Security	Error	Not applicable	Not applicable	—
	Warning	Not applicable	Not applicable	—
	Information	An event on the right related to the security is detected in the Motion module.	☞ Page 637 Security	10000H to 17FFFH
Operation	Error	Not applicable	Not applicable	—
	Warning	Not applicable	Not applicable	—
	Information	Operation by the user on the right is detected in the motion system.	☞ Page 638 Operation	20000H to 27FFFH

■MCFB execution and stop event

- The MCFB execution event can be monitored.
- Restart and multiple start by buffer mode also can be monitored as an event.
- Monitoring the execution event enables check such as whether each operation has started in intended order at the system startup, etc.
- The stop event when the axis stops caused by stop factor input can be monitored.
- Monitoring the stop event enables check of the stop factor caused when the unintended stop has been executed, etc.

Event history file of the Motion module side

- Event history data of the Motion module side is saved into the drive in the motion system as a file.
- Event history is saved to EVENT.LOG in the storage destination specified by System.PrConst.EventHistoryMotion_Path. The file capacity is specified in System.PrConst.EventHistoryMotion_Capacity in a unit of kB. When System.PrConst.EventHistoryMotion_Path is blank, the event history is saved to root path directly.
- When events frequently occur in the intervals shorter than the event history collection intervals of the motion system, the event history storage area in the motion system might be full of event information which has not been collected. If a new event occurs in this state, the motion system discards the event information and outputs the message "*HST.LOSS*" (The event information has been erased.) which indicates the event information has been erased.
- Update of the event history is performed every three seconds after file update completion. File update is not performed when an event is undetected. When over 512 events occur during collection interval, the events are erased.

■Display of the event history

The event history of the Motion module side can be displayed on the engineering tool (The Motion module setting function of GX Works3). For the details about the operating procedures and how to interpret the displayed information etc., refer to the following.

📖GX Works3 Operating Manual

■Clearing the event history

[Clearing by the engineering tool]

The event history can be cleared by the engineering tool (The Motion module setting function of GX Works3). For the details about the operating procedures, etc., refer to the following.

📖GX Works3 Operating Manual

[Clearing by the event history clear request]

- The event history clear is the function to clear the event history by setting System.Cd.EventHistoryMotion_Clear for TRUE.
- System.Md.EventHistoryMotion_ClearStatus turns "1: Executing" during the event history clear execution.
- System.Md.EventHistoryMotion_ClearStatus turns "2: Done" as the event history clear is completed. When executing the event history clear again, set System.Cd.EventHistoryMotion_Clear for FALSE and execute the clearing after confirming that System.Cd.EventHistoryMotion_Clear turns "0: Ready".
- When the event history clear is failed, System.Md.EventHistoryMotion_ClearStatus turns "-1: Error". When turning to "-1: Error", System.Cd.EventHistoryMotion_Clear set to FALSE temporarily and after a while, carry out the event history clear again after confirming that System.Md.EventHistoryMotion_ClearStatus turns "0: Ready".

The event history file of the CPU module side

The event history data of the CPU module side is saved into the drive of the CPU module as a file.
For the details about the event history of the CPU module, refer to the manual of the CPU module.

■Display of the event history

The event history of the CPU module side can be displayed on the engineering tool (GX Works3). For the details about the operating procedures and how to interpret the displayed information, etc., refer to the following.

📖GX Works3 Operating Manual

■Clearing the event history

[Clearing by the engineering tool]

The event history can be cleared by the engineering tool (GX Works3). For the details about the operating procedures, etc., refer to the following.

📖GX Works3 Operating Manual

Filter setting

- The filter setting enables to specify whether the event detected in the motion system is registered in event history.
  For example, when an error is registered to the filter setting, the error processing is executed at the error detection.
  However, the error event is not registered in the event history.
- The following two settings are available for filter setting.

■Filter type

Setting	Details
Event registration in the motion system	Specifies the event code not to be registered in the event history of the motion system at the event detection.
Event registration in the CPU module	Specifies the event code not to be registered in the event history of the CPU module at the event detection.

■Filter setting and event history registration

The following shows the registration result of event history of each module by the filter settings of event registration of the Motion module and the CPU module.

Filter setting	Event history
Excluded	Not registered
Other than the above	Registered

■Default value of filter setting

Setting	Filter setting
Event registration in the motion system	None
Event registration in the CPU module	0x700-0x7ff

■Filter setting method

- The filter can be set for each event code.
- The filter setting can be set by the following.

System.PrConst.EventHistoryMotion_Exclude and System.PrConst.EventHistoryCpu_Exclude

Ex.

[For the setting when the event codes 0x80001000 and 0x80001010 are not to be registered in event history]

0x80001000,0x80001010

- The range can be specified by tying event codes using "-" (hyphen).

Ex.

[For the setting when the event codes from 0x80001000 to 0x80001010 are not to be registered in event history]

0x80001000-0x80001010

[For the setting when all event codes are not to be registered in event history]

0x00000000-0xFFFFFFFF

- The filter setting is enabled at the power OFF of the motion system, reset, or PLC ready [Y0] ON, after writing in the motion system.

Motion error history

The error and warning history occurred in the motion system can be checked up to 129 logs in the latest order by the variable.

Positioning data history

- The positioning data history of each axis can be monitored by the engineering tool.
- 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.
- 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

- When the axis setting is not existed at the power ON, the positioning data history data of nonexistent axis is deleted.
- The occurrence order and saved order of events may not match in the event recorded in the event history. When the event history is displayed in the engineering tool, the history can be checked in the event occurrence order by sorting the occurrence time.
- The history data in the Motion module can record and monitor the event occurrence time in a unit of ns. However, the event history saved in the CPU module is in a unit of ms (round down 1 ms or less).
- The event which occurs frequently may short the memory life of the event history saving destination. It is recommended that unnecessary events are filtered.
- To clear the positioning data history, delete the positioning data history file by file transfer function and turn the power OFF → ON or reset the module.
- When the file version of the positioning data history is different, the warning "Position Data History Update Disabled Warning" (warning code: 0F03H) occurs and the content of the positioning data history file is 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 lacks its capacity, the warning, "Position Data History Update Disabled Warning" (warning code: 0F03H) occurs and the positioning data contents 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 can not be created, the positioning data history file is not created.
- The No.1 CPU clock data is the standard for the Motion module. Therefore, the time and date of the event that occurred during initial processing may be different from the actual time and date. Also, the time and date of event occurrence already saved in the event history cannot be corrected even if clock data is received from the CPU module.

17 MOTION SERVICE PROCESSING

17.1 Operation Overview

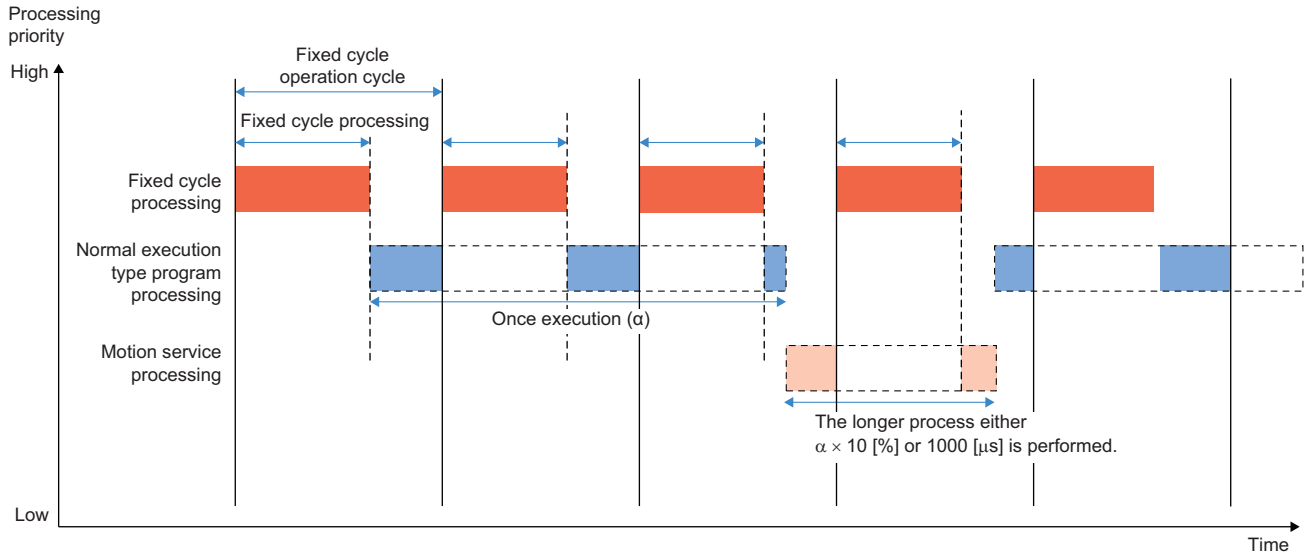
This section describes the motion service processing which executed in the service task.

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 fixed cycle processing as well as the normal execution type program.

When all normal execution type program is executed once, the motion service processing is started.



17.2 Processing Description

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 service processing. Refer to the specification of each FB.
MELSOFT communication processing	Executes the communication with the peripheral equipment such as the engineering tool and GOT.

18 HOW TO CONTROL FROM CPU MODULE

18.1 Specifications of I/O Signals with CPU Modules

This section describes how to control the Motion module from the CPU module (control CPU only).
For motion module program creation procedure, refer to the following.
☞ Creation Procedure for Motion Module Programs

Module label

The global label in the Motion module is available as the module label from the CPU module.
The module label value is updated/stopped by RUN/STOP of the Motion module.

■Using method

Turn "disclosed labels" of the labels to disclose to the CPU module as the module labels to "enabled" on the engineering tool and set "attribute".

Point

The global labels to disclose to the CPU module use the buffer memory (area for the labels) of the Motion module. Read/Write directly for the buffer memory other than user setting area must not be carried out in the user program. For the global label size to disclose (the available label size to assign), refer to the following.
GX Works3 Operating Manual
The disclosed labels are refreshed in the "buffer memory refresh cycle". For the details, refer to the following.
☞ Page 105 Operation Cycle

■Attribute

The disclosed labels have attributes (= refresh direction).
The label attributes provided by the system can not be changed.

- The CPU module → The Motion module

Writes from the CPU module to the Motion module. In the labels provided by the system, they become the attributes when the parameters and control data (Pr, PrConst, Cd, etc.) are disclosed.

- The Motion module → The CPU module

Writes from the Motion module to the CPU module. In the labels provided by the system, they become the attributes when the monitor data (Md, etc.) are disclosed.

Precautions

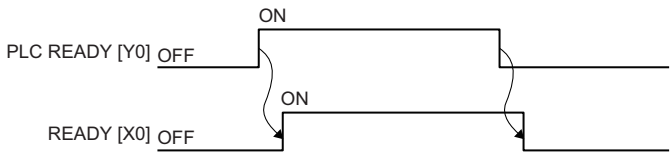
- The disclosed data has restrictions. For the datails, refer to the following.
  GX Works3 Operating Manual
- If the different direction from the attribute is written (e.g. The disclosed labels, which attributes are "The CPU module → The Motion module", are written from the Motion program or watch), the values of the refresh-source overwrite the label values with the next buffer memory refresh cycle.
  The "The CPU module → The Motion module" attribute label (some Cd. etc.) which is changed from the Motion system cannot be confirmed that the value from the CPU module is changed.
  Refer to the Md. which is compatible with the Cd. or use the FB which provides the same function without operating Cd.
- The operation performance is improved and the memory capacity can be reduced by reducing the number of the disclosed lables.
- When the program is carried out with mismatches between the CPU module and the Motion module for the setting of the disclosed labels, the refreshing can not be performed correctly.
  When the setting of the disclosed labels is changed, make sure to carry out the write of the program for both the CPU module and the Motion module.
- The closed labels of the same structure data type can not be substituted for the disclosed labels of the structure including the closed member (and vice versa). Especially, when setting the disclosed labels for the I/O pin (the structure) of the FB, disclose the all member of the disclosed labels.
- When substituting to the structure type labels having the different attribute member such as AXIS_REA type, the member values of the CPU module ⇨ the Motion module attribute are irregular (The values of the refresh-source overwrite the label values with the next buffer memory refresh cycle.)

I/O signals

The Motion module uses 32 points of the input and 32 points of the output for exchanging data with the CPU module.
The following table shows the I/O signals when 0H has been set to the start I/O No. of the Motion module.
The device X is the input signal from the Motion module to the CPU module, and the device Y is the output signal from the CPU module to the Motion module.

Signal direction: Motion module → CPU module		Signal direction: CPU module → Motion module	
Device No.	**Signal name**	**Device No.**	**Signal name**
X0	READY	Y0	PLC READY
X1	Synchronization flag	Y1	Use prohibited
X2	Use prohibited	⋮	
⋮		⋮	
X1F		Y1F	

The ON/OFF timig and conditions of the I/O signals are shown below.

Device No.	Signal name		Description
X0	READY	OFF: Not READY ON: READY	• When the PLC READY signal [Y0] turns from OFF to ON, the parameter setting range is checked. If no error is found, this signal turns ON. • When the PLC READY signal [Y0] turns OFF, this signal turns OFF. • When a moderate error or a major error occurs, this signal turns OFF. • This signal is used for interlock in a program, etc. 
X1	Synchronization flag	OFF: Module access disabled ON: Module access enabled	• After the CPU module is turned ON or resetted, this signal turns ON if the access from the CPU module to the Motion module is possible.*1
Y0	PLC READY	OFF: PLC READY OFF ON: PLC READY ON	• This signal notifies the Motion module that the CPU module is normal. It is turned ON/OFF with the PLC program. • When the data (parameter) is changed, the PLC READY [Y0] is turned OFF depending on the parameter. • The following processes are carried out when the PLC READY [Y0] turns from OFF to ON. The parameter setting range is checked. The READY signal [X0] turns ON. • The following processes are carried out when the PLC READY [Y0] turns from ON to OFF. The READY signal [X0] turns OFF. The operating axis stops.

*1 For accessing to the Motion module from the program, necessity of the interlock according to the module synchronization setting of the CPU module and the access destination in the Motion module are shown below.

Access destination	Module synchronization setting	
	"Synchronize" the rising of the module.	**"Asynchronous" the rising of the module.**
Motion control area	The interlock by X1 is required.	The interlock by X1 is required.
Network control area	The interlock is not required.	The interlock by X1 is required.

Buffer Memory

User setting area can be used for exchanging data between the CPU module and the Motion module.

Start No.	End No.	Name
11478000	11997999	User setting area
11999997	11999997	System (available for user)

Do not use the other areas than the above.

18.2 Using MCFB

This section describes how to use the MCFB in PLC programs of the CPU module.

Relevant variable

Variable/Structure name		Name	Details
System.Md.			
	BuffermemoryFreeMcfbArea	Buffer memory MCFB communication area free size	Indicates the number of unused points of the area for MCFB.

Control details

The specifications of variables that are used for the MCFB of the CPU module side are shown below.

• Specifying AXIS_REF and AXES_GROUP_REF

When using the MCFB of the CPU module side, use the followings for the axis information (AXIS_REF) and the axes group information (AXES_GROUP_REF) that are specified for the I/O variables of the MCFB.

AXIS_REF and AXES_GROUP_REF to be specified	Setting
AXIS_REF(UNIT_LABEL.AxisName.AxisRef) or AXES_GROUP_REF(UNIT_LABEL.AxesGroupName.AxesGroupRef) in the axis disclosed in the module labels or the axes group variables are used.	The setting in the sequence program is not required as the members of AXIS_REF and AXES_GROUP_REF (the axis, axes group No., and module I/O No. of the control target) is set.
AXIS_REF and AXES_GROUP_REF that are defined as labels in the CPU module are used.	Set the members (the axis/axes group No. and the module I/O No. to be controlled) of AXIS_REF and AXES_GROUP_REF by using the PLC program.

• Specifying the I/O No.

When using the MCFB of the CPU module side, the start I/O No. of the target Motion module has to be specified for the I/O variables (AxisName.AxisRef.StartIO, etc.) used in the MCFB.

Each MCFB definitely defines one input variable that requires the StartIO setting. Refer to the following for the input variables that require the StartIO setting.

☞ 24 List of FBs

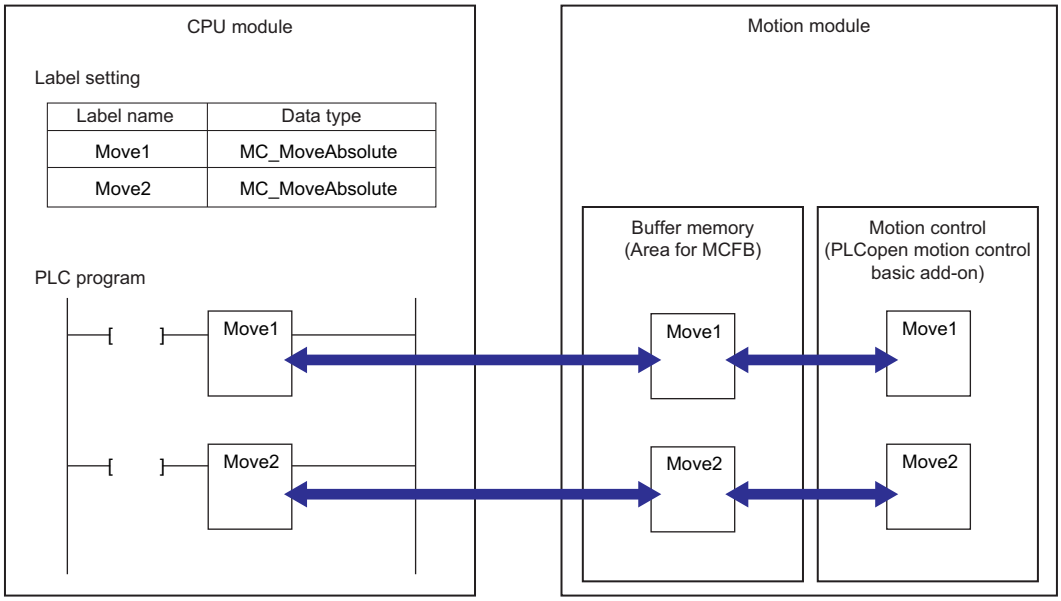
For the MCFB that can input multiple variables whose member includes the StartIO, the setting of the StartIO excluding the corresponding variables is not required. (The values are ignored.)

For the start I/O No. of the target module, refer to UNIT_LABEL.uIO of the module label or directly input the constant.

Be sure to establish the StartIO of each MCFB before the FB is called for the first time.

Generating MCFB instance

Control corresponding to the MCFB can be carried out in the Motion module side by instantiating the MCFB as a global label or a local label on the CPU module and calling the MCFB on the PLC program.



When using the MCFB of the CPU module side, the following memory areas are used. The number of available MCFB instances must not exceed the size of each area.

Memory location	Name	Occupied size	How to check the available size
CPU module	Label memory	☞ Page 669 List of FBs	Check by using the engineering tool
Motion module	Buffer memory (Area for MCFB)		System.Md.BuffermemoryFreeMcfbArea
	Memory for PLCopen motion control basic add-on		System.PrConst.AddonMotionControl_General.RamSizeMax System.Md.AddonMotionControl_General.RamSize

Point

- The buffer memory (area for the MCFB) and the memory for the motion control add-on are hold when the MCFB is called for the first time after the CPU module is set to RUN. If the free space is in short, the error "Insufficient memory capacity" (error code: 349AH) will occur when the MCFB is called for the first time, and the MCFB will not be executed.
- Even if the MCFB of the CPU module side is deleted, the memory on the Motion module side is not released. Therefore, if the MCFB is added or deleted repeatedly by writing during RUN, the memory area of the Motion module side will be in short and the error "Memory shortage" (error code: 349AH) may occur. In this case, reset the CPU module once.

Operating MCFB

• Operation conditions

The conditions (available conditions) to operate the MCFB of the CPU module side are shown below.

CPU module	Motion module	
	RUN	Other than RUN
RUN	Available	Unavailable MCFB in execution is stopped
Other than RUN	Unavailable MCFB in execution is stopped (This state occurs when the "Output Hold/Clear Setting during CPU STOP" and "Output Mode Setting upon CPU Error" of the module parameter are "Hold".	

• Processing order

The processing order of the operation cycle in the Motion module corresponding to the MCFB instance of the CPU module side is the order when the MCFB is called for the first time.

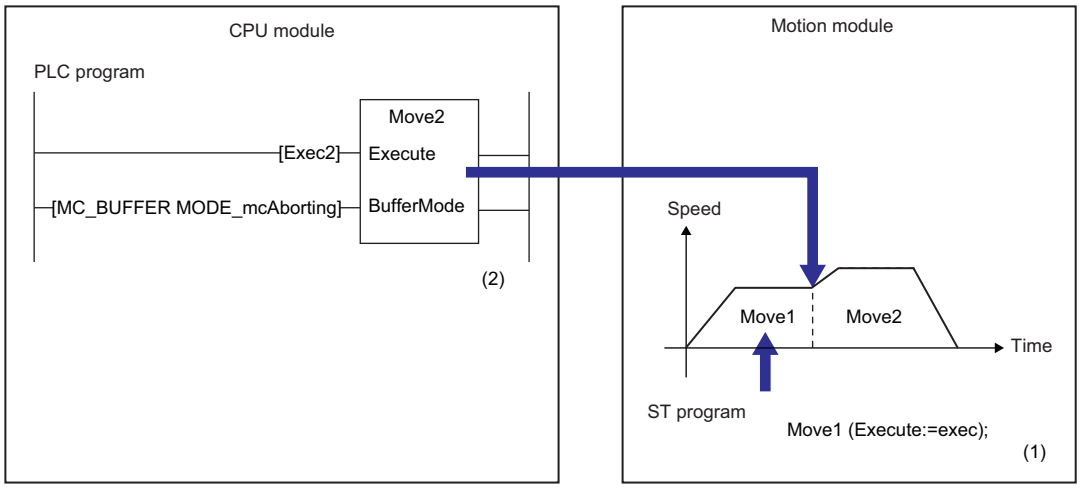
• Mix of the MCFB of CPU module side and the MCFB of the Motion module side.

When the MCFB of the CPU module side and the MCFB of the Motion module side are simultaneously executed to the same axis or axes group, the specifications of the buffer mode and the single axis synchronous control are applied.

Even if the global instance names are the same between the MCFB of the CPU module side and the MCFB of the Motion module side, these are treated as different control FBs in the Motion module.

Ex.

When executing Aborting to the on-going MCFB in the Motion module side by the MCFB of the CPU module side

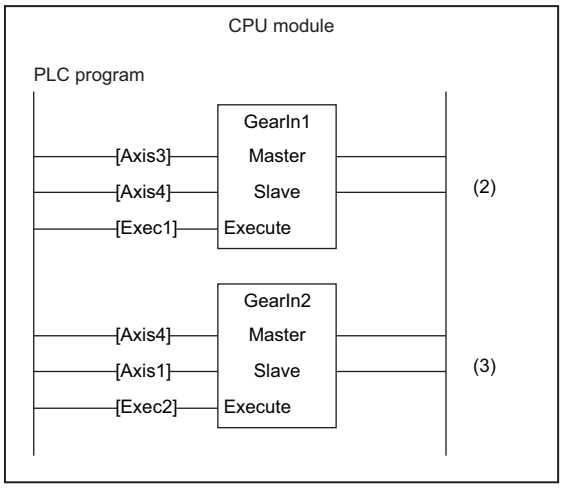


(1) Execute the Move1 of the Motion module side.

(2) When executing the Move2 of the CPU module side while the Move1 is in execution, the program is operated with the buffer mode specified by the Move2.

Ex.

When mixing the MCFBs of the single axis synchronous control in the Motion module side and the CPU module side



Motion module

ST program

```
GearInA(Master:=Axis1, Slave:=Axis2, Execute:=exec);    (1)
GearInB(Master:=Axis2, Slave:=Axis3, Execute:=exec);
```

(1) When executing the GearInA and GearInB of the Motion module side, the Axis2 and Axis3 of the slave axes run.

(2) When executing the GearIn1 of the CPU module side, the Axis4 runs using the slave axis of the GearInB (Axis3) as the master axis.

(3) When attempting to execute the GearIn2 of the CPU module side, the Axis1 to Axis4 make a circular reference. Therefore, an error occurs and the GearIn2 cannot be executed.

- Refresh cycle of I/O variables

The refresh response time of I/O variables for the MCFB of the CPU module side is as shown below.

MCFB call cycle in the CPU module + Buffer memory refresh cycle × 2

Point

Errors (including warnings) of the CPU module side during MCFB execution are output as errors of the Motion module. For the error code output to ErrorID of the MCFB, refer to the following.

☞ Page 28 Error processing

However, when the I/O No. (☞ Page 542 Relevant variable)of the Motion module specified with the MCFB argument is not correct and the Motion module to execute the FB cannot be specified, the error code is output to ErrorID only.

19 FILE CONTROL

19.1 Memory and File

The programs and parameters used in the motion system control are stored in files. The file storage location can be set freely by parameters of each control and I/O variables of FB.
The motion system built-in memory, the control CPU module memory of the motion system, and an SD memory card can be used as data area for file storage.

Operation of this function at each status of system

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Variable/Structure name		Name	Details
System.Md.			
	Storage_rom	User drive information	Stores the information of user drive.
	Storage_sys	System drive information	Stores the information of system drive.
	Storage_ram	RAM drive information	Stores the information of RAM drive.
	Storage_lch	Latch drive information	Stores the information of latch drive.
	Storage_sdc	SD memory card information	Stores the information of SD memory card.
	Environment_UserRootPath	User root path	Stores the absolute path of user root.
	HwStatus_RomWriteCycle	Flash ROM write count index value	Stores the flash ROM write count index value.

Drive

Drive structure

A generic term for the file storage memory and the SD memory card slot of the Motion module is called "Drive". The following shows available drives of the Motion module.

○: Available, ×: Not available

Item	User drive	System drive	RAM drive	Latch drive	SD memory card
Usage	• Project data • General data	• Module software • Add-on	Work data	• Absolute position data • Synchronous restoration data	• Project data • General data
Drive identifier	/rom	/sys	/ram	/lch	/sdc
Memory capacity*1	[RD78G] 16M bytes [RD78GH] 64M bytes	[RD78G] 8M bytes [RD78GH] 24M bytes	[RD78G] 16M bytes [RD78GH] 32M bytes	[RD78G] 240k bytes [RD78GH] 480k bytes	maximum 32G bytes
File system	Equivalent to FAT16(VFAT)*2	Equivalent to FAT16(VFAT)*2	FAT16(VFAT)	FAT12(VFAT)*2	SD memory card: FAT16(VFAT) SDHC memory card: FAT32(VFAT)
Format necessity before the first usage	Not necessary*3	Not necessary*3	Not necessary*4	Not necessary*3	Not necessary*5

*1 Total capacity including file management area. The available capacity is smaller.
*2 Power off is protected. (The file system is not damaged even if the power is off during writing.)
*3 Formatting is completed prior to shipping.
*4 Formatting is completed prior to power on/reset. (The file is deleted at power on/reset.)
*5 To format an SD memory card, format it with the CPU module. If formatted with such as the Windows formatting function, an SD memory card may not be able to be used by inserting it into the Motion module.

Point

The drive that can be used may be restricted depending on functions. Also, the function may be restricted depending on the drive to be used. Refer to each function for details.

Drive status

The drive status can be checked by STORAGE_INFORMATION type variable (System.Md.Storage_<drive>) which corresponding to each drive. (The <drive> indicates drive identifier: rom, sys, ram, lch, sdc.)

Variable/Structure name	Description
STORAGE_INFORMATION.Capacity	Stores the drive capacity in a unit of 1k bytes.
STORAGE_INFORMATION.FreeSpace	Stores the drive vacancy capacity in a unit of 1k bytes.
STORAGE_INFORMATION.Mount	Indicates the drive mounted status. Furthermore, it indicates file access is available when it is set to TRUE.

Memory life

■Life of flash ROM

Since a user drive and system drive use a flash ROM, it has writable times (life). An indication of write times can be monitored by System.Md.HwStatus_RomWriteCycle and data can be written until it reaches to 100,000 times. If the value exceeds 100,000 times, it is registered in the event history.

If the write count index value exceeds 100,000 times, the following symptoms may occur. Replace the Motion module.

- Decrease of writing speed to file
- Unable to write data to file

The write count index value may not match the write count by user operation. For example, the write count index value may not increase even if data is written to a file.

Point

- Since the Motion module operation is checked at factory acceptance test, the initial value of the write count index is not 0.
- Since a Motion module always checks data in the flash ROM, the write count index value may be increased without writing by user operation.

Path setting

The file path (including file name) to be used for control is specified with the STRING or FILE_LOCATION type variable by parameters and I/O variables of FB of each control. The following describes the path specification.

Path specifications

- For the file path, alphabetic characters (a-z, A-Z, 0-9), symbols (!#$%&'()+,-.;=@[]^_`{}~), spaces and directory delimiters (/) are available. Wide characters cannot be used.
- A wild card (*?) is available for a file name depending on the function. Refer to each function for the availability.
- The path length is up to 127 characters.
- The path is not case-sensitive.

■How to set the path

For the path setting, the absolute path and the relative path are available.

- Absolute path

The path start with / is an absolute path. An absolute path must be described with a character string combined with a file name to a drive identifier. For a drive identifier and a file name, refer to the following.

☞ Page 547 Drive, ☞ Page 552 Storage files

Ex.

/sdc/$MOTPRJ$/calc_profile/cam0001.csv

- Relative path

The path not start with / is a relative path. When a relative path is specified, the following directory is the root and the actual file access is performed with a root path + a relative path. The specified root path is shown below.

Module extended parameter storage location setting	Specified root path*1 %PROJECT_ROOT%	Specified root drive %PROJECT_ROOT_DRIVE%*1
Motion module (internal memory)	/rom/$MOTPRJ$/	/rom
Motion module (SD memory card)	/sdc/$MOTPRJ$/	/sdc

*1 The root path is stored in the environmental variable PROJECT_ROOT defined with system. Also the drive name including root path (root drive) is stored in the environmental variable PROJECT_ROOT_DRIVE. These can be changed to the arbitrarily path by the pathset command of file transfer function.

Ex.

When the root path is not specified by the pathset command and the module extended parameter storage location setting is set to "Motion module (SD memory card)"

Specify the following path:

Relative path: calc_profile/cam0002.csv

The actual accessed file is as follows.

sdc/$MOTPRJ$/calc_profile/cam0002.csv

Ex.

When the $MOTPRJ$ path has been specified to /sdc/MyMachine/Work002/ by the pathset command and the following path is specified

Relative path: calc_profile/cam0002.csv

The actual accessed file is as follows.

/sdc/MyMachine/Work002/calc_profile/cam0002.csv

As the special relative path, ./ (indicates current directory) and ../ (indicates upper directory) can be used.

Ex.

When the root path is set to /sdc/$MOTPRJ$/ and the following path is specified

Relative path: ../cam0002.csv

The actual accessed file is as follows.

/sdc/cam0002.csv

■Environmental variables

The path includes environmental variables. The format of environmental variables is specified with %Environmental variable name%. Environmental variables are defined with system and users and those can be set by the pathset command of the file transfer function. Refer to the following for details.

☞ Page 563 File Transfer Function

The environmental variables defined with system are as follows.

Environmental variable	Overview	Default value
PROJECT_ROOT	Root directory	/rom/$MOTPRJ$ (Changed depending on the module extended parameter storage location setting)
CALC_PROFILE_DIR	Operation profile storage location	%PROJECT_ROOT%/calc_profile

Ex.

When the environmental variable MY_DIR defined by user is set to /sdc/my_data by the pathset command and the following path is specified

The path including MY_DIR: %MY_DIR%/file.csv

The actual accessed file is as follows.

/sdc/my_data/file.csv

■Drive No.

To access the file in the motion system with the SLMP communication, use the path combined with the "File name" part to the drive identifier corresponding to the "Drive No." part of the SLMP message.

The following shows the correspondence of drive Nos. and drive identifiers.

Drive No.	Motion system
0000H	Root <./>
0001H	—
0002H	SD memory card </sdc>
0003H	—
0004H	User drive </rom>
0005H	System drive </sys>
0006H	—
0007H	—
0008H	—
0009H	—
000AH	RAM drive </ram>
000BH	Latch drive </lch>
000CH	—
000DH	—

Ex.

When setting as follows and the root path is set to /sdc/$MOTPRJ$/

Drive No.: 0000H (root)

File name: calc_profile/cam0002.csv

The actual accessed file is as follows.

/sdc/$MOTPRJ$/calc_profile/cam0002.csv

Ex.

When setting as follows

Drive No.: 0002H (SD memory card)

File name: $MOTPRJ$/calc_profile/cam0002.csv

The actual accessed file is as follows.

/sdc/$MOTPRJ$/calc_profile/cam0002.csv

Operation that can be executed

The following shows operations that can be executed to the drive in the motion system.

- Writing, reading and deleting a file
- Formatting a drive

Point

- When a file attribute is set to read only, writing and deleting are not executed.
- When write protect is set to an SD memory card, writing and deleting are not executed.
- The update time and create time of files are based on the clock data of CPU No.1 module.

Storage files

The programs and parameters to be used to control the motion system are stored in the root path by default. The directory corresponding to the root path is created automatically when writing a file in the root path. For details, refer to the following.
☞ Page 549 Path setting

File lists

The following shows the list of files to be used in the motion system.

■%PROJECT_ROOT%

File name	Useage	Module extended parameter target	Path change with pathset
%PROJECT_ROOT%/			
/prog		○	○
/F000		○	○
*.PFB	FB/FUN	○	○
*.MLB	Member definition	○	○
/P???	Subfolder (??? = 000 to 032)	○	○
*.PRG	Motion program	○	○
*.LBS	Local label setting	○	○
*.LID	Local label default value	○	○
GLBLINF.IFG	Global label setting	○	×
GLBLINF.LBS	Global label setting	○	×
GLBLINF.LID	Global label default value setting	○	×
MTNSTR.MLB	Member definition	○	×
MTNSTR.STR	Structure type definition	○	×
/calc_profile	Operation profile folder	○	○
/PD??	Subfolder (?? = 00 to 03)	○	○
*.csv	Operation profile (csv format)	○	○
/auto_open	Operation profile folder (automatically opened)	○	○
/PD??	Subfolder (?? = 00 to 03)	○	○
*.csv	Operation profile (csv format)	○	○
*.cab	Project control data for engineering tool	○	×
EVENT.LOG	Motion event history	×	×
PosHist.bin	Position data history file	×	○
filelog.txt	File transfer log file	×	○
filelog.bak	File transfer log backup file	×	○

■rom

File name	Useage	Module extended parameter target
/LOGGING	Logging folder	×
/LOG**	Logging setting ** folder	×
LOGGING**.json	Logging setting file	×
*.csv	Logging data file (csv format)	×
*.json	Logging data file (json format)	×

■sys

File name		Useage
/		
	*.smpk	Motion module software
	*.mpk	Motion module add-on
	/disabled	Temporary disabled file

■ram

File name		Useage
AxisList.json		Axis instance list
AxesGroupList.json		Axes group instance list
AddonInstallInfo.json		Add-on installation information list
/temp		Temporary folder
	/LOGGING	Operation folder for logging

■lch

File name	Useage
abs_axis.bin	Axis absolute position data

■sdc

File name		Useage
$MOTPRJ$		
	autorun.txt	File Transfer at boot
LOGGING**.json		Auto logging

Module extended parameters

The programs and the parameters that are used for controlling the motion system are handled as module extended parameters. For the target files of the module extended parameter, refer to the following.

☞ Page 552 Storage files

The module extended parameter storage location can be selected from the below by "Module extended parameter storage location setting" of the module parameter.

Module extended parameter storage location setting	Storage location	Storage file format
Motion system (internal memory)	User drive of motion system (/rom)	Individual file
Motion system (SD memory card)	SD memory card drive of motion system (/sdc)	Individual file

The module extended parameter storage location setting can be overwritten (override) by specifying PATHSET of the root path using the boot operation file.

Point

- To write the module extended parameter from the engineering tool, specify the writing destination same as the module extended parameter storage location setting. When the different writing destination is specified, the written module extended parameter is not enabled.

Operation folder

When operating files by each function, a temporary file might be created for operating in the operating file (a folder which is indicated with the environmental variable%TEMP%). The user is not allowed to change and delete the data in the operating folder. (The error might occur in the functions under control.)
The operating folder is %TEMP% = /ram/temp by default. The place for %TEMP% can be changed by the pathset command of file transfer function. For handling large amount of files, change the operating folder to the SD memory card, etc. if the RAM drive lacks its capacity. However, the execution speed for file operating will be slower if other than RAM drive is used.

Precautions

Processing of reading/writing files

- Processing of reading/writing files is executed in the background processing of the motion system. Reading/Writing time is changed depending on the file size and the system load state. Therefore, the system startup time and the switching time from STOP to RUN may be longer.
- Writing time of the user drive may be longer if the free capacity of the drive decreases.
- The timeout error may occur during reading/writing files due to the communication failure with the engineering tool. In such a case, try the operation after a while.

Power OFF at file operation (including reset)

- While file operation excluding data reading, if the software is reset or the power of the Motion module is turned OFF or reset, the file contents are not guaranteed. To prevent data damage, turn OFF the power (including reset) after the file operation is completed.
- Check the consistency of the file system at the module initialization (at inserting a card for an SD memory card). It may take time to check when there are many files in the drive.

Access to the same file at the same time

When the following operations are performed via engineering tool or SLMP, an error occurs. Execute the next access after the processing of one request source is completed.

- Execute access (reading/writing) from another request source to the file which is being writing.
- Execute writing from another request source to the file which is being accessing (reading/writing).

Access to the different files from multiple request sources at the same time

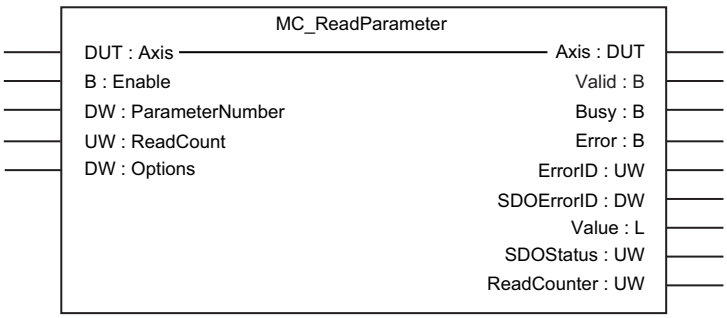
- Access to the different files from multiple request sources at the same time is up to 16 files.

19.2 Parameter Read/Write Function

This function can read/write parameters.
It can read and write objects of the slave devices.

Relevant FBs

MC_ReadParameter

Item	Description
Function overview	Read objects of the slave devices.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
24	28	Subroutine type	Real-time execution

■I/O variable

Input import↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ⎍: Always, ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, the FB is executed.
Parameter No.	ParameterNumber	DWORD(HEX)	⎍	10000H to FFFFFFFFH	0	Indicates the objects of the slave devices.
The number of reading times	ReadCount	WORD(UNIT)	⎍	0 to 65535	0	Indicates the number of reading times of parameters. Carries out continuous read until Enable turns FALSE as 0 is set. Reload is executed at the timing which the Parameter No. is changed.
Options	Options	DWORD(HEX)	⎍	*1	00000000H	Sets function options with bit designation. Reload is executed at the timing which the Parameter No. is changed.

*1 For bits and the function description, refer to the following table.

Bit	Function description
0 to 15	Empty (Reserved)
16	Indicates whether read value of integer data is stored without a sign. FALSE: signed TRUE: unsigned
17 to 31	Empty (Reserved)

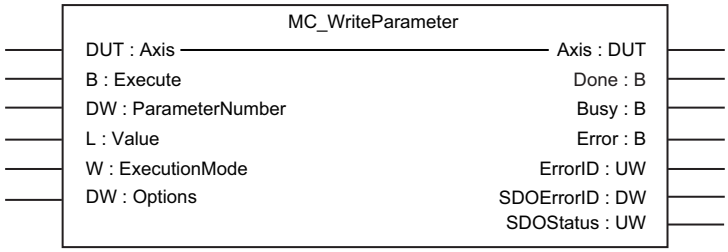
■Output variables

Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	When TRUE, the FB is executed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is executing.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.
Transient error code	SDOErrorID	DWORD(HEX)	0	The error code (SDO Abort Code) generated by transient communication is returned.
Read value	Value	LREAL	0	Outputs the read value from the specified parameters. It is stored as LREAL type in the case that the target parameters are integer data as well.
SDO transfer status	SDOStatus	WORD(UINT)	0	Stores the processing status of transient request.*1
The number of reading times	ReadCounter	WORD(UINT)	0	Stores the number of reading times of parameters. The ring counter is to be "1 to 65535" in the case that "0" is set to ReadCount.

*1 For bits and the function description, refer to the following table.

Bit	Function description
0 to 7	Response object size (byte): Stores object size which the slave devices has responded when the process is completed.
8	The transient transmission acceptance FALSE: Unexecuted transient transmission TRUE: Accepting transient transmission
9	Empty (Reserved)
10	Issuing SLMP FALSE: Unexecuted SLMP TRUE: Issuing SLMP
11 to 15	Empty (Reserved)

MC_WriteParameter

Item	Description
Function overview	Write objects of the slave devices.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
32	14	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execution command	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, the FB is executed.
Parameter No.	ParameterNumber	DWORD(HEX)	↑	10000H to FFFFFFFFH	0	Indicates the objects of the slave devices.
Setting value	Value	LREAL	↑	—	0	Indicates a setting value of the specified parameter.
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0, 1	0	Indicates writing method of the specified parameter. As it is set to "0: mcImmediately", writes immediately. As it is set to "1: mcQueued", writes after the axis stops.
Options	Options	DWORD(HEX)	↑	*1	00000000H	Set the function options by specifying the bit.

*1 For bits and the function description, refer to the following table.

Bit	Function description
0 to 15	Empty (Reserved)
16	Indicates whether the setting value of integer data is defined as the integer value without a sign. FALSE: signed TRUE: unsigned
17 to 31	Empty (Reserved)

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that writing to the parameter is completed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is executing.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
ErrorID	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.
Transient error code	SDOErrorID	DWORD(HEX)	0	The error code (SDO Abort Code) generated by transient communication is returned.
SDO transfer status	SDOStatus	WORD(UINT)	0	Stores the processing status of transient request.*1

*1 For bits and the function description, refer to the following table

Bit	Function description
0 to 7	Response object size (byte): Stores object size which the slave devices has responded when the processing is completed.
8	The transient transmission acceptance FALSE: Unexecuted transient transmission TRUE: Accepting transient transmission
9	Empty (Reserved)
10	Issuing SLMP FALSE: Unexecuted SLMP TRUE: Issuing SLMP
11 to 15	Empty (Reserved)

Slave object (Transient)

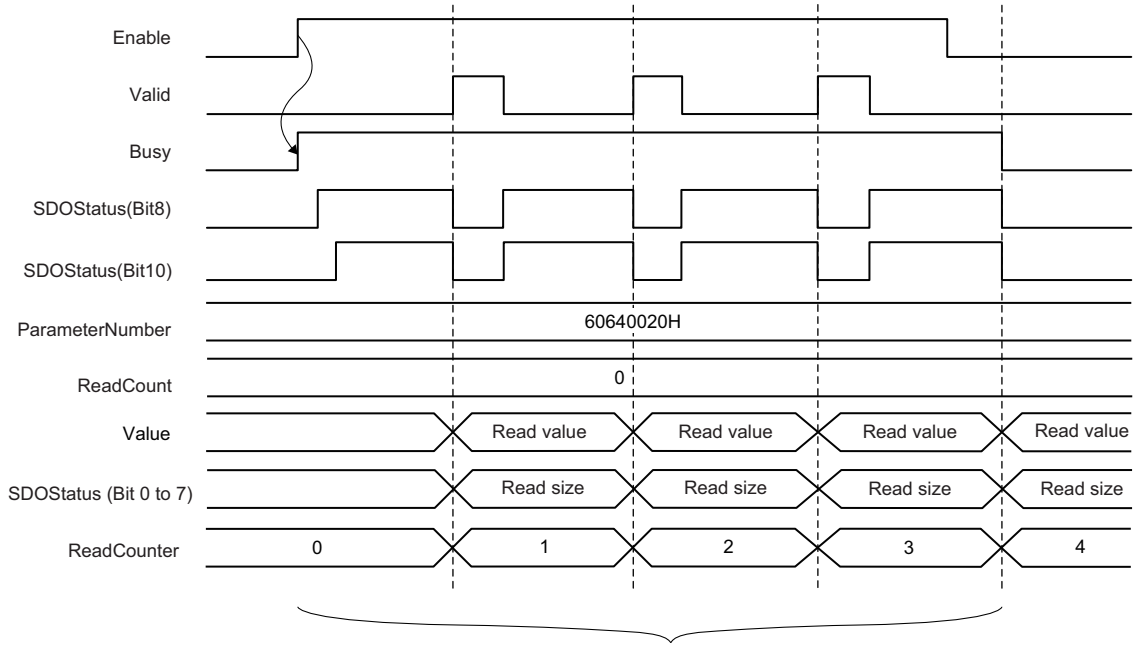
Slave objects can be read/written by indicating 0x10000 or later to the parameter No. In this case, object data is sent/received by using the transient transmission function.

When the error (response code (SDO Abort code)) for transient request is received from the slave device, Error turns TRUE and then the error "SDO Communication Error" (error code: 1800H) is stored to ErrorID and the response code (SDO Abort code) from slave device is stored to SDOErrorID.

■The timing of send/receive

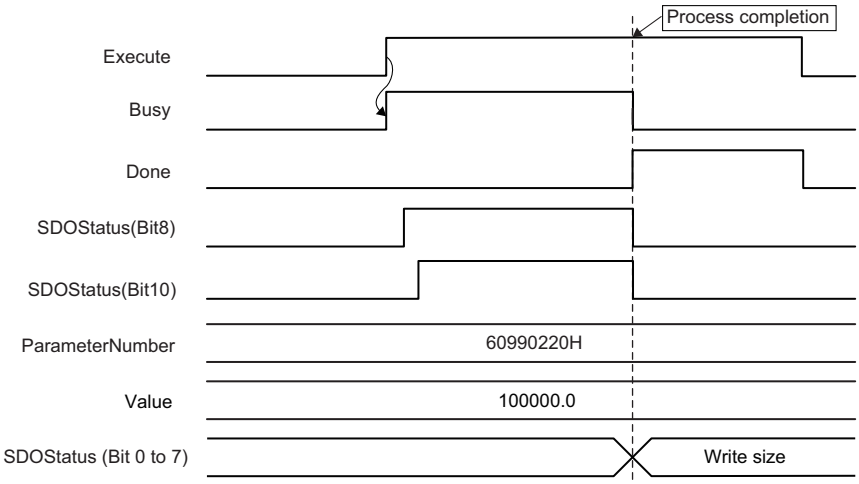
[At successful completion]

- For execuing parameter read



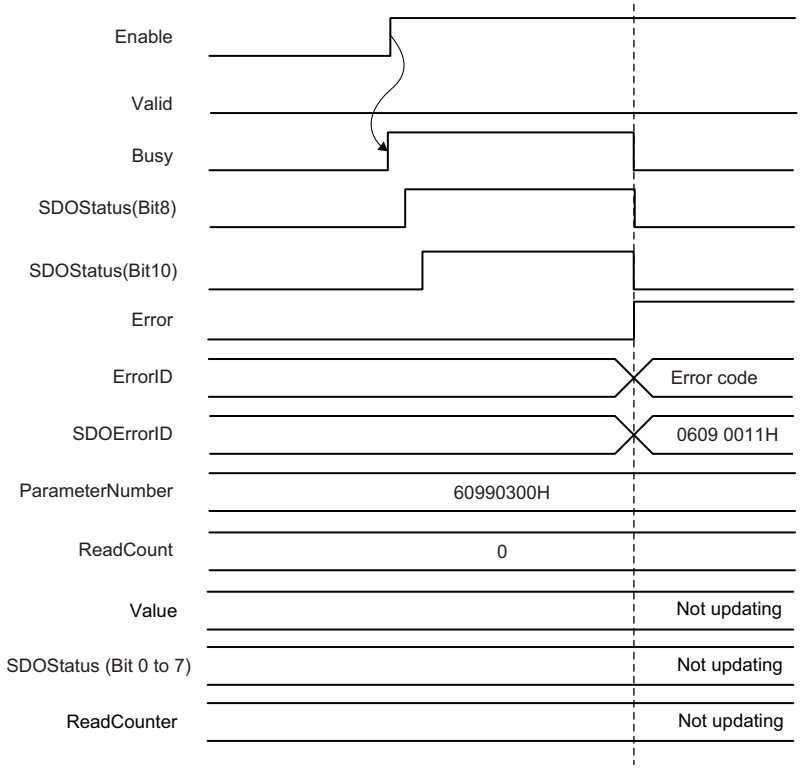
Executes read for a designated number which is indicated with ReadCount until Enable turns FALSE.
(Executes continuously until Enable turns FALSE when ReadCount is set to "0".)

- For execuing parameter write

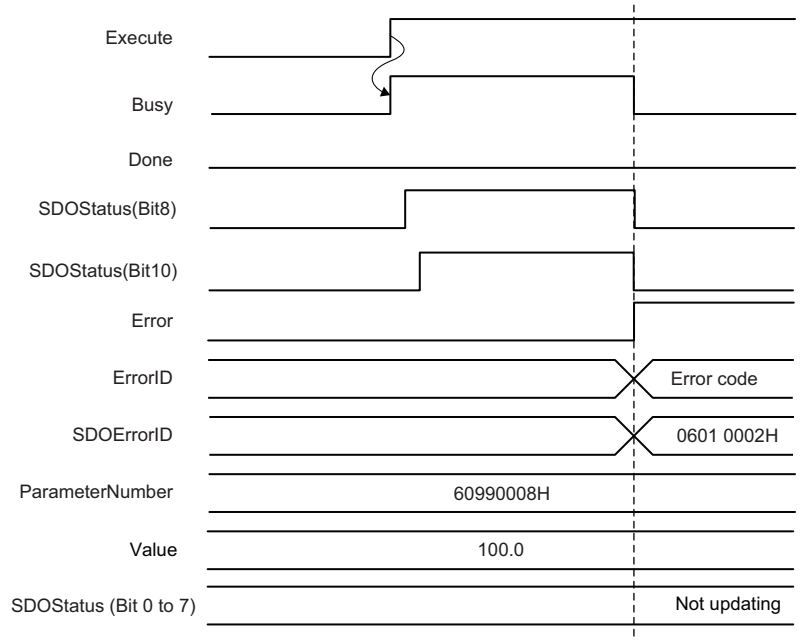


[At unsuccessful completion (SDO communication error has occured.)]

- For execuing parameter read

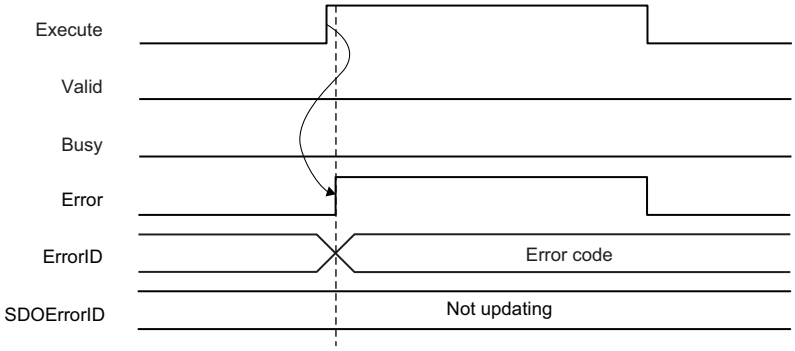


- For execuing parameter write

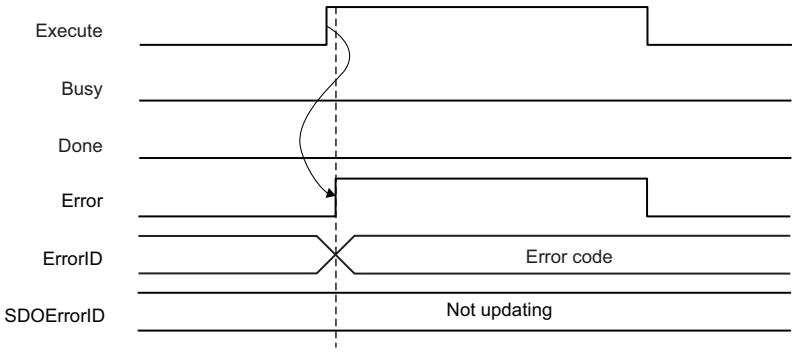


[At unsuccessful completion (the I/O variables and the Input variables are abnormal)]

- For execuing parameter read



- For execuing parameter write



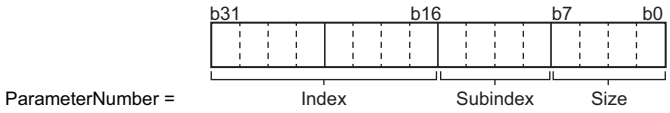
Setting details

■ParameterNumber (parameter No.)

The Parameter No. specified at the parameter read/write is below.

- 0x10000 to 0xFFFFFFFF: the objects of the slave device

For specifying the objects of the slave device, do as follows.



For the size of the objects of the slave device, specify 1 byte / 2 bytes / 4 bytes / 8 bytes in bits.

If "0" is specified, the parameter read is performed with default size and the parameter write is performed with 4 bytes.

If the value other than above is set, the error "Out of Parameter No. Range" (error code: 34A2H) occurs.

When the size specified with ParameterNumber differs from default size of the slave objects, the operations depend on the specifications of the driver.

Ex.

For specifying object index 6099H and UNSIGNED32 object of subindex 02H

For read: Specify "60990200H" (default size).

For write: Specify "60990220H" (the size of 4 bytes)

■ExecutionMode (Start mode)

At executing the parameter write, set the timing of write in ExecutionMode.

If "0: mcImmediately" is specified, write is executed immediately. The axis operations might be affected because the reflection timing depends on each parameter.

If "1: mcQueued" is specified, write is executed after the axis stops (the axis status (AxisName.Md.AxisStatus) is "0: Disabled" or "4: Standstill").

The response code (SDO Abort code)

The response code by using the transient transmission function when the object data send/receive is unsuccessful is shown below.

SDO Abort code	Description	Remedy
0601 0000h	Accessed to an unsupported object.	Check Index and subIndex.
0601 0001h	Performed read access to a write-only object.	
0601 0002h	Performed write access to a read-only object.	
0602 0000h	Accessed to an object which is not defined in the object dictionary.	
0604 0041h	Performed the mapping of an object which is not allowed PDO mapping.	Check the mapping data.
0604 0042h	The number and length of the data which is mapped exceed the value defined by the application.	
0609 0011h	Specified SubIndex that does not exist.	Check Index and subIndex.
0609 0030h	Set an invalid parameter value	Check the data value.
0609 0031h	Set the larger value than the parameter range.	
0609 0032h	Set the smaller value than the parameter range.	
0800 0020h	The application cannot transfer or store data.	Check the status of the target device.

Precautions

- The transient transmission can be executed up to four toward the same axis. If the parameter read/write command for the slave object is executed toward the axis which is already executing four transient transmissions, the error "Parameter Reading And Writing Instruction Execution Disabled Error" (error code: 34A1H) occurs and the next command is not executed. (The command which is being executed continues.) Obtains home position data of the driver by the transient transmission function in a driver homing method. Therefore, if the parameter read/write command for the slave object is executed when MC_Home command is carried out, the error "ABS Reference Point Read Error" (error code: 1AAAH) might occur in MC_Home command.
- When reading/writing the integer type/BOOL type parameters or slave objects, the setting value of MC_WriteParameter is converted into integer type or BOOL type and taken. Also, the written value in MC_ReadParameter is respectively converted into LREA type or BOOL type and output.

Ex.

Write parameters by specifying two bytes size with MC_WriteParameter.

Setting value (Value(LREAL))	Write value (2 bytes data)	
	Options: Bit16 FALSE	Options: Bit16 TRUE
10000.5	10000	10000
-10000.4	-10000	55536
65535.0	-1	65535
-65535.0	1	1
63356.0	0	0
131701.0	-1	65535

Read parameters by specifying two bytes size with MC_ReadParameter.

Parameter value	Setting value (Value(LREAL))	
	Options: Bit16 FALSE	Options: Bit16 TRUE
10000	10000.0	10000.0
-20000	-20000.0	45536.0
65535	-1.0	65535.0
63356	0.0	0.0
131701	-1.0	65535.0

- The changed values by this function are not saved. To use the changed values at the next power supply, save the parameters.
  For slave object devices: Refer to the mannual for slave devices about the parameter saving method.

19.3 File Transfer Function

This function executes file operation and data backup/restore based on the specified command.
This function executes the file operation according to the command description set in System.Cd.FileTransfer_Command by setting TRUE in System.Cd.FileTrasfer_Execute.
While the file transfer is executed, System.Md.FileTransfer_State is set to Executing.
The execution of file transfer is registered in the event history (type: system).

Operation of this function at each status of system

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Variable/Structure name		Name	Details
System.PrConst.			
	FileTransfer_LogCapacity	File transfer log capacity	Specifies the log file capacity in a unit of k byte.
	FileTransfer_AcFile_lch	File transfer access control (File in latch drive)	Specifies the access control to files in the latch drive. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcFile_ram	File transfer access control (File in RAM drive)	Specifies the access control to files in the RAM drive. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcFile_rom	File transfer access control (File in user drive)	Specifies the access control to files in the user drive. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcFile_sdc	File transfer access control (File in SD memory card)	Specifies the access control to files in the SD memory card. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcFile_sys	File transfer access control (File in system drive)	Specifies the access control to files in the system drive. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcImage_lch	File transfer access control (Latch drive image)	Specifies the access control to latch drive images. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcImage_ram	File transfer access control (RAM drive message)	Specifies the access control to RAM drive images. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcImage_rom	File transfer access control (User drive image)	Specifies the access control to user drive images. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcImage_sys	File transfer access control (System drive image)	Specifies the access control to system drive images. For details, refer to the following. ☞ Page 564 Access control setting
	FileTransfer_AcLabel	File transfer access control (Label)	Specifies the access control to labels. For details, refer to the following. ☞ Page 564 Access control setting
System.Cd.			
	FileTransfer_Execute	File transfer execution request	Requests the execution of file transfer. When the file transfer is completed, FALSE is set automatically.
	FileTransfer_Command	File transfer command	Specifies the command of file transfer. When the file transfer is completed, it is cleared automatically. For details, refer to the following. ☞ Page 565 Command format
System.Md.			
	FileTransfer_State	File transfer executing state	Displays the execution state of file transfer. 0: Ready (Waiting for the request) 1: Executing (Executing) -1: Error_ (Error occurrence)
	FileTransfer_DriveOperating	Drive operating	The flag that is TRUE while the operation to the drive is executed.

Access control setting

Set the availability of data transfer by the file transfer function using the engineering tool.

- Set the access permission to each data by the WORD value shown below.

Bit	Meaning
0	Write permission (1: Allowed, 0: Prohibited)
1	Read permission (1: Allowed, 0: Prohibited)
2 to 15	Empty (Set 0.)

- For details of the access permission required for command execution, refer to specifications of each command.
- The access control setting read at the last is enabled at the execution timing of the file transfer function.

Functions of file transfer

Operations to be specified by the file transfer function are as follows.

Function (Command string)	Operation	Remark
Data copy (copy)	Copies a pecificated file, a file in a specificated folder, or a subfolder.	When a file with the same name exists in the copy destination, the file is overwritten.
Data move (move)	Moves a pecificated file, a file in a specificated folder, or a subfolder.	When a file with the same name exists in the destination, the file is overwritten. The source file is deleted.
Data delete (delete)	Deletes the specified file or the specified folder.	—
Environmental variable specification (pathset)	Specifies the data path to be used by each function. It can read the file stored in another folder and start the system without change of the user drive.	—
Filing (file)	Performs filing of label values and image filing of drive (Includes the files in the drive).	• When a file with the same name exists in the specified path destination, the file is overwritten. • During creating the drive image, the operating labels of each drive turn TRUE.
Data compression (compress)	Compresses a pecificated file or a file in a folder. (The name of compressed file is arbitrary.)	When a compressed file with the same name exists in the destination, the file is overwritten. The source file is not deleted.
Data extraction (extract)	Extracts a compressed file to a specified folder.	When a file with the same name exists in the destination, the file is overwritten.
File attribute (attrib)	Changes a file attribute of a specified folder.	—

Command format

Specify the command to be specified by the file transfer function with the following formats.

[Command] [Argument 1] [Argument 2] [Argument 3]

- For details of argument, refer to the description of each command.
- For a delimiter between commands and arguments, write a space.
- Multiple commands can be specified by using a newline code (\\n) as a delimiter. The number of commands to be specified at the same time is not restricted.

Writing example:

```
copy /rom/$MOTPRJ$/* /sdc/$MOTPRJ$/ \\n delete /rom/$MOTPRJ$/
```

- For details of path that can be specified as an argument, refer to the following.
  ☞ Page 549 Path setting
- If a space is included in the path, round the path with double quotation (").
- The path is not case-sensitive.
- When "//" is written before a command, the command is ignored. If the next command exists, the execution continues.
- When the command failed to execute, System.Md.FileTransfer_State turns "Error" and the execution ends.
- When the command format is abnormal, System.Md.FileTransfer_State turns "Error" and the execution ends.
- For the operation to the file set with the read only attribute, refer to the following.
  ☞ Page 551 Operation that can be executed
- When writing commands in ST program, make sure not to include characters which can not be expressed as a character string type constant in the argument or the path, etc. Replacing might be required. For details, refer to the following.
  GX Works3 Operating Manual

Data copy / Data move

■Format

Command	copy or move
Argument 1	• Specify the source data path of the target for copy / move • Wild card characters (*: arbitrary character string, ?: arbitrary single character) enable specification of multiple data. • All data in the specified folder (including the data in the sub directory as well) is copied or moved as the folder is specified. The specified folder itself is not targeted for copy or move. • For copy, read permission to the file is required. • For move, read and write permission to the file is required.
Argument 2	• Specify the folder path of copying or moving destination. Indicates the folder when the path ends in "/" and the file when the path does not end in "/". • As argument 1 is a single file, specifies the move destination folder (ends in "/") or the file (not end in "/"). • As argument 1 is multiple files (including the folder), specifies the move destination folder (ends in "/"). • Write permission to the file is required. • When moved to the same drive, the free capacity of the drive for the source data size is required.
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Note that specifying "nolog" not to output the log.

■Writing example

• Copies IFG of the "/rom/$MOTPRJ$/" folder to the "/sdc/$MOTPRJ$/" folder.

```
copy /rom/$MOTPRJ$/param/*.csv /rom*.IFG/sdc/$MOTPRJ$/
```

• Moves all the data in the "/rom/$MOTPRJ$/" folder to the /sdc/$MOTPRJ$/" folder without leaving the log.

```
move /rom/$MOTPRJ$/ /sdc/$MOTPRJ$/ nolog
```

• Renames ProfileData0001.CSV to ProfileData0002.CSV.

```
move /rom/$MOTPRJ$/calc_profile/PD01/ProfileData0001.CSV /rom/$MOTPRJ$/calc_profile/PD01/ProfileData0002.CSV
```

Data delete

■Format

Command	delete
Argument 1	• Specify the data path of the delete target. • Wild card characters (*: arbitrary character string, ?: arbitrary single character) enable specification of multiple data. • All data in the specified folder (including the data in the sub directory as well) is deleted as the folder is specified. • Writing permission to the file is required.
Argument 2	• Specify whether the output to the log file is enabled. • Note that the argument 2 must not be specified to output the log. • Not to output the log, specify "nolog".

■Writing example

• Delete the MTNSTR.STR of "/rom/$MOTPRJ$//" folder.

```
delete /rom/$MOTPRJ$/MTNSTR.STR
```

Environmental variable specification

■Format

Command	pathset
Argument 1	• Specify the environmental variable. • For details of the environmental variable to be specified, refer to the following. ☞ Page 550 Environmental variables • The specified environmental variable has been enabled until the power ON/reset or the software reset of the motion area.
Argument 2	• Specify the file/folder path to be set to the environmental variable. • Specify "/cpu" to use the data of the CPU module. • Wild card characters (*: arbitrary character string, ?: arbitrary single character) enable specification of multiple data.
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Not to output the log, specify "nolog".

■Writing example

• Specify the root path to the "/sdc/$MOTPRJ$/" folder.

```
pathset PROJECT_ROOT /sdc/$MOTPRJ$/
```

Filing

■Format

Command	file
Argument 1	• Specify the target data for filing. The target data and argument are shown below. Label: label • For the global label of the filing target, refer to the following. ☞ Page 640 List of Variables • Read permission to the target data is required.
Argument 2	• Specify the output destination of the filing data. • Outputting the file with the specified name is allowed as specifying the arbitrarily named file. • For the global label of the filing target, refer to the following. (The label whose attribute is LIST_WRITE_BACK is the filing target.) ☞ Page 640 List of Variables • Write permission to the target data is required.
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Note that specifying "nolog" not to output the log.

Point

- The label value return to an initial value as the system is rebooted with the different value from the label initial value due to rewrite of the label value. The backuped label value at rebooting can be used as filing the label value (backup to the label default fail) by the file command.
- Use the file/restore command for the latch drive to backup/restore the absolute position data.
- When replacing the motion system, all the data in the motion system including the absolute position data is backuped and restored (write) again to the motion system by the backup/restore function of the engineering tool.

■Writing example

• Files the global label.
Files (Backup to the file with a label initial value (GLBLINF.LID)) the label value.

```
file label /rom/$MOTPRJ$/GLBLINF.LID
```

• Files the user drive.
The drive image (driveRom.img) is generated in the "/sdc/$MOTPRJ$/" folder.

```
file /rom /sdc/$MOTPRJ$/
```

Data compression

■Format

Command	compress
Argument 1	• Specify the target file for compression. • Wild card characters (*: arbitrary character string, ?: arbitrary single character) enable specification of multiple data. • All data in the specified folder (including the data in the sub directory as well) is compressed as the folder is specified. • Read permission to the file is required.
Argument 2	• Specify the path witch includes the file name after compression. • Specifies the following for the compressed file extension depending on the intended use. Zip file format: zip • Write permission to the file is required. • If the file password is set for the file specified by argument 1, compress the file as it is (the file password is set for the file). In this case, the compressed file itself (*.zip or *.prm) is not added the file password.
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Note that specifying "nolog" not to output the log.

■Writing example

• Compreees the data in the "/rom/$MOTPRJ$/" folder and saves as the compressed file (compress.zip) in the "/sdc/$MOTPRJ$/" folder.

```
compress /rom/$MOTPRJ$/* /sdc/$MOTPRJ$/compress.zip
```

Data extraction

■Format

Command	extract
Argument 1	• Specify the target file for extraction. • Read permission to the file is required. • If the file password, "read protection" is set to the file in the compressed file, authentication is required.
Argument 2	• Specify the path for the extracted folder destination. • Write permission to the file is required. • If the same named file of the extracted destination is the read-only attribute, System.Md.FileTransfer_State turns "Error".
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Note that specifying "nolog" not to output the log.

■Writing example

• Extracts the compressed file (compress.zip) in the "/sdc/$MOTPRJ$/" folder to the "/rom/$MOTPRJ$/".

```
extract /sdc/$MOTPRJ$/compress.zip /rom/$MOTPRJ$/
```

File attribute

■Format

Command	attrib
Argument 1	Specify the path for the target file which is changed the file attribute.
Argument 2	• Specify the file attribute to be changed. • When setting the read-only attribute, specify "+r". • When clearing the read-only attribute, specify "-r". • This argument cannot be omitted. • Write permission to the file is required.
Argument 3	• Specify whether the output to the log file is enabled. • Note that the argument 3 must not be specified to output the log. • Note that specifying "nolog" not to output the log.

■Writing example

• Makes "/rom/$MOTPRJ$/PRG.PRM" the read-only file.

```
attrib /rom/$MOTPRJ$/PRG.PRM +r
```

Log file

When the file transfer function is executed, the log file (filelog.txt/filelog.bak) is stored in the directory (Default is user root) that the environmental variable FILE_TRANS_LOG indicates at the timing of the execution completion. When the environmental variable is changed by pathset command, the log file is created to the path after change.
The capacity of the log file can be specified by System.PrConst.FileTransfer_LogCapacity and the operation depends on the setting value as follows.

FileTrasfer_LogCapacity (file transfer log capacity) setting	Log create operation
-1	Create a new file in each file transfer execution. The existing filelog.txt is renamed to filelog.bak.
0	Not created.
1 to 2048[kB]	Add writing to a file in each file transfer execution. When filelog.txt exceeds the file capacity, filelog.txt is created after filelog.txt is renamed to filelog.bak.

When the log file (filelog.txt) error is detected, the warning "Log file create disabled warning" (warning code: 0F01H) is output.

Drive operation

When the drive image operation (while the file or restore command is executed), execute the target drive in the unmounted status. Note that not to access the file stored in the drive in operation with System.Md.FileTransfer_DriveOperating as an interlock.
While the drive image is operated, the following bits of System.Md.FileTransfer_DriveOperating becomes TRUE.

- bit0: User drive
- bit1: System drive
- bit2: RAM drive
- bit3: Latch drive
- bit4 to bitF: Reserved

Precautions

- Note that the writing to the file that is being used by the control during PLC ready [Y0] ON may cause unexpected operation. Besides, reading of the file that is being operated by each function may cause lost of the data consistency. Therefore, check the file is not operated and execute the file transfer function.
- The file transfer function is used when the project data is read or written from the engineering tool. While the project data is operated by the engineering tool, note that not write to System.Cd.FileTransfer_Execute and System.Cd.FileTransfer_Command.
- Note that the CPU module must not be reset and that the power must not be turned OFF during the file transmission. If the power is turned OFF or the CPU module is reset during the file transmission and the processing is forced interrupted, the file being transmitted may be broken.
- After the drive restoration, turn the power OFF or reset the CPU module once.

19.4 SD Memory Card

This section describes functions using an SD memory card.

Relevant variables

Variable/Structure name		Name	Details
System.Cd.			
	Storage_sdcRemovalProhibit	SD memory card removal prohibition	Specifies whether the removal of SD memory card is prohibited.
	Storage_sdcForcedDisable	SD memory card force disabled command	Specifies whether the usage of SD memory card forced use stops.
System.Md.			
	Storage_sdc	SD memory card information	Indicates the SD memory card information. STORAGE_INFORMATION structure
	Storage_sdcProtected	SD memory card protected	Indicates whether the write protect switch of the SD memory card is ON/OFF.
	Storage_sdcInserted	SD memory card inserted	Indicates whether the SD memory card is inserted.
	Storage_sdcForcedDisabled	SD memory card force disabled	Indicates whether the usage of SD memory card is being forced stopped.
STORAGE_INFORMATION			
	Capacity	Capacity	Stores the capacity of the SD memory card in a unit of 1k bytes. (Stores the vacancy capacity after formatting.)
	FreeSpace	Vacancy capacity	Stores the vacancy capacity of the SD memory card in a unit of 1k bytes.
	Mount	Mount status	Stores the mount status of the SD memory card.

SD memory card handling

Format an SD memory card which is used with the motion system from the CPU module. If formatting an SD memory card using the function such as the format function of Windows®, an SD memory card may not be able to be used with the motion system.

Data contained in an SD memory card may be corrupted if the power supply is turned OFF, the system is reset, or the SD memory card is removed while the card is being accessed. If the CARD ACCESS LED is ON, always stop access to the SD memory card with the SD memory card access control switch before turning OFF the power supply, resetting, or removing the SD memory card.

Specifications of SD memory card

The SD memory card is handled as the drive in the internal of the motion system and the engineering tool.

For the specifications of SD memory card, refer to the following.

☞ Page 546 Memory and File

Installation and removal of SD memory card

Refer to the following for details.

📖MELSEC iQ-R Motion Module User's Manual (Startup)

Precautions

- If each function accesses to the SD memory card during the SD memory card use stop status, the operation is the same as the operation when the SD memory card is not inserted.
- If the SD memory card is forcibly stopped while writing a file to the SD memory card from an external device, file writing may fail. Write the file again after cancelling the SD memory card use stop status.

20 SECURITY

This function serves to protect the user property stored in a personal computer and the user property inside modules in the MELSEC iQ-R series system against threats such as theft, faulty operation, and unauthorized execution due to the unauthorized access by an outsider. Use an appropriate security function according to the purpose as shown in the following table.

Security function	Purpose
IP filter	Blocks access from an invalid IP address by identifying the IP address of an external device connected by Ethernet. Thus, unauthorized access to the system can be prevented. For derails, refer to the CPU module manual.
Remote password	Limits access to just specific communication routes connected by Ethernet. (A password is used.) Thus, unauthorized access from a remote place to the system via Ethernet can be prevented. For derails, refer to the CPU module manual.

MEMO

21 MODULE SOFTWARE INSTALLATION

How to install software of the motion system is explained in this chapter.

21.1 Motion System Software Installation

The software is installed in the motion system when the product is shipped. Therefore, users do not have to install the software. However, when updating or changing to the new software, users have to install the software again. The latest software can be downloaded from MITSUBISHI ELECTRIC FA Global Website.

Point

- Even if carrying out installation, programs, parameters, and absolute position data that are written in the motion system are not rewritten.
- If installation is interrupted by the following operations during installation execution, the file in installation is deleted. Execute installation again.
  "Turning OFF the power of the motion system"
  "Turning RUN/STOP/RESET switch of the CPU module to RESET"
  "Turning OFF the power of the personal computer (when using the engineering tool)"
  "Disconnecting a communication cable from the personal computer (when using the engineering tool)"
  "Removing the SD memory card (when using SD memory cards)"
- The installed software is reflected when the power is turned ON again.
- While installation is executed, installation operation is not accepted by the other installation method. For example, while installation by the SD memory card is executed, installation executed by the engineering tool will cause an error.
- The type name and the version of the motion system software which is installed to the motion system can be checked with the engineering tool.
- The software files and the add-on function files are protected by CRC. The consistency of the file is checked when turning on the power of the motion system again, then if an error is detected, the error "AddOn Library Load Error" (error code: 3205H) will occur and the system will not start. Execute installation again to install the correct file.
- The combination of the software version should be matched with the one mentioned in the MITSUBISHI ELECTRIC FA Global Website.

Relevant variables

Variable/Structure name		Name	Details
System.Md.			
	Version_BootSw	Boot software version	The version of the boot software
	Version_NetworkBootSw	Network boot software version	The version of the network boot software
	Version_BaseSystemSw	Basic system software version	The version of the basic system software

Software file configuration of motion system

The latest version software for the motion system is included in the motion software package, and these are managed by the engineering tool. The latest version functions of the motion system software will be available by installing the motion system software to the engineering tool and the motion system.

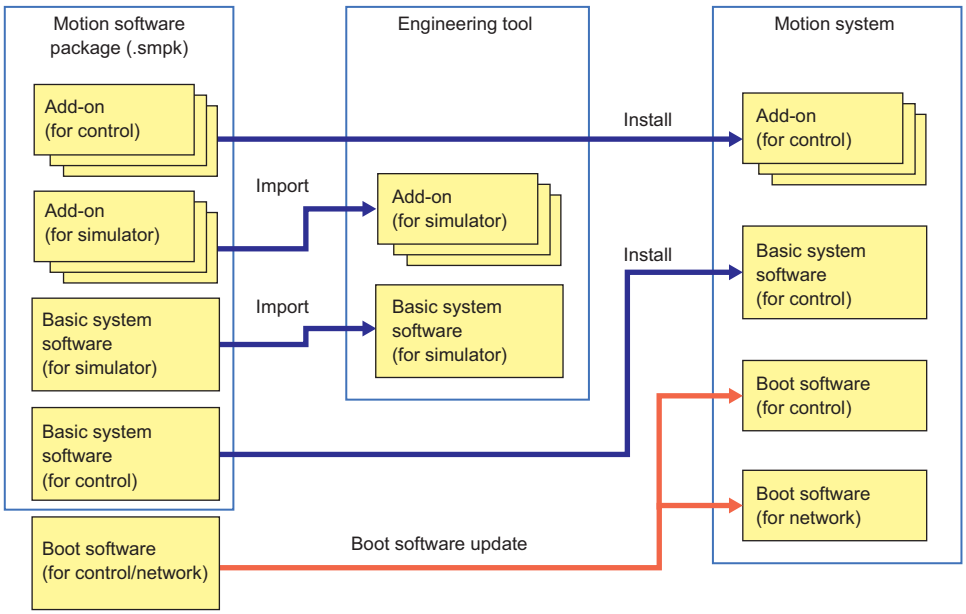
The motion system software is saved in the motion software package (.smpk) format.

For file configuration of the add-on that is to be installed in the motion system, refer to the following.

☞ Page 113 Add-on Function

Refer to the following for updating the boot software.

☞ Page 581 Boot Software Update Function



Motion software package file configuration details

The following files are packed in the motion software package. The motion software package is the same file between the RD78G and the RD78GH.

Folder	File name
Motion software package for the RD78G(H)	Basic system software binary
	Basic system software simulator DLL
	Data definition file (axis data, etc.)
	Add-on binary
	Add-on simulator DLL
	The engineering tool window definition file for add-on
	Boot software binary for network
	Bood software simulator DLL for network

The files are opened as the following on the motion system.

Folder	File name
/sys drive	Basic system software binary
	Add-on binary

The boot software is not recognized as a drive.

Checking software version

The installed software version can be checked with the engineering tool.

Checking the basic system software version

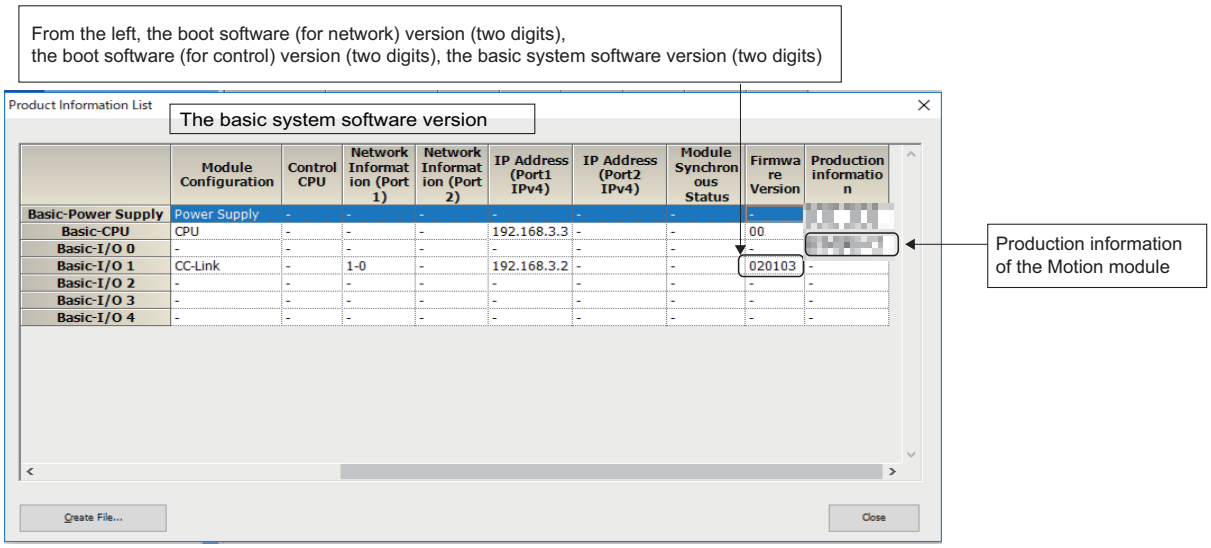
The basic system software version can be checked with System.Md.Version_BaseSystemSw or the engineering tool.

■Checking with the engineering tool

Check on the product information list screen.

[Diagnostics] ⇨ [System monitor] ⇨ [Product Information List]

The basic system software and boot software (for control / for network) versions are displayed.



Checking the add-on version

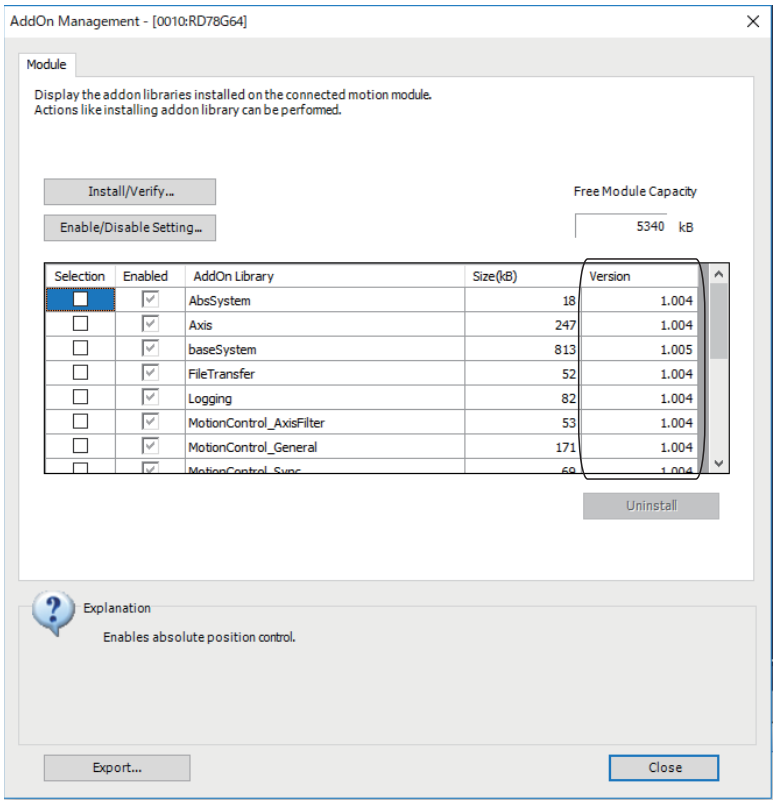
Check the add-on version on the engineering tool.

■Checking with the engineering tool

Check on the add-on management screen.

Navigation window ⇨ "Module Extended Parameter" ⇨ "Tool" ⇨ "AddOn Management..." ⇨ [AddOn Management]

The add-on version is displayed.



Checking the boot software version

The boot software version can be checked with System.Md.Version_BootSw.

21.2 Basic System Software Update Function

Software management

How to install the software

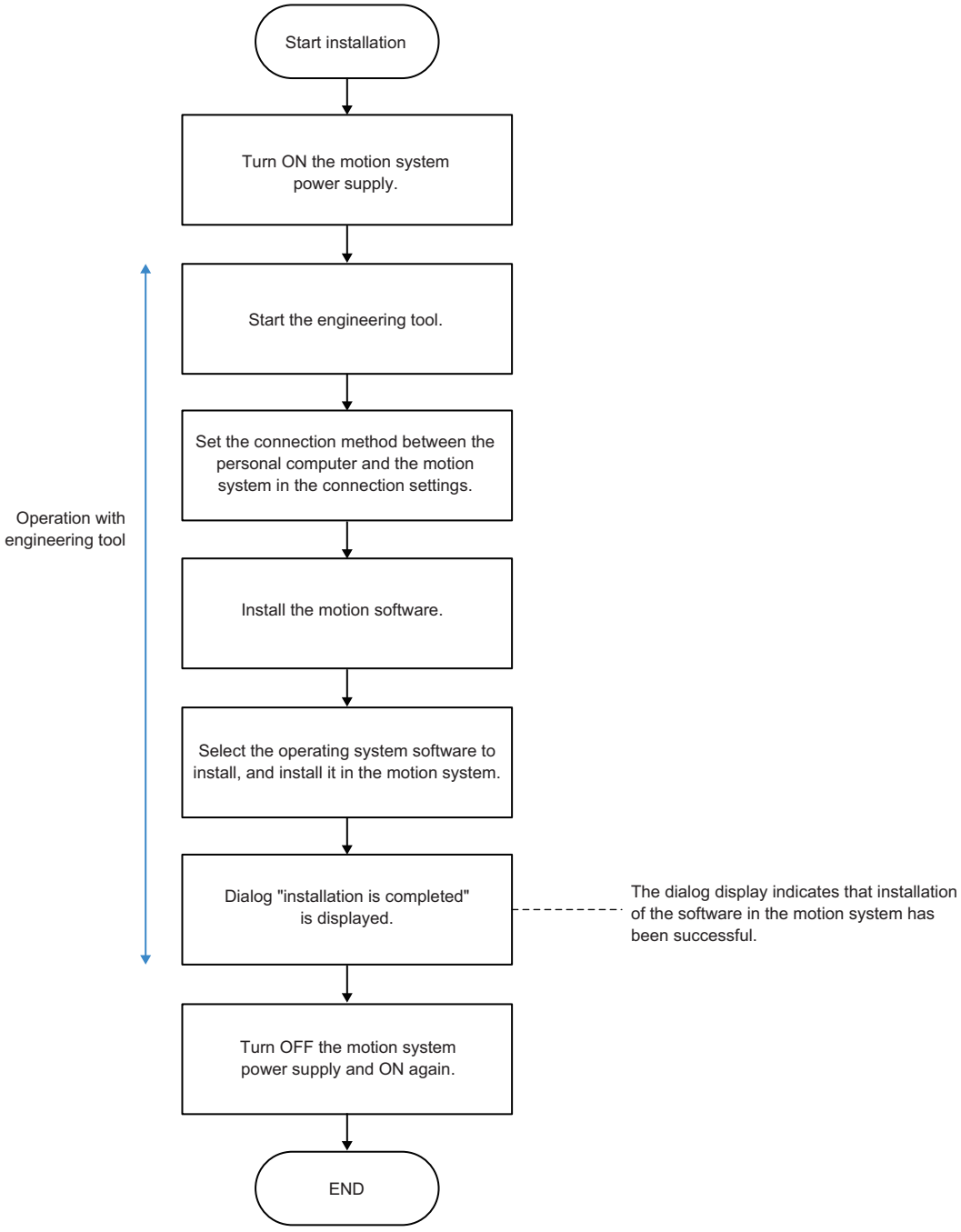
The following explains a procedure for installing the software.

The security function is valid regardless of the installation method. Installation cannot be carried out depending on the setting. For details, refer to the following.

☞ Page 572 SECURITY

■Installation procedure using the engineering tool

The following shows a procedure to install the software by using the engineering tool.



Install the software according to the instructions shown on the screen of the engineering tool. For details, refer to help of the engineering tool.

Point

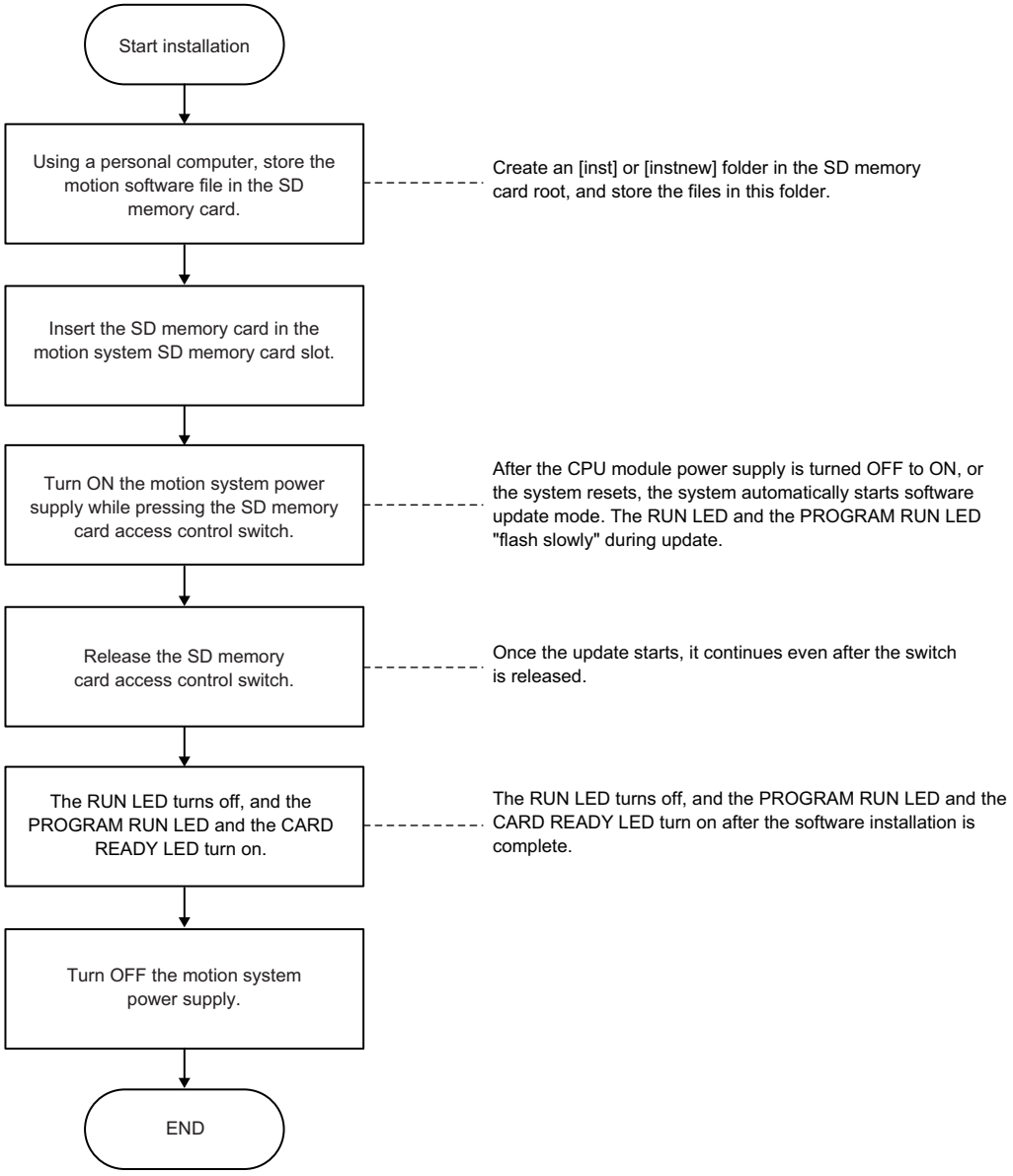
- Each function stored in the motion software package can be selected for the execution of the installation.
- Add-ons which have been installed are not deleted.

■Installation procedure using an SD memory card

The following shows a procedure to install the software by using an SD memory card.

Put the motion software package in the specified folder of the SD memory card.

When selecting files to be installed, create the motion software files to be installed with the engineering tool in advance.



Point

- The motion software creates the [inst] or [instnew] folder in the root of the SD memory card. Store the file in the folder.
  [instnew] folder: When newly installing the file (The file is transmitted after the system drive is formatted.)
  [inst] folder: When updating (overwriting) and when installing an additional module
- When installation could not be normally completed because an error was detected after installation was started, the RUN LED turns OFF, and the PROGRAM RUN LED and the CARD READY LED shows "fast flashing". After dealing with the error, carry out installation again.
  When reading the SD memory card is abnormal, check the SD memory card.
  When the installation file is abnormal or when it cannot be recognized, check the installation file.
  When the system folder is abnormal, format it with instnew then install the file again.
- The forced stop function of the SD memory card cannot be used during installation execution from the SD memory card. Do not remove the SD memory card during installation.

☐: OFF, ■: ON, ●: Flashing

Motion system status	LED display	Description	Remedy
Normal operation	RUN● P RUN● C RDY☐	Flashing (every 500 ms): Executing software version up	Wait until software version up is completed.
	RUN☐ P RUN■ C RDY■	Turning on: Software version up is normally completed	Reset the system, and check that the CPU module can be normally turned RUN/STOP.
Operation failure	RUN☐ P RUN● C RDY●	Flashing (every 200 ms): Software version up is completed with an error.	Turn the power of CPU module OFF and ON, or reset the system, then execute software version up again.

21.3 Boot Software Update Function

This function updates the boot software which starts up the motion system. It is used when the boot software needs to be updated due to the restrictions of the motion software.
The latest boot software can be downloaded from MITSUBISHI ELECTRIC FA Global Website.

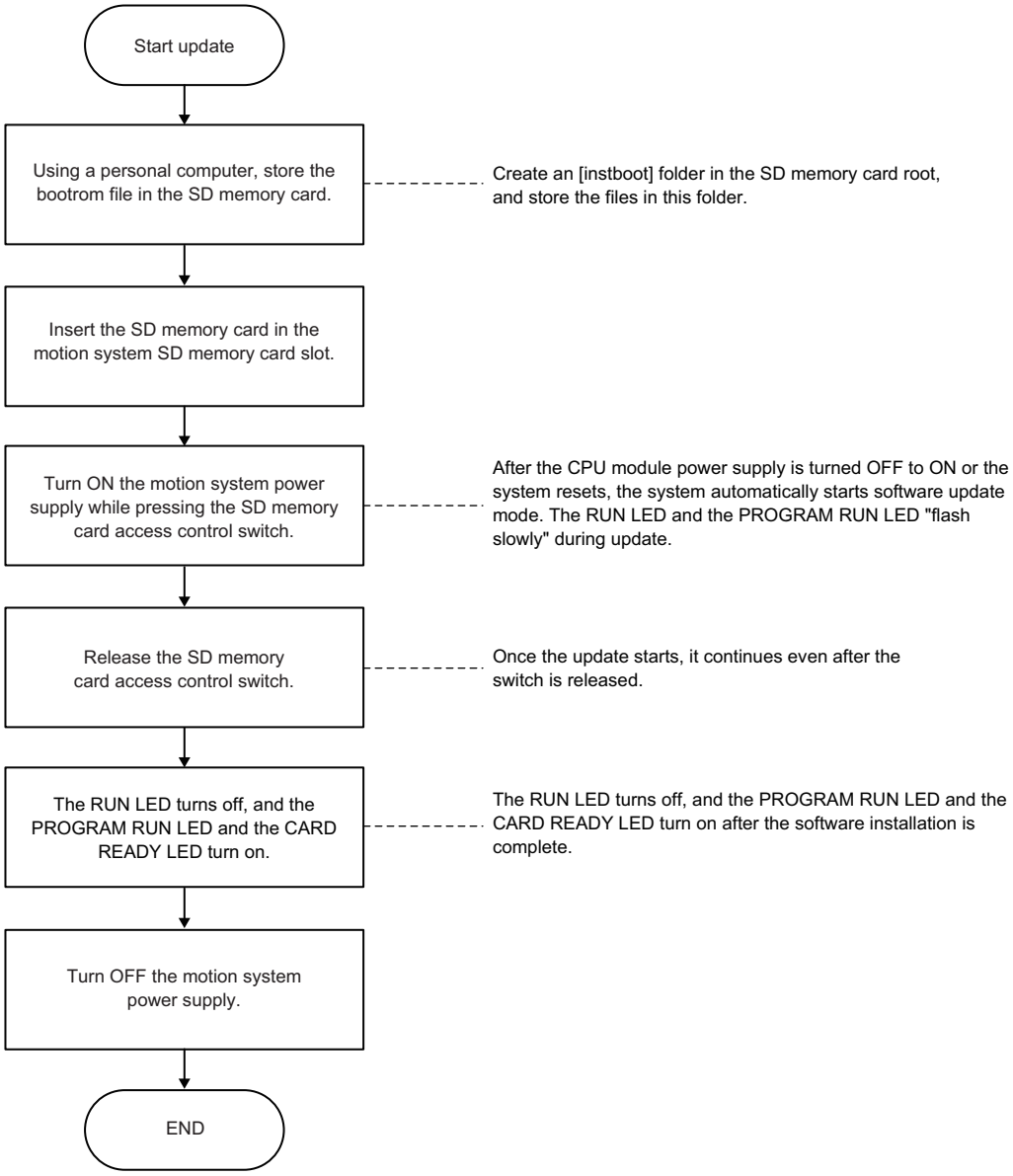
Point

- Even though update is carried out, programs, parameters, and the absolute position data written in the motion system will not be changed.
- If update processing is interrupted during updating execution by the following operation, a file which is being updated will be deleted. Execute update again.
  "Turning OFF the power of the motion system"
  "Turning RUN/STOP/RESET switch of the CPU module to RESET"
  "Removing the SD memory card (when using SD memory cards)"
- The updated software is reflected when the power is turned ON again.
- While update is executed, update operation is not accepted by the other installation method.
- Version of the boot software which is installed to the motion system can be chcked with System.Md.Version_BootSw.
- The boot software is protected by CRC. The consistency of the data is checked when turning on the power of the motion system again, then if an error is detected, the system will not start. Execute update again.

How to update the boot software

■Update procedures using the SD memory card

The following shows a procedure to update the boot software by using an SD memory card.



Point

- The boot software creates the [instboot] folder in the root of the SD memory card. Store the file in the folder.
- When the update did not complete successfully because an error was detected after update of the boot software was started, the RUN LED turns OFF, and the PROGRAM RUN LED and the CARD READY LED show "fast flashing". Update the software again after clearing the error.
  When reading the SD memory card is abnormal, check the SD memory card.
  When the boot rom file is abnormal or when it cannot be recognized, check the boot rom file.
- If the boot software updating can not be completed successfully, the RUN LED turns OFF or the ERR LED turns OFF or "fast flashing" even if the Motion module is powered ON and the Motion module maight not be recognized.
  In this case, insert a SD memory card which the boot software is stored into the slot of the Motion module and power ON the motion system while pressing the SD memory card access control switch. In that condition, release a hand from the SD memory card access control switch after the ERR LED turns "fast flashing" and the boot software can be recovered by turning OFF to ON the power of the Motion module after waiting for five minutes or longer.
- Boot software update and software installation from the SD memory card cannot be executed simultaneously. When there are both folders, boot software update is executed.
- The forced stop function of the SD memory card cannot be used during update execution from the SD memory card. Do not remove the SD memory card during update.

□: OFF, ■: ON, ●: Flashing

Motion system status	LED display	Description	Remedy
Normal operation	RUN● P RUN● C RDY□	Flashing (every 500 ms): Updating the boot rom	Wait until boot rom update is completed.
	RUN□ P RUN■ C RDY■	Boot rom update is normally completed	Reset the system, and check that the motion system can be normally turned RUN/STOP.
Operation failure	RUN□ P RUN● C RDY●	Flashing (every 200 ms): Boot rom update is completed with an error.	Turn the power of the motion system OFF to ON, or reset the system, then execute boot rom update again.

The boot software list

For the boot software list, refer to the following.

☞ 26 Bootsoftware List

22 TROUBLESHOOTING

22.1 LED Control

The status of the motion system can be checked by the following.

The LEDs equipped in the Motion module

The following lists the LED display specifications of the Motion module.

Name	Description
RUN LED	Displays the operation status. ON: Operating normally OFF: Error occurrence*1 or initializing
ERR LED	Displays the error status. ON: Error occurrence*1 Flashing (every 200 ms): Error occurrence*1 Flashing (every 500 ms): A data link faulty station is detected.
PROGRAM RUN LED	Displays the execution status of the built-in program. ON: Executing program OFF: Stopping program
CARD READY LED	Displays the status of an SD memory card. ON: SD memory card is usable Flashing: Preparing OFF: No SD memory card inserted
CARD ACCESS LED	Displays the access status of an SD memory card. ON: Accessing SD memory card OFF: Not accessing SD memory card
D LINK LED	Displays the data link status. ON: Data link (cyclic transmission being performed) Flashing: Data link (cyclic transmission stopped) OFF: Data link not performed (disconnection)
SD/RD LED	Displays the data communication status. Flashing: Communicating data OFF: Not communicating data
L ER LED	Displays the port status. ON: Abnormal data received OFF: Normal data received
LINK LED	Displays the link status. ON: Link-up OFF: Link-down

*1 Error status can be determined by status of the RUN LED and the ERR LED.

RUN LED	ERR LED	Error status	Description
OFF	ON or flickering	Major error	An error such as hardware failure or memory failure. The module stops operating.
ON	Flashing	Moderate error	An error, such as parameter error, which affects module operation. The module stops operating.
ON	ON	Minor error	An error such as communication, positioning control and program failure. The module continues operating.

When multiple errors occur, the error status is displayed in the order of major, moderate, and minor.

22.2 Checking Errors and Warnings

Errors and warnings occurred in the motion system can be checked by the following methods.

Method	Details
Event history of the engineering tool	It can be checked by the event history window of the engineering tool. For details, refer to the following. 📖GX Works3 Operating Manual
Module diagnostic of the engineering tool	It can be checked by the module diagnostic window of the engineering tool. For details, refer to the following. 📖GX Works3 Operating Manual
Motion event history of the engineering tool	It can be checked by the motion event history window of the engineering tool (Motion module setting function). For details, refer to the following. ☞ Page 531 History Data
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 CPU module can refer to these labels by the module label or the dedicated instruction.

Error types are as follows.

Error type	Description
System error	Error not related to the axis or FB such as initial failure and bus failure
Axis/Axes group error	Axis related error which is occurred where the setting value of FB input pin is illegal or in control in the FB where the Axis/AxesGroup pin exists

Relevant variables

Variable/Structure name	Name	Details
System.Md		
Warning	Motion system warning detection	Becomes TRUE at warning occurrence.
Error	Motion system error detection	Becomes TRUE at error occurrence.
NetworkError	Network error detection	Becomes TRUE at network error occurrence.
WarningID	Latest motion system warning code	Stores the latest warning code.
ErrorID	Latest motion system error code	Stores the latest error code.
NetworkErrorID	Network error code	Stores the error code at network error occurrence.
AxisName.Md		
Warning	Axis warning detection	Becomes TRUE at axis warning occurrence.
Error	Axis error detection	Becomes TRUE at axis error occurrence.
DriverError	Drive module 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 module error code	Stores the error No. at drive unit error occurrence.
AxesGroupName.Md.		
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.

Control details

The latest error code occured in motion is output in System.Md.ErrorID.

When multiple errors occur, follow the conditions below whether the error code output to System.Md.ErrorID is updated.

Occurring error	Occurred error					
System.Md.ErrorID	AxisName.Md.ErrorID/AxesGroupName.Md.ErrorID/ System.Md.ErrorID			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

Filter setting

- The warning not to be detected can be set by the filter setting in the engineering tool. The error No. cannot be set. (If set, it will be ignored.)
- When the warning which has been registered in the filter setting occurs, the warning processing is executed, however, the data is not stored in the variable.

Variable/Structure name	Name	Details
System.PrConst		
ExcludeWarning	Excluded warning	Sets the warning which is not to be detected. (Example) "": Not set Not detect the warnings of "0x1000, 0x1001": 0x1000, 0x1001. Not detect the warnings from "0x1000-0x1010": 0x1000 to 0x1010.

22.3 Error and Warning Reset

Errors and warnings occurred in the motion system can be reset by the following methods.

Data to be reset

■System error reset

• All errors/warnings

Error type	Description	Variable name
System	Motion system error detection	System.Md.Error
	Latest motion system error code	System.Md.ErrorID
	Motion system warning detection	System.Md.Warning
	Latest motion system warning code	System.Md.WarningID
	Network error detection	System.Md.NetworkError
	Network 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 module error detection	AxisName.Md.DriverError
	Drive module error code	AxisName.Md.DriverErrorID
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 module error detection	AxisName.Md.DriverError
	Drive module error code	AxisName.Md.DriveErrorID

■Axes group error reset

• Axes group error/warning

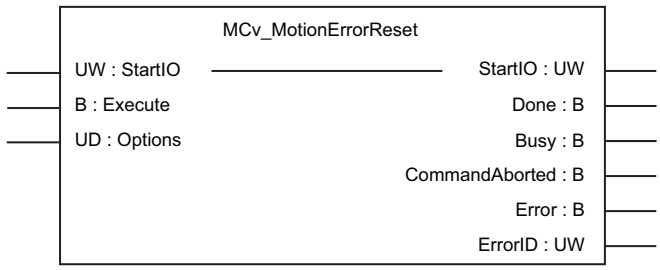
Error type	Description	Variable name
Axes group	Axes group warning detection	AxesGroupName.Md.Warning
	Axes group warning code	AxesGroupName.Md.WarningID
	Axes group error detection	AxesGroupName.Md.Error
	Axes group error code	AxesGroupName.Md.ErrorID
	Axis warning detection*1	AxisName.Md.Warning
	Axis warning code*1	AxisName.Md.WarningID
	Axis error detection*1	AxisName.Md.Error
	Axis error code*1	AxisName.Md.ErrorID
	Drive module error detection*1	AxisName.Md.DriverError
	Drive module error code*1	AxisName.Md.DriverErrorID

*1 Only axis which belongs to axes group

Relevant variables/FB

Variable/Structure name	Name	Details
System.Cd.		
ErrorReset	System error reset	Resets all errors and warnings.
AxisName.Cd.		
ErrorReset	Axis error reset	Resets axis errors/warnings and drive unit errors.
AxesGroupName.Cd.		
ErrorReset	Axes group error reset	Resets axes group errors/warnings.

MCv_MotionErrorReset

item	Description
Function overview	Resets all errors and warnings of the motion system.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
8	6	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
I/O No.	StartIO	WORD(HEX)	↑	0-FF0	Omission possible	Specifies I/O No. The setting is ignored with MCv_MotionErrorReset.

■Input variables

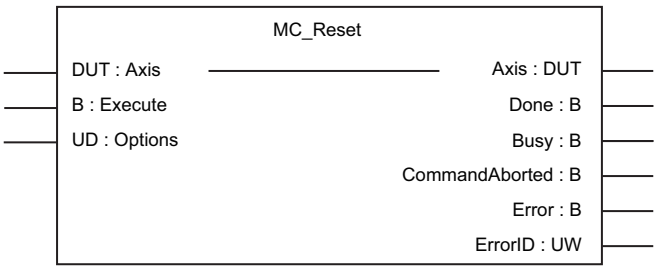
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execution command	Execute	BOOL	↑	TRUE FALSE	FALSE	Turns TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	0	00000000H	Set “0”.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that reset has been completed.
Executing	Busy	BOOL	FALSE	Iindicates that the FB is executing.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the command has been aborted because of timeout. Turns FALSE because of Execute = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.

MC_Reset

Item	Description
Function overview	Resets errors and warnings of the axis.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
16	6	Subroutine type	Real-time execution

■I/O variable

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	↑	—	Omission not possible	☞ Page 641 Axis variables

■Input variables

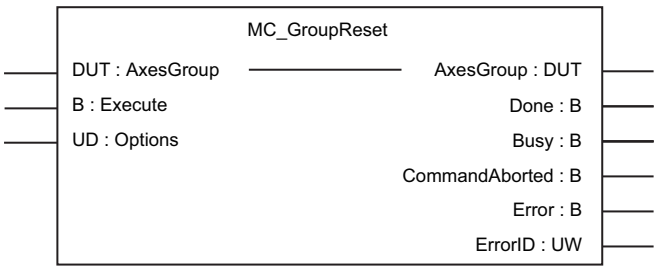
Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execution command	Execute	BOOL	↑	TRUE FALSE	FALSE	Turns TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	0	00000000H	Set “0”.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that reset has been completed.
Executing	Busy	BOOL	FALSE	Indicates that the FB is executing.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the command has been aborted because of timeout. Turns FALSE because of Execute = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
ErrorID	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.

MC_GroupReset

Item	Description
Function overview	Resets errors and warnings of the axes group and each axis under the axes group.
Symbol [Structured Ladder]	
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
16	6	Subroutine type	Real-time execution

■I/O variable

Input import↑: At start

Name	Variable name	Data type	Imput import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 648 Axes group variables

■Input variables

Import↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execute command	Execute	BOOL	↑	TRUE FALSE	FALSE	Turns TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	0	0	Set “0”.

■Output variables

Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that all axes reset of the axes group has been completed.
Executing	Busy	BOOL	FALSE	Iindicates that the FB is executing.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the command has been aborted because of timeout. Turns FALSE because of Execute = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
Error code	ErrorID	WORD(UINT)	0000H	The error code generated in the FB is returned.

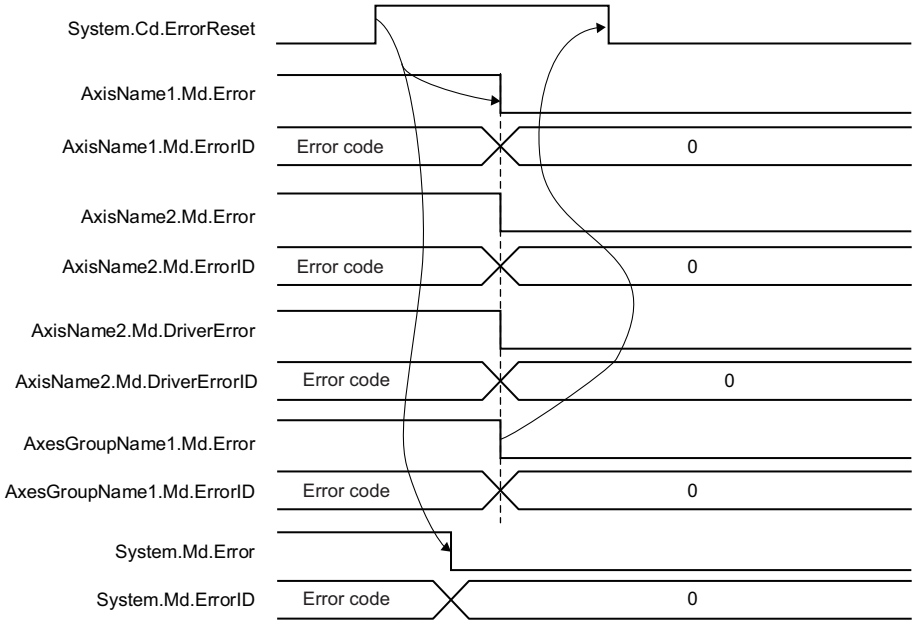
System error reset

- Reset all errors / warnings of the motion system. There are System.Cd.ErrorReset, MCv_MotionErrorReset and clear error button on the module diagnostics window of GX Works3 as a reset method. (SYSTEM.Cd.ErrorReset does not turn TRUE as the reset is performed by clear error button.)

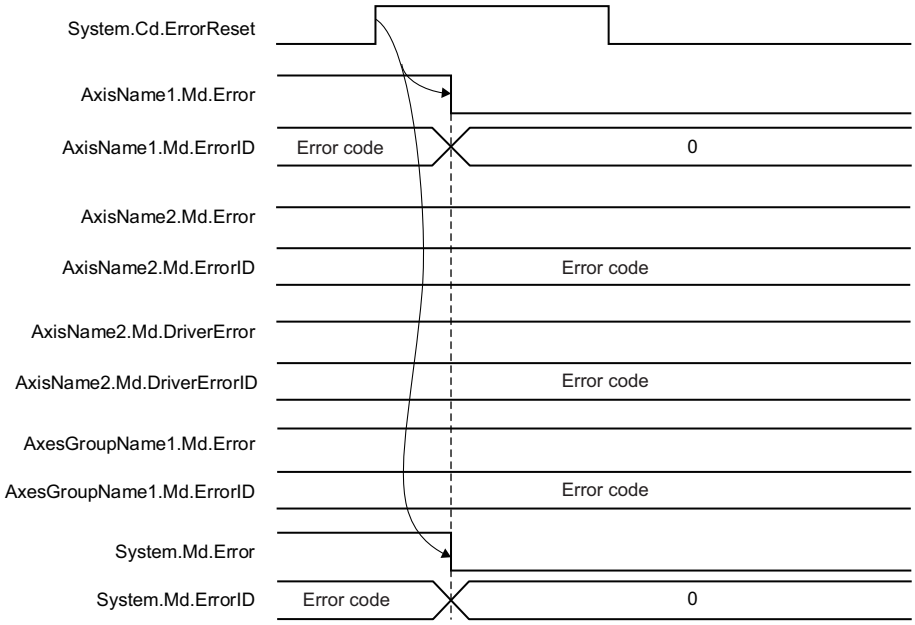
Control details

- Reset is executed at the rising edge detection of System.Cd.ErrorReset.
- When the reset is completed, System.Cd.ErrorReset becomes FALSE.
- If the error reset is not succeeded, System.Cd.ErrorReset remains TRUE.

[When the FB is normally completed] (When the error reset is succeeded)



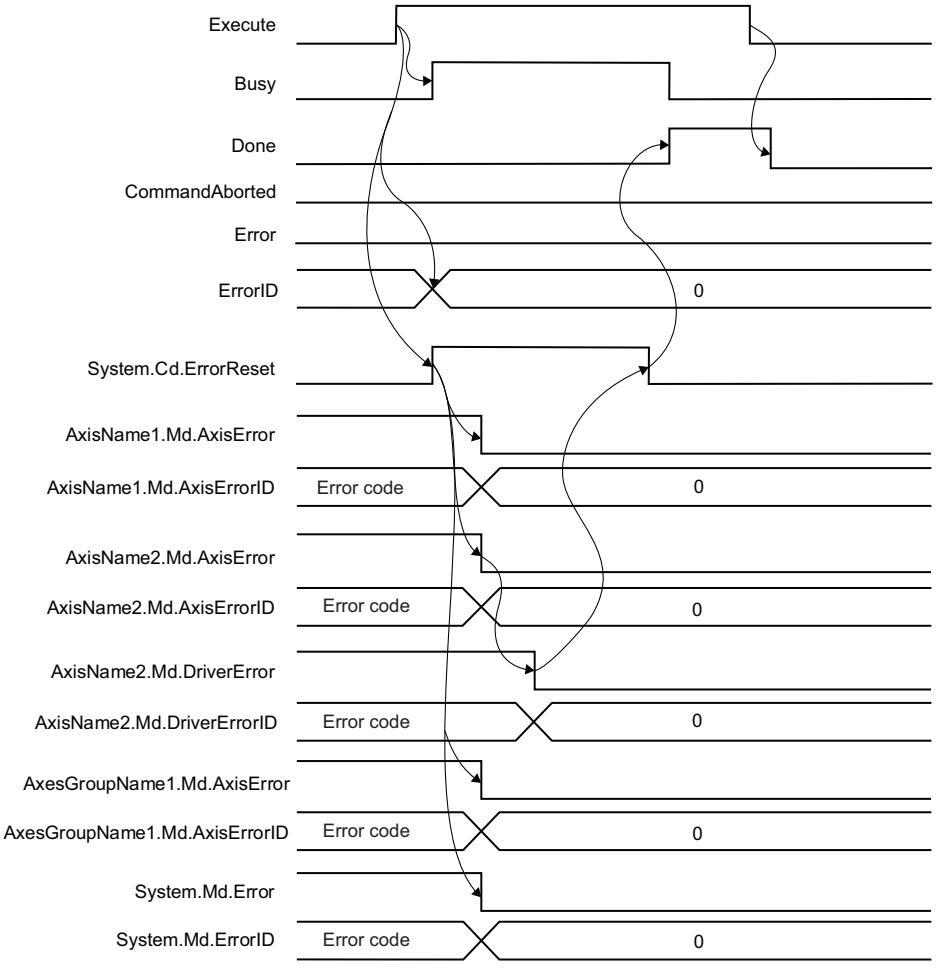
[When an error occurs] (When the error reset is failed)



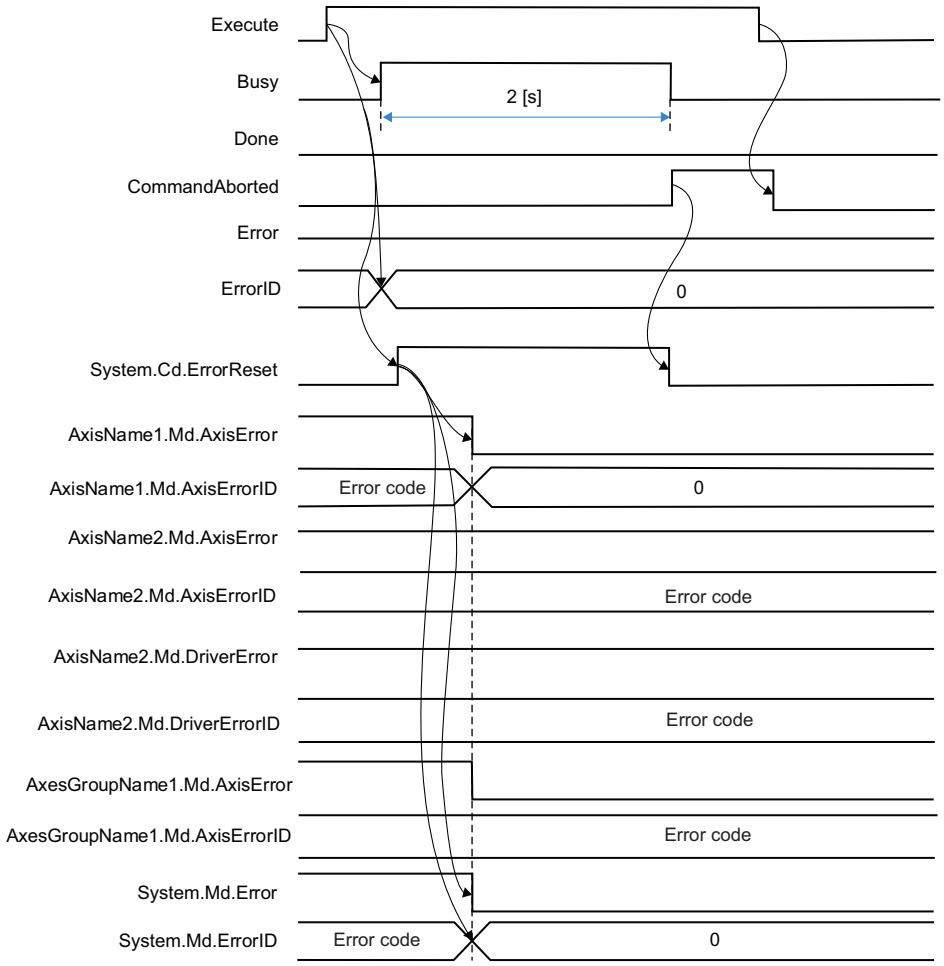
■The motion error reset

- The FB is executed with Execute = TRUE and Busy turns TRUE as the process starts, and then SYSTEM.Cd.ErrorReset turns TRUE.
- Busy turns FALSE and Done turns TRUE as clearing the errors / warnings of the Motion module is completed.
- The errors / warnings are not cleared if Execute turns TRUE while the error / warning causes still remain. In this case, CommandAborted turns TRUE and SYSTEM.Cd.ErrorReset turns FALSE if the errors are not cleared within two seconds after command executed.Turn Execute to FALSE temporarily to clear the error / warning causes and turn Execute to TRUE again.

[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate SYSTEM.Cd.ErrorReset directly while SYSTEM.Cd.ErrorReset is executed.
- Use MCv_MotionErrorReset without operating SYSTEM.Cd.ErrorReset to perform the error reset from the CPU module.

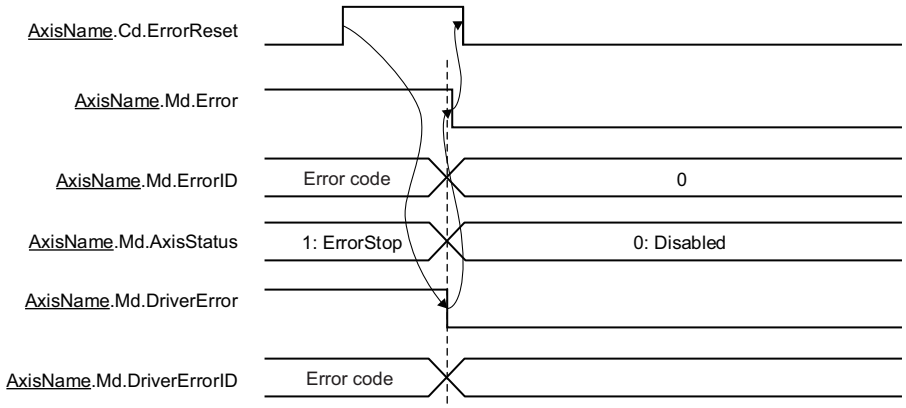
Axis error reset

Reset the error/warning of a single axis and drive unit error by AxisName.Cd.ErrorReset.

Control details

■AxisName.Cd.ErrorReset

- Reset is executed at the rising edge detection of AxisName.Cd.ErrorReset.
- When the reset is completed, AxisName.Cd.ErrorReset becomes FALSE.
- If the error reset is not succeeded, AxisName.Cd.ErrorReset remains TRUE.

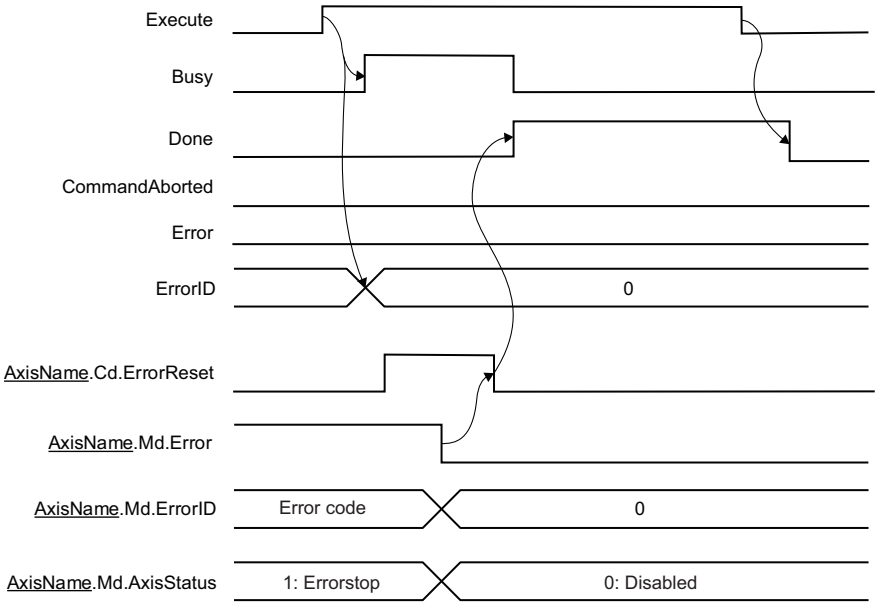


■MC_Reset

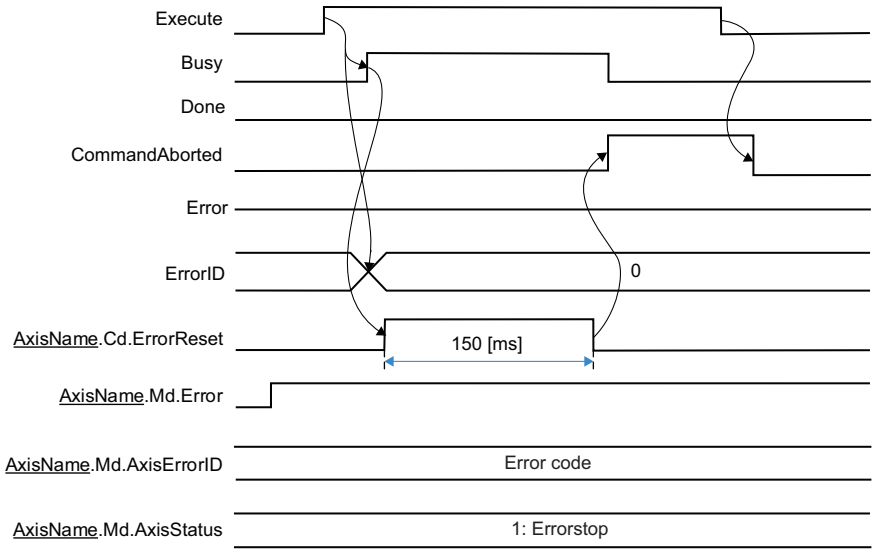
- The FB is executed with Execute = TRUE and Busy turns TRUE as the process starts, and then turn TRUE AxisName.Cd.ErrorReset of the target axis.
- Busy turns FALSE and Done turns TRUE as clearing the errors / warnings of the axis is completed.
- Busy turns FALSE and Done turns TRUE after the warnings are cleared if execution is carried out as the axis status is not ErrorStop.
- The errors / warnings are not cleared if Execute turns TRUE while the error / warning causes of the axis still remain. In this case, CommandAborted turns TRUE. Turn Execute to FALSE temporarily to clear the error / warning causes and turn Execute to TRUE again.
- Error is turned to TRUE and the error code is stored in ErrorID if the error occurs in the FB. For details of error codes, refer to the following.

☞ Page 584 TROUBLESHOOTING

[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate AxisName.Cd.ErrorReset directly while MC_Reset is executed.
- Use MC_Reset without operating AxisName.Cd.ErrorReset to perform the error reset from the CPU module.

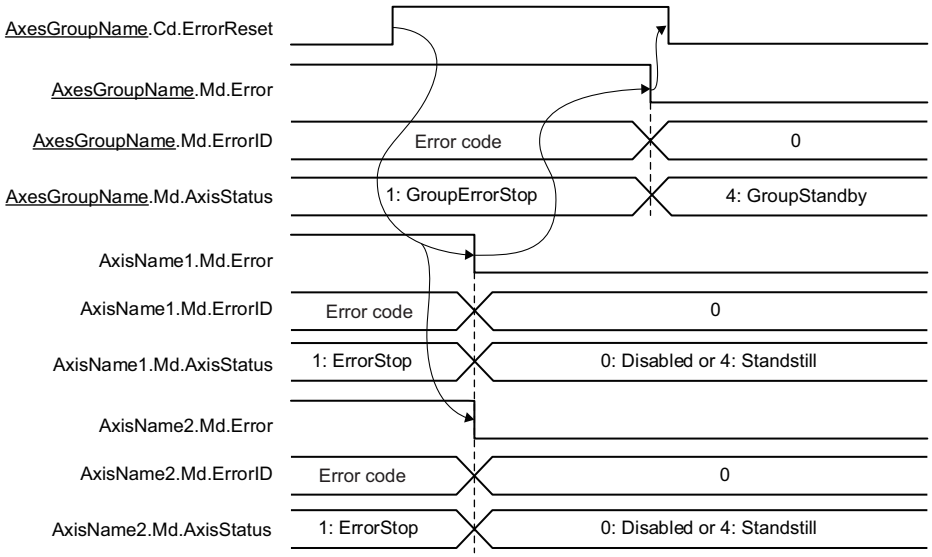
Axes group error reset

Reset the error/warning of the axes group by AxesGroupName.Cd.ErrorReset.
Reset also each axis error which belongs to the axes group in addition to the error/warning of the axes group.

Control details

■AxesGroupName.Cd.ErrorReset

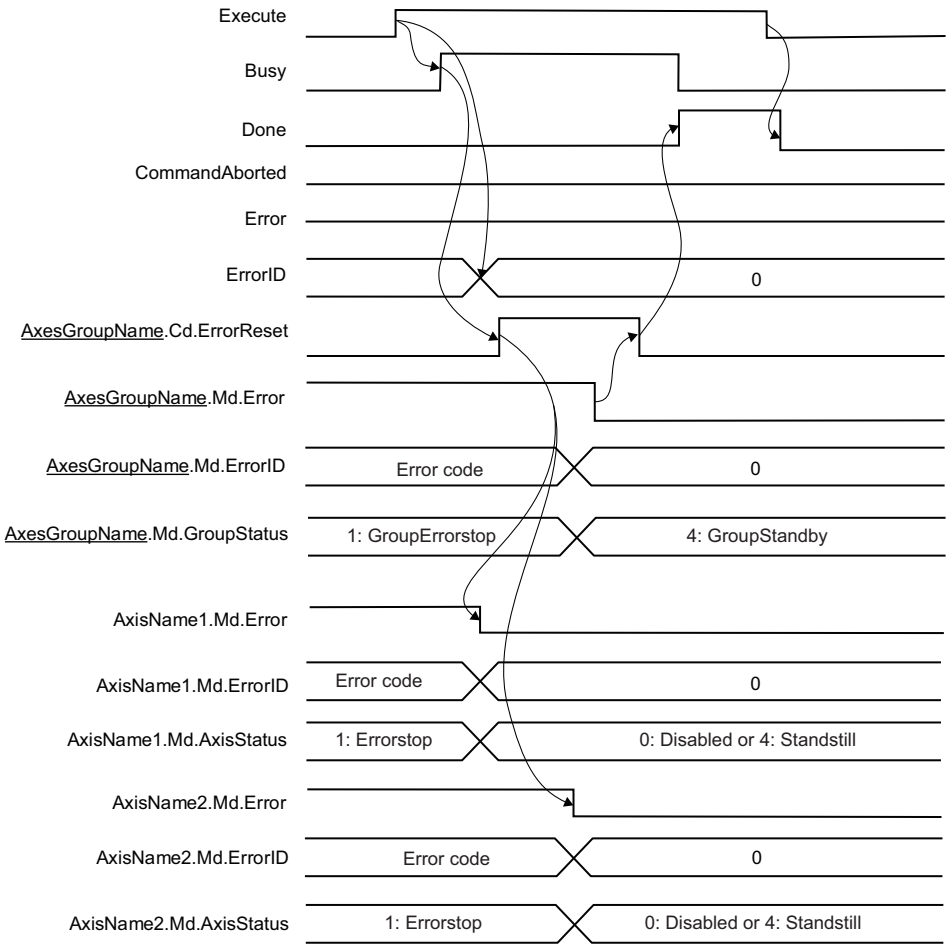
- Reset is executed at the rising edge detection of AxesGroupName.Cd.ErrorReset.
- When the reset is completed, AxesGroupName.Cd.ErrorReset becomes FALSE.
- When the error reset of the configuration axis is not completed, the error reset of the axes group is not completed.
- If the error reset is not succeeded, AxesGroupName.Cd.ErrorReset remains TRUE.
- The error reset can be canceled by changing AxesGroupName.Cd.ErrorReset to FALSE.



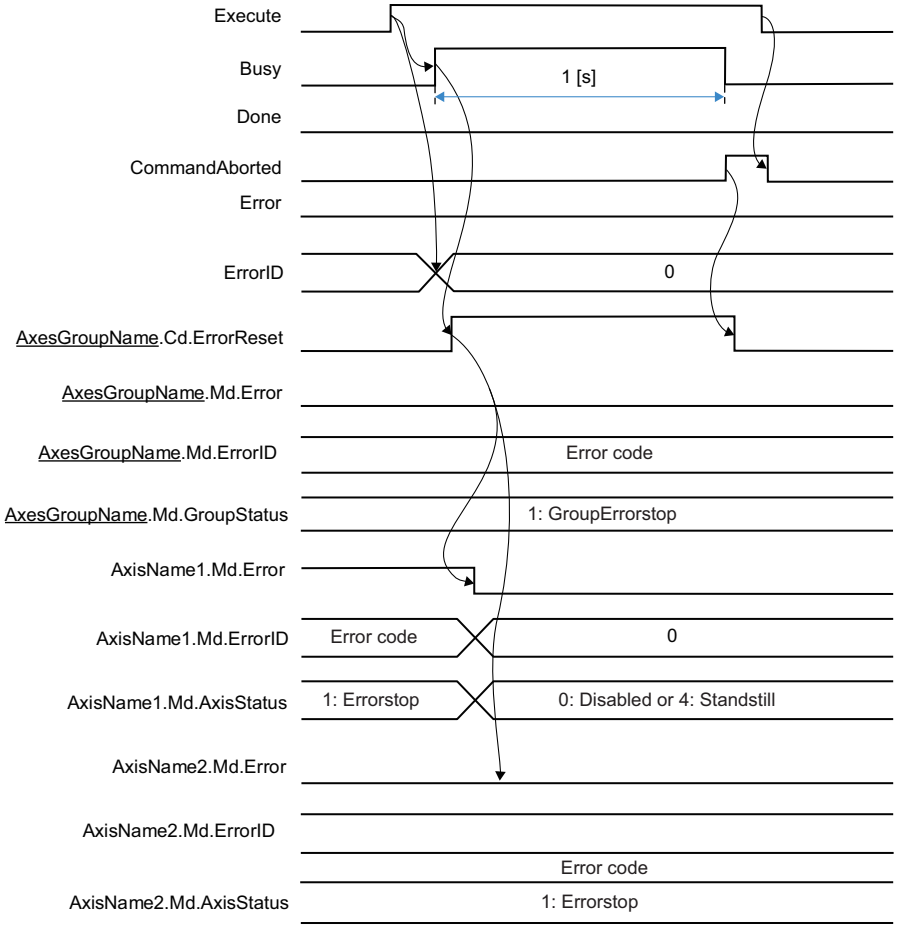
■MC_GroupReset

- The FB is executed at detecting a rising Execute and Busy turns TRUE as the process starts, and then turn TRUE AxesGroupName.Cd.ErrorReset of the target axes group.
- Busy turns FALSE and Done turns TRUE as clearing the errors / warnings of the axis and the axes group is completed.
- Busy turns FALSE and Done turns TRUE after the warnings are cleared if execution is carried out as the axes group status is not "1: GroupErrorStop".
- The errors / warnings are not cleared if Execute turns TRUE while the error / warning causes still remain. In this case, CommandAborted turns TRUE and turns FALSE AxesGroupName.Cd.ErrorReset of the target axes group if the errors are not cleared within a second after command executed. Turn Execute to FALSE temporarily to clear the error / warning causes and turn Execute to TRUE again.
- Error is turned to TRUE and the error code is stored in ErrorID if the error occurs in the FB. For details of error codes, refer to the following.
  ☞ Page 584 TROUBLESHOOTING

[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate AxesGroupName.Cd.ErrorReset directly while MC_GroupReset is executed.
- Use MC_GroupReset without operating AxesGroupName.Cd.ErrorReset to perform the error reset from the CPU module.

22.4 List of Warning Codes

Warning code (Hexadecimal)	Error (System/ axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/ during control	Operation at warning occurrence	Remedy
0D00H	Axis	Absolute Position Data Incorrect Warning	• Absolute position data is incorrect at current position restoration for the following causes. • Axis type was changed. • Absolute position data is erased. • The homing request has been TRUE at backup. • Driver unit conversion of the axis (numerator/denominator) was changed. • Machine homing was started, but not completed properly. [Real drive axis only] • 'Absolute positionerase'for driver was detected. • 'Polarity(607Eh)' b7:position polarity of driver object was changed. • 'HomeOffset(607Ch)' of the driver object was changed. • The connected driver device was changed. • The encoder resolution of connected driver device was changed. [Real encoder axis (via drive module) only] • 'Absolute position erase' at scale measurement encoder was detected. • The encoder resolution of scale measurement encoder was changed.	During control	The current position is restored with the same content as the incremental system, and the homing request turns TRUE.	Please execute homing.
0D01H	Axis	Start during Operation Warning	Instruction that cannot start during operation was executed.	During control	Not start after the execution of FB is interrupted.	Start when axis is Standstill.
0D02H	Axis	JOG Command Input at Both Directions Warning	JogForward and JogBackward became TRUE at the same time.	At start During control	• [At start] Not start after the execution of FB is interrupted. • [During control] Decelerates and continues stop/wait until the other JOG command becomes FALSE.	Set it so that JogForward and JogBackward do not become TRUE at the same time.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control	Operation at warning occurrence	Remedy
0D03H	Axis/Axes group	Speed Limit Value Over Warning	The target velocity exceeded the following when changing velocity/velocity override coefficient. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative • AxesGroupName.Pr.VelocityLimit The set velocity exceeded the following when AxisName.Pr.VelocityLimit_Over Operation is 0:Ignore. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative	At control change During control	[At control change]Continues the operation at the previous speed. [During control] Continues the operation over the speed limit.	[At control change]Set the target velocitywithin the following. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative • AxesGroupName.Pr.VelocityLimit [Controlling] Set the velocity within the following. • AxisName.Pr.VelocityLimit_Positive • AxisName.Pr.VelocityLimit_Negative
0D04H	Axis/Axes group	Acceleration Time Limit Over Warning	Acceleration time exceeded 8400 seconds when changing speed/acceleration (acceleration/deceleration time)/speed override coefficient/acceleration override coefficient.	During control	Continues the operation at the previous speed/acceleration (acceleration/deceleration time).	Set the speed/acceleration (acceleration/deceleration time)/speed override coefficient/acceleration override coefficient so that the acceleration time will not exceed 8400 seconds.
0D05H	Axis/Axes group	Deceleration Time Limit Over Warning	Deceleration time exceeded 8400 seconds when changing speed/deceleration (acceleration/deceleration time)/speed override coefficient/acceleration override coefficient.	During control	Continues the operation at the previous speed/acceleration (acceleration/deceleration time).	Set the speed/deceleration (acceleration/deceleration time)/speed override coefficient/acceleration override coefficient so that the deceleration time will not exceed 8400 seconds.
0D06H	Axis/Axes group	Acceleration Limit Value Over Warning	• Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing [Acceleration/deceleration specification method] acceleration/acceleration override coefficient. • Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing [Acceleration/deceleration time fixed method] speed/acceleration/deceleration time/speed override coefficient/acceleration override coefficient.	During control	• [Acceleration/deceleration specifying method] Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing acceleration/acceleration override coefficient. • [Time-fixed acceleration/deceleration method] Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing velocity/acceleration/deceleration time/velocity override coefficient/acceleration override coefficient.	Set target acceleration so that it does not exceed AxisName(AxesGroupName).Pr.AccelerationLimit.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control	Operation at warning occurrence	Remedy
0D07H	Axis/Axes group	Deceleration Limit Value Over Warning	• Target deceleration exceeded AxisName(AxesGroupName).Pr.DecelerationLimit when changing [Acceleration/deceleration specification method] deceleration/acceleration override coefficient. • Target deceleration exceeded AxisName(AxesGroupName).Pr.DecelerationLimit when changing [Acceleration/deceleration time fixed method] speed/acceleration/deceleration time/speed override coefficient/acceleration override coefficient.	During control	• [Acceleration/deceleration specifying method] Target deceleration exceeded AxisName(AxesGroupName).Pr.DecelerationLimit when changing deceleration/acceleration override coefficient. • [Time-fixed acceleration/deceleration method] Target deceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit when changing velocity/acceleration/deceleration time/velocity override coefficient/acceleration override coefficient.	Set target deceleration so that it does not exceed AxisName(AxesGroupName).Pr.DecelerationLimit.
0D08H	Axes group	Position Command Unit Mismatch Warning	Different values have been set to AxisName(AxesGroupName).Pr.Unit_Position for axes group and interpolation axis.	At start / At multiple start	—	Set the same value to AxisName(AxesGroupName).Pr.Unit_Position for axes group and interpolation axis.
0D09H	Axis	Out of Forward Direction Torque Limit Value Specification Range Warning	The value is out of range for AxisName.Cd.TorqueLimit_Positive.	During control	Continues the operation by the previous torque limit value.	Set AxisName.Cd.TorqueLimit_Positive within the range.
0D0AH	Axis	Out of Reverse Direction Torque Limit Value Specification Range Warning	The value is out of range for AxisName.Cd.TorqueLimit_Negative.	During control	Continues the operation by the previous torque limit value.	Set AxisName.Cd.TorqueLimit_Negative within the range.
0D0BH	Axis/Axes group	Out of Speed Override Coefficient Range Warning	The value is out of range for AxisName(AxesGroupName).Cd.VelocityOverride.	During control	Continues the operation with the previous value.	Set AxisName(AxesGroupName).Cd.VelocityOverride within the range.
0D0CH	Axis/Axes group	Out of Acceleration Override Coefficient Range Warning	The value is out of range for AxisName(AxesGroupName).Cd.AccelerationOverride.	During control	Continues the operation with the previous value.	Set AxisName(AxesGroupName).Cd.AccelerationOverride within the range.
0D0DH	Axis/Axes group	Out of Position/Distance Setting Range Warning	The value is out of range for Position/Distance.	At control change	Continues the operation with the previous Position/Distance.	Set Position/Distance within the range.
0D0FH	Axis/Axes group	Out of Speed Range Warning	The value is out of range for Velocity.	During control	Continues the operation by the previous speed.	Set Velocity within the range.
0D10H	Axis/Axes group	Overrun Warning	Target position turned overrun because the deceleration distance for command output speed 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	During control / When switching by multiple start	Stops immediately.	Set Velocity, Position/Distance and Deceleration so that an overrun will not occur.

Warning code (Hexadecimal)	Error (System/ axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/ during control	Operation at warning occurrence	Remedy
0D11H	Axis/Axes group	Multiple Start Speed Mode Specified Mismatch Warning	The "VelocityMode of executing FB is different from that of multi-started FB.	At multiple start	Operates by "VelocityMode" of each FB.	Set the VelocityModeof executing FB same as that of multi-started FB.
0D12H	Axis	Torque Limit Value Over Warning	Torque was changed to the larger value than AxisName.Md.TorqueLimit_Positive or AxisName.Md.TorqueLimit_Negative.	At control change	Continues the operation by the previous target torque.	Set Torque within the following. • AxisName.Md.TorqueLimit_Positive • AxisName.Md.TorqueLimit_Negative
0D13H	Axis	Filter Cumulated Value Over Warning	Filter cumulated value exceeded the positioning range.	During control	Filter cumulated value is clamped at the positioning range, and continues the operation.	Please reduce Masterspeed.
0D14H	Axis	Current Position Change Axis Status Incorrect Warning	The axis status is not Standstill for the torque input signal detection by executing MCv_SetPositionTriggered.	During control	Current position change is not executed.	Input the torque input signal when the axis status is Standstill.
0D15H	Axis	Current Position Change Execution Disabled Warning	An error occurred when changing the current position.	At start During control	Current position change is not executed.	Check the setting for MC_SetPosition and MCv_SetPositionTriggered.
0D16H	Axis	Out of Torque Setting Range Warning	The value is out of range for Torque.	At control change	Continues the operation by the previous target torque.	Set Torque within the range.
0D17H	Axis/Axes group	Out of Acceleration Range Warning	The value is out of range for Acceleration.	During control	Continues the operation by the previous acceleration.	Set Acceleration within the range.
0D18H	Axis/Axes group	Out of Deceleration Range Warning	The value is out of range for Deceleration.	During control	Continues the operation by the previous deceleration.	Set Deceleration within the range.
0D19H	Axis/Axes group	Out of Acceleration/ Deceleration Time Range Warning	The value is out of range for Acceleration.	During control	Continues the operation by the previous acceleration/ deceleration time.	Set Acceleration within the range.
0D1BH	Axis	Out of Limit Speed Range Warning	The value is out of range for LimitVelocity.	At control change	Continues the operation by the previous limit velocity.	Set LimitVelocity within the range.
0D1CH	Axis	Out of Torque Forward Direction Ramp Range Warning	The value is out of range for TorquePositiveRamp.	At control change	Continues the operation by the previous torque forward direction ramp.	Set TorquePositiveRamp within the range.
0D1DH	Axis	Out of Torque Reverse Direction Ramp Range Warning	The value is out of range for "TorqueNegativeRamp".	At control change	Continues the operation by the previous torque reverse direction ramp.	Set "TorqueNegativeRamp" within the range.
0D1EH	Axes group	Speed Command Unit Mismatch Warning	Executing FB is different from the speed command unit.	At multiple start	—	Set the same value to AxisName(AxesGroupName).Pr.Unit_Velocity for axes group and interpolation axis.
0D1FH	Axis	Driver Warning	Warning occurred in the driver.	During operation	Executes the operation.	Please check the error details and corrective actions according to the content of AxisName.Md.DriverErrorID. (Please refer to the instruction manual of each driver for details of AxisName.Md.DriverErrorID.)
0D20H	Axis	Out of Speed Range during Direction Change Warning	The value is out of movement direction range for Velocity when accelerating again from speed 0 on direction change.	During control	Continues the operation with speed 0.	Set Velocity within the range.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control	Operation at warning occurrence	Remedy
0D21H	Axis	Out of Final Speed Range during Operation Warning	The value is out of range for EndVelocity when changing to the final target speed.	During control	Continues the operation with the last speed.	Set EndVelocity within the range.
0D22H	Axis/Axes group	Warning Starting over Number of Buffering FBs	The maximum number of FBs which can be buffered has been exceeded with multiple start.	At multiple start	Waits analysis of the buffering FB until on-going FB is completed.	Multiple start is executed so that the maximum number of FBs which can be buffered has not been exceeded.
0D23H	Axis	Warning Changing Torque Limit Value to Axis not yet Started	The torque limit value change request was made to the axis not yet started.	At control change	The torque limit value is not sent to the driver.	Please make the torque limit value change request to the started axis.
0D24H	Axis	Out of FilterTime Setting Range of Each Axis Signal Warning	The value is out of range for FilterTime.	At power ON At ready ON	Continues the operation with "FilterTime"0.	Set a value within the range for FilterTime.
0D29H	Axis	Out of Denominator Range at Control Change Warning	The value is out of range for RatioDenominator.	At control change	Continues the operation with the previous gear ratio.	Set RatioDenominator within the range.
0D2CH	Axis/Axes group	Out of Jerk Override Coefficient Range Warning	The value is out of range for AxisName(AxesGroupName).Cd.JerkOverride.	During control	Continues the operation with the previous value.	Set AxisName(AxesGroupName).Cd.JerkOverride within the range.
0D2DH	Axis/Axes group	Out of Position Command Unit Range Warning	The value is out of range for AxisName(AxesGroupName).Pr.Unit_Position.	At power ON At ready ON	Operates as "pulse".	Set AxisName(AxesGroupName).Pr.Unit_Position within the range.
0D2EH	Axis/Axes group	Out of Speed Command UnitRange Warning	The value is out of range for AxisName(AxesGroupName).Pr.Unit_Velocity.	At power ON At ready ON	Operates as "s".	Set AxisName(AxesGroupName).Pr.Unit_Velocity within the range.
0D2FH	Axis/Axes group	Out of Calculation Cycle Converted Speed Range Warning	The speed converted from Velocity by calculation cycle is out of the range.	During control	Continues the operation with the previous speed.	Set Velocity so that the speed converted by calculation cycle is within the range.
0D30H	Axis/Axes group	Out of Deceleration Range at Stop Warning	The value was out of range for AxisName(AxesGroupName).Pr.StopMode_Deceleration or System.Pr.StopMode_AllDeceleration when factors that cause a stop occurred.	During control	• [At the upper limit value and value outside] Decelerates and stops at the upper limit value. • [At the lower limit value and value outside] Stop immediately.	Set AxisName(AxesGroupName).Pr.StopMode_Deceleration or System.Pr.StopMode_AllDeceleration within the range.
0F00H	System	Soft Reboot Disabled Warning	Soft reboot was executed when System.PrConst.SoftReboot_Enable is Disabled.	When executing software reboot	Not execute soft reboot.	Set System.PrConst.SoftRebootEnable as Enabled.
0F01H	System	Log File Create Disabled Warning	An error has been detected when updating log file.	When executing file transfer function	The log file is not created.	• Delete unnecessary files and secure free capacity. • Format the target drive. • Delete log files.
0F02H	System	File Error	• The parameter content is broken. • Major version is unsupported.	When importing file	The file is not imported.	Please check the detailed information (parameter information) and parameter settings.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control	Operation at warning occurrence	Remedy
0F03H	System	Position Data History Update Disabled Warning	• An error was detected when updating position data history. • The memory capacity of addon MotionEventHist is insufficient.	When updating positioning data history file	The position data history is not updated.	• Delete unnecessary files and secure free capacity. • Format the target drive. • Delete position data history. • Please check the memory capacity of addon MotionEventHist.
0F04H	System	File Transfer Command Acquisition Disabled Warning	Failed to get address of System.Cd.FileTransfer_Command.	At system start	Cannot execute the file transfer of the command label.	Start the system again.
0F05H	System	Event Filter Set Failed Warning	• Addon MotionEventHist is disabled. • The memory capacity of addon MotionEventHist is insufficient.	When updating filter setting	Continues the operation by the disabled filter setting.	• Enable addon MotionEventHist. • Please check the memory capacity of addon MotionEventHist.
0F06H	System	File Transfer Parameter Import Failed Warning	• Failed to access to FRAM area. • The compatibility does not exist in the version of file transfer parameter. • The CRC value of file transfer parameter is abnormal.	At system start	"System.PrConst.FileTransfer_LogCapacity"=0, and continues the operation by disabled read/write (0×0000) of other acess control.	Start the system again.
0F07H	System	Event History Parameter Incorrect Warning	The value is out of range for System.PrConst.EventHistoryMotion_Path or System.PrConst.EventHistoryMotion_Capacity.	At system start	Operates by the label default value.	Set System.PrConst.EventHistoryMotion_Path and System.PrConst.EventHistoryMotion_Capacity within the range.
0F08H	System	Cycle Over Warning	Arithmetic processing or other fixed scan processing is not completed within the set cycle.	During operation	Continues the operation.	• Change the fixed scan interval setting of fixed scan execution type program to a larger value. • Change the following to larger values. • System.PrConst.SystemBaseCycle.Cycle • System.PrConst.OperationCycle[1].Cycle • System.PrConst.OperationCycle[2].Cycle • System.PrConst.OperationCycle[3].Cycle • System.PrConst.Buffermemory_RefreshCycle.Cycle
0F09H	System	File Transfer Execution Request Acquisition Disabled Warning	Failed to get address of System.Cd.FileTransfer_Execute.	At system start	Cannot execute the file transfer of the command label.	Start the system again.
0F0AH	System	File Transfer Execution State Update Disabled Warning	Failed to get address of System.Md.FileTransfer_State.	At system start	Cannot execute the file transfer of the command label.	Start the system again.
0F0BH	Axis	Maximum Setting Axis Number Over Warning	The axis setting which exceeded the maximum control axis number exists.	At ready ON	The axis which is greater than the mazimum setting axis number is not recognized as the axis. (Md is not updated)	Set the number of setting axis within the maximum number of control axis.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control	Operation at warning occurrence	Remedy
0F0CH	System	Warning Filter Set Failed Warning	• Addon MotionEventHist is disabled. • The memory capacity of addon MotionEventHist is insufficient.	At ready ON	Continues the operation by disabling the filter set.	• Enable addon MotionEventHist. • Please check the memory capacity of addon MotionEventHist.
0F0DH	System	Program Setting Import Disabled Warning	Failed to import the program setting.	At ready ON	The program setting is not imported.	Please write the project to user root path.
0F0EH	System	Module Extended P]arameter Storage Target Warning	The project content of the storage target different from module extended parameter storage target setting was changed.	At system start	The written module extended parameter is not enabled.	Please check the module extended parameter storage target setting.
0F0FH	System	Out of FilterTime Setting Range of System Signal Warning	The value is out of range for FilterTime.	At ready ON	Continues the operation by the FillterTime = 0.	Set FilterTime within the range.

*1 Note that the setting range of the upper limit value/lower limit value differs depending on the setting value of "AxisName.PrConst.RingCount_Enable".

22.5 List of Error Codes

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1080H	System	Writing to Flash ROM Count Error	The number of writes to the flash ROM has exceeded 100000.	At module start	Not execute the writes to the flash ROM.	Please replace the module.
1800H	System	SDO Communication Error	An error occurred in the SDO communication.	During FB execution	The Error of FB turns ON, and the error code of SDO is output to SDOErrorID.	Remove error factors according to the SDO error code
1A00H	Axis	Software Stroke Limit Over (Target Position)	Value which is out of range of software stroke limit was set in target position.	At start	Not start.	Set the target position within the range of software stroke limit.
1A01H	Axis	Software Stroke Limit Over (Start Position)	• It was started in the position which is out of range of software stroke limit. • It was started in the position out of the range of software stroke limit to the direction where recovery is disabled.	At start	Not start.	Set ONLY_INSIDE or DISABLE to AxisName.Cd.SwStrokeLimit_Override and move to the enabled range.
1A02H	Axis	Start when Software Stroke Limit is Valid	It was started except when AxisName.Pr.SwStrokeLimit_Target is invalid.	At start	Not start.	Set invalid for AxisName.Pr.SwStrokeLimit_Target.
1A03H	Axis	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.	During control	Stops.	Move inside the range of software stroke limit range.
1A04H	Axis	Software Stroke Limit Over (Reverse Direction)	The value specified for AxisName.Pr.SwStrokeLimit_Target during control to reverse direction would result in a move outside the software stroke limit range.	During control	Stops.	Move inside the range of software stroke limit range.
1A05H	Axis/Axes group	Out of Target Position Range	The value is out of range for Position/Distance.	At start	Not start.	Set Position and Distance within the range.
1A06H	Axis	Out of Limit Speed Range	The value is out of range for LimitVelocity.	At start	Not start.	Set LimitVelocity within the range.
1A07H	Axis/Axes group	Speed Limit Value Over	• Target velocity exceeds AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative. • Target velocity exceeds AxesGroupName.Pr.VelocityLimit.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	• Set target velocity so that it does not exceed AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative. • Set target velocity so that it does not exceed AxesGroupName.Pr.VelocityLimit.
1A08H	Axis	Out of Positive Direction Speed Limit Value Setting Range	The value is out of range for AxisName.Pr.VelocityLimit_Positive.	At start	Not start.	Set AxisName.Pr.VelocityLimit_Positive within the range.
1A09H	Axis	Out of Reverse Direction Speed Limit Value Setting Range	The value is out of range for AxisName.Pr.VelocityLimit_Negative.	At start	Not start.	Set AxisName.Pr.VelocityLimit_Negative within the range.
1A0AH	Axis	Out of Operation Setting Range at Speed Limit Value Over	The value is out of range for AxisName.Pr.VelocityLimit_OverOperation.	At start	Not start.	Set AxisName.Pr.VelocityLimit_OverOperation within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1A0BH	Axes group	Out of Speed Limit Value Range (Axes Group)	The value is out of range for AxesGroupName.Pr.VelocityLimit.	At start	Not start.	Set AxesGroupName.Pr.VelocityLimit within the range.
1A0CH	Axis/Axes group	Acceleration/ Deceleration 0 Specified Operation Error at Start	Started after setting AxisName(AxesGroupName).Pr.AccelerationZeroBehavior to -1: ACCError with Acceleration or Deceleration 0.	At start	Not start.	Make settings so that Acceleration and Deceleration do not become 0.
1A0DH	Axis/Axes group	Out of Acceleration/ Deceleration Time Range	Acceleration was out of range when using the time-fixed acceleration/deceleration method.	At start	Not start.	Set Acceleration within the range.
1A0EH	Axis/Axes group	Acceleration/ Deceleration Method Mismatched	The acceleration/deceleration method of executing FB is different from that of multiple start FB.	At multiple start	Stops the operation.	Set the acceleration/ deceleration method of executing FB same as that of multiple start FB.
1A0FH	Axis	Acceleration Time Over at Start	Acceleration time exceeded 8400 seconds.	At start	Not start.	Set target speed/target acceleration/target deceleration/target jerk so that acceleration time does not exceed 8400 seconds.
1A10H	Axis	Deceleration Time Over at Start	Deceleration time exceeded 8400 seconds.	At start	Not start.	Set target speed/target acceleration/target deceleration/target jerk so that deceleration time does not exceed 8400 seconds.
1A11H	Axis	Out of Acceleration Range	The value is out of range for Acceleration.	At start	Not start.	Set Acceleration within the range.
1A12H	Axis	Out of Deceleration Range	The value is out of range for Deceleration.	At start	Not start.	Set Deceleration within the range.
1A13H	Axis/Axes group	Out of Jerk Range	The value is out of range for Jerk.	At start	Not start.	Set Jerk within the range.
1A17H	Axis	Set Velocity of Converted Driver Velocity Unit out of Range	The set velocity of converted driver velocity unit was out of the range from -2147483648 to 2147483647.	At start	Not start.	Set the velocity of converted driver velocity unit within the setting range.
1A18H	Axis	Out of Speed Initial Value Selection Range	The value is out of range for speed initial value selection of Options.	At start	Not start.	Set speed initial value selection of Options within the range.
1A19H	Axis	Out of Driver Unit Conversion Numerator/ Denominator Range	The value is out of range for driver unit conversion numerator/ denominator.	At start	Not start.	Set driver unit conversion numerator/ denominator within the setting range.
1A1BH	Axis	csv Unsupported Driver	The driver does not support csv.	At start	Not start.	Execute the instruction in the driver supporting csv.
1A1CH	Axis	cst Unsupported Driver	The driver does not support cst.	At start	Not start.	Execute the instruction in the driver supporting cst.
1A1DH	Axis	Control Mode Switching Error	Driver control mode switching did not complete within 1 second after control mode switching command had been issued. During communication initialization, driver control mode did not switch to csp.	During control During initial	Stops. Not to connect with driver.	Please check whether error occurred or the setting is incorrect, and take necessary actions.
1A1EH	Axis	Out of Target Torque Range	The value is out of range for Torque.	At start	Not start.	Set Torque within the range.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1A1FH	Axis	Out of Torque Positive Direction Ramp Range	The value is out of range for TorquePositiveRamp.	At start	Not start.	Set TorquePositiveRamp within the range.
1A20H	Axis	Out of Torque Negative Direction Ramp Range	The value is out of range for TorqueNegativeRamp.	At start	Not start.	Set TorqueNegativeRamp within the range.
1A22H	Axis	Start during homing Incomplete	The positioning was started when homing request flag is on.	At start	Not start.	Start the operation after executing homing.
1A26H	Axis	Axis Status Incorrect Start	The axis is started in the status except when AxisName.Md.AxisStatus is Standstill.	At start	Not start.	Start the axis when AxisName.Md.AxisStatus is Standstill.
1A27H	Axes group	Axes Group Status Incorrect Start	The axes group was started when AxesGroupName.Md.AxesGroupStatus was other than GroupStandby.	At start	Not start.	Start the axes group operation when AxesGroupName.Md.AxesGroupStatus is GroupStandby.
1A28H	Axis	Out of Phase Compensation Advance Time Range	The value is out of range for Time.	At start	Not start.	Set a value within the range for Time.
1A29H	Axis	Out of Phase Compensation Time Constant Range	The value is out of range for TimeConstant.	At start	Not start.	Set a value within the range for TimeConstant.
1A2DH	Axis	FLS Signal Detection (at Start)	The signal input from FLS signal at start was detected.	At start	Not start.	Set ONLY_INSIDE or DISABLE to AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.
1A2EH	Axis	RLS Signal Detection (at Start)	The signal input from RLS signal at start was detected.	At start	Not start.	Set ONLY_INSIDE or DISABLE to AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.
1A2F	Axis	FLS Signal Detection (Controlling)	The signal input from FLS signal during controlling was detected.	During control	Stops.	Set ONLY_INSIDE or DISABLE to AxisName.Cd.HwStrokeLimit_Override and move to the controllable range.
1A30H	Axis	RLS Signal Detection (Controlling)	The signal input from RLS signal during controlling was detected.	During control	Stops.	Set "ONLY_INSIDE" or "DISABLE" to "AxisName.Cd.HwStrokeLimit_Override" and move to the controllable range.
1A34H	Axis/Axes group	Out of Gear Denominator Range	The value is out of range for RatioDenominator.	At start	Not start.	Set a value within the range for RatioDenominator.
1A35H	Axis	Out of Time Constant Range	The value is out of range for TimeConstant.	At start	Not start.	Set a value within the range for TimeConstant.
1A36H	Axis/Axes group	Speed Limit Value Over during Controlling	Set velocity exceeded AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative when AxisName.Pr.VelocityLimit_OverOperation is 3:ImmediateStop.	During control	Operates exeeding "AxisName.Pr.VelocityLimit_Positive" or "AxisName.Pr.VelocityLimit_Negative".	Set set velocity so that it does not exceed AxisName.Pr.VelocityLimit_Positive or AxisName.Pr.VelocityLimit_Negative.
1A37H	Axis	Out of Direction Selection Range	The value is out of range for Direction.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set Direction within the range.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1A38H	Axis	Acceleration Limit Value Over	Target acceleration exceeded AxisName(AxesGroupName).Pr.AccelerationLimit.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set target acceleration so that it does not exceed AxisName(AxesGroupName).Pr.AccelerationLimit.
1A39H	Axis	Deceleration Limit Value Over	Target deceleration value exceeded AxisName(AxesGroupName).Pr.DecelerationLimit.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set target deceleration so that it does not exceed AxisName(AxesGroupName).Pr.DecelerationLimit.
1A3AH	Axis	Jerk Limit Value Over	Target jerk exceeded the value of AxisName(AxesGroupName).Pr.JerkLimit.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set target jerk so that it does not exceed AxisName(AxesGroupName).Pr.JerkLimit.
1A3BH	Axis	Deceleration Stop by Servo OFF During Operation	[0: Servo OFF after deceleration stop is completed] was selected for AxisName.Pr.StopModeSurvoOff, and FALSE was set to ServoOn in MC_Power(MCv_AllPower) during operation.	During control	Deceleration stops .	Set TRUE to ServoOn in MC_Power(MCv_AllPower).
1A3CH	Axis	Immediate Stop by Servo OFF During Operation	[1: Servo OFF after immediate stop] 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.	During control	Immediately stops.	Set TRUE to Enable and ServoOn in MC_Power(MCv_AllPower).
1A3DH	Axes group	Stop Cause of Axes Group Configuration Axis	Error occurred in configuration axis.	At start During control	• [At start] Not start. • [During control] Stops.	Please check the error details of configuration axis.
1A3EH	Axis	Master Axis and Slave Axis No. Duplicated	The same axis No. has been set to master axis and slave axis.	At start When executing FB	Not execute FB.	Set different axis No. to master axis and slave axis.
1A3FH	Axis	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.	At start When executing FB	Not execute FB.	Do not set master axis to the slave axis of back part FB. Reduce the number of connected FBs for synchronization less than the upper limit.
1A40H	Axis	Out of Cam Table ID Range	The value is out of range for CamTableID.	At start When executing FB	Not execute FB.	Specify the value within the range for CamTableID.
1A41H	Axis	Out of Master Axis Offset Range	The value is out of range for MasterOffset.	At start When executing FB	Not execute FB.	Set a value within the range for MasterOffset.
1A42H	Axis	Out of Slave Axis Range	The value is out of range for SlaveOffset.	At start When executing FB	Not execute FB.	Set a value within the range for SlaveOffset.
1A43H	Axis	Out of Master Axis Coefficient Range	The value is out of range for MasterScaling.	At start When executing FB	Not execute FB.	Set a value within the range for MasterScaling.
1A44H	Axis	Out of Slave Axis Coefficient Range	The value is out of range for SlaveScaling.	At start When executing FB	Not execute FB.	Set a value within the range for SlaveScaling.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1A45H	Axis	Out of Master Axis Follow-up Distance Range	The value is out of range for MasterStartDistance.	At start When executing FB	Not execute FB.	Set a value within the range for MasterStartDistance.
1A46H	Axis	Out of Master Axis Synchronization Start Position Range	The value is out of range for MasterSyncPosition.	At start When executing FB	Not execute FB.	Set a value within the range for MasterSyncPosition.
1A47H	Axis	Out of Start Mode Range	The value is out of range for StartMode.	At start When executing FB	Not execute FB.	Set a value within the range for StartMode.
1A48H	Axis/Axes group	Out of Master Axis Data Source Range	The value is out of range for MasterValueSource.	At start When executing FB	Not execute FB.	Set a value within the range for MasterValueSource.
1A49H	Axis/Axes group	Same Master Axis Data Source Selection	An axis selected as Master in a configuration that connects multiple axes with single axis synchronization FB is used as Slave axis of latter FB.	At start When executing FB	Not execute FB.	Check axes specified by Master.
1A4AH	Axis	Out of BufferMode Range	The value is out of range for BufferMode.	At start	Not start.	Set BufferMode within the setting range.
1A4CH	Axis	No Cam Table	The cam table specified in CamTableID does not exist.	At start When executing FB	Not execute FB.	Open cam data to the open area with MC_CamTableSelect or MCv_ProfileSelect.
1A4DH	Axis/Axes group	Out of Speed Range	The value is out of range for Velocity.	At start	Not start.	Set Velocity within the range.
1A4EH	Axis	Out of Options Range	The value is out of range for Options.	At start	Not start.	Set Options within the setting range.
1A4FH	Axis	Same Master Axis 1 Slave Axis Error	The same axis No. was set in Master1 and Slave.	At start	Not start.	Set different axis No. for Master1 and Slave.
1A50H	Axis	Same Master Axis 2 Slave Axis Error	The same axis No. was set in Master2 and Slave.	At start	Not start.	Set different axis No. for Master2 and Slave.
1A51H	Axis	Out of Master Axis 1 Gear Denominator Range	The value is out of range for GearRatioDenominatorM1.	At start	Not start.	Set a value within the range for GearRatioDenominatorM1.
1A52H	Axis	Out of Master Axis 2 Gear Denominator Range	The value is out of range for GearRatioDenominatorM2.	At start	Not start.	Set a value within the range for GearRatioDenominatorM2.
1A57H	Axes group	Configuration Axis No. Duplication Error	The duplicated axis number of configuration axis was set.	At power ON / During Configuration Axis Write	• [At power ON] Generating axes group fails. • [During Configuration Axis Write] Continues the configuration axis which is before write.	Set configuration axis so that axis No. does not duplicate.
1A58H	Axes group	Axes Group No. Setting Duplication Error	The axes group No. was duplicated.	At power ON / During Configuration Axis Write	• [At power ON] Generating axes group fails. • [During Configuration Axis Write] Continues the configuration axis which is before write.	Change the axes group No. of axes group where the error was detected.
1A59H	Axes group	Axes Group Configuration Axis Calculation Cycle Incorrect	The calculation cycle of configuration axis in axes group is different.	At power ON / During Configuration Axis Write	• [At power ON] Generating axes group fails. • [During Configuration Axis Write] Continues the configuration axis which is before write.	Set the same calculation cycle in all configuration axes.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1A5AH	Axes group	Axes Group Status Incorrect (During Configuration Axis Write)	MCv_WriteAxesInGroup was executed when AxesGroupName.Md.GroupStatus was other than GroupDisabled.	During Configuration Axis Write	Continues the configuration axis before writing. In operation, the operation is stopped.	Execute MCv_WriteAxesInGroup when AxesGroupName.Md.GroupStatus is GroupDisabled.
1A5BH	Axis	Forced Stop Status	Forced stop signal was detected during operating.	When inputting forced stop signal	Stops immediately.	Please cancel the forced stop signal.
1A5DH	System	Axis Data Memory Size Over	The memory size of axis data exceeds the memory capacity set in system.	At power ON	Generating axis fails.	• Please increase the memory capacity that set in system. • Please delete unnecessary axis and reduce memory size of axis data.
1A5EH	System	Mapping Size Incorrect Error	PDO size exceeds the settable size.	When connecting driver	The axis set incorrectly is not communicated.	Please check the mapping object.
1A5FH	System	Mapping Communication Error	• An object that cannot be mapped was mapped. • An object that does not exist in the slave object setting was mapped. • Motion mode is set to station-specific mode when AxisName.PrConst.FastOperationMode is 5FE2H (high-speed mode). • The mapping for high-speed mode is changed when AxisName.PrConst.FastOperationMode is 5FE2H (high-speed mode).	When connecting driver	The axis set incorrectly is not communicated.	• Please check the mapping object. • Please check the setting of station-specific mode.
1A60H	System	Maximum Number of Registrations for AxesGroup Over	The memory size of axes group data exceeds the memory capacity that set in system.	At power ON At ready ON	Generating axes group fails.	Increase the memory capacity that set in system. Or, delete unnecessary axis and reduce memory size of axis data to memory capacity.
1A61H	Axes group	Out of Speed Mode Range	The value is out of range for speed mode.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops.	Correct the speed mode so that it is within the range.
1A62H	Axes group	Circular Interpolation Axis Unset	• A configuration axis not set up was set in CircAxes. • Same index No. was set in CircAxes in duplicate.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	• Set an axis that has been set up as configuration axis in CircAxes. • Set index No. of configuration axes in CircAxes avoiding duplication.
1A63H	Axes group	Out of Circular Interpolation Mode Range	The value is out of range for CircMode.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set CircMode within the range.
1A64H	Axes group	Out of Boundary Point Address Range	The value is out of range for boundary point (AuxPoint) at circular interpolation.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set boundary point (AuxPoit) within the range.
1A65H	Axes group	Start Point - Center Point Address Same Value	Start point is equal to center point at circular interpolation of center point specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set center point (AuxPoint) so that start point is not equal to center point.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1A66H	Axes group	Start Point - End Point Address Same Value	Start point is equal to end point at circular interpolation.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set end point (EndPoint) so that start point is not equal to end point.
1A67H	Axes group	End Point - Center Point Address Same Value	End point is equal to center point at circular interpolation of center point specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set center point (AuxPoint) or end point (EndPoint) so that end point is not equal to center point.
1A68H	Axes group	Start Point - Boundary Point Address Same Value	Start point is equal to boundary point at circular interpolation of boundary point specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set boundary point (AuxPoint) so that start point is not equal to boundary point.
1A69H	Axes group	End Point - Boundary Point Address Same Value	End point is equal to boundary point at circular interpolation of boundary point specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set boundary point (AuxPoint) so that end point is not equal to boundary point.
1A6AH	Axes group	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.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set boundary point (AuxPoint) so that it is not on the same straight line with start point and end point.
1A6BH	Axes group	Out of Center Point Address Range	The value is out of range for center point (AuxPoint) at circular interpolation.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set center point (AuxPoint) within the range.
1A6CH	Axes group	Out of Radius Range	The radius is out of range at circular interpolation.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set end point (EndPoint) or auxiliary point (AuxPoint) so that radius is within the range.
1A6DH	Axes group	Out of End Point Address Range	The value is out of range for end point (EndPoint) at circular interpolation.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set end point (EndPoint) within the range.
1A6EH	Axes group	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.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set them so that the distance between start point - end point (EndPoint) is less than or equal to the radius (AuxPoint) × 2.
1A6FH	Axes group	Out of Path Selection Range	The value is out of range for PathChoice.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set PathChoice within the range.
1A70H	Axes group	Out of Circular Interpolation Error Allowable Value Range	The value is out of range for CircularErrorTolerance.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set CircularErrorTolerancewithin the range.
1A71H	Axes group	Circular Interpolation Error Allowable Value Over	The differrence between radius of start point - central point and radius of end point - central point exceeds CircularErrorTolerance at circular interpolation of central point specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set end point (EndPoint), center point (AuxPoint), CircularErrorTolerance so that it does not exceed CircularErrorTolerance.
1A72H	Axes group	Stroke Limit Invalid at Circular Interpolation	Circular interpolation included the axis in which AxisName.Pr.SwStrokeLimit_Upper or AxisName.Pr.SwStrokeLimit_Lower is set to be invalid was executed.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Enable AxisName.Pr.SwStrokeLimit_Upper or AxisName.Pr.SwStrokeLimit_Lower.
1A73H	Axes group	Out of Pitch Number Range	The value is out of range for Pitch.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set Pitch within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1A78H	Axis	Out of Signal Selection Range	• The value is out of range for Direction. • The value is out of range for CompensationTime. • The value is out of range for FilterTime.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	• Set Direction within the range. • Set CompensationTime within the range. • Set FilterTime within the range.
1A79H	Axis	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.	At power ON	Generating axis fails.	Set AxisName.TorqueLimit_PositiveInitial within the range of 0 to AxisName.PrConst.TorqueLimit_Max.
1A7AH	Axis	Out of Reverse Direction Torque Limit Initial Value Specification Range	The value larger than AxisName.PrConst.TorqueLimit_Max was set to AxisName.PrConst.TorqueLimit_NegativeInitial.	At power ON	Generating axis fails.	Set AxisName.PrConst.TorqueLimit_NegativeInitial within the range of 0 to AxisName.PrConst.TorqueLimit_Max.
1A7BH	Axes group	Insufficient Movement Amount at Changing Target Address	Movement amount became 0 after changing target position/ movement distance at multiple axes interpolation control of reference axis/long axis speed designation.	During control	Stops the operation.	Set target position/ movement distance so that movement amount is not insufficient.
1A7CH	Axes group	Operation FB Issue Error to the Axis during Axes Group Operating	Multiple start of single axis control FB was executed for operating axis in axes group.	At start	Stops the operation.	Execute multiple start of multiple axes control FB for the axis of axes group operating.
1A7EH	Axis/Axes group	Overrun Error	• Overrun occurred since the deceleration distance for the output speed was not satisfied after the last positioning address detected. • Positioning direction was inverted when executing multiple start by Aborting. • Positioning direction was inverted when changing target position.	Controlling At multiple start At control change	Stops the operation.	Set Velocity, Position/ Distance and Deceleration so that an overrun will not occur.
1A7FH	Axes group	Driver Emulation Switch Error	Driver emulation switch was executed when AxisName.Md.AxisStatus is other than Disable or Standstill.	When executing driver emulate switching	Stops.	Execute driver emulation switch when AxisName.Md.AxisStatus is Disable or Standstill.
1A80H	Axis/Axes group	BufferMode Specification Disabled	Multiple start was executed in combination disable BufferMode.	At multiple start	Stops.	Please specify combinatorial BufferMode.
1A85H	Axis	Out of Frequency Specification Range	The value is out of range for Frequency.	At start	Not start.	Set Frequency within the range.
1A86H	Axis	Out of Filter Operation Specification Range	The value is out of range for Filter.	At start	Not start.	Set Filter within the range.
1A87H	Axis	Out of Direction Limit Value Specification Range	The value is out of range for PositiveLimit, NegativeLimit.	At start	Not start.	Set PositiveLimit, NegativeLimit within the range.
1A8AH	Axis	Out of Overrun Operation Setting Range	The value is out of range for AxisName(AxesGroupName).Pr.OverrunOperation.	At start	Not start.	Set AxisName(AxesGroupName).Pr.OverrunOperation within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1A90H	Axis	Drive Module Via Synchronous Encoder Setting Incorrect	• The real drive axis with the same station address as the real encoder axis via drive module is not set. (Detail Code: 0001H) • The scale measurement function of the connected driver is disabled. (Detail Code: 0002H) • The slave object required to be set for the real encoder axis via drive module does not exist. (Detail Code: 0003H) • Scale measurement encoder Resolution is 0 (Detail Code: 0004H) • The slave object required to be set for the real encoder axis via drive module is not mapped to the real drive axis with the same station address. (Detail Code: 0005H) • Absolute position management settings do not match. (Detail Code: 0006H)	At power ON	Generating axis fails.	• Set the real drive axis with the same station address as the real encoder axis via drive module. • Enable scale measurement function of the connected driver. • Check if the slave object required to be set for the real encoder axis via drive module exists. • Map the slave object required to be set for the real encoder axis via drive module to the real drive axis with the same station address. • Connect the encoder whose Scale measurement encoder Resolution is not 0. • Match the absolute position management settings of the • real encoder axis and the connected device.
1A91H	Axis	Axis No. Setting Duplication Error	The same axis No. is set.	At power ON	Generating axis fails.	Set the different axis No.
1A94H	Axis	Station Address Duplication Error	The combination of IP address and multiple axes ID has duplicated real drive axis.	At power ON	Generating axis fails.	Set the real encoder axis and the combination of IP address and multiple axes ID to one on one.
1A95H	Axis	Station Address Setting Incorrect	There are no specified station address or connection devices in the real axis that not use slave emulation function.	At power ON	Generating axis fails.	• Specify station address which has connection devices, when slave emulation function is not used. • Set real axis to be slave emulation before executing MC_Power, when slave emulation function is used.
1A96H	Axis	Slave Object Setting Incorrect	• The signal set in the slave object data (TARGET_REF type) does not exist. • The signal set in the slave object data (TARGET_REF type) can not be used as slave object. • The signal of the slave object data that needs to be set to each axis type is not set • Changed from initial value when AxisName.PrConst.FastOperationMode is 5FE2H (high-speed mode).	At power ON	Generating axis fails.	• Please specify the data that can be set as slave object. • Please set signal for the slave object data that needs to be set to each axis type. • Please check whether it is changed from initial value when setting high-speed mode.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1A97H	Axes group	Axes Group Status Incorrect (Axes Group Disable)	MC_GroupDisable was executed when AxesGroupName.Md.GroupStatus is other than GroupStandby or "GroupErrorStop".	Axes Group Disable	Stops the operation.	Execute MC_GroupDisable in the status where AxesGroupName.Md.GroupStatus is GroupStandby or GroupErrorStop.
1A98H	Axes group	No Configuration Axis	Configuration axis is not set in axes group.	At power ON / During Configuration Axis Write	• [At power ON] Generating axes group fails. • [During Configuration Axis Write] In operation, the operation is stopped.	Set configuration axis in axes group.
1A99H	Axes group	No axis	The non-existent axis was set in configuration axis.	At power ON / During Configuration Axis Write	• [At power ON] Generating axes group fails. • [During Configuration Axis Write] In operation, the operation is stopped.	Set the existing axis in configuration axis.
1A9AH	Axis	Absolute Position Management Setting Mismatch	The ENCODER_ABS_STATUS object setting in connection devices is not match.	When restoring current position	Current position is not restored.	Please correct the axis and absolute position management setting of connection devices.
1AA3H	Axis	Out of Ring Counter Range	• The setting of ring counter upper limit value and lower limit value exceeds the positioning range. • Ring counter lower limit value > Ring counter upper limit value. • When 0 < |Ring counter upper limit value - Ring counter lower limit value| < 2.0 • The setting value exceeded the positioning range.	At power ON	Generating axis fails.	• 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|.
1AA4H	Axis	Driver Unit Change Magnification Upper Over	The magnification that exceeded upper limit in the driver unit conversion numerator/ denominator is set.	At ready ON	The driver unit conversion numerator/ denominator is not changed.	Set the calculation result of driver unit conversion numerator/denominator that does not exceed 400000000.
1AA5H	Axis	Driver Unit Change Numerator/ Denominator Change Timing Incorrect	The driver unit conversion numerator/denominator setting was changed when follow-up operation can not be executed.	At ready ON	The driver unit conversion numerator/ denominator is not changed.	READY ON when follow-up is possible. Meet both of the following. • AxisName.Md.AxisStatus is Disabled. • AxisName.Md.FollowupDisableStatus is FALSE.
1AA7H	Axis	AddOn Acquisition Failure	Failed to acquire the external signal selection addon when have 'counter disable signal' setting.	At power ON	Generating axis fails.	Install external signal addon and enable it.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1AA8H	Axis/Axes group	Necessary Slave Object Unset	Necessary slave object in control command execution is not set to axis (occasion configuration axis of axes group).	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	• Please set necessary object in control command. • Please use single axis synchronization for virtual link axis.
1AA9H	Axis/Axes group	Out of Acceleration/Deceleration Method Range	The value is out of range for acceleration/deceleration method of Options.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set the acceleration/deceleration method according to the executed control command.
1AAAH	Axis	ABS Reference Point Read Error	Failed to get the data from drive module normally at homing.	During operation	Homing is not completed normally.	Execute homing again.
1AABH	Axes group	Reference Axis Movement Amount 0	The movement amount of the reference axis is "0" in the linear interpolation for reference axis specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set the axis of which the movement amount is not 0 to a reference axis.
1AACH	Axis	Out of Torque Lamp Function Selection Range	The value is out of range for torque lamp function selection of Options.	At start	• [At start] Not start. • [At multiple start] Stops the operation.	Set torque lamp function selection of Options within the range.
1AADH	Axis	Start Not Possible	Positioning start not possible. • Moderate Error Detection (Detail Code: 0001H) • PLC READy OFF (Detail Code: 0002H) • Forced Stop Signal ON (Detail Code: 0003H) • Axis Stop Signal ON (Detail Code: 0004H) • Axis/Axes Group Status Incorrect (Detail Code: 0100H) • Axes Group Operating (Detail Code: 0101H) • Configuration Axis Status Incorrect (Detail Code: 0102H)	At start	Not start.	• Set it so that it will not start when PLC READY is OFF. • Set it so that it will not start when READY is OFF. • Check the sequence program which turns PLC READY signal [Y0] ON/OFF. • Check the status of the drive module power supply, the wiring with the drive module and connector status. • Start it after AxesGroupName.Md.GroupStatus changes into GroupStandby. • Start it after AxisName.Md.AxisStatus changes into Standstill.
1AAEH	Axis	Driver Error	An error occurred in the driver.	During operation	Stops immediately.	Please check the error details and corrective actions according to the content of AxisName.Md.DriverErrorID. (Please refer to the instruction manual of each driver for details of AxisName.Md.DriverErrorID.)
1AAFH	Axis	Driver Ready OFF	Driver power OFF during controlling. • Driver power is OFF • Initial processing when driver power is ON • The driver is not installed • Driver error occurs	During operation	Stops immediately.	Please turn on the power supply of driver.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
1AB0H	Axis	PLC READY OFF During Operation	PLC READY signal [Y0] was turned OFF during operation.	During operation	Stops the operation.	Check the sequence program of which PLC READY signal [Y0] is ON/OFF.
1AB1H	Axis	Module Error During Operation	Moderate error or major error was detected in the motion module during operation.	During operation	Stops the operation.	Please turn the module power on again.
1AB2H	Axis	Driver Network Disconnection	Driver network disconnection was detected during operation.	During operation	Stops immediately.	Please check the connection cable of driver.
1AB3H	Axis	Executing FB Analysis Disabled	An error was detected in executing FB analysis at target changing position. • The value after Position/Distance change is out of range. • Target position after change is outside the software stroke limit range.	At control change	Stops the operation.	Set Position/Distance at changing target position within the range.
1AB4H	Axis/Axes group	Buffering FB Analysis Disabled	An error was detected in the buffering FB analysis.	During operation	Stops the operation.	Set buffering FB analysis so that it will not result in an error.
1AB5H	Axis	Ring Counter Invalid Start	Ring counter setting was started in the invalid status.	At start	Not start.	Enable the AxisName.PrConst.RingCount_Enable.
1AB6H	Axis	External Signal String Incorrect	Incorrect string was set in the string of external signal.	At start	Not start.	Set the valid string in the external signal.
1AB7H	Axes group	Path Choice Setting Incorrect	Incorrect value was set in PathChoice.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set the value that supports CircMode in the PathChoice.
1AB8H	Axes group	Total Movement Angle 0	The angle between start point - end point became 0 at circular interpolation of boundary point specification or radius specification.	At start At multiple start	• [At start] Not start. • [At multiple start] Stops the operation.	Set EndPoint or PathChoice so that the angle of start point - end point will not be 0.
1AB9	Axes group	Liner Interpolation Axis Setting Incorrect	• A configuration axis not set up was set in LinearAxes. • 0 was set in the first element of LinearAxes. • .Same index No. was set in LinearAxes in duplicate. • The number of axes set for LinearAxes exceeded the maximum number of interpolation axes.	At start At multiple star	• [At start] Not start. • [At multiple start] Stops the operation.	• Set an axis that has been set up as configuration axis in LinearAxes. • Set a configuration axis in the first element of LinearAxes. • Set index No. of configuration axes in LinearAxes avoiding duplication. • Set the number of axes set for LinearAxes less than the maximum number of interpolation axes.
1ABFH	Axis/Axis	Each Axis Signal Target Incorrect	Incorrect string is set for the Target of the signal.	At power ON At ready ON	The signal is detected continuously.	Set a valid string for the Target of the signal.
1ACBH	Axis	External Signal Selection AddOn Acquisition Failure	Failed to acquire the external signal selection addon.	At power ON At ready ON	The signal is detected continuously.	Install SignalIO.mpk and enable it.
1ACCH	Axis	Insufficient Memory Capacity of Each Axis Signal.	Cannot create a signal, because the memory capacity of the external signal selection addon is insufficient.	At power ON At ready ON	The signal is detected continuously.	Increase the memory capacity of addon SignalIO.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1AD1H	Axis	Out of Detection Setting Range of Each Axis Signal	The value is out of range for Detection.	At power ON At ready ON	The signal is detected continuously.	Set a value within the range for Detection.
1AD8H	Axis	Out of Master Axis No. Range	The value is out of range for Master.AxisNo.	At start When executing FB	Not execute FB.	• Set a value within the range for Master.AxisNo. • Set the axis No. in which instance is created.
1AD9H	Axis	Out of Slave Axis No. Range	The value is out of range for Slave.AxisNo.	At start When executing FB	Not execute FB.	• Set a value within the range for Slave.AxisNo. • Set the axis No. in which instance is created.
1ADAH	Axis	Out of BufferMode Range	The value is out of range for BufferMode.	At start When executing FB	Not execute FB.	Set a value within the range for BufferMode.
1ADBH	System	Command Filter AddOn System Memory Shortage	Memory capacity that exceeds the System.PrConst.Addon_AddonLibraryName.RamSizeMax was used.	At start At multiple star	Not start.	Please check the System.PrConst.Addon_AddonLibraryName.RamSizeMax.
1ADCH	System	AddOn Memory Shortage	Memory capacity that exceeds the System.PrConst.Addon_AddonLibraryName.RamSizeMax was used for addons related to operation.	At start At multiple star	Not start.	Please check the System.PrConst.Addon_AddonLibraryName.RamSizeMax.
1ADEH	Axes group	Out of Liner Movement Amount Range	The interpolation axis exists in which movement amount exceeds '4,294,967,296.0 (= 2^{32})' in the linear interpolation for composite speed specification.	At start At multiple star	• [At start] Not start. • [At multiple start] Stops .	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})'.
1ADFH	Axis	Insufficient Current Position Backup Capacity	The necessary memory capacity in backup was not secured when restoring current position.	When restoring current position	Restoring current position is not completed.	Please execute soft reboot after checking the System.PrConst.Addon_AbsSystem.BackUpRamSizeMax.
1AE0H	Axis	Driver Restoration Data Incorrect	The parameter of connection driver device was incorrect when restoring current position.	When restoring current position	Restoring current position is not completed.	• Please connect Encoder that MaxAbsCounter is 2 to the power of n. • Please change the Electronic Gear to 2 to the power of n at connection driver side. • Please change the Electronic Gear to 1:1 raito at connection driver side, if connection encoder resolution is not 2 to the power of n.
1AE1H	Axis	Out of Encoder Ring Counter Setting Range	Encoder Ring counter lower limit value > Encoder Ring counter upper limit value.	At power ON	Generating axis fails.	• Set the values so that they meet the following condition: Encoder Ring counter lower limit value < Encoder Ring counter upper limit value.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1AE2H	Axis	Out of Addition and Subtraction Selection Range	The value is out of range for CombineMode.	At start	Not start.	Set CombineMode within the setting range.
1AE3H	Axis	csp Unsupported Driver	The driver does not support csp.	At initial communicating	Unable to connect driver.	Please connect a driver that supports CSP.
1AE4H	Axis/Axes group	Out of Calculation Cycle Converted Speed Range	The speed converted from Velocity by calculation cycle is out of the range.	At start	Not start.	Set Velocity so that the speed converted by calculation cycle is within the range.
1AE5H	Axis	Communication Error of Connected Encoder	A communication error occurred between the driver <=> encoder.	When connecting During control	• [When connecting] Disable to connect encoder. • [During control] Disconnects encoder.	Pleasecheck the motor and encoder cable.
1AE6H	Axis	Driver Command Discard Detection	The command discard (Statusword bit12 OFF) of the connceted driver device was detected during operation.	During operation	Stops the operation.	Please move the command by JOG instruction etc. to the position where the limit signal was detected when using limit signal for driver device.(Please check the specification document of the driver device for details of Statusword)
1AE7H	Axis	Driver Execution Control Mode Incorrect	The control mode of the connected driver device switched to an unsupported mode for the motion system during operation.	During operation	Stops immediately.	Swith the driver control mode to a control mode that is supported by the motion system
1AE8H	Axis/Axes group	Speed Range Over during Controlling	Command current speed exceeded the speed command range.	During operation	Stops the operation.	Set command current speed so that it does not exceed the speed command range.
1C40H	System	Network Parameter Error (Total No. of Stations < Station No.)	The station No. of slave stations that connected to the network exceeds the total number of slave stations that has been set in "Network Configuration Setting".	At power ON	The station can not be connected to the drive unit.	Set the station No. of slave stations that connected to the network within the total number of slave stations.
1C41H	Axis	Watchdog Counter Error	A watchdog counter error of driver was detected.	During communication	Stops immediately.	• Please check the communication cycle. • Please check surrounding environment errors such as noise etc., and remove the cause.
1C42H	Axis	Unsupported Driver Connection	An unsupported driver was connected.	When connecting driver	Creating an instance of driver fails.	Please connect a supported driver.
1C43H	Axis	SLMP Communiction Error	An error occurred in SLMP communication.	During communication	[During initial communication] • Disable to connect driver.	• Please check the slave object setting. • Please check the specification of the driver.
1C44H	System	Network Parameter Error (Station No. Order Error)	The station No. of the slave station to connect to network are not in ascending order for "Network Configuration Settings".	At power ON	The station can not be connected to the drive unit.	Set station No. of the slave station to connect to network in ascending order.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1C45H	System	SLMP Communiction Error (Timeout)	Response timeout was detected in SLMP communication.	During communication	Disable SLMP communication.	Please check the transient transmission time. It is derived by the following formula.(Transient Transmission Time = Communication Cycle Interval Setting - Cyclic Transmission Time - System Reserved Time)
1C46H	System	Time Synchronization Error	There is a disconnected station where time synchronization is incomplete.	At start communication	The station can not be connected to the drive unit.	• Please change to a short communication cycle. • Please check surrounding environment errors such as noise etc., and remove the cause. • Please connect the stations only set in the network configuration setting.
1C47H	System	Communication Cycle Unsupported Driver Connection	The MR-J5-G series which does not support communication cycle 31.25/62.5 μs was connected.	At start communication	The station can not be connected to the drive unit.	Please check the version of MR-J5-G series and apply the latest version.
1C80H	System	Cycle Over	Arithmetic processing or other fixed scan processing is not completed within the set cycle.	During operation	The axis in operation decelerates and stops.	• Change the fixed scan interval setting of fixed scan execution type program to a larger value. • Change the following to lager values. • System.PrConst.SystemBaseCycle.Cycle • System.PrConst.OperationCycle[1].Cycle • System.PrConst.BuffermemoryRefreshCycle.Cycle
1C81H	System	Cycle Assignment Incorrect	The value is out of range for system basic cycle, the first calculation cycle, buffer memory refresh cycle, or the value which cannot be set was specified.	At power ON	Operates in default operation cycle.	Please set the following within the range. • System.PrConst.SystemBaseCycle.Cycle • System.PrConst.OperationCycle[1].Cycle • System.PrConst.OperationCycle[2].Cycle • System.PrConst.OperationCycle[3].Cycle • System.PrConst.BuffermemoryRefreshCycle.Cycle
1C83H	System	Boot Software File Error	The file of boot software is abnormal.	At power supply	The motion system does not start.	Please install the boot software again
1C84H	System	Saved File Number Over	The saved file reached the upper limit value.	At saving files	The files can not be saved.	Please delete all the saved files.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1C85H	System	Event History File Incorrect	• An error was detected in the event history file. • The memory capacity of addon MotionEventHist is insufficient.	At updating the event history file.	Updating the event history file stops.	• Delete unnecessary files and secure free capacity. • Format the t arget d rive. • Delete event history files . • Please c heck the memory capacity of a ddon MotionEventHist.
1C86H	System	Out of Cycle Over Error Selection Range	The value is out of range for "Cycle Over Error Selection".	At power ON	Operates in default cycle over error type.	Please set the followings within the range. • System.PrConst.SystemBaseCycle.CycleOverErrorType • System.PrConst.OperationCycle[1].CycleOverErrorType • System.PrConst.BuffermemoryRefreshCycle.CycleOverErrorType
1C87H	System	Label Incorrect	Failed to import the label definition.	At power ON	Interrupts the process to import the labels.	Please write label setting.
1C88H	System	Label Memory Shortage	Label which exceeds the label capacity has been defined.	At power ON At ready ON	Interrupts the process to import the labels.	• Please change the System.Md.LabelMemoryFreeSize to a larger value. • Please check the label usage.
1C89H	System	System Signal Target Incorrect	Incorrect string is set for the Target of the signal.	At ready ON	The signal is detected continuously.	Set the valid string in the signal Target.
1C8EH	System	Variable Manager Acquisition Failure	Failed to acquire variable manager.	At power ON	The addon which is discribed in the detailed information is invalid function.	Pleasere-install the baseSystem.smpk
1C8FH	System	External Signal Selection AddOn Acquisition Failure	Failed to acquire the external signal selection addon.	At ready ON	The signal is detected continuously.	Install SignalIO.mpk and enable it.
1C91H	System	Insufficient Memory Capacity of System Signal	Cannot create a signal, because the memory capacity of the external signal selection addon is insufficient.	At ready ON	The signal is detected continuously.	Increase the memory capacity of addon SignalIO.
1C92H	System	Out of Detection Setting Range of System Signal	The value is out of range for Detection.	At ready ON	The signal is detected continuously	Set a value within the range for Detection.
1D80H	System	Out of Parameter Range (Axis)	Parameter is out of the range.	When executing FB At power ON At ready ON	• [When executing FB] The error of FB turns ON and the command is not executed. • [At power ON] Generating axis fails. • [At ready ON] The READY signal (OX) does not turn ON.	Change the specified value of detailed information parameter within range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
1D81H	System	Out of Parameter Range (Axes Group)	Parameter is out of the range.	When executing FB At power ON At ready ON	• [At FB] The error on FB turns ON and the command is not executed. • [At power ON] Generating axes group fails. • [At ready ON] The READY signal (OX) does not turn ON.	Change the specified value of detailed information parameter within range.
1D82H	System	Out of Parameter Range (System)	Parameter is out of the range.	When executing FB At power ON At ready ON	• [At FB] The error of FB turns ON and the command is not executed. • [At power ON/At ready ON] The READY signal (OX) does not turn ON.	Change the specified value of detailed information parameter within range.
1D83H	System	Parameter Write-protected	Wrote in the parameter which can only read.	When executing FB	The error of FB turns ON and the command is not executed.	Change to the parameter that can be written.
3200H	System	File Access Error	The following operations was attempted in the engineering tool and SLMP path. • An access (read/write) from other request source to written file was operated. • A write from other request source to access (read/write) file was operated.	When accessing file	Fails to access the files.	Please operate the next access after one process of request source is completed.
3203H	System	WDT Error Detected	System memory setting The memory was not secured for the function that influences controlling. Programming It exceeded 2.0 [s] from start to end of the execution. (Initial execution type) The execution time of all normal execution type programs exceeded 1.0 [s]. Execution time monitor Calculation process or other processes are in abnormal conditions. Processing stopped for more than one second.	During operation	The axis in operation stops immediately.	• System memory setting Increase System.PrConst.Addon_AddonLibraryName.RamSizeMax or System.PrConst.Addon_AddonLibraryName.BackupRamSizeMax. • Programming Reduce the number of command execution of initial execution type and normal execution type by program. • Execution time monitor Change the system basic cycle, the first calculation cycle, and buffer memory refresh cycle to a larger value. Change the fixed scan interval setting of fixed scan execution type program to a larger value.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3205H	System	AddOn Library Load Error	AddOn • The file of AddOn is broken. • AddOn with dependencies has not been installed. • AddOn that cannot be combined has been installed. • Inconsistency occurred in versions.	At power ON	AddOn The motion system does not start.	AddOn • Please install the software again. • Please install the AddOn with dependencies. • Please delete the AddOn that cannot be combined. • Please uninstall or delete the AddOn that inconsistency occurred in versions.
3207H	System	Drive Error	Failed to mount the drive Check disk ended with error Verification error of plane management target memory occurred.	At system start	Access to the target drive is not allowed.	Format the target drive.
3208H	System	Insufficient Total System Memory (RAM)	The total number of System.PrConst.Addon_AddonLibraryName.RamSizeMax for each addon exceeds the total size of system memory (RAM).	At power ON	The motion system does not starts.	Please set the total number of System.PrConst.Addon_AddonLibraryName.RamSizeMax for each addon so that it does not exceed the total size of system memory (RAM).
3209H	System	Insufficient AddOn Total System Memory (RAM)	Memory that exceeded System.PrConst.Addon_AddonLibraryName.RamSizeMax has been used.	At power ON During operation	• [At power ON] The motion system does not starts. • [During operation] WDT error occurs if the function has an effect on control.	Please increase System.PrConst.Addon_AddonLibraryName.RamSizeMax.
320AH	System	Insufficient Total System Memory (Backup RAM)	The total number of System.PrConst.Addon_AddonLibraryName.BackUpRamSizeMax for each addon exceeds the total size of system memory (Backup RAM).	At power ON	The motion system does not starts.	Please set the total number of System.PrConst.Addon_AddonLibraryName.BackUpRamSizeMax for each addon so that it does not exceed the total size of system memory (Backup RAM).
320BH	System	Insufficient AddOn System Memory (Backup RAM)	Memory that exceeded System.PrConst.Addon_AddonLibraryName.BackUpRamSizeMax has been used.	At power ON During operation	• [At power ON] The motion system does not starts. • [During operation] WDT error occurs if the function has an effect on control.	Please increase System.PrConst.Addon_AddonLibraryName.BackUpRamSizeMax.
320CH	System	Cycle Over	Arithmetic processing or other fixed scan processing is not completed within the set cycle.	During operation	The axis in operation stops immediately.	C]hange the fixed scan interval setting of fixed scan execution type program to a larger value. C]hange the followings to a lager value. • System.PrConst.SystemBaseCycle.Cycle • System.PrConst.OperationCycle[1].Cycle • System.PrConst.BuffermemoryRefreshCycle.Cycle

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
320DH	System	Base System Error	• Failed to configure label. • Failed to process initial.	At power ON	The motion system does not starts.	• Please install the software again. • Please write the program again.
320EH	System	Network Driver Error	Failed to communicate with Motion Module and Network Module.	At power ON During operation	• The motion system does not starts. • The axis in operation stops immediately.	• Please install the software again. • Please write the program again.
320FH	System	Servo Driver Error	Failed to initialize the servo driver.	At power ON During operation	• The motion system does not starts. • Creating an instance of driver fails.	Please install the software.
3400H	System	Out of Axis No. Range	• The value is out of range for axis No.. • Invalid axis No. has been set.	At start When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axis No. in which instance is created
3401H	System	Axis No. Duplication Setting	The same axis No. has been set to master axis and slave axis.	At start When executing FB	Not execute FB.	Set different axis No. to master axis and slave axis.
3402H	System	Out of Axes Group No. Range	• The value is out of range for axes group No.. • Invalid axes group has been set.	When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axes group No. in which instance is created
3403H	System	Out of Master Axis No. Range	• The value is out of range for master axis No. • Invalid axis No. has been set.	At start When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axis No. in which instance is created
3404H	System	Out of Slave Axis No. Range	• The value is out of range for slave axis No. • Invalid axis No. has been set.	At start When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axis No. in which instance is created
3405H	System	Out of Master Axis 1 No. Range	• The value is out of range for axis No. of master axis 1. • An unavailable axis No. is set.	At start When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axis No. in which instance is created
3406H	System	Out of Master Axis 2 No. Range	• The value is out of range for axis No. of master axis 2. • Invalid axis No. has been set.	At start When executing FB	Not execute FB.	• Set the value within the range of 1 to 10000 • Set the axis No. in which instance is created
3407H	System	Out of Latch Count Range	The value is out of range for RatchCount.	When executing FB	Not execute FB.	Set the value within the range.
3408H	System	Latch Count Incorrect	RecordCount has not been set when RecodeMode=RecordCount,Ring Buffer.	When executing FB	Not execute FB.	Set RecordCount.
3409H	System	Out of Touch Probe ID Range	The value is out of range for TouchProbeID.	When executing FB	Not execute FB.	Set the valid touch probe ID.
340DH	System	Out of Compensation Time Range	The value is out of range for CompensationTime.	When executing FB	Not execute FB.	Set the value within the range of -5.0 to 5.0 [s].

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
340EH	System	Out of Latch Mode Range	The value is out of range for RatchMode.	When executing FB	Not execute FB.	Set the value within the range for MC_RECORD_MODE.
340FH	System	No Calculation Profile	The calculation profile does not exist.	During operation	The execution of FB is interrupted.	Set the existing calculation profile.
3410H	System	Calculation Profile Incorrect	The value is out of range for Data or Version.	During operation	The execution of FB is interrupted.	Set the data within the range.
3411H	System	Calculation Profile Operating	The operation was executed during calculation profile operating.	During operation	The execution of FB is interrupted.	Operate it when Busy of FB is FALSE.
3412H	System	Calculation Profile Error	The calculation profile is broken, or the format is incorrect.	During operation	The execution of FB is interrupted.	Set the calculation profile for a correct format.
3413H	System	Out of Offset Range	Offset exceeds the number of elements of calculation profile (file or open area).	During operation	The execution of FB is interrupted.	Set a value which does not exceed the number of elements of calculation profile (file and open area) in Offset.
3414H	System	Out of Calculation Profile ID Range	The value is out of range for ProfileData.ID.Number or ProfileID.Number.	At start During operation	• [At start] Not execute FB. • [During operation] Operates with previous setting value.	Set a value within the range for ProfileData.ID.Number or ProfileID.Number.
341DH	System	Out of Input Absolute Coordinate Range	The value is out of range for InputAbsolute.	When executing FB	Not execute FB.	Set the value within the range.
341EH	System	Out of Output Absolute Coordinate Range	The value is out of range for OutputAbsolute.	When executing FB	Not execute FB.	Set the value within the range.
341FH	System	Out of Composite Mode Range	The value is out of range for SynthesizingMode.	When executing FB	Not execute FB.	Set the value within the range.
3421H	System	Out of Input Offset Range	The value is out of range for InputOffset.	When executing FB	Not execute FB.	Set the value within the range.
3422H	System	Out of Output Offset Range	The value is out of range for OutputOffset.	When executing FB	Not execute FB.	Set the value within the range.
3423H	System	Out of Input Coefficient Range	The value is out of range for InputScaling.	When executing FB	Not execute FB.	Set the value within the range.
3424H	System	Out of Output Coefficient Range	The value is out of range for OutputScaling.	When executing FB	Not execute FB.	Set the value within the range.
342FH	System	SD Memory Card Unload	The memory card was removed without SD memory card being disabled.	When removing SD memory card	—	Remove SD memory card after SD memory card being disabled.
343FH	System	Out of Backlash Amount Range	The value is out of range for BacklashAmount.	When executing FB	Not execute FB.	Set the value within the range.
344EH	System	MC_SetPosition Instruction Error	An error occurred during executing MC_SetPosition for the following causes. • Position is out of the range (Detail Code: 1) • ExecutionMode is out of the range (Detail Code: 2) • The current position after changing is out of range of software stroke limit (Detail Code: 3) • Axis status at execution is incorrect (Detail Code: 4) • Other MC_SetPosition was executed in the specified axis (Detail Code: 8) • Options is out of the range (Detail Code: 9)	At start During operation	• Not execute FB. • The execution of FB is interrupted.	• Set Position within the range. • Set ExecutionMode within the range. • Set the values so that the current position after changing is within the software stroke limit range. • Execute it when the axis status is Standstill. • Set Options within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
344FH	System	MCv_SetPositionTriggered Instruction Error	An error occurred during executing MCv_SetPositionTriggered for the following causes. • Position is out of the range (Detail Code: 1) • ExecutionMode is out of the range (Detail Code: 2) • The current position after changing is out of range of software stroke limit (Detail Code: 3) • Axis status at execution is incorrect (Detail Code: 4) • TriggerInput is incorrect (Detail Code: 5,6) • Addon SignalIO is not enabled. (Detail Code: 7) • Other MCv_SetPositionTriggered was executed in the specified axis (Detail Code: 8) • Options is out of range (Detail Code: 9)	At start During operation	• Not execute FB. • The execution of FB is interrupted.	• Set Position within the range. • Set ExecutionMode within the range. • Set the values so that the current position after changing is within the software stroke limit range. • Execute it when the axis status is Standstill. • Please check the setting of TriggerInput. • Please enable theaddon SignalIO. • Set Options within the range.
3450H	System	MCv_SetTorqueLimit Instruction Error	An error occurred during executing MCv_SetTorqueLimit forthe following causes. • PositiveValue is out of range (Detail Code: 1) • NegativeValue is out of range (Detail Code: 2) • ExecutionMode is out of range (Detail Code: 3) • Axis type is incorrect (Detail Code: 4) • Axis status at execution is incorrect (Detail Code: 5) • Other MCv_SetTorqueLimit was executed in the specified axis (Detail Code: 6) • Options is out of range (Detail Code: 7)	At start During operation	Not execute FB.	• 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. • Set Options within the range.
3451H	System	Out of Start Mode Range	The value is out of range for ExecutionMode.	At start	Not execute FB.	Set a value within the range for ExecutionMode.
3452H	System	Insufficient Calculation Profile ID	The profile ID to be assigned automatically is insufficient.	During operation	The execution of FB is interrupted.	Specify and open the unused profile ID.
3453H	System	Calculation Profile Control Unsupported	Control FB was executed for the unsupported calculation profile.	At start	Not execute FB.	Open the calculation profile which supports the calculation profile control FB in the open area.
345AH	System	Out of Output Offset Range	The value is out of range for OutputOffset.	At start During operation	• [At start] Not execute FB. • [During operation] Operates with previous setting value.	Set OutputOffset within the range.
345BH	System	Out of Input Offset Range	The value is out of range for InputsOffset.	At start During operation	• [At start] Not execute FB. • [During operation] Operates with previous setting value.	Set a value within the range for InputsOffset.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
345CH	System	Out of Output Coefficient Range	The value is out of range for OutputScaling.	At start During operation	• [At start]Not execute FB. • [During operation] Operates with previous setting value.	Set a value within the range for OutputScaling.
345DH	System	Out of Input Coefficient Range	The value is out of range for InputsScaling.	At start During operation	• [At start]Not execute FB. • [During operation] Operates with previous setting value.	Set a value within the range for InputsScaling.
345EH	System	Calculation Profile Read/Write Unsupported	The calculation profile which does not support calculation profile read/write is set.	During operation	The execution of FB is interrupted.	Set the calculation profile which supports read/write.
345FH	System	Out of Read Target/ Write Target Range	The value is out of range for Target.	During operation	The execution of FB is interrupted.	Set a value within the range for Target.
3460H	System	Read/Write Data Data Type Incorrect	The incorrect data type is set in Data1 or Data2.	During operation	The execution of FB is interrupted.	Set a normal data type in Data1 and Data2.
3461H	System	Read/Write Data Data Name Specification Method Incorrect	The incorrect data name specification method is set in Data1 or Data2.	During operation	The execution of FB is interrupted.	Set a normal data name specification method in Data1 and Data2.
3462H	System	Read/Write Data Type Incorrect	The incorrect type is set in Data1 or Data2.	During operation	The execution of FB is interrupted.	Set a normal type in Data1 and Data2.
3463H	System	Read/Write Data Target Modification Incorrect	The incorrect target modification is set in Data1 or Data2.	During operation	The execution of FB is interrupted.	Specify a normal target modification in Data1 and Data2.
3464H	System	Number of Read/Write Data Mismatch	Points do not match the number of elements of read/write structured data type.	During operation	The execution of FB is interrupted.	Set Points to match with the number of elements of read/write structured data type.
3465H	System	Number of Offset/Read/ Write Data Incorrect	A value other than Offset=0,Points=0 is set when creating a new file.	During operation	The execution of FB is interrupted.	Set Offset=0,Points=0 when creating a new file.
3466H	System	Out of Current Value per Cycle Range	The value is out of range for Cycle.	During operation	The execution of FB is interrupted.	Set a value within the range for Cycle.
3467H	System	Current Value per Cycle Change Unsupported	FB which does not support the current value per cycle change is set.	At start	Not execute FB.	Set FB which supports the current value per cycle change.
3468H	System	No Instance ID	The set instance ID does not exist.	At start	Not execute FB.	Set the existing instance ID.
3470H	System	SD Memory Card is not Inserted	SD memory card is not inserted.	During operation	The execution of FB is interrupted.	Execute it after SD memory card inserted.
3471H	System	SD Memory Card is Write-protected	SD memory card is write-protected.	During operation	The execution of FB is interrupted.	Execute it after cancelling SD memory card write-protected.
3483H	System	Out of Cam Switch ID Range	The value is out of range for Switches.	When executing FB	Not execute FB.	Set the value within the range.
3484H	System	No Digital Cam Switch	The calculation profile specified in Switches does not exist.	When executing FB	Not execute FB.	Set the existing calculation profile.
348CH	System	Out of Valid Track No. Range	The value is out of range for EnableTrack.	When executing FB	Not execute FB.	Set the value within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3492H	System	Calculation Profile AddOn System Memory Shortage	Memory capacity that exceeds the System.PrConst.Addon_AddonLibraryName.RamSizeMax was used.	At ready ON	The program stops.	• Please check the System.PrConst.Addon_AddonLibraryName.RamSizeMax. • Please check the setting to reduce the usage of the open area. • Please reduce the number of FBs to be executed simultaneously.
3493H	System	Calculation Profile Addon Internal Error	An error occurred in internal of calculation profile addon.	At ready ON	The program stops.	• Please install the software again. • Please write the program again.
3494H	System	Axis Status Incorrect (When Axes Group is Valid)	MC_GroupEnable was executed when AxisName.Md.AxisStatus of configuration axis is other than Standstill or "Disabled".	When Axes Group is Valid	The axes group status does not turn "GroupStandby".	Execute MC_GroupEnable after setting Standstill or Disabled in AxisName.Md.AxisStatus of all configuration axes.
3495H	System	Axes Group Status Incorrect (When Axes Group is Valid)	MC_GroupEnable was executed when AxesGroupName.Md.GroupStatus is other than GroupStandby or GroupDisabled.	When Axes Group is Valid	Not execute FB.	Execute MC_GroupEnable in the status where AxesGroupName.Md.GroupStatus is GroupStandby or GroupDisabled.
3496H	System	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 is TRUE (the configuration axis is in use in another axes group).	When Axes Group is Valid	The axes group status does not turn "GroupStandby"	Disable the axes group in use and execute MC_GroupEnable.
3497H	System	MCv_ChangeCycle Instruction Error	An error occurred during executing MCv_ChangeCycle for the following causes. • Cycle is out of range (Detail Code: 1) • ExecutionMode is out of range (Detail Code: 2) • The current position after changing is out of range of software stroke limit (Detail Code: 3)Axis status at execution is incorrect (Detail Code: 4) • Other MCv_ChangeCycle was executed in the specified instanceID(Detail Code: 8) • Options is out of range (Detail Code: 9)	At start During operation	• Not execute FB. • The execution of FB is interrupted.	• Set Cycle within the range. • Set ExecutionMode within the range. • Set the values so that the current position after changing is within the software stroke limit range. • Execute it when the axis status is Standstill. • Set Options within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3498H	System	MCv_ChangeCycleTriggered Instruction Error	An error occurred during executing MCv_ChangeCycleTriggered for the following causes. • Cycle is out of range (Detail Code: 1) • ExecutionMode is out of range (Detail Code: 2) • The current position after changing is out of range of software stroke limit (Detail Code: 3) • Axis status at execution is incorrect (Detail Code: 4) • TriggerInput is incorrect (Detail Code: 5, 6) • Addon SignalIO is not enabled. (Detail Code: 7) • Other MCv_ChangeCycleTriggered was executed in the specified instanceID(Detail Code: 8) • Options is out of range (Detail Code: 9)	At start During operation	• Not execute FB. • The execution of FB is interrupted.	• Set Cycle within the range. • Set ExecutionMode within the range. • Set the values so that the current position after changing is within the software stroke limit range. • Execute it when the axis status is Standstill. • Please check the setting of TriggerInput. • Please enable theaddon SignalIO. • Set Options within the range.
3499H	System	AddOn Memory Shortage	The related addon memory is insufficient.	At start up	Not execute FB.	Please increase System.PrConst.Addon_AddonLibraryName.RamSizeMax.
349AH	System	Memory Shortage	The memory capacity in which MCFB instance is created is insufficient.	When executing dedicated instruction	Dedicated instruction is completed with the error.	Check setting data.
349BH	System	Motion Command Execution at STOP	Motion Command Execution was executed when it is in STOP status.	When executing dedicated instruction	Dedicated instruction is completed with the error.	Set module to RUN status.
349CH	System	Out of Velocity Override Coefficient VelFactor Range	The value is out of range for VelFactor.	During control	Continues the operation with the previous value.	Set Velocity within the range.
349DH	System	Out of Acceleration Override Coefficient AccFactor Range	The value is out of range for AccFactor.	During control	Continues the operation with the previous value	Set AccFactor within the range.
349EH	System	Out of Jerk Override Coefficient JerkFactor Range	The value is out of range for JerkFactor.	During control	Continues the operation with the previous value.	Set JerkFactor within the range
349FH	System	Latch Data Storage Shortage	The number of elements specified by OutputBuffer does not match RecordCount.	When executing FB	Not execute FB.	Set the number of elements specified by OutputBuffer to be more than RecordCount.
34A0H	System	Out of Backlash Compensation Direction Range	The value is out of range for BacklashDirection.	When executing FB	Not execute FB.	Set the value within the range.
34A1H	System	Parameter Reading And Writing Instruction Execution Disabled Error	Unable to execute the parameter reading instruction or the parameter writing instruction.	When executing FB	Not execute FB.	• Check the setting data. • Check the execution count of transient transmission.
34A2H	System	Out of Parameter No. Range	The value is out of range for ParameterNumber.	When executing FB	Not execute FB.	Set the value within the range.
34A3H	System	Out of Option Range	The value is out of range for Options.	When executing FB	Not execute FB	Set the value within the range.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
34A4H	System	Touch Probe Disabling Unsupported	FB which does not support the touch probe disabling is set.	When executing FB	Not execute FB.	Set FB which supports the touch probe disabling.
34A5H	System	Signal Target Incorrect	Incorrect string is set for the Target of the signal.	When executing FB	Not execute FB.	Set the valid string in the signal Target.
34A6H	System	Out of Detection Setting Range of Signal	The value is out of range for Detection of the signal.	When executing FB	Not execute FB.	Set Detection of the signal within the range.
34A7H	System	Out of CompensationTime Setting Range of Signal	The value is out of range for CompensationTime of the signal.	When executing FB	Not execute FB.	Set CompensationTime of the signal within the range.
34F8H	System	Device/Label Specification Incorrect	The device or label that cannot be used in the instruction was specified.	When executing instruction	Program stops/keeps Follow the setting below. Operation setting at error: Invalid device/ label/buffer memory specification	• Please check and correct error occurrence points. • Please check the public label setting.
34F9H	System	FB/FUN Callee Incorrect	The function block (FB) or function (FUN) specified in the program does not exist.	When executing instruction	The program stops.	• Please check the error occurrence points and correct it. • Please write the program again.
34FAH	System	Label Temporary Area Incorrect	The label temporary area was used incorrectly.	When executing instruction	The program stops.	Please write the program again.
34FBH	System	DI Instruction Nesting Number Error	The number of nesting levels in the DI instruction exceeded its limit (16).	When executing instruction	The program stops.	Please change the number of nesting levels (16 or less).
34FCH	System	FB/FUN Call Nesting Number Error	The number of nesting levels in the function block (FB) or function (FUN) exceeded its limit (32).	When executing instruction	The program stops.	Please change the number of nesting levels (32 or less).
34FDH	System	Pointer execution error	• The target pointer specified in the instruction does not exist. • Exceeded the usable range when the array elements was specified dynamically.	When executing instruction	The program stops.	• Please check the error occurrence points and correct it. • Please write the program again.
34FEH	System	Label Temporary Area Exceeded	The secured label temporary area size exceeded its limit.	When executing instruction	The program stops.	• Please increase the capacity of label area. • Please write the program again.
34FFH	System	Operation Error	Division where the divisor is zero was performed.	When executing instruction	Program stops/ continues. Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.
3500H	System	Operation Error	Incorrect data that cannot be converted by using the data conversion instruction was input.	When executing instruction	Program stops/ continues. Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.
3501H	System	Operation Error	The operation was performed with the invalid data (denormalized number, NaN (not a number), or ±∞).	When executing instruction	Program stops/ continues. Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.
3502H	System	Operation Error	Overflow occurred during calculation.	When executing instruction	Program stops/ continues. Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3503H	System	File Incorrect	The program file is incorrect. Or, not correctly write the program file.	When executing instruction	Interrupts importing the files.	Please write the program again.
3504H	System	Insufficient Memory Capacity	Failed to execute PSCAN/ PSTOP instruction because the execution count of PSCAN/ PSTOP instruction in 1 scan is too many.	When executing instruction	The program stops.	Please correct it so that it does not execute unnecessary PSCAN/ PSTOP instructions after checking the error occurrence points.
3505H	System	Memory Error	The memory jump destination is out of the range for memory assignment.	When executing instruction	The program stops.	Please write the program again.
3506H	System	Device/Label Specification Incorrect	• The device or label specified in the instruction exceeded the usable range. • Insufficient number of array elements.	When executing instruction	Program stops/ continues. Follow the setting below. Operation setting at error: Invalid device/ label/buffer memory specification	Please check and correct error occurrence points.
3507H	System	Operation Error	The data out of the specified range was input.	When executing instruction	Stops/continues Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.
3508H	System	Operation Error	The operation result is out of the output range. (When the result of the instruction that concatenate character strings exceeded the allowable number of characters)	When executing instruction	Stops/continues Follow the setting below. Operation setting at error: Operation error	Please check and correct error occurrence points.
3509H	System	Program Name Specification Incorrect	The program specified in the instruction is not registered to the program setting.	During END processing	Stops/continues Follow the setting below. Operation setting at error: File name specification	Modify it to a correct program name.
350AH	System	Program Error	The program includes any instruction that cannot be used or decoded.	At ready ON	The program stops.	Please check the corresponding program, and correct it.
350BH	System	END Instruction Error	The END (FEND) instruction does not exist in the program.	At ready ON	The program stops.	• Please check the corresponding program, and correct it. • Please write the program and FB program again.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control	Operation at error occurrence	Remedy
350CH	System	Program Execution Error	• After the global label setting file was modified, only the global label setting was written. Or, after the global label setting was modified, only the program and FB/FUN were written. (The global label setting file was not written.) • After the FB/FUN was modified, only the FB/FUN was written. Or, after the FB/FUN was modified, only the program and global label setting were written. (The FB/FUN was not written.) • After the buffer memory refresh setting of the global label setting was modified, only the program and FB/FUN were written to PLC. (The global label setting file was not written.)	At ready ON	The program stops.	Please write the program, FB/FUN and global label setting.
350DH	System	Insufficient Memory Capacity	Insufficient capacity of program storage target.	At ready ON	The program stops.	Please check the memory capacity of ST addon.
350EH	System	FB FUN Program Error	FB/FUN program configuration is incorrect.	At ready ON	The program stops.	• Please check the corresponding file, and correct it. • Please write the program and FB/FUN again.
350FH	System	Operation Error	The link direct device or buffer memory access device is specified for both (s) and (d) used in the BMOV instruction.	At ready ON	The program stops.	Please check the BMOV instruction of corresponding file, and correct it.
3510H	System	Device/Label Specification Incorrect	• The device or label specified in the instruction exceeded the usable range. • Array was not selected.	At ready ON	The program stops.	Please check the corresponding file, and correct it.
3511H	System	FB FUN Execution Error	Before the FB/FUN program ends, the call source program ended.	At ready ON	The program stops.	• Please check the corresponding file, and correct it. • Please write the program and FB/FUN again.
3512H	System	Parameter Error	The fixed scan program interval exceeded 16 kinds.	At ready ON	The program stops.	Please set the fixed scan program interval within 16 kinds.
3513H	System	Parameter Error	• An incorrect execution type has been specified. • An incorrect execution condition has been specified.	At ready ON	The program stops.	• Please change to a correct execution type. • Please check the fixed scan interval.
3514H	System	Program Error	The execution type that cannot be changed has been specified.	During END processing	The program stops.	Please specify the execution type that can be changed.
3515H	System	MCFB Specification Incorrect	The undefined MCFB exists.	At ready ON	The program stops.	• Please write the program again. • Please check if the necessary addon has been installed in MCFB execution.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3516H	System	MCFB Execution Error	Unable to execute MCFB.	When executing instruction	The program stops.	• Please check if the label area which is out of range has not been written. • Please write the program again.
3517H	System	ST AddOn System Memory Shortage	Memory capacity that exceeds the System.PrConst.Addon_AddonLibraryName.RamSizeMax was used.	At ready ON	The program stops.	Please check the System.PrConst.Addon_AddonLibraryName.RamSizeMax.
3518H	System	ST AddOn Internal Error	An error occurred in ST addon.	At ready ON	The program stops.	• Please install the software again. • Please write the program again.
3C00H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C01H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C02H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3C03H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C0FH	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C10H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C11H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.

Error code (Hexadecimal)	Error (System/ axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control	Operation at error occurrence	Remedy
3C14H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Take measures to reduce noise. • Reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3C2FH	System	Memory Error	An error was detected in the memory.	During operation	Stops the system.	• Please take measures to reduce noise. • Please format the memory. And, please write all files, reset the CPU module, and run it again. If the same error occurs again even after taking the above, the possible cause is a hardware failure of the CPU module. Please consult your local Mitsubishi representative.
3F00H]	System	Firmware Version Unsupported	The firmware version is not supported by the CPU module.	At power ON	Stops the system.	Please use a CPU module which supports motion modules.

22.6 List of Logging Error Codes

Error code (Hexadecimal)	Cause	Remedy
4008H	The system is in the BUSY state.	Execute it again after a certain period of time has elapsed.
4030H	Data logging was started in the following status. • Data logging with an invalid device name was specified.	Check the specified device name.
4053H	An error occurred during writing data to the specified drive.	• Check the specified drive, and then write data again. • Replace the target drive, and then write data again.
4080H	An error in the request/setting data.	Check the specified data and write it again.
40C0H	Specified label name does not exist.	• Check the label name. • Execute again after the module RUN when using local labels.
40C1H	Failed to access in label name because specified array number is larger than array size.	Reduce value of specified array, and specify within array size.
41CCH	• Started the data logging in the status that sub folder for storing the file (folder) to be used in each function cannot be created or accessed. • Unable to create and access file (folder) used in each function during data saving or data logging execution.	Execute it again after checking the file name and sub folder name.
41CDH	• Registered in the status that file (folder) cannot be created or accessed because any of the existing files (folders) has the same name as the file (folder) to be used in each function. • Unable to create and access file (folder) during data saving or data logging execution.	• Do not access the specified file or folder. • Execute it again after checking the file or folder.
41CEH	The specified file is read only and write protected.	The specified file is write protected. Check the attributes and then execute again.
41D0H	No free space in the specified drive, or the number of files in the directory of the specified drive has exceeded the maximum limit.	• Increase the free space in the drive and then execute it again. • Delete the files in the drive and then execute it again.
41D2H	It is unsupported function.	Check if the related add-ons are installed. • The SignalIO add-on is required to use devices or labels. • The MotionEventHist add-on is required to use "Event History" for the trigger condition.
41F4H	Unable to execute request content since operation protected in the system is executed.	Enable auto-logging.
4262H	The number of data points exceeds the maximum (1024 points).	Make the number of data points per setting less than 1024.
4277H	Data logging was started in the following status. • The number of saved files exceeding the set number while the "operation for exceeding file number" was set to "Stop". • The number of files exceeding the number of saved files while the "operation for exceeding file number" was set to "Overwrite".	• Execute it again after deleting the files in the memory for saving the data logging results. • Execute it again after changing the save destination.
4283H	Registered when the number of records exceeded the number of collectable records at the set internal buffer capacity.	• Correct the internal buffer capacity setting. • Reduce the number of records.
4288H	Unable to execute the request because the specified file name has exceeded the maximum number of characters.	Recheck the path name and execute it again.
4289H	An item that cannot be set in data sample condition is being set.	Check the setting of data sampled condition.
4293H	Unable to execute because the total of internal buffer has been exceeded the maximum capacity.	Recheck the total of internal buffer capacity setting and execute it again.
4C00H	There is not enough free space on target memory for result file creation.	Increase free space on target memory, then execute it again.
4C06H	System Error	Confirm specified data and write again.
4C0DH	Tried to start data logging when result file is being transferring.	Start data logging again after data logging file transfer is completed.
4C0FH	The sequence program file or global label setting file was changed when the function for which the label (global label, local label) had been specified as "Sample", "Data" or "Trigger condition" is being executed (the status is "RUN waiting (no collection)", "condition waiting (no collection)", "start waiting (no collection)", "pause", "collecting", "trigger waiting (collecting before trigger)", "collecting after trigger", "saving").	Execute it again.
4C56H	• Failed to read (access) file. • The specified file does not exist. Or the specified sub directory does not exist.	• Check if the file is deleted or not. • Check the file name or sub directory name and then execute it again.
4F01H	An error in the data type.	Recheck the data to be collected.

22.7 List of Event Codes

This section lists the events which occur in CC-Link IE TSN.
System, security, and operation are included in the event types.

System

Event code	Overview	Cause
07EF	Follow-up Temporarily Invalid Cancellation	Follow-up invalid has been cancelled.
07F0	MCFB Start (Control System)	MCFB was started.
07F1	MCFB Start (Operation System)	MCFB start or continuous start was executed.
07F2	FB Start	FB was started.
07F3	MCFB Stop	MCFB was stopped by stop cause.
07F4	File Transmission Start	File transmission was started by script file/label.
07F5	Start when SW Stroke Limit is Disabled	Start when software stroke limit is invalid by AxisName.Cd.SwStrokeLimit_Override.
07F6	Start when HW Stroke Limit is Invalid	Start when hardware stroke limit is invalid by AxisName.Cd.HwStrokeLimit_Override.
07F7	Forced Stop Detection	Forced stop signal is detection status.
07F8	Event History File Creation	Event history file was created.
07F9	Homing Request Clear	Homing request clear is ON.
07FA	Current Position Change	Current position change was executed.
07FB	Follow-up Temporary Invalid	Follow-up was switched to invalid.
07FC	Servo ON when Follow-up is Invalid	Change it to servo ON from follow-up disabled status of servo OFF.
07FD	Current Position Restoration Completion	Current position restoration was completed.
07FE	Homing Request OFF to ON	Homing request is ON. • Absolute position erase at driver side was detected. [Real drive axis only] (Detail Code: 0) • Absolute position data error in motion module was detected. (Detail Code: 1) • Axis type was changed. (Detail Code: 2) • 'Polarity(607Eh)' b7:position polarity of driver object was changed. (Detail Code: 3) • Change of driver or motor encoder was detected (Detail Code: 4) • Machine OPR was started. (Detail Code: 5) • Driver unit conversion (numerator/denominator) of axis was changed. (Detail Code: 6) • Machine OPR has never been executed after system started. (Detail Code: 7) • Current position restoration was executed. (Detail Code: 7)

Security

Event code	Overview	Cause
10100	Security key Registration/Deletion	A security key was registered or deleted.
10200	Remote Password Lock	The lock processing for the remote password was performed.
10201	Remote Password Unlock Successful	The unlock processing for the remote password was completed successfully.
10202	Remote Password Unlock Failed	The unlock processing for the remote password was not completed successfully.
10300	Access from IP restricted with IP filter setting	It was accessed from IP address restricted with the IP filter setting.
10400	File Password Registration/Change/ Deletion Successful	Registration, change, or deletion of a file password was performed and completed successfully.
10401	File Password Registration/Change/ Deletion Failed	Registration, change, or deletion of a file password was performed and was not completed successfully.
10402	File Password Clear Successful	Clear of a file password was performed and completed successfully.
10403	File Password Clear Failed	Clear of a file password was performed and was not completed successfully.

Operation

Event code	Overview	Cause
20010	Module Data Initialization	The parameter data initialization was executed by the user.
20011	Module Data Backup	The executed data backup was executed by the user.
20020	F/W Update	The F/W update was executed by the user.
20030	Online Module Change	The online module change was executed by the user.
20050	Servo Transient Transmission	An object was written with servo transient transmission.
27FFE	Execute Soft Reboot	Soft reboot was executed.
27FFF	Clear Event History	Clear Event History was executed.

PART 5 LISTS

23 List of Variables

24 List of FBs

25 Add-on library list

26 Bootsoftware List

23 List of Variables

This section contains the following information.

- Axis variables
- Axes group variables
- System variables
- Other structure variables
- ENUM enumerator

Refer to Help of the engineering tool for the setting method of variables.

Guide for reference of the variables list is shown below.

- Import

Item	Description	Details
Operation cycle	The timing for executing each operation cycle.	☞ Page 106 Operation cycle settings
Normal	The timing for executing normal task of the motion system.	☞ Page 698 Normal execution type
Logging setting cycle	The timing for correcting the logging target data.	☞ Page 510 Logging setting (LOGGING)
Service	The timing for executing the motion service processing control.	☞ Page 537 Motion service processing control
Immediately	—	—
At start	At FB start	—
At system start	At motion system start.	—
When connecting device	At a slave device connection	—
Ready ON	At the PLC READY [YO] ON	☞ Page 541 I/O signals
System basic cycle	The timing for executing the system basic cycle processing.	☞ Page 105 System basic cycle
Operation cycle(GroupEnable)	The timing for executing each operation cycle (GroupEnable)	☞ Page 106 Operation cycle settings
When axes group is valid	The timing when the axes group becomes valid.	☞ Page 68 Axes group enabled

- Type

Item	Description
STRING(??) WSTRING(??)	(??) is a value excluding Null.

- Attribute

Display	Description
LIST_WRITE_BACK	Label list (Write back to initial value possible)
LIST_READ_ONLY	Label list (Write back to initial value not possible)
NOLIST_SYSTEM	Non-label list (Base generation)

- Parameter type

Display	Description
ID_PRCST	Parameter constant (WRITE(⇨ Motion))
ID_PR	Parameter (WRITE(⇨ Motion))
ID_MD	Monitor data (READ(Motion ⇨))
ID_CD	Command data (WRITE(⇨ Motion))
ID_MDCST	Monitor data (Initial value)(READ(Motion ⇨))

Precautions

- Description for labels created automatically by engineering tool.
  If the labels are created manually, attributes can be specified by users.
- The labels with blank parameter type follow the parameter type of the parent member.

Axis variables

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
AxisName.AxisRef.							
AxisNo	Axis No.	—	WORD(UINT)		LIST_WRITE_BACK	1 to 10000	ID_MDCST
StartIO	I/O No.	—	WORD(HEX)		LIST_WRITE_BACK	—	ID_MDCST
AxisName.PrConst.							
AddressOfStation	Station address setting	At system start	WSTRING(63)		LIST_WRITE_BACK	—	ID_PRCST
AxisType	Axis type setting	At system start	ENUM(MC_AXIS_TYPE)	Drive	LIST_WRITE_BACK	—	ID_PRCST
Encoder_AxisType	Real encoder axis type setting	At system start	ENUM(MC_ENCODER_AXIS_TYPE)	Drive	LIST_WRITE_BACK	Drive	ID_PRCST
Encoder_CounterDisableSignal	Counter disabling signal	At system start	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PRCST
Encoder_RingCout_LowerValue	Encoder ring counter lower value	At system start	DINT		LIST_WRITE_BACK	—	ID_PRCST
Encoder_RingCout_UpperValue	Encoder ring counter upper value	At system start	DINT		LIST_WRITE_BACK	—	ID_PRCST
FastOperationMode	High-speed mode setting	At system start	WORD(HEX)	0x0000	LIST_WRITE_BACK	—	ID_PRCST
HwStrokeLimit_FlsSignal	Upper limit signal	At system start	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PRCST
HwStrokeLimit_RlsSignal	Lower limit signal	At system start	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PRCST
OperationCycle	Control cycle setting	At system start	INT		LIST_WRITE_BACK	0: Operate in the first operation cycle	ID_PRCST
PositioningRange	Positioning range	At system start	LREAL		LIST_WRITE_BACK	0.0 | 200000000.0 to 1000000000000.0	ID_PRCST
PosRestoration_AbsPosBase	Absolute position reference setting	At system start	ENUM(MC_POS_SOURCE)	FeedMachinePosition	LIST_WRITE_BACK	FeedMachinePosition	ID_PRCST
PosRestoration_AbsPosEnable	Absolute position management setting	At system start	ENUM(MC_ABS_SYSTEM)	Auto#type=REAL, ABSDisabled	LIST_WRITE_BACK	ABSDisabled|Enabled|Auto	ID_PRCST
RingCount_Enable	Ring counter enabled selection	At system start	BOOL		LIST_WRITE_BACK	0: Disabled|1: Enabled	ID_PRCST
RingCount_LowerValue	Ring counter lower value	At system start	LREAL	-10000000000.0	LIST_WRITE_BACK	$CST_POS_MIN to $CST_POS_MAX	ID_PRCST
RingCount_UpperValue	Ring counter upper value	At system start	LREAL	10000000000.0	LIST_WRITE_BACK	$CST_POS_MIN to $CST_POS_MAX	ID_PRCST
SlaveEmulate_Enable	Slave emulation enabled	At system start	BOOL		LIST_WRITE_BACK	0: Disabled|1: Enabled	ID_PRCST
SlaveObject	Slave object data	At system start	STRUCT(SLAVE_OBJECT_REAL)		LIST_WRITE_BACK	—	ID_PRCST

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
SlaveObject	Slave object data	At system start	STRUCT(SLAVE_OBJECT_GENERAL_OUTPUT)		LIST_WRITE_BACK	—	ID_PRCST
SlaveObject	Slave object data	At system start	STRUCT(SLAVE_OBJECT_ENCODER)		LIST_WRITE_BACK	—	ID_PRCST
SlaveObject	Slave object data	At system start	STRUCT(SLAVE_OBJECT_VIRTUAL_ENCODER)		LIST_WRITE_BACK	—	ID_PRCST
TorqueLimit_Max	Torque limit maximum value	At system start	LREAL	1000.0	LIST_WRITE_BACK	$CST_TORQUE_MIN to $CST_TORQUE_MAX	ID_PRCST
TorqueLimit_NegativeInitial	Negative direction torque limit initial value	At system start	LREAL	300.0	LIST_WRITE_BACK	$CST_TORQUE_MIN to $CST_TORQUE_MAX	ID_PRCST
TorqueLimit_PositiveInitial	Positive direction torque limit initial value	At system start	LREAL	300.0	LIST_WRITE_BACK	$CST_TORQUE_MIN to $CST_TORQUE_MAX	ID_PRCST
AxisName.Pr.							
AccelerationLimit	Acceleration limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
AccelerationZeroBehavior	Operation selection at start acceleration/ deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	ACCError	LIST_WRITE_BACK	ACCError|MaximumAcceleration	ID_PR
CmdInPos_Width	Command in-position width	Ready ON	LREAL	100.0	LIST_WRITE_BACK	0.0 to 10000000000.0	ID_PR
DecelerationLimit	Deceleration limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
Drive_UnitConvRatioDen	Driver unit conversion denominator	Ready ON	DWORD(UDINT)	1	LIST_WRITE_BACK	1 to 2147483647	ID_PR
Drive_UnitConvRatioNum	Driver unit conversion numerator	Ready ON	DWORD(UDINT)	1	LIST_WRITE_BACK	1 to 2147483647	ID_PR
ForcedStop_Signal	Forced stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PR
Homing_Required	Home position return required or not	Ready ON	BOOL	FALSE#type=VIRTUAL_LINK, TRUE	LIST_WRITE_BACK	0: FALSE|1: TRUE	ID_PR
JerkLimit	Jerk limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
OverrunOperation	Operation setting at overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc	ID_PR
StartableAtUnhomed	Start permission at home position return uncompleted	Ready ON	BOOL		LIST_WRITE_BACK	0: Disabled|1: Enabled	ID_PR
StopMode_Deceleration	Deceleration at stop	Ready ON	LREAL		LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	OverrideCurve	LIST_WRITE_BACK	OverrideCurve	ID_PR
StopMode_General	Stop selection at stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc|AlternativeAcc	ID_PR
StopMode_HwStrokeLimit	Stop selection at H/W stroke limit error occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc|AlternativeAcc	ID_PR
StopMode_ServoOff	Process selection at servo OFF command during operation	Ready ON	ENUM(MC_DECEL_STOP_MODE)	Ignore	LIST_WRITE_BACK	Ignore|ServoOffAfterImmediateStop|ServoOffAfterDecelStop	ID_PR
StopMode_SwStrokeLimit	Stop selection at S/W stroke limit error occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc|AlternativeAcc	ID_PR
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Ready ON	BOOL	1	LIST_WRITE_BACK	0: Detection Disabled|1: Detection Enabled	ID_PR
StopSignal	Stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PR
SwStrokeLimit_Lower	Software stroke limit lower value	Ready ON	LREAL	-10000000000.0	LIST_WRITE_BACK	$CST_POS_MIN to $CST_POS_MAX	ID_PR
SwStrokeLimit_Target	Software stroke limit target	Ready ON	ENUM(MC_POS_SOURCE)	Invalid	LIST_WRITE_BACK	Invalid|SetPosition|FeedMachinePosition #type=REAL,Invalid|SetPosition	ID_PR
SwStrokeLimit_Upper	Software stroke limit upper value	Ready ON	LREAL	10000000000.0	LIST_WRITE_BACK	$CST_POS_MIN to $CST_POS_MAX	ID_PR
Unit_Position	Position command unit	Ready ON	DWORD(HEX)	0	LIST_WRITE_BACK	0: pulse|65536: m|4244701184: mm|4194369536: µm|4144037888: nm|4259840: degree|11796480: Revolution|12582912: inch|16711680: arbitrary unit	ID_PR
Unit_PositionString	Position command unit string	Ready ON	WSTRING(31)		LIST_WRITE_BACK	—	ID_PR

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
Unit_Velocity	Speed command unit	Ready ON	DWORD(HEX)	768	LIST_WRITE_BACK	768: U/s|4244636416: U/ms|4194304768: U/µs|4143973120: U/ns|18176: U/min	ID_PR
VelocityLimit_Negative	Negative direction speed limit value	Ready ON	LREAL	2500000000.0	LIST_WRITE_BACK	$CST_SPEED_MIN to $CST_SPEED_MAX	ID_PR
VelocityLimit_OverOperation	Operation setting at speed limit value exceeded	Ready ON	ENUM(MC_VELOCITY_LIMIT_MODE)	Ignore	LIST_WRITE_BACK	Ignore|ImmediateStop	ID_PR
VelocityLimit_Positive	Positive direction speed limit value	Ready ON	LREAL	2500000000.0	LIST_WRITE_BACK	$CST_SPEED_MIN to $CST_SPEED_MAX	ID_PR
AxisName.Md.							
AccelerationLimit	Acceleration limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
AccelerationOverride	Acceleration override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	—	ID_MD
AccelerationZeroBehavior	Operation selection at start acceleration/deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	ACCError	LIST_READ_ONLY	—	ID_MD
ActualPosition	Feedback position	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
ActualVelocity	Feedback speed	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
Analyzing	Analyzing	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
AutoDeceleration	Automatically decelerating	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
AxisName	Axis name	At system start	WSTRING(127)		LIST_READ_ONLY	—	ID_MD
AxisStatus	Axis status	Operation cycle	ENUM(MC_AXIS_STATUS)	Disabled	LIST_READ_ONLY	—	ID_MD
BufferingFBs	Number of buffering FBs	Immediately/At request	INT		LIST_READ_ONLY	—	ID_MD
CmdInPos	Command In-position	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
CmdInPos_Width	Command In-position Width	Ready ON	LREAL	100.0	LIST_READ_ONLY	—	ID_MD
CommandedAcceleration	Specified acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedDeceleration	Specified deceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedJerk	Specified jerk	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedPosition	Specified position	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedVelocity	Specified speed	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
Cst_SetTorque	Command current torque at torque control	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
Cst_TargetTorque	Target torque at torque control	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
CumulativePosition	Cumulative current position	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
DecelerationLimit	Deceleration limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
Drive_RPDO[1..64]	RPDO (Slave device → Motion system) Mapping	When connecting device	DWORD(HEX)		LIST_READ_ONLY	—	ID_MD
Drive_TPDO[1..64]	TPDO (Motion system → Slave device) Mapping	When connecting device	DWORD(HEX)		LIST_READ_ONLY	—	ID_MD
Drive_UnitConvRatioDen	Driver unit conversion denominator	Ready ON	DWORD(UDINT)	1	LIST_READ_ONLY	—	ID_MD
Drive_UnitConvRatioNum	Driver unit conversion numerator	Ready ON	DWORD(UDINT)	1	LIST_READ_ONLY	—	ID_MD
Driver_Mode	Driver control mode	Operation cycle	ENUM(MC_DRIVE_MODE)	NoModeChange	LIST_READ_ONLY	—	ID_MD
Driver_ReadyOn	Driver ready on status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
Driver_ServoOn	Driver servo on status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
Driver_State	Driver status	Operation cycle	ENUM(MC_DRIVE_STATE)	NotReadyToSwitchOn	LIST_READ_ONLY	—	ID_MD
DriverError	Drive module error detection	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
DriverErrorID	Drive module error code	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
Encoder_Connected	Connection status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
Error	Axis error detection	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
ErrorID	Axis error code	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
FeedMachinePosition	Feed function position	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
FollowupDisable	Follow-up disabled	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
ForcedStop_Released	Forced stop cancelling	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
ForcedStop_Signal	Forced stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_READ_ONLY	—	ID_MD
ForcedStop_Valid	Forced stop enabled	Ready ON	BOOL		LIST_READ_ONLY	—	ID_MD
Homing_Complete	Home position return completed	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
Homing_Request	Home position return request	Immediately	BOOL	TRUE	LIST_READ_ONLY	—	ID_MD
Homing_Required	Home position return required or not	Ready ON	BOOL		LIST_READ_ONLY	—	ID_MD
Homing_Status	Home position return operation status	Operation cycle	WORD(HEX)	0xFFFF	LIST_READ_ONLY	—	ID_MD
HwStrokeLimit_FlsStatus	Upper limit signal status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
HwStrokeLimit_Override	Hardware stroke limit override	At start	STRING(15)		LIST_READ_ONLY	—	ID_MD
HwStrokeLimit_RlsStatus	Lower limit signal status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
InVelocity	Target speed reached	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
Io_PosActualValue	Object data_PosActualValue	Operation cycle	DINT		LIST_READ_ONLY	—	ID_MD
Io_PosEncoderResolution	Object data_PosEncoderResolution	Operation cycle	DWORD(UDINT)		LIST_READ_ONLY	—	ID_MD
Io_Statusword	Object data_Statueword	Operation cycle	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
Io_TargetPos	Object data_TargetPos	Operation cycle	DINT		LIST_READ_ONLY	—	ID_MD
JerkLimit	Jerk limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
OperationCycle	Control cycle	At system start	INT		LIST_READ_ONLY	—	ID_MD
OverrunOperation	Operation setting at overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	Ignore	LIST_READ_ONLY	—	ID_MD
PosRestoration_Status	Current position restoration status	Service	ENUM(MC_POS_RESTORATION_STATUS)	NotExecute	LIST_READ_ONLY	—	ID_MD
ProfileID	Execution profile ID No.	Operation cycle	WORD(UINT)		LIST_READ_ONLY	—	ID_MD
SetAcceleration	Command current acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
SetPosition	Command current position	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
SetVelocity	Set velocity	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
SlaveEmulate_Enable	Slave emulating	Service	BOOL		LIST_READ_ONLY	—	ID_MD
StartableAtUnhomed	Start permission at home position return uncompleted	Ready ON	BOOL		LIST_READ_ONLY	—	ID_MD
StopMode_Deceleration	Stop selection at deceleration to stop	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	RapidCurve	LIST_READ_ONLY	—	ID_MD
StopMode_General	Stop selection at stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_READ_ONLY	—	ID_MD
StopMode_HwStrokeLimit	Stop selection at H/W stroke limit error occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_READ_ONLY	—	ID_MD
StopMode_ServoOff	Process selection at servo OFF command during operation	Ready ON	ENUM(MC_DECEL_STOP_MODE)	Ignore	LIST_READ_ONLY	—	ID_MD
StopMode_SwStrokeLimit	Stop selection at S/W stroke limit error occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_READ_ONLY	—	ID_MD
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Ready ON	BOOL		LIST_READ_ONLY	—	ID_MD
StopSignal	Stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_READ_ONLY	—	ID_MD
StopStatus	Stop status	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
SwStrokeLimit_Lower	Software stroke limit lower value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
SwStrokeLimit_Override	Software stroke limit override	At start	STRING(15)		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
SwStrokeLimit_Target	Software stroke limit target	Ready ON	ENUM(MC_POS_SOURCE)	Invalid	LIST_READ_ONLY	—	ID_MD
SwStrokeLimit_Upper	Software stroke limit upper value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
Sync_PhaseShift	Phase compensation amount	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TargetAcceleration	Target acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TargetDeceleration	Target deceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TargetVelocity	Target speed	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TorqueLimit_Negative	Negative direction torque limit value	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TorqueLimit_Positive	Positive direction torque limit value	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
Unit_Position	Position command unit	Ready ON	DWORD(HEX)	0	LIST_READ_ONLY	0: pulse|65536: m|4244701184: mm|4194369536: µm|4144037888: nm|4259840: degree|11796480: Revolution|12582912: inch|16711680: arbitrary unit	ID_MD
Unit_PositionDisplay	Position command unit display	Ready ON	WSTRING(31)	pulse	LIST_READ_ONLY	—	ID_MD
Unit_PositionString	Position command unit string	Ready ON	WSTRING(31)		LIST_READ_ONLY	—	ID_MD
Unit_Velocity	Speed command unit	Ready ON	DWORD(HEX)	0x00000300	LIST_READ_ONLY	768: U/s|4244636416: U/ms|4194304768: U/µs|4143973120: U/ns|18176: U/min	ID_MD
Unit_VelocityDisplay	Speed command unit display	Ready ON	WSTRING(31)	pulse/s	LIST_READ_ONLY	—	ID_MD
UseInGroup	Using axes group	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
VelocityLimit_Negative	Negative direction speed limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
VelocityLimit_OverOperation	Operation setting at speed limit value exceeded	Ready ON	ENUM(MC_DECEL_STOP_MODE)	Ignore	LIST_READ_ONLY	—	ID_MD
VelocityLimit_Positive	Positive direction speed limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
VelocityOverride	Speed override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	—	ID_MD
Warning	Axis warning detection	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
WarningID	Axis warning code	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
AxisName.Cd.							
AccelerationOverride	Acceleration override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	0.01 to 10.00	ID_CD
Encoder_Connect	Connection command	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_CD
Encoder_CounterDisable	Counter disabled	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_CD
Encoder_InputValue	Encoder input value	Operation cycle	DINT		LIST_READ_ONLY	—	ID_CD
ErrorReset	Axis error reset	Service	BOOL		LIST_READ_ONLY	—	ID_CD
FollowupDisable	Follow-up disabled	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_CD
Homing_ClearRequest	Home position return request clear	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_CD
HwStrokeLimit_Override	Hardware stroke limit override	At start	STRING(15)		LIST_READ_ONLY		ID_CD
SlaveEmulate_Param	Slave emulation parameter	Immediately	STRUCT(TARGET_REF)		LIST_READ_ONLY	—	ID_CD
SlaveEmulate_Request	Slave emulation request	Service	ENUM(MC_SWITCHING_REQUEST)	NoRequest	LIST_READ_ONLY	—	ID_CD
SwStrokeLimit_Override	Software stroke limit override	At start	STRING(15)		LIST_READ_ONLY		ID_CD
TorqueLimit_Negative	Negative direction torque limit value	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_CD
TorqueLimit_Positive	Positive direction torque limit value	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_CD
VelocityOverride	Speed override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	0.00 to 10.00	ID_CD

Axes group variables

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
AxesGroupName.AxesGroupRef.							
GroupNo	Axes group No.	—	WORD(UINT)	1	LIST_WRITE_BACK	1 to 10000	ID_MDCST
StartIO	I/O No.	—	WORD(HEX)		LIST_WRITE_BACK	—	ID_MDCST
AxesGroupName.Pr.							
AccelerationLimit	Acceleration limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
AccelerationZeroBehavior	Operation selection at start acceleration/deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	ACCError	LIST_WRITE_BACK	ACCError|MaximumAcceleration	ID_PR
Axis[1..16]	Structuring axis	Ready ON	STRUCT(AxisParameter/AXIS_REF)		LIST_WRITE_BACK	—	ID_PR
CmdInPos_Width	Command In-position width	Ready ON	LREAL	100.0	LIST_WRITE_BACK	0.0 to 10000000000.0	ID_PR
DecelerationLimit	Deceleration limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
JerkLimit	Jerk limit value	Ready ON	LREAL	2147483647.0	LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
OverrunOperation	Operation setting at overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_WRITE_BACK	ImmediateStop	ID_PR
StopMode_Deceleration	Deceleration at stop	Ready ON	LREAL		LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	OverrideCurve	LIST_WRITE_BACK	OverrideCurve	ID_PR
StopMode_ErrorInGroup	Structuring axis operation selection at axis stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_WRITE_BACK	ImmediateStop	ID_PR
StopMode_General	Stop selection at stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc|AlternativeAcc	ID_PR
Unit_Position	Position command unit	When Axes Group is Valid	DWORD(HEX)	0x00000000	LIST_WRITE_BACK	0: pulse|65536: m|4244701184: mm|4194369536: µm|4144037888: nm|4259840: degree|11796480: Revolution|12582912: inch|16711680: arbitrary unit	ID_PR
Unit_PositionString	Position command unit string	When Axes Group is Valid	WSTRING(31)		LIST_WRITE_BACK	—	ID_PR
Unit_Velocity	Speed command unit	When Axes Group is Valid	DWORD(HEX)	0x00000300	LIST_WRITE_BACK	768: U/s|4244636416: U/ms|4194304768: U/µs|4143973120: U/ns|18176: U/min	ID_PR
VelocityLimit	Speed limit value	Ready ON	LREAL	2500000000.0	LIST_WRITE_BACK	$CST_SPEED_MIN to $CST_SPEED_MAX	ID_PR
AxesGroupName.Md.							
AccelerationLimit	Acceleration limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
AccelerationOverride	Acceleration override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	—	ID_MD
AccelerationZeroBehavior	Operation selection at start acceleration/ deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	ACCError	LIST_READ_ONLY	—	ID_MD
ActualVelocity	Feedback speed	Operation cycle(GroupEnable)	LREAL		LIST_READ_ONLY	—	ID_MD
Analyzing	Analyzing	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
AutoDeceleration	Automatically decelerating	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
Axis[1..16]	Structuring axis	Immediately	STRUCT(Axis Parameter/ AXIS_REF)		LIST_READ_ONLY	—	ID_MD
BufferingFBs	Number of buffering FBs	Immediately	INT		LIST_READ_ONLY	—	ID_MD
CmdInPos	Command in-position	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
CmdInPos_Width	Command in-position width	Ready ON	LREAL	100.0	LIST_READ_ONLY	—	ID_MD
CommandedAcceleration	Specified acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedDeceleration	Specified deceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedJerk	Specified jerk	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
CommandedVelocity	Specified speed	Operation cycle(GroupEnable)	LREAL		LIST_READ_ONLY	—	ID_MD
DecelerationLimit	Deceleration limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
Error	Axes group error detection	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
ErrorID	Axes group error code	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
GroupName	Axes group name	Immediately	WSTRING(127)		LIST_READ_ONLY	—	ID_MD
GroupStatus	Axes group status	Operation cycle	ENUM(MC_AXES_GROUP_STATUS)	GroupDisabled	LIST_READ_ONLY	—	ID_MD
InterpolationAxes	Interpolation axis	Operation cycle	DWORD(HEX)		LIST_READ_ONLY	—	ID_MD
InVelocity	Target speed reached	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
JerkLimit	Jerk limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
NumberOfAxes	Number of structuring axes	Immediately	INT		LIST_READ_ONLY	—	ID_MD
OverrunOperation	Operation setting at overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	Ignore	LIST_READ_ONLY	—	ID_MD
SetAcceleration	Command current acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
SetVelocity	Set velocity	Operation cycle(GroupEnable)	LREAL		LIST_READ_ONLY	—	ID_MD
StopMode_Deceleration	Deceleration at stop	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
StopMode_DecelerationCurve	Stop selection at deceleration to stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	RapidCurve	LIST_READ_ONLY	—	ID_MD
StopMode_ErrorInGroup	Structuring axis operation selection at axis stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	ImmediateStop	LIST_READ_ONLY	—	ID_MD
StopMode_General	Stop selection at stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_READ_ONLY	—	ID_MD
TargetAcceleration	Target acceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
TargetDeceleration	Target deceleration	Operation cycle	LREAL		LIST_READ_ONLY	—	ID_MD
TargetVelocity	Target speed	Operation cycle(GroupEnable)	LREAL		LIST_READ_ONLY	—	ID_MD
Unit_Position	Position command unit	When Axes Group is Valid	DWORD(HEX)	0	LIST_READ_ONLY	0: pulse|65536: m|4244701184: mm|4194369536: µm|4144037888: nm|4259840: degree|11796480: Revolution|12582912: inch|16711680: arbitrary unit	ID_MD
Unit_PositionDisplay	Position command unit display	When Axes Group is Valid	WSTRING(31)	pulse	LIST_READ_ONLY	—	ID_MD
Unit_PositionString	Position command unit string	When Axes Group is Valid	WSTRING(31)		LIST_READ_ONLY	—	ID_MD
Unit_Velocity	Speed command unit	When Axes Group is Valid	DWORD(HEX)	0x00000300	LIST_READ_ONLY	768: U/s|4244636416: U/ms|4194304768: U/µs|4143973120: U/ns|18176: U/min	ID_MD
Unit_VelocityDisplay	Speed command unit display	When Axes Group is Valid	WSTRING(31)	pulse/s	LIST_READ_ONLY	—	ID_MD
VelocityLimit	Speed limit value	Ready ON	LREAL		LIST_READ_ONLY	—	ID_MD
VelocityOverride	Speed override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	—	ID_MD
Warning	Axes group warning detection	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
WarningID	Axes group warning code	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
AxesGroupName.Cd.							
AccelerationOverride	Acceleration override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	0.01 to 10.00	ID_CD
ErrorReset	Axes group error reset	Service	BOOL		LIST_READ_ONLY	—	ID_CD
JerkOverride	Jerk Override Coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	1	ID_CD
VelocityOverride	Speed override coefficient	Operation cycle	LREAL	1.0	LIST_READ_ONLY	0.00 to 10.00	ID_CD

System variables

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
System.PrConst.							
Addon_AbsSystem	Addon AbsSystem parameter	At system start	STRUCT(ADDON_PARAM)	{1024|60}	LIST_WRITE_BACK	—	ID_PRCST
Addon_Axis	Addon axis parameter	At system start	STRUCT(ADDON_PARAM)	{16384|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_ExternalSignal	Addon ExternalSignal parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_FileTransfer	Addon FileTransfer parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_Logging	Addon Logging parameter	At system start	STRUCT(ADDON_PARAM)	{16384|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_MotionControl_AxisFilter	Addon MotionControl_AxisFilter parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_MotionControl_General	Addon MotionControl_General parameter	At system start	STRUCT(ADDON_PARAM)	{4096|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_MotionControl_Sync	Addon MotionControl_Sync parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_MotionEngine	Addon MotionEngine parameter	At system start	STRUCT(ADDON_PARAM)	{4096|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_MotionEventHist	Addon MotionEventHist parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_NetworkDriver_CCIETSN	Addon NetworkDriver_CCIETSN parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_PackagingApp	Addon PackagingApp parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_PlcInstruction	Addon PlcInstruction parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_ProfileControl	Addon ProfileControl parameter	At system start	STRUCT(ADDON_PARAM)	{16384|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_Program_ST	Addon Program_ST parameter	At system start	STRUCT(ADDON_PARAM)	{16384|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_ServoDriver_CANopen	Addon ServoDriver_CANopen parameter	At system start	STRUCT(ADDON_PARAM)	{2048|0}	LIST_WRITE_BACK	—	ID_PRCST
Addon_SignalIO	Addon SignalIO parameter	At system start	STRUCT(ADDON_PARAM)	{1024|0}	LIST_WRITE_BACK	—	ID_PRCST
BuffermemoryRefreshCycle	Buffer memory refresh cycle setting	At system start	STRUCT(CYCLE_PARAM)		LIST_WRITE_BACK	—	ID_PRCST
EventHistoryCpu_Exclude	Event excluding CPU event history	At system start	STRING(255)	"0x700-0x7ff"	LIST_WRITE_BACK	—	ID_PRCST
EventHistoryMotion_Capacity	Motion event history capacity	At system start	INT	128	LIST_WRITE_BACK	1 to 2048	ID_PRCST
EventHistoryMotion_Exclude	Motion event history excluded event	At system start	STRING(255)		LIST_WRITE_BACK	—	ID_PRCST

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
EventHistoryMotion_Path	Motion event history path	At system start	STRING(127)		LIST_WRITE_BACK	—	ID_PRCST
ExcludeWarning	Excluded warning	At system start	STRING(255)		LIST_WRITE_BACK	—	ID_PRCST
FastOperationMode	High-speed mode setting	At system start	WORD(HEX)	0x0000	LIST_WRITE_BACK	—	ID_PRCST
FileTransfer_AcFile_lch	File transfer access control (File in latch drive)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcFile_ram	File transfer access control (File in RAM drive)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcFile_rom	File transfer access control (File in user drive)	At system start	WORD(HEX)	1	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
FileTransfer_AcFile_sdc	File transfer access control (File in SD memory card)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcFile_sys	File transfer access control (File in system drive)	At system start	WORD(HEX)	1	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcImage_lch	File transfer access control (Latch drive image)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcImage_ram	File transfer access control (RAM drive message)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
FileTransfer_AcImage_rom	File transfer access control (User drive image)	At system start	WORD(HEX)	2	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcImage_sys	File transfer access control (System drive image)	At system start	WORD(HEX)	0	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AcLabel	File transfer access control (Label)	At system start	WORD(HEX)	3	LIST_READ_ONLY	0: Read protected/ write protected|1: Read protected/ write permitted|2: Read permitted/ write protected|3: Read permitted/ write permitted	ID_PRCST
FileTransfer_AutorunEnable	File transfer auto execution enabled	At system start	BOOL	1	LIST_READ_ONLY	0: Disabled|1: Enabled	ID_PRCST
FileTransfer_LogCapacity	File transfer log capacity	At system start	INT	128	LIST_WRITE_BACK	-1 to 2048	ID_PRCST
LabelMemorySize	Label memory size	At system start	INT	1024	LIST_WRITE_BACK	128 to 8192	ID_PRCST
Link_MotionStationAutoRefresh	Motion control station link device auto refresh	At system start	BOOL		LIST_WRITE_BACK	0: FALSE|1: TRUE	ID_PRCST
Link_MotionStationRefreshType	Refresh method of send/receive data at motion control station	At system start	ENUM(MC_STATION_REFRESH_MODE)	EmphasisOperationCycle	LIST_WRITE_BACK	EmphasisOperationCycle	ID_PRCST
Logging_AutoLoggingEnable	Auto logging enabled	At system start	BOOL		LIST_READ_ONLY	0: Disabled|1: Enabled	ID_PRCST
MeasuresPrograms	Measurement flag for program information	At system start	BOOL	1	LIST_WRITE_BACK	0: Do not measure|1: Measure	ID_PRCST
OperationCycle[1..1]	Operation cycle setting	At system start	STRUCT(CYCLE_PARAM)		LIST_WRITE_BACK	—	ID_PRCST

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
SoftReboot_Enable	Soft reboot enabled	At system start	BOOL	0	LIST_WRITE_BACK	0: Disabled|1: Enabled	ID_PRCST
SystemBaseCycle	System basic cycle setting	At system start	STRUCT(CYCLE_PARAM)		LIST_WRITE_BACK	—	ID_PRCST
MultiThreadMode	For Manufacturer Setting	At system start	WORD(HEX)	0x0000	LIST_WRITE_BACK	—	ID_PRCST
System.Pr.							
ForcedStop_Signal	All axes forced stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_WRITE_BACK	—	ID_PR
StopMode_All	Stop selection at all axes stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_WRITE_BACK	ImmediateStop|KeepCurrentAcc|AlternativeAcc	ID_PR
StopMode_AllDeceleration	Deceleration at all axes stop	Ready ON	LREAL		LIST_WRITE_BACK	$CST_ACC_DEC_MIN to $CST_ACC_DEC_MAX	ID_PR
System.Cd.							
AddonLimit_Key	AddOn library configuration limit key setting	Immediately	STRING(31)		LIST_READ_ONLY	—	ID_CD
AddonLimit_Level	AddOn library configuration limit level	Immediately	INT		LIST_READ_ONLY	—	ID_CD
AddonLimit_Regist	AddOn library configuration limit request	Service	ENUM(MC_ADDON_LIMIT_CMD)	_None	LIST_READ_ONLY	—	ID_CD
BackupRestore	Backup restore request		WORD(HEX)		LIST_READ_ONLY	—	ID_CD
ErrorReset	System error reset	Service	BOOL		NOLIST_SYSTEM	—	ID_CD
EventHistoryMotion_Clear	Motion Event History Clear Execution Request	Service	BOOL		LIST_READ_ONLY	—	D_CD
FileTransfer_Command	File transfer command	Service	STRING(255)		LIST_READ_ONLY	—	ID_CD
FileTransfer_Execute	File transfer execution request	Service	BOOL		LIST_READ_ONLY	—	ID_CD
FileTransfer_Key	File transfer execution key	Service	STRING		LIST_READ_ONLY	—	ID_CD
SequenceReady	PLC ready	Service	BOOL		NOLIST_SYSTEM	—	ID_CD
SoftRebootRequest	Soft reboot request	Service	STRING(15)		NOLIST_SYSTEM	—	ID_CD
Storage_sdcForcedDisable	SD memory card force disabled command	Service	BOOL		LIST_READ_ONLY	—	ID_CD
Storage_sdcRemovalProhibit	SD memory card removal prohibition	Service	BOOL		LIST_READ_ONLY	—	ID_CD
System.Md.							
Addon_AbsSystem	Addon AbsSystem monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_Axis	Addon Axis monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_ExternalSignal	Addon ExternalSignal monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_FileTransfer	Addon FileTransfer monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_Logging	Addon Logging monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
Addon_MotionControl_AxisFilter	Addon MotionControl_AxisFilter monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_MotionControl_General	Addon MotionControl_General monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_MotionControl_Sync	Addon MotionControl_Sync monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_MotionEngine	Addon MotionEngine monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_MotionEventHist	Addon MotionEventHist monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_NetworkDriver_CCIETSN	Addon NetworkDriver_CCIETSN monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_PackagingApp	Addon PackagingApp monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_PlcInstruction	Addon PlcInstruction monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_ProfileControl	Addon ProfileControl monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_Program_ST	Addon Program_ST monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_ServoDriver_CANopen	Addon ServoDriver_CANopen monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
Addon_SignalIO	Addon SignalIO monitor	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
AddonLimit_Level	AddOn library configuration limit level	Immediately	INT		NOLIST_SYSTEM	—	ID_MD
AddonLimit_State	AddOn library configuration limit state	Immediately	ENUM(MC_ADDON_LIMIT_STATE)	NoLimitation	NOLIST_SYSTEM	—	ID_MD
BackupRestoreStatus	Backup restore information	Service	INT		LIST_READ_ONLY	—	ID_MD
BuffermemoryFreeMcfbArea	Buffer memory MCFB Communication area free size	Immediately	DWORD(UDINT)		LIST_READ_ONLY	—	ID_MD
BuffermemoryRefreshCycle	Buffer memory refresh cycle monitor	Immediately	STRUCT(CYCLE_MONI)		NOLIST_SYSTEM	—	ID_MD
Environment_UserRootPath	User root path	At system starte	STRING(127)		NOLIST_SYSTEM	—	ID_MD
Error	Motion system error detection	Immediately	BOOL		NOLIST_SYSTEM	—	ID_MD
ErrorHistory[0..64499]	Error history information	Immediately	WORD(HEX)		LIST_READ_ONLY	—	ID_MD
ErrorHistory_Latest	Latest error history data No.	Immediately	INT		LIST_READ_ONLY	—	ID_MD
ErrorID	Latest motion system error code	Immediately	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
EventHistoryMotion_ClearStatus	Motion event history clear executing state	Service	ENUM(MC_EXECUTION_STATE)	Ready	LIST_READ_ONLY	—	ID_MD
EventHistoryMotion_Path	Motion event history path	At system starte	STRING(127)		NOLIST_SYSTEM	—	ID_MD
FileTransfer_DriveOperating	Drive operating	Service	WORD(HEX)		LIST_READ_ONLY	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
FileTransfer_State	File transfer executing state	Service	ENUM(MC_EXECUTION_STATE)	Ready	LIST_READ_ONLY	—	ID_MD
ForcedStop_Override	All axes forced stop override	Service	STRING(15)		LIST_READ_ONLY		ID_MD
ForcedStop_Released	Forced stop cancelling	Operation cycle	BOOL		LIST_READ_ONLY	—	ID_MD
ForcedStop_Signal	All axes forced stop signal	Ready ON	STRUCT(SIGNAL_SELECT)		LIST_READ_ONLY	—	ID_MD
HwStatus_OperationgTime	Cumulative power-on time	Service	DWORD(UDINT)		NOLIST_SYSTEM	—	ID_MD
HwStatus_RomWriteCycle	Flash ROM write count index value	Service	DWORD(UDINT)		NOLIST_SYSTEM	—	ID_MD
HwStatus_Temperature[0..1]	Internal temperature of module	Service	INT		NOLIST_SYSTEM	—	ID_MD
LabelMemoryFreeSize	Label memory free size	Immediately	INT	0	LIST_READ_ONLY	—	ID_MD
MemorySize	System memory size	Service	STRUCT(ADDON_PARAM)		NOLIST_SYSTEM	—	ID_MD
MemoryUsage	System memory usage	Service	STRUCT(ADDON_MONI)		NOLIST_SYSTEM	—	ID_MD
NetworkError	Network error detection	Immediately	BOOL		NOLIST_SYSTEM	—	ID_MD
NetworkErrorID	Network error code	Immediately	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
OperationCycle[1..1]	Operation cycle monitor	Immediately	STRUCT(CYCLE_MONI)		NOLIST_SYSTEM	—	ID_MD
Program_Ei	EI flag	Immediately	BOOL		LIST_READ_ONLY	—	ID_MD
Program_NormalTaskCycle	Normal task processing time monitor	Normal	STRUCT(CYCLE_MONI)		NOLIST_SYSTEM	—	ID_MD
Ready	Ready	Service	BOOL		NOLIST_SYSTEM	—	ID_MD
StopMode_All	Stop selection at all axes stop by factors	Ready ON	ENUM(MC_DECEL_STOP_MODE)	AlternativeAcc	LIST_READ_ONLY	—	ID_MD
StopMode_AllDeceleration	Deceleration at all axes stop	At startReady ON	LREAL		LIST_READ_ONLY	—	ID_MD
Storage_Ich	Latch drive information	Service	STRUCT(STORAGE_INFORMATION)		NOLIST_SYSTEM	—	ID_MD
Storage_ram	RAM drive information	Service	STRUCT(STORAGE_INFORMATION)		NOLIST_SYSTEM	—	ID_MD
Storage_rom	User drive information	Service	STRUCT(STORAGE_INFORMATION)		NOLIST_SYSTEM	—	ID_MD
Storage_sdc	SD memory card information	Service	STRUCT(STORAGE_INFORMATION)		NOLIST_SYSTEM	—	ID_MD
Storage_sdcForcedDisabled	SD memory card force disabled	Service	BOOL		NOLIST_SYSTEM	—	ID_MD
Storage_sdcInserted	SD memory card inserted	Service	BOOL		NOLIST_SYSTEM	—	ID_MD
Storage_sdcProtected	SD memory card protected	Service	BOOL		NOLIST_SYSTEM	—	ID_MD

Variable/Structure name	Name	Import	Type	Initial value	Attribute	Range	Parameter type
Storage_sys	System drive information	Service	STRUCT(STORAGE_INFORMATION)		NOLIST_SYSTEM	—	ID_MD
Sync	Synchronization flag	Service	BOOL		NOLIST_SYSTEM	—	ID_MD
SystemBaseCycle	System basic cycle monitor	Immediately	STRUCT(CYCLE_MONI)		NOLIST_SYSTEM	—	ID_MD
SystemBaseCycle_Counter	System basic cycle counter	System basic cycle	WORD(UINT)		NOLIST_SYSTEM	—	ID_MD
Version_BaseSystemSw	Basic system software version	At system start	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
Version_BootSw	Boot software version	At system start	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
Version_NetworkBootSw	Network boot software version	At system start	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
Warning	Motion system warning detection	Immediately	BOOL		NOLIST_SYSTEM	—	ID_MD
WarningID	Latest motion system warning code	Immediately	WORD(HEX)		NOLIST_SYSTEM	—	ID_MD
WDTerror	WDT error	Immediately	BOOL		NOLIST_SYSTEM	—	ID_MD
System.LoggingRef[1..10].Cd.							
SettingPath	Logging setting path	Immediately	STRING(127)		LIST_READ_ONLY	—	ID_CD
StartLog	Logging request	Service	BOOL		LIST_READ_ONLY	—	ID_CD
Trigger	Trigger request	Logging setting cycle	BOOL		LIST_READ_ONLY	—	ID_CD
System.LoggingRef[1..10].Md.							
ErrStatus	Error status	Service	WORD(UINT)		LIST_READ_ONLY	—	ID_MD
LogDataPath	Logging data file path	Service	STRING(127)		LIST_READ_ONLY	—	ID_MD
LogDataSavedCount	Number of saved files	Service	WORD(UINT)		LIST_READ_ONLY	—	ID_MD
LoggingStatus	Logging status	Service	BOOL		LIST_READ_ONLY	—	ID_MD
LogType	Logging type	Logging setting cycle	ENUM(MC_LOGGING_TYPE)	None	LIST_READ_ONLY	—	ID_MD
SamplingTime[0..1]	Data collection interval	Service	DWORD(UDINT)		LIST_READ_ONLY		ID_MD
SaveStatus	Save status	Service	ENUM(MC_LOGGING_SAVE_STATUS)		LIST_READ_ONLY	—	ID_MD
SettingPath	Logging setting file	Immediately	STRING(127)		LIST_READ_ONLY	—	ID_MD
TriggerCount	Trigger detection count	Logging setting cycle	INT		LIST_READ_ONLY	—	ID_MD
TrigerCountIgnored	Trigger ignored count	Logging setting cycle	INT		LIST_READ_ONLY	—	ID_MD
Triggered	Triggered	Logging setting cycle	BOOL		LIST_READ_ONLY	—	ID_MD
TriggerStatus[1..32]	Trigger status	Logging setting cycle	BOOL		LIST_READ_ONLY	—	ID_MD

Other structure variables

Variable/Structure name	Name	Type	Initial value
MC_CAM_REF			
ProfileData	Profile	STRUCT(./PROFILE_DATA)	
MC_CAM_ID			
ProfileID	Profile ID	STRUCT(./PROFILE_ID)	
MC_TRIGGER_REF			
Signal	Trigger signal	STRUCT(./SIGNAL_SELECT)	
MC_INPUT_REF			
Signal	Input signal	STRUCT(./SIGNAL_SELECT)	
MC_OUTPUT_REF			
Signal	Output signal	STRUCT(./SIGNAL_SELECT)	
MC_TRACK_REF	Track option		
OnCompensation	ON time compensation	LREAL	
OffCompensation	OFF time compensation	LREAL	
Hysteresis	Switching prohibited distance	LREAL	
TARGET_REF	Input signal		
StartIO	IO No.	WORD(HEX)	
Target	Target	WSTRING(63)	
SIGNAL_SELECT	Signal select		
Source	Signal	STRUCT(./TARGET_REF)	
Detection	Signal detection method	ENUM(MC_SIGNAL_LOGIC)	
CompensationTime	Compensation time	LREAL	
FilterTime	Filter time	LREAL	
PROFILE_DATA			
Location	Calculation profile data storage location	STRUCT(./FILE_LOCATION)	
ID	Profile ID	STRUCT(./PROFILE_ID)	
FILE_LOCATION			
FileName	File name	STRING(63)	
Path	Folder specification	STRING(63)	
PROFILE_ID			
Number	Profile ID No.	WORD(UINT)	
CYCLE_PARAM			
Cycle	Cycle setting	DINT	
NumOfCycleOverWngDetectTimes	Number of cycle over warning detections	WORD(UINT)	1
NumOfCycleOverErrDetectTimes	Number of cycle over error detections	WORD(UINT)	5
CycleOverErrorType	Cycle over error selection	ENUM(MC_ERROR_CLASS)	ModerateError
CYCLE_MONI			
ProcessingTime	Processing time	DWORD(UDINT)	
MaximumProcessingTime	Maximum processing time	DWORD(UDINT)	
Cycle	Setting cycle	DWORD(UDINT)	
CycleOver	Cycle over	BOOL	
ADDON_PARAM			
RamSizeMax	Maximum RAM size	DWORD(UDINT)	
BackupRamSizeMax	Maximum backup RAM size	DWORD(UDINT)	
ADDON_MONI			
RamUsage	RAM usage	DWORD(UDINT)	
RamMaxUsage	RAM usage maximum	DWORD(UDINT)	
BackupRamUsage	Backup RAM usage	DWORD(UDINT)	
BackupRamMaxUsage	Backup RAM usage maximum	DWORD(UDINT)	
Version	Version	STRING(15)	

Variable/Structure name	Name	Type	Initial value
STORAGE_INFORMATION			
Capacity	Capacity	DWORD(UDINT)	
FreeSpace	Free space	DWORD(UDINT)	
Mount	Mount status	BOOL	
INSTANCE_ID			
StartIO	IO No.	WORD(HEX)	
Number	Instance ID	WORD(UINT)	
PROFILE_CAM_DATA			
Interpolate	Specifying interpolation method	INT	
Resolution	Resolution	DWORD(UDINT)	
InputUnitString	Input unit string	WSTRING(31)	
OutputUnitString	Output unit string	WSTRING(31)	
StartPoint	Start point	LREAL	
StartStroke	Initial stroke amount	LREAL	
StartVelocity	Initial speed	LREAL	
StartAcceleration	Initial acceleration	LREAL	
CycleLength	Length per cycle	LREAL	
CycleMin	Minimum value per cycle	LREAL	
CycleMax	Maximum value per cycle	LREAL	
CycleTime	Time per cycle	LREAL	
Stroke	Stroke amount	LREAL	
NumberOfSections	Number of sections	WORD(UINT)	
Options	Options	DWORD(HEX)	
PROFILE_CAM_ELEMENT			
CurveType	Cam curve type	ENUM(./MC_CAM_CURVE_TYPE)	
EndPoint	End point	LREAL	
Stroke	Stroke	LREAL	
RangeP1	Curve application range (P1)	LREAL	
RangeP2	Curve application range (P2)	LREAL	
RangeL1	Acceleration/deceleration range compensation (Range L1)	LREAL	
RangeL2	Acceleration/deceleration range compensation (Range L2)	LREAL	
EndVelocity	End point speed	LREAL	
EndAcceLeration	End point acceleration	LREAL	
PROFILE_ROTARY_CUTTER			
Resolution	Resolution	DWORD(UDINT)	
InputUnitString	Input unit string	WSTRING(31)	
Options	Options	DWORD(HEX)	
AutoGenerationOptions	Auto-generation option	WORD(HEX)	
NumberOfCutter	Number of cutter	WORD(UINT)	
SyncSectionAccRatio	Synchronous section acceleration ratio	LREAL	
SheetLength	Sheet length	LREAL	
SheetSyncWidth	Sheet synchronization width	LREAL	
SyncAxisLength	Synchronous axis length	LREAL	
SyncPositionAdjustment	Synchronous position tuning	LREAL	
AccDecWidth	Acceleration/deceleration width	LREAL	
AsyncSpd	Asynchronous speed result	LREAL	
PROFILE_MULTIDIMENSIONAL_DATA			
Dimension	Number of input dimensions	DWORD(UDINT)	
Resolution	Resolution	DWORD[0..2]	
InputUnitString	Input unit string	WSTRING(31)[0..2]	
OutputUnitString	Output unit string	WSTRING(31)[0..2]	

Variable/Structure name	Name	Type	Initial value
CycleLength	Length per cycle	LREAL[0..2]	
Stroke	Stroke amount	LREAL[0..2]	
Options	Options	DWORD(HEX)	
PROFILE_MULTIDIMENSIONAL_ELEMENT			
Input1	Input value	LREAL	
Input2	Input value	LREAL	
Input3	Input value	LREAL	
Output	Output value	LREAL	
PROGRAM_INFO			
ExecutionTime	Execution time	DWORD(UDINT)	
Number	Execution count	WORD(UINT)	
Status	Status	WORD(HEX)	
SLAVE_OBJECT_REAL			
ControlWord	ControlWord	WSTRING(63)	$CST_CONTROL_WORD
EncoderIncrements	EncoderIncrements	WSTRING(63)	$CST_ENCODER_INCREMENTS
FollowingErrActualValue	FollowingErrActualValue	WSTRING(63)	$CST_FOLLOWING_ERROR
GearRatioMotorRevolutions	GearRatioMotorRevolutions	WSTRING(63)	$CST_GEAR_RATIO_MOTOR_REVOLUTIONS
HomeOffset	HomeOffset	WSTRING(63)	$CST_HOME_OFFSET
MaxMotorSpeed	MaxMotorSpeed	WSTRING(63)	$CST_MAX_MOTOR_SPEED
MaxTorque	MaxTorque	WSTRING(63)	$CST_MAX_TORQUE
ModesOfOp	ModesOfOp	WSTRING(63)	$CST_MODES_OF_OPE
ModesOfOpDisp	ModesOfOpDisp	WSTRING(63)	$CST_MODES_OF_OPE_DISP
NegativeTorqueLimitValue	NegativeTorqueLimitValue	WSTRING(63)	$CST_NEGATIVE_TORQUE_LIMIT
Polarity	Polarity	WSTRING(63)	$CST_POLARITY
PosActualValue	PosActualValue	WSTRING(63)	$CST_POS_ACTUAL_VALUE
PosEncoderResolution	PosEncoderResolution	WSTRING(63)	$CST_POS_ENCODER_RESOLUTION
PosEncoderResolutionMotorRevolutions	PosEncoderResolutionMotorRevolutions	WSTRING(63)	$CST_POS_ENCODER_RESOLUTION_MOTOR_REVOLUTIONS
PositiveTorqueLimitValue	PositiveTorqueLimitValue	WSTRING(63)	$CST_POSITIVE_TORQUE_LIMIT
ShaftRevolutions	ShaftRevolutions	WSTRING(63)	$CST_SHAFT_REVOLUTIONS
SiUnitPos	SiUnitPos	WSTRING(63)	$CST_SI_UNIT_POS
SiUnitVel	SiUnitVel	WSTRING(63)	$CST_SI_UNIT_VEL
StatusWord	StatusWord	WSTRING(63)	$CST_STATUS_WORD
SupportedDriveModes	SupportedDriveModes	WSTRING(63)	$CST_SUPPORTED_DRIVE_MODES
TargetPos	TargetPos	WSTRING(63)	$CST_TARGET_POS
TargetTorque	TargetTorque	WSTRING(63)	$CST_TARGET_TORQUE
TargetVelocity	TargetVelocity	WSTRING(63)	$CST_TARGET_VELOCITY
TargetActualValue	TorqueActualValue	WSTRING(63)	$CST_TORQUE_ACTUAL_VALUE
VelActualValue	VelActualValue	WSTRING(63)	$CST_VEL_ACTUAL_VALUE
vControlDil1	ControlDi1	WSTRING(63)	$CST_CONTROL_DI1
vControlDil2	ControlDi2	WSTRING(63)	$CST_CONTROL_DI2
vControlDil3	ControlDi3	WSTRING(63)	$CST_CONTROL_DI3
vControlDil4	ControlDi4	WSTRING(63)	$CST_CONTROL_DI4
vControlDil5	ControlDi5	WSTRING(63)	$CST_CONTROL_DI5
vControlDil6	ControlDi6	WSTRING(63)	$CST_CONTROL_DI6
vControlDil7	ControlDi7	WSTRING(63)	$CST_CONTROL_DI7
vCurrentAlarm	CurrentAlarm	WSTRING(63)	$CST_CURRENT_ALARM
vEncoderStatus1	EncoderStatus1	WSTRING(63)	$CST_ENCODER_STATUS1
vHomeAbsCounter	HomeAbsCounter	WSTRING(63)	$CST_HOME_ABS_COUNTER
vHomeCycleCounter	HomeCycleCounter	WSTRING(63)	$CST_HOME_CYCLE_COUNTER

Variable/Structure name		Name	Type	Initial value
	vInitialAbsCounter	InitialAbsCounter	WSTRING(63)	$CST_INITIAL_ABS_COUNTER
	vInitialCycleCounter	InitialCycleCounter	WSTRING(63)	$CST_INITIAL_CYCLE_COUNTER
	vInitialPos	InitialPos	WSTRING(63)	$CST_INITIAL_POS
	vMaxAbsCounter	MaxAbsCounter	WSTRING(63)	$CST_MAX_ABS_COUNTER
	vStatusDo1	StatusDo1	WSTRING(63)	$CST_STATUS_DO1
	vStatusDo2	StatusDo2	WSTRING(63)	$CST_STATUS_DO2
	vStatusDo3	StatusDo3	WSTRING(63)	$CST_STATUS_DO3
	vStatusDo4	StatusDo4	WSTRING(63)	$CST_STATUS_DO4
	vStatusDo5	StatusDo5	WSTRING(63)	$CST_STATUS_DO5
	vStatusDo6	StatusDo6	WSTRING(63)	$CST_STATUS_DO6
	vStatusDo7	StatusDo7	WSTRING(63)	$CST_STATUS_DO7
	vSupportedControlDi1	SupportedControlDi1	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI1
	vSupportedControlDi2	SupportedControlDi2	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI2
	vSupportedControlDi3	SupportedControlDi3	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI3
	vSupportedControlDi4	SupportedControlDi4	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI4
	vSupportedControlDi5	SupportedControlDi5	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI5
	vSupportedControlDi6	SupportedControlDi6	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI6
	vSupportedControlDi7	SupportedControlDi7	WSTRING(63)	$CST_SUPPORTED_CONTROL_DI7
	vSupportedStatusDo1	SupportedStatusDo1	WSTRING(63)	$CST_SUPPORTED_STATUS_DO1
	vSupportedStatusDo2	SupportedStatusDo2	WSTRING(63)	$CST_SUPPORTED_STATUS_DO2
	vSupportedStatusDo3	SupportedStatusDo3	WSTRING(63)	$CST_SUPPORTED_STATUS_DO3
	vSupportedStatusDo4	SupportedStatusDo4	WSTRING(63)	$CST_SUPPORTED_STATUS_DO4
	vSupportedStatusDo5	SupportedStatusDo5	WSTRING(63)	$CST_SUPPORTED_STATUS_DO5
	vSupportedStatusDo6	SupportedStatusDo6	WSTRING(63)	$CST_SUPPORTED_STATUS_DO6
	vSupportedStatusDo7	SupportedStatusDo7	WSTRING(63)	$CST_SUPPORTED_STATUS_DO7
	vSyncAbsCounter	SyncAbsCounter	WSTRING(63)	$CST_SYNC_ABS_COUNTER
	vSyncCycleCounter	SyncCycleCounter	WSTRING(63)	$CST_SYNC_CYCLE_COUNTER
	vVelLimitValue	VelLimitValue	WSTRING(63)	|$CST_VEL_LIMIT_VALUE
	vWatchDogCounterDl	WatchDogCounterDl	WSTRING(63)	$CST_WATCH_DOG_COUNTER_DL
	vWatchDogCounterUl	WatchDogCounterUl	WSTRING(63)	$CST_WATCH_DOG_COUNTER_UL
	vEncoderStatus2	EncoderStatus2	WSTRING(63)	$CST_ENCODER_STATUS2
	vScaleCycleCounte	ScaleCycleCounter	WSTRING(63)	$CST_SCALE_CYCLE_COUNTER
	vScaleAbsCounter	ScaleAbsCounter	WSTRING(63)	$CST_SCALE_ABS_COUNTER
	vScaleMeasurementEncoderResolution	ScaleMeasurementEncoderResolution	WSTRING(63)	$CST_SCALE_MEASUREMENT_ENCODER_RESOLUTION
	vScaleMeasurementEncoderReceptionStatus	ScaleMeasurementEncoderReceptionStatus	WSTRING(63)	$CST_SCALE_MEASUREMENT_ENCODER_RECEPTION_STATUS
SLAVE_OBJECT_ENCODER				
	PosActualValue	PosActualValue	WSTRING(63)	
SLAVE_OBJECT_VIRTUAL_ENCODER				
	PosActualValue	PosActualValue	WSTRING(63)	

ENUM enumerator

Type name/Enumerator	Setting value	Description
MC_BUFFER_MODE		
mcAborting	0	Aborting
mcBuffered	1	Buffered
mcBlendingLow	2	BlendingLow
mcBlendingPrevious	3	BlendingPrevious
mcBlendingNext	4	BlendingNext
mcBlendingHigh	5	BlendingHigh
MC_EXECUTION_MODE		
mcImmediately	0	Execute immediately
mcQueued	1	Execute at completion
mcNextExecute	2	Execute at next start
mcSpeculatively	3	Execute speculatively
MC_COMBINE_MODE		
mcAddAxes	0	Add positions of 2 input axes
mcSubAxes	1	Subtract positions of 2 input axes
MC_DIRECTION		
mcPositiveDirection	1	Positive direction
mcNegativeDirection	2	Negative direction
mcShortestWay	3	Shortest path
mcCurrentDirection	4	Current direction
MC_SOURCE		
mcSetValue	1	Set value
mcActualValue	2	Actual value
mcLatestSetValue	101	Latest set value
mcLatestActualValue	102	Latest actual value
MC_CIRC_MODE		
mcBorder	0	Border point designation
mcCenter	1	Center point designation
mcRadius	2	Radius designation
MC_CIRC_PATHCHOICE		
mcCW	0	CW
mcCCW	1	CCW
mcShortWay	2	Short way
mcLongWay	3	Long way
mcCWLongWay	4	CW long way
mcCCWLongWay	5	CCW long way
MC_START_MODE		
mcImmediate	0	Immediately
mcAbsolute	1	Absolute
mcRelative	2	Relative
MC_AXIS_STATUS		
Invalid	-1	Axis variable uninitialization/axis parameter error
Disabled	0	Axis disabled
ErrorStop	1	Error stop
Stopping	2	Deceleration stop
Homing	3	Homing
Standstill	4	Standby
DiscreteMotion	5	Positioning operation
ContinuousMotion	6	Continuous operation
SynchronizedMotion	7	Synchronous operation
MC_AXES_GROUP_STATUS		

Type name/Enumerator	Setting value	Description
GroupDisabled	0	Axes group disabled
GroupErrorStop	1	Error stop
GroupStopping	2	Deceleration stop
GroupHoming	3	Reserved
GroupStandby	4	Standby
GroupMoving	5	Operation
MC_DRIVE_MODE		
NoModeChange	0	Not changed
pp	1	Reserved
vl	2	Reserved
pv	3	Reserved
tq	4	Reserved
Reserved	5	Reserved
hm	6	hm(Homing)
ip	7	Reserved
csp	8	csp(Positioning control)
csv	9	csv(Velocity control)
cst	10	cst(Torque Control)
cstca	11	Reserved
MC_VELOCITY_LIMIT_MODE		
Ignore	0	Ignore
ClampWithRamp	1	Clamp
Truncate	2	Truncate
ImmediateStop	3	Immediate stop
MC_INTERPOLATE_SPEED_MODE		
VectorSpeed	0	Vector speed
LongAxisSpeed	1	Long axis speed
ReferenceAxisSpeed	2	Reference axis speed
MC_SYNTHESIZING_MODE		
Addition	0	Addition
Substitution	1	Substitution
Combine	2	Combine
Interpolation	3	Interpolation
MC_PROFLE_COMBINE_MODE		
Relative	0	Relative
InputRelative	1	Input relative
OutputRelative	2	Output relative
Absolute	3	Absolute
MC_RECORD_MODE		
OneShot	0	One shot mode
RecordCount	1	Number of designation times mode
RingBuffer	2	Ring buffer mode
MC_CLUTCH_MODE		
Exponent	0	Exponent
Linear	1	Linear
LinearInputFollow	2	Linear (Input follow-up)
MC_CAM_CURVE_TYPE		
ConstantSpeed	0	Constant speed
ConstantAcceleration	1	Constant acceleration
DistortedTrapezoid	2	Distorted trapezoid
DistortedSine	3	Distorted sine
DistortedConstantSpeed	4	Distorted constant speed
Cycloid	5	Cycloid

Type name/Enumerator	Setting value	Description
FifthCurve	6	5th curve
Trapecloid	7	Trapecloid
ReverseTrapecloid	8	Reverse trapecloid
DoubleHypotenuse	9	Double hypotenuse
ReverseDoubleHypotenuse	10	Reverse double hypotenuse
SingleHypotenuse	11	Single hypotenuse
FifthCurve_SpeedDesignation	12	5th curve(Speed designation)
MC_AXIS_TYPE		
DriveAxis	0	Real drive axis
EncoderAxis	2	Real encoder axis
VirtualDriveAxis	3	Virtual drive axis
VirtualEncoderAxis	4	Virtual encoder axis
VirtualLinkAxis	5	Virtual linked axis
MC_ENCODER_AXIS_TYPE		
IoModule	0	Via I/O device
Drive	1	Via drive module
MC_ABS_SYSTEM		
ABSDisabled	0	Not use the absolute position control setting
Enabled	1	Use the absolute position control setting
Auto	-1	Automatic setting(Acquire from connected device)
MC_DRIVE_STATE		
NotReadyToSwitchOn	0	Not ready to switch on
Fault	1	Fault
FaultReactionActive	2	Fault reaction active
SwitchOnDisabled	3	Switch on disabled
ReadyToSwitchOn	4	Ready To SwitchOn
SwitchedOn	5	Switched On
OperationEnable	6	Operation enable
QuickStopActive	7	Quick stop active
Invalid	-1	Invalid
MC_DECEL_STOP_MODE		
Ignore	0	Ignore
ImmediateStop	1	Immediate stop
KeepCurrentAcc	2	Keep current acceleration/deceleration
AlternativeAcc	3	Alternative acceleration/deceleration
ServoOffAfterImmediateStop	4	Servo OFF after immediate stop
ServoOffAfterDecelStop	5	Servo OFF after deceleration to stop
MC_STOP_CURVE_MODE		
RapidCurve	0	Recreate deceleration curve at increased deceleration
OverrideCurve	1	Recreate deceleration curve
ContinueCurve	2	Maintain deceleration curve
MC_POS_SOURCE		
Invalid	-1	Invalid
SetPosition	1	Set position
CumulativePosition	2	Cumulative current position
FeedMachinePosition	3	Feed machine position
CommandedPosition	4	Commanded position
ActualPosition	5	Actual position
MC_ACC_ZERO_MODE		
ACCError	-1	Error (Not started)
MaximumAcceleration	1	Maximum acceleration/deceleration
MC_SIGNAL_LOGIC		
HighLevel	0	Detection at TRUE

Type name/Enumerator	Setting value	Description
LowLevel	1	Detection at FALSE
RisingEdge	2	Detection at FALSE → TRUE(leading edge)
FallingEdge	3	Detection at TRUE → FALSE(trailing edge)
BothEdges	4	Detection at leading edge/trailing edge
MC_STATION_REFRESH_MODE		
EmphasisResponse	0	Response preferred method
EmphasisOperationCycle	1	Operation cycle priority method
MC_ERROR_CLASS		
_None	0	None
Warning	1	Warning
MinorError	2	Minor error
ModerateError	3	Moderate error
MajorError	4	Major error
MC_LOGGING_TYPE		
Invalid	-1	Not set
ContinuousLogging	1	Continuous logging
TriggerLogging	2	Trigger logging
MC_LOGGING_SAVE_STATUS		
UnSave	0	Unsaved
Saving	1	Saving
Saved	2	Saved
FullySaved	3	Fully saved
MC_EXECUTION_STATE		
Ready	0	Waiting for the request
Executing	1	Executing
Done	2	Execution completion
Error_	-1	Error occurrence
MC_ACTIVATION_CMD		
_None	0	None
Authorize	1	Authorize activation key
SetSuperPassword	10	Register supervisor password
SetKey	12	Register activation key
VerifyKey	13	Verify activation key
Initialize	-1	Initialize
MC_ACTIVATION_STATE		
NoRegisted	0	Not registered
Authorized	1	Authentication completed
SuperPasswordValid	10	Supervisor password registered
UnAuthorized	12	Activation key registered (Waiting authentication)
VerifyDone	13	Verification completed
Lockout	-1	Lockout
MC_ADDON_LIMIT_CMD		
_None	0	None
Regist	1	Register
TemporaryNoLimitation	10	Temporarily release
Initialize	-1	Initialize
MC_ADDON_LIMIT_STATE		
NoLimitation	0	Not restricted
Limitation	1	Limited
TemporaryNoLimitation	10	Released
Lockout	-1	Lockout
MC_PROFILE_STORAGE		
OpenArea	0	Open area

Type name/Enumerator	Setting value	Description
File	1	File
MC_SWITCHING_REQUEST		
NoRequest	0	No request
Enable_	1	Enable
Disable	2	Disable
MC_POS_RESTORATION_STATUS		
NotExecute	0	Not executed
WaitingRequest	1	Waiting restoration request
RestoredInIncSystem	2	Restoration completed by incremental system
RestoredInAbsSystemUnHomed	3	Restored in absolute position system(Homing uncompleted)
RestoredInAbsSystem	4	Restored in absolute position system
MC_TRANSITION_MODE		
TMNone	0	Standard

24 List of FBs

Name	Description	Type	Reference
MC_CamIn	Starts cam operation.	MCFB(motion/single)	Page 474 MC_CamIn
MC_CombineAxes	Combines the motion of 2 axes.	MCFB(motion/single)	Page 494 MC_CombineAxes
MC_GearIn	Starts gear operation.	MCFB(motion/single)	Page 488 MC_GearIn
MC_GroupStop	Executes a forced stop for an axes group.	MCFB(motion/single)	Page 154 MC_GroupStop
MC_Home	Executes homing.	MCFB(motion/single)	Page 182 MC_Home
MC_MoveAbsolute	Executes positioning (absolute).	MCFB(motion/single)	Page 188 MC_MoveAbsolute
MC_MoveRelative	Executes positioning (relative).	MCFB(motion/single)	Page 191 MC_MoveRelative
MC_MoveVelocity	Executes speed control.	MCFB(motion/single)	Page 259 MC_MoveVelocity
MCv_SpeedControl	Executes speed control (including position loop).	MCFB(motion/single)	Page 203 MCv_SpeedControl
MC_Stop	Executes a forced stop.	MCFB(motion/single)	Page 152 MC_Stop
MC_TorqueControl	Executes torque control.	MCFB(motion/single)	Page 270 MC_TorqueControl
MCv_BacklashCompensationFilter	Backlash compensation filter	MCFB(motion/single)	Page 371 MCv_BacklashCompensationFilter
MCv_DirectionFilter	Travel direction control filter	MCFB(motion/single)	Page 367 MCv_DirectionFilter
MCv_Jog	Executes JOG operation.	MCFB(motion/single)	Page 208 MCv_Jog
MCv_MoveCircularInterpolateAbsolute	Executes circular interpolation control (absolute).	MCFB(motion/single)	Page 221 MCv_MoveCircularInterpolateAbsolute
MCv_MoveCircularInterpolateRelative	Executes circular interpolation control (relative).	MCFB(motion/single)	Page 224 MCv_MoveCircularInterpolateRelative
MCv_MoveLinearInterpolateAbsolute	Executes linear interpolation control (absolute).	MCFB(motion/single)	Page 217 MCv_MoveLinearInterpolateAbsolute
MCv_MoveLinearInterpolateRelative	Executes linear interpolation control (relative).	MCFB(motion/single)	Page 219 MCv_MoveLinearInterpolateRelative
MCv_SmoothingFilter	Enables smoothing filter.	MCFB(motion/single)	Page 364 MCv_SmoothingFilter
MCv_SpeedLimitFilter	Velocity control filter	MCFB(motion/single)	Page 369 MCv_SpeedLimitFilter
MC_AbortTrigger	Disables the touch probe.	MCFB(motion/single)	Page 405 MC_AbortTrigger
MC_CamTableSelect	Selects cam tables.	MCFB(administrative)	Page 417 MC_CamTableSelect
MC_GroupDisable	Disables an axes group.	MCFB(administrative)	Page 64 MC_GroupDisable
MC_GroupEnable	Enables an axes group.	MCFB(administrative)	Page 62 MC_GroupEnable
MC_GroupReset	Axes group error reset	MCFB(administrative)	Page 590 MC_GroupReset
MC_GroupSetOverride	Sets the values of override for an axes group.	MCFB(administrative)	Page 343 MC_GroupSetOverride
MC_Power	Controls the power stage (ON or OFF) for a single axis.	MCFB(administrative)	Page 84 MC_Power
MC_ReadParameter	Parameter read	MCFB(administrative)	Page 555 MC_ReadParameter
MC_Reset	Axes error reset	MCFB(administrative)	Page 589 MC_Reset
MC_SetOverride	Sets the values of override.	MCFB(administrative)	Page 341 MC_SetOverride
MC_SetPosition	Changes the current position.	MCFB(administrative)	Page 287 MC_SetPosition
MC_TouchProbe	Enables the touch probe.	MCFB(administrative)	Page 403 MC_TouchProbe
MC_WriteParameter	Parameter write	MCFB(administrative)	Page 557 MC_WriteParameter
MCv_AllPower	Controls the power stage (ON or OFF) for all axes.	MCFB(administrative)	Page 87 MCv_AllPower
MCv_ChangeCycle	Changes the current value per cycle.	MCFB(administrative)	Page 428 MCv_ChangeCycle
MCv_ChangeCycleTriggered*1	Changes the current value per cycle.	MCFB(administrative)	Page 430 MCv_ChangeCycleTriggered
MCv_MotionErrorReset	Motion error reset	MCFB(administrative)	Page 588 MCv_MotionErrorReset
MCv_SetPositionTriggered*1	Compensates the current position at a trigger event.	MCFB(administrative)	Page 290 MCv_SetPositionTriggered
MCv_SetTorqueLimit	Sets torque limits.	MCFB(administrative)	Page 353 MCv_SetTorqueLimit
MCv_ProfileCalc*1	Calculates profile data.	General FB	Page 422 MCv_ProfileCalc

Name	Description	Type	Reference
MCv_ProfileSelect*1	Selects profile data.	General FB	Page 420 MCv_ProfileSelect
MCv_ReadProfileData	Reads profile data.	General FB	Page 424 MCv_ReadProfileData
MCv_WriteProfileData	Writes profile data.	General FB	Page 426 MCv_WriteProfileData

*1 These FBs are planned for a future support.

25 Add-on library list

Each add-on version which is compatible with the software version of the Motion module is as follows.

Add-on library name	The software version of the Motion module				
	01	02	03	04	05
baseSystem	1.0.1.0	1.2.1.0	1.3.1.0	1.4.1.0	1.5.1.0
MotionEngine	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
Axis	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
MotionControl_General	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
MotionControl_Sync	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
AbsSystem	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
ServoDriver_CANopen	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
NetworkDriver_CCIETSN	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
PlcInstruction	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
SignalIO	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
ExternalSignal	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
Program_ST	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
Logging	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
MotionEventHist	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
FileTransfer	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
MotionControl_AxisFilter	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
ProfileControl	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0
PackagingApp	1.0.1.0	1.1.1.0	1.2.1.0	1.3.1.0	1.4.1.0

The details about the add-on library are as follows.

—: No dependent add-on

Add-on library name	Name	Description	Dependent add-on (Necessary)	Dependent add-on (Restricted)
baseSystem	baseSystem	Basic software	—	—
MotionEngine	Motion control basic	Basic add-on for motion control	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"} {"Name":"Axis","Later":"1.3"}	—
Axis	Axis control	Add-on for axis control	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"MotionEngine","Later":"1.3"}	[AbsSystem] [ServoDriver] [SignalIO] [MotionEventHist] [ExternalSignal]
MotionControl_General	PLCopen motion control single-axis/multi-axis control FB	Enables PLCopen® motion control single-axis/multi-axis control FB.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"MotionEngine","Later":"1.3"}, {"Name":"Axis","Later":"1.3"}	—
MotionControl_Sync	PLCopen motion control synchronous control	Enables PLCopen® motion control synchronous control FB.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"MotionEngine","Later":"1.3"}, {"Name":"Axis","Later":"1.3"}, {"Name":"MotionControl_General","Later":"1.3"}	—
AbsSystem	Absolute position control	Enables absolute position control.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"Axis","Later":"1.3"}	—
ServoDriver_CANopen	Servo driver (CANopen)	CANopen servo driver	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"Axis","Later":"1.3"}, {"Name":"NetworkDriver","Later":"1.3"} {"Name":"SignalIO","Later":"1.3"}	—
NetworkDriver_CCIETSN	Network driver (CC-Link IE TSN)	Network driver of CC-Link IE TSN	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	—
PlcInstruction	External sequence dedicated instructions	Enables external sequence dedicated instructions.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	[PLCopenMC_General] [ST]
SignalIO	I/O signal	Provides the signal input/output function.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	[Axis]
ExternalSignal	External signal	Enables external signals.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"SignalIO","Later":"1.3"}, {"Name":"Axis","Later":"1.3"}	—
Program_ST	ST language execution	Add-on that executes ST language	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	—
Logging	Logging	Provides the logging function.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"SignalIO","Later":"1.3"}	[MotionEventHist]
MotionEventHist	Motion event history	Add-on for motion event history.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	—
FileTransfer	File transfer	Provides the file transfer function.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}	—
MotionControl_AxisFilter	Command filter	Enables PLCopen® motion control command filter FB.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"MotionEngine","Later":"1.3"}, {"Name":"Axis","Later":"1.3"}, {"Name":"MotionControl_General","Later":"1.3"} {"Name":"MotionControl_Sync","Later":"1.3"}	—

Add-on library name	Name	Description	Dependent add-on (Necessary)	Dependent add-on (Restricted)
ProfileControl	Operation profile control	Enables operation profile control.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"MotionEngine","Later":"1.3"}, {"Name":"Axis","Later":"1.3"}, {"Name":"MotionControl_General","Later":"1.3"}	[SignalIO]
PackagingApp	Packaging	Provides functions for packaging machines.	{"Name":"baseSystem","Later":"1.4","Earlier":"1.4"}, {"Name":"ProfileControl","Later":"1.3"}	—

Point

baseSystem is necessary.

26 Bootsoftware List

The versions of each boot which is compatible with the software version of the Motion module are shown below.

Boot name	The software version of the Motion module				
	01	02	03	04	05
Network	1	2	2	3	3
VxWorks	1	1	1	2	3
IPL	1	1	1	1	1

MEMO

APPENDICES

Appendix 1 Connectable device to CC-Link IE TSN

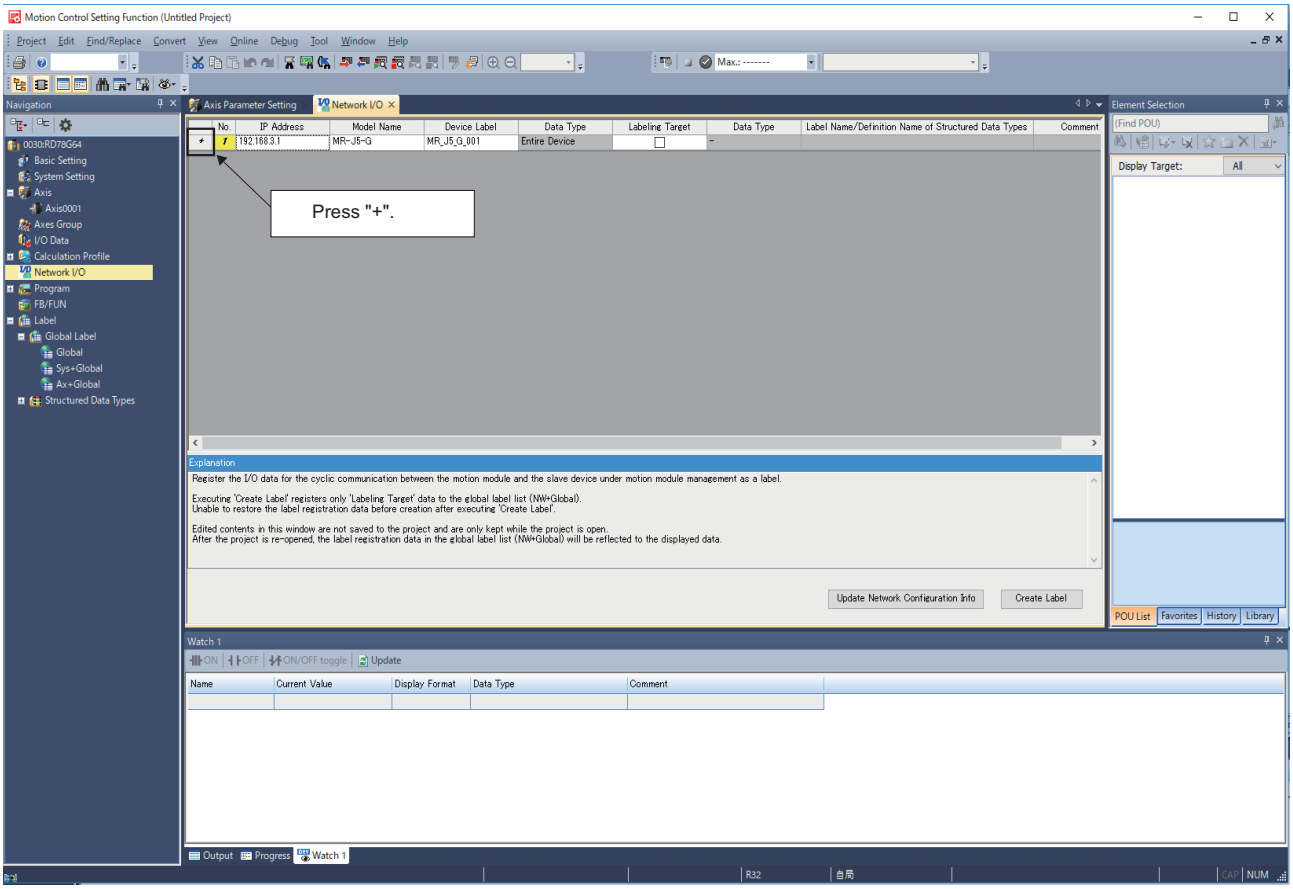
This section describes how to set and use the Motion module when a connectable device to CC-Link IE TSN is connected with the Motion module.
Refer to the manual of each device for the wiring and the details of the parameters.

Common Items for all devices

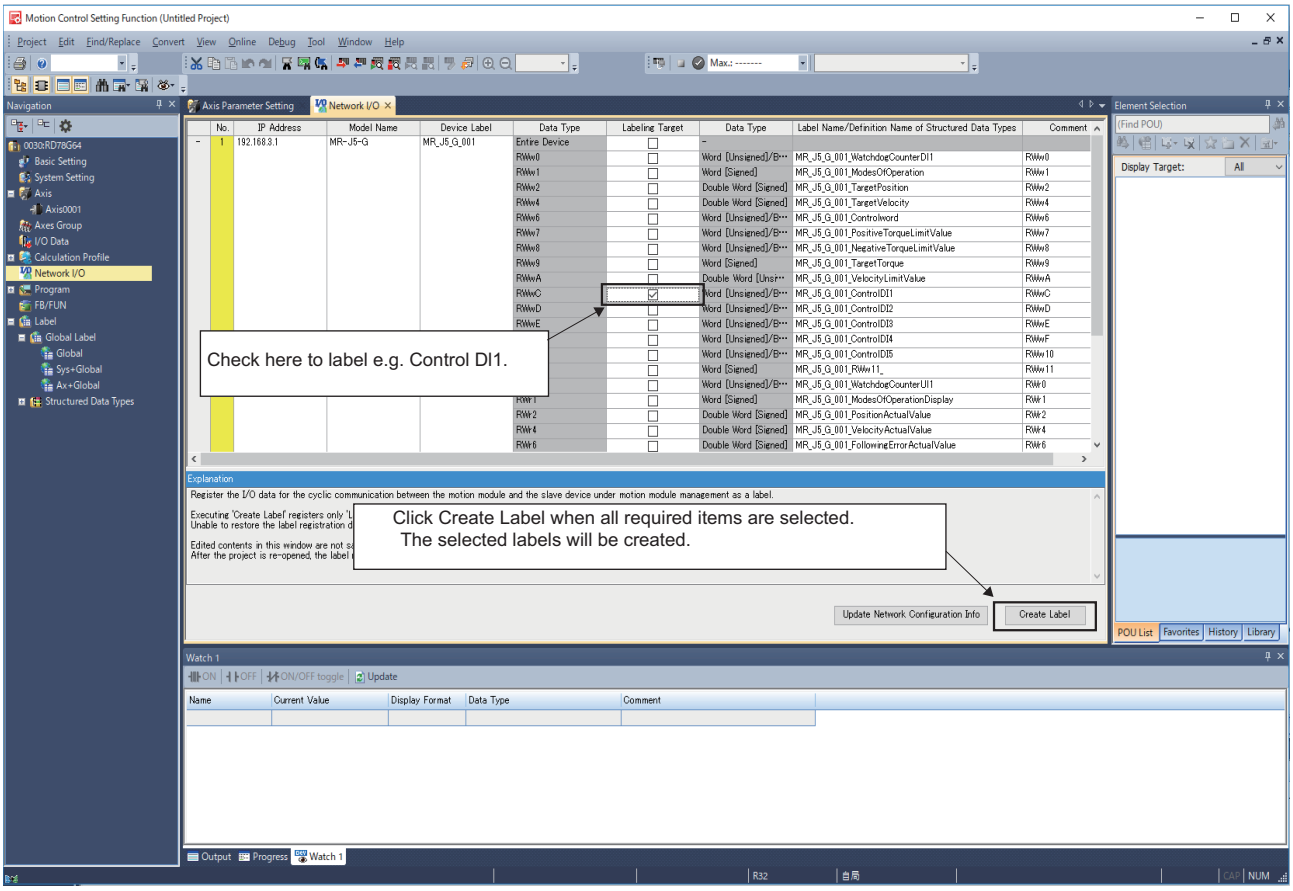
• How to use the device label

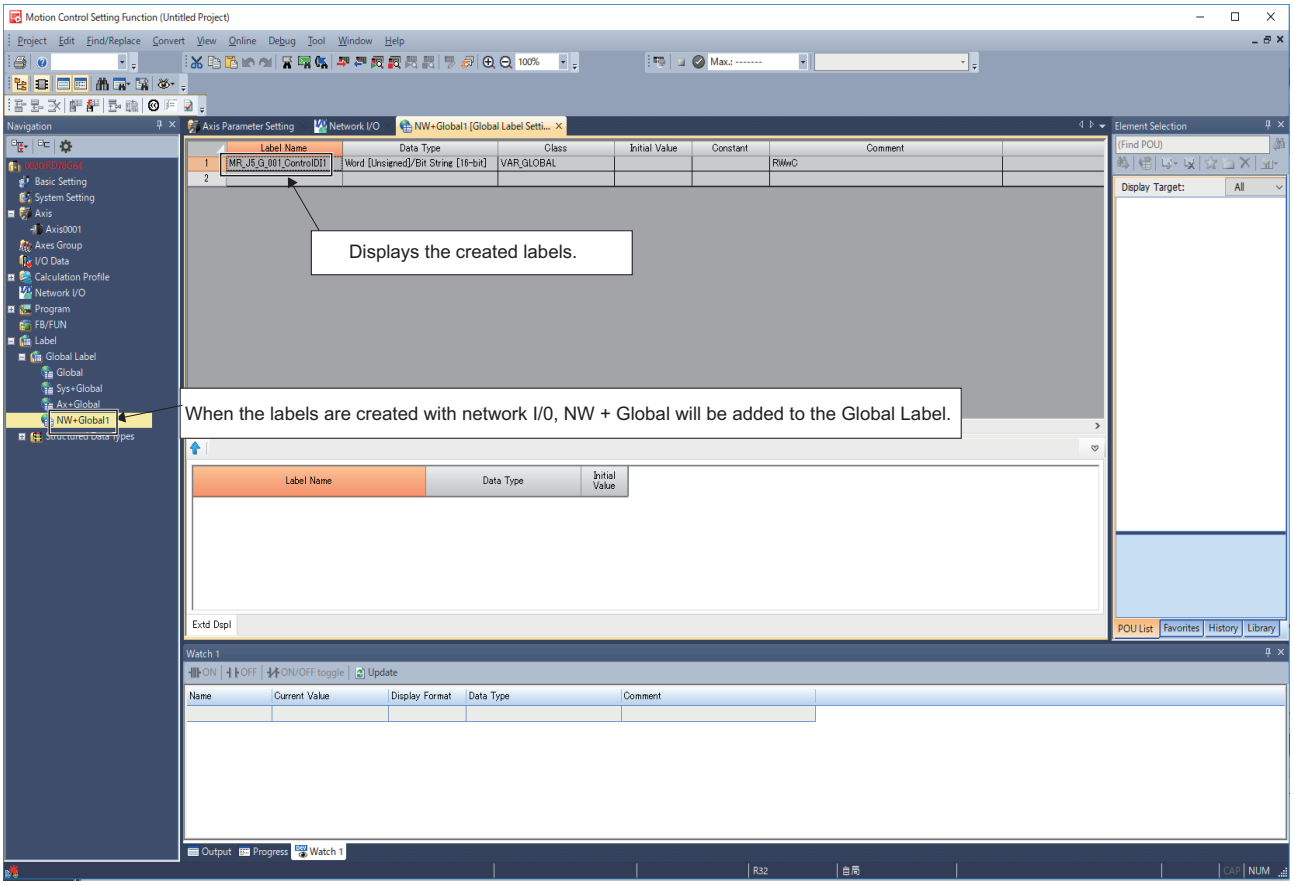
The method of using the device label is shown below. The following shows the MR-J5-G usage example and other device can also use it with the same method.

1. Click the left end "+" of the device, its label is generated, from the devices displayed on Network I/O screen.



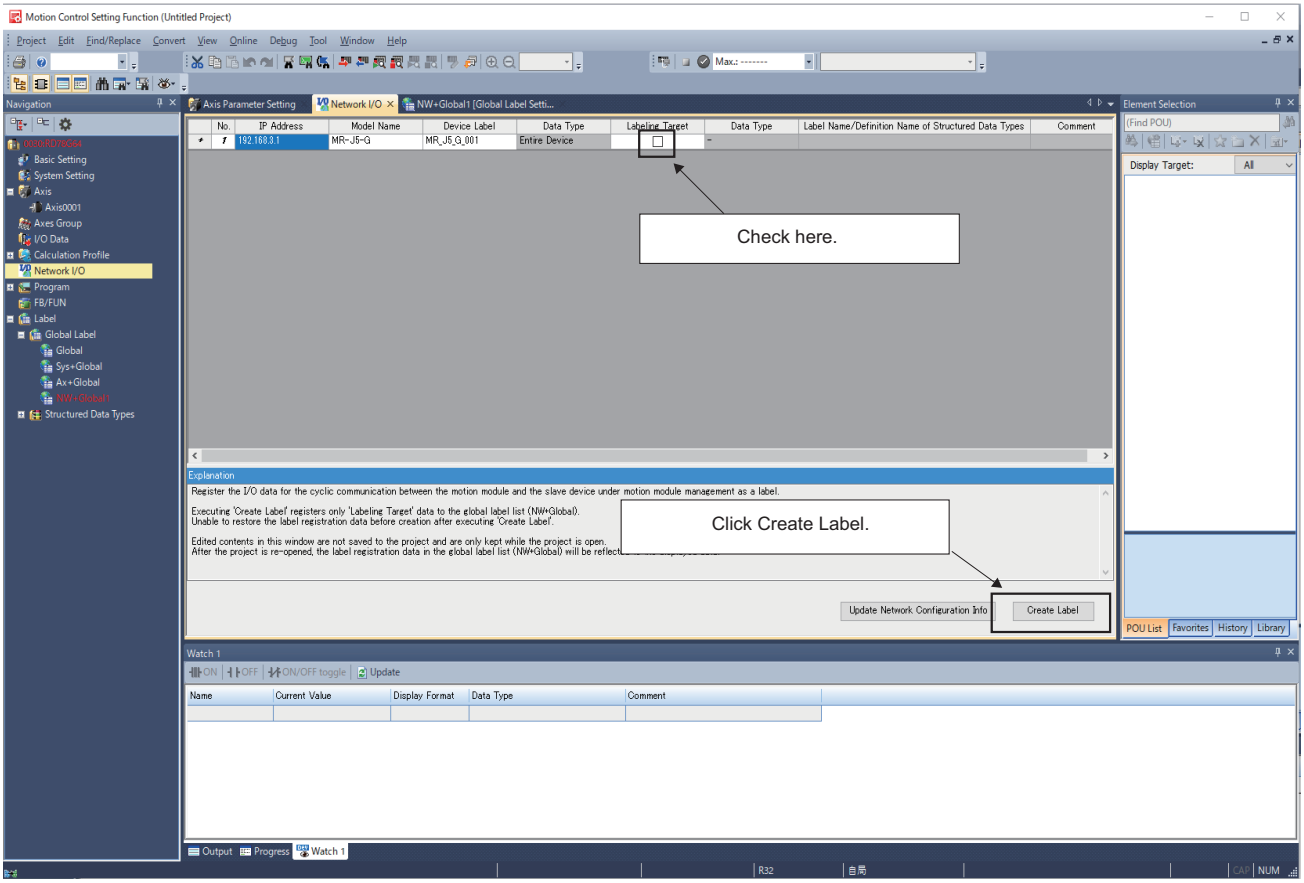
2. Set as the following to label each object.





A

3. Set as follows to label the whole device.



MR-J5(W)-G (Cyclic synchronous mode) connection method

This section describes how to set when connecting MR-J5(W)-G (Cyclic synchronous mode) and use various functions.
For details about wiring and parameters of MR-J5(W)-G, refer to MR-J5(W)-G manuals.

Setting methods

■Parameter setting value to use MR-J5(W)-G

Set the parameters of MR-J5(W)-G as below when executing motion control with 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 PT01.1 is "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 (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 (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 PT01.1 is "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 for 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 PA06 and PA07 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
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 Velocity actual value[Obj.606Ch]may not be acquired correctly when other than 1:1 is set for electronic gear.
*3 This function is the same as the software stroke limit function of Motion module. Therefore, use the function of Motion module side to restrict the command position.
*4 Set 1 when the resolution of the encoder connected with MR-J5-G(W) is not multiple of two to the power of n.

For the following parameters, the setting values of the table below are recommended.

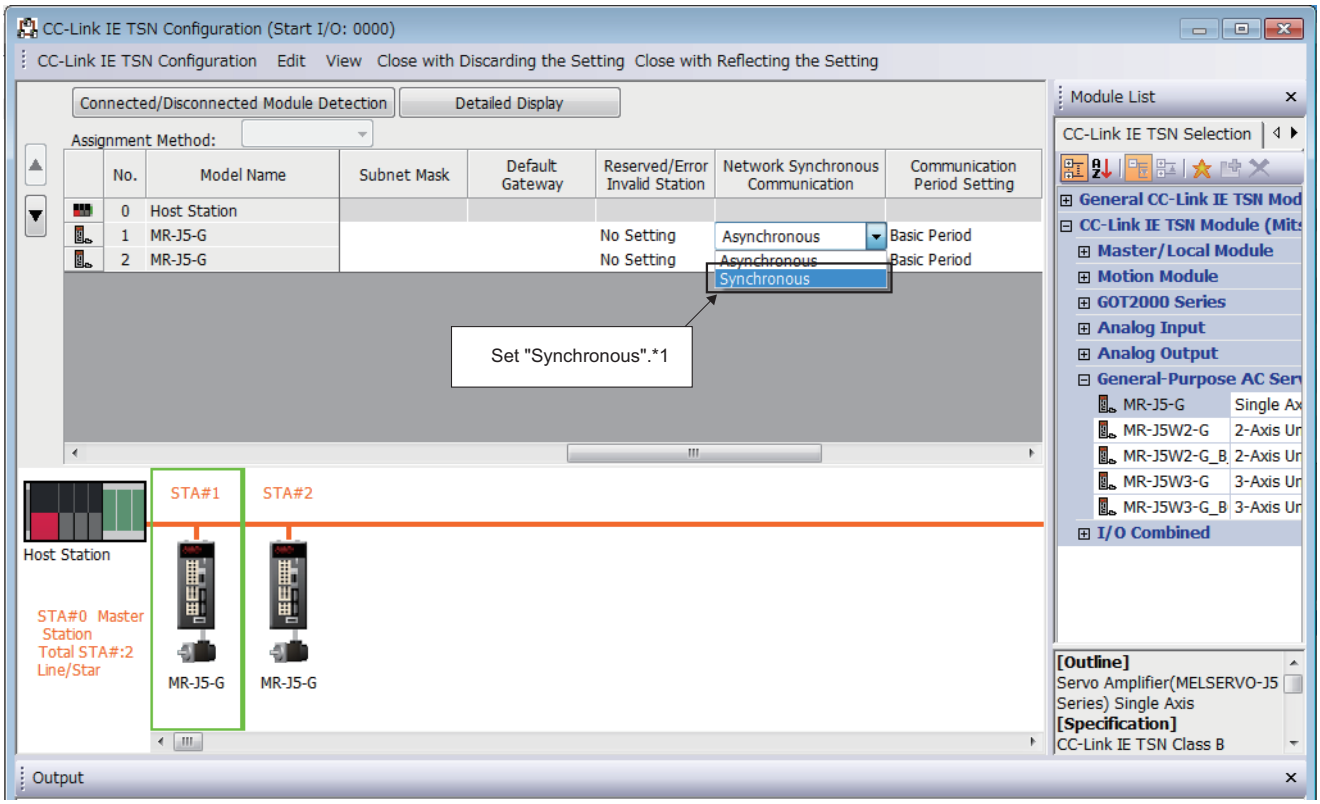
No.	Name	Default value	Overview
PD01	Input signal automatic on selection 1	00000000 1h	000000001h
PD41.2	Limit switch enabled status selection	0h	1h (Enabled only for homing mode)*1
PD41.3	Sensor input method selection	0h	1h (Input from controller (FLS/RLS/DOG))*2
PT29.0	Device input polarity 1	0h	1h: Dog detection with on (When PD41.3 is 1h (Input from the 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 MR-J5(W)-G side during control. Consider any of the following to stop the system safely.
Method 1:
Invalidates the detected signal of the MR-J5(W)-G side, and detects the limit by the hardware stroke limit function of the Motion system side.
Method 2:
Turns AxisName.Pr.StopOption_DriverTargetIgnored 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 side since the input to MR-J5(W)-G becomes invalid. In the case of wiring to MR-J5(W)-G, the motor does not stop if the limit is detected.
Also, the labeling of the device must not be carried out since [Control DI 5(2D05h)] of the RPDO mapping is used for sending signal to MR-J5(W)-G side.

■Network parameter setting to use MR-J5(W)-G

Set "Synchronous" in the network parameters setting when performing motion control with using MR-J5(W)-G.



*1 The setting, "Synchronous" is available from "Ver. 1.5" or laterof baseSystem add-on.
Set "Asynchronous" when using "Ver.1.4" or earlier.

Using methods

■How to operate external signal of MR-J5(W)-G via communication

1. Preparation

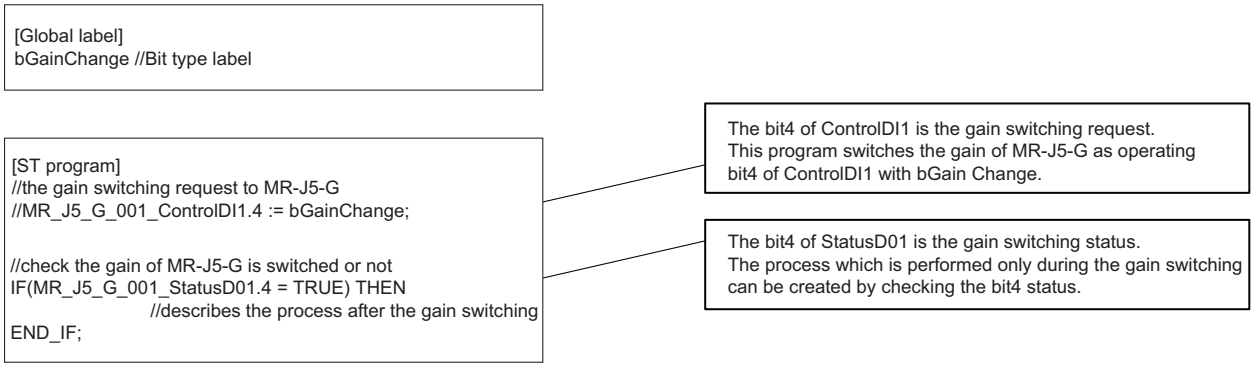
Generates the required objects of the device label according to the procedures described in common items for all devices.
External signals of MR-J5(W)-G are assigned to the objects below.

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 MR-J5(W)-G manuals.

2. Using methods

Operating / referring external signals of MR-J5(W)-G are allowed by changing / referring the values of generated labels from the program or watch.
A sample program to carry out the gain switching by using the device label is shown below. (Generate the label previously as Control DI1 and Status DO1 are used for the gain switching.)



A

■The connection with MR-J5(W)-G in high-speed mode

For details of the high-speed mode, refer to the following.

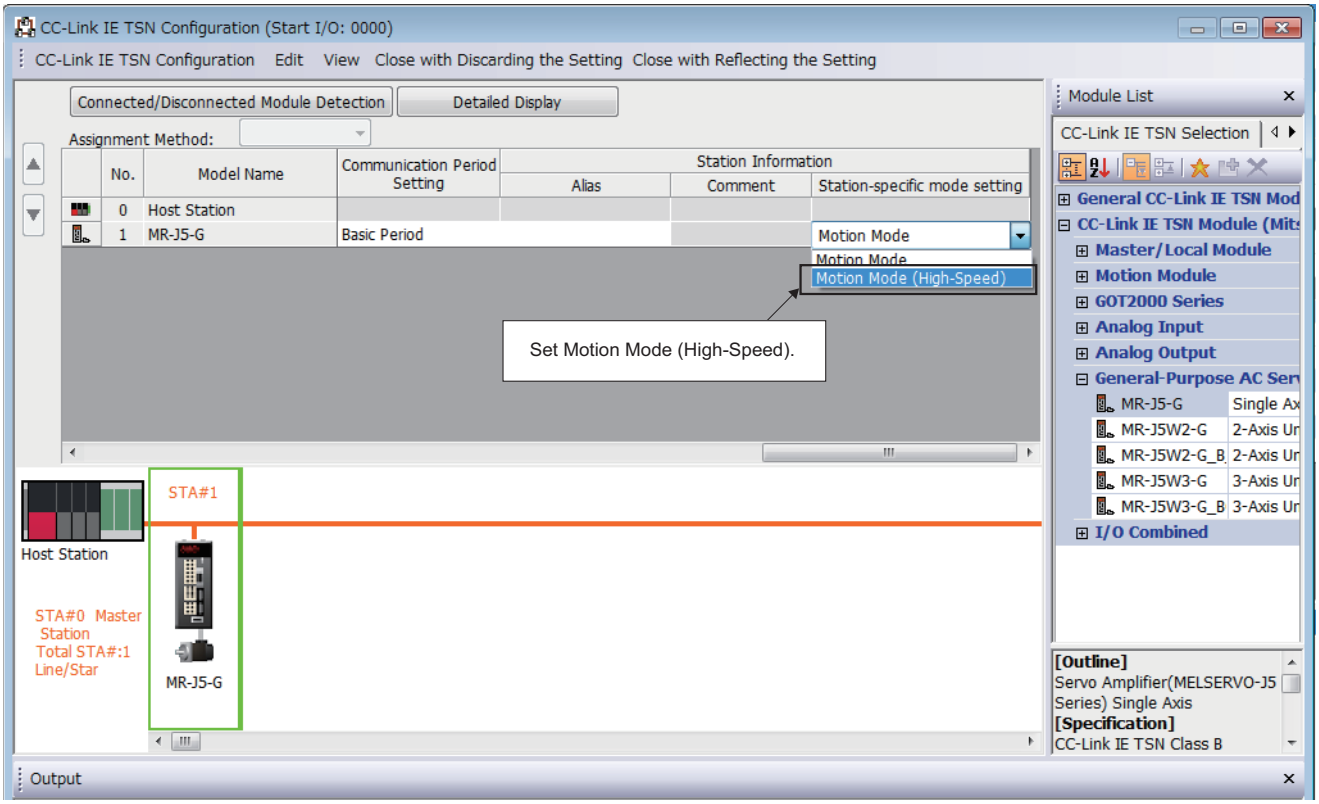
☞ Page 105 Operation Cycle

1. Preparation

[Setting of CPU [GX Works3]]

[Module Parameter (Network)]⇨[Basic settings]⇨[Network Configuration Settings]

Set the station-specific mode to the Motion Mode (High-Speed) on the "CC-Link IE TSN Configuration" screen.



When the Motion Mode (High-Speed) is set, PDO mapping is as follows.

• RPDO

No.	Object name
1	Watch dog counter DL
2	Modes of operation
3	Target position
4	Controlword
5	Control DI4

• TPDO

No.	Object name
1	Watch dog counter UL
2	Modes of operation display
3	Position actual value
4	Statusword
5	Status DO1
6	Status DO4
7	Torque actual value
8	Velocity actual value
9	Current alarm

[Motion module setting [Engineering tool]]

Set to the high-speed mode. For details, refer to the following.

☞ Page 105 Operation Cycle

[MR-J5(W)-G setting [MR Configurator2]]

When connecting with 31.25μs of communication cycle interval setting, set "High speed mode selection" (PA01.7) to "1h (Enabled)". When connecting with other than 31.25 μs, no specific setting is required.

2. Using method

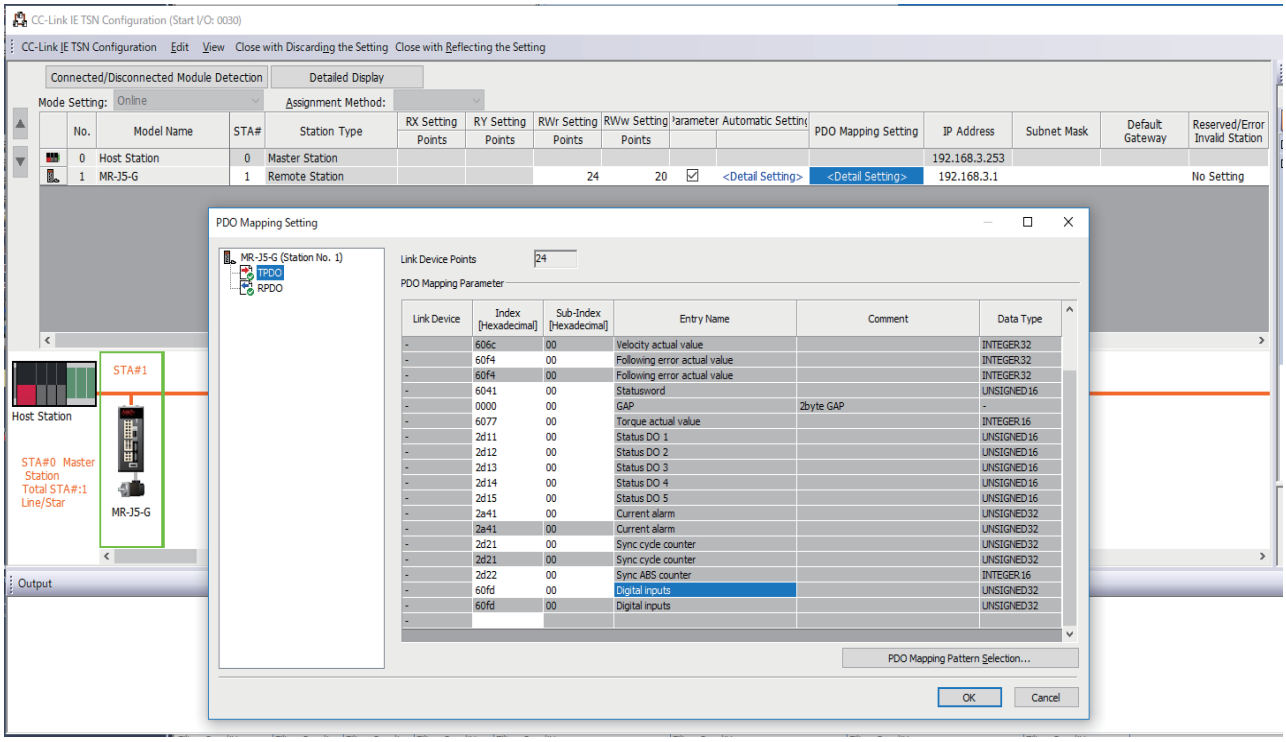
Communication in high speed mode is allowed when MR-J5(W)-F is connected with Motion module in the above setting.

■The method for setting (LSP/LSN/DOG) input into MR-J5(W)-G to the upper limit/lower limit and home position switch of the Motion module

(LSP/LSN/DOG) input signal of the servo amplifier side can be used as the FLS/RLS, and home position switch signal by assigning the object, [Digital inputs(60fdh)] to TPDO mapping of MR-J5(W)-G and creating the device label.

1. Map [Digital inputs(60fdh)] to TPDO.

Add Digital inputs by specifing index: 60fdh and subindex: 00h to TPDO of the target amplifier in Network Configuration Settings on the engineering tool.



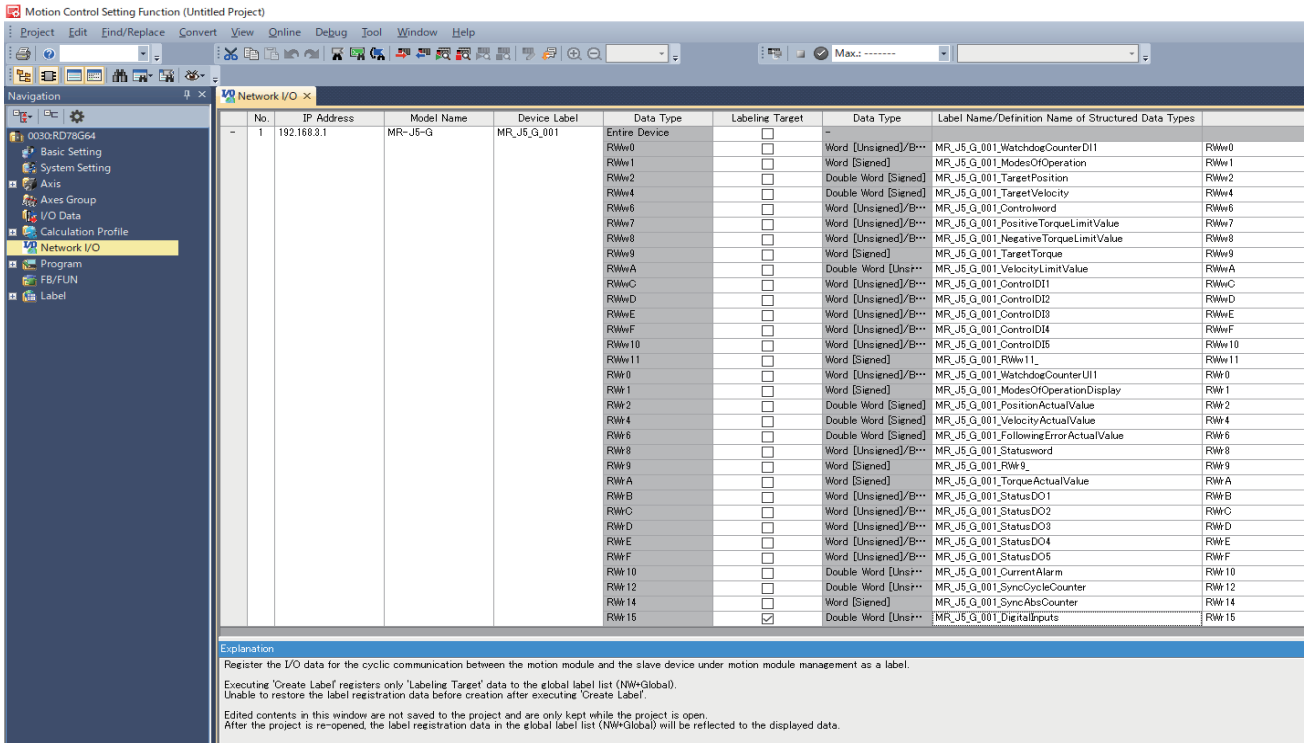
2. Make [Digital inputs(60fdh)] the device label.

For the method of the labeling, refer to the following.

☞ Page 676 Common Items for all devices

Ex.

When the labeling is performed with the name of "MR_J5_G_001_DigitalInputs".

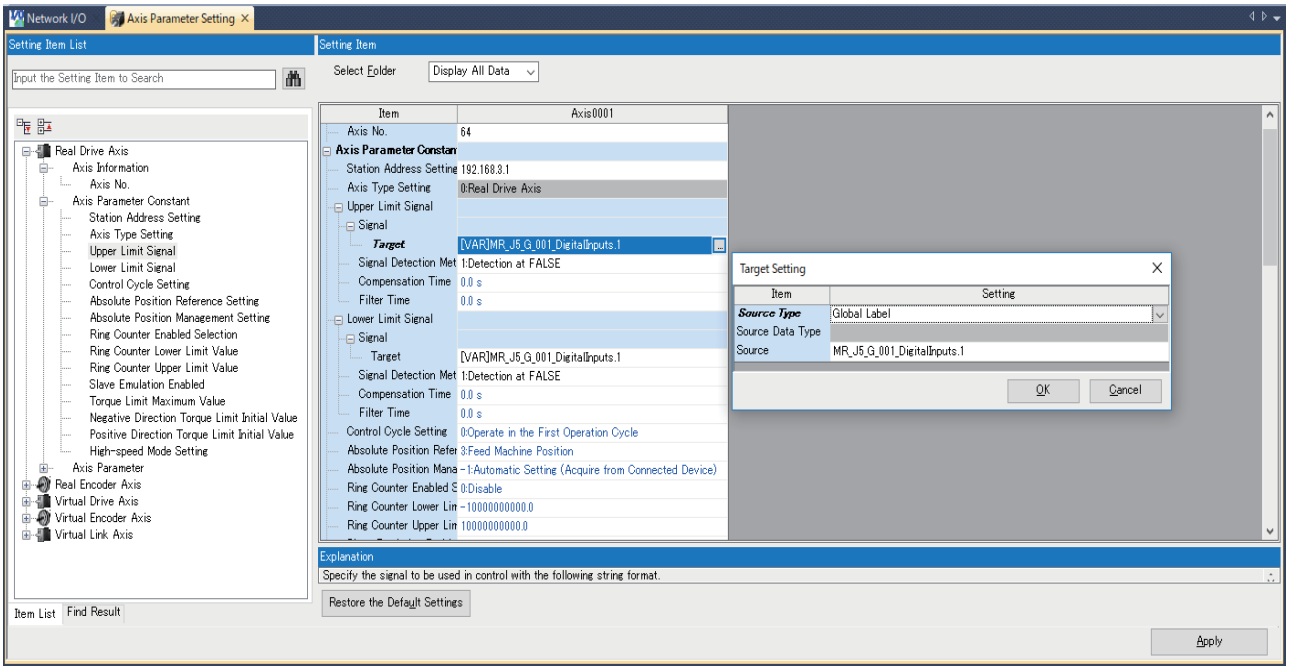


3. Specify the device label to the home position switch of FLS/RLS or MC_Home.

[The upper limit/lower limit setting]

Set the upper limit signal target/lower limit signal target of the axis parameter.

Variable	Setting value (when PA14 is 0)
AxisName.PrConst.HwStrokeLimit_FlsSignal.Source.Target	[VAR]MR_J5_G_001_DigitalInputs.1
AxisName.PrConst.HwStrokeLimit_RlsSignal.Source.Target	[VAR]MR_J5_G_001_DigitalInputs.0



[Specify the DOG signal at homing]

Specify the following to "home position switch" input into MC_Home.

Variable	Setting value (when 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), input the DOG signal to MRJ5(W)-G directly.
- 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).

Precautions

- Assign LSP/LSN/DOG signal to "Input device selection 1 to 3" (PD03 to 05) of MR-J5(W)-G side to use the signal of the Motion module.
- The polarities of Bit0(Negative limit switch) and Bit1(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 of each drive unit.
- Set the signal detection method of the Motion module side to be the same device input polarity of MR-J5(W)-G. If the setting is different, unintended operation may occur.

Precautions

- When labeling of data sent from the Motion Module is performed, the send data is overwritten with the label values. Labeling of only necessary objects should be performed because the motion control cannot be performed for a part of the objects such as Target position by the labeling.

The following table shows whether the labeling of the mapped objects in the initial state is possible or not.

○: labeling possible, ×: labeling not possible, △: restrictions apply

Index	SubIndex	Object name	Labeling possible/not possible
1D01h	1	Watchdog counter DL	×
6060h	0	Modes of operation	×
607Ah	0	Target position	×
60FFh	0	Target velocity	×
6040h	0	Controlword	×
60E0h	0	Positive torque limit value	×
60E1h	0	Negative torque limit value	×
6071h	0	Target torque	×
2D20h	0	Velocity limit value	×
2D01h	0	Control DI 1	○
2D02h	0	Control DI 2	○
2D03h	0	Control DI 3	○
2D04h	0	Control DI 4	×
2D05h	0	Control DI 5	△*1

*1 When "Sensor input method selection" (PD41.3) is set to "1h: Input from controller (FLS/RLS/DOG)", the input of FLS and RLS from the Motion module can not be sent to the servo amplifier. For making it the device label, change to "0h: Input from servo amplifier (LSP/LSN/DOG)" in "Sensor input method selection" (PD41.3).

- 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 CPU module 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, carry out writing of the project into the CPU module after starting MR Configurator2 and changing the parameters via GX Works3.
- A servo error (AL. 035 Command frequency error) may be detected in MR-J5(W)-G when an operation cycle over occurs in the Motion module 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.
- When connecting MR-J5(W)-G in communication cycle 31.25 μs/62.5 μs, use A6 version or later. If its version is not compatible, the error "Communication Cycle Unsupported Driver Connection" (error code: 1C47H) will occur at connection and it can not be connected with the driver.

MR-J5(W)-G (Profile mode) connection method

This section describes how to set when connecting MR-J5(W)-G (Profile mode) and use various functions.

For details of wiring and parameters of MR-J5(W)-G, refer to MR-J5(W)-G manuals.

The firmware for MR-J5(W)-G which is available with profile mode is shown below.

Model name	Version
MR-J5(W)-G	A4 or later

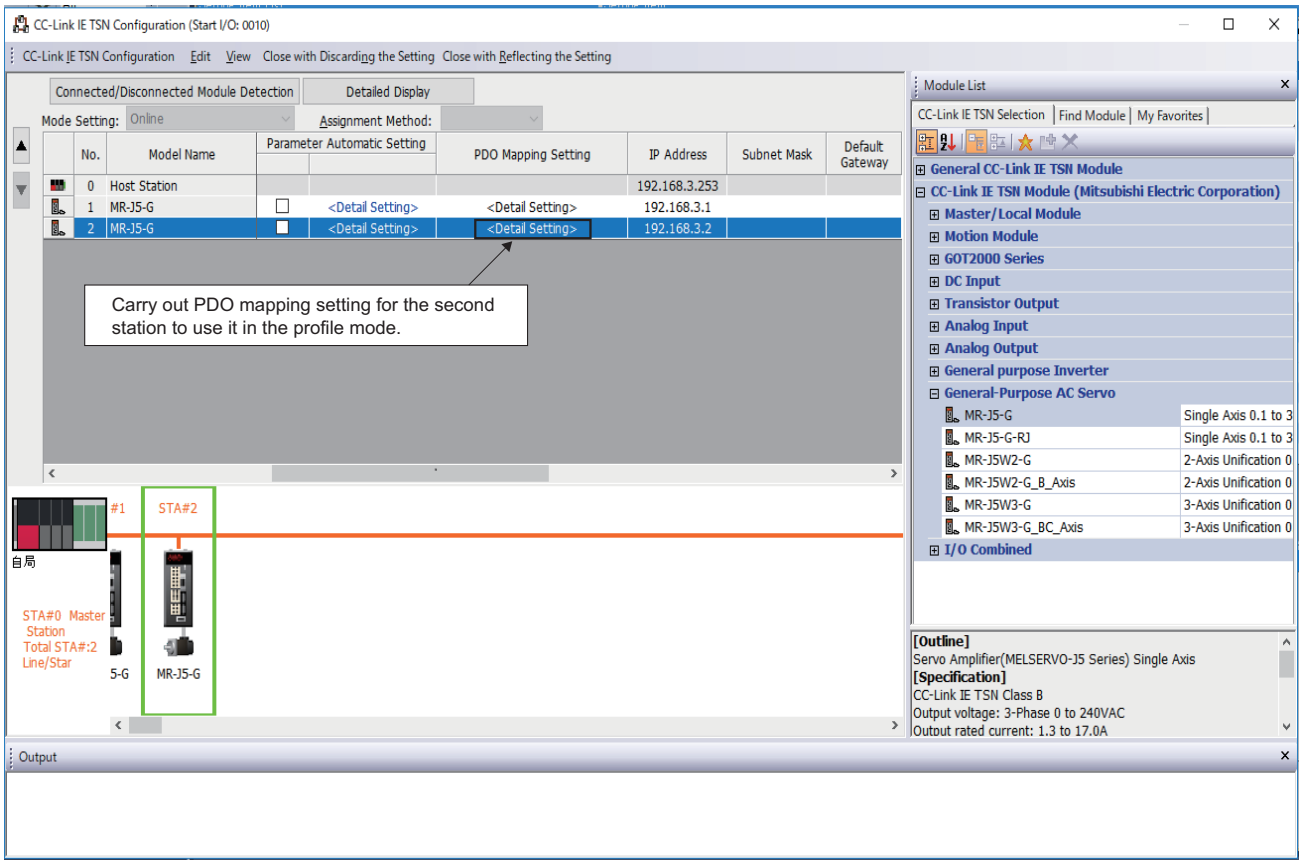
Setting method

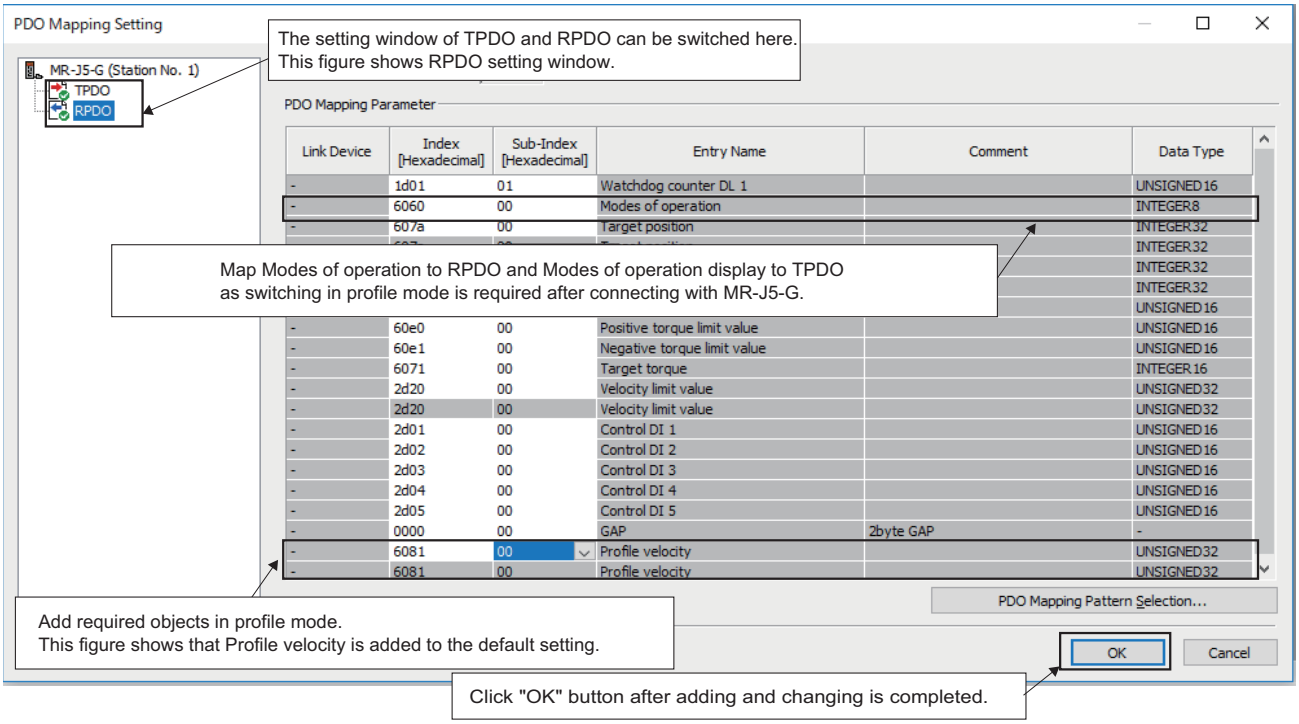
An example is shown below for using two MR-J5-G as the first station (192.168.3.1) set with the cyclic synchronous mode and the second station (192.168.3.2) set in profile mode.

■CPU setting [GX Works3]

[Module Parameter (Network)]⇨[Basic Settings]⇨[Network Configuration Settings]

Set PDO mapping and map required objects in profile mode on the "CC-Link IE TSN Configuration" screen.

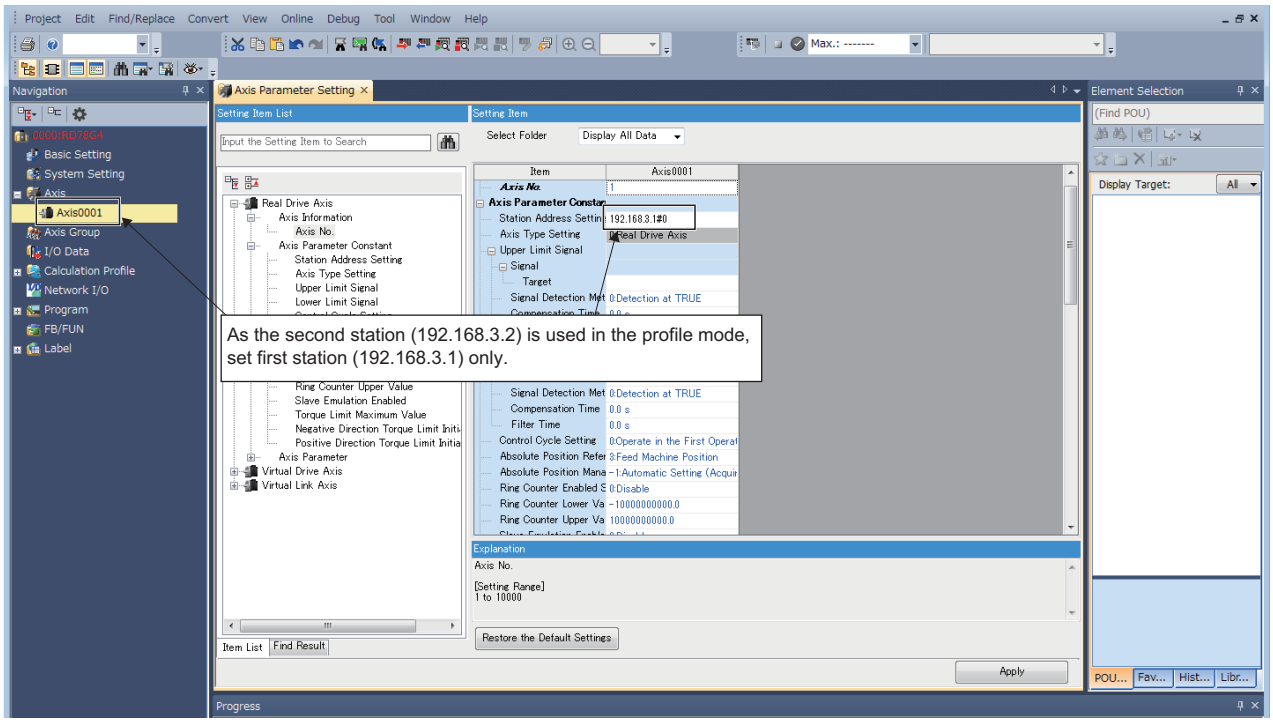




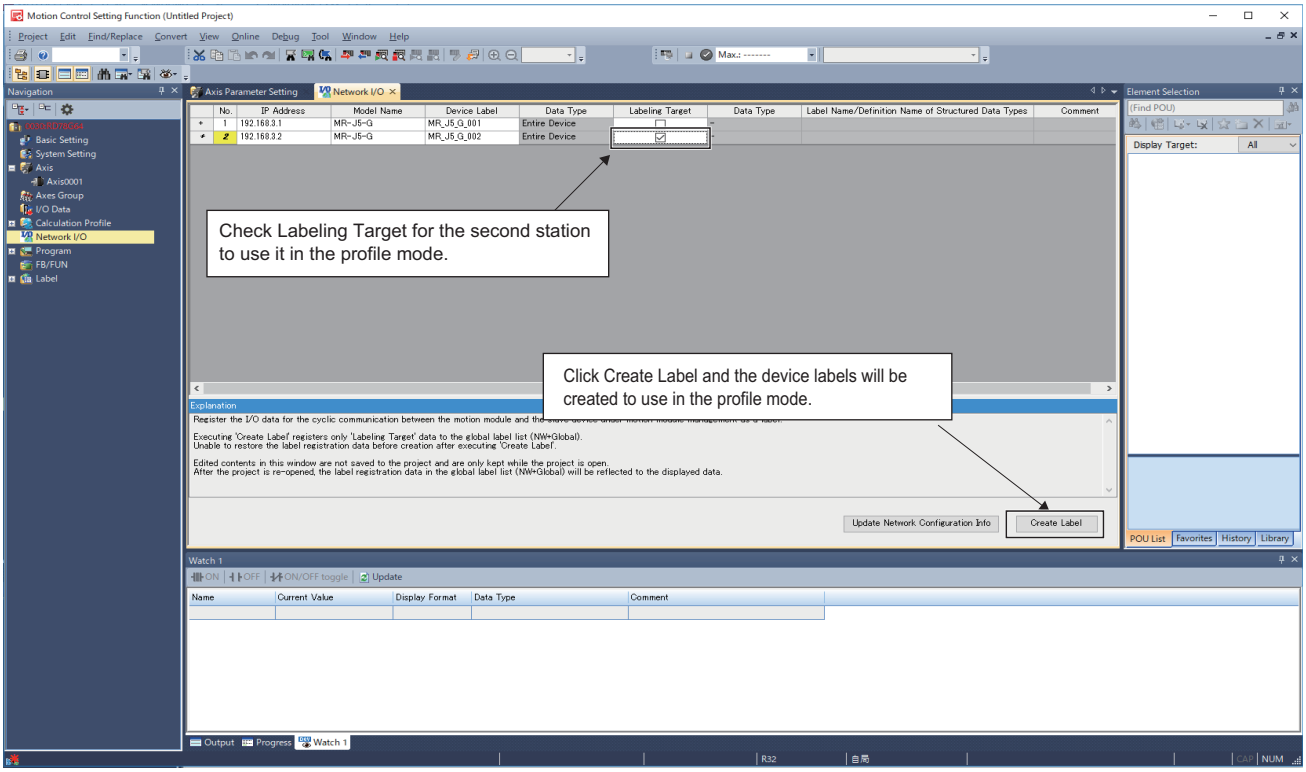
A

■The Motion module setting [Motion control setting function]

The axis to be used in profile mode must not be set.



Generate the device label of MR-J5-G using for the profile mode according to the procedure described in "Common Items for all devices". For using with the profile mode, generate labels of the entire device as the labeling target.

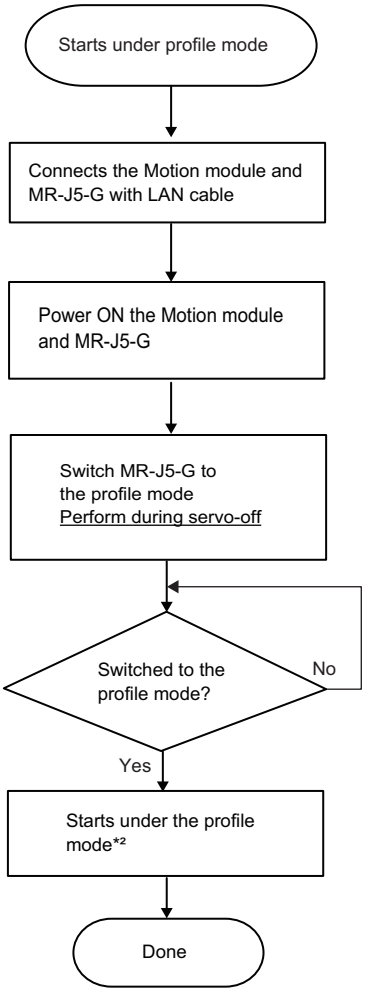


■MR-J5-G setting [MR Configurator2]

No setting is required.

Setting method

The following figure describes the process for driving motors with the profile mode.



MR-J5-G starts with csp mode.
Change MR-J5-G to the profile mode by modifying MR_J5_002_Modes OF Operation*1 from program or watch.
(e.g.: Set the label to "1" for changing to pp mode)

Refer to MR_J5_002_Modes OF OperationDisplay*1 and check the control mode of MR-J5-G is switched.

*1 A label name differs depending on a labeled device. The name described in this process indicates the name for generating the label targeting the second station of MR-J5-G.

*2 When Watch dog counter DL is mapped to the PDO, creating the program to update Watch dog counter DL is required for each communication cycle. (When updating is not performed, the motors do not drive.)
When it is not needed, exclude it from mapping.
When using Watch dog counter DL, set as follows in the program.
Method 1:
Turn bit15 ON.
Method 2:
Add 1 for each communication cycle. (Be sure not to be turned OFF bit15 by adding 1 as bit15 has to be turned ON constantly.)

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 with the profile mode, the Motion module does not perform the limit check of the command, etc. Carry out safety measures at the user's program or MR-J5(W)-G side.
- Do not switch MR-J5(W)-G set as the axis to the 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 CPU module 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, carry out writing of the project into the CPU module after starting MR Configurator2 and changing the parameters via GX Works3.
- When connecting MR-J5(W)-G in communication cycle 31.25 μs/62.5 μs, use A6 version or later. If its version is not compatible, the error "Communication Cycle Unsupported Driver Connection" (error code: 1C47H) will occur at connection and it can not be connected with the driver.

How to connect MR-JET-G

This section describes how to set when connecting MR-JET-G and use various functions.
For details of wiring and parameters of MR-JET-G, refer to MR-JET-G manuals.

Setting method

The same as MR-J5(W)-G

How to use

The same as MR-J5(W)-G

Precautions

Do not set the following objects as MR-JET-G is not compatible with them.

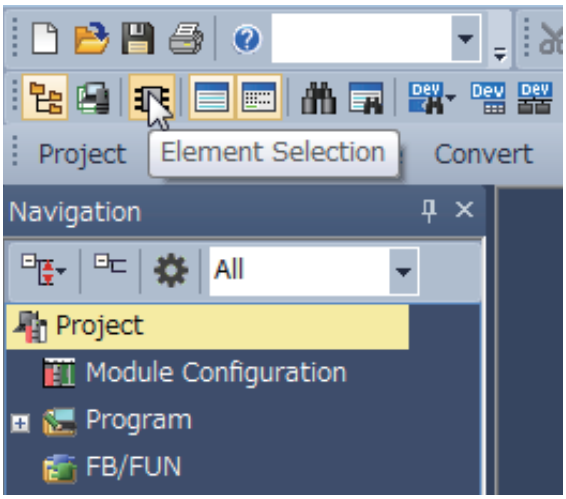
Index	SubIndex	Object name	Parameter name
2D35h	2	Encoder status 2	AxisName.PrConst.SlaveObject.vEncoderStatus2
2D36h	0	Scale cycle counter	AxisName.PrConst.SlaveObject.vScaleCycleCounter
2D37h	0	Scale ABS counter	AxisName.PrConst.SlaveObject.vScaleAbsCounter
2D38h	0	Scale measurement encoder resolution	AxisName.PrConst.SlaveObject.vScaleMeasurementEncoderResolution
2D3Ch	0	Scale measurement encoder reception status	AxisName.PrConst.SlaveObject.vScaleMeasurementEncoderReceptionStatus

- MR-JET-G is not compatible with the communication with 31.25 μs and 62.5 μs. Set the communication period interval setting with 125 μs or more.
- 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 CPU module 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, carry out writing of the project into the CPU module after starting MR Configurator2 and changing the parameters via GX Works3.
- A servo error (AL. 035 Command frequency error) may be detected in MR-JET-G when an operation cycle over occurs in the Motion module 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.

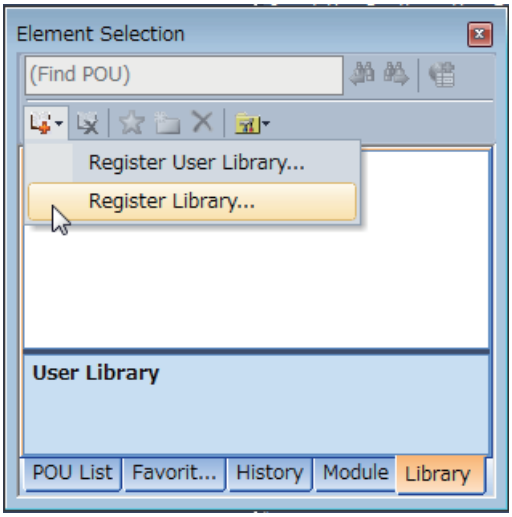
Appendix 2 Project Setting Example

Library Registration Procedure

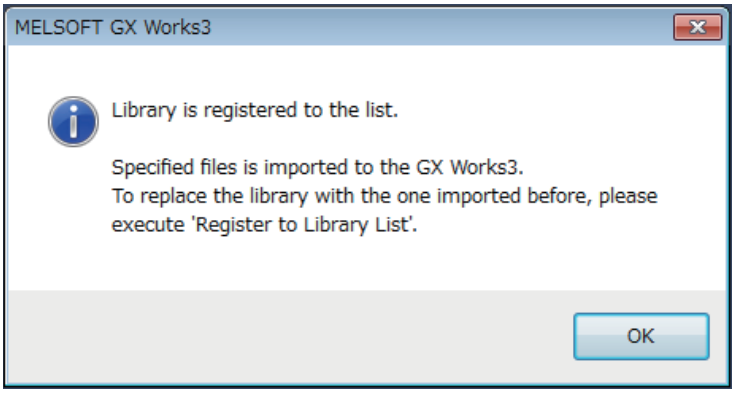
1. For MCFB library, please consult your local Mitsubishi representative.
2. Start GX Works3, select [Project] ⇨ [New], and select a type. Display the Element Selection window.



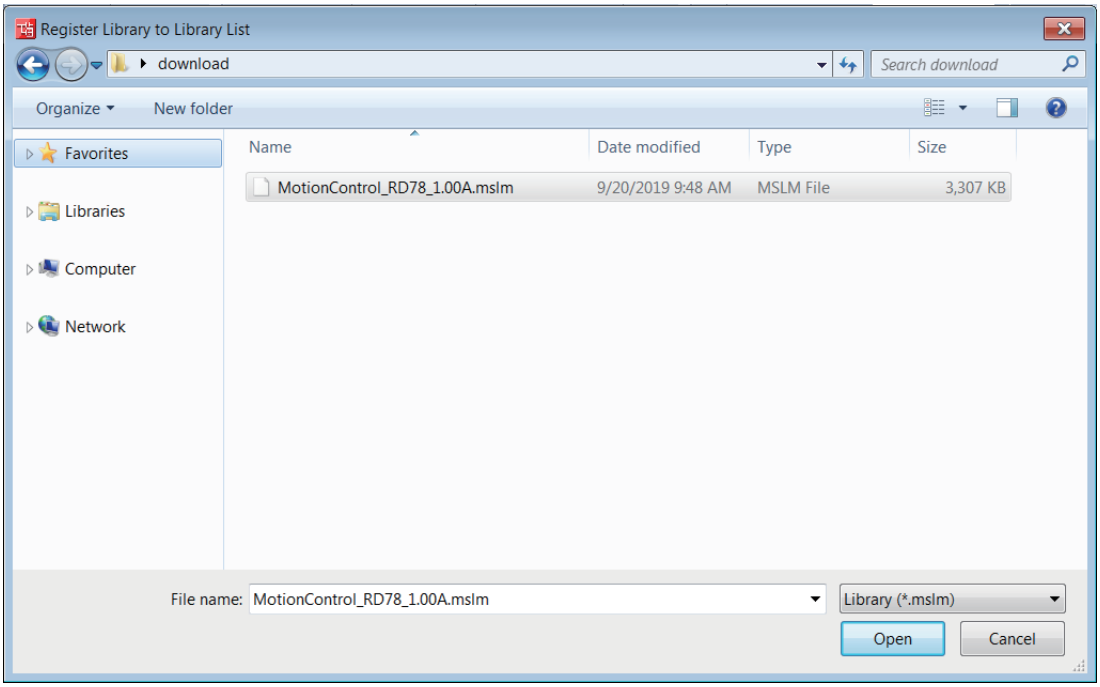
3. Select the Library tag, and select "Register Library..." of the "Register to Library List" icon.



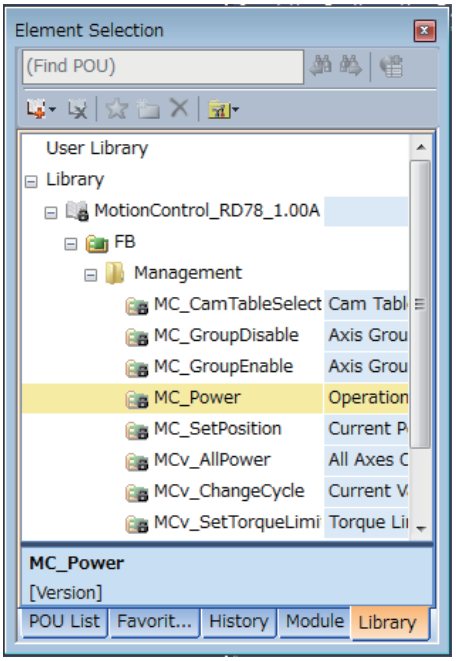
4. The following dialog box appears. Click the [OK] button.



5. The "Register Library to Library List" window appears. Select "MotionControl_****.mslm" and click the [Open] button.



6. Imported FBs are displayed in the Element Selection window.



7. Select an FB in the Element Selection window and drag and drop it into the work window. The FB is added in the Navigation window.

A

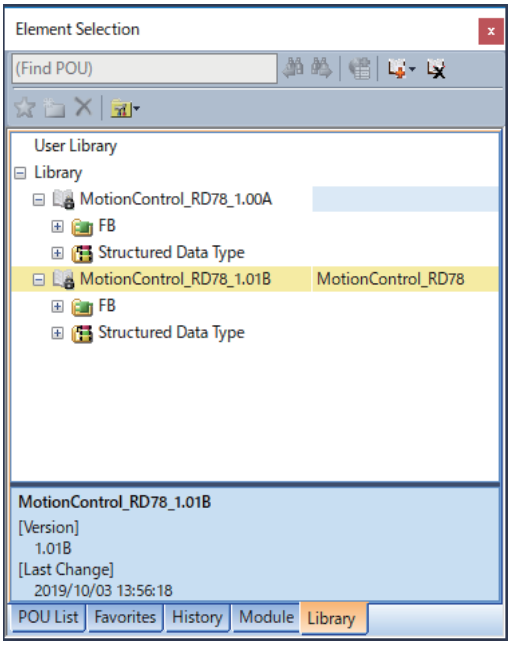
Library Update Procedure

To update the version of the FB library, register the new version of the library according to "Library Registration Procedure" and carry out "Update library element".

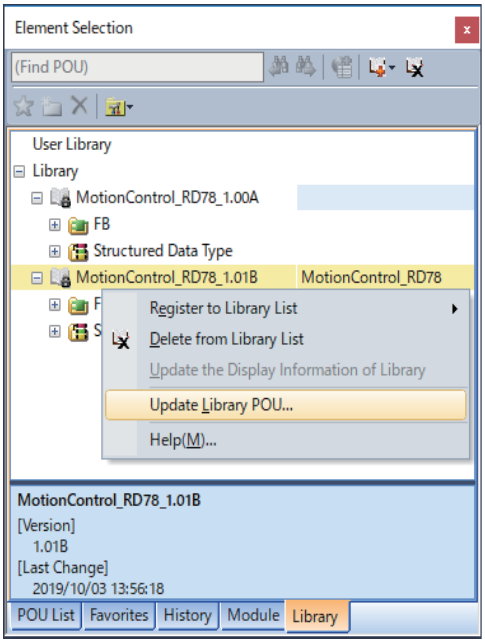
Ex.

Update from Ver.1.00A to Ver.1.01B.

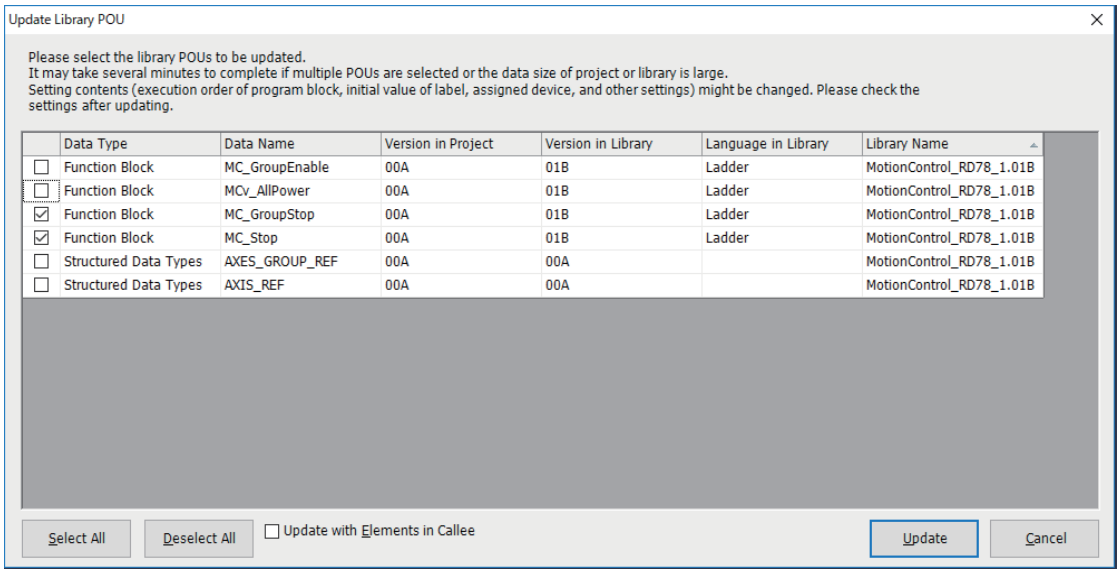
1. Register the new version of the library which is carried out updating according to "Library Registration Procedure". The current library version is shown in the following window.

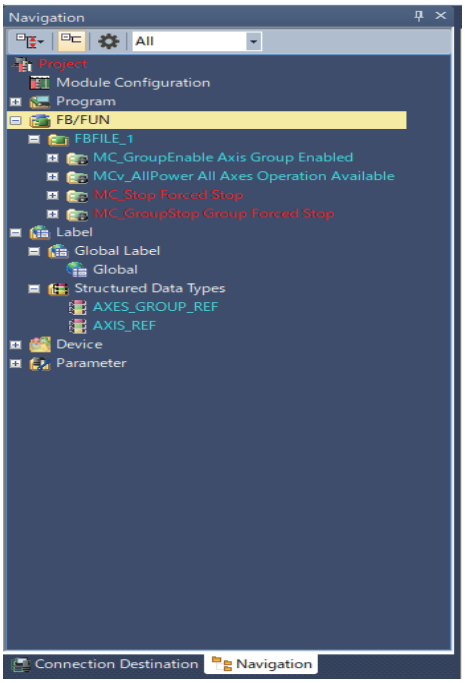


2. Right-click the library name and select "Update library element...".



3. The FB list used for the project is displayed in "Update library element" window.
As the FBs required updating of the version are automatically selected their checkboxes, click the [Update] button.





A

Appendix 3 Motion Module Programs

Variables

The variables used in programs fall into two categories, devices and labels.

Areas related to axis control, such as parameters, monitor data, and control commands, are assigned to the labels (structure) provided by the system.

Type	Description
Device	These variables are expressed as a name and number. The name, type, and method of use are defined by the system. ■Devices that are usable by the Motion system • Buffer memory(G) • Link special relay(SB) • Link special register(SW)
Label	These variables are expressed with a given character string. The label defined by the system for the name, type, and method of use as well as the label defined by the user are available.

Precautions

■Inputting project data

While the power is ON, reload of areas such as label definitions, initial values, and programs is not performed. To reflect changes in the written project, turn the power from OFF to ON.

■Calling MCFB instances

Calling a single MCFB instance from multiple programs can cause unforeseen operations to occur.

■Inconsistency caused by variable bit-specification/digit specification for bit-type devices

If access is performed from tasks with different execution cycles by variable-bit specification or bit-type device digit specification, inconsistency may occur producing an unintended operation result. Correct the execution cycles so that they are the same or access another area in word units.

Ex.

Inconsistency occurs when switching between the following

- Normal execution type program↔fixed scan execution type program
- Normal execution type program↔updating through the Motion system
- Normal execution type program↔accessing from a PLC or other external device

■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, an error will occur when converting the program. If the array index is specified with data other than a constant, an error will not occur when converting the program and processing will be performed by accessing another device.

Relevant variables/function blocks (FB)

Variable/Structure name	Name	Details
System.Md		
Program_Ei	EI flag	TRUE when EI instruction is executed. • TRUE: during EI • FALSE: during DI
System.PrConst		
MeasuresPrograms	Measurement flag for program information	Set to measure the program execution time, number of program executions, and program execution status. The measured data is stored in the PROGRAM_INFO structure of each program. • TRUE: measure • FALSE: do not measure
PROGRAM_INFO		
ExecutionTime	Execution time	Stores the program execution time in units of [μs]. Performs a 0 clear when changed from STOP→RUN.
Number	Number of executions	Counts the number of program executions. (0 to 65535.) After surpassing 65535, the number returns to 0. Performs a 0 clear when changed from STOP→RUN.
Status	Status	0: MC_PROGRAM_WAITING (standstill) 1: MC_PROGRAM_RUNNING (running) 3: MC_PROGRAM_ERROR (stop due to error) 4: MC_PROGRAM_DI (standstill by DI)

Execution of programs

The program changes to RUN status when PLC READY [Y0] turns ON and the program is executed in accordance with the program execution type and execution procedure settings.

Execution types for programs

Set the timing that program processing is executed for each execution type.

Settable execution types are shown below.

Execution type	Reference
Initial	☞ Page 697 Initial execution type
Normal	☞ Page 698 Normal execution type
Fixed scan	☞ Page 698 Fixed scan execution type
Standby	☞ Page 699 Standby execution type

■Initial execution type

The program is executed only once when PLC READY [Y0] changes from OFF→ON.

After the initial execution type program completes, a program of a different execution type is executed.

Restriction

For initial execution type programs, do not use a command that requires multiple execution cycles (a command containing a complete device) or a Motion control FB until the program completes.

■Normal execution type

The program is executed by normal task through the Motion system.

Restriction

While running fixed scan execution type programs, the execution of normal execution type programs is interrupted. However, fixed scan execution type programs can be disabled through a normal execution type program with a Disable Interrupt (DI) instruction. After being disabled through DI instruction, fixed scan execution type programs will remain disabled until an Enable Interrupt (EI) instruction is executed.
The enabled/disabled status of fixed scan execution type programs can be checked with "System.Md.Program.Ei".

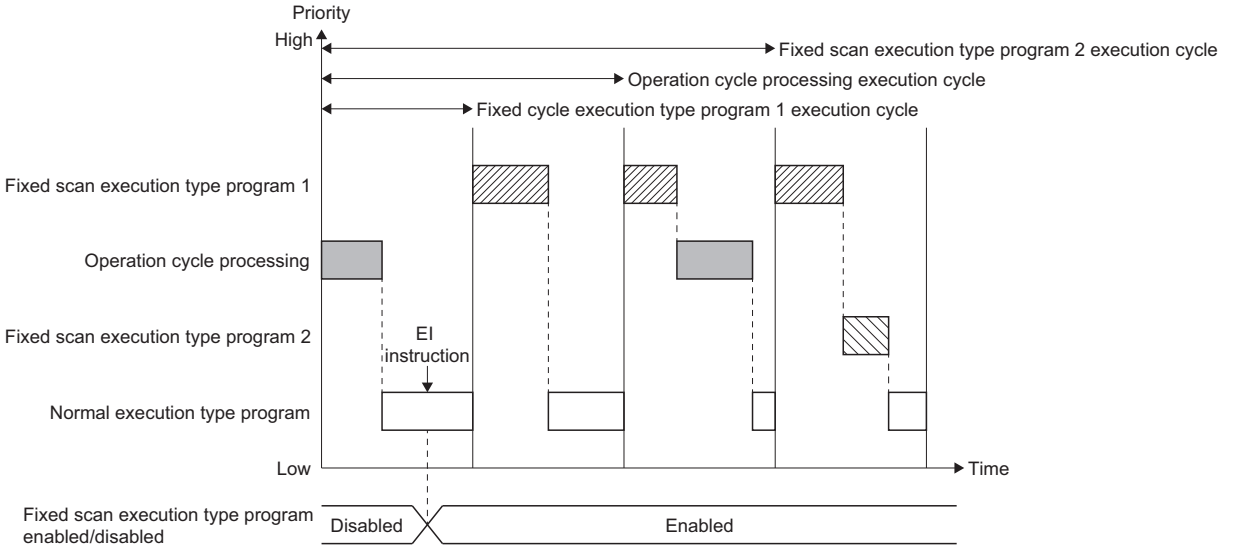
■Fixed scan execution type

The program is executed at each specified time.
The time can be set from that of the first operation cycle up to 60000[ms] (in integer multiples of the first operation cycle).
Processing is prioritized by execution interval length and starts by processing programs with the shortest intervals.

Point

To execute a fixed scan execution type program, it is necessary to change its status to execution enabled through EI instruction.

The fixed scan execution type program is executed at the start of the next fixed scan after EI instruction is issued.
The fixed scan interval counter is monitored after the power is turned ON and then used to determine execution conditions.



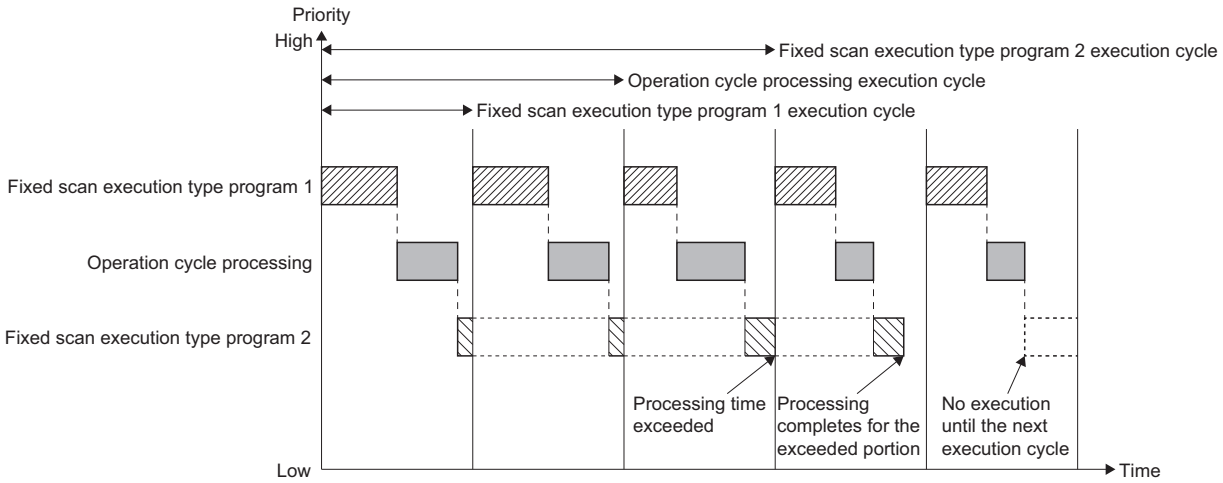
Restriction

Fixed scan execution type programs cannot be executed if they have been disabled (DI) from a normal execution type program.

- Interruption of processing

  Other high-priority processing can interfere with program execution processing in some cases.

  If processing interference occurs due to interruption while running a fixed scan execution type program, the processing will resume after the interrupt processing completes. In addition, all further execution cycles are ignored until the processing completes if the processing time is exceeded for the fixed scan interval. Execution resumes from the next execution cycle after the processing completes.



Restriction

A warning or error does not occur even if the processing time is exceeded.
Check the processing time on the execution time monitor.

Point

In some cases, the operation load of fixed scan operation type programs can cause an operation cycle over to occur.

■Standby execution type

The program is executed at execution request.

The program is converted to a normal execution type program and then executed by using a PSCAN instruction from another running program.

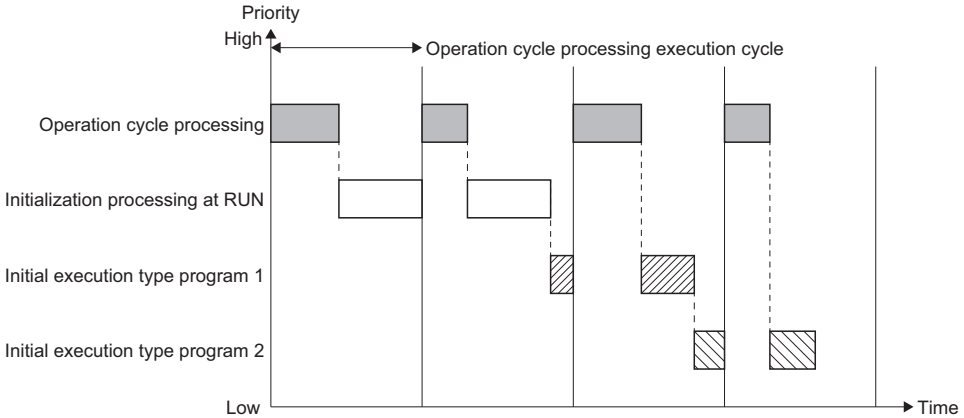
Flow of program execution

The flow of execution for each program is shown below.

■Processing for initial execution type programs when PLC READY [Y0] is ON

The timing chart for processing that is executed when PLC READY [Y0] is ON is shown below.

Processing for initial execution type programs is interrupted by operation cycle processing.



When the PLC READY [Y0] is turned from OFF to ON

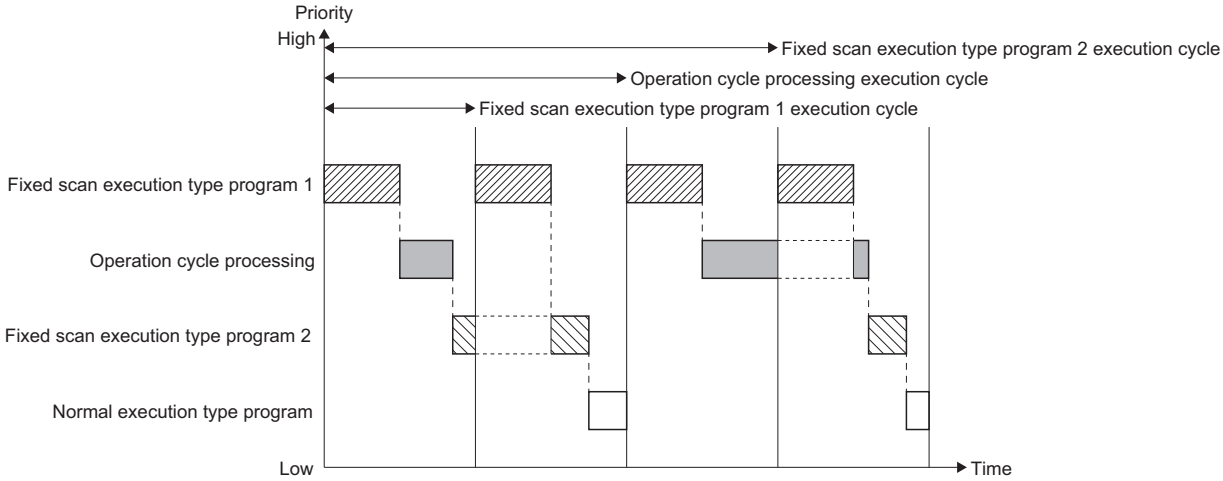
Point

Fixed scan type programs are not executed until the processing for initial execution type programs completes, even if an EI instruction is issued during an initial execution type program.

■Processing at completion of initial execution type programs

The timing chart for each program that operates after initial execution type program processing has fully completed is shown below.

The 3 kinds of fixed cycle processing (fixed scan execution type program 1, fixed scan execution type program 2, and operation cycle processing) are performed with priority given to those with the shortest execution cycles.



Point

Programs of the same execution type/with the same execution cycle settings are executed in order starting with those with the smallest execution order number.

The execution order can be checked with the engineering tool in "Program Execution Setting".

The execution type and execution cycle setting have higher priority than the execution order.

■Initialization processing at power ON

The following processing is performed during label initialization processing when the power turns from OFF to ON.

- Expansion of global label files, structure definition files, and FB definition files
- Configuration and setting of initial values for global labels
- Input of program settings

■Initialization processing at first RUN

The following processing is performed during first RUN initialization processing after the power turns from OFF to ON.

- Expansion of program files and configuration of program local labels.
- Checking of each parameter and program.
- Setting of initial values for labels/FB.

Point

The time required to check parameter settings, programs, and files varies by volume and may cause a delayed response from peripheral devices in some cases.

■Initialization processing at 2nd and subsequent RUN

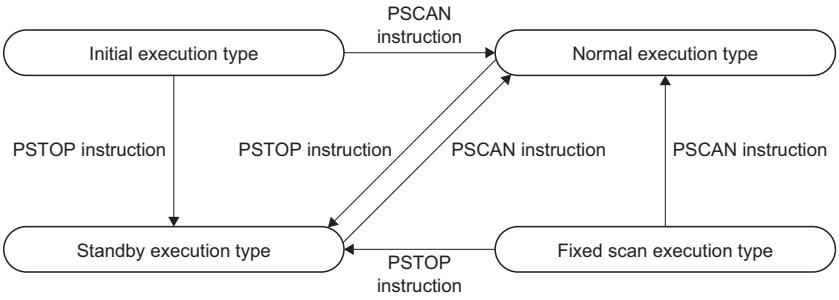
Reinput of each file and label reconfiguration cannot be performed after the power turns from OFF to ON during the 2nd and subsequent RUN. Only processing for the initial value setting is performed.

Refer to label initialization function for details of the initial values that are set.(☞ Page 703 Label initialization function)

Changing the execution type

To change the program execution type while PLC READY [Y0] is ON, use the program control command shown below.

- Program scan execution registration (PSCAN)
- Program standby (PSTOP)



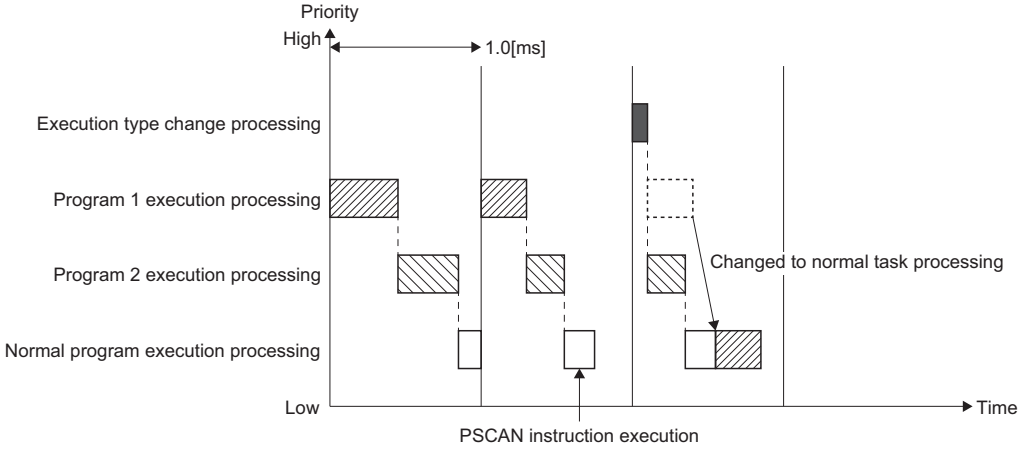
■Timing for changing the execution type

The timing for changing the execution type is shown below.

Execution type	Executed instruction	
	PSCAN	PSTOP
Initial	Changes to normal execution type.	Changes to standby type after program END processing completes.
Normal	No operation.	
Fixed scan	Changes to normal execution type after program END processing completes.	
Standby	Changes to normal execution type.	No operation.

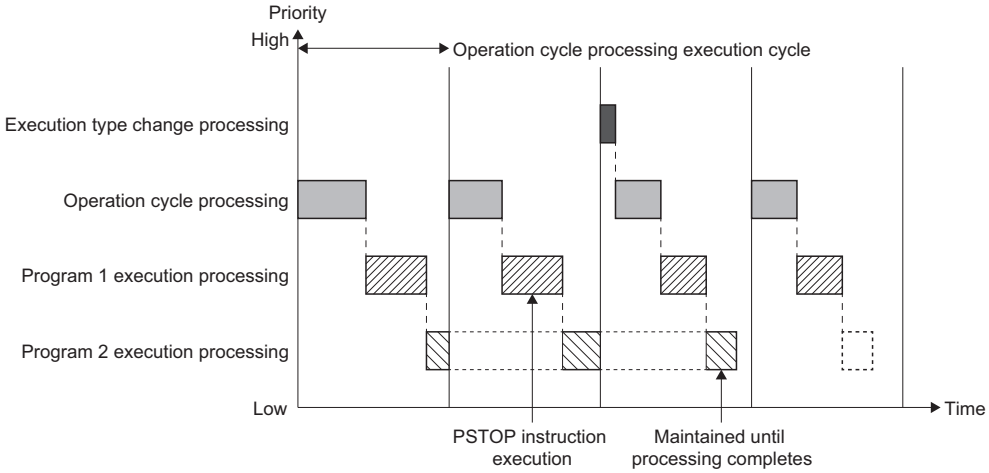
Ex.

When there are 2 fixed scan execution type programs and PSCAN instruction is executed for program 1.



Ex.

When there are 2 normal execution type programs and PSTOP instruction is executed for program 2.



■Precautions

- When changing the execution type of an initial execution type program or a fixed scan execution type program, it is not possible to revert back to the original execution type.
- When multiple instructions are executed in a single program, the last instruction determines the operation.
- The change in execution type is not reflected until processing for the relevant program completes.

Label initialization function

For the Motion system, label initialization processing is performed when the power turns from OFF to ON and also at STOP→RUN.

The execution details for initialization processing are shown below.

Label		Initial value setting provided/ none	Operation for label initialization		
			Power OFF→ON	When STOP→RUN	
				First time	2nd and subsequent time
Motion label	Parameter	—	Set the initial value		
	Non-parameter	—	Set the initial value	No operation (value is stored)	
User-defined global label		Provided	Set the initial value	No operation (value is stored)*1	
		None	Set the initial value (=0)	No operation (value is stored)	
User-defined local label		Provided	— (no labels configured)	Set the initial value	No operation (value is stored)*1
		None	— (no labels configured)	Set the initial value (=0)	No operation (value is stored)

*1 When performing STOP→RUN 2 or more times through settings, setting of the initial value can be performed.

Item	Description	Setting range	Initial value
Label initial value is reflected at STOP→RUN (2nd and subsequent time)	Specify whether or not to set the label initial value at STOP→RUN (2nd and subsequent time). (Values are always reflected the first time.)	• Enable • Disable	Disable

Appendix 4 Creation Procedure for Motion Module Programs

Motion module programs are created using the following methods.

- Use Structured Text (ST) language to create an ST program with the Motion module. (☞ Page 704 Program creation procedure for ST programs)
- Use labels registered to the Motion module on the CPU module side and create a sequence program. (☞ Page 726 Creation procedure for programs using the public label function)

Program creation procedure for ST programs

This section describes the areas that need to be set for the Motion system using an engineering tool as well as the procedure for creating ST programs.

1. Parameter settings

Set the module configuration and the CPU parameters. (☞ Page 705 Parameter settings)

2. Network settings

Set network related parameters in "Module Parameter (Network)".

Set the servo amplifiers to connect using CC-Link IE TSN in "Network Configuration Settings".

(☞ Page 706 Network settings)

3. Module parameter settings

Carry out the setting of RD78G related operations in "Module Parameter (Motion)". (☞ Page 709 Module parameter settings)

4. Module extended parameter settings

Carry out the setting of RD78G axis control related areas using the "Motion Control Setting Function".

- Basic settings (☞ Page 710 Basic settings)
- System settings (☞ Page 711 System settings)
- Axis (☞ Page 714 Axis)
- Axes group (☞ Page 722 Axes group)

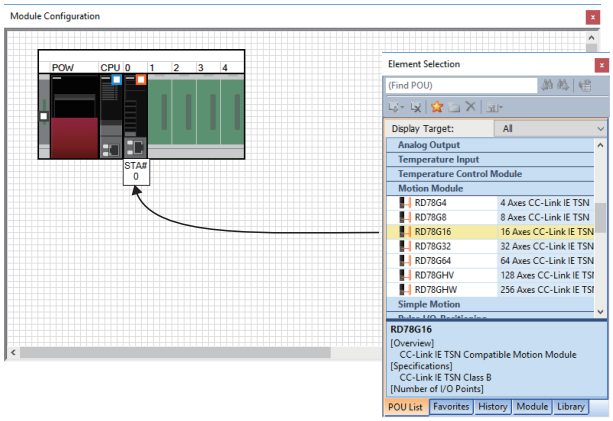
5. ST program creation (☞ Page 724 ST program creation)

Create an ST language program to operate RD78G with using the "Motion Control Setting Function".

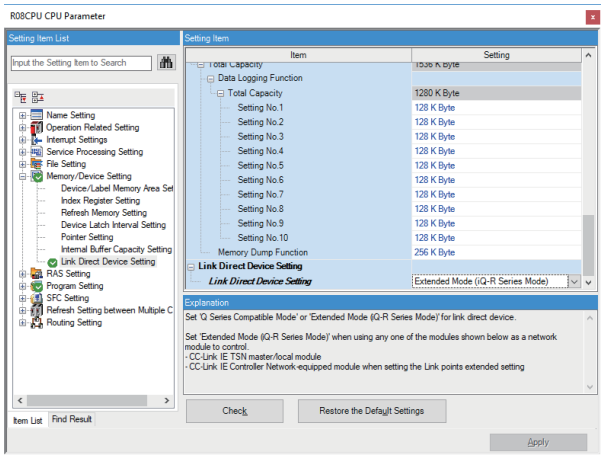
- Inserting Motion control FBs (☞ Page 725 Inserting Motion control FBs)
- Registering labels (☞ Page 725 Registering labels)

Parameter settings

Set the module configuration and the CPU parameters.



1. From the [Navigation window], select [Module Configuration] to open the Module Configuration and add RD78G from the Element Selection window so it can be used.
To fix the module configuration, select [Edit]⇨[Parameter]⇨[Fix] from the menu.



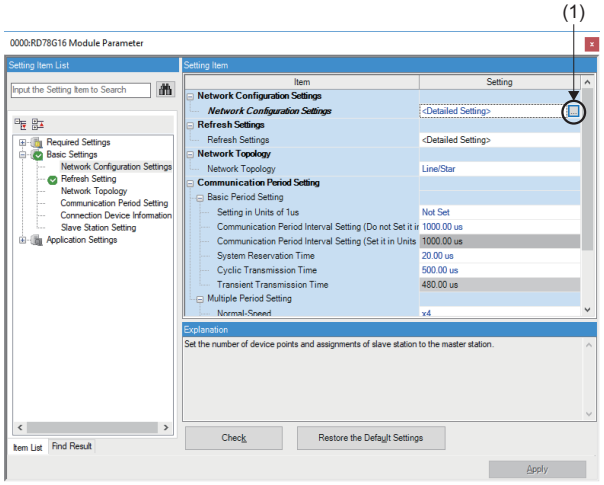
2. From the [Navigation window], select [Parameter]⇨[Module model name*1]⇨[CPU Parameter] to display the parameter editor.
From "Memory/Device Setting"⇨"Link Direct Device Setting", select "Extended Mode (iQ-R Series Mode)" in the pull down list, then click the [Apply] button.

*1: The model name of the set CPU module is displayed.

A

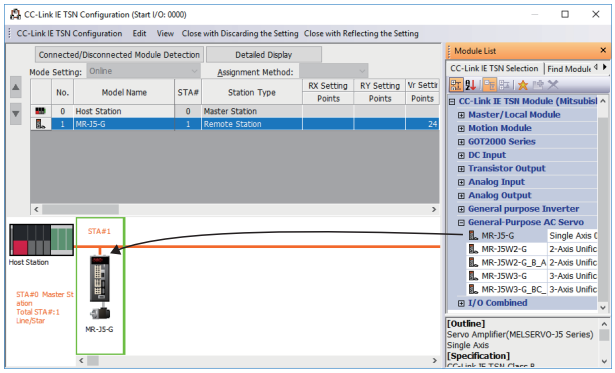
Network settings

Set the module parameters (network).

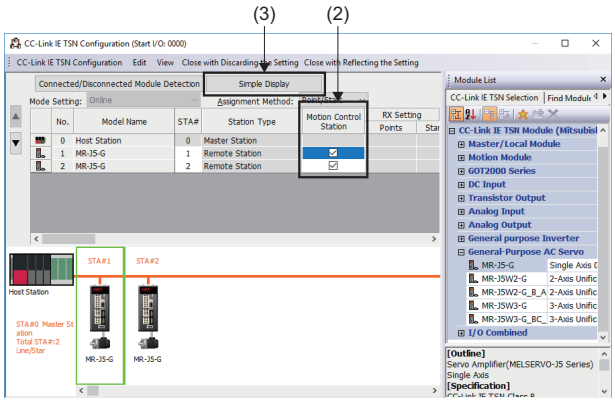


1. From the [Navigation window], select [Parameter]⇨[Module Information]⇨[Module model name*1]⇨[Module Parameter (Network)] to display the parameter editor. Select "Basic Settings"⇨"Network Configuration Settings"⇨"Detailed Setting", then click the [...] button (1).

*1: The model name of the set Motion module is displayed.

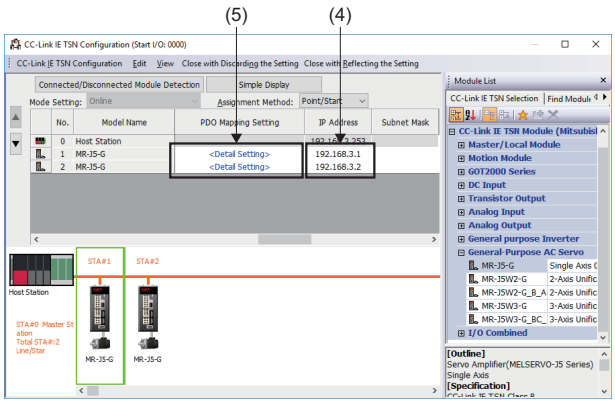


2. The "CC-Link IE TSN Configuration" screen is displayed. From [Module List]⇨[CC-Link IE TSN Device (Mitsubishi Electric Corporation)]⇨"General-Purpose AC Servo", select a servo amplifier and drag and drop it into its assigned position.



3. Place a check in the Motion Control Station (2) check box for each set servo amplifier.

*: If the Motion Control Station is not displayed, click the [Detailed Display] button (3) to switch to the detailed display.

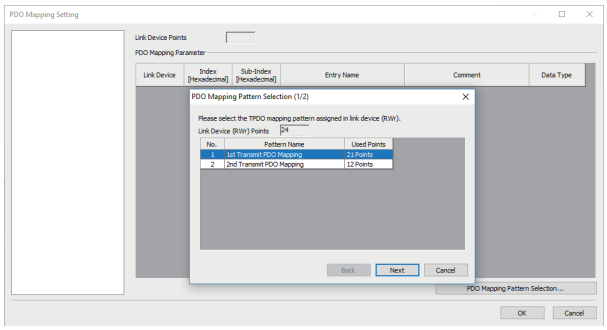


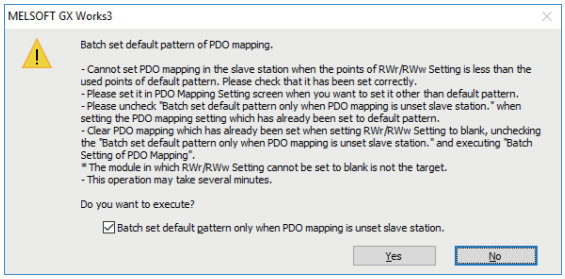
4. Check the IP Address (4) that is assigned to the set servo amplifiers.

*: The IP Address (4) setting is required when creating an axis to set with the Motion Control Setting Function.

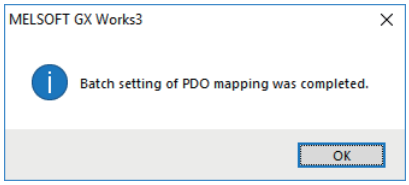
5. When the network configuration is complete, select [CC-Link IE TSN Configuration]⇨[Batch Setting of PDO Mapping] from the menu.

*: Performing Batch Setting of PDO Mapping allows batch setting of the PDO mapping default pattern. When not setting the default pattern, double-click "Detailed Setting" (5) in PDO Mapping Setting to display the "PDO Mapping Pattern Selection" screen, then select the PDO Mapping pattern to assign to the link device. The selected PDO mapping pattern can be changed on the "PDO Mapping Setting" screen.

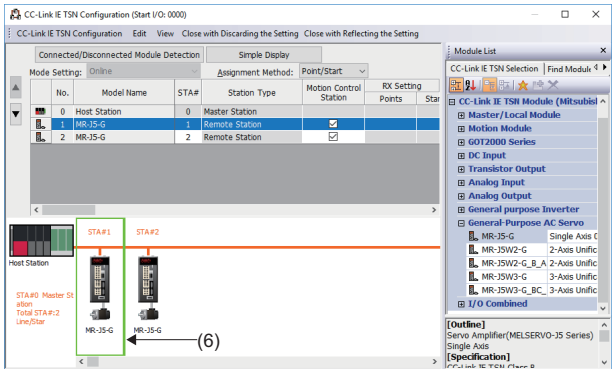




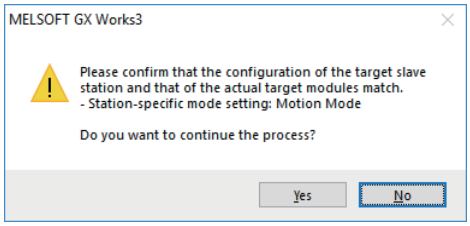
6. When the "Batch set default pattern of PDO mapping." message appears, click the [Yes] button.



7. The "Batch setting of PDO mapping was completed." message is displayed. Click the [OK] button.

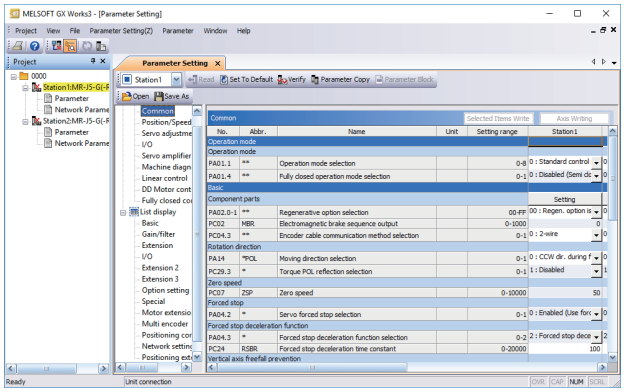


8. From the network configuration, double-click the servo amplifier (6) to be set.



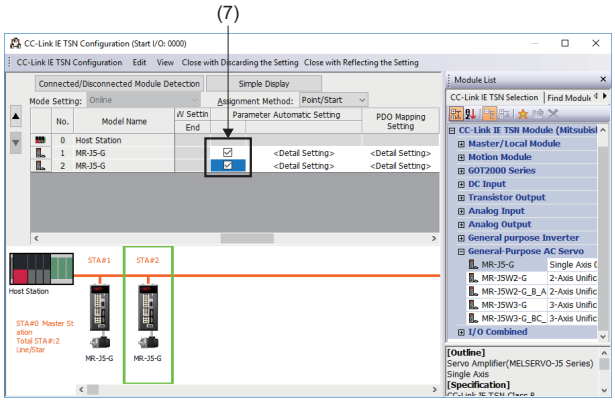
9. When the "Please confirm that the configuration of the target slave station and that of the actual target modules match." message appears, click the [Yes] button.

A



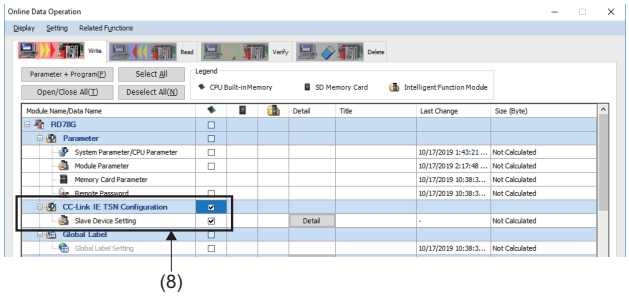
10. The Parameter Setting screen is displayed.
Set the servo parameters for each axis.

11. When the setting of servo parameters is complete, close the Parameter Setting screen.

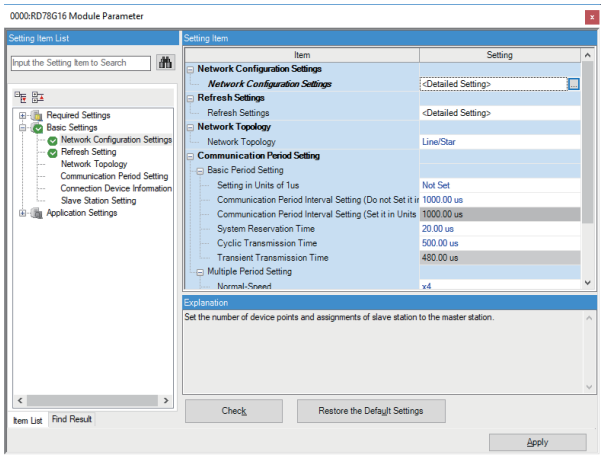


12. Return to the "CC-Link IE TSN Configuration" screen.
Place a check in the Parameter Automatic Setting (7) check box.

*: When performing writing of the servo parameters, place a check in "CC-Link IE TSN Configuration" (8) on the "Online Data Operation" screen.



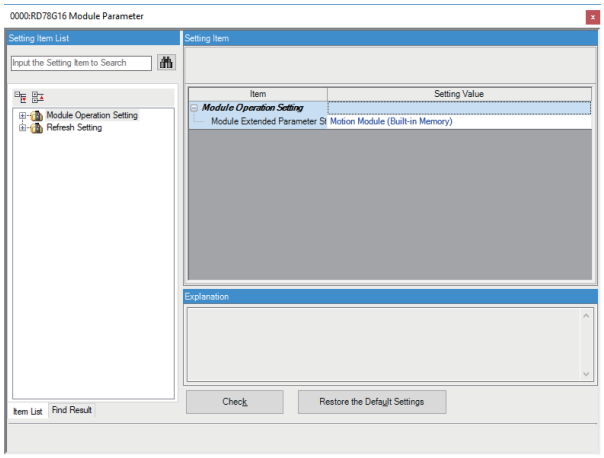
13. Select [Close with Reflecting the Setting], then close the "CC-Link IE TSN Configuration" screen.



14. Click the [Apply] button to complete Module Parameter (Network) settings.

Module parameter settings

Set the module parameters (Motion).



1. From the [Navigation window], select [Parameter]⇨[Module Information]⇨[Module model name*1]⇨[Module Parameter (Motion)] to display the parameter editor. Set the parameters in "Module Operation Setting".

*1: The model name of the set Motion module is displayed.

Displayed items

■Module operation setting

Item	Setting range	Initial value
Module extended parameter storage target setting	Motion module (built-in memory), Motion module (SD memory card)	Motion module (built-in memory)

- Module extended parameter storage target setting

  Set the target for module extended parameters to be used for the Motion module. When writing the module extended parameters from GX Works3, write to the target that is specified for this parameter.

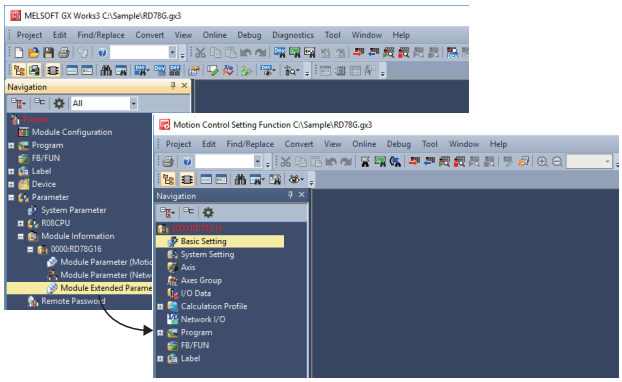
Setting	Description
Motion module (built-in memory)	Use the module extended parameter that is written to the flash ROM of the Motion module.
Motion module (SD memory card)	Use the module extended parameter that is written to the SD memory card of the Motion module.

A

Module extended parameter settings

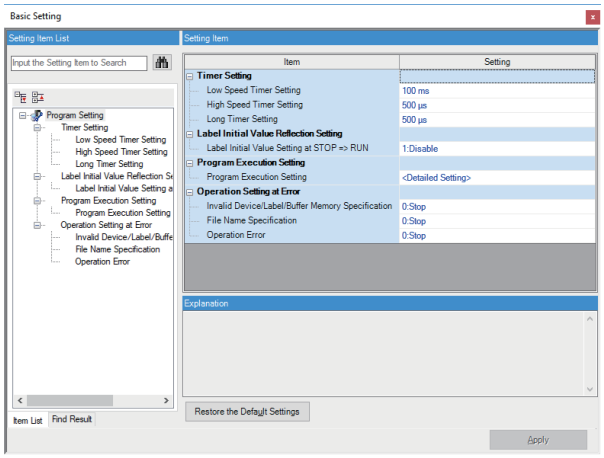
Set the module extended parameters on the Motion Control Setting Function screen.

■Basic settings



1. From the [Navigation window], select [Parameter]⇨[Module Information]⇨[Module model name*1]⇨[Module Extended Parameter] to display the "Motion Control Setting Function" screen.

*1: The model name of the set Motion module is displayed.



2. From the [Navigation window], select [Basic Setting] to display the parameter editor. Set the parameters for the basic settings.
3. When the setting of parameters for the basic settings is complete, click the [Apply] button.

Displayed items

• Program settings

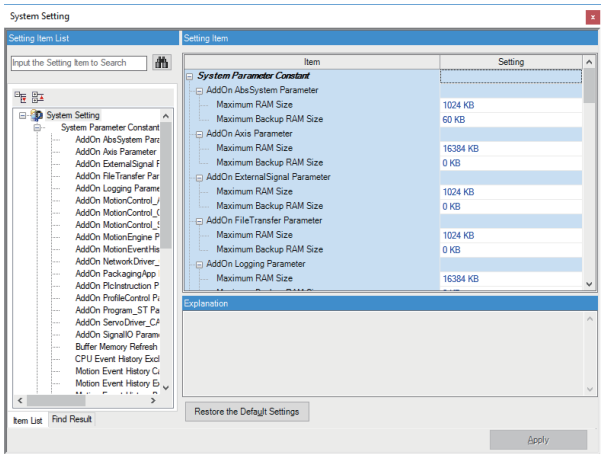
Item		Setting range	Initial value
Timer setting	Low speed timer setting	1 to 10000[ms]	100[ms]
	High speed timer setting	1 to 10000[μs]	500[μs]
	Long timer setting	1 to 1000000[μs]	500[μs]
Label initial value reflection setting	Label initial value setting at STOP→RUN	0: Enable 1: Disable	1: Disable
Program execution setting	Program execution setting	<Detailed setting>*1	—
Operation setting at error	Invalid device/label/buffer memory specification	0: Stop 1: Continue	0: Stop
	File name specification		0: Stop
	Operation error		0: Stop

*1 Set when changing the execution order, execution type, and other areas for the programs being used.

Item			Setting description
Execution order			Execute programs in order from 1 to 2048
Program name			The name of the created program is displayed
Execution type			0: Standby 1: Normal 2: Initial 3: Fixed scan
Program execution condition*2	Fixed scan interval setting	Unit	1ns, 0.01ms
		Fixed scan interval	• When set to 1ns: 125000 to 600000[ns] • When set to 0.01ms: 0.25 to 6000[ms]

*2 Can only be set when selecting "3. Fixed scan" as the execution type.

■System settings



1. From the [Navigation window], select [System Setting] to display the parameter editor.
   Set the parameters for the system settings.
2. When the setting of parameters for the system settings is complete, click the [Apply] button.

Displayed items

- System settings

Item [Variable/Structure name]			Setting range	Initial value
System parameter constant	Addon □□ parameter [□□]*1	Maximum RAM size [ADDON_PARAM.RamSizeMax]	—	*1
		Maximum backup RAM size [ADDON_PARAM.BackupRamSizeMax]	—	*1
	Buffer memory refresh cycle setting [System.PrConstBuffermemoryRefreshCycle]	Cycle setting [CYCLE_PARAM.Cycle]	0: Automatic setting	0
		Number of cycle over warning detections [CYCLE_PARAM.NumOfCycleOverWngDetectTimes]	0 to 65535	1
		Number of cycle over error detections [CYCLE_PARAM.NumOfCycleOverErrDetectTimes]	0 to 65535	5
		Cycle over error selection [CYCLE_PARAM.CycleOverErrorType]	0: None 1: Warning 2: Minor error 3: Moderate error 4: Major error	3: Moderate error
	CPU event history excluded event [System.PrConst.EventHistoryCpu_Exclude]		—	0x700-0x7ff
	Motion event history capacity [System.PrConst.EventHistoryMotion_Capacity]		1 to 2048[kB]	128[kB]
	Motion event history excluded event [System.PrConst.EventHistoryMotion_Exclude]		—	No setting
	Motion event history path [System.PrConst.EventHistoryMotion_Path]		—	No setting
	Excluded warning [System.PrConst.ExcludeWarning]		—	No setting
	For manufacturer setting		—	0000
	File transfer access control (file in latch drive) [System.PrConst.FileTransfer_AcFile_lch]		Read protected/write protected, read permitted/write protected, read permitted/write permitted	Read permitted/ write permitted
	File transfer access control (file in RAM drive) [System.PrConst.FileTransfer_AcFile_ram]			Read permitted/ write permitted
	File transfer access control (file in user drive) [System.PrConst.FileTransfer_AcFile_rom]			Read permitted/ write protected
	File transfer access control (file in SD memory card) [System.PrConst.FileTransfer_AcFile_sdc]			Read permitted/ write permitted
	File transfer access control (file in system drive) [System.PrConst.FileTransfer_AcFile_sys]			Read permitted/ write protected
	File transfer access control (latch drive image) [System.PrConst.FileTransfer_AcImage_lch]			Read permitted/ write permitted

A

Item [Variable/Structure name]				Setting range	Initial value
System parameter constant	File transfer access control (RAM drive image) [System.PrConst.FileTransfer_AcImage_ram]			Read protected/write protected, read permitted/write protected, read permitted/write permitted	Read permitted/ write permitted
	File transfer access control (user drive image) [System.PrConst.FileTransfer_AcImage_rom]				Read permitted/ write protected
	File transfer access control (system drive image) [System.PrConst.FileTransfer_AcImage_sys]				Read protected/ write protected
	File transfer access control (label) [System.PrConst.FileTransfer_AcLabel]				Read permitted/ write permitted
	File transfer auto execution enabled [System.PrConst.FileTransfer_AutorunEnable]			0: Disabled 1: Enabled	1: Enabled
	File transfer log capacity [System.PrConst.FileTransfer_LogCapacity]			-1 to 2048[kB]	128[kB]
	Label memory size [System.PrConst.LabelMemorySize]			128 to 8192[kB]	1024[kB]
	Refresh method of send/receive data at Motion control station [System.PrConst.Link_MotionStationRefreshType]			1: Operation cycle priority method	1: Operation cycle priority method
	Auto logging enabled [System.PrConst.Logging_AutoLoggingEnable]			0: Disabled 1: Enabled	0: Disabled
	Measurement flag for program information [System.PrConst.MeasuresPrograms]			0: Do not measure 1: Measure	0: Do not measure
	Operation cycle setting [1] [System.PrConst.OperationCycle[1].Cycle]	Cycle setting [CYCLE_PARAM.Cycle]		0: Automatic setting	0
		Number of cycle over warning detections [CYCLE_PARAM.NumOfCycleOverWngDetectTimes]		0 to 65535	1
		Number of cycle over error detections [CYCLE_PARAM.NumOfCycleOverErrDetectTimes]		0 to 65535	5
		Cycle over error selection [CYCLE_PARAM.CycleOverErrorType]		0: None 1: Warning 2: Minor error 3: Moderate error 4: Major error	3: Moderate error
	Soft reboot enabled [System.PrConst.SoftReboot_Enable]			0: Disabled 1: Enabled	0: Disabled
System parameter	All axes forced stop signal [System.Pr.ForcedStop_Signal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*2	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE(leading edge) 3: Detection at TRUE→FALSE(trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]

Item [Variable/Structure name]		Setting range	Initial value
System parameter	Stop selection at all axes stop by factors [System.Pr.StopMode_All]	1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	3: Alternative acceleration/ deceleration
	Deceleration at all axes stop [System.Pr.StopMode_AllDeceleration]	■When "Acceleration/ deceleration method" is Jerk 0, 0.0001 to 2147483647.0 ■When "Acceleration/ deceleration method" is other than Jerk 0, 0.000000, 0.000001 to 8400.0 *: It will stop immediately at "0".	0.0

*1 "□□" refers to the name of each addon parameter or the variable/structure name.

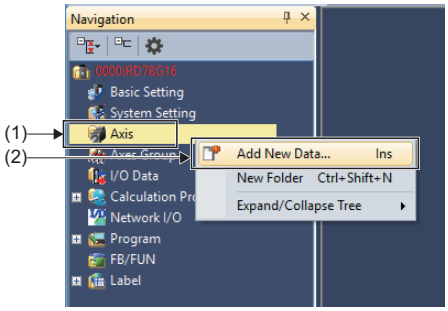
Item [Variable/Structure name]	Initial value	
	Maximum RAM size [ADDON_PARAM.RamSizeMax]	Maximum backup RAM size [ADDON_PARAM.BackupRamSizeMax]
Addon AbsSystem parameter [System.PrConst.Addon_AbsSystem]	1024[kB]	60[kB]
Addon Axis parameter [System.PrConst.Addon_Axis]	16384[kB]	0[kB]
Addon ExternalSignal parameter [System.PrConst.Addon_ExternalSignal]	1024[kB]	0[kB]
Addon FileTransfer parameter [System.PrConst.Addon_FileTransfer]	1024[kB]	0[kB]
Addon Logging parameter [System.PrConst.Addon_Logging]	16384[kB]	0[kB]
Addon MotionControl_AxisFilter parameter [System.PrConst.Addon_MotionControl_AxisFilter]	1024[kB]	0[kB]
Addon MotionControl_General parameter [System.PrConst.Addon_MotionControl_General]	4096[kB]	0[kB]
Addon MotionControl_Sync parameter [System.PrConst.Addon_MotionControl_Sync]	1024[kB]	0[kB]
Addon MotionEngine parameter [System.PrConst.Addon_MotionEngine]	4096[kB]	0[kB]
Addon MotionEventHist parameter [System.PrConst.Addon_MotionEventHist]	1024[kB]	0[kB]
Addon NetworkDriver_CCIETSN parameter [System.PrConst.Addon_NetworkDriver_CCIETSN]	1024[kB]	0[kB]
Addon PackagingApp parameter [System.PrConst.Addon_PackagingApp]	1024[kB]	0[kB]
Addon PlcInstruction parameter [System.PrConst.Addon_PlcInstruction]	1024[kB]	0[kB]
Addon ProfileControl parameter [System.PrConst.Addon_ProfileControl]	16384[kB]	0[kB]
Addon Program_ST parameter [System.PrConst.Addon_Program_ST]	16384[kB]	0[kB]
Addon ServoDriver_CANopen parameter [System.PrConst.Addon_ServoDriver_CANopen]	2048[kB]	0[kB]
Addon SignalIO parameter [System.PrConst.Addon_SignalIO]	1024[kB]	0[kB]

*2 Set the signal that will be used as the target.

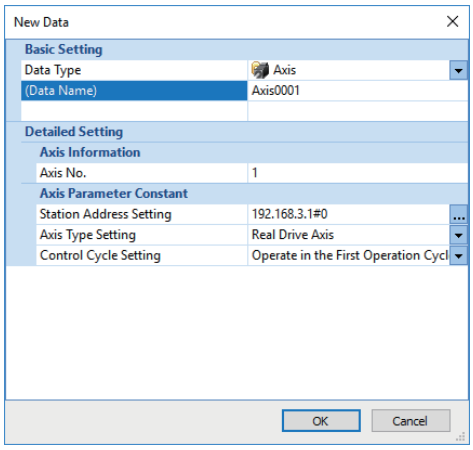
Item	Setting description
Source type	Global label, CANopen object, device, constant
Source data type*3	BOOL, INT, DINT, WORD, DWORD, REAL, LREAL
Source	—

*3 Can only be set when selecting "Device" as the source type.

■Axis

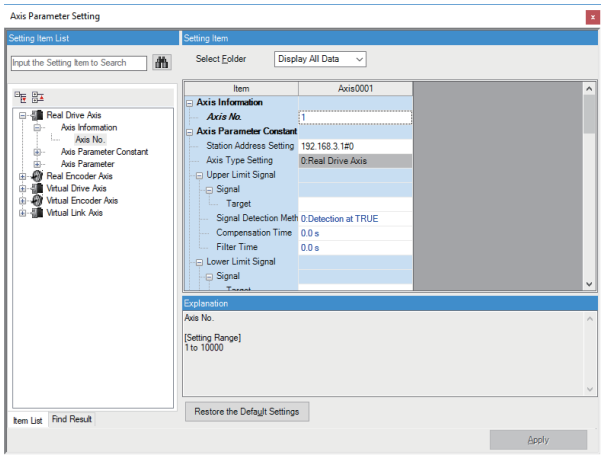


1. From the [Navigation window], right click [Axis] (1), then select [Add New Data] (2).



2. Carry out the setting of the axis to be created, then click the [OK] button.

- Data Name:
  Set the instance name of the axis to be used in the ST program.
- Station Address Setting[*1]:
  When creating a [Real Drive Axis], set the IP address of the servo amplifier and the multi-drop No.[*2] after checking them on the "CC-Link IE TSN Configuration" screen.
- Axis Type Setting:
  Set the type of the axis being created.



3. The [Data name[*3]] is added to the [Navigation window]⇨[Axis] and the parameter editor is displayed. Set parameters for the axis.

4. When the setting of parameters for the axis is complete, click the [Apply] button.

*1 Set the values in station address settings as shown below.

192.168.3.1#0
- Multi-drop No.
- IP address

*2 Set multi-drop No. values as shown below.

Servo amplifier	Setting value
Single axis servo amplifier	#0
2-axis/3-axis servo amplifiers	#0 to #2

*3 The set data name is displayed.

Displayed items

• Real drive axis

Item [Variable/Structure name]				Setting range	Initial value
Axis information	Axis No. [AxisName.AxisRef.AxisNo]			1 to 10000	—
Axis parameter constant	Station address setting [AxisName.PrConst.AddressOfStation]			—	No setting
	Axis type setting [AxisName.PrConst.AxisType]			—	0: Real drive axis
	Upper limit signal [AxisName.PrConst.HwStrokeLimit_FlsSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Lower limit signal [AxisName.PrConst.HwStrokeLimit_RlsSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Control cycle setting [AxisName.PrConst.OperationCycle]			0: Operate in the first operation cycle	0: Operate in the first operation cycle
	Absolute position reference setting [AxisName.PrConst.PosRestoration_AbsPosBase]			3: Feed machine position	3: Feed machine position
	Absolute position management setting [AxisName.PrConst.PosRestoration_AbsPosEnable]			0: Disable absolute position system 1: Enable absolute position system -1: Automatic setting (aquire from connected device)	-1: Automatic setting (aquire from connected device)
	Ring counter enabled selection [AxisName.PrConst.RingCount_Enable]			0: Disable 1: Enable	0: Disable
	Ring counter lower value [AxisName.PrConst.RingCount_LowerValue]			-1000000000000.0 to 1000000000000.0	-10000000000.0
	Ring counter upper value [AxisName.PrConst.RingCount_UpperValue]			-1000000000000.0 to 1000000000000.0	10000000000.0
	Slave emulation enabled [AxisName.PrConst.SlaveEmulate_Enable]			0: Disable 1: Enable	0: Disable
	Torque limit maximum value [AxisName.PrConst.TorqueLimit_Max]			0.0 to 1000.0%	1000.0[%]

Item [Variable/Structure name]				Setting range	Initial value
Axis parameter constant	Negative direction torque limit initial value [AxisName.PrConst.TorqueLimit_NegativeInitial]			0.0 to 1000.0%	300.0[%]
	Positive direction torque limit initial value [AxisName.PrConst.TorqueLimit_PositiveInitial]			0.0 to 1000.0%	300.0[%]
Axis parameter	Acceleration limit value [AxisName.Pr.AccelerationLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation selection at start acceleration/deceleration 0 [AxisName.Pr.AccelerationZeroBehavior]			-1: Error (not started) 1: Maximum acceleration/ deceleration	-1: Error (not started)
	Command in-position width [AxisName.Pr.CmdInPos_Width]			0.0 to 10000000000.0	100.0
	Deceleration limit value [AxisName.Pr.DecelerationLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Driver unit conversion denominator [AxisName.Pr.Drive_UnitConvRatioDen]			1 to 2147483647	1
	Driver unit conversion numerator [AxisName.Pr.Drive_UnitConvRatioNum]			1 to 2147483647	1
	Forced stop signal [AxisName.Pr.ForcedStop_Signal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Home position return required or not [AxisName.Pr.Homing_Required]			0: FALSE 1: TRUE	1: TRUE
	Jerk limit value [AxisName.Pr.JerkLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation setting at overrun [AxisName.Pr.OverrunOperation]			1: Immediate stop 2: Keep current acceleration/ deceleration	1: Immediate stop
	Start permission at home position return uncompleted [AxisName.Pr.StartableAtUnhomed]			0: Disable 1: Enable	0: Disable
	Deceleration at stop [AxisName.Pr.StopMode_Deceleration]			0.0001 to 2147483647.0	0.0
	Stop selection at deceleration to stop [AxisName.Pr.StopMode_DecelerationCurve]			1: Recreate deceleration curve	1: Recreate deceleration curve
	Stop selection at stop by factors [AxisName.Pr.StopMode_General]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	3: Alernative acceleration/ deceleration
	Stop selection at H/W stroke limit error occurrence [AxisName.Pr.StopMode_HwStrokeLimit]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	1: Immediate stop

Item [Variable/Structure name]				Setting range	Initial value
Axis parameter	Process selection at servo OFF command during operation [AxisName.Pr.StopMode_ServoOff]			0: Ignore 4: Servo OFF after immediate stop 5: Servo OFF after deceleration to stop	0: Ignore
	Stop selection at S/W stroke limit error occurrence [AxisName.Pr.StopMode_SwStrokeLimit]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	1: Immediate stop
	Stop signal [AxisName.Pr.StopSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Software stroke limit lower value [AxisName.Pr.SwStrokeLimit_Lower]			-1000000000000.0 to 1000000000000.0	-10000000000.0
	Software stroke limit target [AxisName.Pr.SwStrokeLimit_Target]			-1: Invalid 1: Command current position 3: Feed machine position	-1: Invalid
	Software stroke limit upper value [AxisName.Pr.SwStrokeLimit_Upper]			-1000000000000.0 to 1000000000000.0	10000000000.0
	Position command unit [AxisName.Pr.Unit_Position]			pulse, m, mm, um, nm, degree, Revolution, inch, arbitrary unit	pulse
	Position command unit string [AxisName.Pr.Unit_PositionString]			—	No setting
	Speed command unit [AxisName.Pr.Unit_Velocity]			U/s, U/ms, U/us, U/ns, U/min	U/s
	Negative direction speed limit value [AxisName.Pr.VelocityLimit_Negative]			0.0001 to 2500000000.0	2500000000.0
	Operation setting at speed limit value exceeded [AxisName.Pr.VelocityLimit_OverOperation]			0: Ignore 3: Immediate stop	0: Ignore
	Positive direction speed limit value [AxisName.Pr.VelocityLimit_Positive]			0.0001 to 2500000000.0	2500000000.0

*1 Set the signal that will be used as the target.

Item	Setting description
Source type	Global label, CANopen object, device, constant
Source data type*2	BOOL, INT, DINT, WORD, DWORD, REAL, LREAL
Source	—

*2 Can only be set when selecting "Device" as the source type.

A

• Virtual drive axis

Item [Variable/Structure name]				Setting range	Initial value
Axis information	Axis No. [AxisName.AxisRef.AxisNo]			1 to 10000	—
Axis parameter constant	Axis type setting [AxisName.PrConst.AxisType]			—	3: Virtual drive axis
	Upper limit signal [AxisName.PrConst.HwStrokeLimit_FlsSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Lower limit signal [AxisName.PrConst.HwStrokeLimit_RlsSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Control cycle setting [AxisName.PrConst.OperationCycle]			0: Operate in the first operation cycle	0: Operate in the first operation cycle
	Absolute position management setting [AxisName.PrConst.PosRestoration_AbsPosEnable]			0: Disable absolute position system 1: Enable absolute position system -1: Automatic setting (aquire from connected device)	0: Disable absolute position system
	Ring counter enabled selection [AxisName.PrConst.RingCount_Enable]			0: Disable 1: Enable	0: Disable
	Ring counter lower value [AxisName.PrConst.RingCount_LowerValue]			-1000000000000.0 to 1000000000000.0	-10000000000.0
	Ring counter upper value [AxisName.PrConst.RingCount_UpperValue]			-1000000000000.0 to 1000000000000.0	10000000000.0

Item [Variable/Structure name]				Setting range	Initial value
Axis parameter	Acceleration limit value [AxisName.Pr.AccelerationLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation selection at start acceleration/deceleration 0 [AxisName.Pr.AccelerationZeroBehavior]			-1: Error (not started) 1: Maximum acceleration/ deceleration	-1: Error (not started)
	Command in-position width [AxisName.Pr.CmdInPos_Width]			0.0 to 10000000000.0	100.0
	Deceleration limit value [AxisName.Pr.DecelerationLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Forced stop signal [AxisName.Pr.ForcedStop_Signal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Home position return required or not [AxisName.Pr.Homing_Required]			0: FALSE 1: TRUE	1: TRUE
	Jerk limit value [AxisName.Pr.JerkLimit]			0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation setting at overrun [AxisName.Pr.OverrunOperation]			1: Immediate stop 2: Keep current acceleration/ deceleration	1: Immediate stop
	Start permission at home position return uncompleted [AxisName.Pr.StartableAtUnhomed]			0: Disable 1: Enable	0: Disable
	Deceleration at stop [AxisName.Pr.StopMode_Deceleration]			0.0001 to 2147483647.0	0.0
	Stop selection at deceleration to stop [AxisName.Pr.StopMode_DecelerationCurve]			1: Recreate deceleration curve	1: Recreate deceleration curve
	Stop selection at stop by factors [AxisName.Pr.StopMode_General]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	3: Alternative acceleration/ deceleration
	Stop selection at H/W stroke limit error occurrence [AxisName.Pr.StopMode_HwStrokeLimit]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	1: Immediate stop
	Process selection at servo OFF command during operation [AxisName.Pr.StopMode_ServoOff]			0: Ignore 4: Servo OFF after immediate stop 5: Servo OFF after deceleration to stop	0: Ignore
	Stop selection at S/W stroke limit error occurrence [AxisName.Pr.StopMode_SwStrokeLimit]			1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	1: Immediate stop

Item [Variable/Structure name]				Setting range	Initial value
Axis parameter	Stop signal [AxisName.Pr.StopSignal]	Signal [SIGNAL_SELECT.Source]	Target [TARGET_REF.Target]	*1	No setting
		Signal detection method [SIGNAL_SELECT.Detection]		0: Detection at TRUE 1: Detection at FALSE 2: Detection at FALSE→TRUE (leading edge) 3: Detection at TRUE→FALSE (trailing edge) 4: Detection at leading edge/ trailing edge	0: Detection at TRUE
		Compensation time [SIGNAL_SELECT.CompensationTime]		—	0.0[s]
		Filter time [SIGNAL_SELECT.FilterTime]		—	0.0[s]
	Software stroke limit lower value [AxisName.Pr.SwStrokeLimit_Lower]			-1000000000000.0 to 1000000000000.0	-10000000000.0
	Software stroke limit target [AxisName.Pr.SwStrokeLimit_Target]			-1: Invalid 1: Command current position 3: Feed machine position	-1: Invalid
	Software stroke limit upper value [AxisName.Pr.SwStrokeLimit_Upper]			-1000000000000.0 to 1000000000000.0	10000000000.0
	Position command unit [AxisName.Pr.Unit_Position]			pulse, m, mm, um, nm, degree, Revolution, inch, arbitrary unit	pulse
	Position command unit string [AxisName.Pr.Unit_PositionString]			—	No setting
	Speed command unit [AxisName.Pr.Unit_Velocity]			U/s, U/ms, U/us, U/ns, U/min	U/s
	Negative direction speed limit value [AxisName.Pr.VelocityLimit_Negative]			0.0001 to 2500000000.0	2500000000.0
	Operation setting at speed limit value exceeded [AxisName.Pr.VelocityLimit_OverOperation]			0: Ignore 3: Immediate stop	0: Ignore
	Positive direction speed limit value [AxisName.Pr.VelocityLimit_Positive]			0.0001 to 2500000000.0	2500000000.0

*1 Set the signal that will be used as the target.

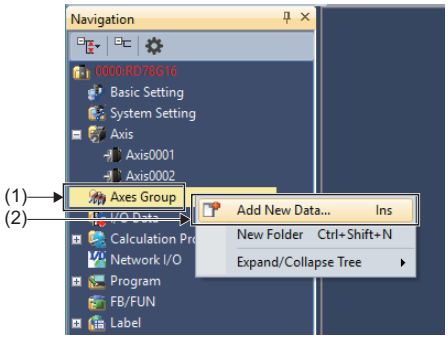
Item	Setting description
Source type	Global label, CANopen object, device, constant
Source data type*2	BOOL, INT, DINT, WORD, DWORD, REAL, LREAL
Source	—

*2 Can only be set when selecting "Device" as the source type.

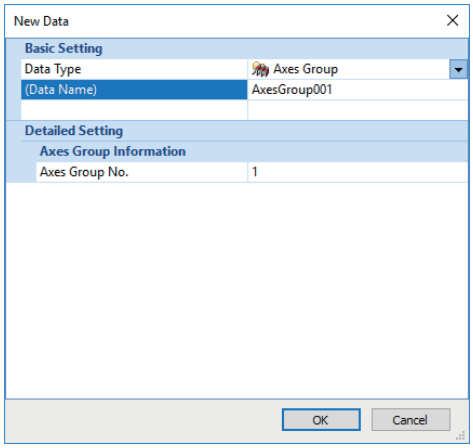
• Virtual link axis

Item [Variable/Structure name]		Setting range	Initial value
Axis information	Axis No. [AxisName.AxisRef.AxisNo]	1 to 10000	—
Axis parameter constant	Axis type setting [AxisName.PrConst.AxisType]	—	5: Virtual link axis
	Control cycle setting [AxisName.PrConst.OperationCycle]	0: Operate in the first operation cycle	0: Operate in the first operation cycle
	Absolute position management setting [AxisName.PrConst.PosRestoration_AbsPosEnable]	0: Disable absolute position system 1: Enable absolute position system -1: Automatic setting (acquire from connected device)	0: Disable absolute position system
	Ring counter enabled selection [AxisName.PrConst.RingCount_Enable]	0: Disable 1: Enable	0: Disable
	Ring counter lower value [AxisName.PrConst.RingCount_LowerValue]	-1000000000000.0 to 1000000000000.0	-10000000000.0
	Ring counter upper value [AxisName.PrConst.RingCount_UpperValue]	-1000000000000.0 to 1000000000000.0	10000000000.0
Axis parameter	Home position return required or not [AxisName.Pr.Homing_Required]	0: FALSE 1: TRUE	0: FALSE
	Start permission at home position return uncompleted [AxisName.Pr.StartableAtUnhomed]	0: Disable 1: Enable	0: Disable
	Position command unit [AxisName.Pr.Unit_Position]	pulse, m, mm, um, nm, degree, Revolution, inch, arbitrary unit	pulse
	Position command unit string [AxisName.Pr.Unit_PositionString]	—	No setting
	Speed command unit [AxisName.Pr.Unit_Velocity]	U/s, U/ms, U/us, U/ns, U/min	U/s

■Axes group

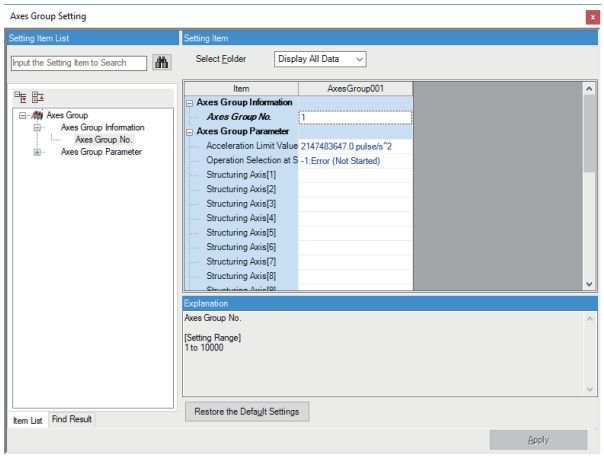


1. From the [Navigation window], right click [Axes Group] (1), then select [Add New Data] (2).



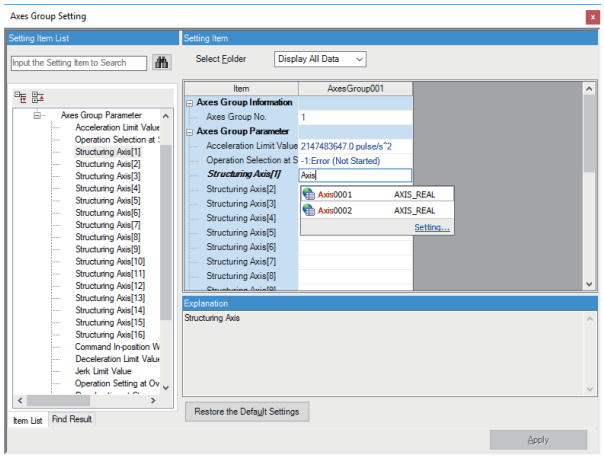
2. Carry out the setting of the axes group to be created, then click the [OK] button.

- Data Name:
  Set the instance name of the axes group to be used in the ST program.



3. The [Data name[*1]] is added to the [Navigation window]⇨[Axes Group] and the parameter editor is displayed.

*1: The set data name is displayed.



4. Set the structuring axes for the created axes group. Set the [Data Name] (the instance name for the axis to be used in the ST program) that was set in the [Navigation window]⇨[Axis].

5. When the setting of parameters for the axes group is complete, click the [Apply] button.

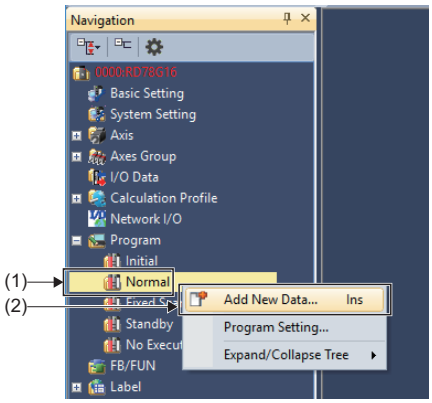
Displayed items

• Axes group

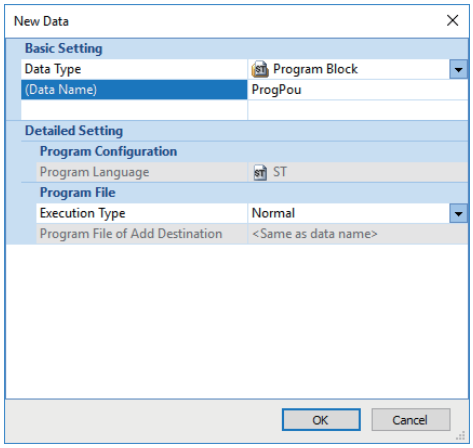
Item [Variable/Structure name]		Setting range	Initial value
Axes group information	Axes group No. [AxesGroupName.AxesGroupRef.GroupNo]	1 to 10000	—
	I/O No. [AxesGroupName.AxesGroupRefStart.IO_No]	—	0000
Axes group parameter	Acceleration limit value [AxesGroupName.Pr.AccelerationLimit]	0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation selection at start acceleration/deceleration 0 [AxesGroupName.Pr.AccelerationZeroBehavior]	-1: Error (not started) 1: Maximum acceleration/ deceleration	-1: Error (not started)
	Structuring axis[□] [AxesGroupName.Pr.Axis[□]] *: □=1 to 16	—	No setting
	Command in-position width [AxesGroupName.Pr.CmdInPos_Width]	0.0 to 10000000000.0	100.0
	Deceleration limit value [AxesGroupName.Pr.DecelerationLimit]	0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Jerk limit value [AxesGroupName.Pr.JerkLimit]	0.0000, 0.0001 to 2147483647.0 *: Limit is not executed at "0.0000".	2147483647.0
	Operation setting at overrun [AxesGroupName.Pr.OverrunOperation]	1: Immediate stop	1: Immediate stop
	Deceleration at stop [AxesGroupName.Pr.StopMode_Deceleration]	0.0001 to 2147483647.0	0.0
	Stop selection at deceleration to stop [AxesGroupName.Pr.StopMode_DecelerationCurve]	1: Recreate deceleration curve	1: Recreate deceleration curve
	Structuring axis operation selection at axis stop by factors [AxesGroupName.Pr.StopMode_ErrorInGroup]	1: Immediate stop 4: Servo OFF after immediate stop 5: Servo OFF after deceleration to stop	1: Immediate stop
	Stop selection at stop by factors [AxesGroupName.Pr.StopMode_General]	1: Immediate stop 2: Keep current acceleration/ deceleration 3: Alternative acceleration/ deceleration	3: Alternative acceleration/ deceleration
	Position command unit [AxesGroupName.Pr.Unit_Position]	pulse, m, mm, um, nm, degree, Revolution, inch, arbitrary unit	pulse
	Position command unit string [AxesGroupName.Pr.Unit_PositionString]	—	No setting
	Speed command unit [AxesGroupName.Pr.Unit_Velocity]	U/s, U/ms, U/us, U/ns, U/min	U/s
	Speed limit value [AxesGroupName.Pr.VelocityLimit]	0.0001 to 2500000000.0	2500000000.0

ST program creation

Create a program using ST programming language.



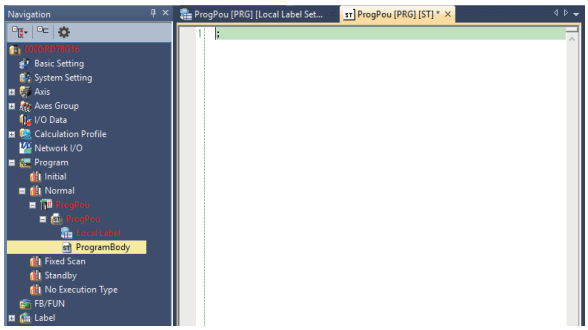
1. From the [Navigation window], right click [Program] (1), then select [Add New Data] (2).



2. Carry out the setting of the program to be created, then click the [OK] button.

- Data Name:
  Set the instance name for the program.
- Execution Type*1:
  Set the execution type for the program.

*1: Refer to execution of programs for details of execution types.(☞ Page 697 Execution of programs)



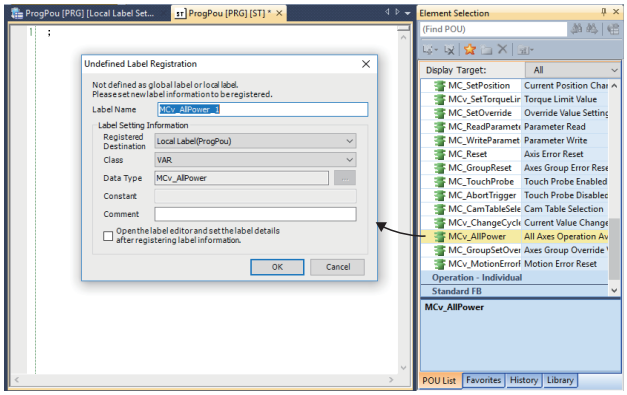
3. [ProgPou]⇨[ProgPou]⇨[Local Label]/[ProgramBody] are added to the [Navigation window]⇨[Program]⇨[Execution type*2] and the program work window is displayed.

4. Create the ST program.

*2: The execution type that was set is displayed as the execution type name.
*3: The program file is created in the tree of the execution type that was set.

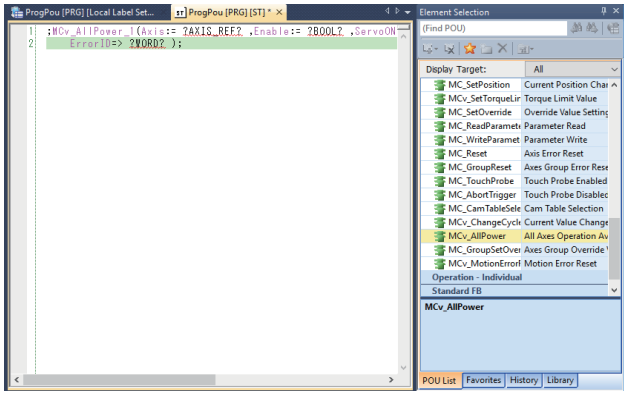
■Inserting Motion control FBs

To create a program, assign Motion control FBs by dragging and dropping them onto the ST program.



1. From the [Navigation window], select [Program]⇨[Execution type*1]⇨[ProgPou]⇨[ProgPou]⇨[ProgramBody] to display the program work window.
2. Select the FB to be inserted from the Element Selection window and drag and drop it into its assigned position to display the "Undefined Label Registration" screen.
3. Set the label name and label setting information, then click the [OK] button.

*1: The name of the created execution type is displayed.

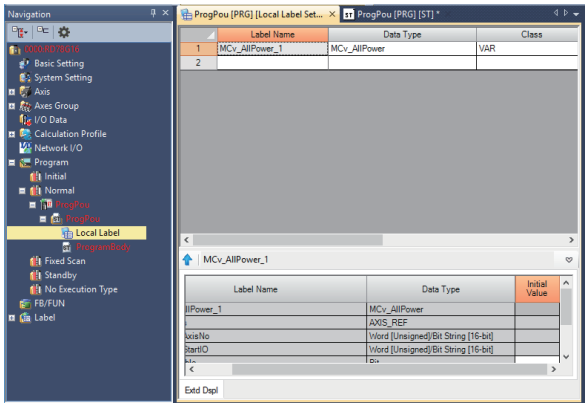


4. The FB is inserted into the program work window.

*2: Inserting a FB from the Element Selection window registers a label using the inserted FB label name into the label setting list.

■Registering labels

Register the local labels to be used in the ST program.



1. From the [Navigation window], select [Program]⇨[Execution type*1]⇨[ProgPou]⇨[ProgPou]⇨[Local Label] to display the local label work window.
2. Carry out the setting of label names, data types, and classes, then register them.

*1: The name of the created execution type is displayed.

A

Creation procedure for programs using the public label function

This section describes the procedure for creating a sequence program that uses the public label function with an engineering tool.

1. Perform steps 1. to 4. in "Program creation procedure for ST programs".

- Parameter settings (☞ Page 705 Parameter settings)
- Network settings (☞ Page 706 Network settings)
- Module parameter settings (☞ Page 709 Module parameter settings)
- Motion extended parameter settings (☞ Page 710 Module extended parameter settings)

2. Label registration

Register labels used by the Motion module using the "Motion Control Setting Function".
Register labels to be made public to the CPU module side in global labels.
(☞ Page 727 Label registration)

3. Public label settings

Carry out settings so that global labels registered using the "Motion Control Setting Function" are made public to the CPU module side.
(☞ Page 728 Public label settings)

4. Label conversion

Convert labels to fix areas that were set using the "Motion Control Setting Function".
Check the labels that were set, then create the label information to be made public.
(☞ Page 729 Label conversion)

5. Public label reflection

Reflect public label information created using the "Motion Control Setting Function" to the project on the CPU module side.
After reflection completes, the public label information is automatically registered to the CPU module side as module labels.
(☞ Page 731 Public label reflection)

6. Sequence program creation

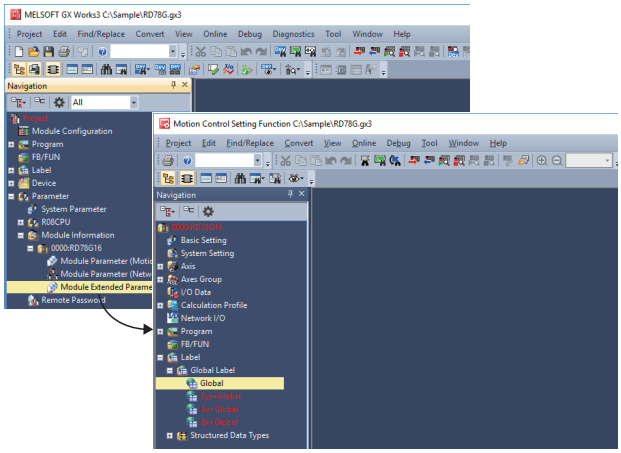
Create a sequence program using the Motion module labels that were made public.
(☞ Page 733 Sequence program creation)

7. Writing the created program

Write the program, global labels, and module parameters created on the CPU module side and Motion module side to both modules.
(☞ Page 734 Writing the created program)

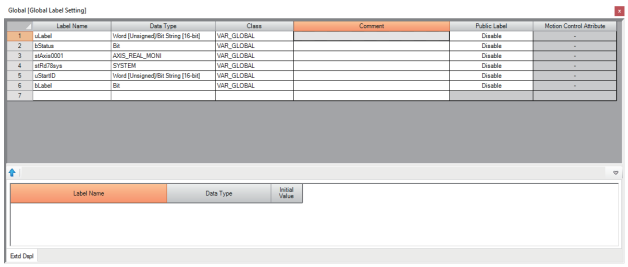
Label registration

Register the labels (global labels) to be used by the Motion module on the Motion Control Setting Function screen.



1. From the [Navigation window], select [Parameter]⇨[Module Information]⇨[Module model name*1]⇨[Module Extended Parameter] to display the "Motion Control Setting Function".

*1: The model name of the set Motion module is displayed.



2. From the [Navigation window], select [Label]⇨[Global Label]⇨[Global*2] to display the label editor for global labels. Register the labels to be used by the Motion module.

*2: New global label lists can also be created and used to register labels.

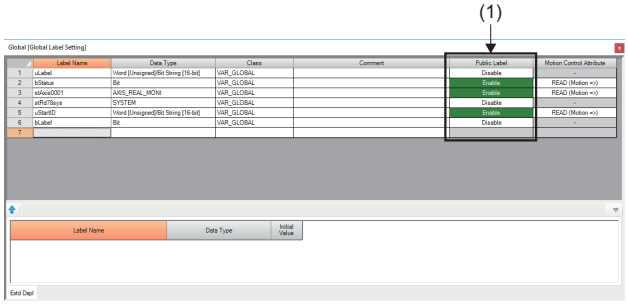
Point

Labels registered in global labels are made public to the CPU module side. Labels registered in local labels cannot be made public.

A

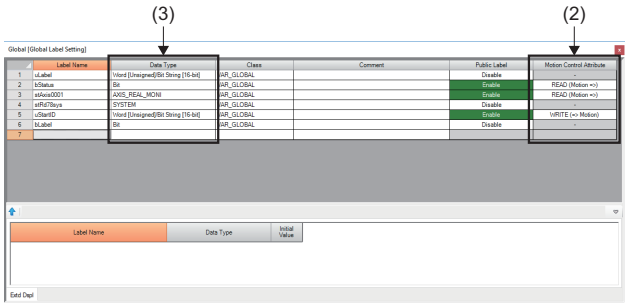
Public label settings

To make registered global labels public to the CPU module side, set the "Public Label" and "Motion Control Attribute".



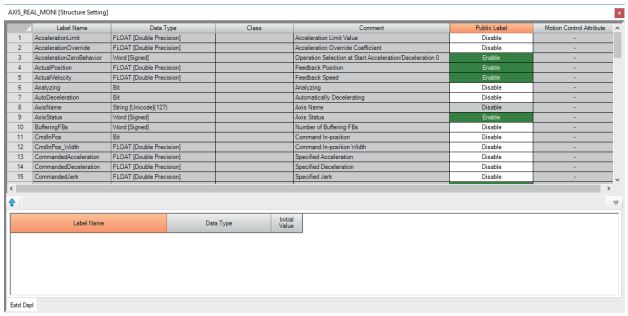
1. In the label editor, set the public label (1) of label names to be made public to the CPU module side to "Enable".

*1: Labels set to certain data types and classes cannot be set as public labels. (☞ Page 728 Conditions for making labels public to the CPU module side)



2. For label names whose public label was set to "Enable", set the refresh direction in Motion Control Attribute (2)*2. When the data type of the set label name is a structured data type, set the refresh direction using the type of structure set in Data Type (3).

*2: Refer to Motion control attribute setting items for the items to set. (☞ Page 729 Motion control attribute setting items)



3. When the data type of the label name was set to a structured data type in Step 2., select [Navigation window]⇨[Label]⇨[Structured Data Types]⇨[Structure name*3] to display the structure label editor. Set the public label and Motion control attribute for label names to be made public to the CPU module side.

*3: The set structure name is displayed.

■Conditions for making labels public to the CPU module side

The conditions for making labels public to the CPU module side are shown below.

○: Setting possible, ×: Setting not possible, △: Setting not possible in some cases

Variable type	Type	Array selection	Public label setting possible/not possible	Remark
Global label	Simple type	None	○	Setting is not possible for the following labels and classes. ■Label • String type labels • Timer type labels • Counter type labels • Long counter type labels • Retentive timer type labels • Long retentive timer type labels • Long timer type labels ■Class • VAR_GLOBAL_CONSTANT class
		Provided	△*1*2	
	Structured data type	None	△*3	
		Provided	△*1*2*4*5	
	Function block (including MCFB)	None	×	
		Provided	×	
Program	—	—	×	
Program block local label	—	—	×	
Structure	—	—	△*3*5	
MCFB structure	—	—	△*6*7	

*1 Individual array elements cannot be set as public labels.
*2 When using a bit-type array, this cannot be set to "Enable". (When using a structure array, that member alone cannot be set to "Enable".)
*3 When using a string type as a member in a structured data type, that member cannot be set to "Enable".
*4 Structured data types that can be made public can be a maximum of 4 layers.
*5 When using a structure array as a member in a structure, that member cannot be set to "Enable".
*6 This is used in some cases by the CPU module side within a PLCopen MCFB program.
*7 When using a string type in an MCFB structure, that particular MCFB structure cannot be set.

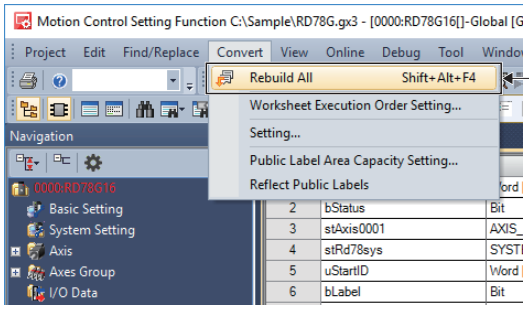
■Motion control attribute setting items

The items to set for the Motion control attribute are shown below.

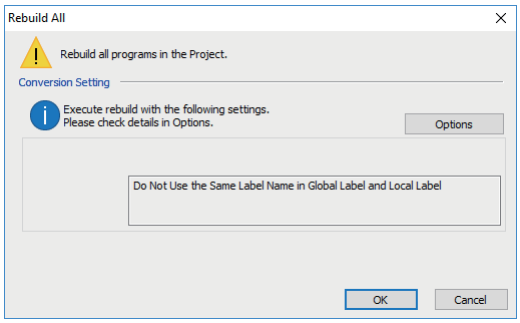
Setting item	Description
READ(Motion⇨)	Read only from the CPU module side. When writing is executed from the CPU module side, the value for the label that was made public is not reflected. (The Motion module side overwrites the value with the value stored on the Motion module.)
WRITE(⇨Motion)	Readable and writable from the CPU module side. When writing is executed from the Motion module side, the value for the label that was made public is not reflected. (The CPU module side overwrites the value with the value stored on the CPU module.)
—	Setting not possible. • This is automatically set by an engineering tool in some cases. • When the data is structured data type, the Motion control attribute setting for each member in the structure is applied.

Label conversion

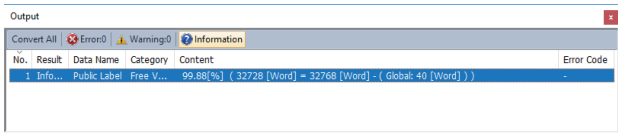
To fix the labels that were set, perform label conversion on the Motion Control Setting Function screen.



1. From the menu, select [Convert]⇨[Rebuild All] (1) to convert the set label data.



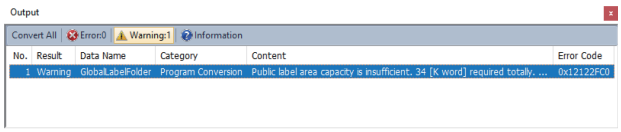
2. When the "Rebuild all programs in the Project." message appears, click the [OK] button.



3. After the "Rebuild All" operation completes normally, the free space in the public label area is displayed in "Information" in the Output window.

*1: If the Output window is not initially displayed, select [Display]⇨[Docking Window]⇨[Output] from the menu to display it.

*2: If a conversion error occurs, correct the setting based on the content of the error, then execute the conversion operation again after all errors have been removed.



4. If the set public labels exceed the capacity of the public label area, a warning message is displayed in "Warning" in the Output window.
Confirm the label memory size in the Public Label Area Capacity Setting, then change the size so that it is within the label area capacity with the following methods.

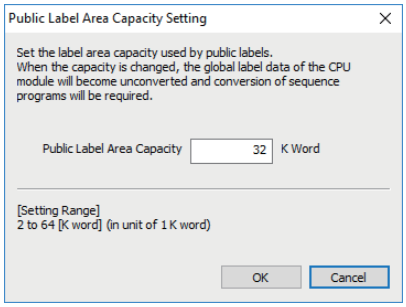
- Increase the capacity of the public label area in Public Label Area Capacity Setting. (☞ Page 730 Public Label Area Capacity Setting)
- Reduce the number of public labels set to "Enable".

A

■Public Label Area Capacity Setting

Set the capacity of the public label area.

The capacity of the public label area can be changed in Public Label Area Capacity Setting when a different capacity is desired, or if the public labels set using "Rebuild All" exceed the capacity of the public label area.



1. From the menu, select [Convert]⇨[Public Label Area Capacity Setting] to display the "Public Label Area Capacity Setting" screen.
   Set the public label area capacity.
2. When the setting is complete, click the [OK] button.

*: If a warning message is displayed in the Output window, confirm the contents of the message, then set the label capacity so that it is within the range.

Point

- Changing the public label area capacity in Public Label Area Capacity Setting will cause the label data to become unconverted. As such, conversion must be executed for the project.
- Reduce the number of labels to be made public if a warning message stating that the public label area capacity exceeds 64k words is displayed during conversion operation.

Displayed items

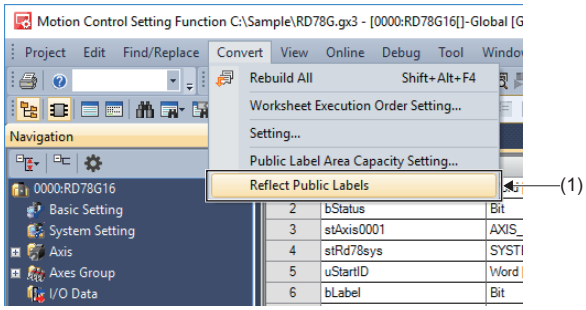
- Public Label Area Capacity Setting

Item	Setting range	Initial value
Public label area capacity	2 to 64k words	32k words

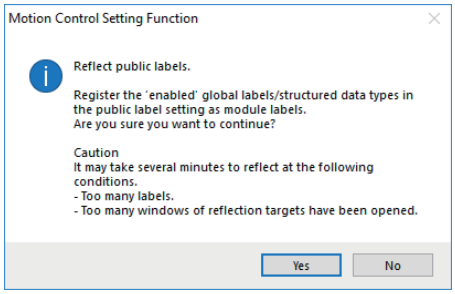
Public label reflection

Reflect the created public label information to the project on the CPU module side from the Motion Control Setting Function screen.

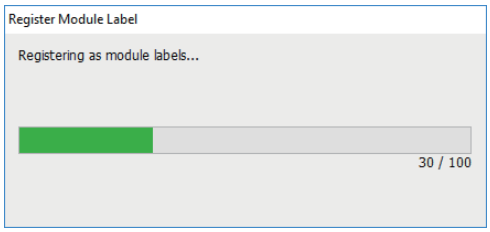
After reflection of the public labels completes, the label information is automatically registered to the CPU module side as module labels.



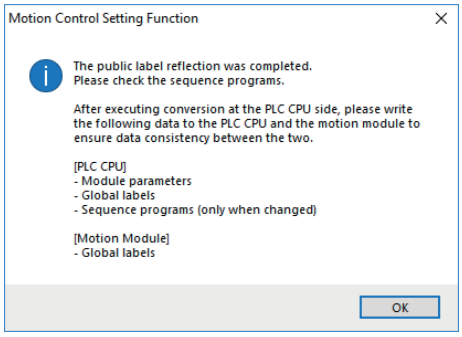
1. From the menu, select [Convert]⇨[Reflect Public Labels] (1).



2. When the "Reflect public labels." message is displayed, click the [Yes] button.



3. Reflect the public labels.
Labels whose public label was set to "Enable" are registered to the CPU module side as module labels.



4. After reflection of the public labels completes, the "The public label reflection was completed." message is displayed.
Click the [OK] button.

Point

Performing public label reflection will register the labels to the CPU module side as module labels and cause the project on the CPU module side to become unconverted. As such, conversion must be executed for the project on the CPU module side.

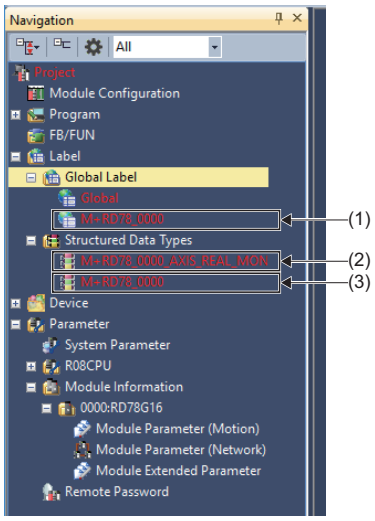
■Project on the CPU module side with public labels reflected

The data that is registered to a project on the CPU module side after relection of public labels has completed is shown below.

- Project tree

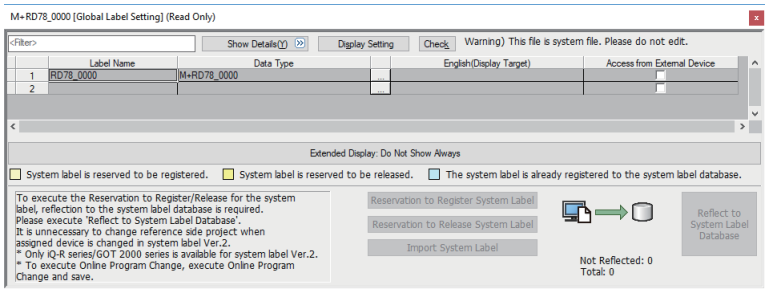
  Global labels and label data for structured data types set to public using the Motion Control Setting Function are added to the global label project tree or the structured data types project tree on the CPU module side.

<Project tree on the CPU module side>



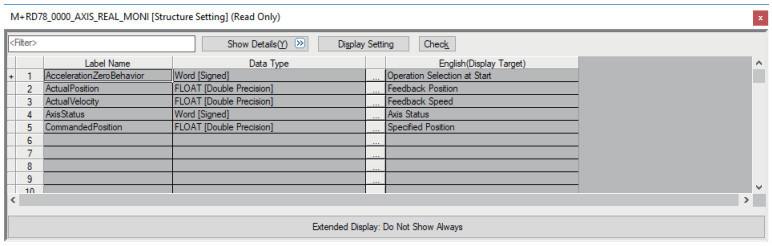
1. Global labels (1)

- The data is created in the global label project tree. (1 data item for each Motion module.)
- The data in the global label list is named "M+RD78_*****"[*1].
- "RD78_*****"[*1] labels are registered to the added global label list.
- The data type of registered labels is a "M+RD78_*****"[*1] structured data type (3).
- The added global label list is read only and cannot be edited.



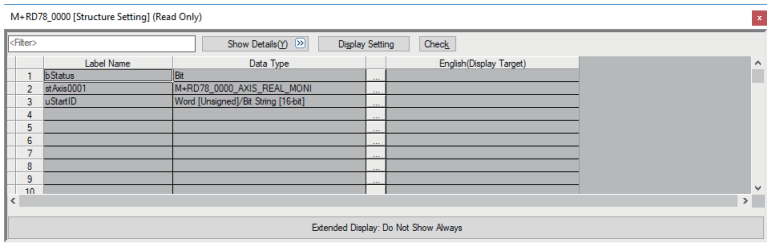
2. Public Motion module structured data types (2)

- Members of structures that were set to public using the Motion Control Setting Function are registered to the CPU module side as structures named "M+RD78_****_####"[*1*2].
- For members of structures, only members whose public label was set to "Enable" using the Motion Control Setting Function are registered.
- The added structure is read only and cannot be edited.



3. Public Motion module global labels (3)

- Label data set to public using the Motion Control Setting Function is registered to the CPU module side as individual members of a structure named "M+RD78_*****"[*1].
- The added structure is read only and cannot be edited.



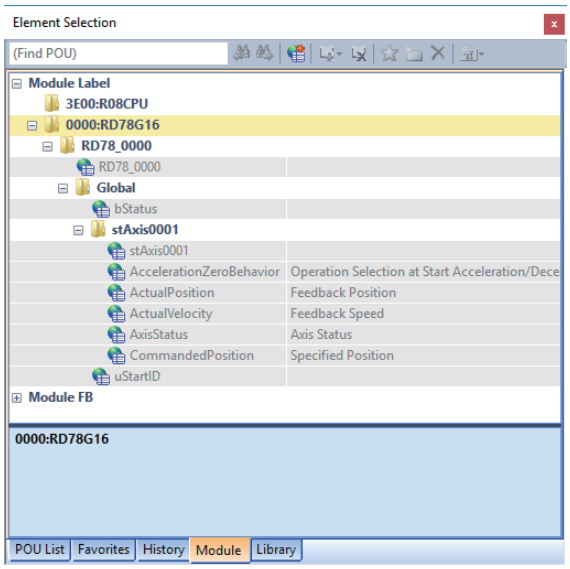
*1 ****=Start I/O No.

*2 ####=Structure name within the Motion Control Setting Function

• Element Selection window

Motion module labels set to public using the Motion Control Setting Function are displayed as module labels in the Element Selection window.

<Element Selection window on the CPU module side>



- Labels set to public are registered as module labels in the [Module] tab in the Element Selection window.
- The module label data is named "****:RD78☐n" *1*2*3.
- A list of the label data that was set to public using the Motion Control Setting Function is displayed in the "****:RD78☐n"*1*2*3 tree.

*1 ****=Start I/O No.

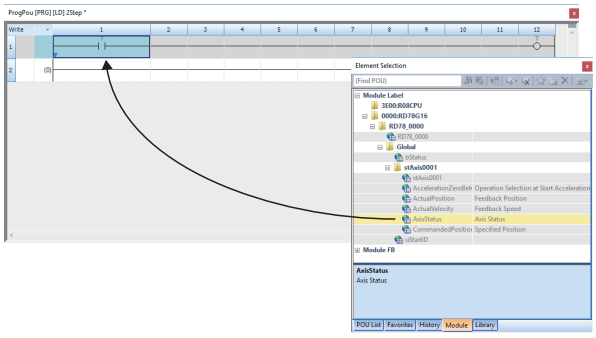
*2 ☐=Motion module model name

- When set to RD78G: G
- When set to RD78GH: GH

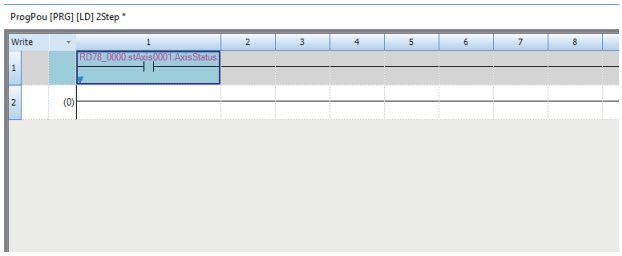
*3 n=Number of Motion module control axes

Sequence program creation

Create a sequence program using the Motion module labels that were made public.



1. Select the label to be inserted from the Element Selection window, then drag and drop it into its assigned position.



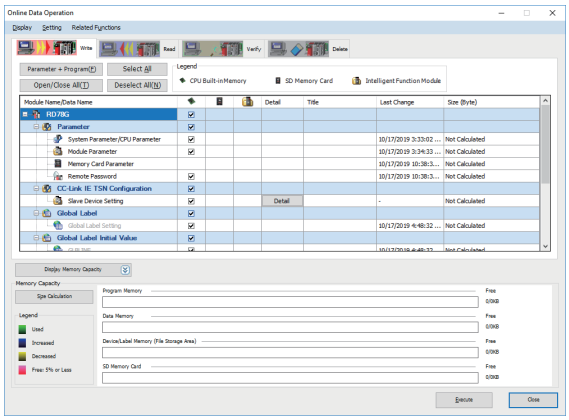
2. The label is inserted into the program work window.

*: The label to be used is registered as a member of the structure, so the instance name of the structure is added.

Writing the created program

Write the program, global labels, and module parameters created using on the CPU module side and Motion module side to the CPU module and the Motion module. After executing writing to both modules, perform a reset of the CPU module.

■Writing to the CPU module

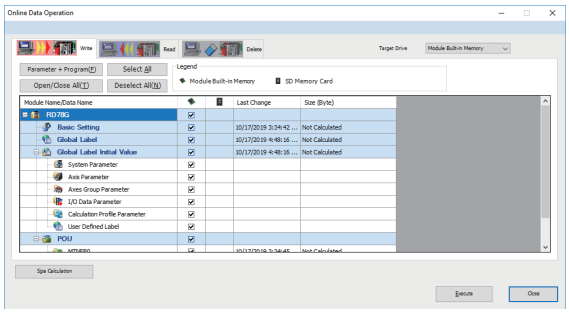


1. From the menu, select [Online]⇨[Write to PLC] to display the "Online Data Operation" screen. Select the data to perform the writing on, then click the [Execute] button. Execute the writing to the PLC CPU.

Point

If the "Reflect Public Labels" operation was executed using the Motion Control Setting Function, be sure to select the "Module Parameter" and "Global Label" data.

■Writing to the Motion module



1. Using the Motion Control Setting Function, select [Online]⇨[Write to Module] from the menu to display the "Online Data Operation" window. Select the data to write, then click the [Execute] button to perform writing to the Motion module.

Point

If the "Reflect Public Labels" operation was executed using the Motion Control Setting Function, be sure to select the "Global Label" data.

⚠Caution

- If a Motion label was made public, be sure to write the data to both the CPU module side and the Motion module side. An unexpected operation may occur If the label data on the CPU module side and the label data on the Motion module side do not match.

Data transfers using the Motion module buffer memory

Data transfers between the CPU module and the Motion module

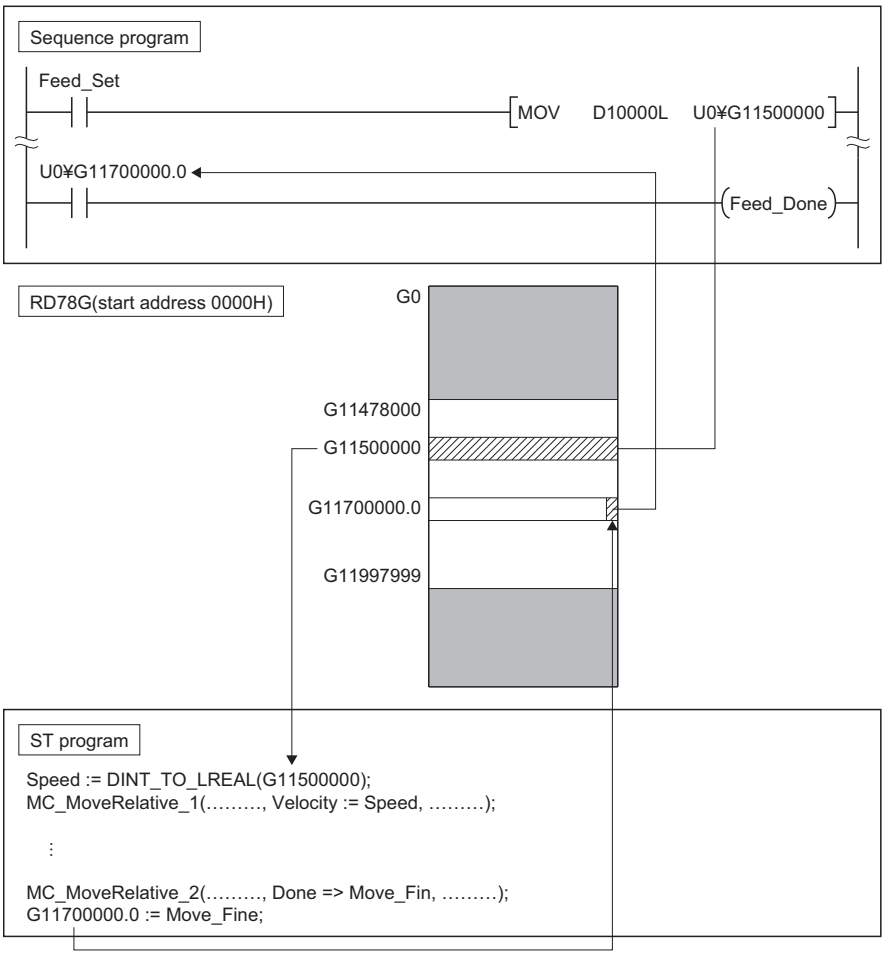
Data can be transferred between the CPU module and the Motion module using the buffer memory of the Motion module.
The devices used for data transfers are shown below.

Module	Device used
CPU module	Un\Gn(module access device)
Motion module	Gn(buffer memory)

The usable buffer memory range for data transfers is shown below. Ensure that the buffer memory used is not outside the usable range.

Setting range
G11478000 to G11997999 (520000 words)

Ex.
For a data transfer that uses the buffer memory of the Motion module



For a program using labels

While label programming can be performed by assigning global labels to the Motion module buffer memory, labels cannot be cross-referenced between the CPU module and the Motion module.

Point

A double-precision real number (LREAL-type) cannot be transferred to the buffer memory by ST instruction when sending data from the CPU module to the Motion module. The reading/writing of double-precision real number-type labels can be performed by using a dedicated instruction.

Appendix 5 Restrictions by the version

The CPU module and engineering tool versions corresponding to each Motion module are shown below.

Model		Version		
		GX Works3	CPU module	MCFB Library
RD78G	Ver. 04 or earlier	1.056J or later	R00CPU/R01CPU/R02CPU: 12 or later R04CPU/R08CPU/R16CPU/R32CPU/ R120CPU: 44 or later R04ENCPU/R08ENCPU/R16ENCPU/ R32ENCPU R120ENCPU: 44 or later	1.00A
	Ver. 05 or later	1.060N or later (The Motion module setting function 1.005F or later)		1.00A or later
RD78GH	—	1.060N or later	R00CPU/R01CPU/R02CPU: 14 or later R04CPU/R08CPU/R16CPU/R32CPU/ R120CPU: 46 or later R04ENCPU/R08ENCPU/R16ENCPU/ R32ENCPU/ R120ENCPU: 46 or later	1.00A or later

The engineering tool versions corresponding to MCFB Library are shown below.

Version	
MCFB Library	GX Works3
1.00A	1.056J or later (Motion module setting function 1.000A or later)
1.01B or later	1.060N or later (Motion module setting function 1.005F or later)

The corresponding CPU module and engineering tool versions have restrictions depending on the functions of the Motion module. Refer to the following function and version combinations.

The add-on versions and software versions of the Motion module combinations are shown below.

☞ Page 671 Add-on library list

Point

Other than the above engineering tool does not support the Motion module.

—: There is no restriction by the version.

Item		Detail
Function		Supports communication cycle 31.25 μs, 62.5 μs and 8000.0 μs.
Add-on library		
	baseSystem	1.5
CPU module firmware		—
GX Works3		1.060N
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports network synchronous communication setting.
Add-on library		
	baseSystem	1.5
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports PDO mapping configuration.
Add-on library		
	baseSystem	1.5
	ServoDriver_CANopen	1.4
CPU module firmware		—
GX Works3		1.060N

Item		Detail
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports up to 120 network stations.
Add-on library		
	baseSystem	1.5
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports general purpose connection of CANopen devices.
Add-on library		
	NetworkDriver_CCIETSN	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports MR-JET-G.
Add-on library		
	baseSystem	1.5
	ServoDriver_CANopen	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports partial read and write of operation profile.
Add-on library		
	ProfileControl	1.4
	PackagingApp	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Adds file transfer commands (copy, move, file, compress, extract and attrib).
Add-on library		
	FileTransfer	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Adds fast axis operation mode.
Add-on library		
	Axis	1.4
	ServoDriver_CANopen	1.4
	NetworkDriver_CCIETSN	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds encoder axis types.
Add-on library		
	Axis	1.4
	ServoDriver_CANopen	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds override function, MC_SetOverride and MC_GroupSetOverride.
Add-on library		
	MotionEngine	1.4
	Axis	1.4
	MotionControl_General	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MC_SetOverride	00A
	MC_GroupSetOverride	00A
Motion control setting function		1.005F

Item		Detail
Function		Adds MC_ReadParameter and MC_WriteParameter.
Add-on library		
	Axis	1.4
	MotionControl_General	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MC_ReadParameter	00A
	MC_WriteParameter	00A
Motion control setting function		1.005F

Item		Detail
Function		Adds MC_Reset, MC_GroupReset and MCv_MotionErrorReset.
Add-on library		
	MotionControl_General	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MCv_MotionErrorReset	00A
	MC_GroupReset	00A
	MC_Reset	00A
Motion control setting function		1.005F

Item		Detail
Function		Adds MC_TouchProbe and MC_AbortTrigger.
Add-on library		
	MotionControl_General	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MC_TouchProbe	00A
	MC_AbortTrigger	00A
Motion control setting function		1.005F

Item		Detail
Function		Supports unit label.
Add-on library		
	baseSystem	1.5
	Axis	1.4
	Program_ST	1.4
CPU module firmware		—
GX Works3		1.060N
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Supports TargetIgnored status of the drive unit.
Add-on library		
	Axis	1.4
	ServoDriver_CANopen	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds file transfer access control.
Add-on library		
	FileTransfer	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds MCv_BacklashCompensationFilter, MCv_DirectionFilter and MCv_SpeedLimitFilter.
Add-on library		
	MotionControl_AxisFilter	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MCv_BacklashCompensationFilter	00A
	MCv_DirectionFilter	00A
	MCv_SpeedLimitFilter	00A
Motion control setting function		1.005F

Item		Detail
Function		Adds purged pool monitor in MCv_SmoothingFilter.
Add-on library		
	MotionControl_AxisFilter	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	MCv_SmoothingFilter	01B
Motion control setting function		1.005F

Item		Detail
Function		Supports RD78GH.
Add-on library		
	baseSystem	1.5
CPU module firmware		R00CPU/R01CPU/R02CPU: 14 R04CPU/R08CPU/R16CPU/R32CPU/R120CPU: 46 R04ENCPU/R08ENCPU/R16ENCPU/R32ENCPU/R120ENCPU: 46
GX Works3		1.060N
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds memory usage monitor for BaseSystem.
Add-on library		
	—	—
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Adds clearing command for motion event history.
Add-on library		
	MotionEventHist	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

Item		Detail
Function		Supports initial stroke of operation profile.
Add-on library		

Item		Detail
	ProfileControl	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F

A

INDEX

A

Absolute Position Control 94
Absolute Positioning Control 189
Acceleration/deceleration Processing Function . . 308
Addition/Subtraction 490
Add-on library 110
Axis 32
Axis Type 37

B

Backlash compensation filter 379
Boot Software 576
Buffer memory refresh 108

C

CC-Link IE TSN 669
Circular interpolation control 243
Command format 561
Command In-position 294
Connectable Stations 51
CPU MODULE 535

D

DIRECT CONTROL 254
Driver unit conversion 357

E

Engineering tool 72
External Signal Selection 394

F

Follow Up 91

G

Gear Operation 484

H

Hardware Stroke Limit 302
HOMING 177

J

jerk acceleration/deceleration 327
Jerk limit value 324
JOG operation 207
JSON File Data Specifications 519

L

LED 579
Library 684
Log file 565
LOGGING 498

M

MCFB 538
Module extended parameters 549
MOTION SERVICE PROCESSING 533
Motion synchronization station link device auto refresh 108
Motion System Software 569
MR-J5(W)-G 672
Multiple Axes Positioning Control 212
Multiple Start 121

O

Operation Cycle 105
Operation Profile Data 412
Override Function 336

P

PDO mapping 55
Positioning Range 79
Processing time over check 525

R

RAS 521
Real drive axis 40
Real encoder axis 41
Relative Positioning Control 197

S

Servo ON/OFF 84
Set position 80
SIGNAL_SELECT structure 394
Single Axis Manual Control 204
Single Axis Positioning Control 184
Single Axis Speed Control 199
Single Axis Synchronization 466
Slave Emulate 410
Slave object 54
Slave object map 348
Smoothing filter 369
Software Reboot 115
Software Stroke Limit 296
State transition 35
Storage files 548
System basic cycle 105

T

TARGET_REF structure 396
The response code (SDO Abort code) 558
Torque Control 266
Torque limit 347
Touch Probe 399
Trigger condition (TRIGGERCONDITION) 510

V

Virtual drive axis 46

Virtual encoder axis 46
Virtual linked axis 50

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision date	*Manual number	Description
July 2019	IB(NA)-0300411ENG-A	First edition
January 2020	IB(NA)-0300411ENG-B	■Added models RD78GHV, RD78GHW ■Added or modified parts TERMS, GENERIC TERMS AND ABBREVIATIONS, HOW TO READ THIS MANUAL, FUTURE SUPPORT PLANNED,FUTURE SUPPORT PLANNED, Chapter 23, 24, 25, 26, Section 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3, 4.3, 4.4, 4.5, 5.1, 6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 8.1, 8.4, 9.1, 9.2, 9.3, 10.2, 11.1, 11.2, 12.1, 12.2, 12.3, 13.1, 13.2, 14.2, 14.3, 14.4, 14.5, 14.6, 14.7, 14.8, 14.9, 15.1, 15.2, 16.1, 16.2, 18.1, 18.2, 19.1, 19.2, 19.3, 21.1, 21.3, 22.3, 22.4, 22.5, 22.6, 25, Appendix 1, 2, 3, 4, 5,INDEX, WARRANTY, TRADEMARKS

Japanese manual number: IB-0300410-C

This manual confers no industrial property 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.

© 2019 MITSUBISHI ELECTRIC CORPORATION

WARRANTY

Warranty

1. Warranty period and coverage

We will repair any failure or defect hereinafter referred to as "failure" in our FA equipment hereinafter referred to as the "Product" arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

For terms of warranty, please contact your original place of purchase.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule.
It can also be carried out by us or our service company upon your request and the actual cost will be charged. However, it will not be charged if we are responsible for the cause of the failure.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;

1. a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
2. a failure caused by any alteration, etc. to the Product made on your side without our approval
3. a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
4. a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
5. any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
6. a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
7. a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
8. any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas countries

Our regional FA Center in overseas countries will accept the repair work of the Product. However, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

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. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

(1) For the use of our Motion module, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in the Motion module, and a backup or fail-safe function should operate on an external system to the Motion module when any failure or malfunction occurs.

(2) Our Motion module is designed and manufactured as a general purpose product for use at general industries.
Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used
In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used.
We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

TRADEMARKS

Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.
Unicode is either a registered trademark or a trademark of Unicode, Inc. in the United States and other countries.
PLCopen is a registered trademark of PLCopen®.
VxWorks is registered trademarks or trademarks of Wind River Systems, Inc.
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.

IB(NA)-0300411ENG-B(2001)MEE
MODEL: RD78-U-APP-E

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BUILDING, 2-7-3 MARUNOUCHI, CHIYODA-KU, TOKYO 100-8310, JAPAN
NAGOYA WORKS : 1-14 , YADA-MINAMI 5-CHOME , HIGASHI-KU, NAGOYA , 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.