

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. For the safety precautions of the programmable controller system, refer to the MELSEC iQ-R Module Configuration Manual.

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.
 - Configure a circuit so that the external power supply is turned off first and then the programmable controller. If the programmable controller is turned off first, an accident may occur due to an incorrect output or malfunction.
 - For the operating status of each station after a communication failure, refer to manuals for the network used. For the manuals, please consult your local Mitsubishi representative. 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. When a Safety CPU is used, data cannot be modified while the Safety CPU is in SAFETY MODE.
 - 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. For areas used for safety communications, they are protected from being written by users, and thus safety communications failure caused by data writing does not occur.
 - If a communication cable is disconnected, the network may be unstable, resulting in a communication failure of multiple stations. Configure an interlock circuit in the program to ensure that the entire system will always operate safely even if communications fail. Incorrect output or malfunction due to a communication failure may result in an accident. When safety communications are used, an interlock by the safety station interlock function protects the system from an incorrect output or malfunction.
 - 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. Doing so may result in malfunction due to electromagnetic interference. Keep a distance of 100 mm or more between those cables.
 - During control of an inductive load such as a lamp, heater, or solenoid valve, a large current (approximately ten times greater than normal) may flow when the output is turned from off to on. Therefore, use a module that has a sufficient current rating.
 - After the 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.
 - When changing the operating status of the CPU module from external devices (such as the remote RUN/STOP functions), select "Do Not Open by Program" for "Opening Method" of "Module Parameter". If "Open by Program" is selected, an execution of the remote STOP function causes the communication line to close. Consequently, the CPU module cannot reopen the line, and external devices cannot execute the remote RUN function.
-

[Security Precautions]

WARNING

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

[Installation Precautions]

WARNING

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

[Installation Precautions]

CAUTION

- Use the programmable controller in an environment that meets 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.
 - To mount a module with no module fixing hook, place the concave part(s) located at the bottom onto the guide(s) of the base unit, push in the module, and fix it with screw(s). Incorrect interconnection may cause malfunction, failure, or drop of the module.
 - Tighten the screws within the specified torque range. Undertightening can cause drop of the component or wire, short circuit, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction. For the specified torque range, refer to the MELSEC iQ-R Module Configuration Manual.
 - When using an extension cable, connect it to the extension cable connector of the base unit securely. Check the connection for looseness. Poor contact may cause malfunction.
 - When using an SD memory card, fully insert it into the SD memory card slot. Check that it is inserted completely. Poor contact may cause malfunction.
 - 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.
 - Beware that the module could be very hot while power is on and immediately after power-off.
 - Do not directly touch any conductive parts and electronic components of the module, SD memory card, 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. Failure to do so may result in malfunction due to noise. Keep a distance of 100 mm or more between those cables.
 - Place the cables in a duct or clamp them. If not, dangling cables may swing or inadvertently be pulled, resulting in malfunction or damage to 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
 - Connecting/disconnecting the extension cable to/from the base unit
 - After the first use of the product, do not insert/remove the SD memory card to/from the 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. Wearing a grounded antistatic wrist strap is recommended. Failure to do so may cause the module to fail or malfunction.
 - Use a clean and dry cloth to wipe off dirt on the module.
-

[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.
-

[Computer Connection Precautions]

CAUTION

- When connecting a personal computer to a module having a USB interface, observe the following precautions as well as the instructions described in the manual for the personal computer used.
Failure to do so may cause the module to fail.
(1) When the personal computer is AC-powered
When the personal computer has a 3-pin AC plug or an AC plug with a grounding wire, connect the plug to a grounding receptacle or ground the grounding wire. Ground the personal computer and the module with a ground resistance of 100 ohms or less.
When the personal computer has a 2-pin AC plug without a grounding wire, connect the computer to the module by following the procedure below. For power supplied to the personal computer and the module, using the same power source is recommended.
 1. Unplug the personal computer from the AC receptacle.
 2. Check that the personal computer is unplugged. Then, connect the personal computer to the module with a USB cable.
 3. Plug the personal computer into the AC receptacle.
(2) When the personal computer is battery-powered
The personal computer can be connected to the module without taking specific measures.
For details, refer to the following.
Cautions When Using Mitsubishi Programmable Controllers or GOTs Connected to a Personal Computer With the RS-232C/USB Interface (FA-A-0298)
When the USB cable used is the GT09-C30USB-5P manufactured by Mitsubishi Electric, specific measures are not required to connect the AC-powered personal computer to the module. However, note that the signal ground (SG) is common for the module and its USB interface. Therefore, if an SG potential difference occurs between the module and the connected devices, it causes failures of the module and the connected devices.

[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.)

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PART 2 MOTION CONTROL

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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
MELSEC iQ-R Programming Manual (Motion Control Function Blocks) [IB-0300533ENG]	Motion control function blocks, variables, and programming	Print book e-Manual PDF
Motion Module Quick Start Guide [L03191ENG]	Describes system startup, parameter settings, and programming methods for first-time users of the Motion module	e-Manual PDF

For programs, refer to the following.

 MELSEC iQ-R Programming Manual (Program Design)

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
Dedicated instruction	An instruction for using functions of the module
Device	Various memory data in a 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.
External signal high-accuracy input	An input signal linked with signal detection time of the slave station
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. The global label in the motion system can be made public as the module label (global label) in the control CPU module.
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 variable used for a program
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
Machine feed value	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.
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 in the CPU module.
Motion area	Software that performs the motion control in the Motion module
Motion control station	A slave station to exchange cyclic data by a slave label and motion control
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 module	Another term for the RD78G(H)
Motion synchronization station	Another term for motion control station
MR-J5-G	MR-J5-_G_(-RJ) servo amplifier
MR-J5D-G	MR-J5D-_G_ 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.

Term	Description
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
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.
Reconnection	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.)
Safety communications	A function to exchange safety data between safety stations on the same network
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 slave station other than motion synchronization (control) 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
Transient transmission	A function of data communication unperiodically among nodes (station) on network. A function used to send message to the target station when requested by a link dedicated instruction or the engineering tool Communication is available with station on another network via relay station, or gateway.
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.

Generic term/abbreviation	Description
CC-Link IE	A generic term for the following items: • CC-Link IE TSN • CC-Link IE Controller Network (MELSEC iQ-R CC-Link IE Controller Network User's Manual (Application)) • CC-Link IE Field Network (MELSEC iQ-R CC-Link IE Field Network User's Manual (Application))
CPU module	An abbreviation for the MELSEC iQ-R series CPU module
csp	An abbreviation for cyclic synchronous position mode (One of the control modes for the driver side)
cst	An abbreviation for cyclic synchronous torque mode (One of the control modes for the driver side)
csv	An abbreviation for cyclic synchronous velocity mode (One of the control modes for the driver side)
ct	The abbreviation for continuous operation to torque control mode (One of the control modes for the driver side)
GOT	A generic term for Mitsubishi Electric Graphic Operation Terminal GOT1000 and GOT2000 series
hm	An abbreviation for homing mode (One of the control modes for the driver side)
MCFB	An abbreviation for Motion Control FB
MR-J5(W)-G	A generic term for MR-J5-_G_(-RJ)/MR-J5W_-_G/MR-J5D_-_G_ servo amplifier
PDO	An abbreviation for Process Data Object. Aggregation of application objects transferred periodically between multiple CANopen nodes.
RAS	An abbreviation for Reliability, Availability, and Serviceability. This term refers to the overall usability of automated equipment.
RD78G(H)	A generic term for RD78G_, RD78GH_ (high performance version)
SDO	An abbreviation for Service Data Object. A message to access an object entry in the object dictionary of a CANopen node. Data is sent/received between the stations aperiodically.
SLMP	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 CC-Link 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
Safety station	A generic term for a station that performs safety communications and standard communications
Slave station	A generic term for a local station and remote station on CC-Link IE TSN
Software	A generic term for a firmware which configures the motion system. It consists of add-ons, baseSystem software and boot software.
Data link	A generic term for a cyclic transmission and a transient transmission
Drive unit	A generic term for motor drive devices such as a servo amplifier
Motion system	A generic term for software that performs the motion control and the network control
Reboot	A generic term for hardware reboot and software reboot

HOW TO READ THIS MANUAL

This section describes how to use Motion control FBs and the common specifications.

The Motion control FBs that can be used in the motion system include FBs established by PLCopen®. The basic specifications of I/O signals follow the PLCopen® Motion control FBs.

How to use Motion control FB

The procedure for using Motion control FBs is described as follows.

1. Create the Motion control FB instance (global label or local label) using the engineering tool.
2. Create a program which sets the I/O argument for the Motion control FB instance.
3. The control will be executed when Execute command (Execute) or Enable (Enable) of the Motion control FB is set to TRUE. For details, refer to the specification of each control and "Start" and "Stop".

Point

When one Motion control FB instance is being executed (including during buffering), the instance cannot be executed on multiple axes by changing the axis input (AXIS_REF input or AXES_GROUP_REF input). The axis input of the Motion control FB can only be changed when an instance is not being executed. When the axis input is changed while an instance is being executed, a warning will occur and the change will be ignored. Therefore, ensure that the number of Motion control FB instances created is equal to the number of axes being controlled at the same time.

Operation of this function for each system status

Motion control FBs can only be executed during RUN.

○: Possible, ×: Not possible

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

Motion control FB types

Motion control FBs are classified according to the operation details and the execution method.

■Motion FB/Administrative FB/General FB

Motion control FBs are classified into the following types according to the operation details.

Type	Description
Motion FB	A Motion control FB that takes an axis or an axes group for the argument and changes the axis status or the axes group status by execution.
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. (There are some exceptions)
General FB	A motion control FB that does not take an axis or 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 134 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 command (Execute) type/Enable (Enable)

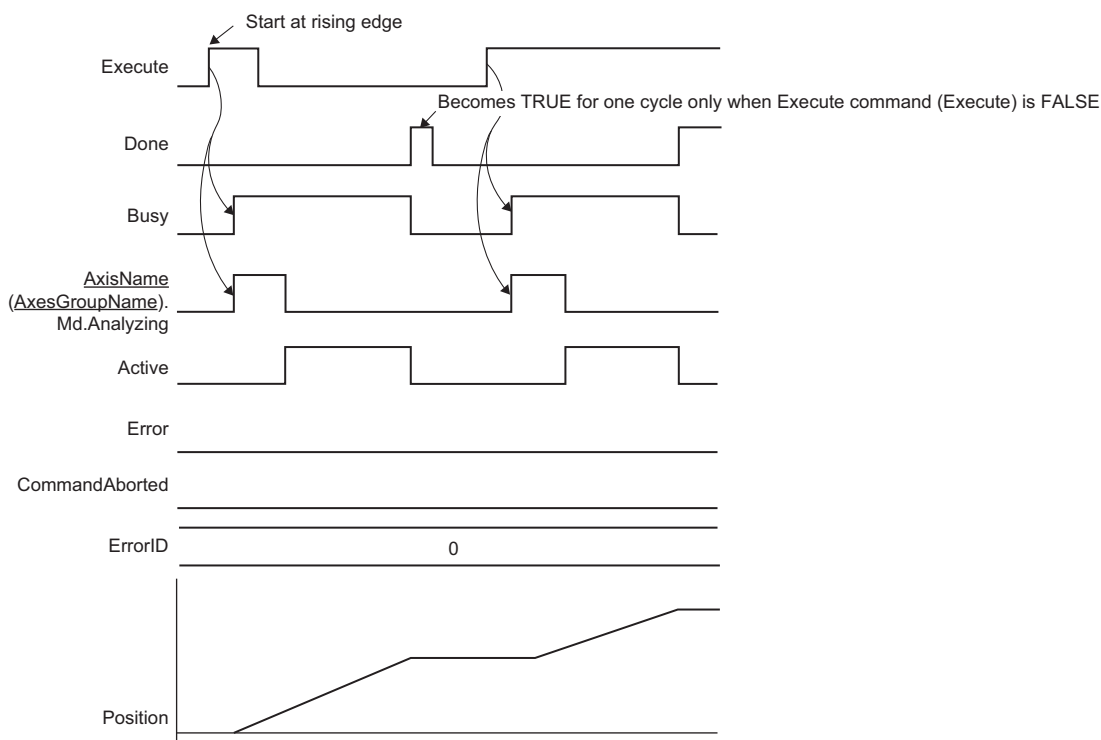
Some Motion control FBs are executed with Execute command (Execute), while others are executed with Enable (Enable). The basic operation of each Motion control FB by Execute command (Execute) and Enable (Enable) is shown below. Note that some Motion control FBs have different specifications. For details, refer to each FB specifications.

[Basic operation of Execute command (Execute) type Motion control FBs]

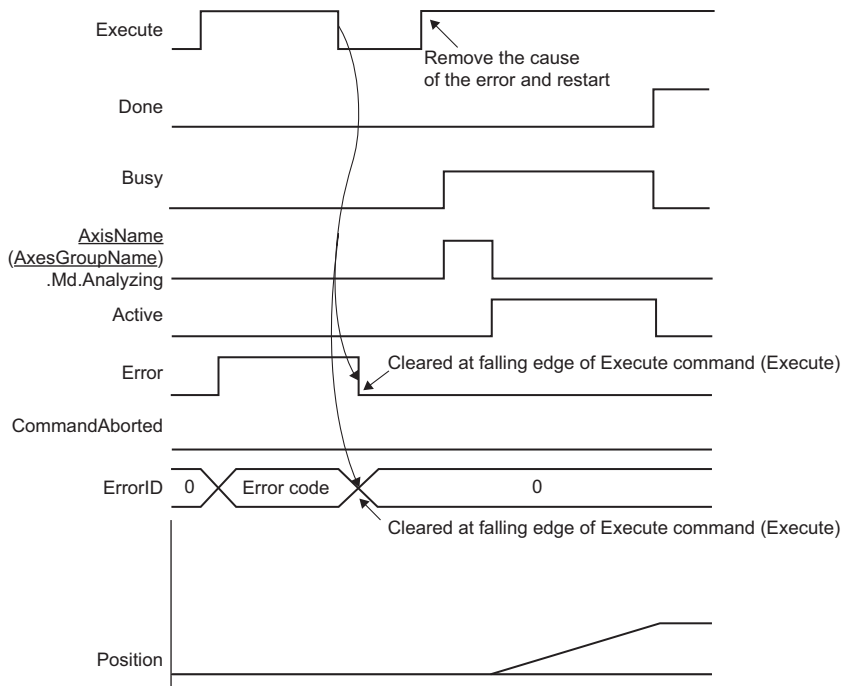
- Execute command (Execute) type FBs read the input parameters at the rising edge of Execute command (Execute) and then start operation. Once operation is started, the operation will be continued until it is completed even if Execute command (Execute) is set to FALSE.
- When operation is started, only one output variable among Executing (Busy), Execution completion (Done), Error (Error), and Abortion of execution (CommandAborted) becomes TRUE.
- Execution completion (Done), Error (Error), Error code (ErrorID), and Abortion of execution (CommandAborted) are reset at the falling edge of Execute command (Execute). Executing (Busy) and Controlling (Active) are not affected.
- When changing the input parameter during operation, the change is reflected at restart (retrigger) of Execute command (Execute) or by continuous update using Continuous update (ContinuousUpdate). For details, refer to the following.
[Page 133 Retrigger/Continuous Update](#)
- Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes TRUE from the rising edge of Executing (Busy), and Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes FALSE after starting the operation.
- When Execute command (Execute) is used in pulse, Execution completion (Done) becomes TRUE for one cycle only.

The timing chart for Execute command (Execute) type Motion control FBs is shown below.

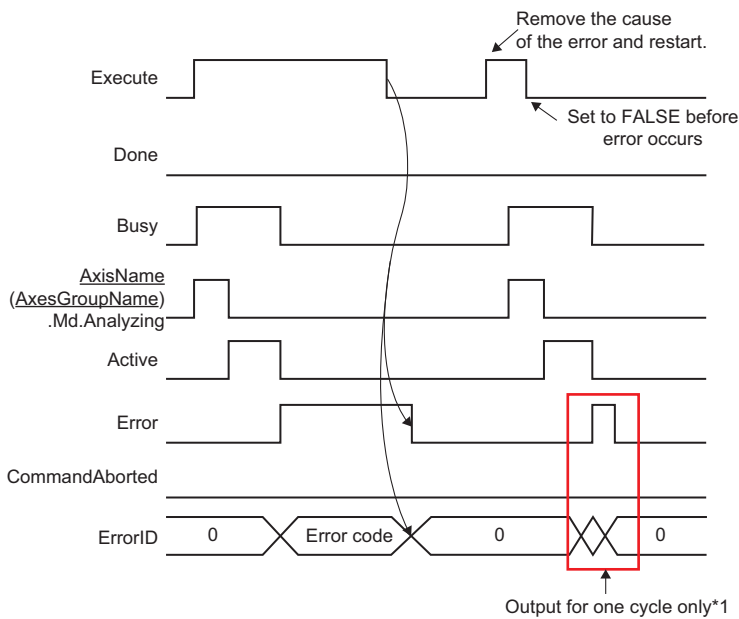
[When the FB is normal]



[When the I/O variables are abnormal]



[When the input variables are abnormal]



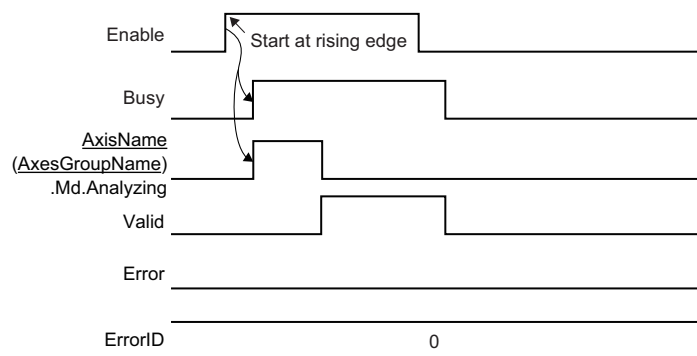
- *1 The following operation is carried out when termination condition of FB (Execute command (Execute) = FALSE) is met.
 For FBs not related to the axis or FBs which do not stop with decelerating, Error (Error) becomes TRUE for one cycle only and Error code (ErrorID) is output.
 For FBs that need to perform a deceleration stop, Error (Error) becomes TRUE until the stop with decelerating and Error code (ErrorID) is maintained. At stop completion of the axis, Error (Error) becomes FALSE and Error code (Error ID) is cleared.

[Basic operation of Enable (Enable) type Motion control FBs]

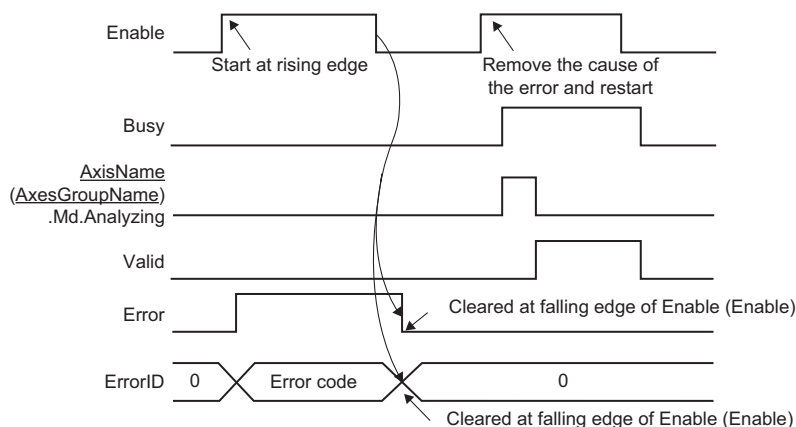
- Enable (Enable) type Motion control FBs are continuously executed while Enable (Enable) is TRUE.
- Output value valid (Valid) indicates that the output is a valid value. After Output value valid (Valid) becomes FALSE, each output does not change.
- Only one output variable among Output value valid (Valid)/Enabled (Enabled)/Executing (Busy), Error (Error), and Abortion of execution (CommandAborted) becomes TRUE.
- Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes TRUE from the rising edge of Executing (Busy), and Analyzing (AxisName.Md.Analyzing/AxesGroupName.Md.Analyzing) becomes FALSE after starting the operation.

The timing chart for Enable (Enable) type Motion control FBs is shown below.

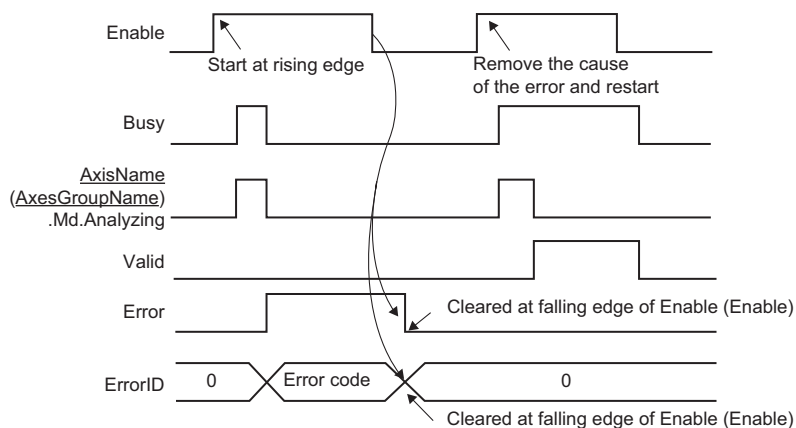
[When the FB is normal]



[When the I/O variables are abnormal]



[When the input variables change is abnormal]



Motion control types

The following types of axis and axes group control can be executed by operation type Motion control FBs. For details, refer to each function.

Large classification	Middle classification	Small classification	Reference
Axis control	Single axis control	Positioning control	Page 216 Single Axis Positioning Control
		Continuous control	Page 290 DIRECT CONTROL
		Synchronous control	Page 473 SYNCHRONOUS CONTROL Page 405 Command Filter
		Manual control	Page 235 Single Axis Manual Control
		Homing control	Page 206 HOMING
Axes group control	Multiple axes control	Positioning control	Page 243 Multiple Axes Positioning Control

The following shows generic terms for operation type Motion control FBs which perform each control.

Generic term for FB	Definition
Positioning control FB	An operation type Motion control FB in which Axis (or Axes group) status is set to "5: During positioning operation (DiscreteMotion)" (or "5: Operating (GroupMoving)") and the axis (or axes group) is moved to the target position.
Continuous control FB	An operation type Motion control FB in which Axis status is set to "6: During continuous operation (ContinuousMotion)" and continuous control is performed for the axis.
Synchronous control FB	An operation type Motion control FB in which has Master axis (Master) and Slave axis (Slave) as I/O variables and performs synchronous control for the axis with the Axis status of Slave axis (Slave) set to "7: During synchronous operation (SynchronizedMotion)".
Homing FB	An operation type Motion control FB in which Axis status is set to "3: During homing (Homing)" and continuous control is performed for the axis.

Error processing

If an error occurs while the Motion control FB is executed, Error (Error) becomes TRUE and the error code is output to Error code (ErrorID). If using an axis, Axis status transits to "1: Stopping on error (ErrorStop)" at this time. If using an axes group, Axes group status transits to "1: Stopping on error (GroupErrorStop)" at this time.

When the axis status of an available axis transits to the "1: Stopping on error (ErrorStop)" status, all buffering FBs are aborted. Error (Error) of the aborted FBs becomes TRUE.

After that, an error reset needs to be executed to start the axis or axes group. For how to check errors of the axis or axes group and how to reset the error, refer to the following.

👉 Page 685 Checking Errors and Warnings, 👉 Page 688 Error and Warning Reset

Point

One of the following values is output to Error code (ErrorID). (The value output depends on the control.) Note that warning codes are not output. For action of errors, refer to the following.

👉 Page 684 TROUBLESHOOTING

- Axis Error Code (AxisName.Md.ErrorID)
- Axes Group Error Code (AxesGroupName.Md.ErrorID)
- Latest Motion Area System Error Code (System.Md.ErrorID)

For the error (including warning) while the Motion control FB is executed on the CPU module side is output as the Motion module error.

The error codes to be output to Error code (ErrorID) of the Motion control FB are shown below.

Error code	Description
0400H	- No response from the Motion module within default time. Execute the FB again. - The Motion control FB may be executed in an interrupt program of the CPU module or the control syntax such as the MC instruction and the IF statement. Execute it after the special relay, SM752 turns on.
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 "User Function Execution Instruction" in the following manual.  MELSEC iQ-R Programming Manual (Motion Module Instructions, Standard Functions/Function Blocks)
1C01H	
1C02H	
1C03H	
1C04H	
1C05H	
1C06H	
1C07H	
1C0FH	

Precautions

When the I/O No. of the Motion module specified with the Motion control FB argument is not correct and the Motion module which executes the FB cannot be specified, no operation is performed or the error code is output on the CPU module side.

Units used in control

Units for the position, velocity, 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 79 Technical Units

The following types exist for the control values such as the position and the velocity that are used in the motion system. For details on the control values related to the position and the velocity, refer to the following.

 Page 85 Positioning Range,  Page 88 Velocity Range

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

I/O variables used in Motion control FBs

This section describes the I/O variables used in Motion control FBs.

■I/O variable/input variable/output variable

The following shows the variables and their classes.

Variable	Class
I/O variable	VAR_IN_OUT
Input variable	VAR_INPUT
Output variable	VAR_OUTPUT

For details, refer to specifications of each FB.

■Data type

In this part, the variable type is indicated. For details, refer to the following.

 Page 748 List of Data Type

■Enumeration type constant

Enumeration type constant which is used for various parameters, monitor data, or Motion control FBs actually uses INT type values. On the engineering tool, "enumeration type name_enumerator", INT type global data is available. For details on enumeration type and enumerator, refer to the following.

 Page 748 ENUM enumerator

Ex.

The label which is available for MC_BUFFER_MODE type enumerator of mcBuffered on the engineering tool is "MC_BUFFER_MODE_mcBuffered" and Constant "1" is set.

■Omission of input variable

When omitting FB inputs, the default value that is defined for each FB is applied. For details of the default value, refer to specifications of each Motion control FB.

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

 Page 134 Multiple Start (Buffer Mode)

■Refresh timing of input/output

Each argument of the FB is refreshed at the 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 a Motion control FB on the CPU module side, the I/O No. of the target Motion module must be set in the I/O variables (ex. AxisName.AxisRef.StartIO) that are used in the Motion control FB. For details, refer to the following.

 Page 634 HOW TO CONTROL FROM CPU MODULE

When using Motion control FBs on the Motion module side, the I/O No. does not need to be specified in the I/O variable. (Ex.: I/O No. (AxisName.AxisRef.StartIO)). (The specification is ignored.)

Precautions

- I/O arguments of the Motion control FB are refreshed at the call timing of the FB, but the cycle that the control is actually executed in differs depending on the FB. For example, the motion FBs perform the control at the operation cycle regardless of the FB call task (normal/fixed cycle). For details, refer to specifications of each FB.
- During the Motion control FBs operation (Executing (Busy) is on), call the FB. When the FB is written in the control syntax such as the IF statement and the Motion control FB is not called, the changed values of the input variables are not reflected and the output variables, such as Execution completion (Done) and Error (Error), cannot be updated.
- The FB imports input values when Execution command (Execute) or Enable (Enable) is set to TRUE. Therefore, set input values before setting Execution command (Execute) and Enable (Enable) to TRUE. In addition, when changing multiple input arguments by a retrigger/continuous update of the FB, change them by the same task as the FB call task to match the import timing of each argument.
- When changing Execution command (Execute) to FALSE after it has been set to TRUE, wait until after Executing (Busy) has changed to the TRUE status before setting Execution command (Execute) to FALSE.
- The motion control function uses 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 Motion control FB, refer to "Data Specification Method" in the following manual.

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

For details about the truncation error by real number data processing within the Motion control function, refer to the following.

 Page 85 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.

Item	Description
Axis assignment	Setting of slave object
Operation cycle	Auto refresh link devices of motion synchronization stations
Send/Receive data refresh of network connected devices	Standard station
Stop	The following setting values of Configuration Axes Operation Selection at Axis Stop Cause Occurrence (<u>AxisGroupName.Pr.StopMode_ErrorInGroup</u>) • "4: Servo OFF After Immediate Stop (<u>ServoOffAfterImmediateStop</u>)" • "5: Servo OFF After Deceleration to Stop (<u>ServoOffAfterDecelStop</u>)" The following setting values of Stop Selection at Deceleration to Stop (<u>AxisName.Pr.StopMode_DecelerationCurve/AxesGroupName.Pr.StopMode_DecelerationCurve</u>) • "0: Recreate Deceleration Curve at Increased Deceleration (<u>RapidCurve</u>)" • "2: Maintain Deceleration Curve (<u>ContinueCurve</u>)"
Current position change function	MCv_SetPositionTriggered (Trigger current position change) Set position change at control execution during axis operation
Acceleration/deceleration processing function	Acceleration/deceleration time change
Slave emulate	Slave Emulation Parameter (<u>AxisName.Cd.SlaveEmulate_Param</u>) Slave Emulation Request (<u>AxisName.Cd.SlaveEmulate_Request</u>)
Operation profile data	MCv_ProfileSelect (Profile data selection) MCv_ProfileCalc (Profile operation) MCv_ChangeCycleTriggered (Trigger change of current value per cycle) Multidimensional profile Operation profile data control
Cam operation	"2: Relative (mcRelative)" of Start mode (StartMode) "1: Absolute coordinate (TRUE)" of Master axis absolute coordinate (MasterAbsolute)
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

MEMO

PART 1

BASIC SPECIFICATIONS

PART 1

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
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. -1: Axis variable uninitialization/Axis parameter error (Invalid) 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill) 5: During positioning operation (DiscreteMotion) 6: During continuous operation (ContinuousMotion) 7: During synchronous operation (SynchronizedMotion)

Maximum number of controlled axes

The maximum number of controlled axes controlled by the motion system is the number of real drive axes. The other type of axes are not counted in the number of axes. For details, refer to the following.

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	Up to 1024 axes can be set. Settable number of axis varies depending on the system memory capacity setting. ^{*2} Axis assignment method is as follows. • Set on the Engineering tool (Axis setting window)						
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.

^{*2} For the memory capacity, refer to the following.

📖 Page 59 Memory usage

If the axis setting exceeds the maximum number of controlled axes, the warning "Maximum Setting Axis Number Over Warning" (warning code: 0F0BH) is output.

The axis is used as the control axis sequentially which the axis is assigned as the axis variable to the global label and the axis which exceeds the maximum number of the control axis turns Axis Status (AxisName.Md.AxisStatus) to "-1: Axis variable uninitialization/Axis parameter error (Invalid)" and it can not be used for the control.

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 56 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 details on parameter settings, refer to the specifications of each axis type.

Axis variables

An axis is generated/initialized by the axis setting in the engineering tool. The set axis is assigned to the global label data as an axis variable.

The axis is defined as an axis variable configured with monitor information 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 56 Axis Assignment

Setting axis No.	Engineering tool default axis name
1	Axis0001
2	Axis0002
⋮	⋮
10000	Axis10000

Data type

The following data types are assigned based on the axis type. For details on data type, refer to the relevant variables of each axis type.

Axis type	Data type
Real drive axis	AXIS_REAL
Real encoder axis	AXIS_ENCODER
Virtual drive axis	AXIS_VIRTUAL
Virtual encoder axis	AXIS_VIRTUAL_ENCODER
Virtual linked axis	AXIS_VIRTUAL_LINK

Each data type has the following members 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. Re-importing to the control data is not executed after axis variables initialization.
Pr		Stores the axis parameter data. Opens the default value at the axis variable initialization. Re-importing to the control data is executed after axis variables 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 global label data, and initializes all set axis variables.
PLC READY [Y0] OFF→ON	• Uninitialized axes • Initialized axes Refers to the global label data and initializes all axes variables. Refer to the global label data for the axis parameter data and reload again. When the parameter error occurs at loading, the axis is not deleted. In this case, the ready [X0] does not turn to ON. For the label initialization processing when the PLC READY [Y0] turns OFF to ON, refer to "Label initialization function" in the following manual.  MELSEC iQ-R Programming Manual (Motion Control Function Blocks)

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 then reconnected. (The axes can be emulated without network connection. (➡ Page 460 Slave Emulation))

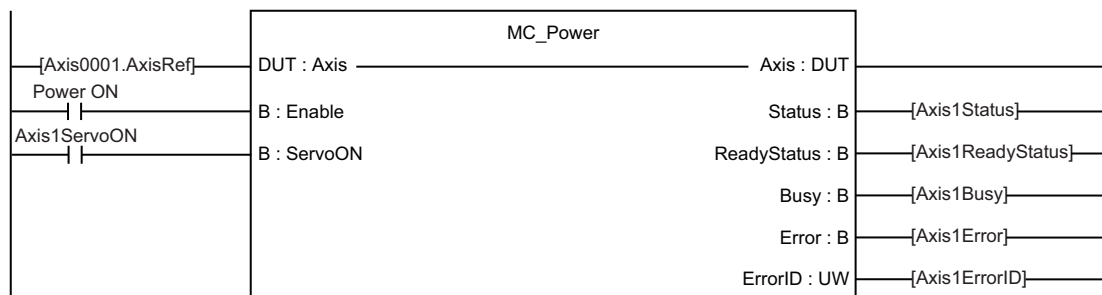
How to specify in a user program

When specifying the axis by the Motion control FB, set the AXIS_REF type member (AxisName.AxisRef) of each axis variable to the I/O variables which the data type is "AXIS_REF".

Ex.

When executing the MC_Power with the following conditions:

axis type: real drive axis, axis No.: 1, axis name: Axis0001



Axis status

Axis state transition

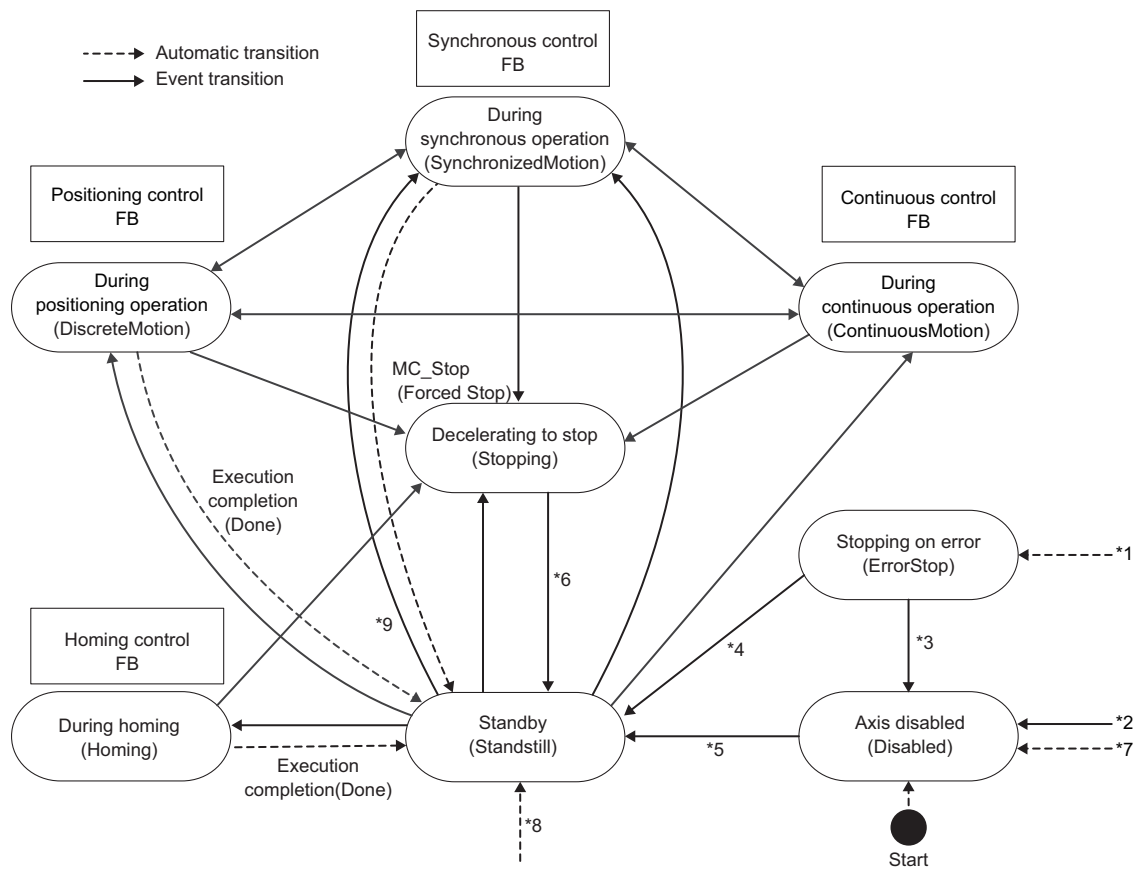
The following shows the status that a single axis can be in.

The current status can be confirmed in Axis Status (AxisName.Md.AxisStatus).

Status	Description
-1: Axis variable uninitialization/Axis parameter error (Invalid)	Axes cannot be used in this status due to axis variable uninitialization (parameter error occurrence at an initialization, etc.).
0: Axis disabled (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: Stopping on error (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: Decelerating to stop (Stopping)	The status where the deceleration stop has been executed by MC_Stop (Forced Stop). After the axis stop is completed, this status continues until the Execute command (Execute) of MC_Stop (Forced Stop) changes to FALSE. The Motion control FB cannot be executed in this status.
3: During homing (Homing)	The status where the homing has been executed in the driver or the motion system by the homing FB.
4: Standby (Standstill)	The status where the Motion control FB can be used. In case of a real drive axis, the axis is servo ON stop.
5: During positioning operation (DiscreteMotion)	The status where the positioning operation has been executed to the target position by the positioning control FB.
6: During continuous operation (ContinuousMotion)	The status where the operation is not stopped after the processing is completed in the continuous control FB (such as the FB of speed control and torque control).
7: During synchronous operation (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: Operating (GroupMoving)" status.

The status transits as shown below according to the start of the Motion control FB. The state transition may varies depending on the axis type. For the specifications of each axis type, refer to the following.

Page 42 Axis Type



*1 From any state, transits when an error in the axis occurred.

*2 From any state, transits when Enable (Enable) of MC_Power (Operation Available) is FALSE and there is no error in the axis.
 Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and no error occurs in the axis.
 Transits when Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) is changed to which Servo ON request (ServoON) is FALSE from "0: Ignore (Ignore)" and "2: Decelerating to stop (Stopping)"
 The axis status does not transit until the axis is stopped completely. After the axis stops completely the status transits to "0: Axis disabled (Disabled)". For details, refer to the following.

Page 165 Stop

*3 Transits by the status error cancel for the error reset command during the servo OFF state.

*4 Transits by the status error cancel for the error reset command during the servo ON state.

*5 Transits when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.

*6 Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execute command (Execute) of MC_Stop (Forced Stop) is FALSE.

*7 Transits from "4: Standby (Standstill)" when the forced servo OFF by the driver is executed and the axis is enabled.

Transits when a communication with the driver is failed from 4: Standby (Standstill).

*8 Transits automatically when the virtual axis is enabled.

*9 Transits when the axes group used as configuration axes changes to "5: Operating (GroupMoving)".

For the classification of the motion FBs, refer to the following.

Page 774 List of FBs

Precautions

The error "Out of Parameter Range (Axis)" (error code: 1D80H) occurs if a parameter error occurs at the axis variable initialization. At this time, Axis Status (AxisName.Md.AxisStatus) will be "-1: Axis variable uninitialization/Axis parameter error (Invalid)". The monitor data, etc. of the axis where "-1: Axis variable uninitialization/Axis parameter error (Invalid)" occurred is not refreshed. If the axis is specified by the user program, the error "Out of Axis No. Range" (error code: 3400H) occurs.

Relevant add-ons

The following add-ons are required to use this function.

- Axis
- MotionEngine
- NetworkDriver_CCIETSN^{*1}
- ServoDriver_CANopen^{*1}

^{*1} When using the real axis

System memory capacity

For details, refer to the following.

 Page 59 Memory usage

1.2 Axis Type

Relevant variables

Real drive axis data type AXIS_REAL members (excluding AxisRef)

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	☞ Page 56 Axis Assignment
AddressOfStation	Station Address Setting	☞ Page 56 Axis Assignment
PosRestoration_AbsPosBase	Absolute Position Reference Setting	☞ Page 57 Absolute position control setting
OperationCycle	Control Cycle Setting	☞ Page 56 Axis Assignment
SlaveObject	Slave Object Data	☞ Page 56 Axis Assignment
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. -1: Axis variable uninitialization/Axis parameter error (Invalid) 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill) 5: During positioning operation (DiscreteMotion) 6: During continuous operation (ContinuousMotion) 7: During synchronous operation (SynchronizedMotion)
UseInGroup	Using Axes Group	Displays whether the 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 56 Axis Assignment
Io_Statusword	Object Data_Statusword	Indicates a value of object data_Statusword. ☞ Page 56 Axis Assignment
Io_TargetPos	Object Data_TargetPos	Indicates a value of object data_TargetPos. ☞ Page 56 Axis Assignment

Real encoder axis data type AXIS_ENCODER members (excluding AxisRef)

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	☞ Page 56 Axis Assignment
AddressOfStation	Station Address Setting	Via 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 (Drive)
Encoder_CounterDisableSignal	Counter Disabling Signal	☞ Page 97 Follow Up
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill)
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the encoder. FALSE: Counter enabled TRUE: Counter disabled
Io_Statusword	Object Data_Statusword	Displays the synchronous encoder status emulated by the motion system.
Io_PosActualValue	Object Data_PosActualValue	Displays the input pulse value [encoder pulse unit] acquired from the synchronous encoder.
Io_PosEncoderResolution	Object Data_PosEncoderResolution	Displays the synchronous encoder resolution. Reads the value from the setting location when the drive unit is connected.

Virtual drive axis data type AXIS_VIRTUAL members (excluding AxisRef)

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	☞ Page 56 Axis Assignment
PosRestoration_AbsPosBase	Absolute Position Reference Setting	☞ Page 57 Absolute position control setting
OperationCycle	Control Cycle Setting	☞ Page 56 Axis Assignment
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. -1: Axis variable uninitialization/Axis parameter error (Invalid) 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill) 5: During positioning operation (DiscreteMotion) 6: During continuous operation (ContinuousMotion) 7: During synchronous operation (SynchronizedMotion)
Io_TargetPos	Object Data_TargetPos	Displays a value which is converted into the command value in a driver unit from the cumulative current position.

Virtual encoder axis data type AXIS_VIRTUAL_ENCODER members (excluding AxisRef)

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	☞ Page 56 Axis Assignment
Encoder_CounterDisableSignal	Counter Disabling Signal	☞ Page 97 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 specified: -2147483648 to 2147483647
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill)
Encoder_Connected	Connection Status	Displays the virtual encoder axis connection status. FALSE: Not connected TRUE: Connected
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the encoder. FALSE: Counter enabled TRUE: Counter disabled
Io_PosActualValue	Object Data_PosActualValue	Displays the value [encoder pulse unit] acquired from the encoder input.
Io_PosEncoderResolution	Object Data_PosEncoderResolution	Displays the synchronous encoder resolution.
<u>AxisName.Cd.</u>		
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
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	 Page 56 Axis Assignment
PosRestoration_AbsPosBase	Absolute Position Reference Setting	 Page 57 Absolute position control setting
OperationCycle	Control Cycle Setting	 Page 56 Axis Assignment
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Displays the current axis status. -1: Axis variable uninitialization/Axis parameter error (Invalid) 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill) 5: During positioning operation (DiscreteMotion) 6: During continuous operation (ContinuousMotion) 7: During synchronous operation (SynchronizedMotion)

Real drive axis

This axis uses 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

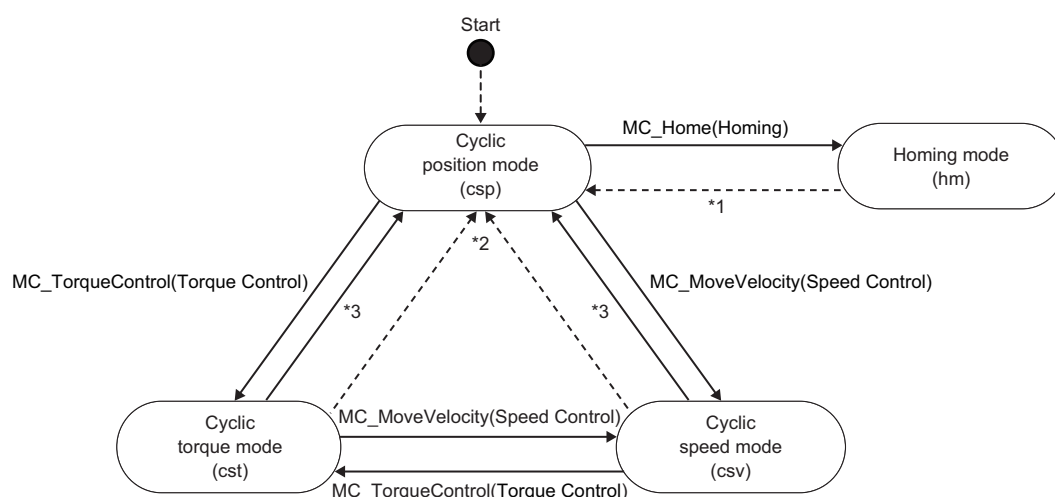
A driver device connected as a real drive axis follows the CiA402 drive protocol, and changes the control mode according to the "Modes of operation" object output from the motion system. The driver inputs the current mode as the "Modes of operation display" object in the motion system and displays it in Driver control mode (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.
Cyclic position mode (csp)	8: csp	Executes control following the sequential positioning command from the controller in each communication cycle.
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 the Motion control FB 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 (Speed Control)/MC_TorqueControl (Torque Control) is being Aborting/Buffered.

Precautions

If the axis parameter has an error when the controller power is turned ON with the driver being connected, the driver is connected as the remote I/O although the axis which has an error is not generated.

In this state, the axis is not generated even if the axis parameter is reviewed or the PLC READY [Y0] is turned OFF to ON again.

For generating the axis, power on the controller and the driver again.

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.

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 56 Axis No.
Axis type	○	Page 56 Axis type
Real encoder axis type setting	○	Page 47 Real encoder axis type setting
Station address	○	Page 47 Station address Page 57 Station address
Absolute position control setting	○	Page 57 Absolute position control setting
Control cycle	○	Page 57 Control cycle
Slave object setting		Page 47 Slave object setting Page 58 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 402 Compensation Function
Driver unit conversion denominator	○	
Position command unit setting	○	
Velocity command unit setting	○	
Command unit string	○	
Ring counter enabled selection	○	Page 85 Positioning Range
Ring counter upper limit value	△	
Ring counter lower limit value	△	
Counter disabling signal	△	Page 97 Follow Up

Real encoder axis type setting

Sets the synchronous encoder type which will be the origin of generating the real encoder axis input value.

Setting value	Description
1: Via Drive Unit (Drive)	Uses the synchronous encoder input value via drive unit connected to the specified drive unit as the synchronous encoder input.

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 47 Slave object setting

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

☞ Page 56 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 56 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 "Synchronous Encoder Via Drive Unit 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 442 TARGET_REF structure

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

Required functions to use

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

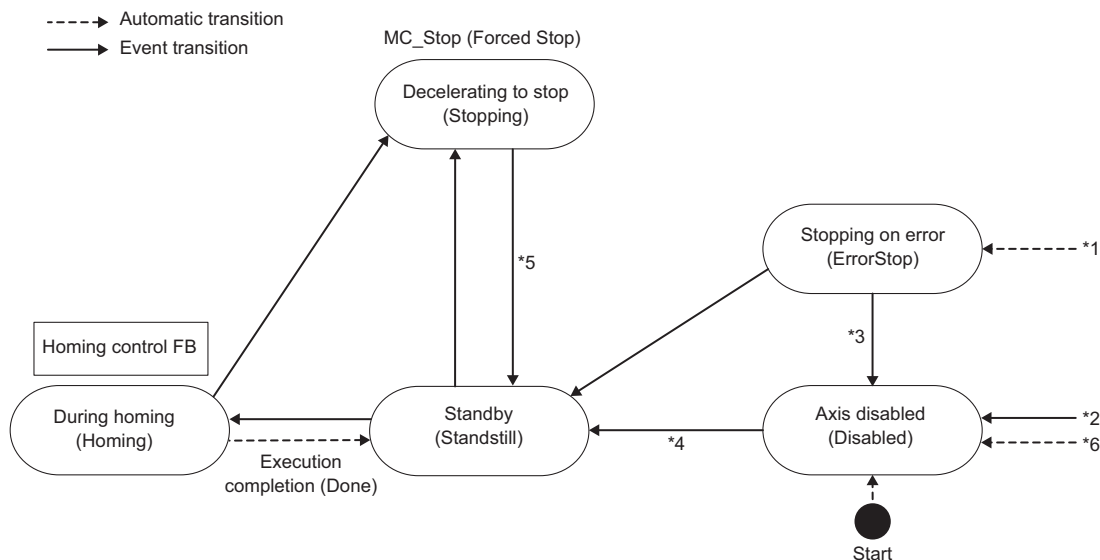
Function		Description	Axis type specific detailed information
Axis assignment		☞ Page 56 Axis Assignment	—
Technical units		☞ Page 79 Technical Units	—
Compensation function	Driver unit conversion function	☞ Page 402 Compensation Function	—
Absolute position control		☞ Page 101 Absolute Position Control	—
Operation cycle		☞ Page 112 Operation Cycle	—
State transition	Single axis state transition	☞ Page 53 Single axis state transition	—
Follow up (counter enabled/counter disabled)		☞ Page 97 Follow Up	—
Servo ON/OFF		☞ Page 90 Servo ON/OFF	—
Ring counter setting		☞ Page 85 Positioning Range	—
Control change function	Current position change function	☞ Page 321 Current Position Change Function	☞ Page 49 Control change function
Command filter	Smoothing filter	☞ Page 405 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 Transits from any state when an error of the axis occurs.

*2 Transits from any state when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is FALSE and the axis has no error.

Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and the axis has no error.

*3 Transits when the status error is cleared by the error reset command during servo OFF. (The state is the current position restoration not executed when the axis status transits to "0: Axis disabled (Disabled)" because the follow up is not executed in the "1: Stopping on error (ErrorStop)" state.)

*4 After the real drive axis which is the same station address is connected, transits when Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.

*5 Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execute command (Execute) of MC_Stop (Forced Stop) is FALSE.

*6 Transits from any state when the real drive axis which is the same station address is not to be connected.

Control change function

When starting the current position change control unconditionally, use MC_SetPosition (Current Position Change).



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

Setting examples

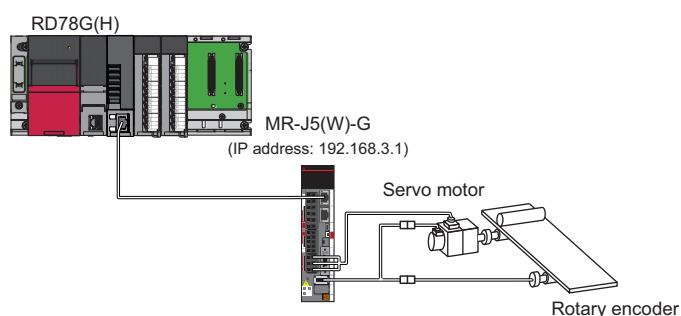
The setting example of the real encoder axis is shown below.

[Via drive unit]

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

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: Real Drive Axis (DriveAxis)	2: Real Encoder Axis (EncoderAxis)
Real encoder axis type setting	Unnecessary	1: Via Drive Unit (Drive)
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: Automatic Setting (Acquire from Connected Device) (Auto)	Arbitrary ^{*1}
Control cycle	0	0 ^{*2}

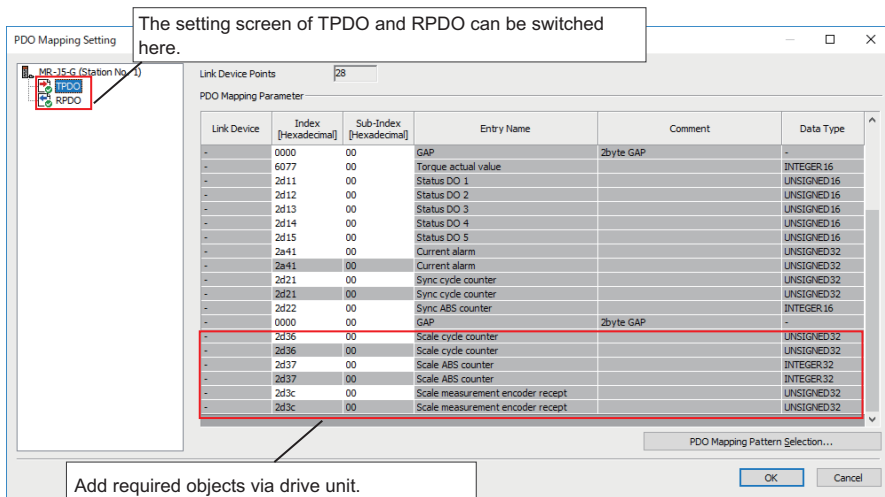
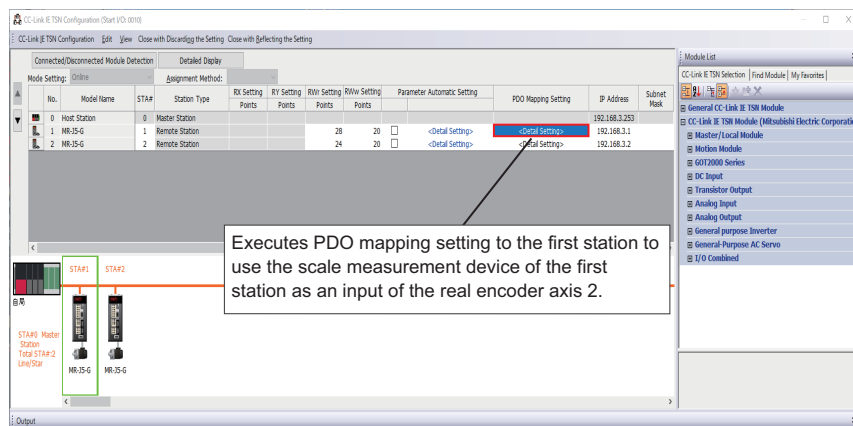
*1 Set the setting that matches with the setting of the synchronous encoder and driver side to be connected. When "-1: Automatic Setting (Acquire from Connected Device) (Auto)" is set, acquires the absolute position system setting from the driver side.

*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, It is recommended that the real encoder axis control cycle is set as the same cycle as the connecting real drive axis.

■PDO mapping setting

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

- 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 on the parameter and connection method of the encoder, refer to the driver device specification.

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 emulation function to the real axis drive. For details, refer to the following.

☞ Page 460 Slave Emulation

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 56 Axis No.
Axis type	○	Page 56 Axis type
Station address	—	—
Absolute position control setting	○	Page 57 Absolute position control setting
Control cycle	○	Page 57 Control cycle
Slave object setting		
PosActualValue	△	Page 52 Slave object setting
Driver unit conversion numerator	○	Page 402 Compensation Function
Driver unit conversion denominator	○	
Position command unit setting	○	Page 79 Technical Units
Velocity command unit setting	○	
Command unit string	○	
Ring counter enabled selection	○	Page 85 Positioning Range
Ring counter upper limit value	△	
Ring counter lower limit value	△	
Encoder ring counter upper limit value	○	Page 52 Encoder ring counter upper limit value/ lower limit value
Encoder ring counter lower limit value	○	
Counter disabling signal	△	Page 97 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 "Encoder Input Value (<u>AxisName</u>.Cd.Encoder_InputValue)" as the encoder input value when omitted. Set the encoder input value sequentially by encoder pulse unit.

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

📖 Page 442 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.



- For the encoder input value, set the cycle counter of "the encoder ring counter lower limit value ≤ the encoder input value ≤ the encoder ring counter upper limit value" as the input value. If the encoder input value is out of the above range, the encoder input value will not be read.
- Set the encoder input value that one operation cycle movement amount meets the following equation. If it does not meet, the actual input movement amount and the movement amount counted by the motion system may not match.

$$\text{One operation cycle movement amount} \leq \frac{\text{the encoder ring counter upper limit value} - \text{the encoder ring counter lower limit value} + 1}{2}$$
- 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.

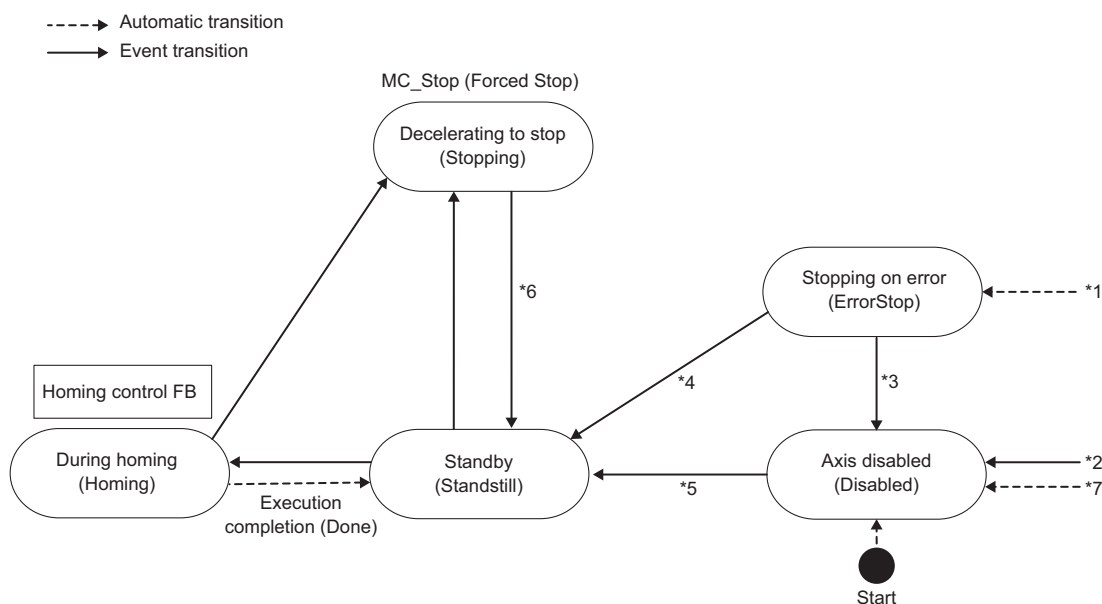
Function		Description	Axis type specific detailed information
Axis assignment		☞ Page 56 Axis Assignment	—
Technical units		☞ Page 79 Technical Units	—
Compensation function	Driver unit conversion function	☞ Page 402 Compensation Function	—
Absolute position control		☞ Page 101 Absolute Position Control	—
Operation cycle		☞ Page 112 Operation Cycle	—
State transition	Single axis state transition	☞ Page 53 Single axis state transition	☞ Page 48 State transitions
Follow up (counter enabled/counter disabled)		☞ Page 97 Follow Up	—
Ring counter setting		☞ Page 85 Positioning Range	—
Control change function	Current position change function	☞ Page 321 Current Position Change Function	☞ Page 49 Control change function
Command filter	Smoother filter	☞ Page 405 Command Filter	—
	Movementdirection control filter		—

For other functions, refer to each function, check the required slave object for the function. 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 Transits from any state when an error of the axis occurs.

*2 Transits from any state when Enable (Enable) of MC_Power (Operation Available) is FALSE and the axis has no error.
 Transits from "4: Standby (Standstill)" when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is FALSE, and the axis has no error.

*3 Transits when the status error is cleared by the error reset command during servo OFF.

*4 Transits when the status error is cleared by the error reset command during servo ON.

*5 After Connection Command (AxisName.Cd.Encoder_Connect) is set to TRUE, transits when Enable (Enable) of MC_Power (Operation Available) is TRUE, Servo ON request (ServoON) is TRUE, and Operable (Status) of MC_Power (Operation Available) is TRUE.

*6 Transits when Execution completion (Done) of MC_Stop (Forced Stop) is TRUE and Execute command (Execute) of MC_Stop (Forced Stop) is FALSE.

*7 Transits from any state when Connection Command (AxisName.Cd.Encoder_Connect) is FALSE.

Control change function

When starting the current position change control unconditionally, use the MC_SetPosition (Current Position Change).

Restriction

The encoder input value will be read by every virtual encoder axis control cycle. When the encoder input value update cycle is slow, the velocity change increases. Use the smoothing filter to smooth the velocity change.

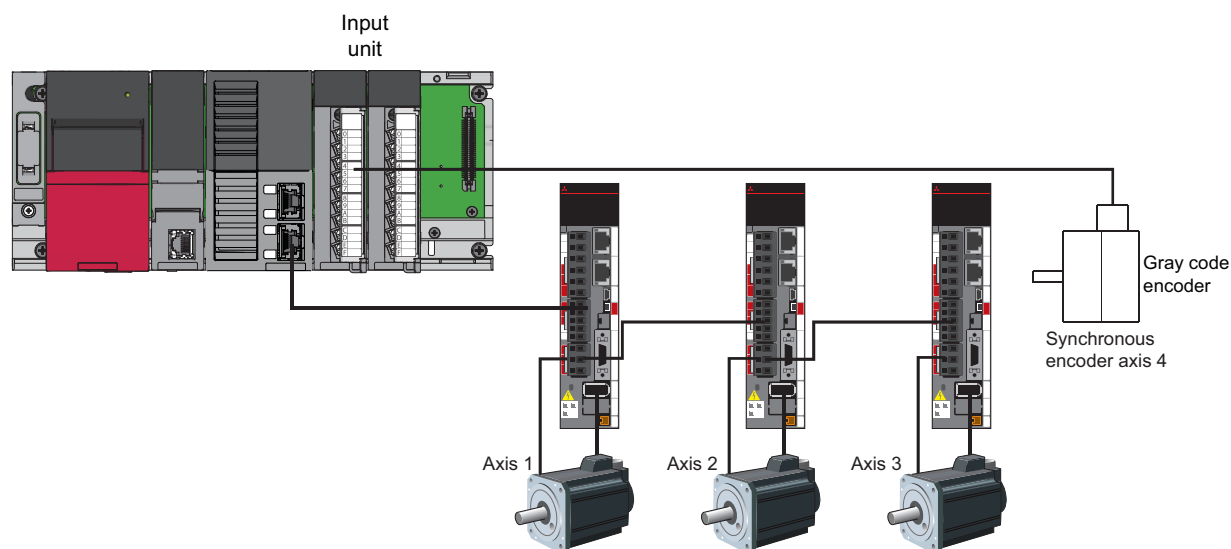
Setting example

The setting example of the virtual encoder axis and the method of use are shown below.

Ex.

When the axis 4 is used as the virtual encoder axis.

(Gray code encoder connected to the input unit: The resolution 4096 [pulse/rev] encoder value is used to control)



Axis setting

Setting items	Setting value
AxisNo.	4
AxisType	4: Virtual Encoder Axis (VirtualEncoderAxis)
Absolute position control setting	0: Disable Absolute Position System (ABSDisabled)
Encoder ring counter upper limit value	4095
Encoder ring counter lower limit value	0
Object data_PosActualValue	[DEV](DINT)G11478000

1. Set Connection Command (AxisName.Cd.Encoder_Connect) to TRUE.
2. Check Current Position Restoration Status (AxisName.Md.PosRestoration_Status) is "2: Restoration Completed in Incremental System (RestoredInIncSystem)", and Connection Status (AxisName.Md.Encoder_Connected) is TRUE.
3. Set Enable (Enable) of MC_Power (Operation Available)/MCv_AllPower (All Axes Operation Available) and Servo ON request (ServoON) to TRUE.
4. Check Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
5. Read the encoder value of the gray code encoder by program, update the device setup on PosActualValue with 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 56 Axis Assignment

Precautions

- Software stroke limit cannot be set in the virtual linked axis. When virtual linked axes are used to connect between each user program of single axis synchronous control, set the software stroke limit in the end axis of connected single axis synchronous control.
- When temporarily generated axis is started, it will take longer than the usual to start the axis because the axis variables are generated in the motion service processing.

1.3 Axis Assignment

Axes are generated/initialized by setting axis settings on the axis setting window in the engineering tool. The axes set on the axis setting window are assigned to the global label as axis variables. For the setting method, refer to Help of the engineering tool.

Operation of this function for each system status

○: Possible, ×: Not possible

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

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
Virtual linked axis generated automatically	20001 to 30000

■Axis type

Specify an axis type of the axis.

Axis type	Setting value
Real drive axis	0: DriveAxis
Real encoder axis	2: 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 on data types of each axis type, refer to the following.

☞ Page 36 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 on the TARGET_REF structure, refer to the following.

📖 Page 442 TARGET_REF structure

Even though the station address have not been set ("" in the real axis, by setting Slave Emulation Enabled (`AxisName.PrConst.SlaveEmulate_Enable`) to 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 101 Absolute Position Control

■Control cycle

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

📖 Page 112 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
<u>AxisName.AxisRef.</u>		
AxisNo	Axis No.	Sets the axis No. 0: Not set 1 to 10000: Setting axis No.
<u>AxisName.PrConst.</u>		
AxisType	Axis Type Setting	Sets the axis type. 0: Real Drive Axis (DriveAxis) 2: Real Encoder Axis (EncoderAxis) 3: Virtual Drive Axis (VirtualDriveAxis) 4: Virtual Encoder Axis (VirtualEncoderAxis) 5: Virtual Linked Axis (VirtualLinkAxis)
AddressOfStation	Station Address Setting	Sets network address of the slave station with a character string.
PosRestoration_AbsPosEnable	Absolute Position Control Setting	Sets the absolute position control setting. 0: Disable Absolute Position System (ABSDisabled) 1: Enable Absolute Position System (Enabled) -1: Automatic Setting (Acquire from Connected Device) (Auto)
OperationCycle	Control Cycle Setting	Sets Control cycle setting. For details, refer to the following. 📖 Page 112 Operation Cycle
<u>AxisName.Md.</u>		
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 on the format to specify the data, refer to the following. ☞ Page 442 TARGET_REF structure Differently from specifying objects by TARGET_REF structure, slave objects which are not mapped to cyclic data can be specified when specifying objects in the slave object setting.

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 on slave object attribute, refer to the following.

☞ Page 60 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 60 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 on PDO mapping settings, refer to "Cyclic Transmission" of Part 1 in the following manual.

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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	Necessary slave object name
Output (RPDO)	Control 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.

Memory usage

The memory usage differs depending on the axis types. Specify the memory capacity of the axis data according to the axis type and the number of the axis to be used.

The memory usage of each axis type is shown below and these indicate the usage of every axis.

Axis type	Memory usage (k bytes/axis)
Real drive axis	160
Real encoder axis	40
Virtual drive axis	60
Virtual encoder axis	40
Virtual linked axis	40

The memory capacity for axis data is specified by Maximum RAM Size (System.PrConst.Addon_Axis.RamSizeMax).

When the axis data memory usage exceeds the capacity at initializing the axis variable, the error "Axis Data Memory Size Over" (error code: 1A5DH) occurs and the axis is not generated. Check the memory capacity and execute the software reboot.

Check the memory capacity of the following add-on library as needed.

- MotionEngine
- NetworkDriver_CCIETSN (for using real drive axis)
- ServoDriver_CANopen (for using real drive axis)
- SignalIO (for using external signal)
- ExternalSignal (for using external signal)

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	Data Type	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	60410010	Gets the status of the driver device.
Status DO 1	U16	ro	TxPDO	2D110010	Sets the output device in driver device.
Status DO 2	U16	ro	TxPDO	2D120010	Sets the output device in driver device.
Status DO 3	U16	ro	TxPDO	2D130010	Sets the output device in driver device.
Status DO 4	U16	ro	TxPDO	2D140010	Sets the output device in driver device.
Status DO 5	U16	ro	TxPDO	2D150010	Sets the output device in driver device.
Status DO 6	U16	ro	No	2D160010	Sets the output device in driver device.
Status DO 7	U16	ro	No	2D170010	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 driver device.
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	Data Type	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 velocity 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 36 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 the real axis, the registered slave objects can be confirmed with RPDO (Slave device→Motion system) Mapping (AxisName.Md.Drive_RPDO[1..64]) and TPDO (Motion system→Slave device) Mapping (AxisName.Md.Drive_TPDO[1..64]).

For the virtual axis, the registered slave objects are fixed for each axis type.

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

 Page 60 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 (Speed Control)	TargetVelocity	◎	The error "Necessary Slave Object Unset" (error code: 1AA8H)
MC_TorqueControl (Torque Control)	TargetTorque	◎	The error "Necessary Slave Object Unset" (error code: 1AA8H)
Torque limit function	PositiveTorqueLimitValue NegativeTorqueLimitValue	○	The command is ignored.
MC_Home (Homing)	HomeOffset	—	Operates with data set method.

Precautions

Relevant add-ons

The following add-on is required to use this function.

- Axis

System memory capacity

For details, refer to the following.

 Page 59 Memory usage

1.4 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

Variable/Structure name	Name	Details
<u>AxesGroupName.AxesGroupRef.</u>		
GroupNo	Axes Group No.	Sets axes group No. in the motion system. 0: Not set 1 and later: Setting axes group No.
<u>AxesGroupName.Pr.</u>		
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (<u>AxisName.AxisRef</u>) which configures the axes group.
<u>AxesGroupName.Md.</u>		
GroupStatus	Axes Group Status	Displays the current axes group status. -1: Axes group variable uninitialization/Axes group parameter error (Invalid) 0: Axes group disabled (GroupDisabled) 1: Stopping on error (GroupErrorStop) 2: Decelerating to stop (GroupStopping) 4: Standby (GroupStandby) 5: Operating (GroupMoving)
GroupName	Axes Group Name	Stores the axes group name.
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (<u>AxisName.AxisRef</u>) which configures the axes group.

Relevant FBs

MC_GroupEnable

Item	Description
Function overview	Transits specified Axes Group Status (<u>AxesGroupName</u> .Md.GroupStatus) from "Axes group disabled (GroupDisabled)" to "4: Standby (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 Axes Group Status (AxesGroupName.Md.GroupStatus) of the AXES_GROUP_REF structure from "0: Axes group disabled (GroupDisabled)" to "4: Standby (GroupStandby)".

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

When the processing is normally completed, Execution completion (Done) becomes TRUE and Executing (Busy) becomes FALSE.

When an error has occurred in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID).

For details on error codes, refer to the following.

📖 Page 711 List of Error Codes

For Axes Group Status (AxesGroupName.Md.GroupStatus), refer to the following.

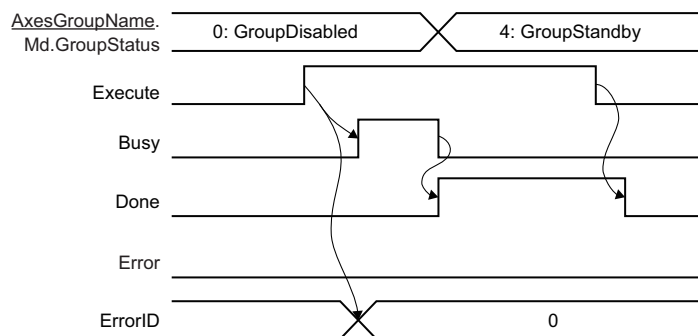
📖 Page 71 Axes group state transition

■Restrictions

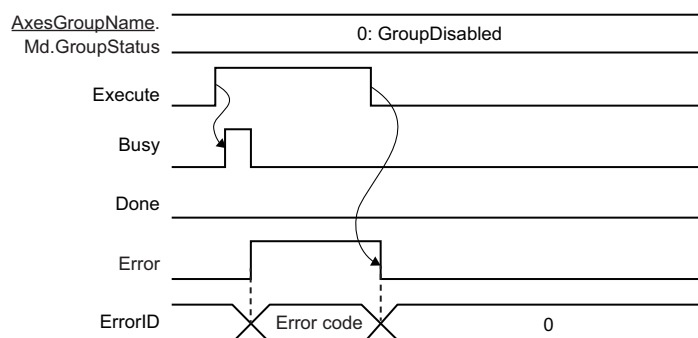
- Axes Group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.
- This FB can be executed only when Axis Status (AxisName.Md.AxisStatus) of all configuration axes is the "4: Standby (Standstill)" or the "0: Axis disabled (Disabled)" status.

■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 758 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: Standby (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)	0	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 711 List of Error Codes

MC_GroupDisable

Item	Description
Function overview	Transits specified axes group status to "0: Axes group disabled (GroupDisabled)".
Symbol [Structured Ladder]	MC_GroupDisable DUT : AxesGroup B : Execute AxesGroup : DUT Done : B Busy : B Error : B ErrorID : UW
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 Axes Group Status (AxesGroupName.Md.GroupStatus) of the AXES_GROUP_REF structure to "0: Axes group disabled (GroupDisabled)".

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

When the processing is normally completed, Execution completion (Done) becomes TRUE and Executing (Busy) becomes FALSE.

When an error has occurred in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID).

For details on error codes, refer to the following.

📖 Page 711 List of Error Codes

For Axes Group Status (AxesGroupName.Md.GroupStatus), refer to the following.

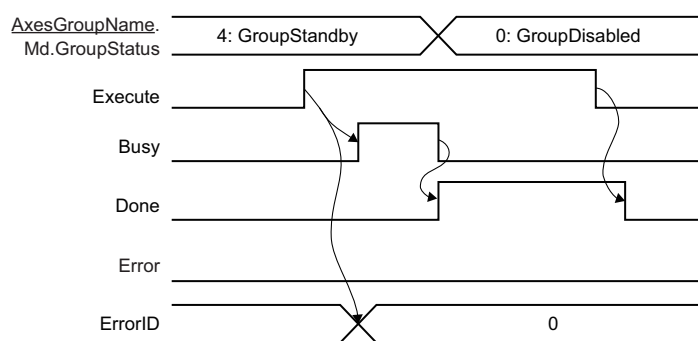
📖 Page 71 Axes group state transition

■Restriction

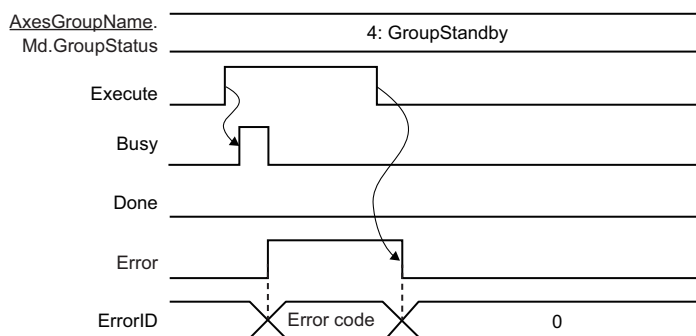
Axes Group No. (GroupNo) of the AXES_GROUP_REF structure must be set in advance before this FB is executed.

■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 758 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 "0: Axes group disabled (GroupDisabled)".
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)	0	The error code generated in the FB is returned. For details, refer to the following. Page 711 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 77 Axes Group Assignment

Item	Description
Axes group No.	Sets axes group No. of the motion system.
Axes group name	Sets an arbitrary axes group name.
Configuration axis	Sets Axis No. (AxisNo) of Axis Information (AxisName.AxisRef) which configures the axes group.

Axes group variables

Axes group variables are generated by adding the axes group setting in the engineering tool. A generated axes group is assigned to the global label as an axes group variable.

Axes group is defined as an axes group variable configured with monitor information such as parameter information, the current position, and the status.

Axes group variable name (default)

The following names are assigned based on the setting axes group No. It can be changed to an arbitrary name. For details, refer to the following.

 Page 77 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. Re-importing to the control data is executed after axes group variables initialization. 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 global label data, and initializes all set axes group variables.
PLC READY [Y0] is turned ON	• Uninitialized axis group Refers to the global label data and initializes all axes group variables. • Initialized axes group Refer to the global label data for the axes group parameter data and import it again. However, do not import again the configuration axis. When the parameter error occurs at importing, the axes group is not deleted. At this time, READY [X0] does not turn ON. For the label initialization processing when the PLC READY [Y0] turns OFF to ON, refer to "Label initialization function" in the following manual.  MELSEC iQ-R Programming Manual (Motion Control Function Blocks)

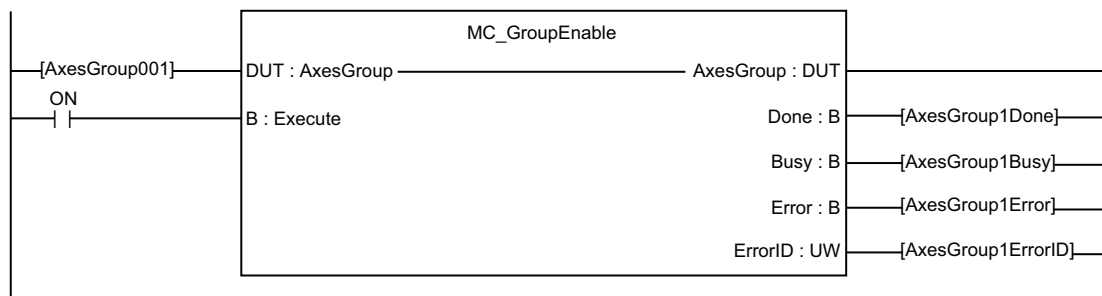
How to specify in a user program

When specifying the axes group by the Motion control FB, set the AXES_GROUP_REF type member (AxesGroupName.AxesGroupRef) of each axes group variable to the I/O variables which the data type is "AXES_GROUP_REF".

Ex.

When executing the MC_GroupEnable (Axes Group Enabled) with the following conditions:

axes group No.: 1, axes group name: AxesGroup001



Axes group status

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

Axes group state transition

The following shows status that an axes group can enter.

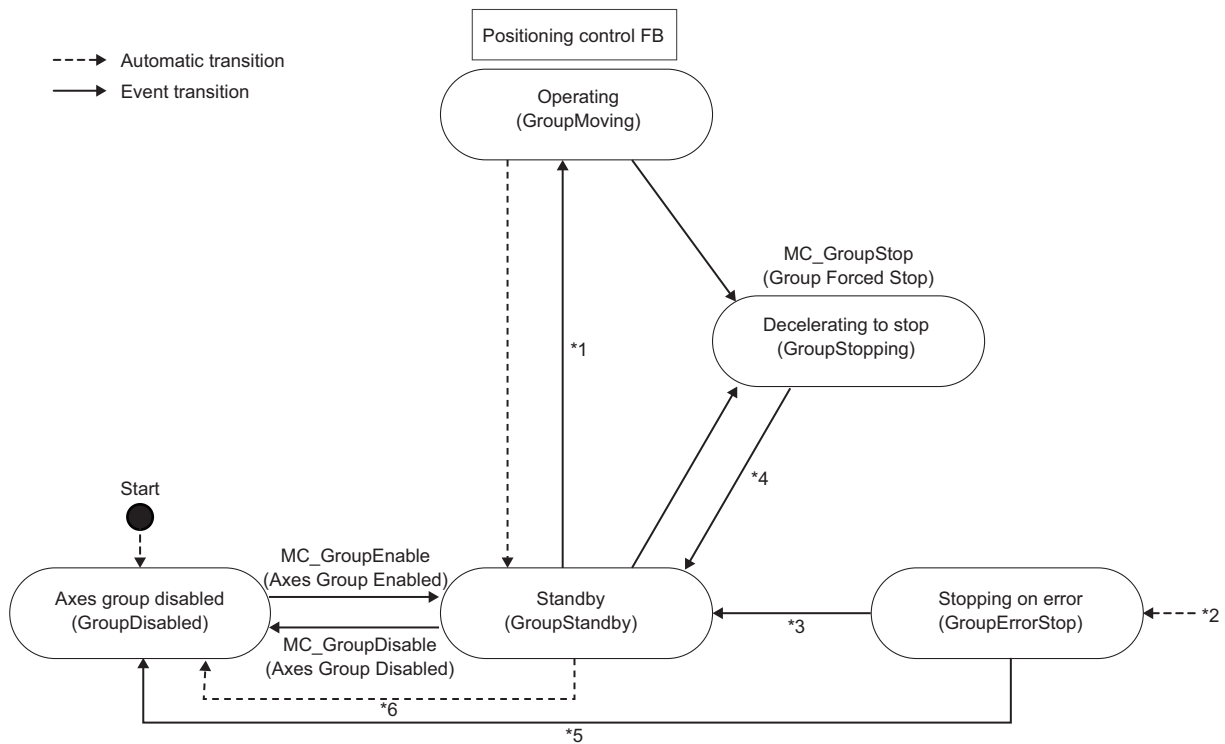
The current status can be confirmed with Axes Group Status (AxesGroupName.Md.GroupStatus).

When the axes group changes to "4: Standby (GroupStandby)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes TRUE.

When the motion FB is executed for the axis (the axis of which Using Axes Group (AxisName.Md.UseInGroup) is TRUE) used in the axes group, the error "Start Not Possible" (error code: 1AADH) occurs. Disable the axes group by MC_GroupDisable (Axes Group Disabled).

Status	Description
-1: Axes group variable uninitialization/Axes group parameter error (Invalid)	Axes group is disabled because of the axes group variables are not initialized (such as an parameter error occurrence at initialization).
0: Axes group disabled (GroupDisabled)	Axes group is disabled. Motion control FB cannot be executed in this status. The axis which is being controlled will be stopped immediately to transit this status.
1: Stopping on error (GroupErrorStop)	Axes group is in the deceleration stop or the stop status by an error occurrence. When Axis Status (<u>AxisName</u> .Md.AxisStatus) is set to "1: Stopping on error (ErrorStop)" in any of the configuration axes, the axes group also enters this status.
2: Decelerating to stop (GroupStopping)	The deceleration stop is executed by MC_GroupStop (Group Forced Stop) . After the axis stop is completed, this status will be maintained until the Execute command (Execute) of MC_GroupStop (Group Forced Stop) becomes FALSE. The Motion control FB cannot be executed in this status.
4: Standby (GroupStandby)	Axes group is enabled and stand-by. (Not depending on the servo ON/OFF status of the configuration axis.)
5: Operating (GroupMoving)	The positioning control FB is executed in an axes group. When transiting into this status, Axis Status (<u>AxisName</u> .Md.AxisStatus) of all configuration axes turn to "7: During synchronous operation (SynchronizedMotion)".

The status is transited as the following figure according to start of the Motion control FB.



*1 All group motion FB

*2 Transits when an error caused by an axes group occurs in the status other than "0: Axes group disabled (GroupDisabled)".
 Transits when an error caused by an configuration axes occurs in the status other than "0: Axes group disabled (GroupDisabled)".

*3 Transits when status error is cleared by resetting axes group error

*4 Transits when Execution completion (Done) of MC_GroupStop (Group Forced Stop) is TRUE and Execute command (Execute) MC_GroupStop (Forced Stop) is FALSE.

*5 Transits when MC_GroupDisable (Axes Group Disabled) is executed or the status is the axes group disabled at clearing the status error by resetting the axes group error.

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

For classifications of the motion FB, refer to the following.

☞ Page 774 List of FBs

Axes group enabled

This section describes enabling an axes group.

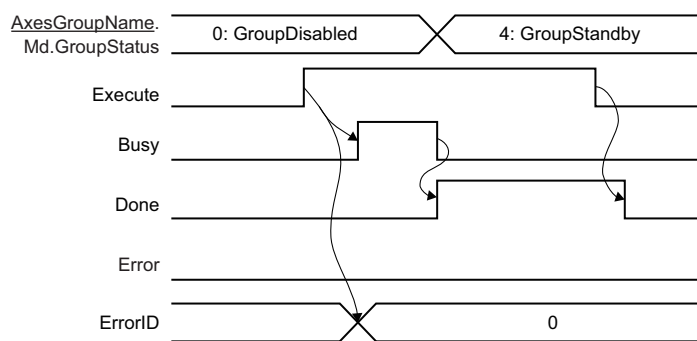
Control details

Specify Axes Group Information (AxesGroup) and change Axes Group Status (AxesGroupName.Md.GroupStatus) into the "4: Standby (GroupStandby)" status.

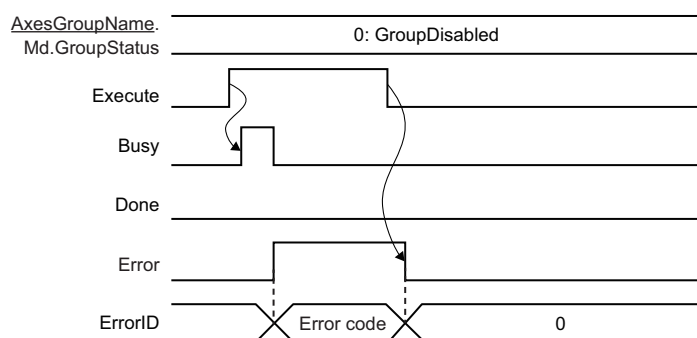
- The axes group can start the motion FB only when Axes Group Status (AxesGroupName.Md.GroupStatus) is the "4: Standby (GroupStandby)" status.
- MC_GroupEnable (Axes Group Enabled) can be executed only when Axis Status (AxisName.Md.AxisStatus) of all configuration axes is the "4: Standby (Standstill)" or the "0: Axis disabled (Disabled)" status.
- When Axes Group Status (AxesGroupName.Md.GroupStatus) changes to the "4: Standby (GroupStandby)", Using Axes Group (AxisName.Md.UseInGroup) of the configuration axis becomes TRUE.
- When MC_GroupEnable (Axes Group Enabled) is executed by specifying another axes group including the configuration axis which Using Axes Group (AxisName.Md.UseInGroup) is TRUE, the error "Axes Group Configuration Axis Is in Use" (error code: 3496H) occurs.
- If the error occurs in any of the configuration axis, Axes Group Status (AxesGroupName.Md.GroupStatus) will be "1: Stopping on error (GroupErrorStop)".
- When MC_GroupEnable (Axes Group Enabled) is executed for an axes group that has already been enabled, Execution completion (Done) becomes TRUE and the execution ends.

■Timing chart

[When the operation is normally completed]



[When an error occurs]



■Details of setting items

- Execution completion (Done)

It becomes TRUE when Axes Group Status (AxesGroupName.Md.GroupStatus) transits to "4: Standby (GroupStandby)".

- Executing (Busy)

It becomes TRUE while the FB is executed. It becomes FALSE after Axes Group Status (AxesGroupName.Md.GroupStatus) transits to "4: Standby (GroupStandby)".

- Error (Error)

It becomes TRUE when an error occurs in the FB.

- Error code (ErrorID)

It returns the error code occurred in the 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 only be executed when Axis Status (AxisName.Md.AxisStatus) of all structuring axes is "4: Standby (Standstill)" or "0: Axis disabled (Disabled)".

Axes group disabled

This section describes disabling an axes group.

Control details

Axes Group Status (AxesGroupName.Md.GroupStatus) can be changed to "0: Axes group disabled (GroupDisabled)" by specifying Axes Group Information (AxesGroup).

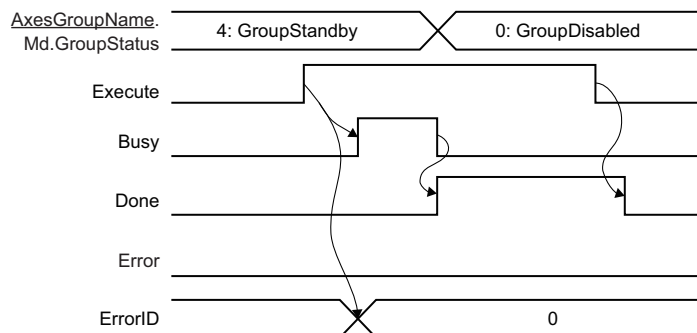
- An axes group cannot execute the motion FB when Axes Group Status (AxesGroupName.Md.GroupStatus) is the "0: Axes group disabled (GroupDisabled)" status.
- MC_GroupDisable (Axes Group Disabled) can only be executed when Axes Group Status (AxesGroupName.Md.GroupStatus) is "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)". When executing this FB while Axes Group Status is "1: Stopping on error (GroupErrorStop)" and the axes group is in operation, the axes group status transits to "0: Axes group disabled (GroupDisabled)" after the stop completes. When this FB is executed while Axes Group Status (AxesGroupName.Md.GroupStatus) is other than "4: Standby (GroupStandby)" or "1: Stopping on error (GroupErrorStop)", the error "Axes Group Status Incorrect (When Axes Group is Disabled)" (error code: 1A97H) occurs. The positioning control FB stops. For details on stop processing, refer to the following.

Page 165 Stop

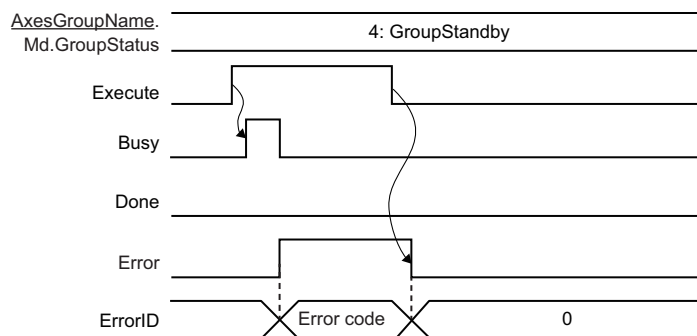
- When Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "0: Axes group disabled (GroupDisabled)", Using axes group (AxisName.Md.UseInGroup) of the configuration axis becomes FALSE.
- When MC_GroupDisable (Axes Group Disabled) is executed for an axes group that has already been disabled, Execution completion (Done) becomes TRUE and the execution ends.

Timing chart

[When the operation is normally completed]



[When an error occurs]



■Details of setting items

- Execution completion (Done)

It becomes TRUE when Axes Group Status (AxesGroupName.Md.GroupStatus) transits to "0: Axes group disabled (GroupDisabled)".

- Executing (Busy)

It becomes TRUE while the FB is executed. It becomes FALSE after Axes Group Status (AxesGroupName.Md.GroupStatus) transits to "0: Axes group disabled (GroupDisabled)".

- Error (Error)

It becomes TRUE when an error occurs in this FB.

- ErrorID (Error code)

It returns the error code occurred in the FB.

Precautions

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

Precautions

If the parameter error occurs at axes group variable initialization, the error "Out of Parameter Range (Axes Group)" (error code: 1D81H) occurs. In this case, Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "-1: Axis variable uninitialization/Axis parameter error (Invalid)". Refreshing of the monitor data, etc. is not executed for axes groups whose status is "-1: Axis variable uninitialization/Axis parameter error (Invalid)". If the axes group is specified by the user program, the error "Out of Axes Group No. Range" (error code: 3402H) occurs.

Relevant add-ons

The following add-on is required to use this function.

- Axis
- MotionEngine
- MotionControl_General

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

1.5 Axes Group Assignment

Axes groups can be set in the engineering tool. For the setting method, refer to Help of the engineering tool.
Based on parameter settings of the axes group, the instance of the axes group is initialized when the power turns ON or when the PLC READY [Y0] turns ON.

Relevant variables

Variable/Structure name	Name	Details
<u>AxesGroupName.AxesGroupRef.</u>		
GroupNo	Axes Group No.	Sets the axes group No. 0: No setting 1 to 10000: Setting axes group No.
<u>AxesGroupName.Pr.</u>		
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (<u>AxisName.AxisRef</u>) which configures the axes group.
<u>AxesGroupName.Md.</u>		
NumberOfAxes	Number of Configuration Axes	Indicates the number of configuration axes of the axes group.
GroupName	Axes Group Name	Stores the axes group name.
Axis[1..16]	Configuration Axis	Stores Axis No. (AxisNo) of Axis Information (<u>AxisName.AxisRef</u>) 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 Configuration Axis (AxesGroupName.Pr.Axis[1..16]).

Set the AxisName.AxesRef structure of the axis variable for the configuration axes.

Set the configuration axes of the maximum 16 axes in the left-justified format from the configuration axis 1.

The error "No axis" (error code: 1A99H) and the error "Axes Group Configuration Axis Operation Cycle Incorrect" (error code: 1A59H) occur 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]

Memory usage

Memory usage for the axes group is 60 [K bytes] per an axes group.

The memory capacity for axis data is specified by Maximum RAM Size (System.PrConst.Addon_Axis.RamSizeMax).

When the axis data memory usage exceeds the capacity at initializing the axes group variable, the error "Maximum Number of Registrations for Axes Group Over" (error code: 1A60H) occurs and the axes group is not generated. Check the memory capacity and execute the software reboot.

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.

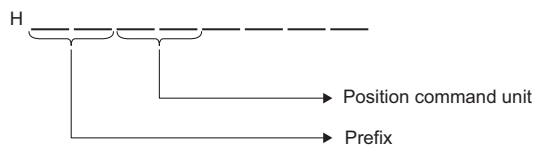
Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Pr.</u> <u>AxesGroupName.Pr.</u>		
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 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).
<u>AxisName.Md.</u> <u>AxesGroupName.Md.</u>		
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.

Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position)



■ Setting value of the position command unit

Setting value	Position command unit
H00	pulse
H01	m
H41	degree
HB4	Revolution
HC0	inch
HFF	An arbitrary unit character string ^{*1}

^{*1} For setting an arbitrary unit character string, set Position Command Unit String (AxisName(AxesGroupName).Pr.Unit_PositionString).

■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.

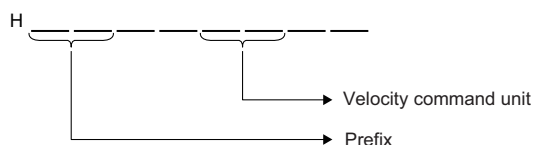
Setting value of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) and display examples of Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay)

Position Command Unit (<u>AxisName(AxesGroupName).Pr.Unit_Position</u>)	Position Command Unit Display (<u>AxisName(AxesGroupName).Md.Unit_PositionDisplay</u>)
H00010000	m
HFD010000	mm
HFA010000	μ m
HF7010000	nm
H00B40000	Revolution
H00410000	degree
HFA410000	$\times 10^{-6}$ degree
H00000000	pulse
H00C00000	inch

Point

If "1" is set in the program when Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) is HFD010000, the position will be regarded as 1.0 mm.

Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity)



■Setting value of the velocity command unit

Setting value	Velocity command unit
H03	s
H47	min

■Setting value of 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 Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) and display examples of Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)

Velocity Command Unit (<u>AxisName(AxesGroupName).Pr.Unit_Velocity</u>)	Velocity Command Unit Display (<u>AxisName(AxesGroupName).Md.Unit_VelocityDisplay</u>)
H00004700	[Position command unit]/min
HFD000300	[Position command unit]/ms
HFA000300	[Position command unit]/ μ s
HF7000300	[Position command unit]/ns

Point

If Position Command Unit (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 Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay).

If "1" is set in the program when Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) is HFD000300, the velocity will be regarded as 1.0 [position command unit]/ms.

Ex.

Setting value of Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position), Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) and display example of Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay)

Position Command Unit (<u>AxisName(AxesGroupName).Pr.Unit_Position</u>)	Velocity Command Unit (<u>AxisName(AxesGroupName).Pr.Unit_Velocity</u>)	Velocity Command Unit Display (<u>AxisName(AxesGroupName).Md.Unit_VelocityDisplay</u>)
HFD010000	HFD000300	[mm/ms]

Combination of command units during multiple axes positioning control

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

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

- For the input (Target position (Position), Movement amount (Distance), etc.) regarding position in multiple axes positioning control, specify the value based on the position command unit of the each interpolation axes necessarily. For details, refer to the following.

☞ Page 274 Target position (Position)/Movement amount (Distance)

- For the input (Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk)) in multiple axes positioning control, specify the value based on the velocity command unit used for each control necessarily. For details, refer to the following.

☞ Page 274 Velocity (Velocity)

Velocity command units used for each control are shown below.

The following operations depend on interpolation controls.

■Linear interpolation control (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control), MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))

VelocityMode	Operation
0: Vector Velocity (VectorSpeed)	• The movement amount on the linear path (combined movement amount) is calculated from the value of current position and Target position (Position) or Movement amount (Distance). The position command unit of the axes group and the interpolation axes is not affected. • Unit of the axes group is used for the velocity command unit in controlling.
1: Long Axis Velocity (LongAxisSpeed)	• The axis whose movement amount value is the largest is regarded as the long axis from the value of current position and Target position (Position) or Movement amount (Distance). The position command unit of the axes group and the interpolation axes is not affected. • The unit of the long axis is used for the velocity command unit in controlling. Unit of the axes group is not used.
2: Reference Axis Velocity (ReferenceAxisSpeed)	The unit of the reference axis (First element of Linear interpolation axes (LinearAxes)) is used for the velocity command unit in controlling.

For details, refer to the following.

☞ Page 268 Linear interpolation control

■ Circular interpolation control (MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control), MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control))

- Calculates circular path from the value of current position, Sub point (AuxPoint), and End point (EndPoint). The position command unit of the axes group and the the configuration axes is not affected.
- The unit of the axes group is used for the velocity command unit in controlling.

For details, refer to the following.

☞ Page 277 Circular interpolation control

- When the combination of the position command unit between the axes group and the interpolation axes 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 velocity command unit and the FB being executed at multiple start, the warning "Velocity Command Unit Mismatch Warning" (warning code: 0D1EH) will occur at multiple start.

Ex.

Operation when axes group unit and interpolation axes unit are mismatched

The following shows the operation example when the position/velocity command units of the configuration axis 1 and 2, and axes group in linear interpolation control are different.

- Axis setting and Axes group setting

Setting item	Setting details	Setting value
Position/Velocity command unit of the axes group	mm/ms	Position Command Unit (AxesGroupName.Pr.Unit_Position): HFD010000 Velocity Command Unit (AxesGroupName.Pr.Unit_Velocity): HFD000300
Position/Velocity command unit of the configuration axis 1	mm/s	Position Command Unit (AxisName.Pr.Unit_Position): HFD010000 Velocity Command Unit (AxisName.Pr.Unit_Velocity): H00000300
Position/Velocity command unit of the configuration axis 2	degree/min	Position Command Unit (AxisName.Pr.Unit_Position): H00410000 Velocity Command Unit (AxisName.Pr.Unit_Velocity): H00004700

- FB input (MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control))

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Movement amount (Distance[0])	300
Movement amount (Distance[1])	400
Velocity (Velocity)	1000
Velocity Mode (VelocityMode)	0: Vector Velocity (VectorSpeed)

- Operation

Linear interpolation is performed by Movement amount (Distance) 300 [mm] of the configuration axis 1, and 400 [degree] of the configuration axis 2.

Position and velocity command units of axes group are used for the unit of Velocity (Velocity) as a vector velocity.

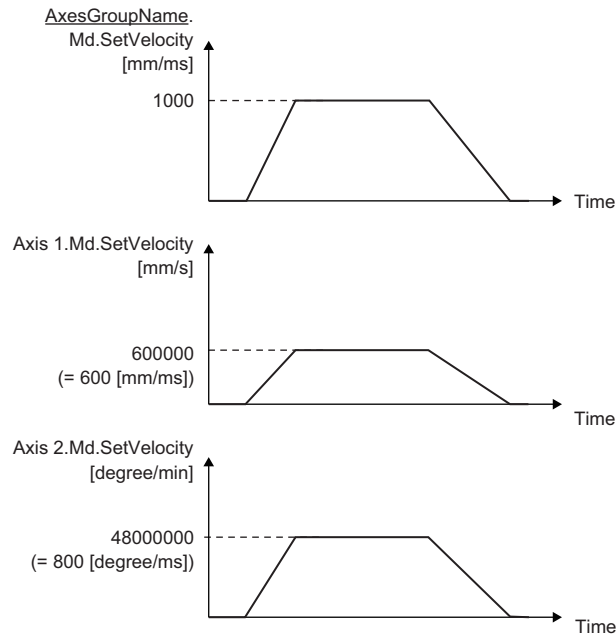
It will be controlled by the vector velocity at 1000 [mm/ms].

The motion system calculates a combined movement amount $\sqrt{(300^2 + 400^2)} = 500$ [mm] from each value of the configuration axis movement amount. Each axis movement amount of every operation cycle is calculated from the combined movement amount 500 [mm] and vector velocity 1000 [mm/s]. The calculated amount is commanded as a movement amount in the position command unit of each axis.

The motion system calculates positioning speed of each axis such as follow.

Positioning speed of each axis	Calculated value
Positioning speed of configuration axis 1	$1000 \times 300 / 500 = 600$ [mm/ms] (= 600000 [mm/s])
Positioning speed of configuration axis 2	$1000 \times 400 / 500 = 800$ [degree/ms] (= 48000000 [degree/min])

A monitor value of each axis speed is stored by the velocity command unit of each axis.



Precautions

- When the parameter is out of the range, the initial value is stored in Position Command Unit Display (AxisName(AxesGroupName).Md.Unit_PositionDisplay) and Velocity Command Unit Display (AxisName(AxesGroupName).Md.Unit_VelocityDisplay). (the default value of position command unit: pulse, velocity command unit: pulse/s)
- Even if Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position), Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) and Position Command Unit String (AxisName(AxesGroupName).Pr.Unit_PositionString) are changed, the homing request will not become TRUE.
- 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 " $-10000000000.0 \leq \text{positioning range} < 10000000000.0$ ". The range of Set Position (AxisName.Md.SetPosition) is determined by Ring Counter Upper Limit Value (AxisName.PrConst.RingCount_UpperValue) and Ring Counter Lower Limit Value (AxisName.PrConst.RingCount_LowerValue).

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName</u> .PrConst.		
RingCount_Enable	Ring Counter Enabled Selection	Selects the ring counter enable/disable. 0: Disabled ^{*3} 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
<u>AxisName</u> .Md.		
SetPosition	Set Position	Stores the current position address. ^{*2} • The set position is a value which the cumulative current value is rounded with the ring counter range.
CumulativePosition	Cumulative Current Position	Stores the current position address. • When the current position is changed, the address is changed to the current position change value. • The ring address is " $-10000000000.0 \leq \text{CumulativePosition} < 10000000000.0$ ".
FeedMachinePosition	Machine Feed Value	Stores the current position address by the machine coordinate. • The accumulative value from the homing completed position is set. • The address is not changed even if the current position is changed. • The ring address is " $-10000000000.0 \leq \text{Machine feed value} < 10000000000.0$ ".
CommandedPosition	Commanded Position	Stores Target position (Position)/Movement amount (Distance) imported to the positioning FB being controlled. • Stores "0" after the positioning is completed.
ActualPosition	Actual Position	Stores the actual current position. • The value of "the current position $\times$ driver unit conversion denominator / numerator" is set. For details, refer to the following.  Page 402 Driver unit conversion function • The actual position is a value which is rounded with the ring counter range.

*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.

*3 Positioning range is " $-10000000000.0 \leq \text{positioning range} < 10000000000.0$ ".

Set position

Set Position (AxisName.Md.SetPosition) can be set to an arbitrary ring address by setting Ring Counter Upper Limit Value (AxisName.PrConst.RingCount_UpperValue) and Ring Counter Lower Limit Value (AxisName.PrConst.RingCount_LowerValue). The ring counter upper/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 (Relative Value Positioning) is executed repeatedly, it may cumulative the truncation error between the set position and the specified movement value.

If the truncation error is a problem, execute the positioning of absolute position specification such as MC_MoveAbsolute (Absolute Value Positioning).

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 on the setting method, refer to the following.

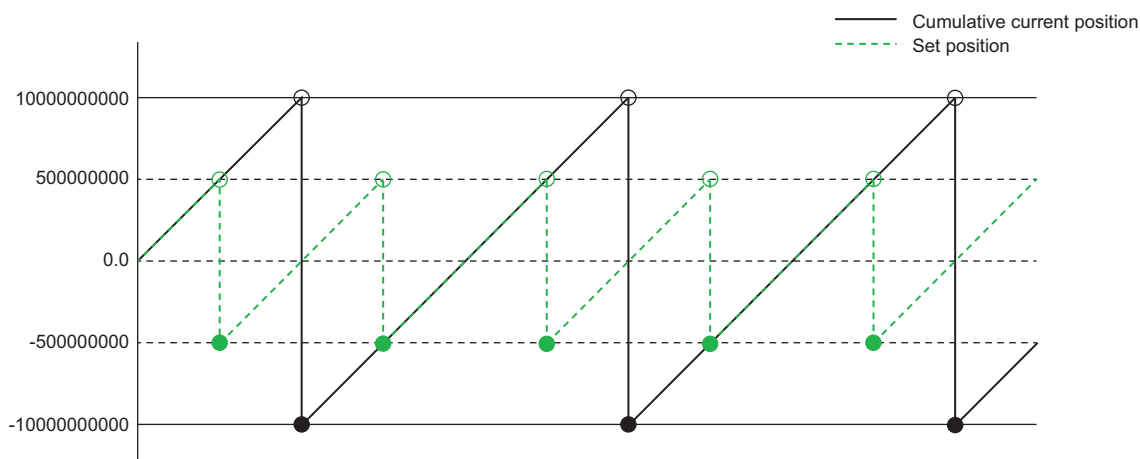
 Page 79 Technical Units

Control details

Set Position (AxisName.Md.SetPosition) to be the ring address is calculated based on Cumulative Current Position (AxisName.Md.CumulativePosition). The cumulative current position will be the ring address of " $-10000000000.0 \leq$ 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 " $-500000000.0 \leq$ set position < 500000000.0 ".



The ring counter upper/lower limit value is fetched to the parameter at the timing when the axis is enabled.

Combination with other functions

The available range of positioning differs depending on the type of the positioning control FB.

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

Precautions

When Ring Counter Enabled Selection (AxisName.PrConst.RingCount_Enable) is "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
<u>AxisName.Md.</u>		
SetVelocity	Set Velocity	- Stores the set output velocity.*¹ - This velocity is calculated from the difference of the set position. The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction). - Stores the set velocity of the configuration axis during the axes group operation.*¹
CommandedVelocity	Commanded Velocity	- Stores commanded velocity imported to the motion FB being controlled. - Stores "0.0" after the control is completed. - Stores "0.0" in Commanded Velocity (<u>AxisName.Md.CommandedVelocity</u>) of the configuration axis during the axes group operation.
TargetVelocity	Target Velocity	- Stores the actual target velocity whose override and velocity limit value are considered. [For the positioning control FB] The value becomes more than "0.0" regardless of the movement direction. [For other than the positioning control FB] The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction) - Stores "0.0" after the control is completed. - Stores "0.0" in Target Velocity (<u>AxisName.Md.TargetVelocity</u>) of the configuration axis during axes group operation.
ActualVelocity	Actual Velocity	Stores the actual velocity This velocity is calculated from the difference of the actual position. The value is positive when moving to the positive direction (Address increase direction), and the value is negative when moving to the negative direction (Address decrease direction).
<u>AxesGroupName.Md.</u>		
SetVelocity	Set Velocity	- Stores the set output velocity during the axes group operation. - The value becomes more than "0.0" as it is regardless of the movement direction of the configuration axes.*² - Stores "0.0" after the control is completed.
CommandedVelocity	Commanded Velocity	- Stores the commanded velocity imported to the motion FB being controlled.*³ - Stores "0.0" after the control is completed.
TargetVelocity	Target Velocity	- Stores the actual target velocity whose override and velocity limit value are considered.*⁴ - The value becomes more than "0.0" regardless of the movement direction of the configuration axis. - Stores "0.0" after the control is completed.
ActualVelocity	Actual Velocity	- Stores the actual velocity. It is the vector velocity of the actual velocity of the configuration axes. The value becomes more than "0.0" as it is regardless of the movement direction of the configuration axes. - Stores "0.0" when the axes group is invalid.

*¹ The stored value includes an error because a floating-point error occurs.

*² When "1: Long Axis Velocity (LongAxisSpeed)" or 2: Reference Axis Velocity (ReferenceAxisSpeed) is specified in the linear interpolation control, stores the absolute value of set velocity of the relevant axis.

*³ When "1: Long Axis Velocity (LongAxisSpeed)" or 2: Reference Axis Velocity (ReferenceAxisSpeed) is specified on Velocity mode (VelocityMode) in the linear interpolation control, stores the commanded velocity of relevant axis.

*⁴ When "1: Long Axis Velocity (LongAxisSpeed)" or 2: Reference Axis Velocity (ReferenceAxisSpeed) is specified on Velocity mode (VelocityMode) in the linear interpolation control, stores the target velocity of relevant axis.

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

 Page 268 Linear interpolation control

Velocity set range

The set velocity in the motion system is as follow.

Name	Description	Range
Commanded velocity	Set velocity that is specified in the motion FB.	0, ± 0.0001 to ± 2500000000.0
Target velocity	The actual set velocity whose override and velocity limit value are considered with the commanded velocity.	

- For the valid range of the commanded velocity of each motion FB, refer to the each FB specifications.
- The operation that the target velocity be out of the range because of using override function, refer to the following.
 Page 380 Override Function
- When 0 is set to the commanded velocity in the FB to execute multiple start, the commanded velocity of previous FB will be set. For details, refer to the following.
 Page 134 Multiple Start (Buffer Mode)
- To perform floating-point operation, the lower limit value of the commanded velocity is limited by the following restrictions.
 If the speed that is converted from commanded velocity to operation cycle is less than 0.00001, the error "Out of Operation Cycle Converted Velocity Range" (error code: 1AE4H) (when changing the velocity, the warning "Out of Operation Cycle Converted Velocity Range Warning" (warning code: 0D2FH)) occurs.
 To improve the precision of floating-point operation, specify the speed that is converted into operation cycle so as not to be less than 0.00001 by changing Position Command Unit (AxisName(AxesGroupName).Pr.Unit_Position) or Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity).

Ex.

When the commanded velocity and units are set as follows with operation cycle 0.5 [ms], the error "Out of Operation Cycle Converted Velocity Range" (error code: 1AE4H) occurs.

Position command unit: 1×10^0 [pulse] (AxisName(AxesGroupName).Pr.Unit_Position = H00000000),

Velocity command unit: 1×10^0 [pulse/s] (AxisName(AxesGroupName).Pr.Unit_Velocity = H00000300),

Commanded velocity: 0.0001

Calculation Cycle Converted Speed = $0.0001 \text{ [pulse/s]} \div 1000 \times 0.5 \text{ [ms]} = 0.00000005 \text{ [pulse]} \dots$ the error occurs

The error can be avoided by changing the position command unit from [pulse] to $\times 10^{-3}$ [pulse], and changing the commanded velocity following the change of the position command unit.

Position command unit: 1×10^{-3} [pulse] (AxisName(AxesGroupName).Pr.Unit_Position = HFD000000),

Velocity command unit: 1×10^0 [pulse/s] (AxisName(AxesGroupName).Pr.Unit_Velocity = H00000300),

Commanded velocity: 0.1

Calculation Cycle Converted Speed: $= 0.1 \times 10^{-3} \text{ [pulse/s]} \div 1000 \times 0.5 \text{ [ms]} = 0.00005 \times 10^{-3} \text{ [pulse]}$

Precautions

When $0 < \text{velocity after velocity override} < 0.0001$, the warning "Out of Velocity Range Clamping Warning" (warning code: 0D34H) occurs and becomes 0.

2.4 Servo ON/OFF

Relevant variables

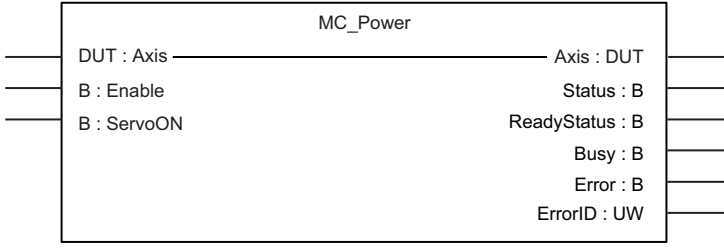
This function executes servo ON/OFF of the real axis connected to the motion system.

The servo ON enables the operation of the real axis.

Variable/Structure name	Name	Details
<u>AxisName</u> .Md.		
Driver_ReadyOn	Driver Ready On Status	Becomes TRUE when Driver Status (<u>AxisName</u> .Md.Driver_State) of the connected driver is as follows. 5: Switched On (SwitchedOn) 6: Operation Enable (OperationEnable) 7: Quick Stop Active (QuickStopActive)
Driver_ServoOn	Driver Servo On Status	Becomes TRUE when Driver Status (<u>AxisName</u> .Md.Driver_State) of the connected driver is as follows. 6: Operation Enable (OperationEnable) 7: Quick Stop Active (QuickStopActive)

Relevant FBs

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 (Enable) and the Servo ON request (ServoON) are TRUE, the selected axis is switched to the operation possible status.

Executing (Busy) becomes TRUE when the processing is started.

Operable (Status) becomes TRUE when the drive unit has been switched to the operation possible status.

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

For details on error codes, refer to the following.

📖 Page 711 List of Error Codes

Axis Status (AxisName.Md.AxisStatus) of the AXIS_MONI structure transits from "0: Axis disabled (Disabled)" to "4: Standby (Standstill)".

For Axis Status (AxisName.Md.AxisStatus), refer to the following.

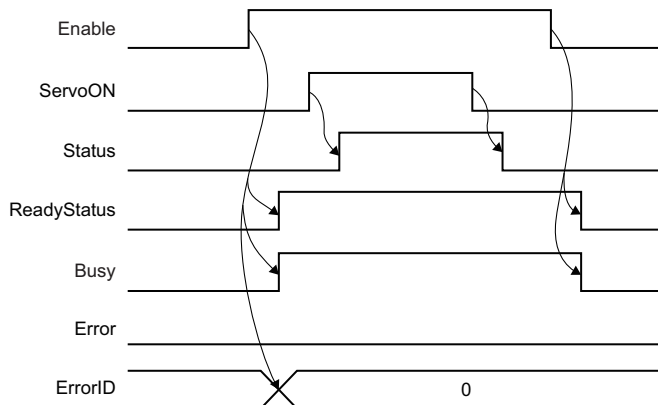
📖 Page 39 Axis status

■Restrictions

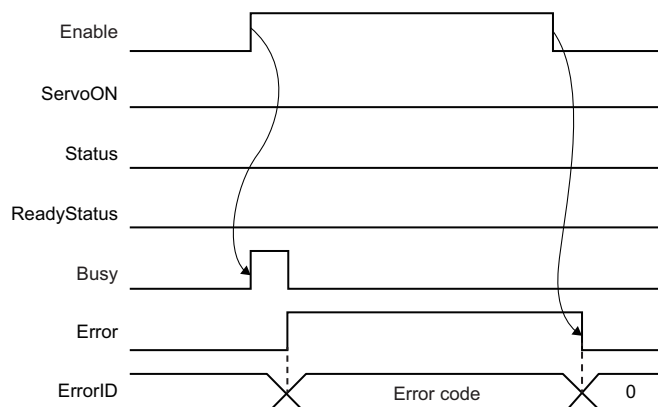
Before executing this FB, set Axis No. (AxisNo) of the AXIS_REF structure.

■Timing chart

[When the FB is normally completed]



[When an error occurs]



■I/O variable

Input import ☐: Always

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Axis information	Axis	AXIS_REF	☐	—	Omission not possible	Page 754 Axis variables For MC_Power (Operation Available), the axis information is established when the command is called for the first time after switching to the PLC READY [Y0] ON.

■Input variables

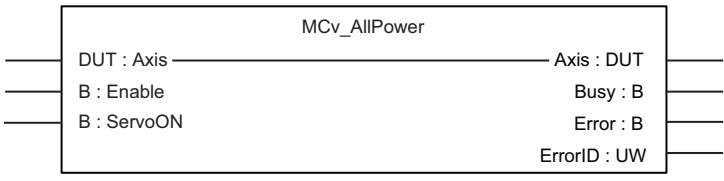
Import ☐: Always

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	☐	TRUE, FALSE	FALSE	While Enable (Enable) 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)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 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 (Enable) and the Servo ON request (ServoON) are TRUE, every axis is switched to the operation possible status.

Executing (Busy) becomes TRUE when the processing is started.

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

For details on error codes, refer to the following.

 Page 684 TROUBLESHOOTING

■Restrictions

For the axis specifying MC_Power (Operation Available), the command of MC_Power (Operation Available)] is given priority at switching to operable status.

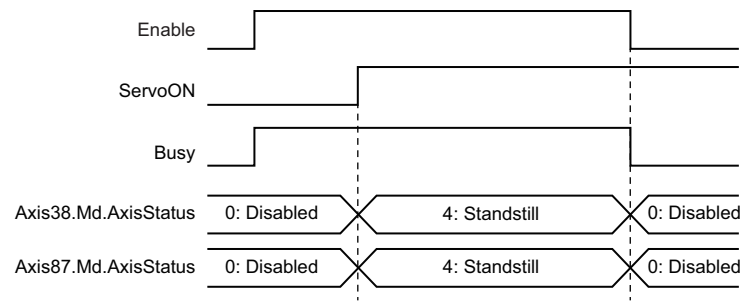
When used on the Motion module side, ignores the setting of Axis Information (Axis). When used on the CPU module side, sets the I/O No. in I/O No. (StartIO) of Axis Information (Axis). For specifying the I/O No., refer to the following.

 Page 32 Specification of I/O No.

Timing chart

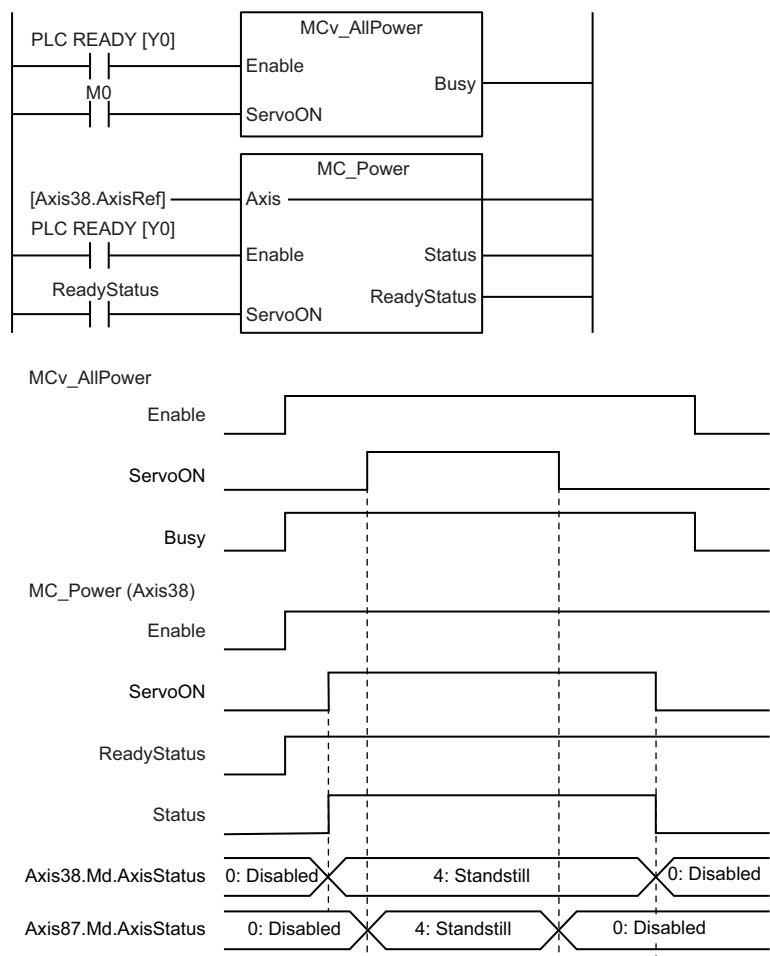
Ex.

When the axis 38 and 87 are set as real axes



Ex.

When MC_Power (Operation Available) 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	Omission is possible when the FB is used in the motion system side. Ignores the setting value. Set I/O No. (StartIO) when the FB is used in the CPU module side. Ignores Axis No. (AxisNo).

■Input variables

Import: □: Always

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Enable	Enable	BOOL	□	TRUE, FALSE	FALSE	While Enable (Enable) 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)	0	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 96 Control details

■MC_Power (Operation Available) 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 (Enable) and Servo ON request (ServoON) of MC_Power (Operation Available).

Input variables		Output variables		Servo ON/OFF status	Driver Status (AxisName.Md.Driver_State)
Enable (Enable)	Servo ON request (ServoON)	Ready ON status (ReadyStatus)	Operable (Status)		
TRUE	TRUE	TRUE	TRUE	Servo ON	6: Operation Enable (OperationEnable)
	FALSE	TRUE	FALSE	Servo OFF	5: Switched On (SwitchedOn)
FALSE	TRUE	FALSE	FALSE	Servo OFF	3: Switch On Disabled (SwitchOnDisabled)
	FALSE	FALSE	FALSE	Servo OFF	3: Switch On Disabled (SwitchOnDisabled)

- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during the servo OFF status depends on the driver device specification.
- While the drive unit error occurs, Enable (Enable) and Servo ON request (ServoON) are not required to be turned from FALSE to TRUE again since MC_Power (Operation Available) has been sent to the driver.

■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 (Enable) and Servo ON request (ServoON) of MCv_AllPower (All Axes Operation Available).

Input variables		Servo ON/OFF status	Driver Status (AxisName.Md.Driver_State)
Enable (Enable)	Servo ON request (ServoON)		
TRUE	TRUE	Servo ON	6: Operation Enable (OperationEnable)
	FALSE	Servo OFF	5: Switched On (SwitchedOn)
FALSE	TRUE	Servo OFF	3: Switch On Disabled (SwitchOnDisabled)
	FALSE	Servo OFF	3: Switch On Disabled (SwitchOnDisabled)

- If the real axis is rotated by external force during the servo OFF status, follow up processing is performed.
- The servo ON/OFF control can be operated regardless of the control mode. The control mode during the servo OFF status depends on the driver device specification.
- While the drive unit error occurs, since MCv_AllPower (All Axes Operation Available) has been sent to the driver, Enable (Enable) and Servo ON request (ServoON) are not required to be turned from FALSE to TRUE again.

Point

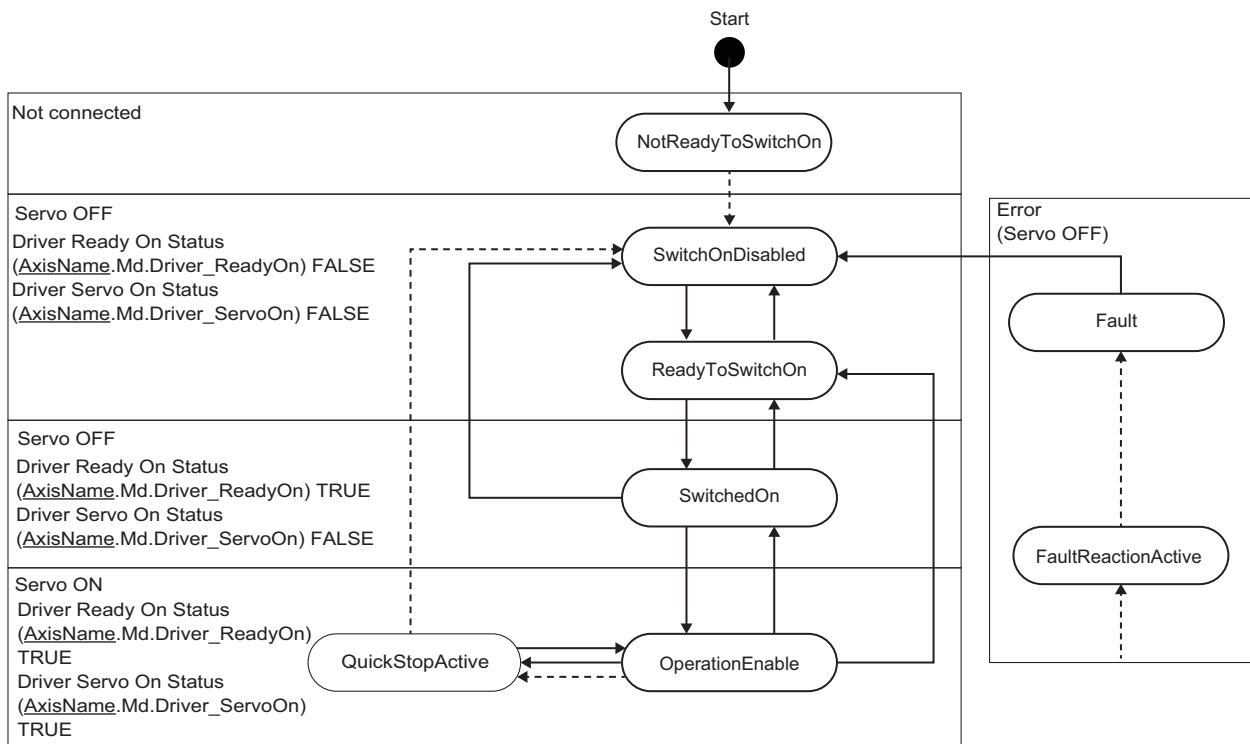
To individually execute servo OFF when using MCv_AllPower (All Axes Operation Available), use MC_Power (Operation Available) together. When MCv_AllPower (Operation Available) and MC_Power (All Axes Operation Available) are used together, the command of MC_Power (Operation Available) is given priority.

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 Driver Status (AxisName.Md.Driver_State).

For details on operation in each status, refer to the connected driver device specification.



Precautions

- When MC_Power (Operation Available) calls the instruction first after the PLC READY [Y0] is switched to ON, the axis information is determined. Even if the axis information is changed while Enable (Enable) is FALSE, the change is not reflected.
- Do not set two or more MC_Power (Operation Available) for one axis. The operation is not guaranteed if those are set.
- If MC_Power (Operation Available) is executed to the virtual axis, both Operable (Status) and Ready ON status (ReadyStatus) become TRUE regardless of the input of Servo ON request (ServoON).
- The servo ON/OFF status when stopping the program is maintained while the ready [X0] is OFF

2.5 Follow Up

Follow up is the function to reflect the input (current position) from the slave device to the set position of the axis.

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 (Speed Control)/MC_TorqueControl (Torque Control) 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.

Operation of this function for each system status

○: Possible, ×: Not possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
Encoder_CounterDisableSignal	Counter Disabling Signal	A signal to switch to the counter disable. Only "0: Detection at TRUE" or "0: Detection at FALSE" can be select for Signal Detection Method (Detection). Only "0 [s]" can be specified for Compensation Time (CompensationTime). 0.0 to 5.0 [s] can be specified for Filter Time (FilterTime). If another method is selected, the error "Out of Parameter Range (Axis)" (error code: 1D80H) will occur.
<u>AxisName.Md.</u>		
FollowupDisable	Follow-up Disabled	Displays the follow up disable status. When it is disabled, the follow up is not executed. FALSE: Follow up enabled TRUE: Follow up disabled
Encoder_CounterDisable	Counter Disabled	Becomes TRUE while disabling the input from the synchronous encoder. FALSE: Counter enabled TRUE: Counter disabled
Io_PosActualValue	Object Data_PosActualValue	Follow up can be used in the axis which has this slave object.
<u>AxisName.Cd.</u>		
FollowupDisable	Follow-up 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

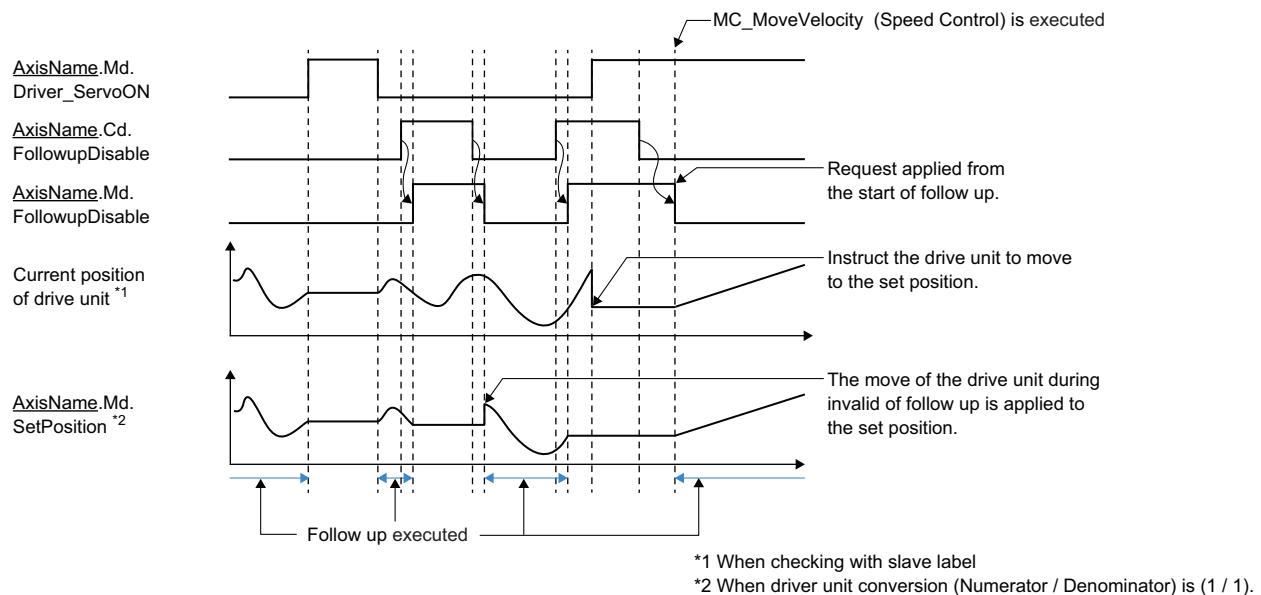
The follow up enabled/disabled can be switched for each axis (default status: enabled). Input from the slave device (the current position) is disabled and not reflected in the set position by switching the follow up to enabled.

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.

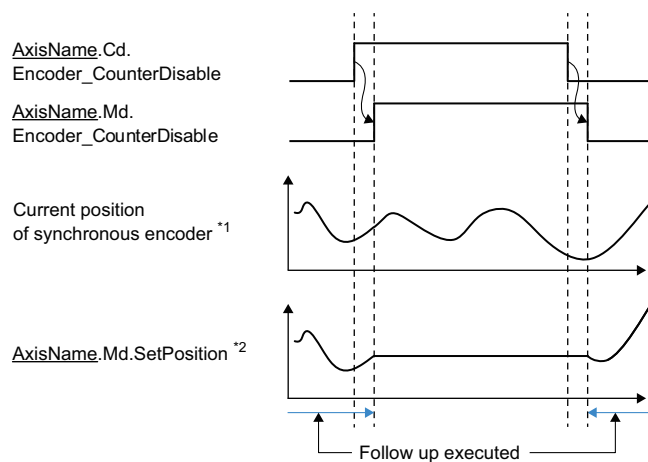
For real drive axis

Follow-up Disabled (AxisName.Md.FollowupDisable) becomes TRUE by setting Follow-up Disabled (AxisName.Cd.FollowupDisable) to TRUE, and the follow up is disabled.



For real encoder axis/virtual encoder axis

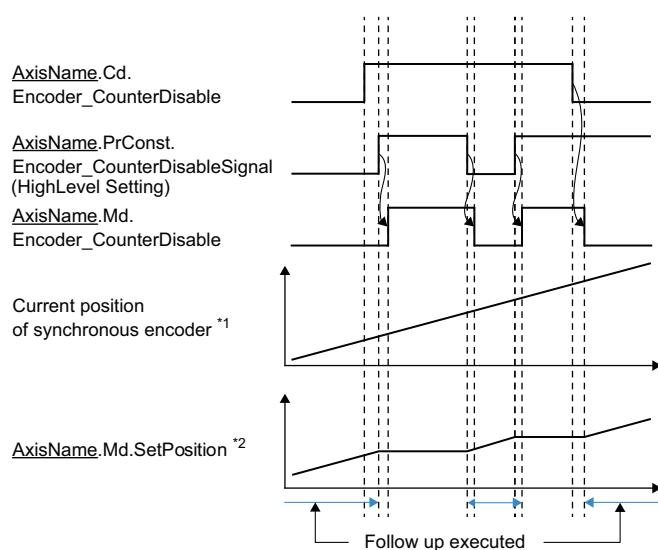
If Counter Disabling Signal (AxisName.PrConst.Encoder_CounterDisableSignal) is "no setting", Counter Disabled (AxisName.Md.Encoder_CounterDisable) becomes TRUE by setting Counter Disabled (AxisName.Cd.Encoder_CounterDisable) to TRUE and the input from the synchronous encoder will be disabled.



*1 When checking with the slave label

*2 When driver unit conversion (Numerator / Denominator) is (1 / 1).

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



*1 When checking with the 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.

[For all axes types]

- When the movement amount of every operation cycle exceeds the following range, the follow-up does not operate normally because of the movement amount of axis are different with the movement amount of slave device. Use the slave devices so that their movement amount is within the following range.

Axis type	Valid range for available follow-up per operation cycle
Real drive axis	(Movement amount per operation cycle) [Driver unit] within signed 32bit integral number range
Real encoder axis (Real encoder axis type: via drive unit)	$-\left(\left(\text{Multiple revolution counter maximum value}\right) / 2 \times \left(\text{Encoder resolution}\right)\right) \leq \left(\text{Movement amount per operation cycle}\right) [\text{Encoder pulse unit}] \leq \left(\left(\text{Multiple revolution counter maximum value}\right) / 2 \times \left(\text{Encoder resolution}\right) - 1\right)$
Virtual encoder axis	$-\left(\text{Encoder ring counter upper limit value} - \text{Encoder ring counter lower limit value} + 1\right) / 2 < \left(\text{Movement amount per operation cycle}\right) [\text{Encoder pulse unit}] < \left(\text{Encoder ring counter upper limit value} - \text{Encoder ring counter lower limit value} + 1\right) / 2$

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 108 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 103 Current position restoration

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
PosRestoration_AbsPosEnable	Absolute Position Control Setting	Sets the absolute position control setting. 0: Disable Absolute Position System (ABSDisabled) 1: Enable Absolute Position System (Enabled) -1: Automatic Setting (Acquire from Connected Device) (Auto)
PosRestoration_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: Machine Feed Value (FeedMachinePosition)
<u>AxisName.Pr.</u>		
Homing_Required	Homing Required or Not	Sets FALSE when the homing is not required. If FALSE is set, the homing request will not become TRUE at the current position restoration. FALSE: Homing Not Required TRUE: Homing Required
<u>AxisName.Md.</u>		
Homing_Required	Homing Required or Not	Displays whether the axis requires the homing or not. If FALSE is set, the homing request will not become TRUE at the current position restoration. FALSE: Homing Not Required TRUE: Homing Required
PosRestoration_Status	Current Position Restoration Status	Displays the current position restoration status. 0: Not Executed (NotExecute) 1: Waiting for Restoration Request (WaitingRequest) 2: Restoration Completed in Incremental System (RestoredInIncSystem) 3: Restoration Completed in Absolute Position System (Homing Uncompleted) (RestoredInAbsSystemUnHomed) 4: Restoration Completed in Absolute Position System (RestoredInAbsSystem) "0: Not Executed (NotExecute)" is displayed when the slave device is disconnected.
Homing_Request	Homing Request	The timing of becoming TRUE differs depending on the absolute position control setting. For details, refer to the following.  Page 105 Homing request Becomes 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	Machine Feed Value	Stores the current position address by the machine coordinate. • It is the cumulative current value from the homing completed position. • The address is not change even though the current position is changed.
<u>System.Md.</u>		
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
<u>System.Cd.</u>		
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
Disable absolute position system	0: ABSDisabled	☞ Page 103 Incremental system
Enable absolute position system	1: Enabled	☞ Page 104 Absolute position system
Automatic setting (Acquire from connected device)	-1: Auto	☞ Page 104 Connected device setting

"-1: Automatic Setting (Acquire from Connected Device) (Auto)" can be set when the connected device has the ENCODER_ABS_STATUS object.

When "-1: Automatic Setting (Acquire from Connected Device) (Auto)" is not set, the connected device side setting and the motion system side setting must be matched. 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 Control 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: Enable Absolute Position System (Enabled)" for Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) 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 108 Current position restoration for each axis type



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 machine feed value) becomes "0", and the homing request becomes TRUE. (The set position may not become "0" depending on the ring counter setting. (☞ Page 85 Positioning Range))

When restoration is completed, the axis current position restoration status is "2: Restoration Completed in Incremental System (RestoredInIncSystem)".

If the machine position establishment with the slave device is not required, set to FALSE in the homing request or not. This prevents the homing request from becoming TRUE at the restoration.

The absolute position data backup is not executed.

Absolute position system

This system restores the current position using the absolute position data.

At the current position restoration, the axis current position (set position, cumulative current position, and machine feed value) is restored based on backed up absolute position data. When restoration is completed, the axis current position restoration status becomes "4: Restoration Completed in Absolute Position System (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: Restoration Completed in Absolute Position System (Homing Uncompleted) (RestoredInAbsSystemUnHomed)". The current position is restored with the same content as the incremental system and the homing request becomes TRUE. (The absolute position data is maintained.) At this time, the absolute position system is not enabled until homing is completed. Be sure to execute homing. (When homing has been normally completed, the axis current position restoration status becomes "4: Restoration Completed in Absolute Position System (RestoredInAbsSystem)".)

When the absolute position system is used, the restoration content differs depending on the axis type. For details, refer to the following.

 Page 108 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.

[Only for real encoder axes (via drive unit)]

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

[Only for virtual encoder axes]

- The upper limit value/the lower limit value of the encoder ring counter 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.



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

2

Absolute position control setting ^{*1}	Cause	Detection timing ^{*2}
Common	The system power is turned ON or reset. ^{*3}	At the system power ON or after reset
	The axis type is changed.	At the current position restoration
	Homing is started. (The homing request flag will not become FALSE unless homing is normally completed.)	At homing start
	The axis driver unit conversion (numerator/denominator) is changed.	At current position restoration At the PLC READY [Y0] ON
	The driver power turns on. ^{*3} [The real drive axis only]	At current position restoration
Disable absolute position system	The current position restoration is executed.	At the current position restoration
Enable absolute position system	Since the absolute position data has been erased by the memory error, etc..	At the current position restoration
	Change of the driver and the motor encoder is detected.	
	Only for real drive axes	
	"Polarity (607EH)" b7: position polarity of the driver object is changed.	At the current position restoration and cause occurring
	An electric gear of the driver side is changed.	
	"Absolute position erased" is detected in the driver side.	
	Only for real encoder axes (via drive unit)	At current position restoration
	"Absolute position erased" is detected by the scale measurement encoder.	
	The encoder resolution of the scale measurement encoder is changed.	
	Only for virtual encoder axes	The upper limit value/lower limit value of the encoder ring counter is changed.

*1 For the "-1: Automatic Setting (Acquire from Connected Device) (Auto)" setting, refer based on the connected device setting.

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

*3 When the system/driver power is OFF when "1: Enable Absolute Position System (Enabled)" is set and the homing is completed at resetting, the homing request will not become TRUE.

Absolute position data backup

When the absolute position system is used, the absolute position data of each axis is backed up. The absolute position data is backed up 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: /lch

File name: abs_axis.bin

- Memory capacity

Memory capacity of the absolute position data differs depending on the axis type. Specify memory capacity of the absolute position data according to the axis type and the number of axes.

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 Maximum Backup RAM Size

(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.

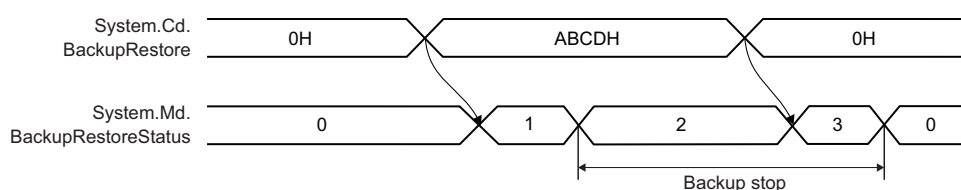
After restoring is completed, software reboot is required to enable the restored absolute position data. (The backup is maintained stop and it can not be cleared until software reboot is carried out.)

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 memory card

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



Precautions

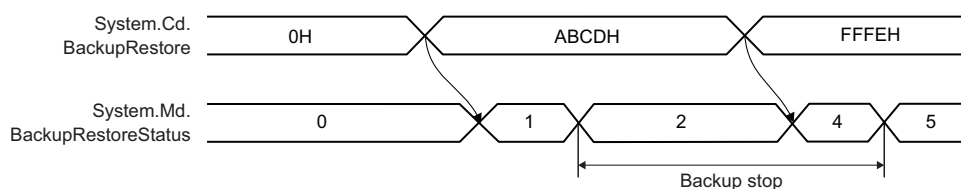
The current position of moved axes after backup stop is not saved.

To execute backup after confirming all axes stop is recommended.

Ex.

When restoring absolute position data saved in an SD memory card

1. Set "ABCDH: Backup stop request" to Backup/Restore Request (System.Cd.BackupRestore).
2. Confirm Backup/Restore Information (System.Md.BackupRestoreStatus) changes to "1: Backup stop required" and "2: Backup stop".
3. Transfer the "axis_abs.bin" file backed up in an arbitrary folder in an SD memory card by using file transfer (Execution data backup).
4. Set "FFFEH: Restored data saving request" to Backup/Restore Request (System.Cd.BackupRestore) after confirming file transfer (Execution data backup).
5. Confirm Backup/Restore Information (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 Backup/Restore Information (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
		Absolute Position Reference Setting (PosRestoration_AbsPosBase) is "3: Machine Feed Value (FeedMachinePosition)"
Machine feed value	Restored in "0".	Differs depending on the restoration method. For details, refer to the following. Page 101 Absolute position system
Cumulative current position	The same value as restored machine feed value.	
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 on the absolute position system to execute the 64-bit current position restoration, refer to the following.

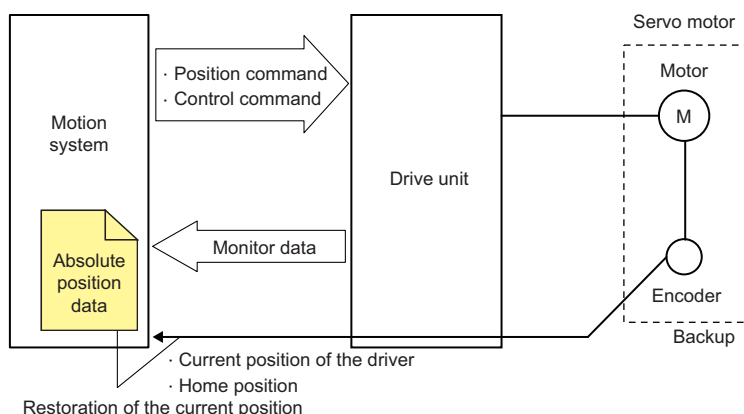
Page 101 Absolute position system

The servo ON status is not established until the current position restoration is completed.

Absolute position system

This section describes precautions for constructing the absolute position system in a real drive axis.

The following shows the absolute position system configuration when the drive unit is used as the servo amplifier.



A drive unit/servo motor which can detect the absolute position must be used to construct the absolute position system.

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

For MR-J5(W)-G: MR-J5-G/MR-J5W-G User's Manual (Parameters)

The current position restoration of the absolute position system can be classified into the following 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 unit or motor encoder unit
- For the motor encoder 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 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 Slave Object Data (AxisName.PrConst.SlaveObject) (STRUCT(SLAVE_OBJECT_REAL))	Setting description
vHomeCycleCounter (HomeCycleCounter)	Specifies the object ID storing the encoder position within one revolution at homing.
vHomeAbsCounter (HomeAbsCounter)	Specifies the object ID storing the encoder multiple revolution counter at homing.
vInitialPos (InitialPos)	Specifies the object ID storing Position actual value at connection.
vInitialCycleCounter (InitialCycleCounter)	Specifies the object ID storing the encoder position within one revolution at connection.
vInitialAbsCounter (InitialAbsCounter)	Specifies the object ID storing the encoder multiple revolution counter at connection.
vMaxAbsCounter (MaxAbsCounter)	Specifies the object ID storing the maximum value of the multiple revolution counter.

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 may not be completed. 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: Automatic Setting (Acquire from Connected Device) (Auto)" or "1: Enable Absolute Position System (Enabled)" in Absolute Position Control Setting(AxisName.PrConst.PosRestoration_AbsPosEnable) in the real drive axis whose connected device is 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 Real Encoder Axis Type Setting (AxisName.PrConst.Encoder_AxisType) of the axis parameter shown below.

Real encoder axis type	Current position restoration method	Description	Remark
Via drive unit	64-bit current position restoration	Correctly executes the current position restoration within up to the signed 64-bit integral number range ^{*1} [encoder pulse unit] from the backup position.	Only the synchronous encoder connected to the drive unit can be used. For details on the setting, refer to the following.  Page 36 Axis

^{*1} The actual restoration possible range is - ((Multiple revolution counter maximum value) / 2 × (Encoder resolution)) to ((Multiple revolution counter maximum value) / 2 × (Encoder resolution) - 1).

■Current position restoration timing

Current position restoration is executed after the real drive axis of the same station address is connected.

Virtual drive axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored 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 on the axis variable initialization timing, refer to the following.

 Page 38 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 Connection Command (AxisName.Cd.Encoder_Connect) becomes TRUE.

Virtual linked axis

Each current position is restored as follows.

Current position	Incremental system	Absolute position system
Cumulative current position	Restored 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 on the axis variable initialization timing, refer to the following.

 Page 38 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 Control Setting Mismatch" (error code: 1A9AH) will occur at current position restoration.)
- If the homing required or not is set to TRUE, address information stored in the motion system is not guaranteed.
- During backup/restoration by the engineering tool, do not write in Backup/Restore Request (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.

Operation of this function for each system status

○: Possible, ×: Not possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	×

Relevant variables

Variable/Structure name	Name	Details
System.PrConst.		
OperationCycle[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")
BuffermemoryRefreshCycle.Cycle	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 -118192 to -110001: Multiplication by n of the first operation cycle (1 to 8192)
Link_MotionStationRefreshType	Motion Synchronization Station Send/Receive Data Refresh Method	Sets the send/receive data refresh method of the motion synchronization station.
FastOperationMode ^{*1}	Fast Operation Mode Setting	Switch the operation process of the entire system to fast operation mode. 50EFH: Fast operation mode Others: Normal mode
AxisName.PrConst.		
OperationCycle	Control Cycle Setting	0: Operates at the first operation cycle
FastOperationMode ^{*1}	Fast Operation Mode Setting	Switch the operation process of the set axis to fast operation mode. ^{*2} 5FE2H: Fast operation mode Others: 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 fast operation mode, set both the system parameter and axis parameter to the fast operation mode. If both system parameter and axis parameter are not set to the fast operation mode, it is not switched to the fast operation 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 Operation Cycle Setting (System.PrConst.OperationCycle[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 [μ s]	—					—*1	
62.5 [μ s]	1 axis					2 axes*2	
125 [μ s]	4 axes					14 axes	
250 [μ s]	4 axes	8 axes	14 axes			20 axes	
500 [μ s]	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 fast operation mode.

*2 Up to 4 axes can be connected by using the fast operation mode.

Point

Adjust the operation cycle setting depending on the system load status.

The following functions increase the operation cycle, so use them depending on the system load status.

- Public label
- Device label setting
- Instanciating and execution of the Motion control FB
- Logging

Set execution scan of ST programs depending on the system load status as executing ST programs by fixed scan increases operation time.

The operation time increases when the function block starts. The increase of operation time can be reduced by changing the start timing.

Note the following for parameter setting values, and adjust them depending on the system load status.

- The operation time increases at output the warning "Cycle Over Warning" (warning code: 0F08H). Set 0 to number of cycle over warning detections (System.PrConst.OperationCycle[1].NumOfCycleOverWngDetectTimes), so the warning "Cycle Over Warning" (warning code: 0F08H) will not be output.
- User needs to check the normal operation range of the number of cycle over error detections (System.PrConst.OperationCycle[1].NumOfCycleOverErrDetectTimes), and change values to avoid the errors "Cycle Over" (error code: 1C80H) and "Cycle Over" (error code: 320CH).

Operation cycle assignment

An operation cycle of the axis can be set by Control Cycle Setting (AxisName.PrConst.OperationCycle).

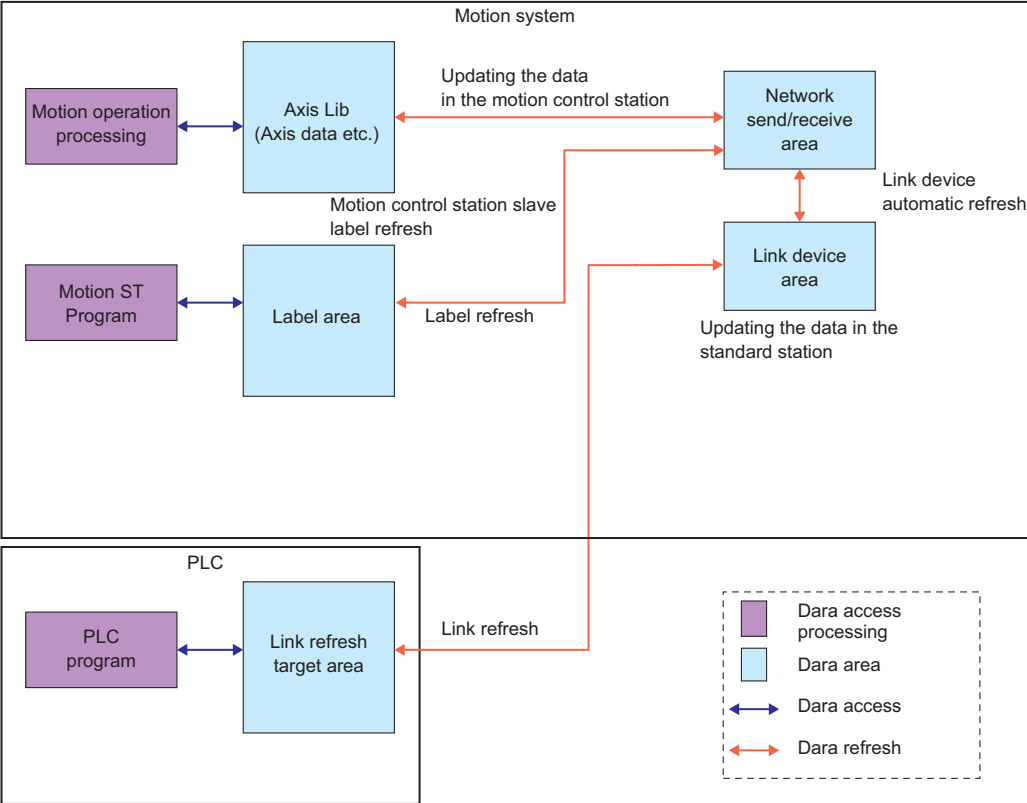
Send/Receive data refresh of network connected devices

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

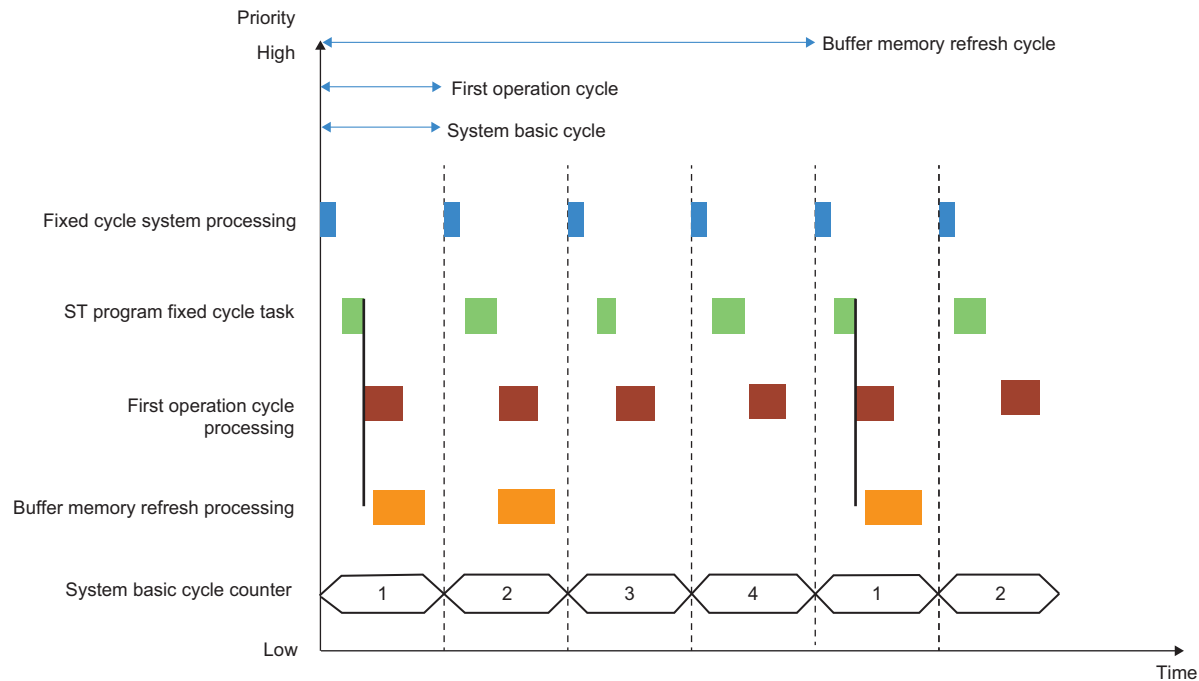
Station	Explanation
Motion synchronization station	• The motion system refreshes data by directly synchronizing the network send/receive with the operation cycle. • The target link device is not refreshed.
Standard station*1	• Stations other than motion synchronization stations are standard stations.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



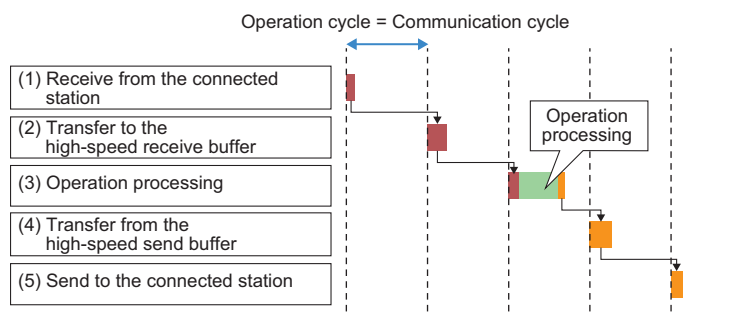
Motion synchronization station

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 Motion Synchronization Station Send/Receive Data Refresh Method (System.PrConst.Link_MotionStationRefreshType). It is common in all of the operation cycles.

Motion synchronization station send/receive data refresh method	Description
Operation cycle preferred method	- Data receive, motion operation, and data send are executed in different operation cycles. A fast 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 preferred method

With operation cycle preferred 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 synchronization stations exchanges with motion system by cyclic communication registers as labels and enables read/write. Refreshing slave labels are carried out in operation cycle. For the using and setting methods of slave label, refer to the following.

☞ Page 781 Connectable device to CC-Link IE TSN

Standard station

The following stations update the data.

- Programmable controller

For details, refer to "Network Synchronous Communication" of Part 1 in the following manual.

📖 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 "Cyclic Transmission" of Part 1 in the following manual.

📖 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 Motion control FB 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 the Motion control FB
- Area for the public labels (module labels)

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 Buffer Memory Refresh Cycle Setting (System.PrConst.BuffermemoryRefreshCycle).

Axis operation process fast operation mode

The following shows the axis operation process fast operation mode.

If it is switched to the fast operation mode, some of the functions will be restricted, but it may be able to communicate with shorter operation cycle.

Axis operation process fast operation mode restrictions

In the fast operation mode, compared to the normal mode, it has the following function restrictions.

- Function restrictions of the motion system

No.	Restriction	Detail
1	Slave object unsettingtable	Operates by fixed initial setting ([OBJ] setting).
2	PDO mapping cannot be changed	Operates by fixed fast operation 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. • Set Acceleration (AxisName.Md.SetAcceleration) • Actual Velocity (AxisName.Md.ActualVelocity) • Actual Position (AxisName.Md.ActualPosition) (For real encoder axis) • Object Data_TargetPos(AxisName.Md.lo_TargetPos) • Object Data_PosActualValue (AxisName.Md.lo_PosActualValue) • Object Data_VelActualValue (AxisName.Md.lo_VelActualValue) • Object Data_TargetVelocity (AxisName.Md.lo_TargetVelocity) • Object Data_TorqueActualValue (AxisName.Md.lo_TorqueActualValue) • Object Data_Statusword (AxisName.Md.lo_Statusword) • Drive Unit Error Detection (AxisName.Md.DriverError) • Drive Unit Error Code (AxisName.Md.DriverErrorID) • Drive Unit Error Detail Code (AxisName.Md.DriverErrorDetailID) • Velocity Override Factor (AxisName.Md.VelocityOverride) • Acceleration Override Factor (AxisName.Md.AccelerationOverride) • Jerk Override Factor (AxisName.Md.JerkOverride) • Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive) • Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative) • Driver Ready On Status (AxisName.Md.Driver_ReadyOn) • Driver Servo On Status (AxisName.Md.Driver_ServoOn) • Velocity Override Factor (AxesGroupName.Md.VelocityOverride) • Acceleration Override Factor (AxesGroupName.Md.AccelerationOverride)
4	A part of axis command unusable	The input of the following command will be ignored. • Homing Request Clear (AxisName.Cd.Homing_ClearRequest) • Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) • Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) • Velocity Override Factor (AxisName.Cd.VelocityOverride) • Acceleration Override Factor (AxisName.Cd.AccelerationOverride) • Velocity Override Factor (AxesGroupName.Cd.VelocityOverride) • Acceleration Override Factor (AxesGroupName.Cd.AccelerationOverride) Even if the FB is executed to change the command to be ignored, the change is not carried out.
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 fast operation 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.
- The fast operation mode of the axes group becomes valid when axes set to fast operation mode are included in configuration axes.
- Note the description in the following Point.

☞ Page 113 Operation cycle settings

Operation cycle 31.25 setting [RD78GH]

By using RD78GH enables to communicate by operation cycle 31.25 μ s setting.

The procedure to operate by 31.25 μ s is shown below.

Procedure to operate by 31.25 [μ s]

- Enabling add-on

When using by 31.25 [μ s], 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	AbsSystem	×
2	Axis	○
3	baseSystem	○
4	ExternalSignal	×
5	FileTransfer	×
6	Logging	×
7	MotionControl_AxisFilter	○
8	MotionControl_General	○
9	MotionControl_Sync	○
10	MotionEngine	○
11	MotionEventHist	×
12	NetworkDriver_CCIETSN	○
13	PackagingApp	×
14	PlcInstruction	○
15	ProfileControl	×
16	Program_ST	○
17	ServoDriver_CANopen	○
18	ServoSystemRecorder	×
19	SignalIO	○

- Parameter setting

Set the axis to be operated by 31.25 [μ s] to the fast operation mode. For details, refer to the following.

☞ Page 112 System basic cycle



The system load status can be confirmed by Processing Time (System.Md.OperationCycle[1].ProcessingTime).

Do not let Processing Time (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 usable. If the operation cycle exceeds by adding this 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 the number of axis is 1-axis and using the device labels, adjust the number of device labels depending on the system load status. When the number of axis is 2-axes, do not use the device labels. The operation cycle exceeds at start of function block, but soon the operation time settles within the operation cycle thus the motion control is not affected.

Setting example

The setting examples for operations under the 2-axis interpolation control in the operation cycle 31.25 [μs] are shown below.

■Configuration

- Real drive axis: MR-J5-G, 2-axes
- Axes group setting: 1
- Device label: No setting

■Parameter setting

- System setting

Parameter name	Setting value
Buffer memory refresh cycle setting	—
Number of cycle over warning detections	0
Number of cycle over error detections	20
High-speed mode setting	50EFH
Operation cycle setting	—
Number of cycle over warning detections	0
Number of cycle over error detections	20

For the seting value of parameters other than the above, the initial value is applied.

- Axis parameter

Parameter name	Setting value
Absolute position control setting	0: ABSDisabled (Disable absolute position system)
High-speed mode setting	5FE2H
Command in-position width	0.0

For the setting value of parameters other than the above, the initial value is applied.

- Axes group parameter

For the setting value of parameters other than configuration axis, the initial value is applied.

■Program

Executes MCv_AllPower (All Axes Operation Available), MC_GroupEnable (Axes Group Enabled), and MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control) by normal execution type program of the motion ST program.

3.2 Add-on Function

This section describes add-on Function.

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

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

☞ Page 776 List of Add-on Library

Operation of this function for each system status

○: Possible

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

Relevant variables

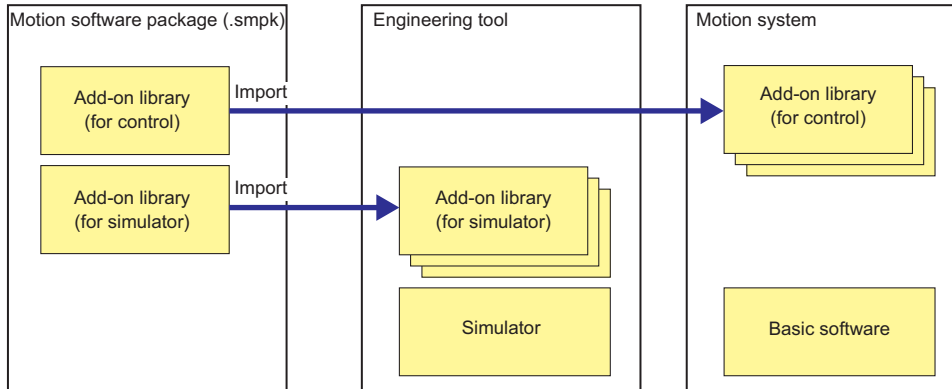
The following shows common variables in each add-on library. Available variables other than the following are different depending on the add-on library. For details, refer to the specifications of each add-on library.

Variable/Structure name	Name	Details
System.PrConst.		
Addon_ <u>AddonLibraryName</u>	Add-on <AddonLibraryName> Parameter	ADDON_PARAM structure For add-on used for <AddonLibraryName>, refer to the following. ☞ Page 760 System variables
System.Md.		
Addon_ <u>AddonLibraryName</u>	Add-on <AddonLibraryName> Monitor	ADDON_MON structure For add-on used for <AddonLibraryName>, refer to the following. ☞ Page 760 System variables
ADDON_PARAM		
RamSizeMax	Maximum RAM Size	Specifies the maximum amount of system memory (RAM) used in the add-on in k bytes. For details on the setting method, refer to the following. ☞ Page 122 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 on the setting method, refer to the following. ☞ Page 122 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 system.



Installation file configuration

The installation file of the software is one file.

For details, refer to the following.

📖 Page 673 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 on configuration of the motion software package, refer to the following.

📖 Page 673 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 system. The motion system recognizes direct add-on libraries of the system folder (/sys).

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

 Page 672 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 system 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 on the setting method, refer to the following.

 Page 122 System Memory Settings

Examples of adjustable memory:

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

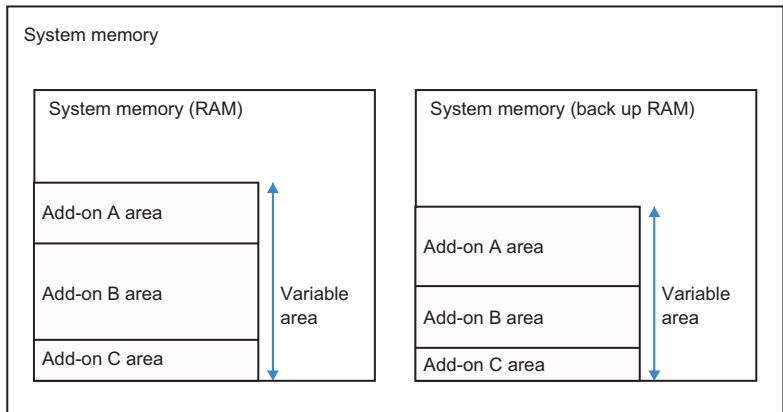
Loading add-on library

Add-on libraries are loaded when the motion system is initialized. When the loading can not be performed because of the followings, the error "Add-on Library Load Error" (error code: 3205H) occurs and the motion system does not turn to RUN.

- The file of add-on library is broken.
- The add-on library with dependencies has not been installed.
- The add-on library that cannot be combined has been installed.
- Inconsistency occurred in the versions of the add-on libraries.
- Inconsistency occurred in the versions of the add-on library and the software of the module.

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).



Operation of this function for each system status

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant term

Term	Description
System memory	A generic term for memory areas which are available add-ons in the motion system. The areas do not include the memory area used for baseSystem.

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_ <u>AddonLibraryName</u>	Add-on <AddonLibraryName> Parameter	ADDON_PARAM structure For add-on used for <AddonLibraryName>, refer to the following.  Page 760 System variables
System.Md.		
Addon_ <u>AddonLibraryName</u>	Add-on <AddonLibraryName> Monitor	ADDON_MONI structure For add-on used for <AddonLibraryName>, refer to the following.  Page 760 System variables
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 on the setting method, refer to the following.  Page 124 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 on the setting method, refer to the following.  Page 125 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 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 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	96M bytes	256M bytes

System memory (RAM) usage setting

The amount of system memory (RAM) available in each add-on library is set by Maximum RAM Size (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 usage amount and the maximum usage amount for the system memory (RAM) used in the add-ons can be monitored by RAM Usage (System.Md.Addon_AddonLibraryName.RamUsage) and RAM Usage Maximum (System.Md.Addon_AddonLibraryName.RamMaxUsage) respectively. The value is stored in k bytes.

The current usage amount and the maximum usage amount for system memory (RAM) used in the all add-ons can be monitored by RAM Usage (System.Md.MemoryUsage.RamUsage) and RAM Usage Maximum (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.)

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 (backup RAM) size	232k bytes	472k bytes

System memory (backup RAM) usage setting

The amount of system memory (backup RAM) available in each add-on library is set by Maximum Backup RAM Size (`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 usage amount or the maximum usage amount for the system memory (RAM) used in add-on can be monitored by Backup RAM Usage (`System.Md.Addon_AddonLibraryName.BackupRamUsage`) or Backup RAM Usage Maximum (`System.Md.Addon_AddonLibraryName.BackupRamMaxUsage`) respectively. The value is stored in k bytes.

The current usage amount and the maximum usage amount for system memory (RAM) used in the all add-ons can be monitored by Backup RAM Usage (`System.Md.MemoryUsage.BackupRamUsage`) and Backup RAM Usage Maximum (`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 motion system stops 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 request, 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 Software Reboot Request (System.Cd.SoftRebootRequest).

Action	Software Reboot Request (System.Cd.SoftRebootRequest)	Target	Details
Reset	MOTION_RESET	Motion area	Resets parameters and control data while connection to the network communication is kept.
Clear	MOTION_CLEAR	Motion area	Clears built-in memory.
Quick clear	MOTION_QCLEAR	Motion area	Clears built-in memory quickly.

Software Reboot Enabled (System.PrConst.SoftReboot_Enable) 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 "Software 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	Software Reboot Enabled	Sets the software reboot execution enable/disable. When the setting is disabled, the software reboot is not executed.
System.Cd.		
SoftRebootRequest	Software Reboot Request	Executes the software reboot. MOTION_RESET: Executes a reset of the motion area only. MOTION_CLEAR: Executes a clear of the memory after rebooting the motion area. MOTION_QCLEAR: Executes a quick clear of the memory after rebooting the motion area. Others: Not executed. The memory is deleted 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. As MOTION_RESET is issued, motion area is reset, however, network area is not reset.

The each type data and the status of the network communication after the software reboot and hardware reboot are shown below.

Item	Software reboot (MOTION_RESET)	Hardware reboot
Label	Sets the default value	Sets the default value
Device	Clear ^{*1}	Clear
Program	Equivalent to STOP → RUN	Equivalent to STOP → RUN
Network communication	Watchdog counter update stop ^{*2}	All stations are disconnected and then reconnected after restart
File transmission by script file	Execute	Execute
Base system 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 software 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 software 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.
- When software reboot is executed while monitoring the engineering tool, incorrect variable values may appear on the monitor. In such a case, stop the monitor once after software reboot completion and restart.
- 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

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

13 SYNCHRONOUS CONTROL

14 OPERATION PROFILE FUNCTION

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 FBs 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 Axis Status (AxisName.Md.AxisStatus) of "4: Standby (Standstill)" or Axes Group Status (AxesGroupName.Md.GroupStatus) of "4: Standby (GroupStandby)" is called "start" of the axis.

Function blocks have Execute command (Execute) type and Enable (Enable) type, and these are started at the rising edge of Execute command (Execute) or Enable (Enable) which are input variables of the Motion control FB.

Operation of this function for each system status

○: Possible, ×: Not possible

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

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Md.</u>		
AxisStatus	Axis Status	Stores the axis status. 0: Axis disabled (Disabled) 1: Stopping on error (ErrorStop) 2: Decelerating to stop (Stopping) 3: During homing (Homing) 4: Standby (Standstill) 5: During positioning operation (DiscreteMotion) 6: During continuous operation (ContinuousMotion) 7: During synchronous operation (SynchronizedMotion)
UseInGroup	Using Axes Group	Displays whether the axis is 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 the RLS.
ForcedStop_Released	Forced Stop Cancelling	Displays forced stop cancel status.
StopStatus	Stop Status	Displays TRUE/FALSE of the stop signal (STOP).
<u>AxesGroupName.Md.</u>		
GroupStatus	Axes Group Status	Stores the axes group status. 0: Axes group disabled (GroupDisabled) 1: Stopping on error (GroupErrorStop) 2: Decelerating to stop (GroupStopping) 4: Standby (GroupStandby) 5: Operating (GroupMoving)
<u>System.Cd.</u>		
SequenceReady	PLC Ready	Specifies RUN/STOP of the system. FALSE: STOP TRUE: RUN Becomes TRUE/FALSE automatically by rising/falling of the Motion module [Y0]
<u>System.Md.</u>		
Ready	Ready	Stores ON/OFF of the ready [X0].
Sync	Synchronization flag	Stores ON/OFF of the synchronization flag [X1].



Note the following when switching STOP/RUN by operating PLC Ready (System.Cd.SequenceReady).

- When setting PLC Ready (System.Cd.SequenceReady) to the public label, do not operate [Y0] of the Motion module. STOP/RUN may not be switched correctly.
- The STOP/RUN status of the CPU module and the Motion module do not interlock. Even if the CPU module turns to STOP status with the axis controlled state by Motion control FB of the CPU module side, the axis control does not stop. Monitor the CPU operating status by the Motion module side program as necessary and stop the axis control. "SB004C: CPU operating status of own station" or "SW004B: CPU status of own station" shows the CPU operating status. For "SB004C: CPU operating status of own station" and "SW004B: CPU status of own station", refer to "List of Link Special Relay (SB)" and "List of Link Special Register (SW)" in the following manual.

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When the stop error occurs in the CPU module, the Motion module also turns to STOP automatically.

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 Status	4: Standby (Standstill)	<u>AxisName</u> .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
	Using Axes Group	FALSE	Not used	<u>AxisName</u> .Md.UseInGroup
	Homing Request	FALSE	Homing request FALSE	<u>AxisName</u> .Md.Homing_Request
External signal	Forced Stop Cancelling	TRUE	Emergency stop input FALSE (Forced stop cancel)	<u>AxisName</u> .Md.ForcedStop_Released
	Upper Limit Signal Status	FALSE	Within the upper limit range	<u>AxisName</u> .Md.HwStrokeLimit_FlsStatus
	Lower Limit Signal Status	FALSE	Within the lower limit range	<u>AxisName</u> .Md.HwStrokeLimit_RlsStatus
	Stop Status	FALSE	Stop signal (STOP) FALSE	<u>AxisName</u> .Md.StopStatus

Starting conditions for motion function blocks of the axes group

■State transition

Name	State	Variable name
Axis Status	4: Standby (Standstill)	<u>AxisName</u> .Md.AxisStatus
Axes Group Status	4: Standby (GroupStandby)	<u>AxesGroupName</u> .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	<u>AxisName</u> .Md.Homing_Request
External signal	Forced Stop Cancelling	TRUE	Emergency stop input FALSE (Forced stop cancel)	<u>AxisName</u> .Md.ForcedStop_Released
	Upper Limit Signal Status	FALSE	Within the upper limit range	<u>AxisName</u> .Md.HwStrokeLimit_FlsStatus
	Lower Limit Signal Status	FALSE	Within the lower limit range	<u>AxisName</u> .Md.HwStrokeLimit_RlsStatus
	Stop Status	FALSE	Stop signal (STOP) FALSE	<u>AxisName</u> .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 command (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 command (Execute) becomes FALSE to TRUE and when Continuous update (ContinuousUpdate) becomes 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.
Immediately after execution: During Analyzing (AxisName.Md.Analyzing) is TRUE
Immediately before termination: Immediately before Execution completion (Done) becomes TRUE
- 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 command (Execute), a retrigger can be executed by the re-rising edge of Execute command (Execute).

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

Continuous update

If Continuous update (ContinuousUpdate) is TRUE when Execute command (Execute) changes FALSE to TRUE, input variables will be continuously imported.

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

4.3 Multiple Start (Buffer Mode)

Motion control FBs can be executed continuously without stopping multiple Motion control FBs by executing the motion FB of another instance to the axis and the axes group that are executing the motion control FB.

Point

- To execute the Motion control FB with the axis and the axes group stop status ("4: Standby (Standstill)" or "4: Standby (GroupStandby)") is called "start". For details, refer to the following.
 Page 130 Start
- When Axis Status (AxisName.Md.AxisStatus) and Axes Group Status (AxesGroupName.Md.GroupStatus) are as the following, to execute the motion FB of another instance is called "multiple start".
[Axis Status (AxisName.Md.AxisStatus) that can be multiple started]
3: During homing (Homing) (Only MC_Stop (Forced Stop) is possible)
5: During positioning operation (DiscreteMotion)
6: During continuous operation (ContinuousMotion)
7: During synchronous operation (SynchronizedMotion)
[Axes Group Status (AxesGroupName.Md.GroupStatus) that can be multiple started]
5: Operating (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 "Motion 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	Reference	
			During single axis operation	During multiple axes operation
0: mcAborting	Aborting	Aborts (cancels) the FB being executed and executes the next FB immediately.	Page 142 Aborting during single axis operation	Page 150 Aborting during multiple axes operation
1: mcBuffered	Buffered	Buffers the next FB on the FB being executed. If the FB being executed already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after completion of the FB being executed.	Page 143 Buffered during single axis operation	Page 151 Buffered during multiple axes operation
2: mcBlendingLow	BlendingLow	Buffers the next FB on the FB being executed.* ¹ If the FB being executed already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the FB being executed reaches the target position. The lower target velocity between the FB being executed and the buffering FB is used as the switching speed.	Page 147 BlendingLow	Page 154 BlendingLow
3: mcBlendingPrevious	BlendingPrevious	Buffers the next FB on the FB being executed.* ¹ If the FB being executed already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the FB being executed reaches the target position. The switching speed changes to the target velocity of the FB being executed.	Page 145 BlendingPrevious	Page 152 BlendingPrevious
4: mcBlendingNext	BlendingNext	Buffers the next FB on the FB being executed.* ¹ If the FB being executed already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the FB being executed reaches the target position. The switching speed changes to the target velocity of the buffering FB.	Page 146 BlendingNext	Page 153 BlendingNext
5: mcBlendingHigh	BlendingHigh	Buffers the next FB on the FB being executed.* ¹ If the FB being executed already has an FB buffering on it, subsequent FBs are buffered consecutively. (Up to 2.) Buffering FBs are executed in order after the FB being executed reaches the target position. The switching speed changes to the higher target velocity value between the FB being executed and the buffering FB.	Page 147 BlendingHigh	Page 154 BlendingHigh

*¹ Stops are not performed between the FB being executed and the buffering FB.

- 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.

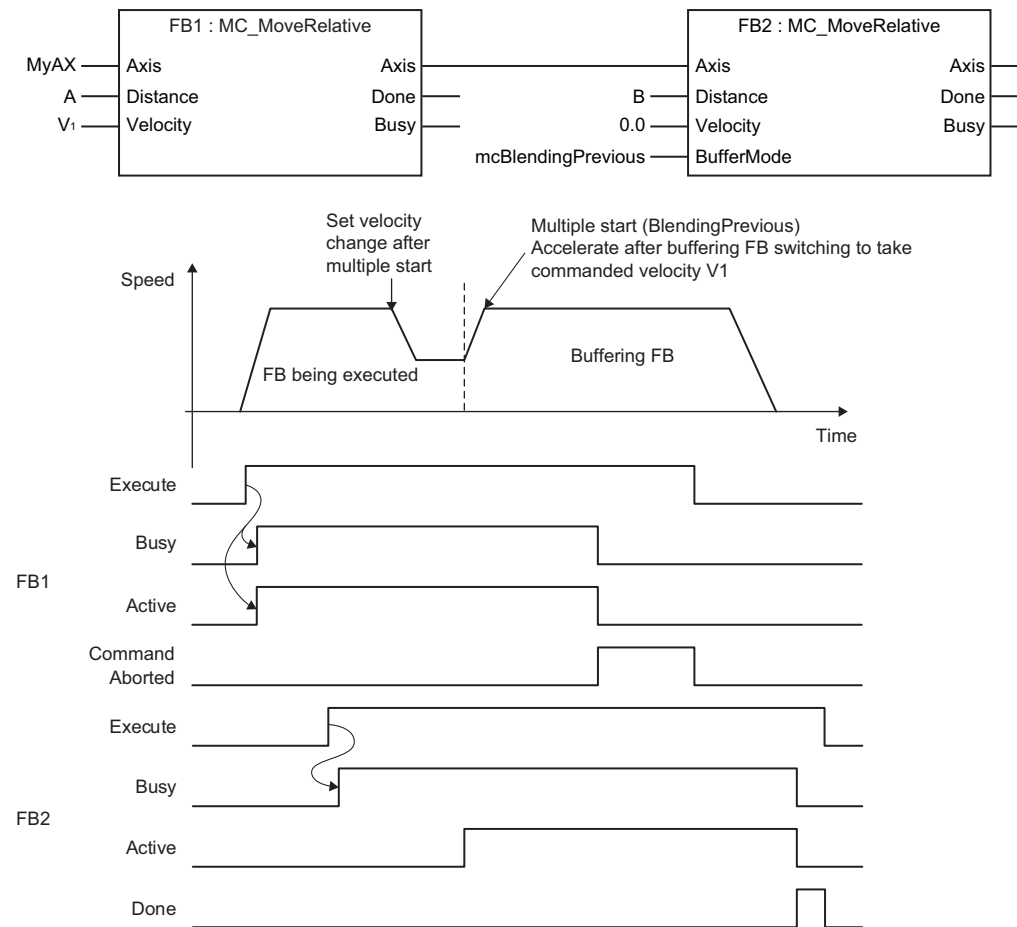
 Page 685 Checking Errors and Warnings

When an error or a stop cause occurred in the FB being executed, 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 FB being executed is completed. If the multiple FBs are waiting for the analysis by the multiple start, the next buffering FB may not be in order.
- Since multiple started FBs are executed immediately when Aborting has been specified, the FBs are not buffered. When the FBs being executed include a buffering FB, all buffering FBs are interrupted. However, as the FBs which are awaiting analysis are not interrupted, those FBs start after the multiple started FBs are completed by specifying Aborting.
- When an error or a stop cause occurred, all buffering FBs are interrupted (the output of Abortion of execution (CommandAborted) becomes TRUE).

Command omission at multiple start

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



- 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 348 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 (Executing (Busy) is TRUE).

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Pr.</u>		
OverrunOperation	Operation Setting at Overrun	Sets the operation settings when overrun occurs during operation. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)
<u>AxisName.Md.</u>		
BufferingFBs	Number of Buffering FBs	The number of buffering FBs (0 to 2)
<u>AxesGroupName.Pr.</u>		
OverrunOperation	Operation Setting at Overrun	Sets the operation settings when overrun occurs during operation. 1: Immediate Stop (ImmediateStop)
<u>AxesGroupName.Md.</u>		
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: Standby (Standstill)" status, it is regarded as "start".)

[Axis Status (`AxisName.Md.AxisStatus`) that can be multiple started]

3: During homing (Homing) (Only MC_Stop (Forced Stop) is possible)

5: During positioning operation (DiscreteMotion)

6: During continuous operation (ContinuousMotion)

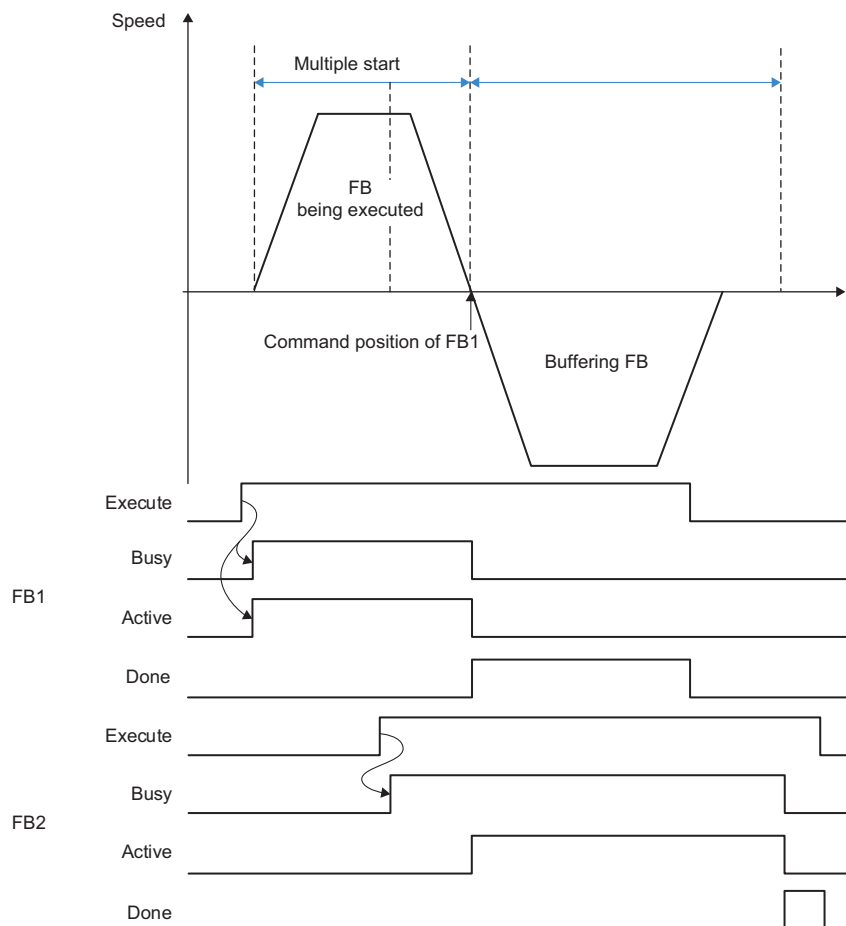
7: During synchronous operation (SynchronizedMotion)

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

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

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

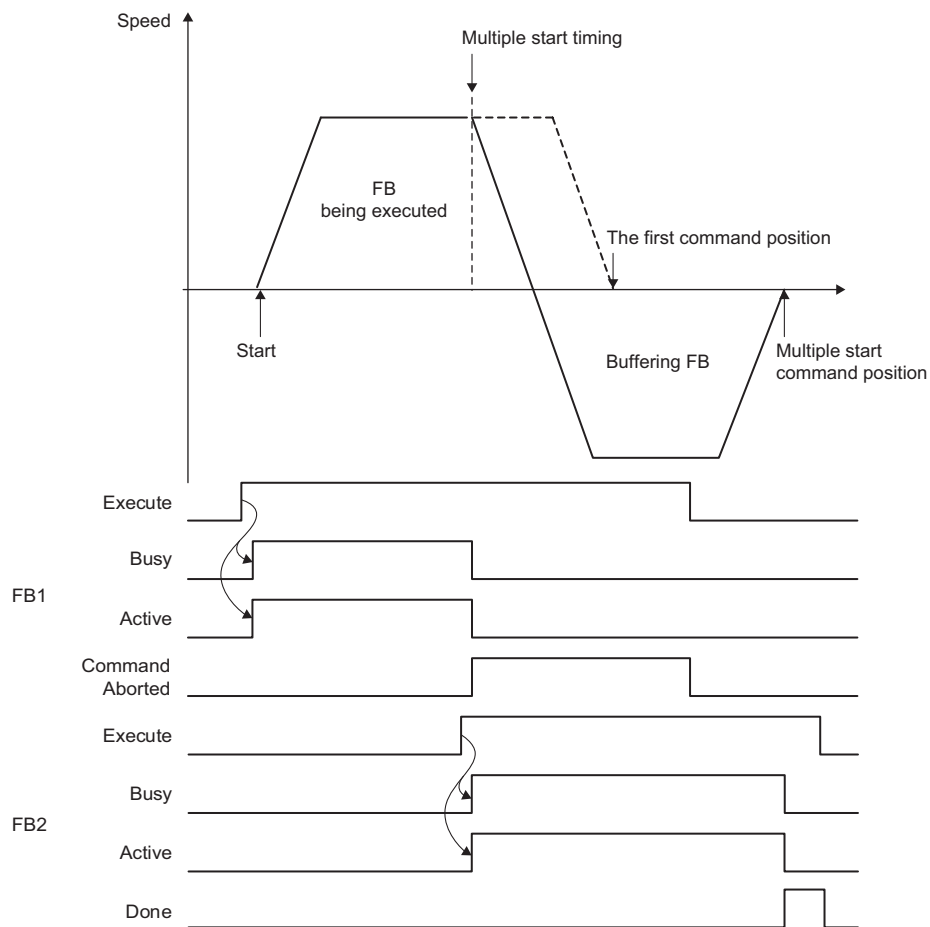
Deceleration stop setting at reverse (BlendingPrevious)



When reverse is enabled

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

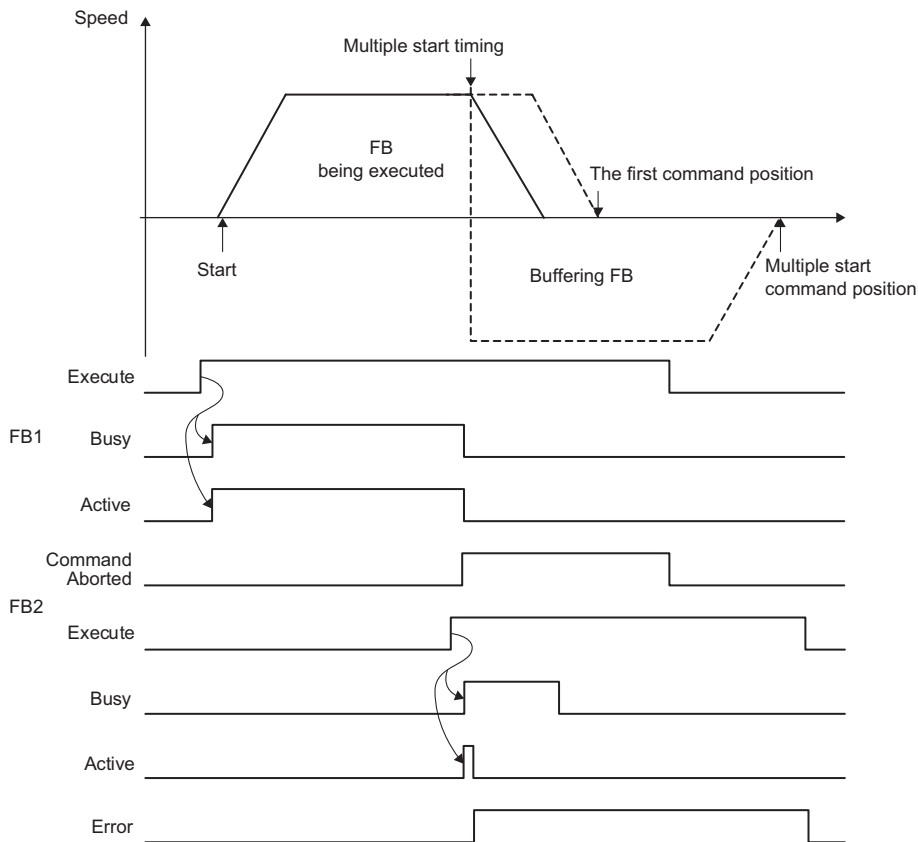
Deceleration stop setting at reverse (Aborting)



When reverse is disabled

When reverse rotation no permission is set in Reverse rotation permission selection (Options 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 on 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 motion FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_Home (Homing)	—*1	—	—	Execution completion (Done)	○*2	—	—
MC_Stop (Forced Stop)	○	—	—	Execution completion (Done)	○*2	—	—
MC_MoveAbsolute (Absolute Value Positioning)	○	○	○	Execution completion (Done)	○	○	○
MC_MoveRelative (Relative Value Positioning)	○	○	○	Execution completion (Done)	○	○	○
MCv_Jog (JOG Operation)	—*1	—	—	Execution completion (Done)	○	○	—
MCv_SpeedControl (Speed Control (Including Position Loop))	○	○	○	Target velocity reached (InVelocity)	○	○	—
MC_MoveVelocity (Speed Control)	○	○	—	Target velocity reached (InVelocity)	○	○	—
MC_TorqueControl (Torque Control)	○	○	—	Target torque reached (InTorque)	○	○	—
MC_CamIn (Cam Operation Start)	○	○	—	Cam cycle completion (EndOfProfile)	○	○	—
MC_GearIn (Gear Operation Start)	○	○	—	Gear ratio reached (InGear)	○	○	—
MC_CombineAxes (Addition/Subtraction Positioning)	○	○	—	In synchronization (InSync)	○	○	—
MCv_SmoothingFilter (Smoothing Filter)	—*1	—	—	—	○*2	—	—
MCv_DirectionFilter (Moving Direction Restriction Filter)	—*1	—	—	—	○*2	—	—
MCv_SpeedLimitFilter (Speed Limit Filter)	—*1	—	—	—	○*2	—	—
MCv_BacklashCompensationFilter (Backlash Compensation)	—*1	—	—	—	○*2	—	—

*1 Multiple start can not be executed because this FB can be started only when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".

*2 Only MC_Stop (Forced Stop) is possible.

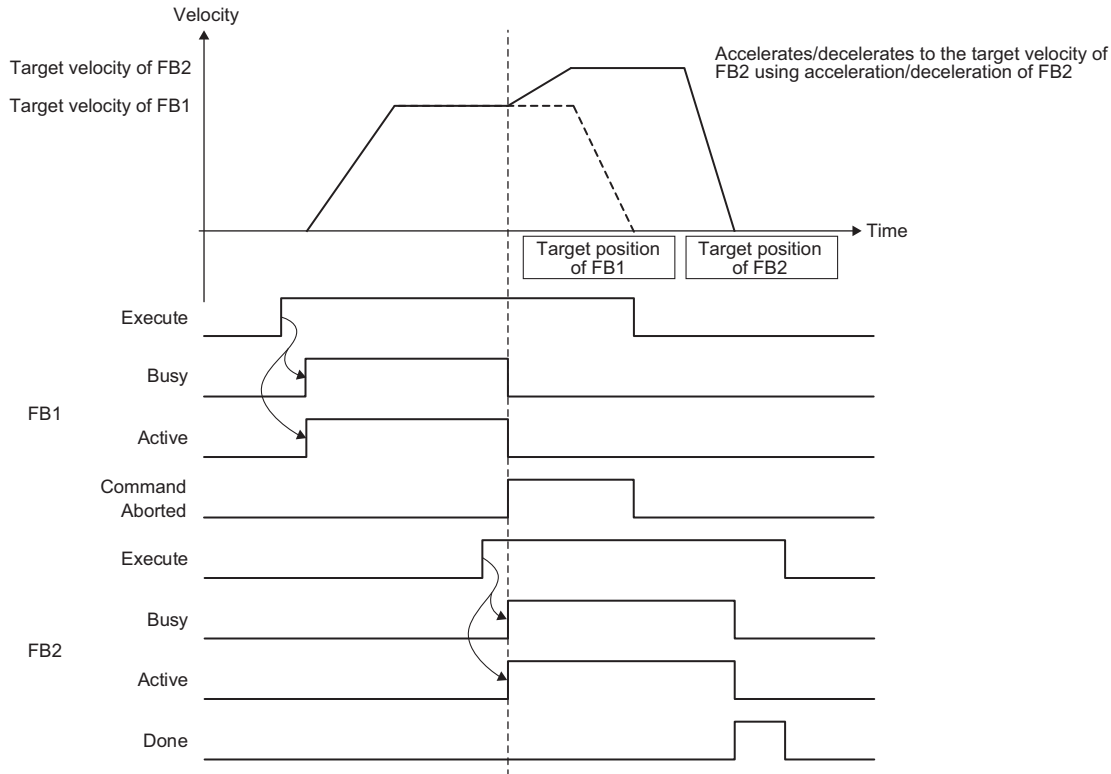
Aborting during single axis operation

The FB being executed 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.)

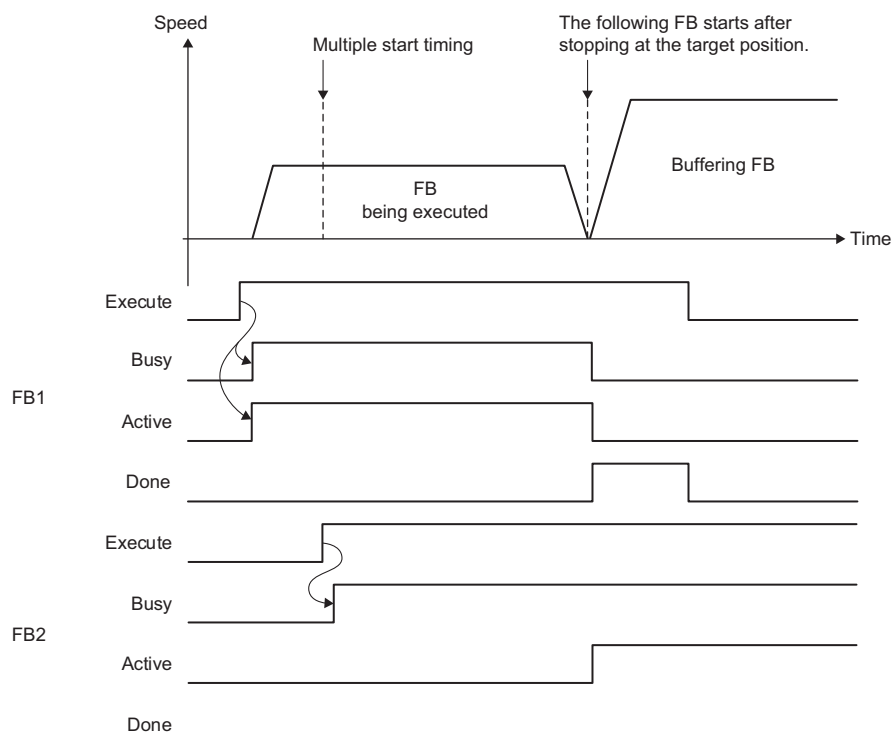
When omitting to specify the buffer mode, this operation is performed.

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



Buffered during single axis operation

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



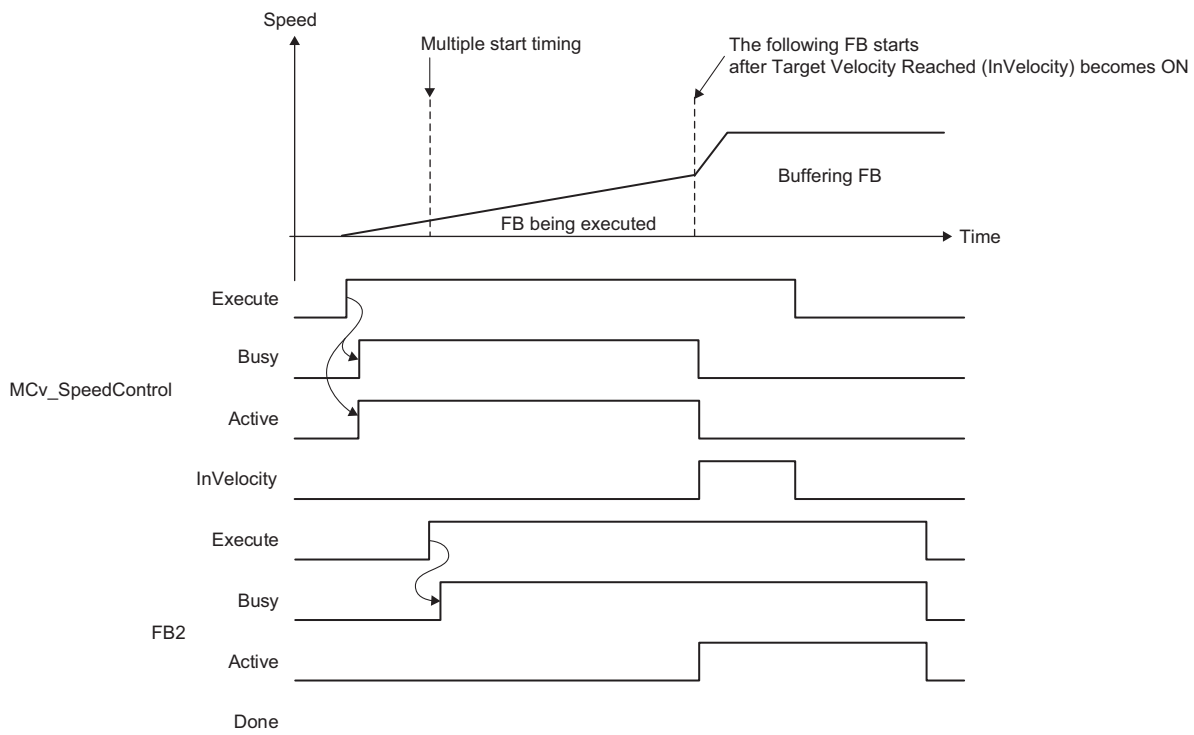
Conditions to determine completion are different depending on the Motion control FB, and the FB may not be in the stop status with speed 0 at completion. For details, refer to the following.

📖 Page 138 Multiple start during single axis operation

Ex.

When an FB is multiple started with Buffered in MCv_SpeedControl (Speed Control (Including Position Loop))

In MCv_SpeedControl (Speed Control (Including Position Loop)), the FB is determined that it is completed when Target velocity reached (InVelocity) becomes TRUE, and the following buffering FB is executed. (The current speed at this time is used as the switching speed.)

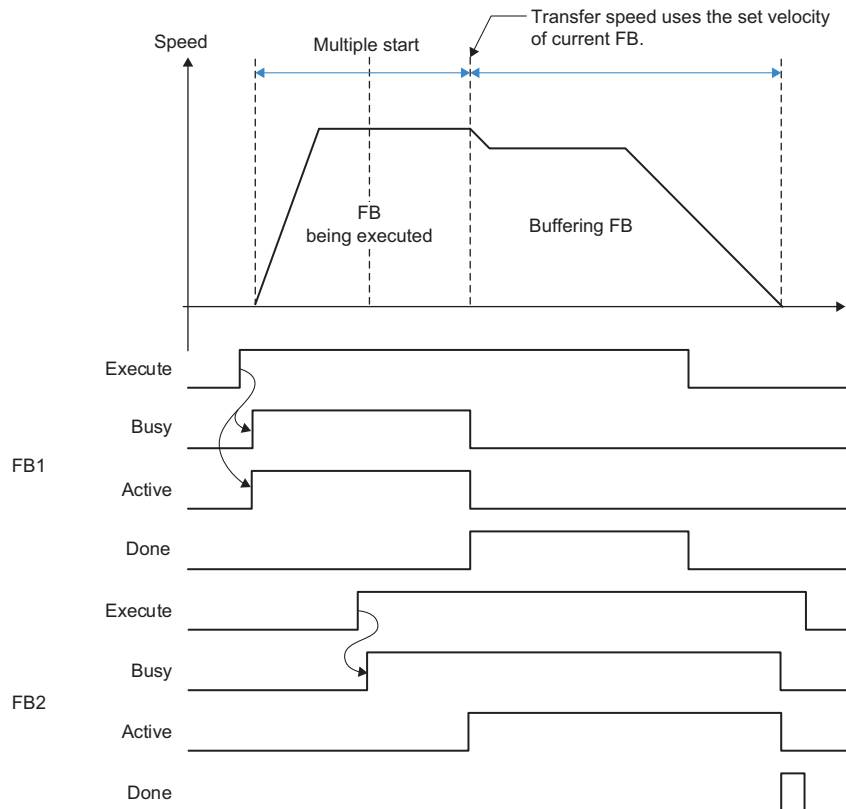


Blending during single axis operation

Multiple started FBs are buffered and wait until the FB being executed is completed. After the FB being executed 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.

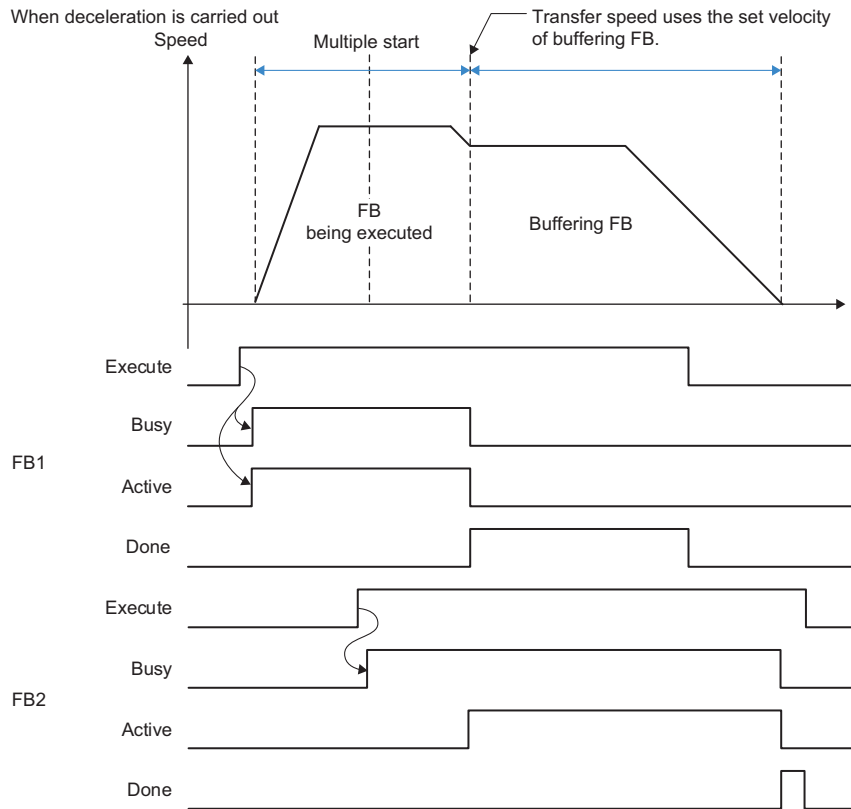
■BlendingPrevious

The FB is operated at the speed of the FB being executed 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.

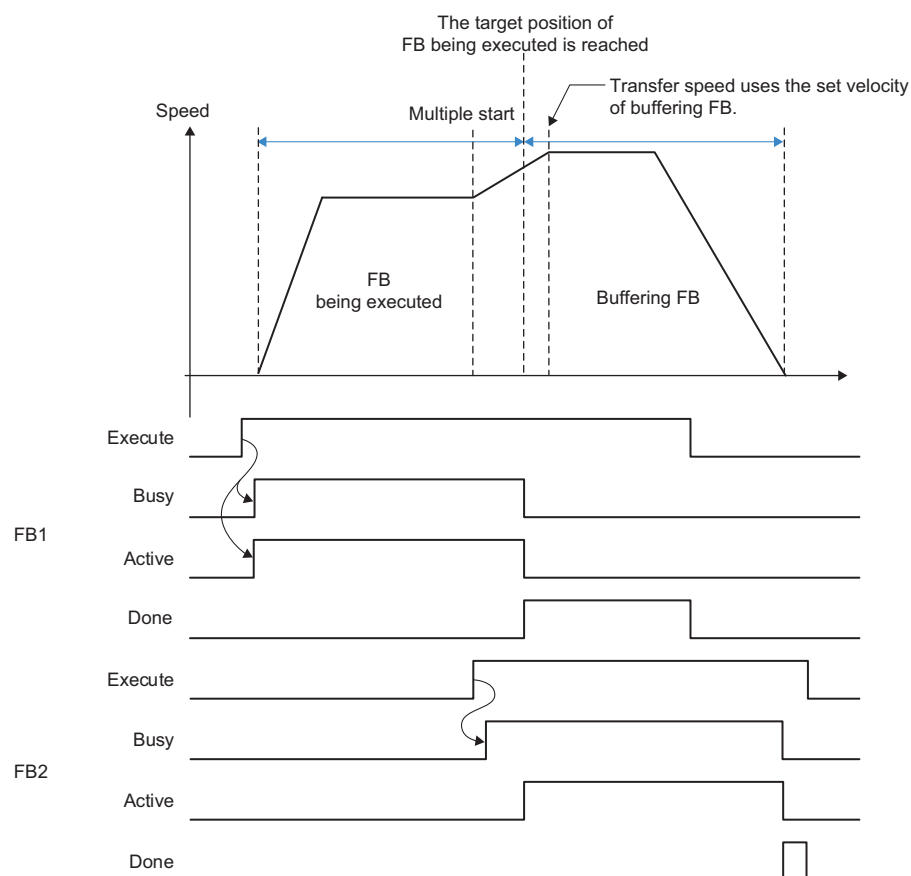


■BlendingNext

The FB is operated so that the velocity becomes the target velocity of the FB in buffering at the target position of the FB being executed.



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 FB being executed. 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 FB being executed.



■BlendingLow

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

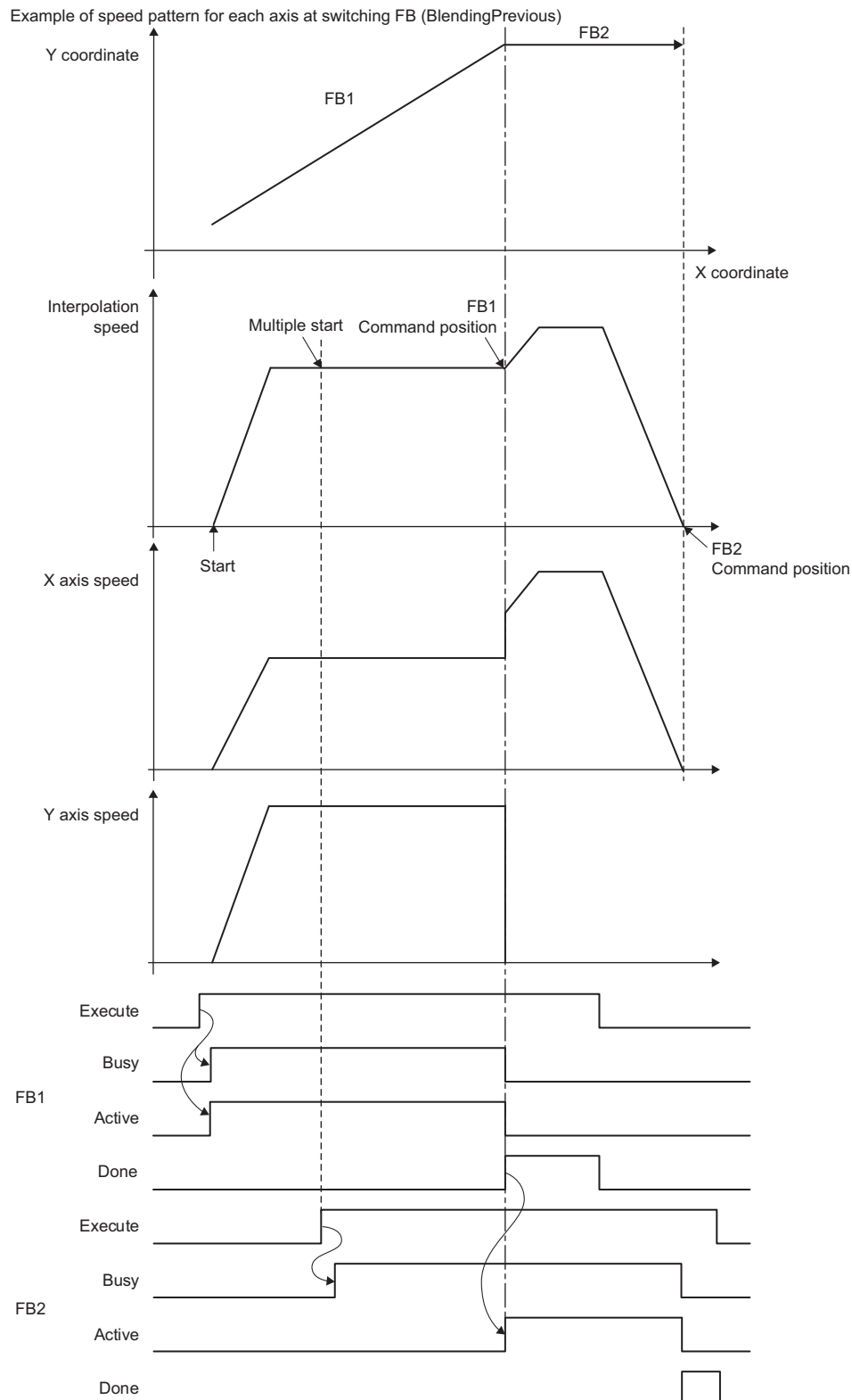
Multiple start during multiple axes operation

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: Standby (GroupStandby)" status, it is regarded as "start".)

[Axes Group Status (AxesGroupName.Md.GroupStatus) that can be multiple started]

5: Operating (GroupMoving)

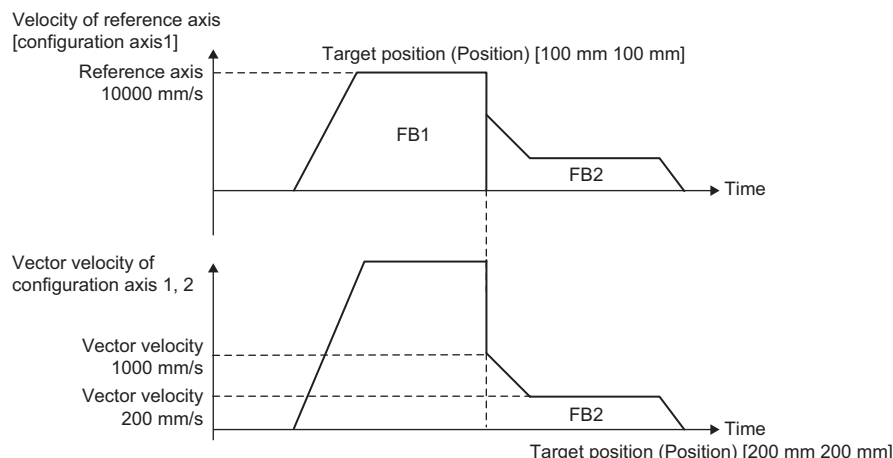
In multiple start during multiple axes operation, the current interpolation speed of the FB being executed is used as the switching speed. Therefore, acceleration/deceleration may not be executed and rapid a velocity change may occur depending on the movement amount and direction of each axis in the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



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

Ex.

Multiple start by specifying BlendingPrevious from FB1 with the reference axis velocity to FB2 with the vector velocity



The operation is carried out so that the reference axis velocity of FB1 becomes the velocity set in Velocity (Velocity) (reference axis velocity 1000 [mm/s]). The reference axis velocity at the target position of FB1 is regarded as the switching speed and the current vector velocity value of FB2 without conversion, and it accelerates and decelerates the vector velocity (200 [mm/s]) set in Velocity (Velocity) of FB2.

Multiple start of the single axis control FB cannot be executed to the axis that is during operation in the axes group. If it is executed, the error "Motion 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 on 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 motion FB		
	Aborting	Buffered	Blending		Aborting	Buffered	Blending
MC_GroupStop (Group Forced Stop)	—*1	—	—	Execution completion (Done)	○*2	—	—
MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)	○	○	○	Execution completion (Done)	○	○	○
MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)	○	○	○	Execution completion (Done)	○	○	○
MCv_MoveCircularInterpolateAbsolute (Absolute Value Circular Interpolation Control)	○	○	○	Execution completion (Done)	○	○	○
MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control)	○	○	○	Execution completion (Done)	○	○	○

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

*2 Only MC_GroupStop (Group Forced Stop) is possible.

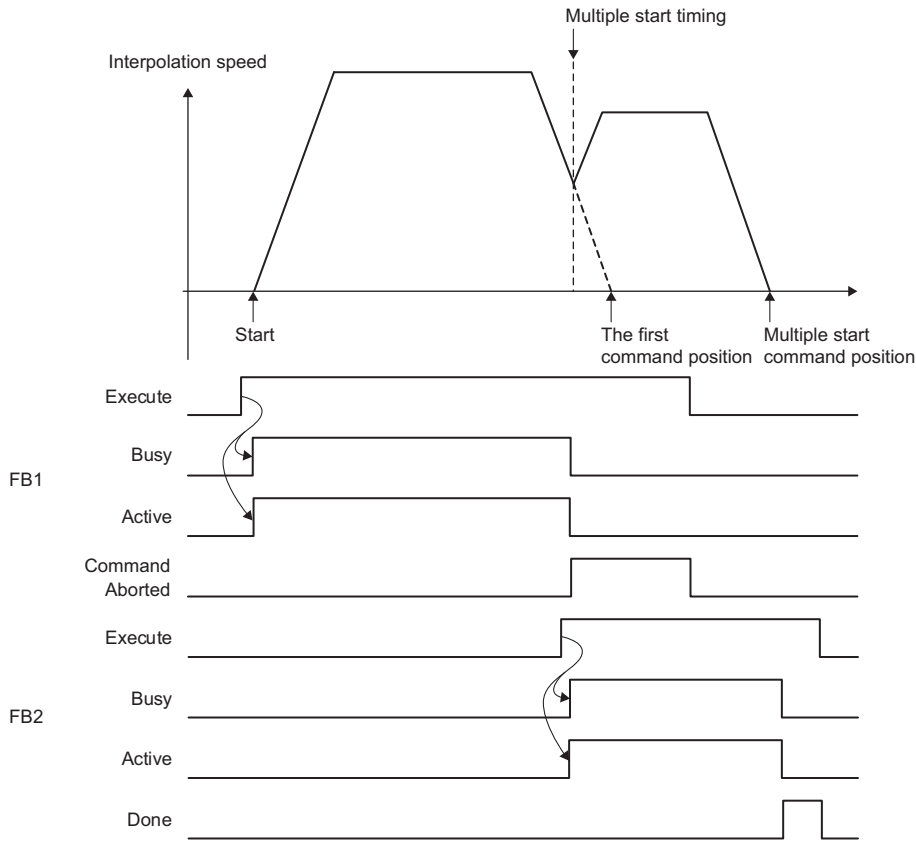
Aborting during multiple axes operation

The FB being executed 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 FBs being executed have already been in buffering, and the FB is executed. (All FBs during buffering are interrupted.)

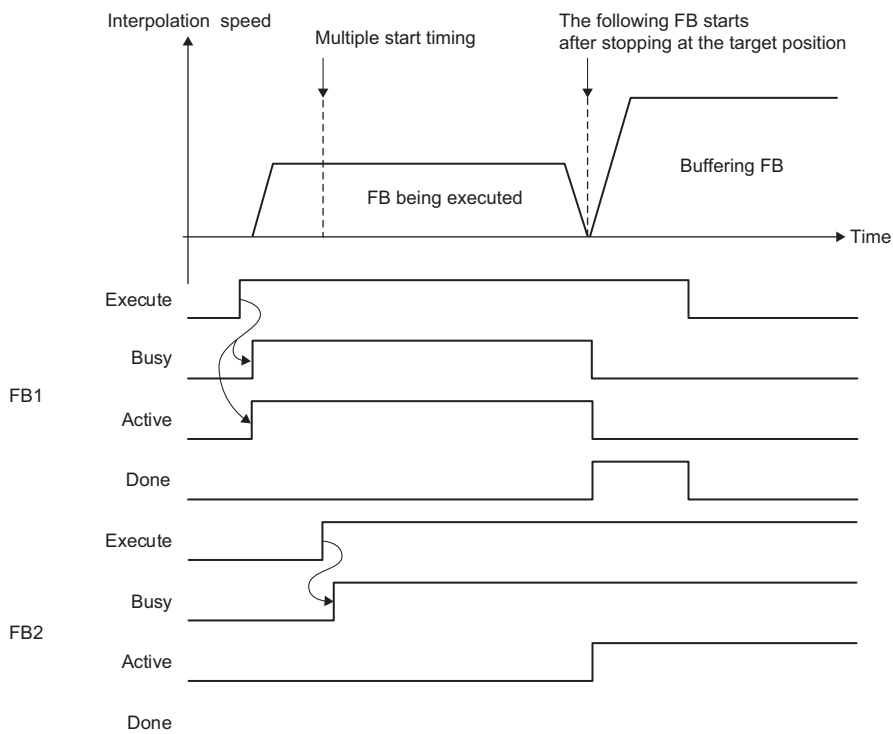
When omitting to specify the buffer mode, this operation is performed.

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



Buffered during multiple axes operation

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

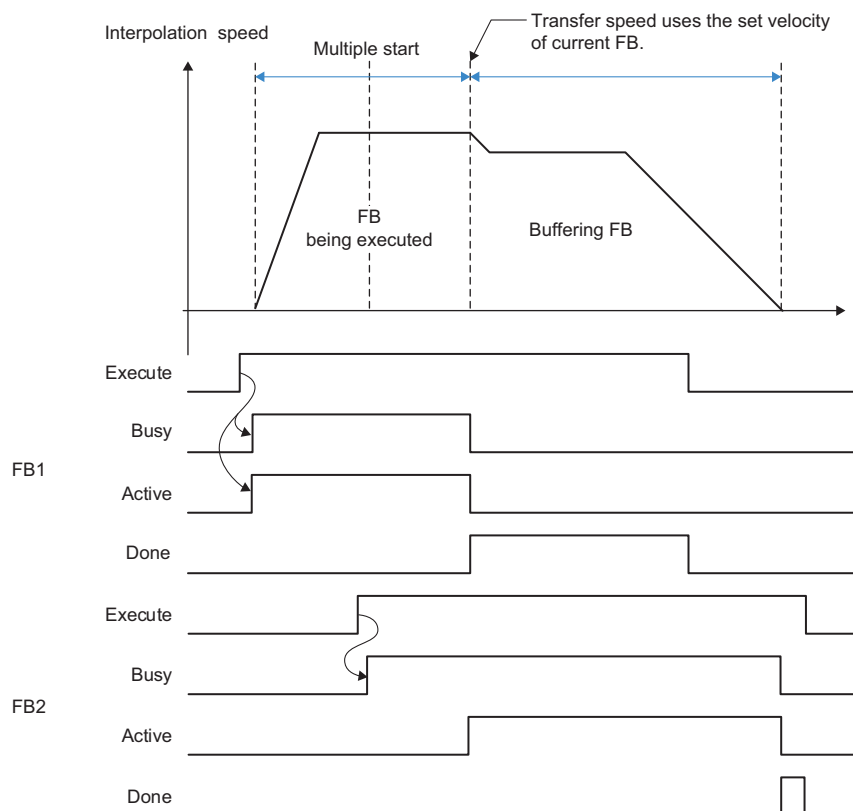


Blending during multiple axes operation

Multiple started FBs are buffered and wait until the FB being executed is completed. After the FB being executed 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.

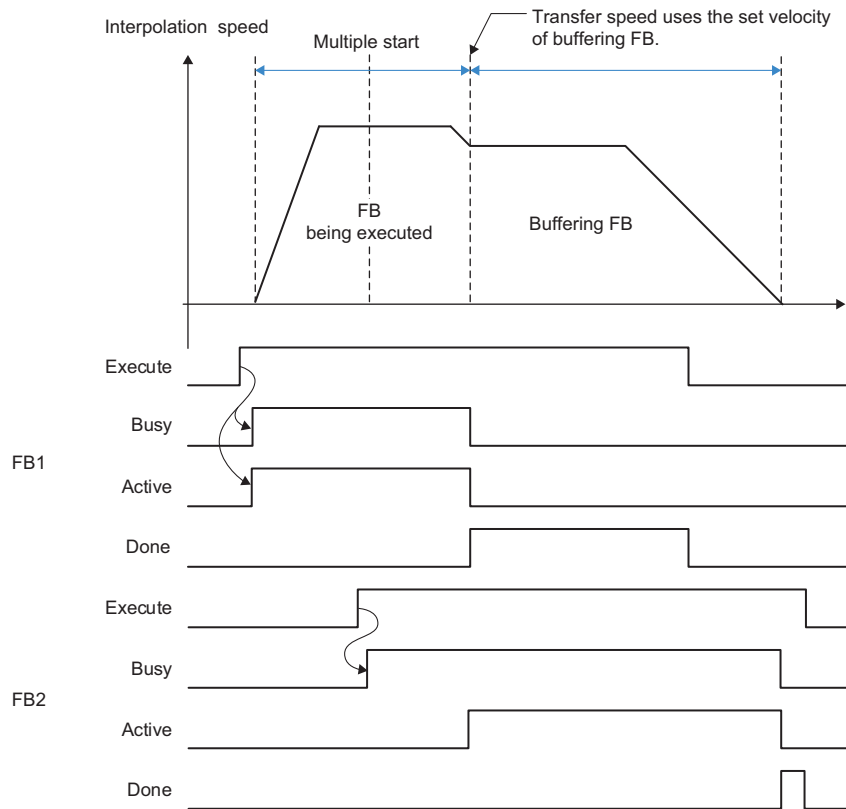
■BlendingPrevious

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

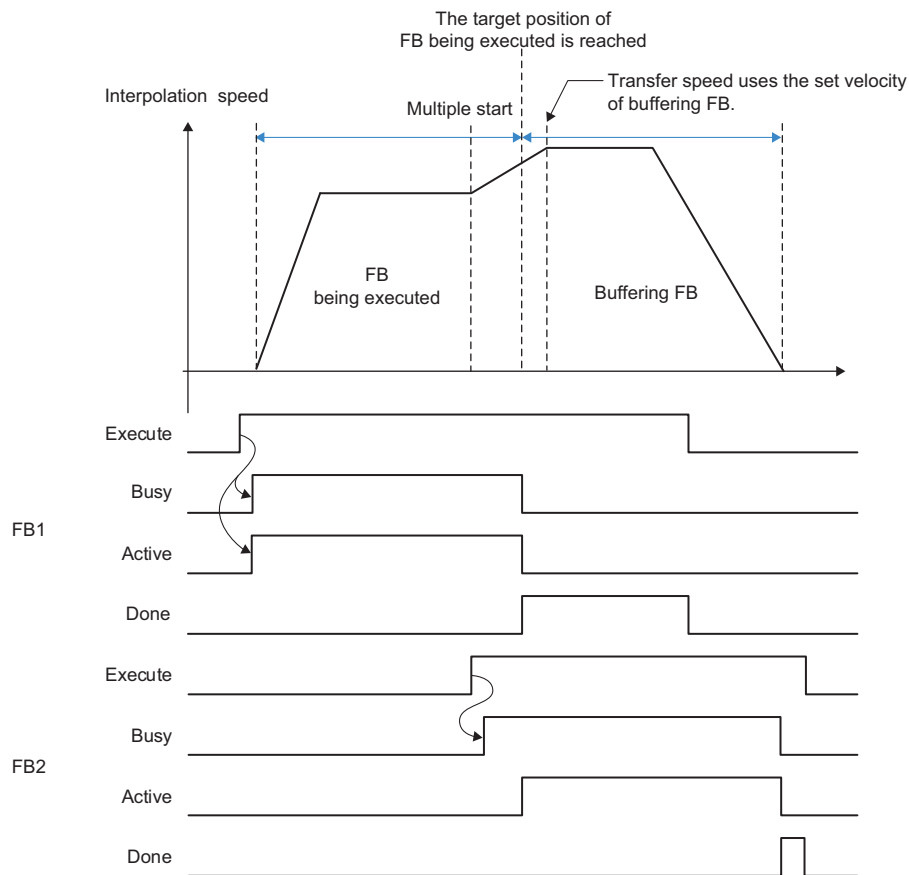


■BlendingNext

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 FB being executed.



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 FB being executed. 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 FB being executed.



■BlendingLow

The smaller target velocity between the FB being executed and the buffering FB is used as the switching velocity. When the smaller switching velocity is the FB being executed, the control is the same as BlendingPrevious, and when the smaller switching velocity is the buffering FB, the control is the same as BlendingNext.

■BlendingHigh

The larger target velocity between the FB being executed and the buffering FB is used as the switching velocity. When the larger switching velocity is the FB being executed, the control is the same as BlendingPrevious, and when the larger switching velocity is the buffering FB, the control is the same as BlendingNext.

Option of buffering FB

Set the option of the function used for the buffering FB by Options (Options) of the buffering FB. For the positioning control FB which can be specified, refer to details for the operation of the each positioning control FB.

The option to be used by the multiple start is shown below.

Positioning selection in the buffer mode (Options (Options) bit3)

When the relative value positioning control is multiple started, the relative value positioning control from set position or actual position is carried out by Position selection at the multiple start of FB (Options (Options) bit 3).

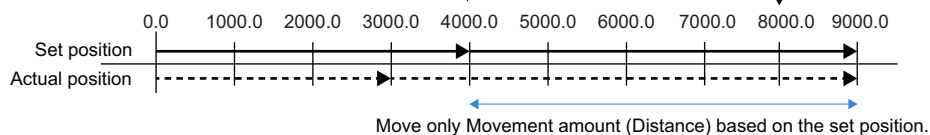
The axis type which does not have the actual position ignores this setting.

Setting value	Description
0	The relative value positioning control from set position
1	The relative value positioning control from actual position

Ex.

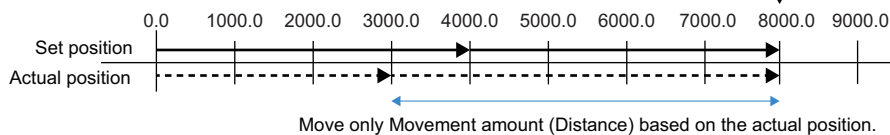
When Relative value positioning control from set position (Options (Options) bit 3 = 0) is specified

MC_MoveRelative (Relative Value Positioning) is multiple started with the following settings.
Distance := 5000.0
Options := H00000000 //bit3 = 0



When Relative value positioning control from actual position (Options (Options) bit 3 = 1) is specified

MC_MoveRelative (Relative Value Positioning) is multiple started with the following settings.
Distance := 5000.0
Options := H00000008 //bit3 = 1



Reverse rotation permission selection (Options (Options) bit5)

In the single axis motion FB, reverse rotation is allowed when the operation direction differs between the FB being executed and the buffering FB. For details, refer to the following.

Page 138 Multiple start during single axis operation

Setting value	Description
0	Reverse is allowed.
1	Reverse is not allowed.

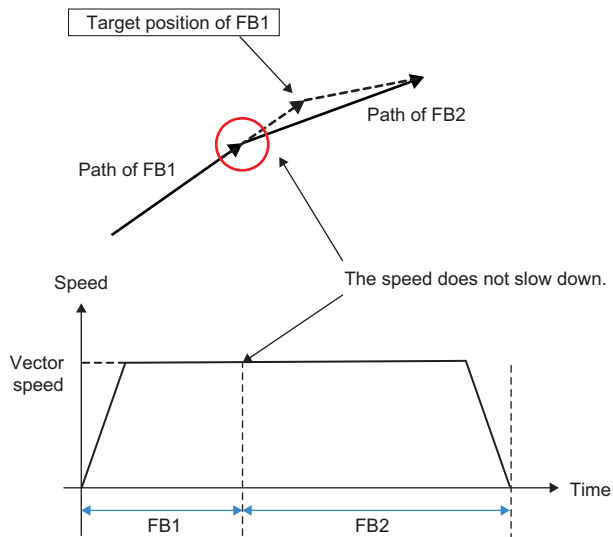
Near pass

At multiple start by Blending, near pass is performed to suppress machine vibration which occurs at switching of the positioning control FB.

The remainder of the movement amount which occurs at the end of the positioning control FB is used for the next one. Set velocity does not decrease and machine vibration which occurs by the velocity change can be suppressed as the positioning is not carried out for each positioning control FB. Since the alignment is not performed every positioning control FB, the operation is controlled in a path that passes near the position set in the FB.

Ex.

For multiple starting the 2-axes linear interpolation control with Blending (multiple start of FB2 during controlled of FB1)



Combination with retrigger/continuous update

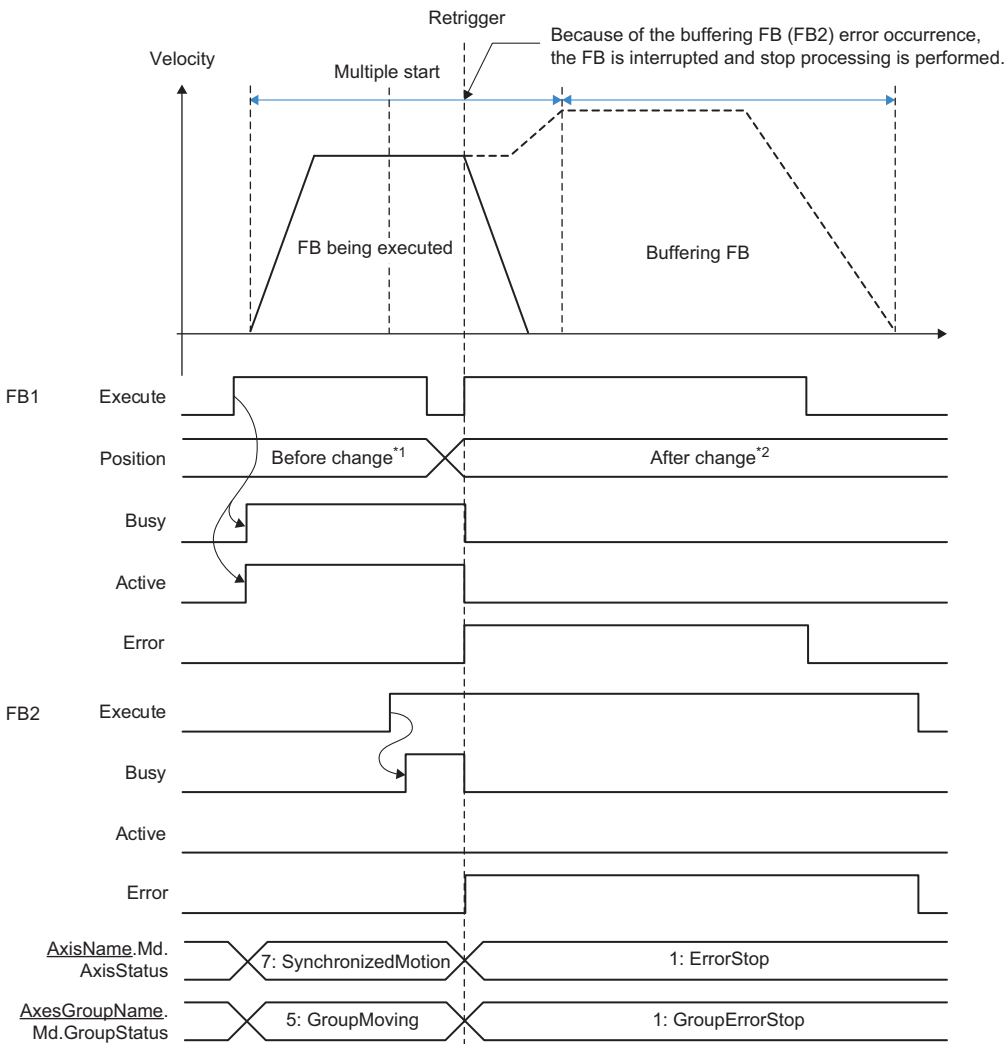
Reanalysis of the buffering FB by retrigger/continuous update

When the target position or the target velocity is changed by retrigger/continuous update for the FB being executed, the reanalysis of the buffering FB may be needed.

As a result of reanalysis, when an error occurs in any of the FBs, Axis Status (AxisName.Md.AxisStatus) becomes "1: Stopping on error (ErrorStop)" or Axes Group Status (AxesGroupName.Md.GroupStatus) becomes "1: Stopping on error (GroupErrorStop)" and the FB being executed is interrupted and stopped. (The buffering FB is canceled.)

Ex.

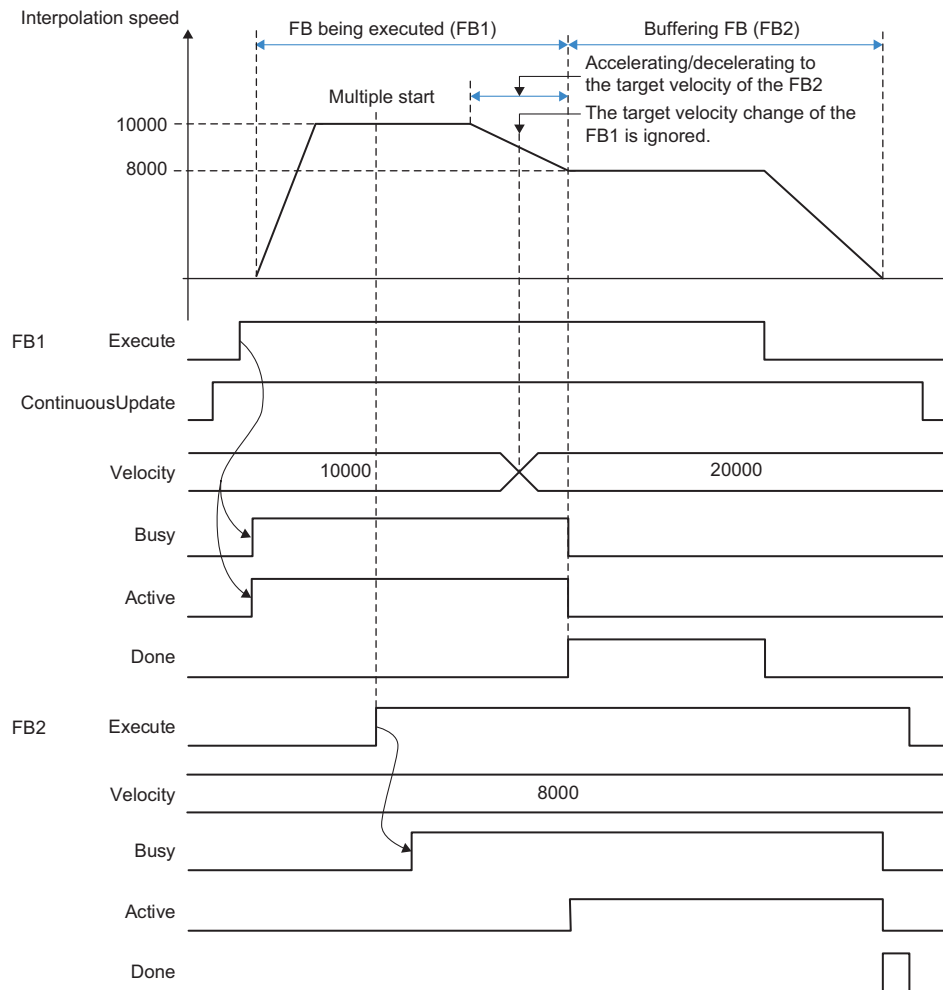
The changed target position is out of the software stroke limit range by retriggering the FB being executed.



*1 The target position is within the software stroke limit range.
*2 The target position is out of the software stroke limit range.

BlendingNext changes target velocity at accelerating/decelerating

As BlendingNext is specified and the multiple start is executed, while the buffering FB is accelerating/decelerating to its target velocity (transfer speed), the target velocity change of FB being executed is not allowed.



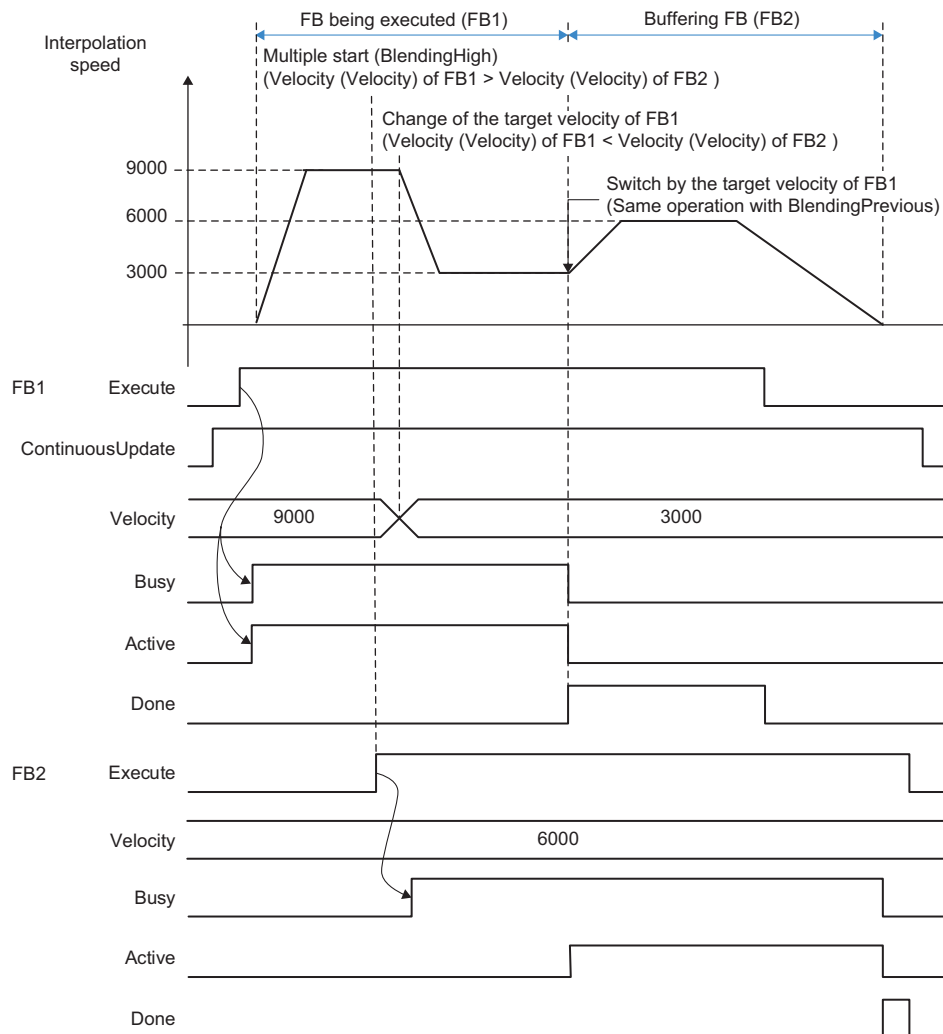
BlendingLow/BlendingHigh changes target velocity after multiple start

Which velocity is used, the velocity of FB being executed or buffering FB, is determined at the multiple start by BlendingLow/BlendingHigh.

Therefore, if the size relation the target velocity between the FB being executed and the buffering FB is changed by target velocity change after multiple start, the velocity used for switching is not changed.

Ex.

When the target velocity is changed after multiple start by BlendingHigh

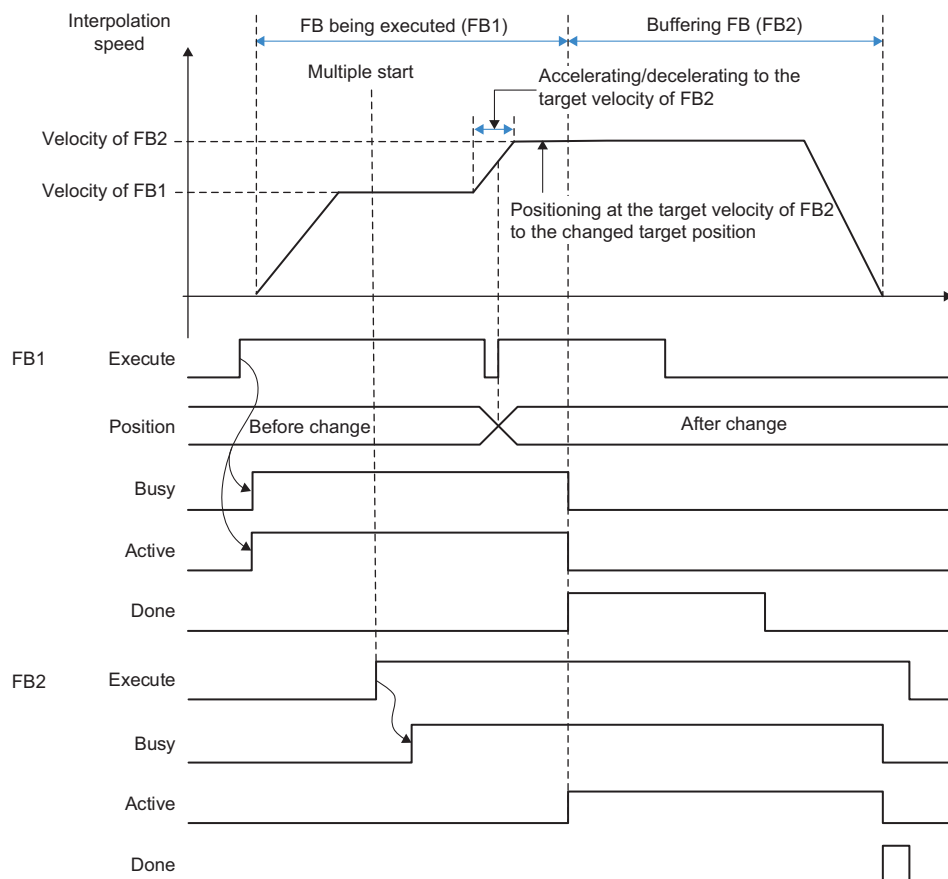


BlendingNext changes target position/movement distance at accelerating/decelerating

As BlendingNext is specified and the multiple start is executed, when the target position/movement distance change during accelerating/decelerating to the target velocity (transfer speed) of the buffering FB is executed, the operation of retrigger and continuous update is different.

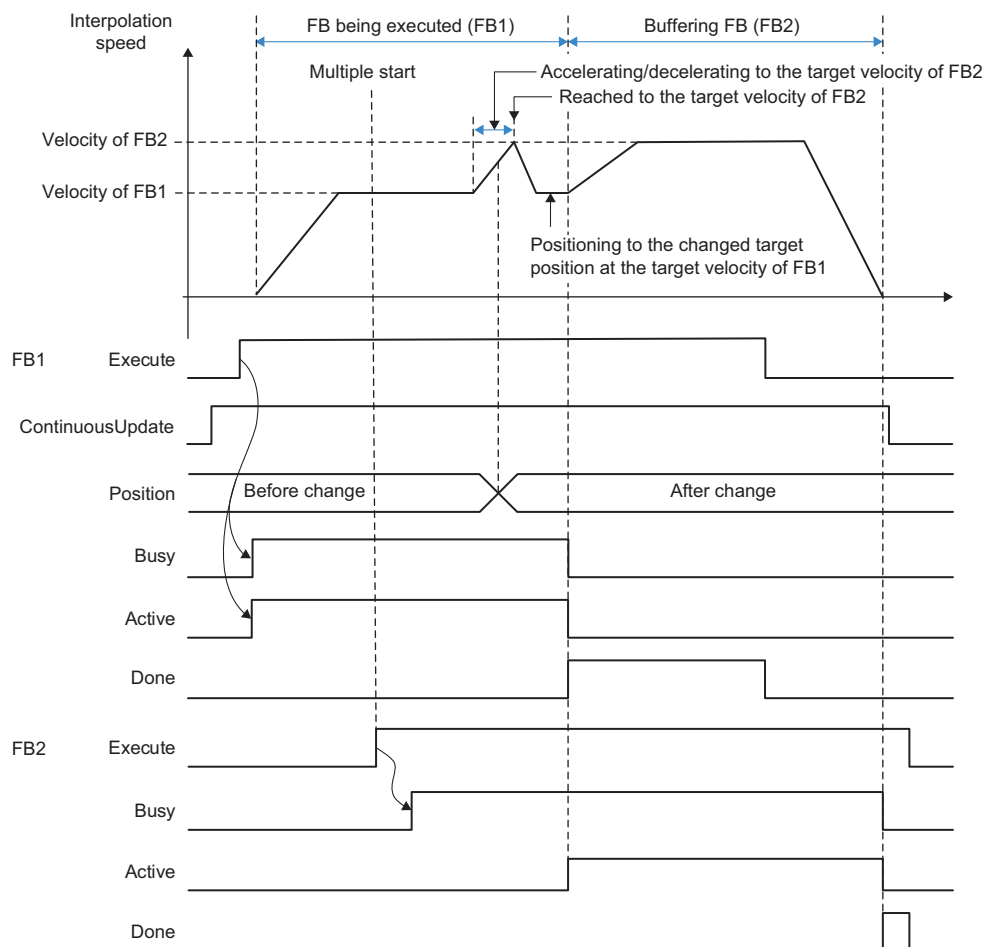
■Target position/movement distance change by retrigger

When the target position/movement distance change is carried out by retrigger, the target velocity (transfer speed) of the buffering FB is maintained and the position to the changed target position/movement distance is fixed.



■Target position/movement distance change by continuous update

When the target position/movement distance change is carried out by continuous update, the velocity accelerates/decelerates to the target velocity (transfer speed) of the buffering FB. After that, it accelerates/decelerates again to the target velocity of on-going FB and positioning to the changed target position/movement distance is fixed.

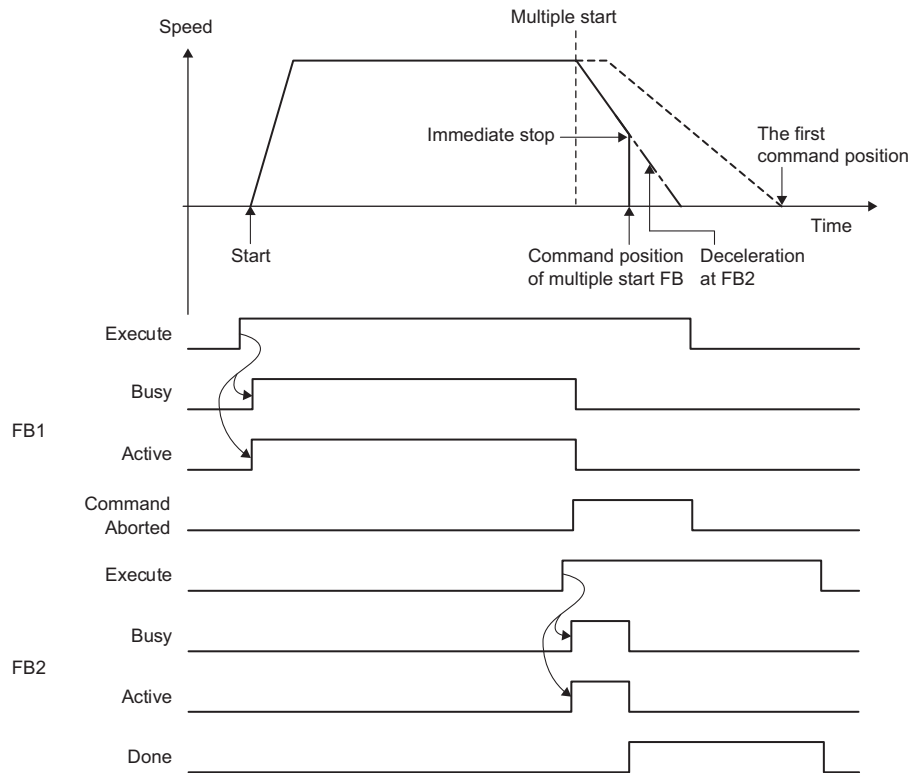


Precautions

When deceleration distance of a buffering FB cannot be secured with the switching speed and the target position is overrun at switching to the buffering FB, automatic deceleration operation is performed according to the setting of Operation Setting at Overrun (`AxisName(AxesGroupName).Pr.OverrunOperation`).

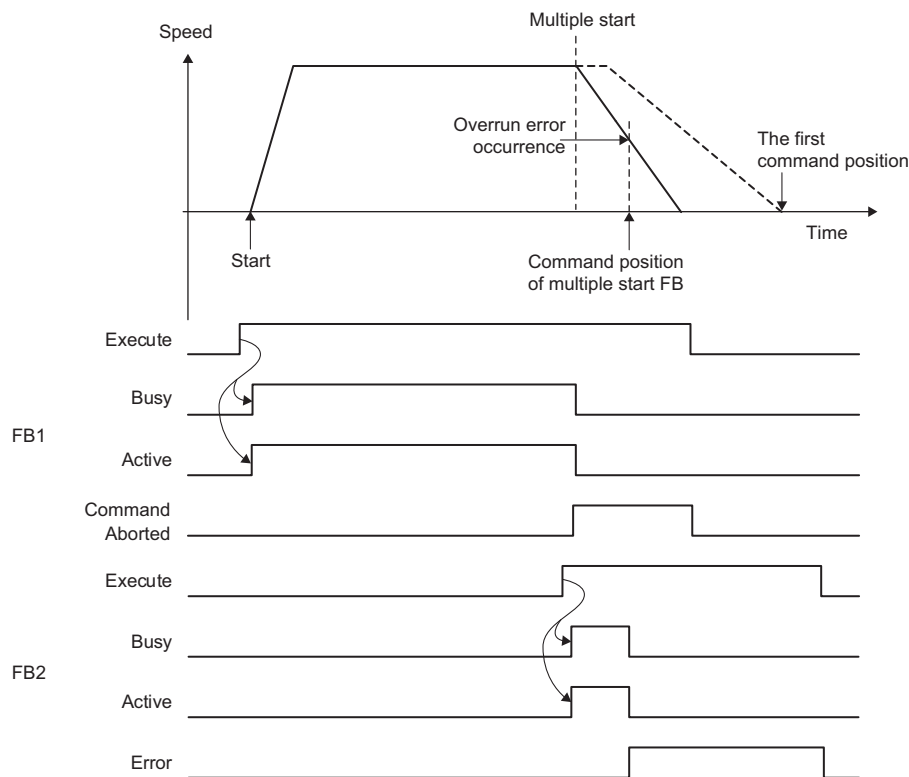
- For "1: Immediate Stop (ImmediateStop)"

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: Keep Current Acceleration/Deceleration (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 Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General). To stop the axis after it exceeds the target position, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).



Point

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

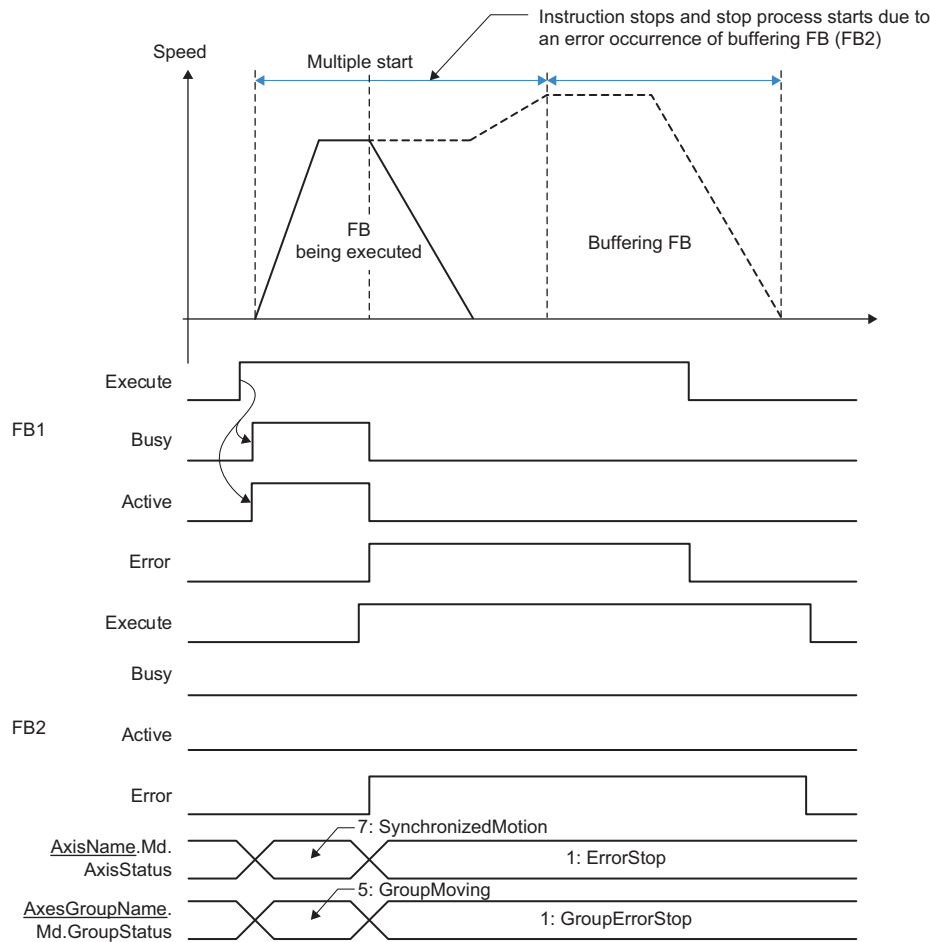
[When Operation Setting at Overrun (AxisName.Pr.OverrunOperation) is "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" setting]

- 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 Operation Setting at Overrun (AxisName.Pr.OverrunOperation) is other than "2: Keep Current Acceleration/Deceleration (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, Axis Status (AxisName.Md.AxisStatus) and Axes Group Status (AxesGroupName.Md.GroupStatus) will be "1: Stopping on error (GroupErrorStop)" and the FBs being executed will stop.



If the acceleration/deceleration method settings are different between the FB being executed 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.

Changes are reflected at the switching of FB when restart or continuous update is executed to the buffering FB after multiple start. If the warning occurs at the switching of FB, it operates with the value at multiple start without accepting the changes.

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 (Enable)" of MC_Power (Operation Available) is FALSE
- When "Servo ON request (ServoON)" of MC_Power (Operation Available) is FALSE
- When the hardware stroke limit upper/lower limit error occurs
- When a CPU module error occurs
- When the "PLC READY [Y0]" is turned OFF
- When the cycle over error occurs
- When a moderate error or a major error of the motion system occurs
- When the software stroke limit upper/lower limit error occurs
- When an axis error is detected
- When "Execute command (Execute)" of MC_Stop (Forced Stop) is TRUE
- When "The stop signal (STOP)" 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 command (Execute)" of MC_GroupStop (Group Forced Stop) is TRUE
- When "the stop signal (STOP)" 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.

Operation of this function for each system status

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Variable/Structure name	Name	Details
AxisName.Pr.		
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Selects operation when the hardware stroke limit upper/lower limit error occurs. 1: Immediate Stop (ImmediateStop) (Initial value) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	Selects operation when the software stroke limit upper/lower limit error occurs. 1: Immediate Stop (ImmediateStop) (Initial value) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_General	Stop Selection at Stop Cause Occurrence	Selects operation when a stop cause for each axis other than the stop cause 1 and 2 occurs. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) 3: Alternative Acceleration/Deceleration (AlternativeAcc) (initial value) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_Deceleration	Deceleration at Stop	Specifies the deceleration 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 $[\text{U/s}^2]^{*1}$ - 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 $[\text{s}]^{*1}$ 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: Recreate Deceleration Curve at Increased Deceleration (RapidCurve) 1: Recreate Deceleration Curve (OverrideCurve) (Initial value) 2: Maintain Deceleration Curve (ContinueCurve)
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Selects operation when Servo ON request (ServoON) of MC_Power (Operation Available) becomes FALSE during operation. 0: Ignore (Ignore) (Initial value) 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop) 5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)
OverrunOperation	Operation Setting at Overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. 1: Immediate Stop (ImmediateStop) (Initial value) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Variable/Structure name	Name	Details
StopSignal	Stop Signal	Sets a signal that uses the stop signal (STOP) of the external input signal. Stop signal (StopSignal) is a structure of SIGNAL_SELECT type. The specific setting and operation for this signal are below. • I/O No. (StartIO) Ignores input values. • Target (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 "Out of Parameter Range (Axis)" (error code: 1D80H) is output. • Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) • Compensation Time (CompensationTime) Ignores the input value. • Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting Range of Each Axis Signal Warning" (warning code: 0D24H) is output and the axis operates with 0.0 of the filter time. The fetch timing of the label is at ready ON and the detection timing of the signal is the axis operation cycle. For the details on the SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection
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)
<u>AxisName.Md.</u>		
StopSignal	Stop Signal	Displays input status of the stop signal (STOP) of the external input signal. Stop signal (StopSignal) is a structure of SIGNAL_SELECT type. The specific output for this signal is below. • I/O No. (StartIO) 0 is always displayed. • Target (Target) The fetch result of the parameter is displayed. • Signal Detection Method (Detection) The fetch result of the parameter is displayed. • Compensation Time (CompensationTime) 0.0 is always displayed. • Filter Time (FilterTime) The fetch result of the parameter is displayed. For the details on the SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection
StopStatus	Stop Status	Displays the input status of the 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 Cause Occurrence	Displays input status of the stop selection at stop cause occurrence.
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Displays input status of the stop selection at the hardware stroke limit error occurrence.
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Displays input status of the processing selection at servo OFF command during operation.
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	Displays input status of the stop selection at the software stroke limit error occurrence.
OverrunOperation	Operation Setting at Overrun	Displays input status of the overrun operation setting.
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Displays driver command discard detection setting status
<u>AxesGroupName.Pr.</u>		

Variable/Structure name	Name	Details
StopMode_General	Stop Selection at Stop Cause Occurrence	Selects operation when a stop cause of the axes group occurs. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) 3: Alternative Acceleration/Deceleration (AlternativeAcc) (Initial value) (Immediate stop will be executed when executing an instruction without deceleration specification.)
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Selects operation when a stop cause occurs during deceleration (including a stop cause and automatic deceleration). 0: Recreate Deceleration Curve at Increased Deceleration (RapidCurve) 1: Recreate Deceleration Curve (OverrideCurve) (Initial value) 2: Maintain Deceleration Curve (ContinueCurve)
OverrunOperation	Operation Setting at Overrun	Selects operation when stop position is reached during deceleration stop processing by a stop cause. If other than "1: Immediate Stop (ImmediateStop)" (Initial value) is set, an error will occur. 1: Immediate Stop (ImmediateStop)
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	During operation in the axes group, when the driver servo is turned OFF on the configuration axis and an immediate stop axis error occurs, it sets the operation of the axis which an error does not occur. 1: Immediate Stop (ImmediateStop) (Default value) 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)
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	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	Displays input status of the configuration axes operation selection at axis stop cause occurrence.
StopMode_General	Stop Selection at Stop Cause Occurrence	Displays input status of the stop selection at stop cause occurrence.
OverrunOperation	Operation Setting at Overrun	Displays input status of the overrun operation setting.
System.Pr.		
StopMode_All	Stop Selection at All Axes Stop Cause Occurrence	Selects whether to stop immediately or decelerate to stop when an all axes stop cause occurs. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc) 3: Alternative Acceleration/Deceleration (AlternativeAcc) (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 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.

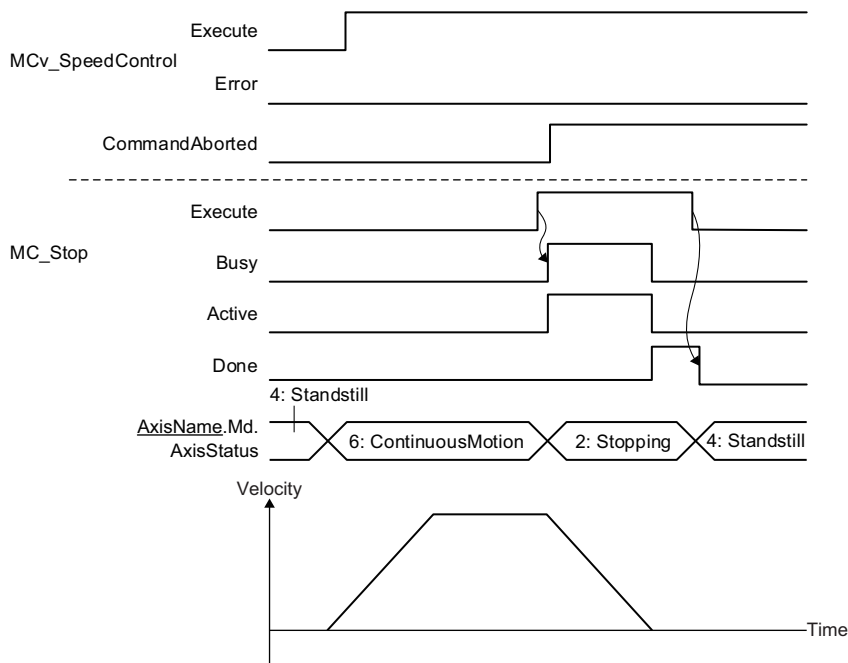
*1 Clamp by the upper limit value when the upper limit value is out of the range at stop by factors, and handle as 0 (Immediate stop) when lower limit value is out of the range.

Relevant FBs

MC_Stop			
Item	Description		
Function overview	Decelerates specified axis to stop.		
Symbol [Structured Ladder]	MC_Stop DUT : Axis Axis : DUT B : Execute Done : B L : Deceleration Busy : B L : Jerk Active : B UD : Options CommandAborted : B Error : B ErrorID : UW		
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
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 27 Execute command (Execute) type/Enable (Enable)

■ 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 754 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 353 Input variables to use	0.0	Sets the deceleration.
Jerk (Reserved)	Jerk	LREAL	↑/R	0.0	0.0	Set "0.0". (If a value other than "0.0" is set, the error "Out of Jerk Range" (error code: 1A13H) will occur.)
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Set "00000000H". (If a value other than "00000000H" is set, the error "Out of Options Range" (error code: 1A4EH) 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 has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

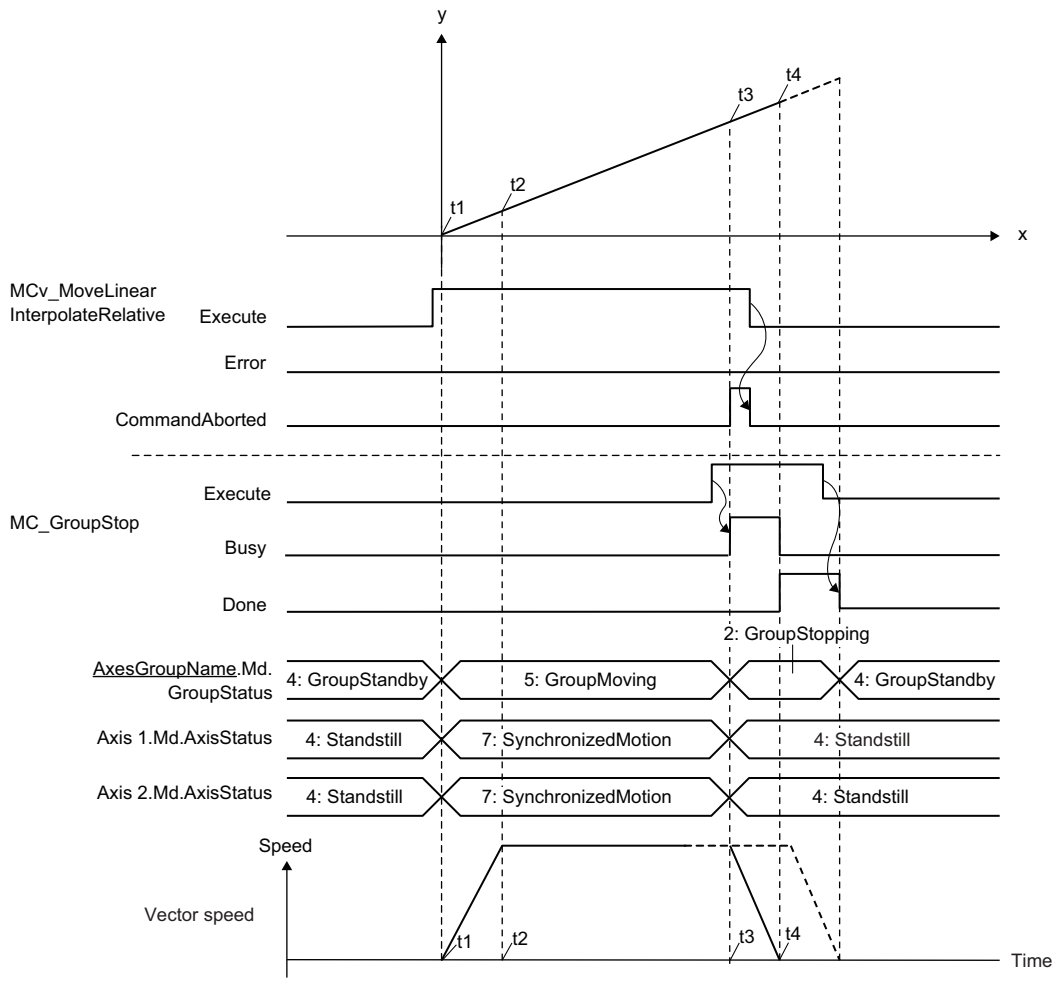
MC_GroupStop

Item	Description
Function overview	Decelerates specified axes group to stop.
Symbol [Structured Ladder]	MC_GroupStop DUT : AxesGroup B : Execute L : Deceleration L : Jerk UD : Options AxesGroup : DUT Done : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW
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
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 27 Execute command (Execute) type/Enable (Enable)

■ 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 758 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 353 Input variables to use	0.0	Sets the deceleration.
Jerk (Reserved)	Jerk	LREAL	↑	0.0	0.0	Set "0.0". (If a value other than "0.0" is set, the error "Out of Jerk Range" (error code: 1A13H) will occur.)
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Set "00000000H". (If a value other than "00000000H" is set, the error "Out of Options Range" (error code: 1A4EH) 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 has been aborted because of other FBs.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 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 (<u>AxisName</u> .Md.AxisStatus)		Stop process ^{*1}
			During deceleration stop	After stop	
1	"Forced stop input" is FALSE	Each axis/All axes	—	1: Stopping on error (ErrorStop)	Immediate stop ^{*2}
2	Drive unit power supply is OFF	Each axis	—	1: Stopping on error (ErrorStop)	Immediate stop ^{*2}
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable (Enable) of MC_Power (Operation Available) is FALSE				
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (<u>AxisName</u> .Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)") ^{*3}				
	Drive unit control mode has switched to the control mode which the motion system axis control is not supported.				Immediate stop ^{*6}
3	Hardware stroke limit upper/lower limit error occurrence	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Hardware Stroke Limit Error Occurrence (<u>AxisName</u> .Pr.StopMode_HwStrokeLimit))
4	CPU module error occurrence	All axes	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at All Axes Stop Cause Occurrence (<u>System</u> .Pr.StopMode_All))
	PLC READY [Y0] is OFF				
	Cycle over error occurrence				
	Motion system moderate error or major error occurrence				
5	Software stroke limit upper/lower limit error occurrence	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Software Stroke Limit Error Occurrence (<u>AxisName</u> .Pr.StopMode_SwStrokeLimit))
6	Axis error detection ^{*4}	Each axis	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxisName</u> .Pr.StopMode_General))
7	Execute command (Execute) of MC_Stop (Forced Stop) is TRUE	Each axis	2: Decelerating to stop (Stopping)	2: Decelerating to stop (Stopping) ^{*5}	Deceleration stop (Follows the deceleration set in the FB)
8	"The stop signal (STOP) " of external input signal is TRUE	Each axis	No change	4: Standby (Standstill)	Deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxisName</u> .Pr.StopMode_General))

*1 For each operation of the stop process, refer to the following.

☞ Page 176 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 Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.

☞ Page 182 Stop causes by Servo ON request (ServoON) input of MC_Power (Operation Available)

*4 If an axis error (the error that transits the state into the "1: Stopping on error (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 command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

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

Precautions

Provide the emergency stop circuits outside the servo system to prevent cases where danger may result from abnormal operation of the entire system in the event of an external power supply fault or servo system failure.

Stop causes during axes group operation

The following shows stop causes during axes group operation and the process when each cause occurs.

Cause No.	Stop cause		Stop axis	Axes Group Status (<u>AxesGroupName.Md.GroupStatus</u>)		Stop process ^{*1}	
				During deceleration stop	After stop		
1	Stop cause occurrence in the configuration axis	Axis error detection	Axes group	1: Stopping on error (GroupErrorStop)	1: Stopping on error (GroupErrorStop)	Stop cause occurrence axis	Axes group deceleration stop/immediate stop ^{*2} (For axes group deceleration stop, it follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>))
						Other configuration axes	Axes group deceleration stop/immediate stop (For axes group deceleration stop, it follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>)) ^{*3}
2		"The stop signal (STOP)" of external input signal is TRUE	Axes group	No change	4: Standby (GroupStandby)	Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>))	
3	Axes group error detection ^{*4}		Axes group	1: Stopping on error (GroupErrorStop)	1: Stopping on error (GroupErrorStop)	Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>))	
4	Execute command (Execute) of MC_GroupStop (Group Forced Stop) is TRUE		Axes group	2: Decelerating to stop (GroupStopping)	2: Decelerating to stop (GroupStopping) ^{*5}	Axes group deceleration stop (Follows the deceleration set in the FB)	

*1 For each operation of the stop process, refer to the following.

☞ Page 178 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 Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup). For details, refer to the following.

☞ Page 191 Stop cause occurrence in the configuration axis

*4 If an axes group error (the error that transits the state into the "1: Stopping on error (GroupErrorStop)" status) occurs in the FB which can be linked by the buffer mode, automatic deceleration will be performed from the axes group error occurrence.

*5 When Execute command (Execute) of MC_GroupStop (Group Forced Stop) is FALSE at stop completion, Axes Group Status (AxesGroupName.Md.GroupStatus) after stop will be "4: Standby (GroupStandby)".

Types of stop processes

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

Stop processes for single axis

■Deceleration stop

The operation decelerates from the speed during operation to speed 0. The deceleration differs depending on Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).

Stop Selection at Stop Cause Occurrence (<u>AxisName.Pr.StopMode_General</u> setting value)	Deceleration at stop
2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)	Deceleration at instruction during operation
3: Alternative Acceleration/Deceleration (AlternativeAcc)	Deceleration at Stop (<u>AxisName.Pr. StopMode_Deceleration</u>)

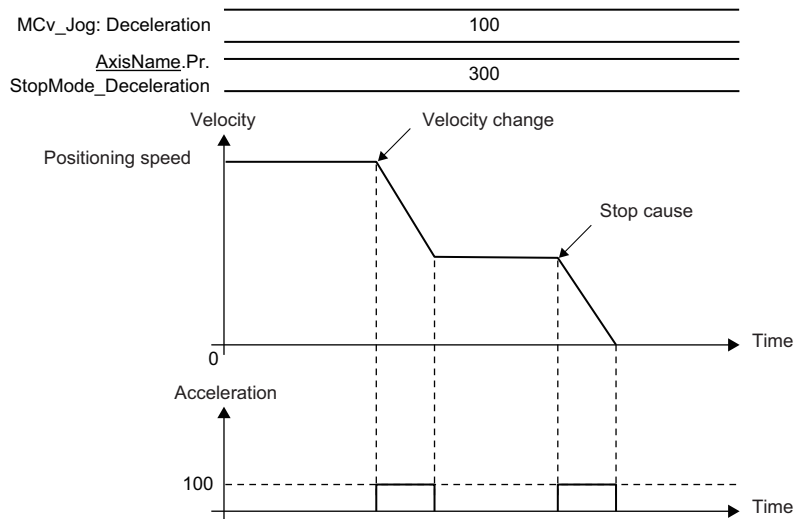
However, the stop is performed by the MC_Stop (Forced Stop) execution, the deceleration specified in Deceleration (Deceleration) is applied.

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.

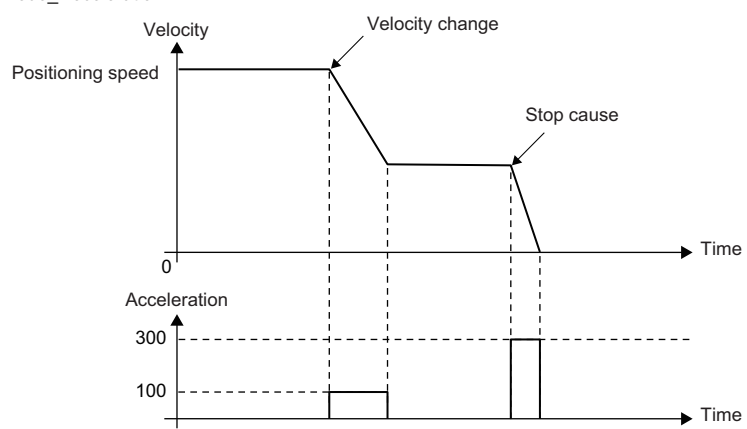
☞ Page 348 Acceleration/deceleration Processing Function

- When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) (When the instruction in operation is MCv_Jog (JOG Operation))



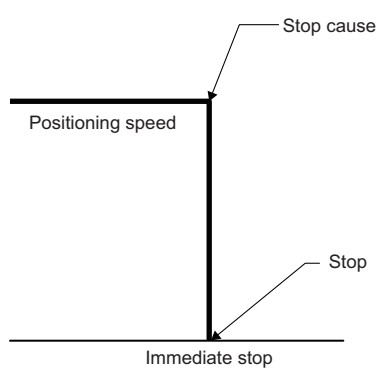
- When "3: Alternative Acceleration/Deceleration (AlternativeAcc)" is set to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) (When the instruction in operation is MCv_Jog (JOG Operation))

MCv_Jog: Deceleration	100
<u>AxisName</u> .Pr.	300
StopMode_Deceleration	



■ Immediate stop

The operation does not decelerate and immediately stops the command.
 For the stop method of the drive unit, refer to each drive unit manual.
 For MR-J5(W)-G: MR-J5-G/MR-J5W-G User's Manual (Parameters)



Stop processes for axes group

Deceleration stop

The operation decelerates from the interpolation speed during operation to the interpolation speed 0. The deceleration differs depending on Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).

Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>) setting value	Deceleration at stop
2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)	Deceleration at instruction during operation
3: Alternative Acceleration/Deceleration (AlternativeAcc)	Deceleration at Stop (<u>AxesGroupName.Pr. StopMode_Deceleration</u>)

However, the stop is performed by the MC_GroupStop (Group Forced Stop) execution, the deceleration specified in Deceleration (Deceleration) is applied.

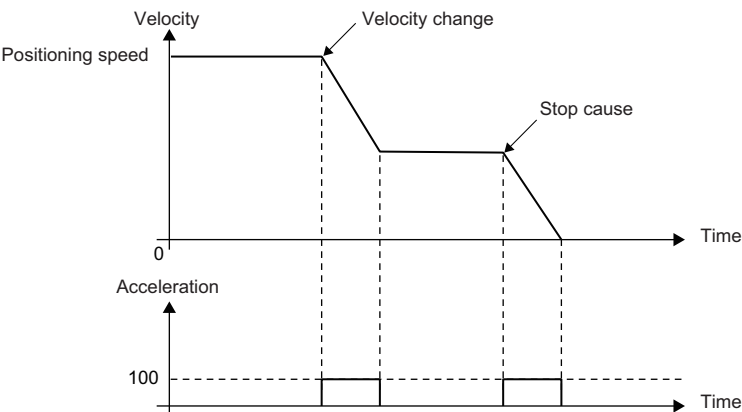
The acceleration/deceleration method and the jerk setting of deceleration stop take over the setting value of FB which was being executed when stop cause occurred.

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

Page 348 Acceleration/deceleration Processing Function

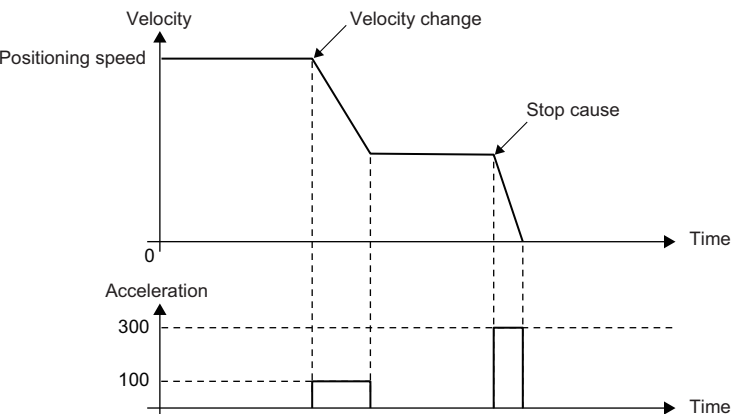
- When "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" is set to Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General (When the instruction in operation is MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)))

MCv_MoveLinearInterpolateRelative	100
: Deceleration	
<u>AxesGroupName.Pr.</u>	300
StopMode_Deceleration	



- When "3: Alternative Acceleration/Deceleration (AlternativeAcc)" is set to Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General) (When the instruction in operation is MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)))

MCv_MoveLinearInterpolateRelative	100
: Deceleration	
<u>AxesGroupName.Pr.</u>	300
StopMode_Deceleration	

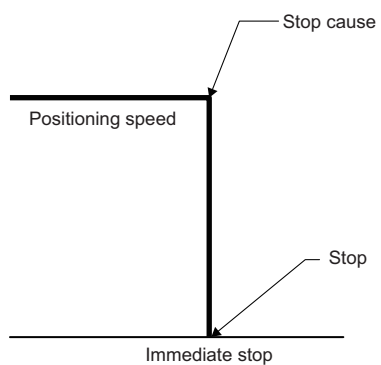


■ Immediate stop

The operation does not decelerate and immediately stops the command.

For the stop method of the drive unit, refer to each drive unit manual.

For MR-J5(W)-G:  MR-J5-G/MR-J5W-G User's Manual (Parameters)



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: Stop Selection at Deceleration to Stop (AxisName.Pr.StopMode_DecelerationCurve)
- Axes group: Stop Selection at Deceleration to Stop (AxesGroupName.Pr.StopMode_DecelerationCurve)

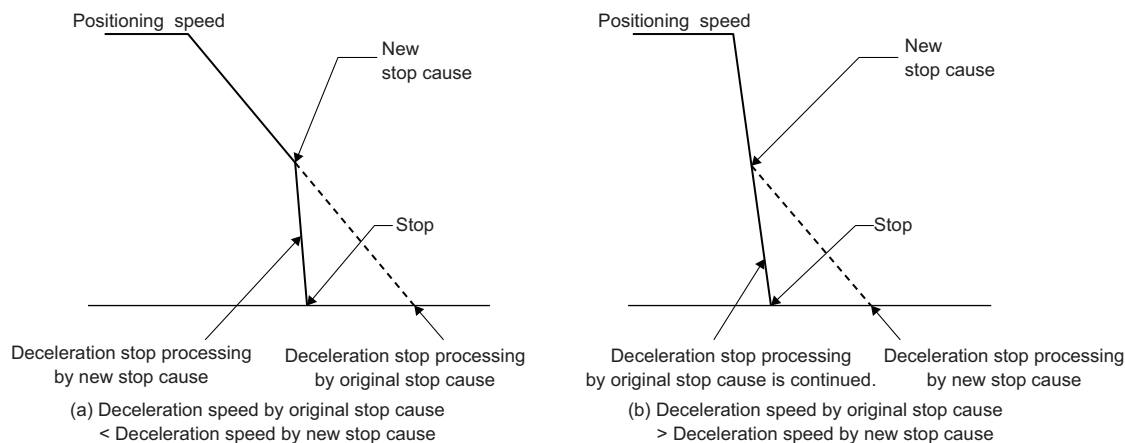
For Stop Selection at Deceleration to Stop (AxisName.Pr.StopMode_DecelerationCurve/

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: Recreate Deceleration Curve at Increased Deceleration (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: Recreate Deceleration Curve (OverrideCurve)

A deceleration curve is re-processed from the deceleration of the new stop cause.

During single axis operation, the stop position can be overrun depending on the deceleration and the jerk setting. To avoid overrun, set "1: Immediate Stop (ImmediateStop)" in Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

For operation details, refer to the following.

 Page 181 Overrun at stop cause occurrence

Deceleration curve continuation

2: Maintain Deceleration Curve (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 (Enable) of MC_Power (Forced Stop) 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.

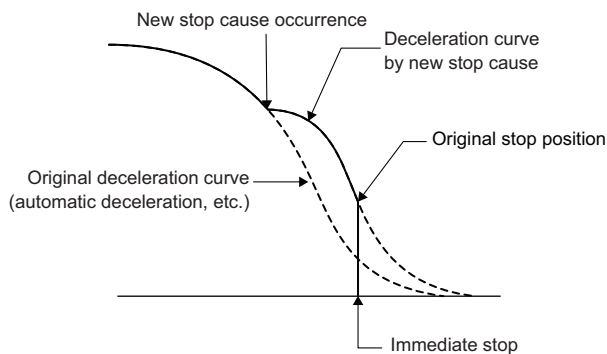
- Single axis: Operation Setting at Overrun (AxisName.Pr.OverrunOperation)
- Axes group: Operation Setting at Overrun (AxesGroupName.Pr.OverrunOperation)

Operation Setting at Overrun (AxisName.Pr.OverrunOperation and AxesGroupName.Pr.OverrunOperation) have the following two functions.

Immediate stop

1: Immediate Stop (ImmediateStop)

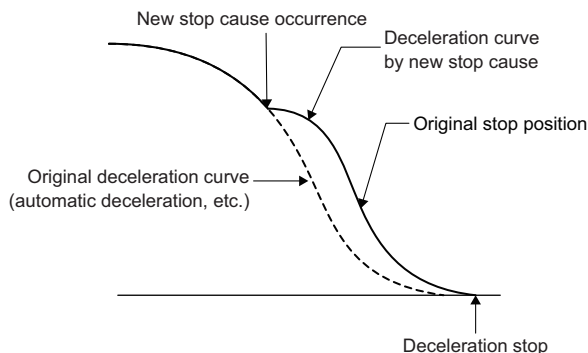
The operation is immediately stopped when reaching the original positioning address during deceleration by a stop cause. In this case, the operation does not exceed the positioning address set in the on-going FB.



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

2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)

Deceleration continues even though the operation reached the original deceleration stop position during deceleration by a stop cause. In this case, there is no guarantee that it stops before the positioning address set in the 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.

For MR-J5(W)-G:  MR-J5-G/MR-J5W-G User's Manual (Parameters)

- "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 (Enable)" of MC_Power (Operation Available) is FALSE

The forced stop input is set in Forced Stop Signal (AxisName.Pr.ForcedStop_Signal). For operation details, refer to the following.

 Page 200 Forced Stop

Stop causes by Servo ON request (ServoON) input of MC_Power (Operation Available)

■ Process selection at servo OFF command during operation

When Servo ON request (ServoON) of MC_Power (Operation Available) is set to FALSE, the stop operation differs depending on the setting of Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) has the following three functions.

- 0: Ignore (Ignore)

During operation, this function ignores the servo OFF command even though it is input and continues on-going operation. If Servo ON request (ServoON) of MC_Power (Operation Available) is set to FALSE when Axis Status (AxisName.Md.AxisStatus) of the operation completion axis turns "4: Standby (Standstill)", servo OFF will be executed. (The axis will not stop.)

- 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)

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

- 5: Servo OFF After Deceleration to Stop (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 Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE when the operation has reached speed 0, servo OFF will be executed.

The axis type which does not have Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff) during operation operates "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)".

■Axis state transition

The axis state changes based on the input combination of Enable (Enable) and Servo ON request (ServoON) of MC_Power (Operation Available).

Axis status before input operation (<u>AxisName</u> .Md.AxisStatus)	Input		Process Selection at Servo OFF Command During Operation (<u>AxisName</u> .Pr.StopMode_ServoOff)	Axis Status (<u>AxisName</u> .Md.AxisStatus) after input operation
	Enable (Enable)	Servo ON request (ServoON)		
4: Standby (Standstill) 0: Axis disabled (Disabled)	TRUE	TRUE	Independent of the setting	4: Standby (Standstill)
		FALSE		0: Axis disabled (Disabled)
	FALSE	TRUE		0: Axis disabled (Disabled)
		FALSE		0: Axis disabled (Disabled)
1: Stopping on error (ErrorStop)	TRUE	TRUE		1: Stopping on error (ErrorStop)
		FALSE		1: Stopping on error (ErrorStop)
	FALSE	TRUE		1: Stopping on error (ErrorStop)
		FALSE		1: Stopping on error (ErrorStop)
Others	TRUE	TRUE		No transition
		FALSE	0: Ignore (Ignore)	No transition ^{*1,2}
			4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)	1: Stopping on error (ErrorStop) ^{*4}
			5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)	1: Stopping on error (ErrorStop) ^{*3}
	FALSE	TRUE	Independent of the setting	1: Stopping on error (ErrorStop) ^{*4}
		FALSE		1: Stopping on error (ErrorStop) ^{*4}

*1 It is "0: Axis disabled (Disabled)" when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" or "2: Decelerating to stop (Stopping)" after deceleration stop.

*2 Axis Status (AxisName.Md.AxisStatus) will not transit if Axis Status (AxisName.Md.AxisStatus) is "1: Stopping on error (ErrorStop)" after deceleration stop.

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

*4 When Enable (Enable)/Servo ON request (ServoON) becomes FALSE during operation, the error "Immediate Stop by Servo OFF During Operation" (error code: 1A3CH) occurs. In this case, the FB being executed will be completed or stop immediately, and servo OFF will be executed.

Hardware stroke limit upper/lower limit error occurrence

When the hardware stroke limit upper/lower limit error occurs, the operation stops according to the process selected by Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit).

For details, refer to the following.

📖 Page 341 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 Stop Selection at All Axes Stop Cause Occurrence (System.Pr.StopMode_All).

Cycle over error occurrence

When the cycle over error occurs in operation cycle processing or buffer memory refresh processing, the operation stops according to the process selected by Stop Selection at All Axes Stop Cause Occurrence (System.Pr.StopMode_All). According to the set values of Cycle Setting (System.PrConst.OperationCycle[1].Cycle) and Cycle Setting (System.PrConst.BuffermemoryRefreshCycle.Cycle), different error code is output in every axis.

Setting value	Error
2: Minor error (MinorError)	The error "Cycle Over" (error code: 1C80H)
3: Moderate error (ModerateError)	The error "Module Error During Operation" (error code: 1AB1H)* ¹

*¹ It causes the operation stop as the stop cause at the motion system moderate error or major error occurrence.

Software stroke limit upper/lower limit error occurrence

When the software stroke limit upper/lower limit error occurs, the operation stops according to the process selected by Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit).

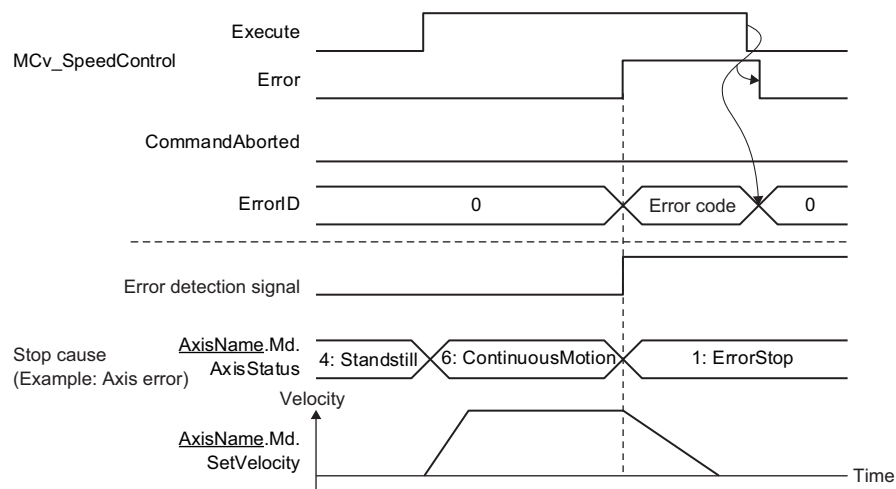
For details, refer to the following.

📖 Page 334 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 error "Cycle Over" (error code: 1C80H), 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 Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General). In this case, Axis Status (AxisName.Md.AxisStatus) transits to "1: Stopping on error (ErrorStop)".

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



■Driver command discard detection

By setting Driver Command Discard Detection 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 or forced stop 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 Object Data_Statusword (AxisName.Md.lo_Statusword)).

For details, refer to the following.

☞ Page 341 Hardware Stroke Limit

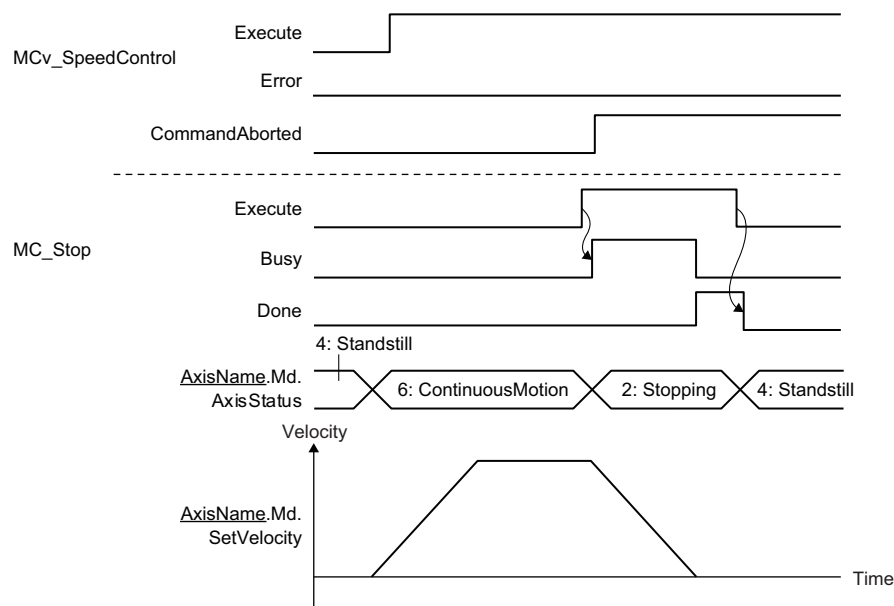
The details of Statusword Bit12 differs depending on the connect driver unit control mode. Also, for Statusword changing conditions etc., refer to the connected device driver device specification.

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

MC_Stop (Forced Stop)

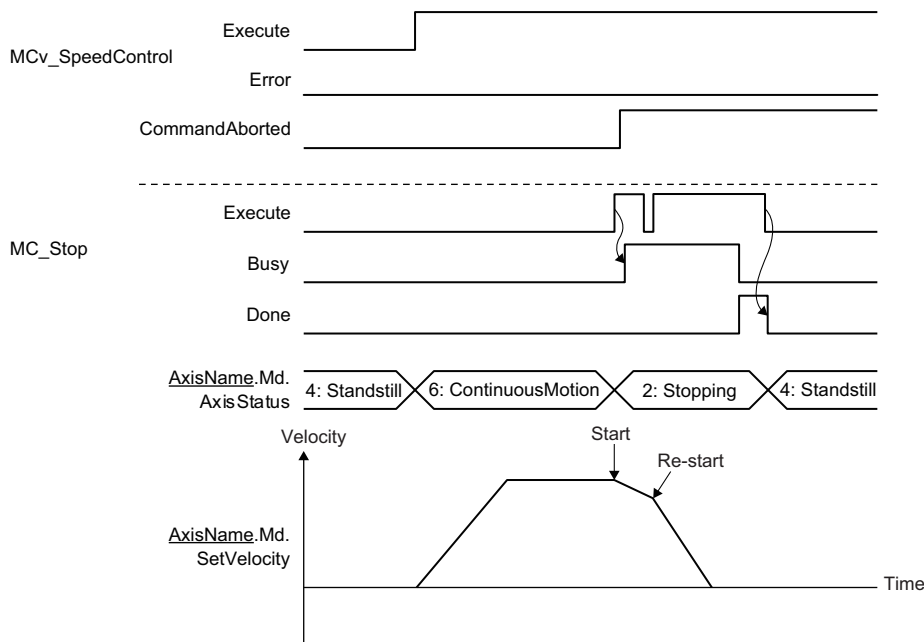
In MC_Stop (Forced Stop), Deceleration (Deceleration) is set and the instruction being executed is decelerated to stop. When MC_Stop (Forced Stop) is executed, Abortion of execution (CommandAborted) of the instruction being executed becomes TRUE and Axis Status (AxisName.Md.AxisStatus) transits to the "2: Decelerating to stop (Stopping)" status. While Execute command (Execute) is TRUE or while the speed does not reach 0, the "2: Decelerating to stop (Stopping)" status is maintained. When Execution completion (Done) becomes TRUE and Execute command (Execute) becomes FALSE at stop completion, the axis status changes to the "4: Standby (Standstill)" status.

■MCv_Stop (Forced Stop) execution during MC_SpeedControl (Speed Control (Including Position Loop))

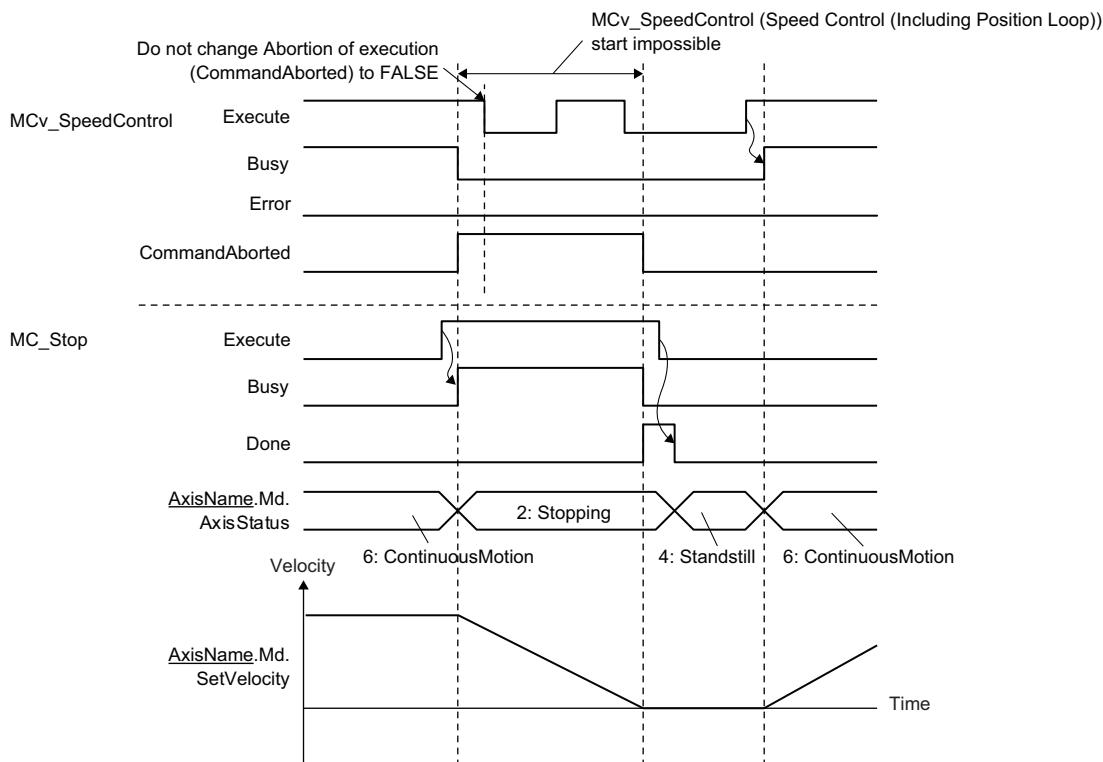


■ Operation description

- During deceleration to stop by this FB and while Execute command (Execute) of the input variable is TRUE, any operation command other than MC_Stop (Forced Stop) is not accepted.
- If the deceleration is set to 0.0 or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the control being executed and decelerate.
- If MC_GroupStop (Group Forced Stop) is executed during single axis synchronous control, synchronization to the master axis will be canceled.
- When the setting value of Deceleration (Deceleration) is changed and MC_Stop (Forced Stop) is restarted
A deceleration stop is executed from the restart point based on Deceleration (Deceleration) set in MC_Stop (Forced Stop).



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

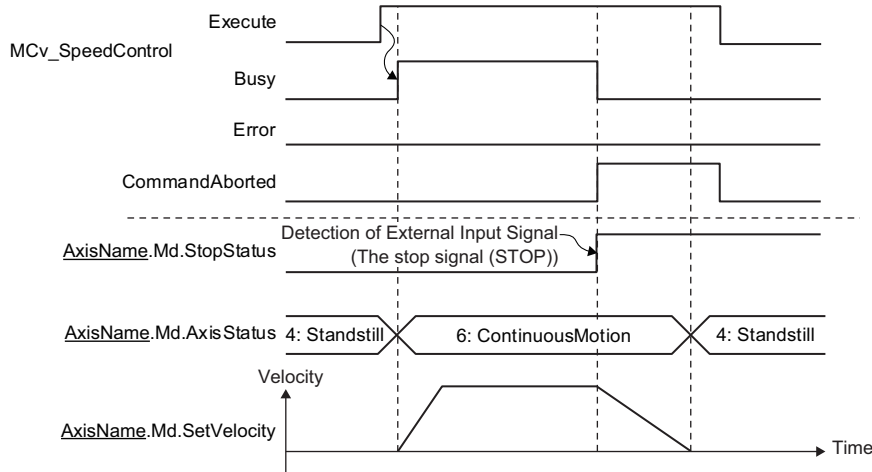


"The stop signal (STOP)" of external input signal is TRUE

The operation being executed is stopped by setting the stop signal (STOP) set by Stop Signal (AxisName.Pr.StopSignal) to TRUE.

- The operation stops by the operation set in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).
- The operation being executed sets Abortion of execution (CommandAborted) to TRUE by changing the stop signal (STOP) to TRUE.

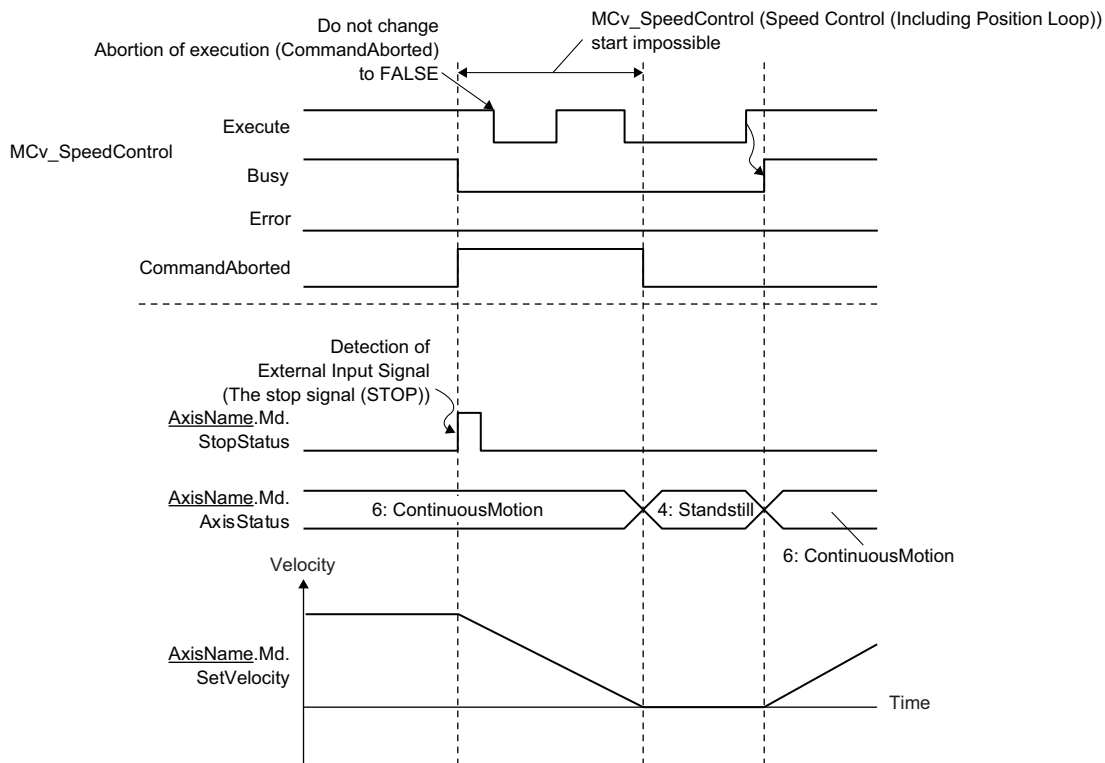
When the speed reached 0, Axis Status (AxisName.Md.AxisStatus) transits to "4: Standby (Standstill)".



Point

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

- Even if Execute command (Execute) of command aborted FB is set to FALSE by changing the stop signal (STOP) to TRUE, once the stop operation is started, TRUE of Abortion of execution (CommandAborted) will be continued until it is completed. After it stops completely, changes Abortion of execution (CommandAborted) to FALSE if Execute command (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 (<u>AxisName.Md.AxisStatus</u>) at stop cause occurrence	Stop process	Axes Group Status (<u>AxesGroupName.Md.GroupStatus</u>)	Stop process
1	"Forced stop input" is OFF	1: Stopping on error (ErrorStop)	Immediate stop*1	1: Stopping on error (GroupErrorStop)	Stop cause occurrence axis: Immediate stop Other configuration axes: Axes group deceleration stop/immediate stop (Follows Configuration Axes Operation Selection at Axis Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_ErrorInGroup</u>))
2	Drive unit power supply is OFF	1: Stopping on error (ErrorStop)			
	Drive unit network disconnection detection				
	Drive unit error				
	Forced stop input to the drive unit				
	Enable (Enable) of MC_Power (Operation Available) is FALSE				
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (<u>AxisName.Pr.StopMode_ServoOff</u>) is "4": Servo OFF After Immediate Stop (ServoOffAfterImmediateStop))				
3	Hardware stroke limit upper/lower limit error occurrence in the configuration axis	1: Stopping on error (ErrorStop)	Based on the axes group stop process		Operation differs depending on the setting value of Stop Selection at Hardware Stroke Limit Error Occurrence (<u>AxisName.Pr.StopMode_HwStrokeLimit</u>) of the configuration axis. • When the configuration axis has an axis set to "1: Immediate Stop (ImmediateStop)": Immediately stop • When the configuration axis does not have an axis set to "1: Immediate Stop (ImmediateStop)": Axes group deceleration stop/immediately stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>))
4	CPU module error occurrence	1: Stopping on error (ErrorStop)			
	PLC READY [Y0] is OFF				
	Cycle over error occurrence				
5	Software stroke limit upper/lower limit error occurrence in the configuration axis	1: Stopping on error (ErrorStop)			

Stop cause occurrence axis				Axes group	
Cause No.	Stop cause	Axis Status (<u>AxisName.Md.AxisStatus</u>) at stop cause occurrence	Stop process	Axes Group Status (<u>AxesGroupName.Md.GroupStatus</u>)	Stop process
6	Axis error detection	1: Stopping on error (ErrorStop)	Based on the axes group stop process	1: Stopping on error (GroupErrorStop)	Axes group deceleration stop/immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxesGroupName.Pr.StopMode_General</u>))
7	Execute command (Execute of MC_Stop (Forced Stop) is TRUE)	1: Stopping on error (ErrorStop)*2			
8	"The stop signal (STOP)" of external input signal is TRUE	No change		No change	

*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 195 Axis error

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

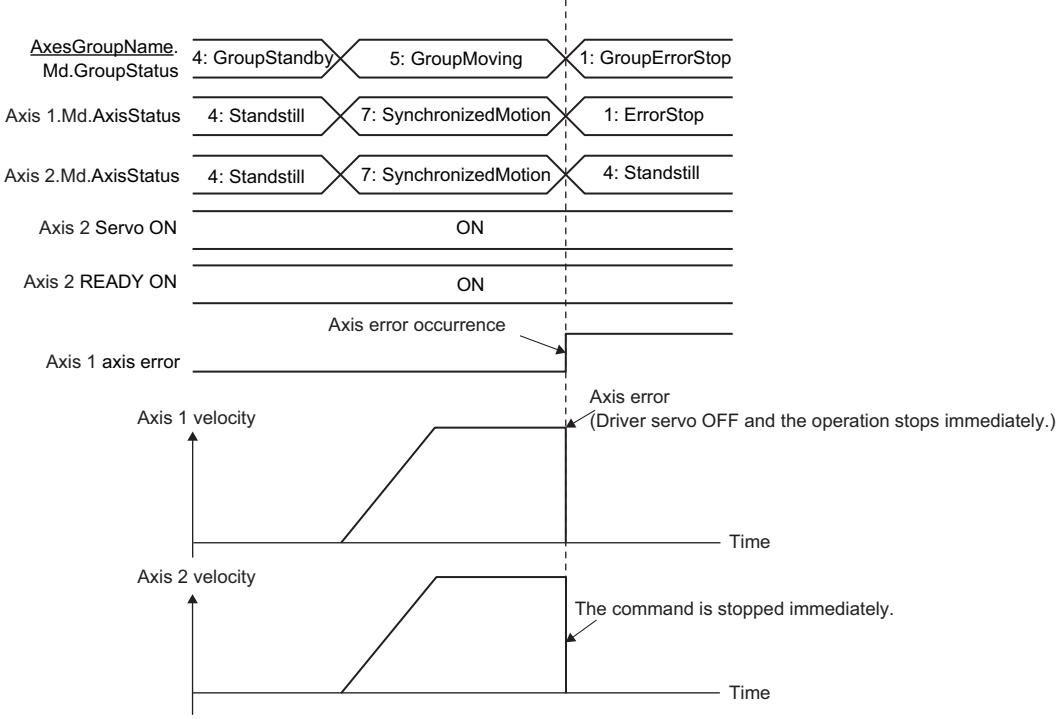
■For an axis error (driver servo OFF and immediate stop)

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 Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ErrorInGroup).

When a stop cause has occurred in a configuration axis during the axes group operation, one of the following three methods can be selected to stop the other configuration axes.

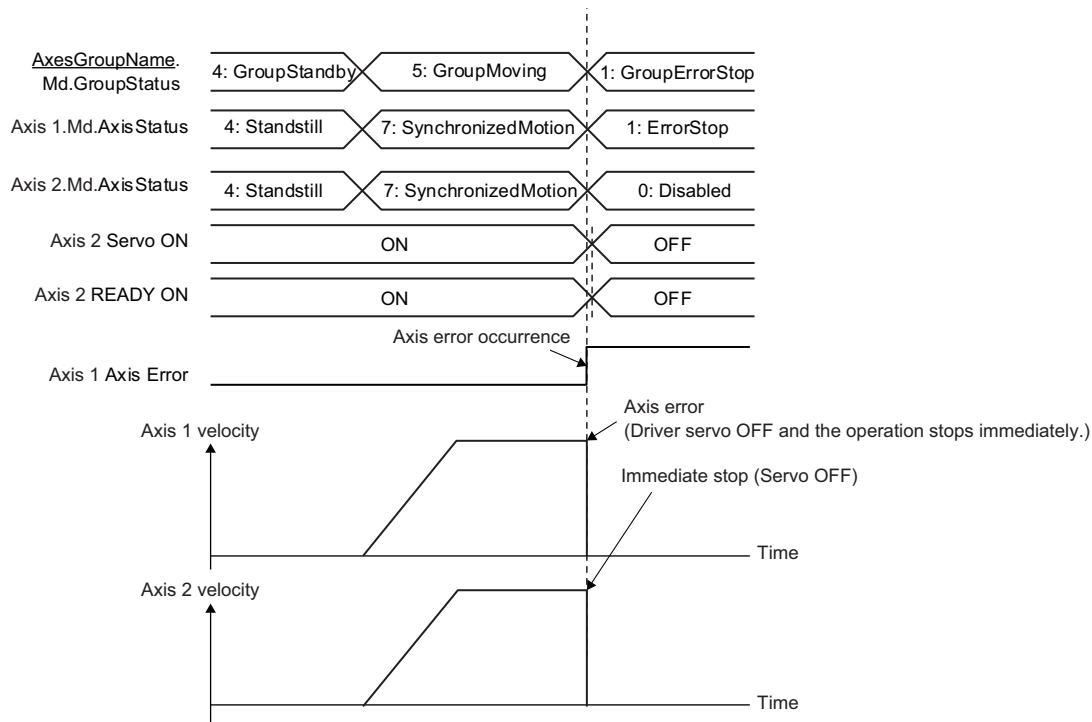
- 1: Immediate Stop (ImmediateStop)

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



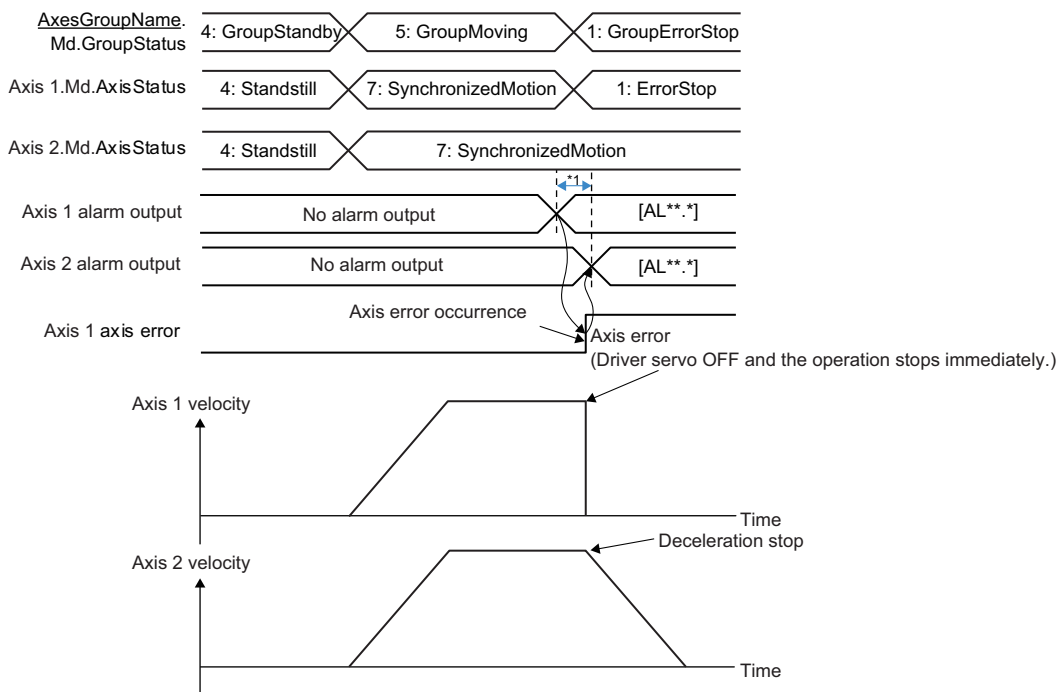
- 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)

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.



- 5: Servo OFF After Deceleration to Stop (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 Deceleration at Stop (AxisGroupName.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

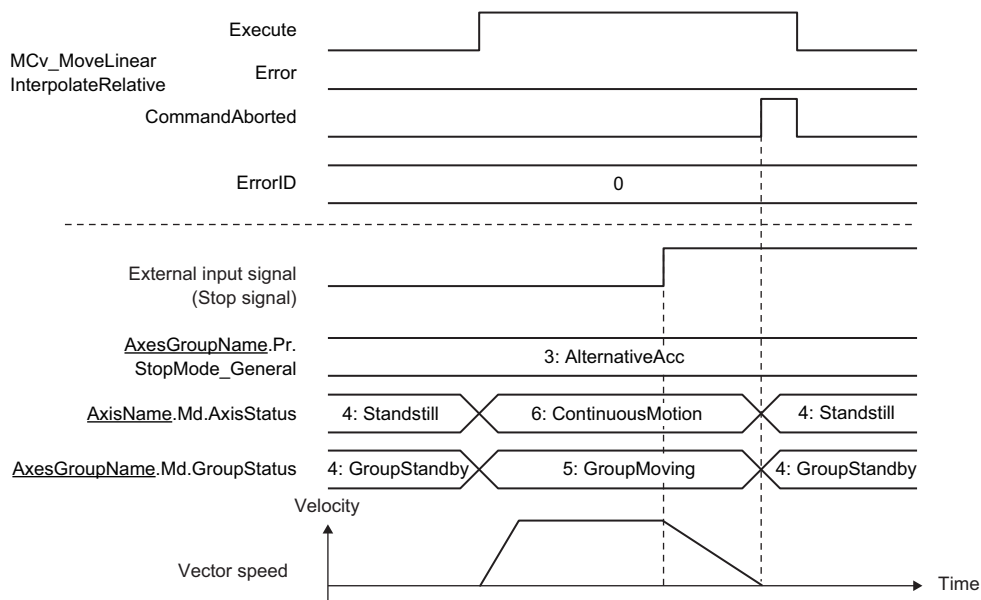
If an axis error has occurred in the configuration axis, the error "Stop Cause of Axes Group Configuration Axis" (error code: 1A3DH) will occur in the axes group. In this case, the axes group will pass through the path and stop according to the setting of Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).

If a single axis control FB is executed to the configuration axis being operated in the axes group, an error will occur in the single axis control FB, and the specified axis will change to the "Instruction issue to the configuration axis being operated in the axes group" and then the "1: Stopping on error (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 Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General).

■"The stop signal (STOP)" of external input signal is TRUE

When Stop Signal (AxisName.Pr.StopSignal) is set to TRUE to the configuration axis, the axis stops according to the setting of Stop Selection at Stop Cause Occurrence (AxesGroupName.Pr.StopMode_General). The axes group will pass through the path and decelerate to a stop. When the speed reaches 0, Abortion of execution (CommandAborted will become TRUE, and Axes Group Status (AxesGroupName.Md.GroupStatus) will transit to "4: Standby (GroupStandby)". The value set in Deceleration at Stop (AxesGroupName.Pr.StopMode_Deceleration) will be used for the deceleration at this time.



Point

- When stopping by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE, Axes Group Status (AxesGroupName.Md.GroupStatus) after stop will not change.
- When the stop processing is being executed by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE, the deceleration can be changed by executing MC_GroupStop (Group Forced Stop).
- The deceleration can be changed by setting Stop Signal (AxisName.Pr.StopSignal) to TRUE during MC_GroupStop (Group Forced Stop) execution. In this case, Axes Group Status (AxesGroupName.Md.GroupStatus) after the deceleration stop will not change.

■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: Stopping on error (GroupErrorStop)".

- When the stop cause "Hardware stroke limit error" is occurring in any axis of configuration axes, "1: Immediate Stop (ImmediateStop)" is set to Stop Selection at Hardware Stroke Limit Error Occurrence (AxisName.Pr.StopMode_HwStrokeLimit) in one or more axes.
- When the stop cause "Software stroke limit error" is occurring in any axis of configuration axes, "1: Immediate Stop (ImmediateStop)" is set to Stop Selection at Software Stroke Limit Error Occurrence (AxisName.Pr.StopMode_SwStrokeLimit) in one or more axes.

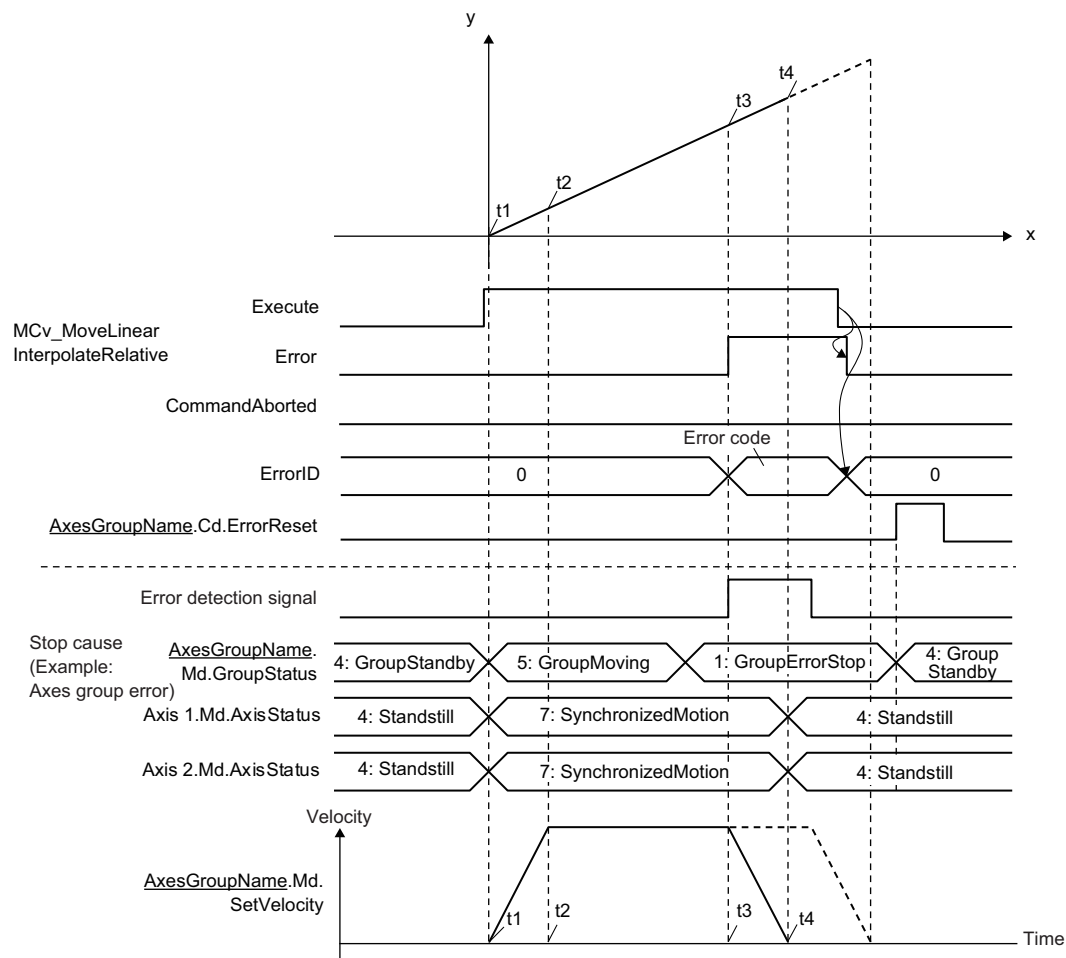
Hardware stroke limit error	Software stroke limit error
• Error "FLS Signal Detection (at Start)" (error code: 1A2DH) • Error "RLS Signal Detection (at Start)" (error code: 1A2EH) • Error "FLS Signal Detection (Controlling)" (error code: 1A2FH) • Error "RLS Signal Detection (Controlling)" (error code: 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 Stop Selection at Stop Cause Occurrence

(AxesGroupName.Pr.StopMode_General). The value set in Deceleration at Stop (AxesGroupName.Pr.StopMode_Deceleration) will be used for the deceleration at this time.

- Operation of the FB that received a stop cause by axes group error occurrence

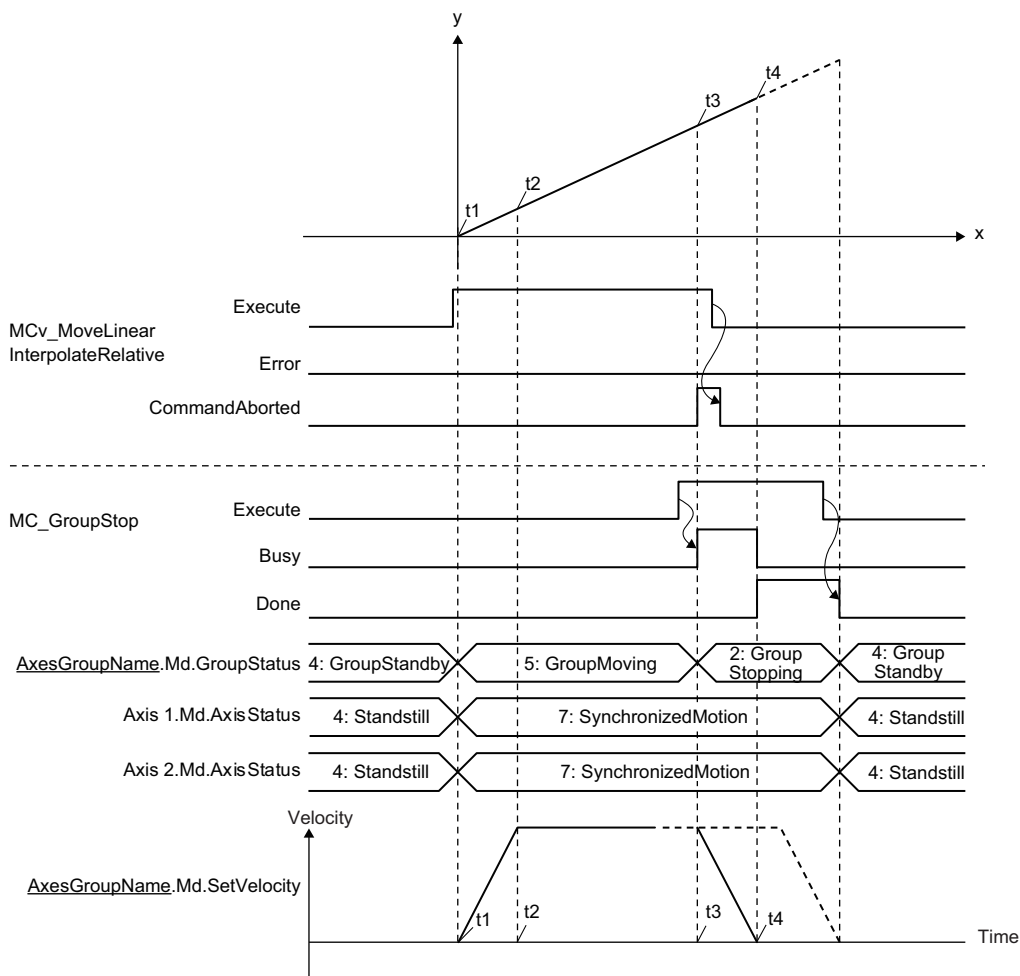


MC_GroupStop (Group Forced Stop)

In MC_GroupStop (Group Forced Stop), Deceleration (Deceleration) is set and the instruction being executed is decelerated to stop. The axes group passes through the previous operation path and decelerates to a stop.

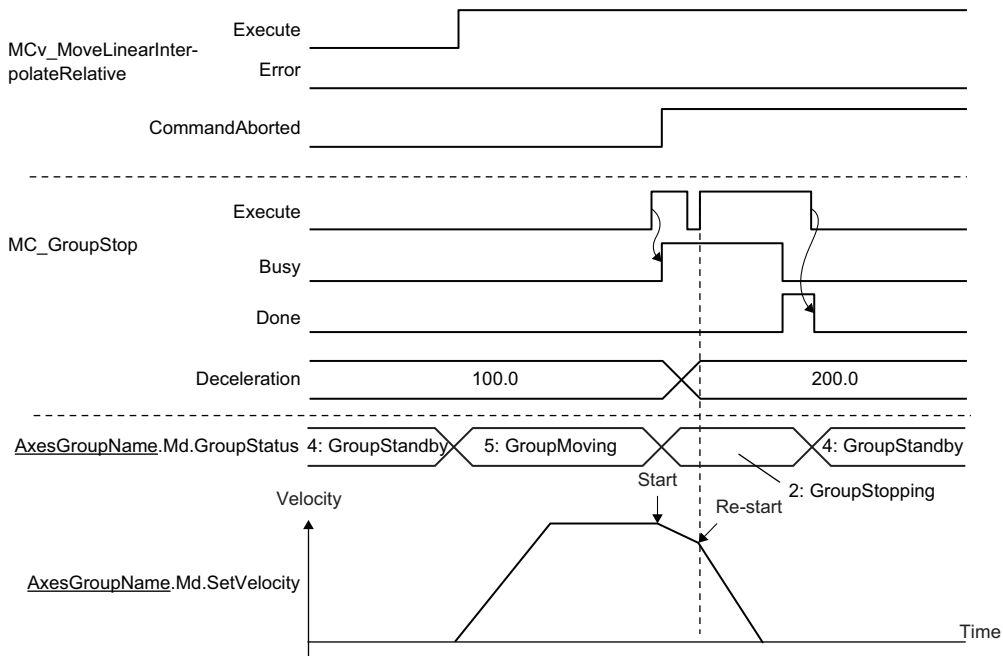
When MC_GroupStop (Group Forced Stop) is executed, Abortion of execution (CommandAborted) of the instruction being executed becomes TRUE and Axes Group Status (AxesGroupName.Md.GroupStatus) transits to the "2: Decelerating to stop (GroupStopping)" status. While Execute command (Execute) is TRUE or while the speed does not reach 0, the "2: Decelerating to stop (GroupStopping)" status is maintained. When Execution completion (Done) becomes TRUE and Execute command (Execute) becomes FALSE at stop completion, the axes group status changes to the "4: Standby (GroupStandby)" status.

■MC_GroupStop (Group Forced Stop) execution during MCv_MoveLinearInterpolateRelative (Relative Value Linear Interpolation Control)

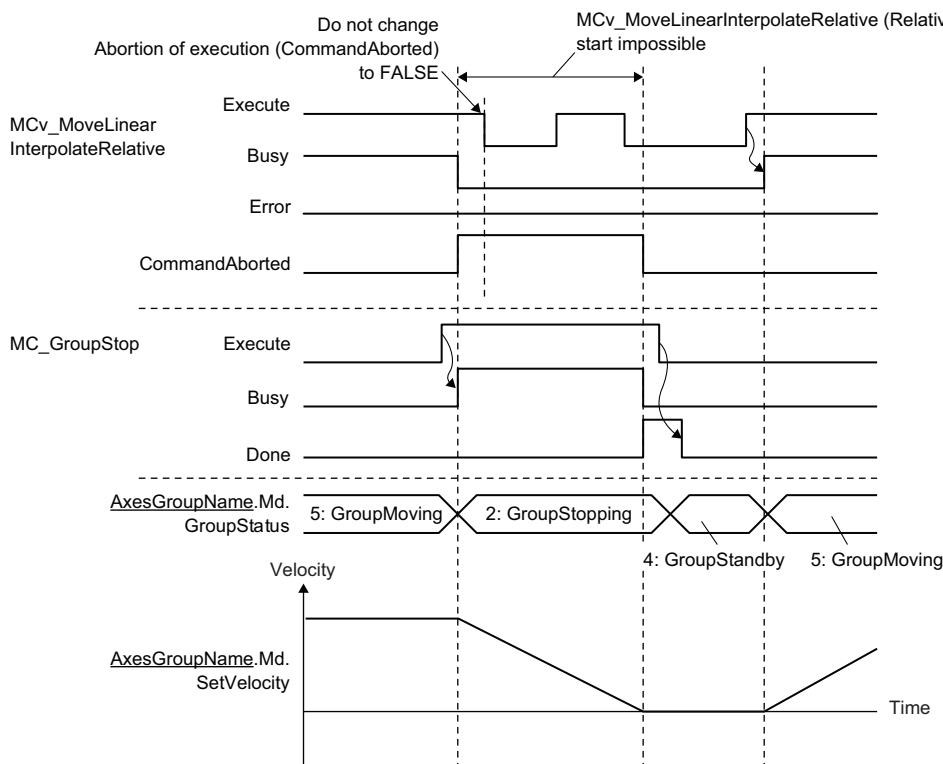


■ Operation description

- During deceleration stop by this FB and while Execute command (Execute) of the input variable is TRUE, any operation command other than MC_GroupStop (Group Forced Stop) is not accepted.
- If Deceleration (Deceleration) is set with 0 or omitted, immediate stop will be executed.
- The acceleration/deceleration method and the jerk take over the method specified in the on-going control.
- When the setting value of Deceleration (Deceleration) is changed and MC_GroupStop (Group Forced Stop) is restarted
A deceleration stop is executed from the restart point based on Deceleration (Deceleration) set in MC_GroupStop (Group Forced Stop) and Jerk (Jerk) used in the instruction being executed.



- When an FB that operates axes other than MC_GroupStop (Group Forced Stop) is executed while Axes Group Status (AxesGroupName.Md.GroupStatus) is the "2: Decelerating to stop (GroupStopping)" status, the error "Start Not Possible" (error code: 1AADH) occurs and Error of MC_GroupStop (Group Forced Stop) becomes TRUE, and then Axes Group Status (AxesGroupName.Md.GroupStatus) changes to "1: Stopping on error (GroupErrorStop)".
- Even if Execute command (Execute) of command aborted FB is set to FALSE by MC_GroupStop (Group Forced Stop), once the stop operation is started, Abortion of execution (CommandAborted) will remain TRUE until it is completed. After it stops completely, changes Abortion of execution (CommandAborted) to FALSE if Execute command (Execute) of command aborted FB is FALSE.



Precautions

Relevant add-ons

The following add-on is required to use this function.

- Axis
- MotionEngine
- ExternalSignal
- MotionControl_General
- ServoDriver_CANopen

*1 For using the stop signal, the forced stop signal, the all axes forced stop signal, and the upper/lower limit signal

*2 For using the following FBs
 Page 169 Relevant FBs

*3 For using the real drive axis or the real encoder axis

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

4.5 Forced Stop

This function stops axes with the forced stop signal.

The axis types which the forced stop is valid are as follows

- The forced stop signal of each axis is valid for the axis type which supports Forced Stop Signal (AxisName.Pr.ForceStop_Signal).

For its availability of every axis type, refer to the following.

 Page 768 List of Supported Axis Type

- All axes forced stop signal stops axes of all types including the types which unsupport Forced Stop Signal (AxisName.Pr.ForceStop_Signal).

Refer to the driver device specification after the forced stop signal is sent.

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.

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Pr.</u>		
ForcedStop_Signal	Forced Stop Signal	Sets a signal using the each axis forced stop. ForcedStop_Signal is the structure of SIGNAL_SELECT type. The specific setting and the operation of this signal are shown below. • I/O No. (StartIO) Ignores the input value. • Target (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 "Out of Parameter Range (Axis)" (error code: 1D80H) is output. • Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) • Compensation Time (CompensationTime) Ignores the input value. • Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting Range of Each Axis Signal Warning" (warning code: 0D24H) is output and the axis operates with 0.0 of the filter time. The fetch timing of the label is at ready ON, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection
<u>AxesGroupName.Pr.</u>		
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	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: Immediate Stop (ImmediateStop) (Default value) 4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop) 5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop) (Immediate stop will be executed when executing instructions without deceleration specification.)
<u>AxisName.Md.</u>		

Variable/Structure name	Name	Details
ForcedStop_Released	Forced Stop Cancelling	FALSE: Forced stop input TRUE (Forced stop) TRUE: Forced stop input FALSE (Forced stop release)
ForcedStop_Signal	Forced Stop Signal	Displays the input status of each axis forced stop signal. ForcedStop_Signal is the structure of SIGNAL_SELECT type. The specific output of this signal is shown below. • I/O No. (StartIO) 0 is always displayed. • Target (Target) The fetch result of the parameter is displayed. • Signal Detection Method (Detection) The fetch result of the parameter is displayed. • Compensation Time (CompensationTime) 0.0 is always displayed. • Filter Time (FilterTime) The fetch result of the parameter is displayed. For details on SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection

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. The specific setting and the operation of this signal are shown below. • I/O No. (StartIO) 0 is always displayed. • Target (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 "Out of Parameter Range (System)" (error code: 1D82H) is output. • Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Parameter Range (System)" (error code: 1D82H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) • Compensation Time (CompensationTime) Ignores the input value. • Filter Time (FilterTime) Setting range of the filter time is 0.0 to +5.0. When a value outside the range is set, the warning "Out of Filter Time Setting Range of System Signal Warning" (warning code: 0F0FH) is output and the axis operates with 0.0 of the filter time. The fetch timing of the label is at ready ON, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection

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. The specific output of this signal is shown below. • I/O No. (StartIO) 0 is always displayed. • Target (Target) The fetch result of the parameter is displayed. • Signal Detection Method (Detection) The fetch result of the parameter is displayed. • Compensation Time (CompensationTime) 0.0 is always displayed. • Filter Time (FilterTime) The fetch result of the parameter is displayed. For details on SIGNAL_SELECT type, refer to the following.  Page 439 External Signal Selection

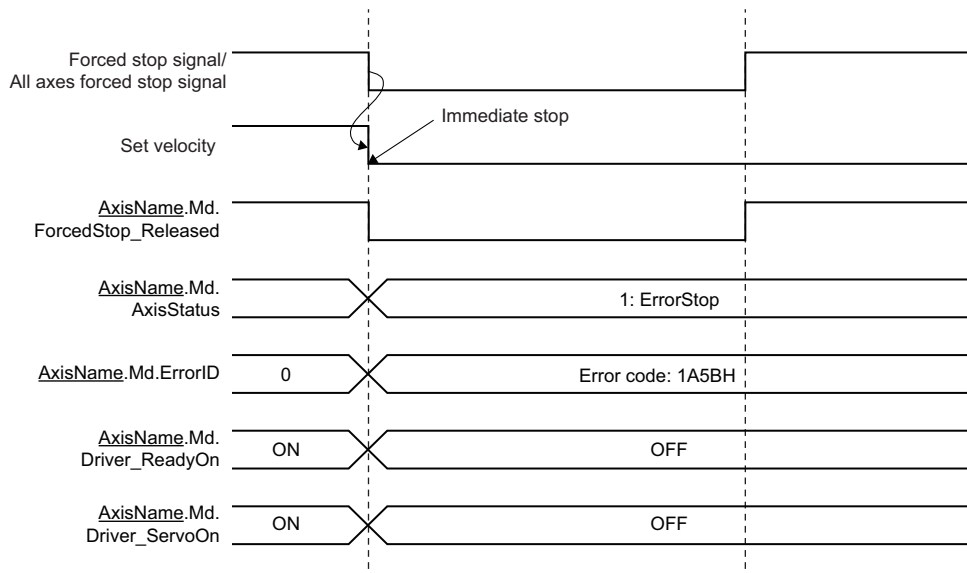
Operation at the forced stop occurrence

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

Ex.

The slave device which servo OFF is executed when "Quick Stop" is issued is connected.

During axis operation



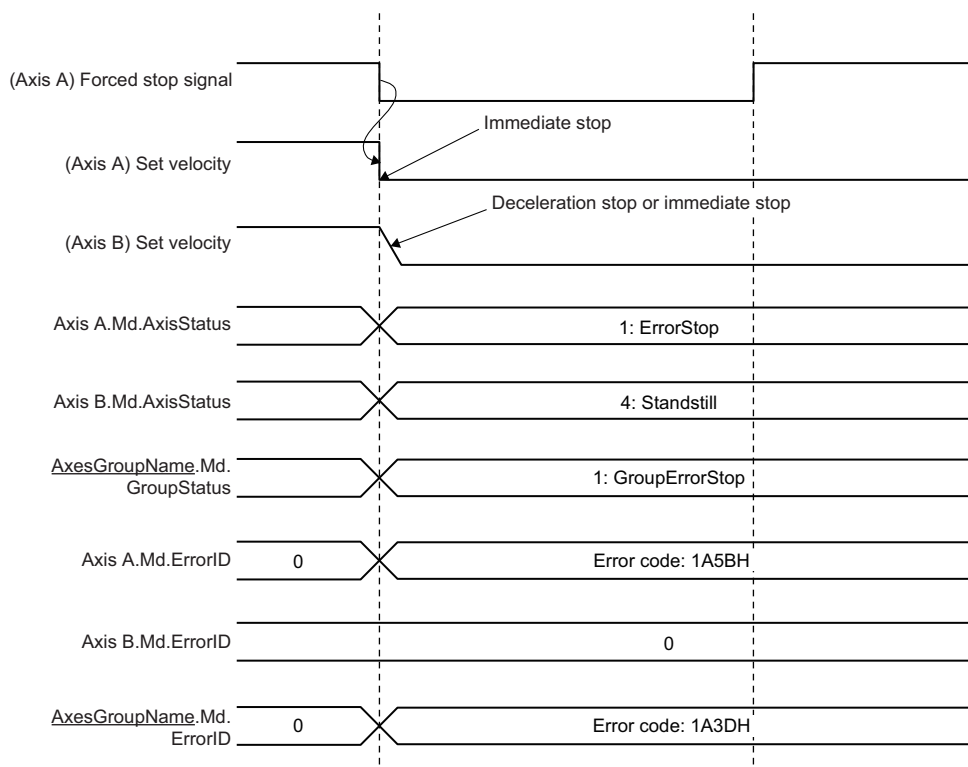
- In the axis that a forced stop occurred, MC_Power is in the error status and the servo OFF is executed. The servo ON will not be executed until the forced stop is released. The error is not output when the axis is not operated.
- In positioning or stopping, the event, "Forced stop detection" is registered in the event history. The error "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: Stopping on error (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. 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.



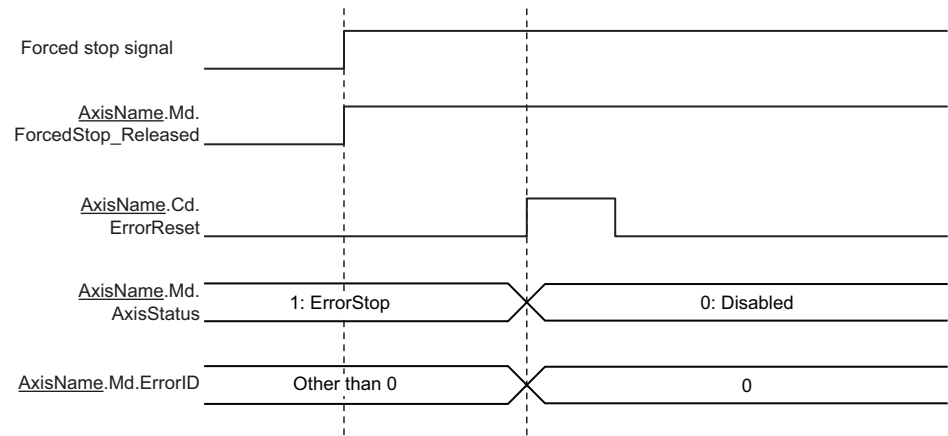
The stop method of the axis B can be set in Configuration Axes Operation Selection at Axis Stop Cause Occurrence (AxesGroupName.Pr.StopMode_ForcedStopInGroup). For the operation of each setting, refer to the following.

📖 Page 191 Stop cause occurrence in the configuration axis

Operation at the forced stop release

The operation the forced stop is released from the forced stop occurrence status is shown below.

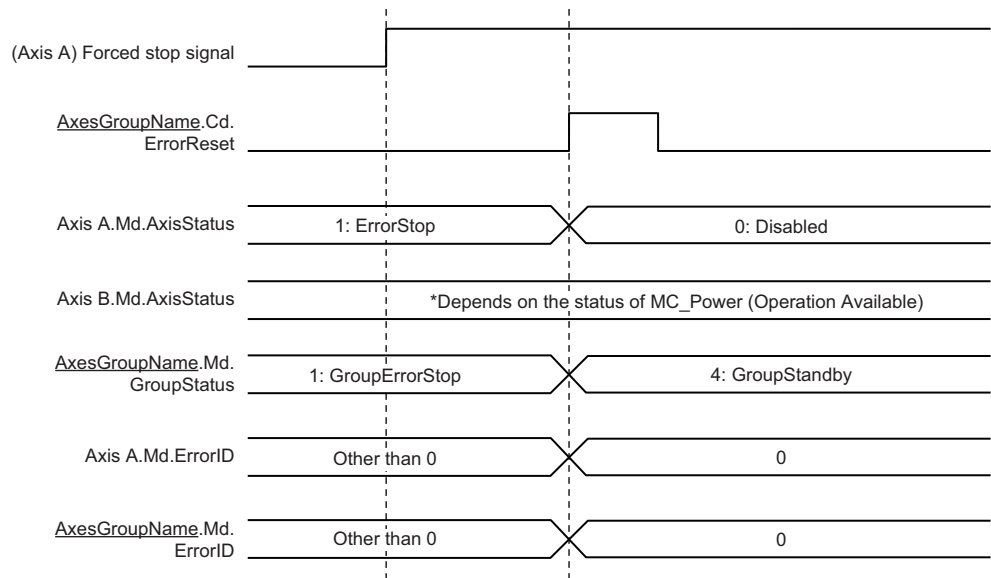
Single axis



1. Release the forced stop.
The forced stop input changes to "1".
Axis Status (AxisName.Md.AxisStatus) is still "1: Stopping on error (ErrorStop)".
2. Execute the axis error reset.
Axis Status (AxisName.Md.AxisStatus) changes to "0: Axis disabled (Disabled)".

Axes group

The following shows the release operation when a forced stop has occurred to the axis A while an axes group configured with the axis A and B is being operated.



1. Release the forced stop.
The forced stop input changes to "1".
Axes Group Status (AxisGroupName.Md.GroupStatus) is still "1: Stopping on error (GroupErrorStop)".
2. Execute the axes group error reset.
Axes Group Status (AxisGroupName.Md.GroupStatus) changes to "4: Standby (GroupStandby)", and the error Nos. are cleared in both the axis A and the axes group.

**Point**

When the forced stop is issued, the servo ON command of MC_Power (Operation Available) continues.

Check method

Whether the forced stop input is in the TRUE/FALSE status can be checked with Forced Stop Cancelling (AxisName.Md.ForcedStop_Released).

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 homing always at the following cases: on starting up and when the controller or absolute position motor has been replaced. Check the homing request signal using the 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 Homing Request (AxisName.Md.Homing_Request) is TRUE.

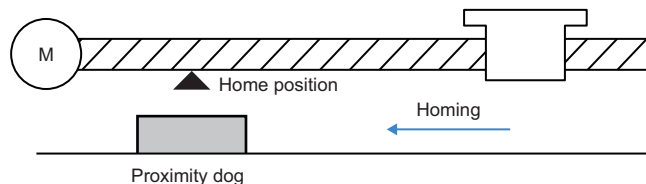
Homing Request (AxisName.Md.Homing_Request) is FALSE and Homing Completed (AxisName.Md.Homing_Complete) is TRUE if the homing is executed and is completed normally.

5.1 Overview

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
- "HomeOffset (607CH)" 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

Variable/Structure name	Name	Details
AxisName.Md		
Homing_Status	Homing Operation Status	Stores the homing status of the driver.*1
Homing_Request	Homing Request	Becomes TRUE when homing is required and becomes FALSE when it is completed. For details, refer to the following. Page 209 Homing Request
Homing_Complete	Homing Completed	Becomes TRUE when homing is normally completed, and it becomes FALSE when operation starts and homing is required.

*1 The following value of homing operation status is stored.

Stored value	Status	Statusword		
		Bit 13	Bit 12	Bit 10
FFFFH	Homing procedure is not in progress	—		
0000H	Homing procedure is in progress	0	0	0
0001H	Homing procedure is interrupted or not started	0	0	1
0002H	Homing is attained, but target is not reached	0	1	0
0003H	Homing procedure is completed successfully	0	1	1
0004H	Homing error occurred, velocity is not 0	1	0	0
0005H	Homing error occurred, velocity is 0	1	0	1

Relevant FBs

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 754 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	↑	-10000000000.0 ≤ Setting value < 10000000000.0 ^{*1}	0.0	Sets the home position address.
Home position switch	AbsSwitch	MC_INPUT_REF	↑	Refer to the description on the right.	—	Sets the proximity dog signal that is transmitted to the slave device in the driver homing method. Page 439 External Signal Selection [VAR], [DEV], [CONST], and [OBJ] are available as Target (Source.Target). Only "0: Detection at TRUE (HighLevel)" or "Detection at FALSE (LowLevel)" can be selected for Signal Detection Method (Detection). Only "0.0 [s]" can be specified for Compensation Time (CompensationTime). "0.0 to 5.0 [s]" can be specified for Filter Time (FilterTime). If the setting value is not within the valid range, an error will occur.
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Set "00000000H". (If a value other than "00000000H" is set, the error "Out of Options Range" (error code: 1A4EH) will occur.)

*1 When ring counter is enabled, the range is ring counter range.

*2 [OBJ] cannot use the external signal high-accuracy input. when the external signal high-accuracy input is specified, it is operated with the same accuracy as normal signal.

■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 execution has been aborted because of other FBs.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

Homing Request

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



The reason of Homing Request (AxisName.Md.Homing_Request) is TRUE is recorded in event history.

For causes of which Homing Request (AxisName.Md.Homing_Request) becomes TRUE, refer to the following.

 Page 105 Homing request

Homing Request (AxisName.Md.Homing_Request) becomes FALSE at homing completion.

When homing is not required

Execute a homing request clear in systems that do not require homing. Homing Request (AxisName.Md.Homing_Request) becomes FALSE by performing the homing request clear. For details, refer to the following.

 Page 214 Operation Setting for Incompletion of Homing

Precautions

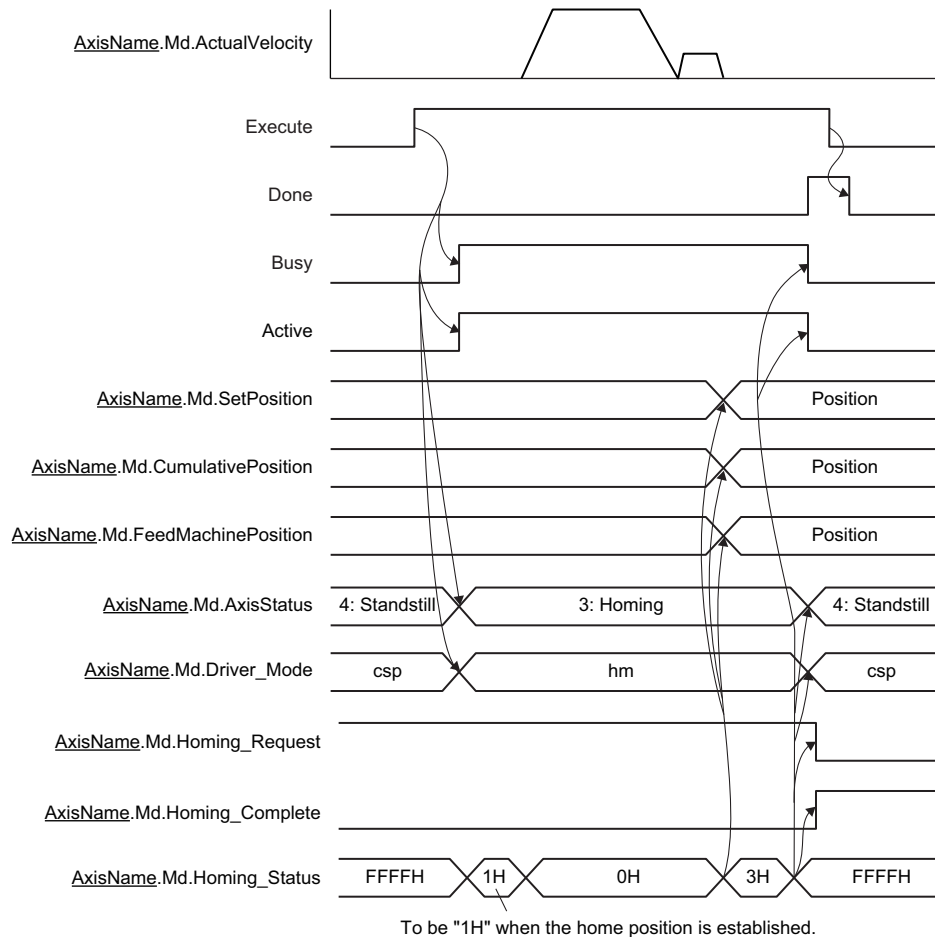
Directly rewriting Homing Request (AxisName.Md.Homing_Request) to FALSE with a program, etc. will not clear the homing request in the Motion system. Be sure to use the homing request clear to set Homing Request (AxisName.Md.Homing_Request) to FALSE.

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 (Parameter Write) 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



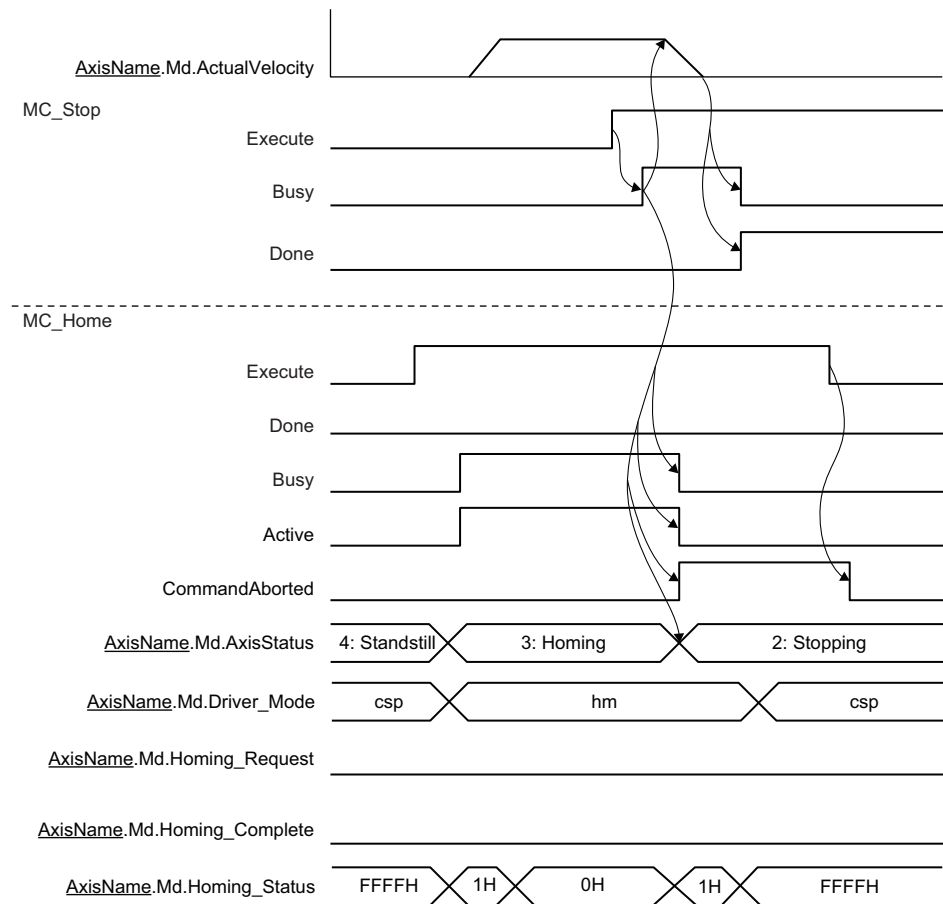
■When an error occurs

The data set method homing is the same.

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■ When MC_Stop (Forced Stop) is executed



- When MC_Stop (Forced Stop) is set to TRUE at homing, the "HALT" signal is sent to the 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 device specifications. Therefore, Deceleration (Deceleration) and Jerk (Jerk) of MC_Stop (Forced Stop) are ignored.

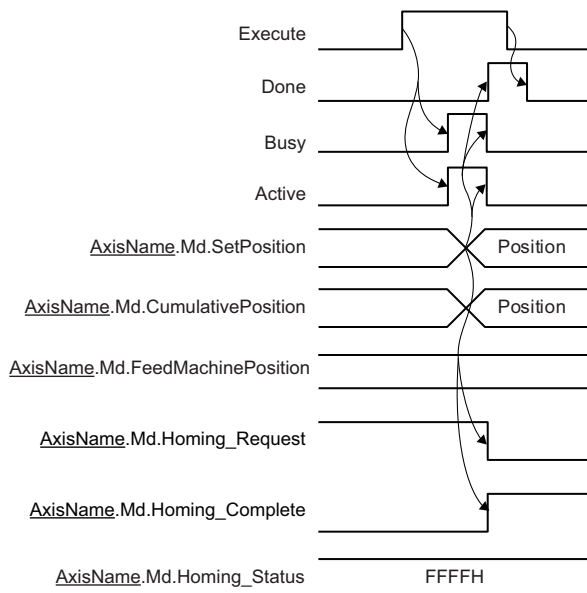
Precautions

- The homing cannot be started during servo-off. Thus, the driver homing method, Homing method 35 and 37 (Data set method), cannot be executed during servo-off.
- When the external signals (the hardware stroke limit specified with axis variables and the proximity dog specified with Home position switch (AbsSwitch)) are assigned, 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.
- 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 "Velocity 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)
 - Home ABS counter (2D3EH)
- DOG signal inputted in the servo amplifier at MR-J5(W)-G connection can be specified as a home position switch signal. For details on the setting method, refer to the following.
 -  Page 786 Using methods
- The hardware stroke limit signal detection is performed during the homing in the Motion module. When the signal is detected, "HALT" signal is sent to the driver. To stop by using the limit switch signal of the driver side, make the hardware stroke limit check of the Motion module side invalid temporarily by turning Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) to DISABLE (Check disabled).
- If ONLY_INSIDE (Check disabled for movement returning to the range) is set in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) at homing start, the error "Start Not Possible" (error code: 1AADH) occurs and the homing start is not carried out.

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. Target position (Position) (home position address) at homing is registered in the motion system as the home position, and Set Position (AxisName.Md.SetPosition) and Cumulative Current Position (AxisName.Md.CumulativePosition) are rewritten to Target position (Position) (home position address).

Timing chart



Precautions

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

Error

Check that Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" at MC_Home (Homing) execution. If it is other than "4: Standby (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, 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 Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed).

○: Axis start possible, ×: Axis start impossible

FB	Start Permission at Homing Uncompleted (<u>AxisName</u> .Pr.StartableAtUnhomed)	
	"TRUE: Allow" and the homing request is TRUE	"FALSE: Do not allow" 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. For details, refer to each drive unit manual.

For MR-J5(W)-G:  MR-J5 User's Manual (Function)

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName</u> .Pr.		
StartableAtUnhomed	Start Permission at Homing Uncompleted	Sets whether axis start when homing is incompletion is allowed or not. TRUE: Allowed FALSE: Do not allow
<u>AxisName</u> .Md.		
Homing_Request	Homing Request	Becomes TRUE when homing is required and becomes FALSE when it is completed. For details, refer to the following.  Page 209 Homing Request
<u>AxisName</u> .Cd.		
Homing_ClearRequest	Homing Request Clear	Sets the homing request to FALSE forcibly. After the homing request is set to FALSE, FALSE is set in this variable automatically.

FBs that can be started when homing is incompletion

The following FBs can start the axis regardless of Start Permission at Homing Uncompleted (AxisName.Pr.StartableAtUnhomed) and Homing Request (AxisName.Md.Homing_Request) status.

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

Homing request clear

When Homing Request (AxisName.Md.Homing_Request) is TRUE, Homing Request (AxisName.Md.Homing_Request) can be changed to FALSE forcibly by setting Homing Request Clear (AxisName.Cd.Homing_ClearRequest) to TRUE.

Precautions

- In Homing Request Clear (AxisName.Cd.Homing_ClearRequest), when turning Homing Request (AxisName.Md.Homing_Request) FALSE and starting the axis, it is operated not based on the home position but based on the current coordinate system.
- Do not turn Homing Request Clear (AxisName.Cd.Homing_ClearRequest) 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.

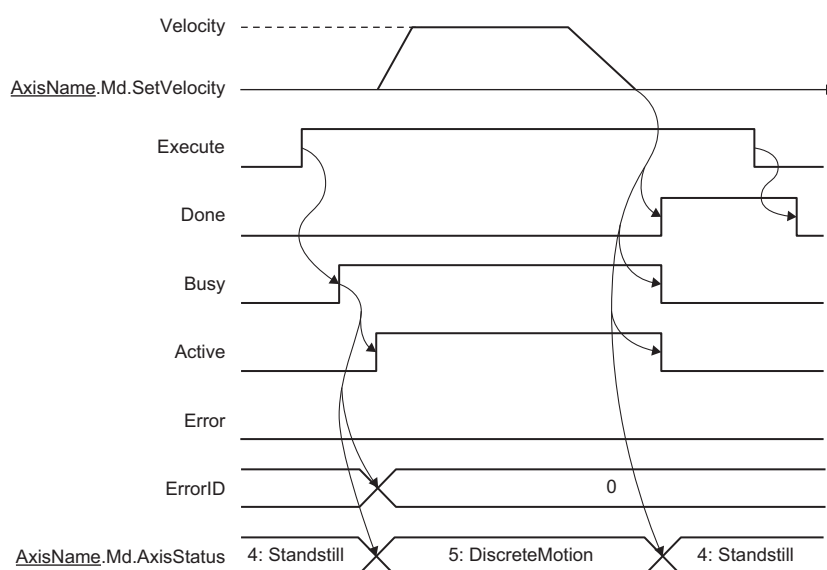
Relevant FBs

MC_MoveAbsolute

Item	Description		
Function overview	Executes positioning after specifying the target position of the absolute position.		
Symbol [Structured Ladder]	MC_MoveAbsolute DUT : Axis Axis : DUT B : Execute Done : B B : ContinuousUpdate Busy : B L : Position Active : B L : Velocity CommandAborted : B L : Acceleration Error : B L : Deceleration ErrorID : UW L : Jerk ENUM : Direction ENUM : BufferMode UD : Options		
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 27 Execute command (Execute) type/Enable (Enable)

■ 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 754 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 221 Target position (Position)	0.0	Sets the target position of the absolute position according to unit of axis.
Velocity	Velocity	LREAL	↑/R/C	0, 0.0001 to 2500000000.0	0.0	Sets the velocity according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	0.0	Sets the jerk according to unit of axis.
Direction selection	Direction	MC_DIRECTION	↑	1 to 3	0	Sets the direction to move from the current position to the target position when the software stroke limit is invalid. 1: Positive Direction (mcPositiveDirection) 2: Negative Direction (mcNegativeDirection) 3: Shortest Path (mcShortestWay) When this setting is omitted, the error "Out of Direction Selection Range" (error code: 1A37H) occurs.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following. ☞ Page 228 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	☞ Page 228 Options (Options)	0000000H	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	Indicates that execution has been aborted because of other FBs. Becomes TRUE when this FB is stopped by an error or this FB is started during an error occurrence. Becomes FALSE when Execute command (Execute) is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

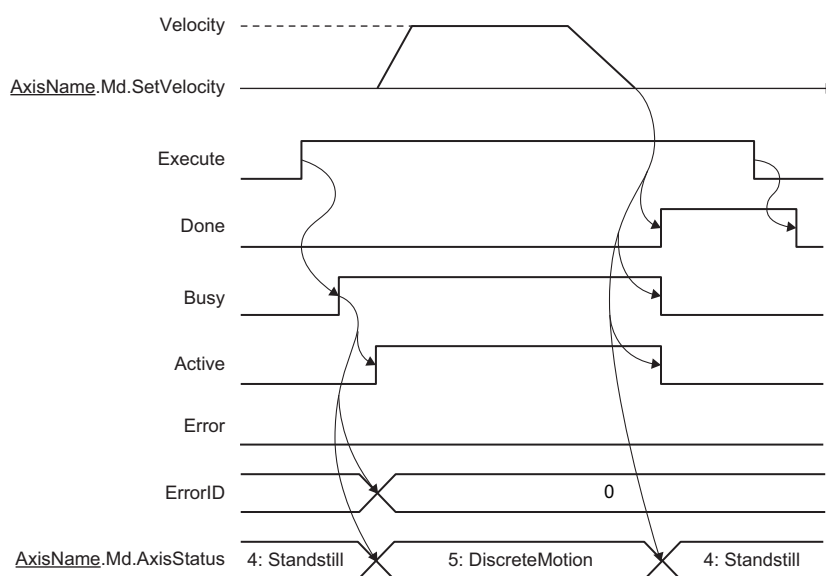
MC_MoveRelative

Item	Description
Function overview	Executes positioning after specifying the movement amount of the relative position.
Symbol [Structured Ladder]	The diagram shows the MC_MoveRelative function block with the following inputs and outputs: Inputs: DUT : Axis, B : Execute, B : ContinuousUpdate, L : Distance, L : Velocity, L : Acceleration, L : Deceleration, L : Jerk, ENUM : BufferMode, UD : Options. Outputs: Axis : DUT, Done : B, Busy : B, Active : B, CommandAborted : B, Error : B, ErrorID : UW.
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 27 Execute command (Execute) type/Enable (Enable)

■ 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 754 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 87 Combination with other functions	0.0	Sets the relative position according to unit of axis from the current position at start to the end point.
Velocity	Velocity	LREAL	↑/R/C	0.0, 0, 0.0001 to 2500000000.0	0.0	Sets the velocity according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	 Page 353 Input variables to use	0.0	Sets the jerk according to unit of axis.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following.  Page 228 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	 Page 230 Options (Options)	00000000H	Sets a function option.

■ Output variables

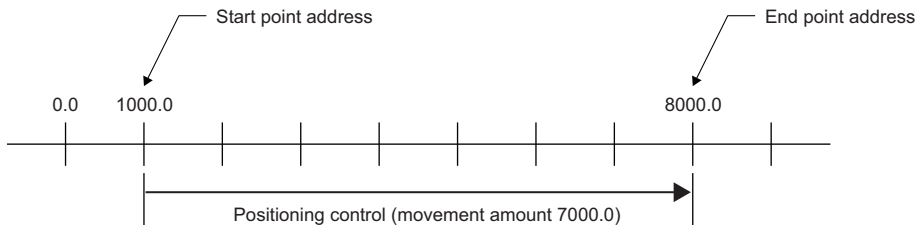
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	When TRUE, it indicates that the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the axis is being controlled.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution has been aborted because of other FBs. Becomes TRUE when this FB is stopped by an error or this FB is started during an error occurrence. Becomes FALSE when Execute command (Execute) is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

Absolute Positioning Control

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

Ex.

When the start point address is 1000.0, and Target position (Position) is 8000.0, positioning is carried out in the positive direction for a movement amount of 7000.0 (8000.0 - 1000.0).



Details of setting items

■Target position (Position)

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

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

Setting range: Ring counter lower limit value ≤ Target position < Ring counter upper limit value

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

- When the software stroke limit is invalid (Software Stroke Limit Target (AxisName.Md.SwStrokeLimit_Target) is "-1: Invalid (Invalid)")

Direction selection (Direction)	Target position specification exceeding the ring counter (Options (Options) bit 16)	Setting range of Target position (Position)
Positive Direction (mcPositiveDirection)	0: Do not allow	Ring counter lower limit value ≤ Target position < Ring counter upper limit value
	1: Allow	Ring counter lower limit value ≤ Target position < Positioning range upper limit value ^{*1}
Negative Direction (mcNegativeDirection)	0: Do not allow	Ring counter lower limit value ≤ Target position < Ring counter upper limit value
	1: Allow	Positioning range lower limit value ^{*1} ≤ Target position < Ring counter upper limit value
Shortest Path (mcShortestWay)	0: Do not allow	Ring counter lower limit value ≤ Target position < Ring counter upper limit value
	1: Allow	

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

☞ Page 85 Positioning Range

To set the target position specification (Options (Options) bit 16) exceeding ring counter value to "1: Allow" can position in one rotation or more.

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.

For details on the direction moving toward the target position, refer to the following.

☞ Page 222 Direction selection (Direction)

■Velocity (Velocity)

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

☞ Page 89 Velocity set range

■Acceleration (Acceleration)

Specify the acceleration. The setting details defer depending on Acceleration/deceleration method setting (Options (Options) bit 0 to 2). For details, refer to the following.

☞ Page 267 Multiple Axes Positioning Control

■Deceleration (Deceleration)

Specify the deceleration. The setting details defer depending on Acceleration/deceleration method setting (Options (Options) bit 0 to 2). For details, refer to the following.

☞ Page 267 Multiple Axes Positioning Control

■Jerk (Jerk)

Set Jerk. For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Direction selection (Direction)

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.

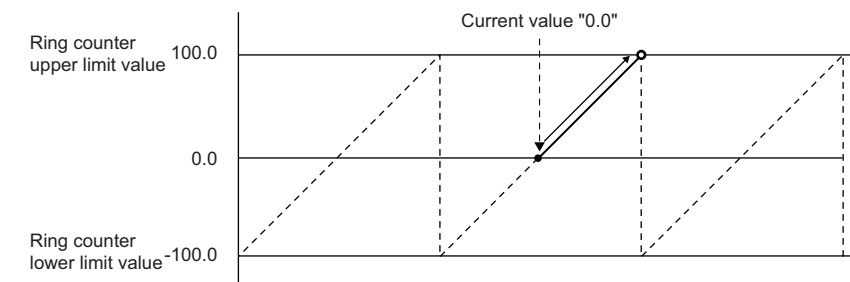
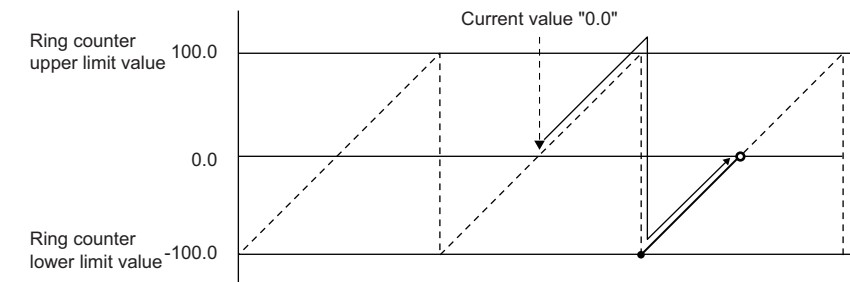
When the software stroke limit is invalid, specify the direction used to move from the current position to the target position by selecting "1: Positive Direction (mcPositiveDirection)", "2: Negative Direction (mcNegativeDirection)", and "3: Shortest Path (mcShortestWay)".

- 1: Positive Direction (mcPositiveDirection)

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

[When setting the target position exceeding the ring counter (Options (Options) bit 16)] is "0: Do 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	

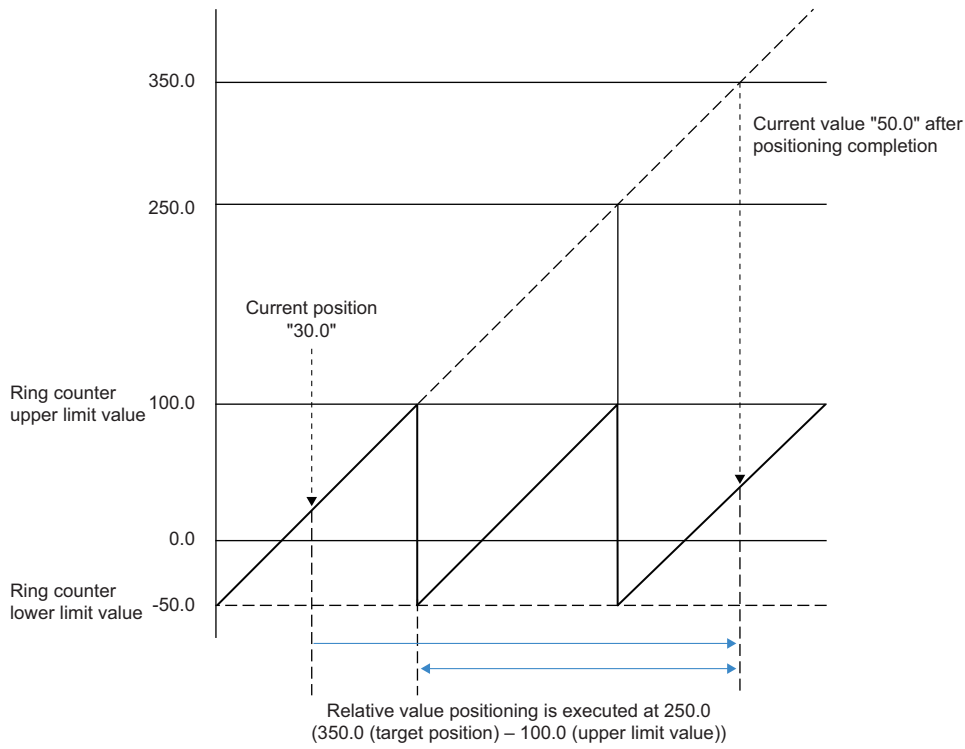
[When setting the target position exceeding the ring counter (Options (Options) bit 16)) is "1: Allow"

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 Target Position Range" (error code: 1A05H).

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: Do 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 "100.0", the ring counter lower limit value to "-50.0", the current position to "30.0", and the target position to "350.0" (the relative value positioning is executed after exceeding the ring counter upper limit value)



- 2: Negative Direction (mcNegativeDirection)

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

[When setting the target position exceeding the ring counter (Options (Options) bit 16)] is "0: Do 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	Ring counter upper limit value 100.0 0.0 Ring counter lower limit value -100.0 Current value "0.0"
Current value < Target position < Ring counter upper limit value	Ring counter upper limit value 100.0 0.0 Ring counter lower limit value -100.0 Current value "0.0"

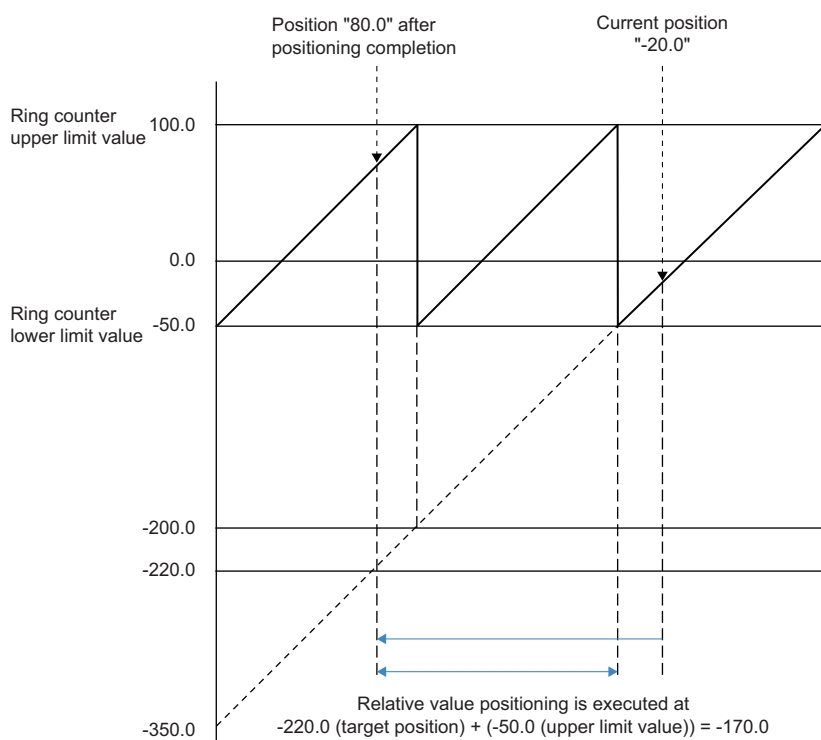
[When setting the target position exceeding the ring counter (Options (Options) bit 16)) is "1: Allow"

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 Target Position Range" (error code: 1A05H).

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: Do 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 "100.0", the ring counter lower limit value to "-50.0", the current position to "-20.0", and the target position to "-220.0"



• 3: Shortest Path (mcShortestWay)

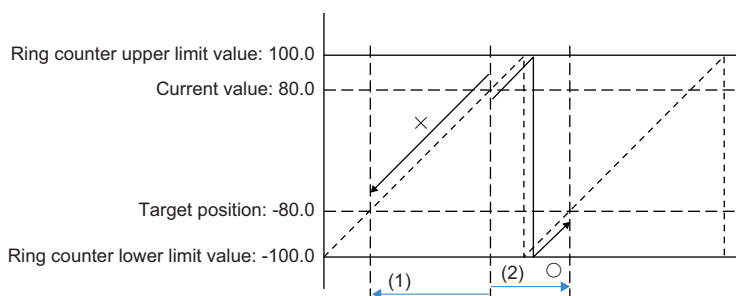
Based on the current position, positioning control is performed in the direction close to the target position (the one with the smaller absolute value of the movement amount). If the distance is the same in the positive direction and the negative direction, it is operated in the current direction.

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

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 "100.0", the lower limit value to "-100.0", the current position to "80.0", and the target position to "- 80.0"



Since the movement amount of (1) is 160.0 and that of (2) is 40.0, positioning moves to the positive direction of (2).

■Buffer mode (BufferMode)

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

📖 Page 135 Buffer mode type

■Options (Options)

Set the function options that are used in MC_MoveAbsolute (Absolute Value Positioning) 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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. 📖 Page 348 Acceleration/deceleration Processing Function
3 to 4	Empty (Specify "0".)*1
5	Reverse rotation permission selection 0: Allow 1: Do not allow It is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode) or changing target position. For details, refer to the following. 📖 Page 134 Multiple Start (Buffer Mode) 📖 Page 434 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: Do 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) occurs, and the function does not start.

■Execution completion (Done)

It becomes TRUE when reaching the target position.

■Executing (Busy)

It is TRUE during the instruction execution. It becomes FALSE after reaching the target position.

■Controlling (Active)

It is TRUE while the axis is controlled. It becomes FALSE after reaching the target position.

■Abortion of execution (CommandAborted)

It becomes TRUE when another instruction is started during the execution of this FB.

■Error (Error)

It becomes 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_MoveAbsolute (Absolute Value Positioning), set the following slave object to the axis.

- Target position (607AH)

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 on the slave object setting, refer to the following.

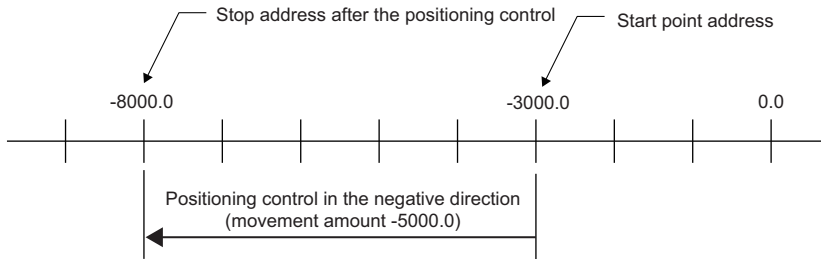
📖 Page 56 Axis Assignment

Relative Positioning Control

In MC_MoveRelative (Relative Value Positioning), Movement amount (Distance), Velocity (Velocity), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode) can be set, and positioning of movement amount set in Movement amount (Distance) is executed from the current position at start (start point address). The movement direction is determined by the sign of the movement amount. Axis Status (AxisName.Md.AxisStatus) becomes "5: During positioning operation (DiscreteMotion)".

Ex.

When the start point address is 3000.0, and the movement amount is - 5000.0, positioning is carried out to - 8000.0.



Details of setting items

■Movement amount (Distance)

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 Target Position Range" (error code: 1A05H) occurs and the FB does not start.

For details on movement amount range, refer to the following.

☞ Page 85 Positioning Range

■Velocity (Velocity)

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

☞ Page 89 Velocity set range

■Acceleration (Acceleration)

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

☞ Page 267 Multiple Axes Positioning Control

■Deceleration (Deceleration)

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

☞ Page 267 Multiple Axes Positioning Control

■Jerk (Jerk)

Set Jerk. For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Buffer mode (BufferMode)

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

☞ Page 135 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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
3	Position selection during buffer mode 0: Set position 1: Actual position This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode). For details, refer to the following. ☞ Page 134 Multiple Start (Buffer Mode)
4	Empty (Specify "0".)*1
5	Reverse rotation permission selection 0: Allow 1: Do not allow This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode) or changing target position. For details, refer to the following. ☞ Page 134 Multiple Start (Buffer Mode) ☞ Page 434 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) occurs, and the function does not start.

■Execution completion (Done)

It becomes TRUE when reaching the target position.

■Executing (Busy)

It is TRUE during the instruction execution. It becomes FALSE after reaching the target position.

■Controlling (Active)

It is TRUE while the axis is controlled. It becomes FALSE after reaching the target position.

■Abortion of execution (CommandAborted)

It becomes TRUE when another instruction is started during the execution of this FB.

■Error (Error)

It becomes 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 (Relative Value Positioning), set the following slave object to the axis.

- Target position (607AH)

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 on the slave object setting, refer to the following.

☞ Page 56 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.

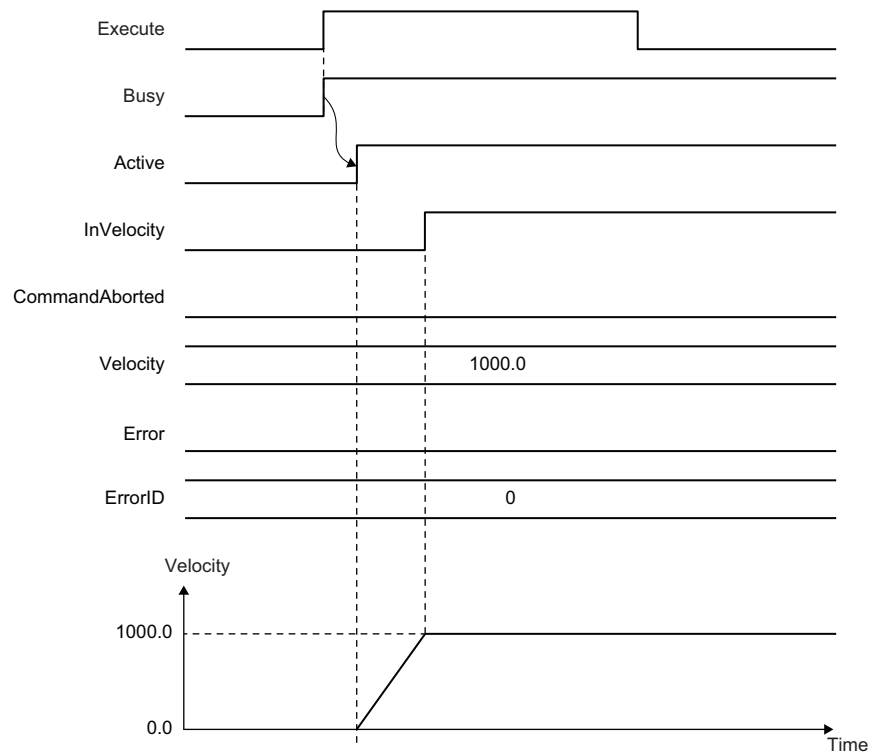
Page 291 Velocity Control

Relevant FB

MCv_SpeedControl			
Item	Description		
Function overview	Executes the speed control including position loop.		
Symbol [Structured Ladder]	MCv_SpeedControl DUT : Axis B : Execute B : ContinuousUpdate L : Velocity L : Acceleration L : Deceleration L : Jerk ENUM : Direction ENUM : BufferMode UD : Options Axis : DUT InVelocity : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW		
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 27 Execute command (Execute) type/Enable (Enable)

■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 754 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	Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration) can be continuously changed during TRUE.
Velocity	Velocity	LREAL	↑/R/C	0.0, ±0.0001 to ±2500000000.0	0.0	Sets commanded[velocity. If the speed is negative, it moves in the negative direction. If it is omitted, the axis is not operated, however, Axis Status (AxisName.Md.AxisStatus) will be "6: During continuous operation (ContinuousMotion)".
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the acceleration.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the deceleration.
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	0.0	Sets the jerk.
Direction selection	Direction	MC_DIRECTION	↑	1 to 2	0	Sets the direction selection. MC_DIRECTION definition can be used. 1: Positive Direction (mcPositiveDirection) 2: Negative Direction (mcNegativeDirection) When "2: Negative Direction (mcNegativeDirection)" is selected and Velocity (Velocity) is negative, the motor movement direction will be positive direction. If this setting is omitted, the error "Out of Direction Selection Range" (error code: 1A37H) will occur.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following. ☞ Page 234 BufferMode
Options	Options	DWORD(HEX)	↑	*1	0000000H	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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
3 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■Output variables

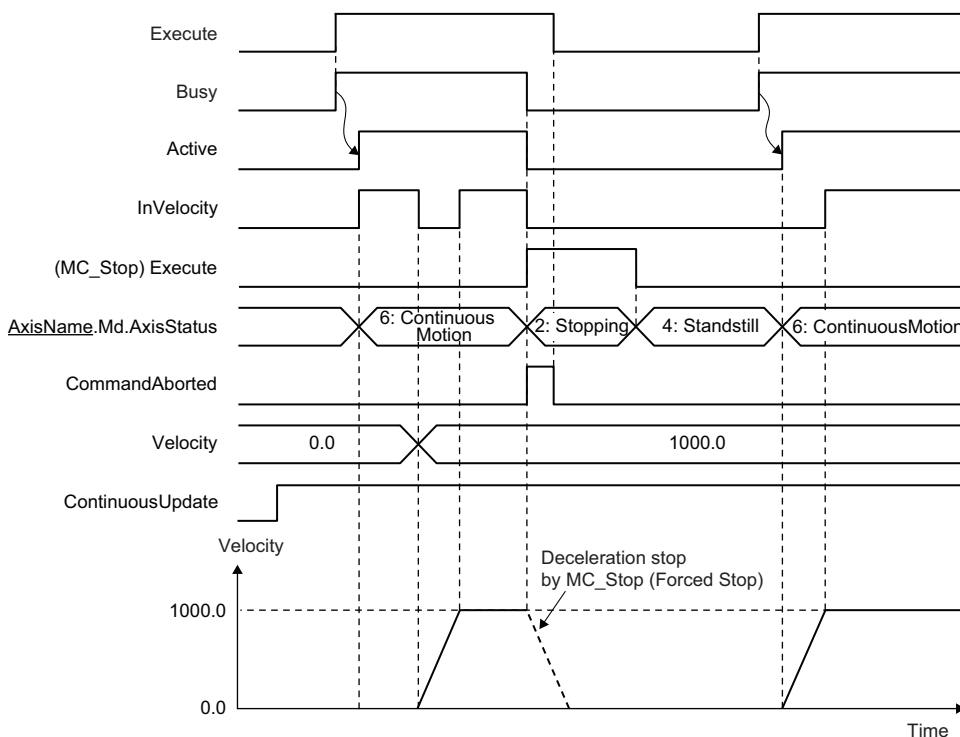
Name	Variable name	Data type	Default value	Description
Target velocity reached	InVelocity	BOOL	FALSE	Indicates that the set velocity has reached the target velocity. When the target value has been changed due to change at Continuous update (ContinuousUpdate) TRUE, it maintains FALSE until the set velocity 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 execution has been aborted because of other FBs. Becomes TRUE when this FB is stopped by an error or this FB is started during an error occurrence. Becomes FALSE when Execute command (Execute) is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following. Page 711 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 (Speed Control (Including Position Loop)) is used to execute. To stop the axis, use MC_Stop (Forced Stop) or start another motion FB.

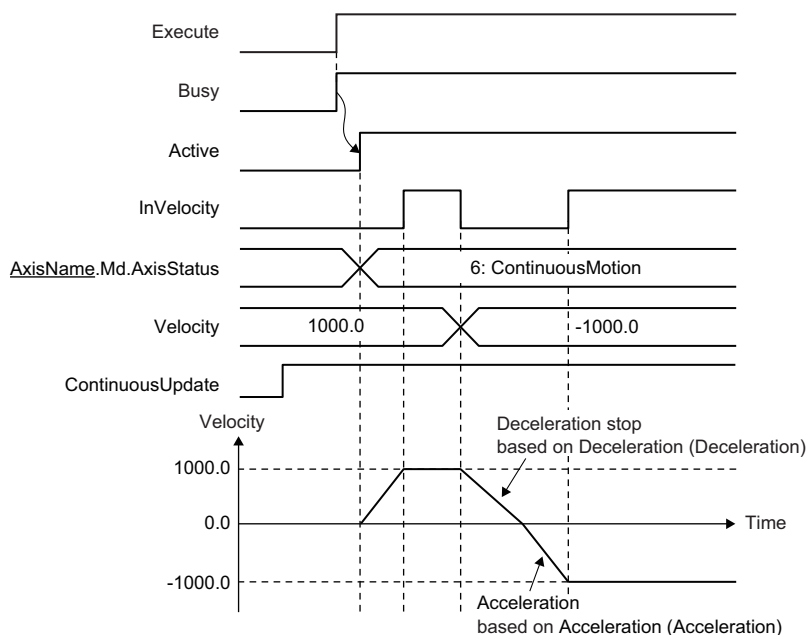
To perform the speed control with the control mode of the driver set to csv, use MC_MoveVelocity (Speed Control), etc.

Timing chart at start and the stop cause occurrence



Timing chart when the operation direction is changed

If the sign of Velocity (Velocity) is reversed and the operation direction is changed when Continuous update (ContinuousUpdate) is TRUE, the axis accelerates toward the target velocity once after the deceleration stop.



BufferMode

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

☞ Page 135 Buffer mode type

Necessary slave object

When using Speed Control (Including Position Loop) for a single axis, set the following slave objects for the axis.

- Target position (607AH)

If the above slave object is not set, the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs, and the velocity control of the axis does not start.

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

☞ Page 56 Axis Assignment

6.3 Single Axis Manual Control

This section describes the single axis manual control.

Relevant variables

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.

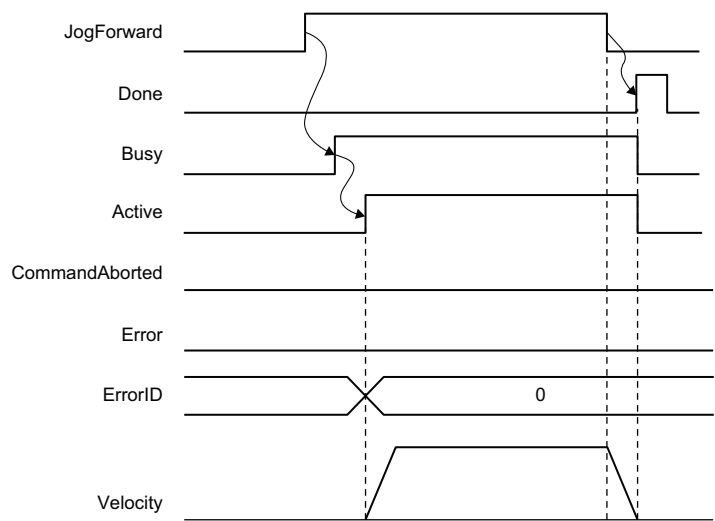
Relevant FB

MCv_Jog (JOG Operation)

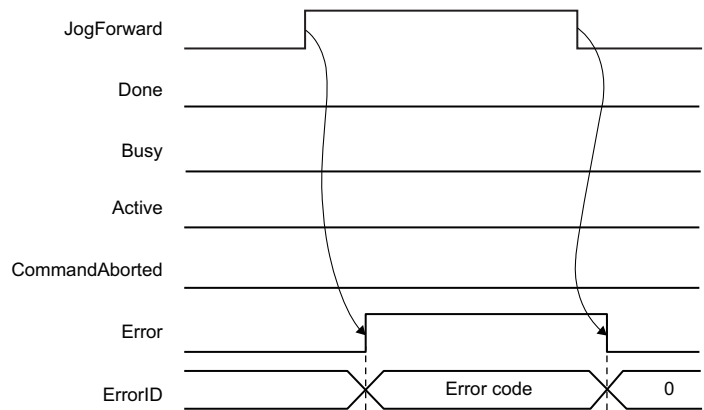
Item	Description		
Function overview	Executes JOG operation according to the commanded velocity.		
Symbol [Structured Ladder]	MCv_Jog DUT : Axis Axis : DUT B : JogForward Done : B B : JogBackward Busy : B L : Velocity Active : B L : Acceleration CommandAborted : B L : Deceleration Error : B L : Jerk ErrorID : UW UD : Options		
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 754 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.
Velocity	Velocity	LREAL		0.0, 0.0001 to 2500000000.0	0.0	Sets the set velocity.
Acceleration	Acceleration	LREAL		 Page 353 Input variables to use	0.0	Sets the acceleration.
Deceleration	Deceleration	LREAL		 Page 353 Input variables to use	0.0	Sets the deceleration.
Jerk	Jerk	LREAL		 Page 353 Input variables to use	0.0	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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function will not start.

Output variables

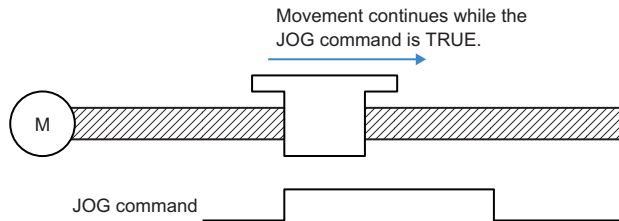
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	When deceleration stop by JOG command OFF is completed, Execution completion (Done) bit becomes TRUE for only one scan.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the execution has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 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

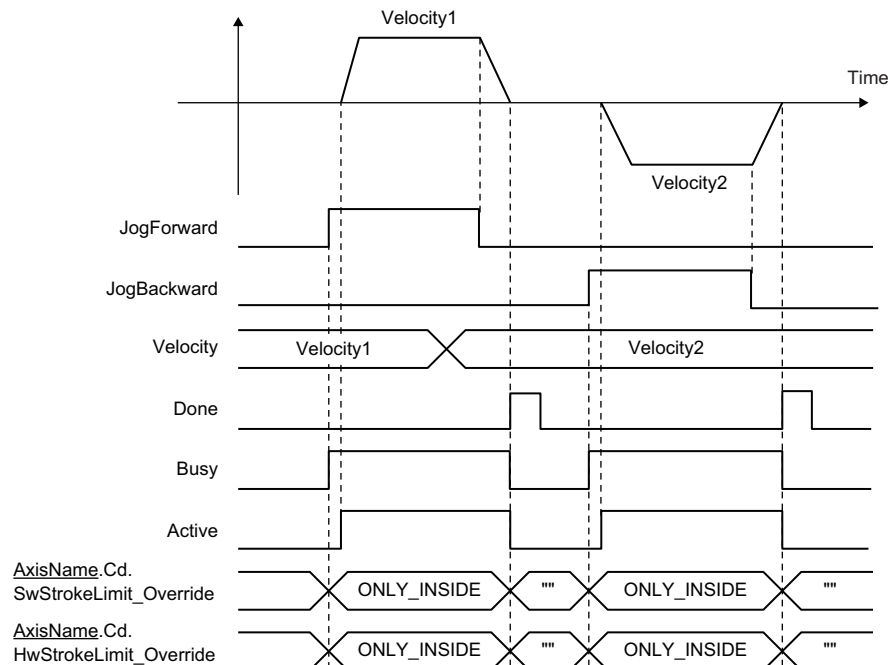
In JOG operation, the command is output from the motion system to the axis while the positive/reverse rotation JOG command is input by using MCv_Jog (JOG Operation), and then the axis operates to the specified direction.

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 (JOG Operation).
- The target axis is moved to the specified direction during TRUE, by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to TRUE.
- Axis Status (AxisName.Md.AxisStatus) during JOG operation is "6: During continuous operation (ContinuousMotion)".
- A deceleration stop is executed by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to FALSE.
Axis Status (AxisName.Md.AxisStatus) changes to "4: Standby (Standstill)" after the deceleration stop is completed.
- When Error (Error) becomes TRUE during the deceleration by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to FALSE, Error (Error) becomes TRUE until Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) is changed TRUE.
- When another operation instruction is started during a JOG operation, the operation is carried out based on the Buffer mode (BufferMode) setting.
- When a JOG operation is started during another operation instruction, the start request will be ignored and the warning "Start during Operation Warning" (warning code: 0D01H) will occur. Start a JOG operation when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
- Use velocity change by override function to change the velocity during JOG operation. For details, refer to the following.
 Page 380 Override Function

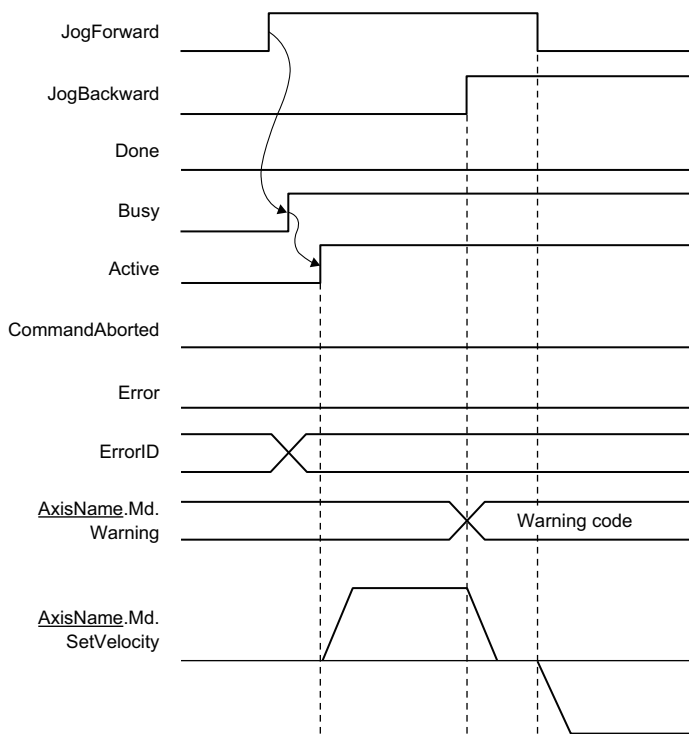
Details of setting items

■ Positive rotation JOG command (JogForward) / Reverse rotation JOG command (JogBackward)

- Positive rotation JOG operation and reverse rotation JOG operation are started by setting Positive rotation JOG command (JogForward) and Reverse rotation JOG command (JogBackward) to TRUE respectively, and the target axis is moved to the specified direction during TRUE.
- If Positive rotation JOG command (JogForward) and Reverse rotation JOG command (JogBackward) are turned TRUE simultaneously, the warning "JOG Command Input at Both Directions Warning" (warning code: 0D02H) will be detected, Abortion of execution (CommandAborted) becomes TRUE, and the JOG operation is not carried out.
After that, both direction JOG operation sets to FALSE and as only one of the JOG operation sets to TRUE after Abortion of execution (CommandAborted) turns to FALSE, the operation is carried out.
- If the other JOG command of the same FB becomes 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, become TRUE either Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward).

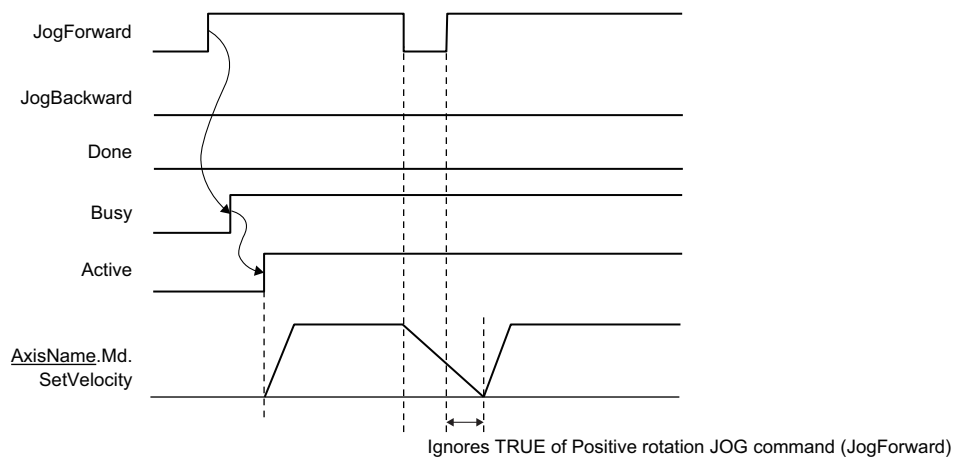
Ex.

When the other JOG command is TRUE during operation



- During deceleration stop when Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) are FALSE, re-acceleration will not be performed even if the JOG command is set to TRUE. After the deceleration stop is completed, the acceleration will be performed.

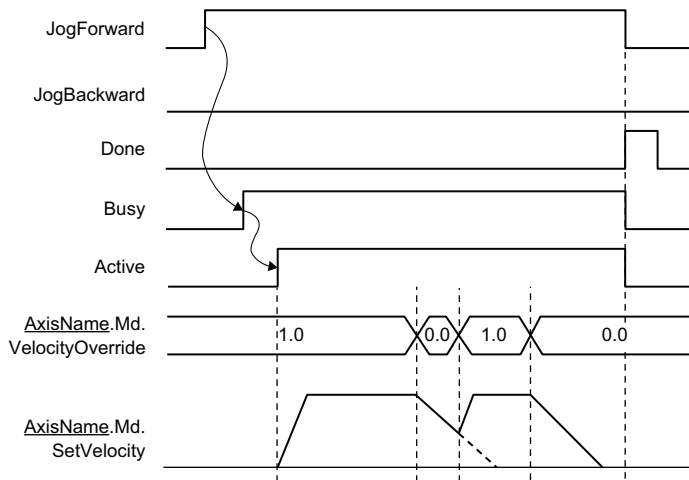
Ex.



- To repeatedly perform deceleration stop and acceleration while moving by JOG operation, use the override function to perform the velocity change.
- For details on the override function, refer to the following.

➞ Page 380 Override Function

Ex.



■Velocity (Velocity)/Acceleration (Acceleration)/Deceleration (Deceleration)/Jerk (Jerk)

- Set Velocity, Acceleration, Deceleration, and Jerk during JOG operation.
- The settings are imported when JOG operation is started by setting Positive rotation JOG command (JogForward) or Reverse rotation JOG command (JogBackward) to TRUE. A change during JOG operation is not accepted.
- For details on combined operation, refer to the following.

➞ Page 89 Velocity set range, ➞ Page 348 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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ➞ Page 348 Acceleration/deceleration Processing Function
3 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs and the function will not start.

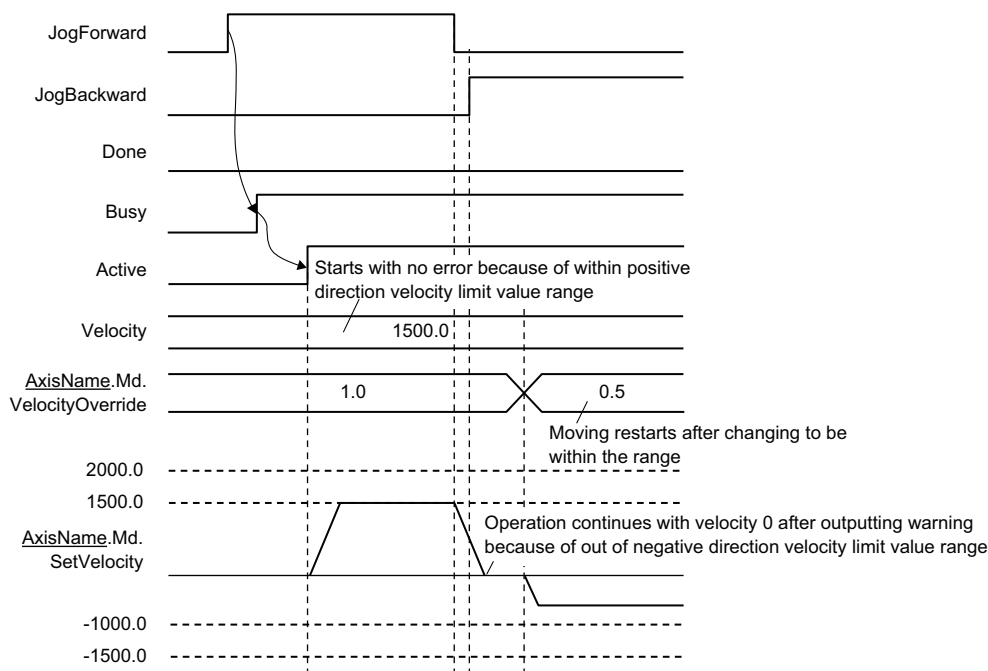
Precautions

- For safety, set a small value in Velocity (Velocity) first and check the movement, and then gradually increase the value.
- Use the hardware stroke limit function when carrying out JOG operation near the upper or lower limits. If the hardware stroke limit function is not used, the workpiece may exceed the moving range and cause an accident.
- When software stroke limit function is valid and Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) is other than DISABLE (Check disabled) or ONLY_INSIDE (Check disabled for movement returning to the range), rewrites Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) into ONLY_INSIDE (Check disabled for movement returning to the range) during MCv_Jog (JOG Operation) execution, and rewrites it into "" during JOG operation completion.
- When software stroke limit function is valid and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is other than DISABLE (Check disabled) or ONLY_INSIDE (Check disabled for movement returning to the range), rewrites Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) into ONLY_INSIDE (Check disabled for movement returning to the range) during MCv_Jog (JOG Operation) execution, and rewrites it into "" during JOG operation completion.
- Do not change Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) during MCv_Jog (JOG Operation) execution.

- Note that the value of Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) are retained to the next instruction during multiple start because the next instruction is analyzed during operation when multiple start is executed during JOG operation.
- When moving to negative direction against at start after deceleration stop during JOG operation, and when the target velocity exceeds the velocity limit value, the warning "Speed Limit Value Exceeded during Direction Change Warning" (warning code: 0D20H) occurs. Also, when the acceleration time exceeds 8400.0 [s] seconds, the warning "Acceleration Time Over Warning on Direction Change" occurs. (The operation continues with velocity 0.) The moving starts after changing control to remove the cause.

Ex.

When setting Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) = 2000.0, and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) = 1000.0



Necessary slave object

When using JOG operation, set the following slave objects for the axis.

- Target position (607AH)

If the above slave object is not set, the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs, and the axis will not start.

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

📖 Page 56 Axis Assignment

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

Variable/Structure name	Name	Details
<u>AxesGroupName.AxesGroupRef.</u>		
GroupNo	Axes Group No.	Indicates axes group No. 0: No setting From 1 to the maximum number of setting: Set axes group No.
<u>AxesGroupName.Pr.</u>		
Axis[1..16]	Configuration Axis	Sets Axis No. (AxisNo) of Axis Information (<u>AxisName.AxisRef</u>) configuring the axes group.
VelocityLimit	Velocity Limit Value	Specifies the velocity.
<u>AxesGroupName.Md</u>		
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.

6

Monitor data in multiple axes positioning control

Configuration axes of the axes group that are used for the multiple axes positioning control can be checked in Interpolation Axes (AxesGroupName.Md.InterpolationAxes).

Relevant FBs

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]	MCv_MoveLinearInterpolateAbsolute DUT : AxesGroup B : Execute B : ContinuousUpdate W : LinearAxes L : Position L : Velocity L : Acceleration L : Deceleration L : Jerk ENUM : VelocityMode ENUM : Direction ENUM : BufferMode UD : Options AxesGroup : DUT Done : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW		
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 758 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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously reflect the input of import "C".
Linear interpolation axes	LinearAxes	INT[0..15]	↑	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 Velocity mode (VelocityMode) is 2: Reference Axis Velocity (ReferenceAxisSpeed), the first element of the array is regarded as the reference axis.
Target position	Position	LREAL[0..15]	↑	 Page 274 Target position (Position)/ Movement amount (Distance)	0.0	Sets the target position of the absolute position according to unit of axis. It is 1-dimensional array data. It is treated as the absolute position of the configuration axis 1 to 16.
Velocity	Velocity	LREAL	↑/R/C	0.0, 0.0001 to 2500000000.0	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	 Page 353 Input variables to use	0.0	Sets the jerk according to unit of axis.
Speed mode	VelocityMode	MC_INTERPOLATE_SPEED_MODE	↑	0 to 2	0	Specifies the speed mode of interpolation control. 0: Vector Velocity (VectorSpeed) 1: Long Axis Velocity (LongAxisSpeed) 2: Reference Axis Velocity (ReferenceAxisSpeed)
Direction selection	Direction	MC_DIRECTION[0..15]	↑	1 to 3	0	Sets the direction selection. It is 1-dimensional array data. It is treated as the direction selection of the configuration axis 1 to 16. 1: Positive Direction (mcPositiveDirection) 2: Negative Direction (mcNegativeDirection) 3: Shortest Path (mcShortestWay) When this setting is omitted, the error "Out of Direction Selection Range" (error code: 1A37H) occurs.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following.  Page 275 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	*1	0000000H	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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 to 15	Empty (Specify "0".)*1
16	The target position specification exceeding the ring counter range 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: Do 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) occurs, and the function will not start.

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, it maintains TRUE until Execute command (Execute) is changed to FALSE. When Execute command (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, Controlling (Active) of only one FB becomes TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted because of an error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UNIT)	0	The generated error code is returned. For details, refer to the following.  Page 711 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 group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	☞ Page 758 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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it reflects input of the import "C".
Linear interpolation axes	LinearAxes	INT[0..15]	↑	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 Velocity mode (VelocityMode) is 2: Reference Axis Velocity (ReferenceAxisSpeed), the first element of the array is regarded as the reference axis.
Movement amount	Distance	LREAL[0..15]	↑	☞ Page 274 Target position (Position)/ Movement amount (Distance)	0.0	Sets the relative position according to unit of axis from the current position at start to the end point. It is 1-dimensional array data. It is treated as the relative position of the configuration axis 1 to 16.
Velocity	Velocity	LREAL	↑/R/C	0.0, 0.0001 to 2500000000.0	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	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: Vector Velocity (VectorSpeed) 1: Long Axis Velocity (LongAxisSpeed) 2: Reference Axis Velocity (ReferenceAxisSpeed)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 5	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following. ☞ Page 275 Buffer mode (BufferMode)
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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
3	Position selection during buffer mode 0: Set position 1: Actual position This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode). For details, refer to the following. ☞ Page 134 Multiple Start (Buffer Mode)
4 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, it maintains TRUE until Execute command (Execute) is changed to FALSE. When Execute command (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, Controlling (Active) of only one FB becomes TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted because of an error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0	The generated error code is returned. For details, refer to the following. ☞ Page 711 List of Error Codes

MCv_MoveCircularInterpolateAbsolute

Item	Description
Function overview	Executes positioning by 2-axis circular interpolation by using arbitrary 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 group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	Page 758 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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it reflects input of the import "C".
Circular interpolation axes	CircAxes	INT[0..1]	↑	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: Border Point Specification (mcBorder) Sub point (AuxPoint) defines a point on the arc connecting the start point and the end point. 1: Central Point Specification (mcCenter) Sub point (AuxPoint) defines the center point of the circle. 2: Radius Specification (mcRadius) Sub point (AuxPoint) defines the radius of the circle.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Sub point	AuxPoint	LREAL[0..15]	↑	For "0: Border Point Specification (mcBorder)", "1: Central Point Specification (mcCenter)": -10000000000.0 ≤ Setting value < 10000000000.0 ^{*1} For "2: Radius Specification (mcRadius)": 0.000001 to 2147483647.0	0.0	It is 1-dimensional array data. It is as follows in the circular interpolation mode. For "0: Border Point Specification (mcBorder)" and "1: Central Point Specification (mcCenter)": It is used as the absolute position of the configuration axis 1 to 16. Sets the absolute position depending on the axis unit to the border point and the center point. For "2: Radius Specification (mcRadius)": The first element is used for the radius, and the second or later elements are ignored.
End point	EndPoint	LREAL[0..15]	↑	-10000000000.0 ≤ Positioning range < 10000000000.0 ^{*1}	0.0	Set the absolute position of end point according to unit of axis. It is 1-dimensional array data. It is treated as the absolute position of the configuration axis 1 to 16.
Path selection	PathChoice	MC_CIRC_PATHCHOICE	↑	0 to 5	0	Sets rotation direction of circular interpolation. 0: CW (mcCW) 1: CCW (mcCCW) 2: Shortcut (mcShortWay) 3: Detour (mcLongWay) 4: CW Detour (mcCWLongWay) 5: CCW Detour (mcCCWLongWay) When specifying "0: Border Point Specification (mcBorder)" in Circular interpolation mode (CircMode), the input is ignored. When specifying "2: Radius Specification (mcRadius)" in Circular interpolation mode (CircMode), "0: CW (mcCW)" and "1: CCW (mcCCW)" mean the CW shortcut and the CCW shortcut respectively.
Velocity	Velocity	LREAL	↑/R/C	0.0, 0.0001 to 2500000000.0	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	 Page 353 Input variables to use	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: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following.  Page 287 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑/R	*2	0000000H	Sets a function option with bit specification.

*1 The range is ring counter range when the ring counter is enabled.

*2 For a bit and the function description, refer to the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function will not start.

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, it maintains TRUE until Execute command (Execute) is changed to FALSE. When Execute command (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, Controlling (Active) of only one FB becomes TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution has been aborted because of an error or multiple start.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0	The generated error code is returned. For details, refer to the following.  Page 711 List of Error Codes

MCv_MoveCircularInterpolateRelative

Item	Description
Function overview	Executes positioning by 2-axis circular interpolation by using arbitrary 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 group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	Page 758 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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it reflects input of the import "C".
Circular interpolation axes	CircAxes	INT[0..1]	↑	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: Border Point Specification (mcBorder) Sub point (AuxPoint) defines a point on the arc connecting the start point and the end point. 1: Central Point Specification (mcCenter) Sub point (AuxPoint) defines the center point of the circle. 2: Radius Specification (mcRadius) Sub point (AuxPoint) defines the radius of the circle.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Sub point	AuxPoint	LREAL[0..15]	↑	For "0: Border Point Specification (mcBorder)", "1: Central Point Specification (mcCenter)": -10000000000.0 to 10000000000.0 For "2: Radius Specification (mcRadius)": 0.000001 to 2147483647.0	0.0	It is 1-dimensional array data. It is as follows in the circular interpolation mode. For "0: Border Point Specification (mcBorder)" and "1: Central Point Specification (mcCenter)": It is used as the relative position of the configuration axis 1 to 16. Sets the relative position depending on the axis unit from current position at start to the border point and the center point. For "2: Radius Specification (mcRadius)": The first element is used for the radius, and the second or later elements are ignored.
End point	EndPoint	LREAL[0..15]	↑	-10000000000.0 to 10000000000.0	0.0	Set the relative position according to unit of axis from the current position at start to the end point. It is 1-dimensional array data. It is treated as the absolute position of the configuration axis 1 to 16.
Path selection	PathChoice	MC_CIRC_PATHCHOICE	↑	0 to 5	0	Sets rotation direction of circular interpolation. 0: CW (mcCW) 1: CCW (mcCCW) 2: Shortcut (mcShortWay) 3: Detour (mcLongWay) 4: CW Detour (mcCWLongWay) 5: CCW Detour (mcCCWLongWay) When specifying "0: Border Point Specification (mcBorder)" in Circular interpolation mode (CircMode), the input is ignored. When specifying "2: Radius Specification (mcRadius)" in Circular interpolation mode (CircMode), "0: CW (mcCW)" and "1: CCW (mcCCW)" mean the CW shortcut and the CCW shortcut respectively.
Velocity	Velocity	LREAL	↑/R/C	0.0, 0.0001 to 2500000000.0	0.0	Sets the speed command value according to unit of axis.
Acceleration	Acceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the acceleration according to unit of axis.
Deceleration	Deceleration	LREAL	↑/R/C	 Page 353 Input variables to use	0.0	Sets the deceleration according to unit of axis.
Jerk	Jerk	LREAL	↑	 Page 353 Input variables to use	0.0	Sets the jerk according to unit of axis.
Circular interpolation error tolerance	CircularErrorTolerance	LREAL	↑	0.000001 to 100000.0	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: Aborting (mcAborting) 1: Buffered (mcBuffered) 2: BlendingLow (mcBlendingLow) 3: BlendingPrevious (mcBlendingPrevious) 4: BlendingNext (mcBlendingNext) 5: BlendingHigh (mcBlendingHigh) For details, refer to the following.  Page 287 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	*1	0000000H	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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3	Position selection during buffer mode 0: Set position 1: Actual position This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode). For details, refer to the following.  Page 134 Multiple Start (Buffer Mode)
4 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function will not start.

Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, it maintains TRUE until Execute command (Execute) is changed to FALSE. When Execute command (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, Controlling (Active) of only one FB becomes TRUE.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution of FB has been aborted because of an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD (UINT)	0	The generated error code is returned. For details, refer to the following.  Page 711 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 65 Axes Group,  Page 77 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

- In multiple axes positioning control, specify axes (interpolation axes) to be used for interpolation control in the configuration axis of the axes group. Up to 4 axes can be set.

Positioning speed in multiple axes positioning control

Positioning speed at multiple axes positioning control can be set in Velocity (Velocity) of the Motion control FB. In 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 velocity specification
- Long axis velocity specification
- Reference axis velocity specification

The motion system control methods for each set method are described in the following.

■Vector velocity specification

0: Vector Velocity (VectorSpeed)

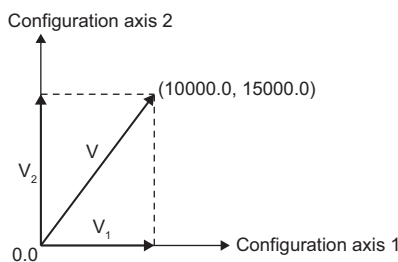
The positioning speed of each interpolation axis is calculated from the movement amount of each interpolation axis by the motion system based on the positioning speed of the set control target.

The positioning speed of the control target is called the vector velocity.

Set each inputs in the motion control FB: Linear interpolation axes (LinearAxes) as the interpolation axes, Target position (Position) or Movement amount (Distance) as the movement amount of each interpolation axis, and Velocity (Velocity) as the vector velocity.

Ex.

The following shows the case for 2-axis linear interpolation control.



Program example

Setting item	Setting value
Linear interpolation axes	Configuration axis 1, Configuration axis 2
Configuration axis 1 movement amount (D ₁)	10000.0 [pulses]
Configuration axis 2 movement amount (D ₂)	15000.0 [pulses]
Velocity unit of axes group	[s]
Vector velocity (V)	7000.0 [pulses/s]

For the above conditions, the positioning speed of each axis is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = V \times D_1 / \sqrt{D_1^2 + D_2^2}$
Configuration axis 2 positioning speed	$V_2 = V \times D_2 / \sqrt{D_1^2 + D_2^2}$

Point

For the vector velocity specification, the set velocity limit value is valid to the Velocity (Velocity) which is as the vector velocity. For details, refer to the following.

☞ Page 377 Velocity Limit

■Long axis velocity specification

1: Long Axis Velocity (LongAxisSpeed)

The control is carried out based on the positioning speed (the long axis velocity) of interpolation axes whose movement amount is the largest in the addresses set in each interpolation axis.

The positioning speed of the other interpolation axes is calculated by the motion system from the movement amount of each interpolation axis.

Set each inputs in the motion control FB: Linear interpolation axes (LinearAxes) as the interpolation axes, Target position (Position) or Movement amount (Distance) as the movement amount of each interpolation axis, and Velocity (Velocity) as the long axis velocity.

Ex.

The following shows the case for 4-axis linear interpolation control.

Program example

Setting item	Setting value
Linear	Configuration axis 1, Configuration axis 2, Configuration axis 3, Configuration axis 4
Configuration axis 1 movement amount (D ₁)	10000.0 [pulses]
Configuration axis 2 movement amount (D ₂)	15000.0 [pulses]
Configuration axis 3 movement amount (D ₃)	5000.0 [pulses]
Configuration axis 4 movement amount (D ₄)	20000.0 [pulses]
Configuration axis 4 velocity unit	[s]
Long axis velocity (V)	7000.0 [pulses/s]

In the above case, the long axis is the configuration axis 4 whose movement amount is the largest, and the control is carried out by long axis velocity to the configuration axis 4. The positioning speed of the other interpolation axes is calculated by the motion system with the following calculation formulas.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = D_1 / D_4 \times V$
Configuration axis 2 positioning speed	$V_2 = D_2 / D_4 \times V$
Configuration axis 3 positioning speed	$V_3 = D_3 / D_4 \times V$

- For the long axis velocity specification, set velocity limit value is valid for the Velocity (Velocity) which is as the long axis velocity. For details, refer to the following.

Page 377 Velocity Limit

- Note that the vector velocity when specifying the long axis velocity may be larger than the velocity limit value.

(Ex.)

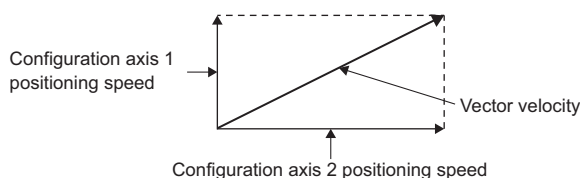
When setting a value like the following in the 2-axis linear interpolation, the vector velocity exceeds the velocity limit value.

The setting items and the setting values are shown below.

- Linear interpolation axes: Configuration axis 1, Configuration axis 2
- Configuration axis 1 movement amount: 100 [pulses]
- Configuration axis 2 movement amount: 200 [pulses]
- Long axis velocity: 50 [pulses/s]
- Velocity limit value of configuration axis 2: 55 [pulses/s]

In the above case, the reference axis is configuration axis 2 whose movement amount is the largest, and the control is carried out based on the positioning speed specified to the configuration axis 2. The positioning speed and the vector velocity of each axis are shown below.

- Configuration axis 1 positioning speed: $100 / 200 \times 50 = 25$ [pulses/s]
- Configuration axis 2 positioning speed: 50 [pulses/s]
- Vector velocity: $\sqrt{(25^2 + 50^2)} = 55.9$ [pulses/s]



The vector velocity becomes a value that exceeds the velocity limit value 55 of configuration axis 2.

■Reference axis velocity specification

2: Reference Axis Velocity (ReferenceAxisSpeed)

The motion system controls the positioning speed of other interpolation axes calculating from each interpolation axis movement amount based on the positioning speed of the set reference axis (the reference axis velocity), and carries out the control.

In motion control FB, set Linear interpolation axes (LinearAxes) to the reference axis as a interpolation axes to the first element of the array in Linear interpolation axes (LinearAxes). Also, set Target position (Position) or Movement amount (Distance) as the movement amount of each axis and set the Velocity (Velocity) as the reference axis speed.

- If "0.0" is set to the axis movement amount of configuration axes 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
Linear interpolation axes	Configuration axis 1, Configuration axis 2, Configuration axis 3, Configuration axis 4
Configuration axis 1 movement amount (D ₁)	10000.0 [pulses]
Configuration axis 2 movement amount (D ₂)	15000.0 [pulses]
Configuration axis 3 movement amount (D ₃)	5000.0 [pulses]
Configuration axis 4 movement amount (D ₄)	20000.0 [pulses]
Configuration axis 4 velocity unit	[s]
Reference axis velocity (V)	7000.0 [pulses/s]

In the above case, the reference axis is the configuration axis 4, and control is carried out at the positioning speed specified to the configuration axis 4.

The positioning speed of the other interpolation axes is calculated by the motion system with the following calculation formula.

Setting item	Setting value
Configuration axis 1 positioning speed	$V_1 = D_1 / D_4 \times V$
Configuration axis 2 positioning speed	$V_2 = D_2 / D_4 \times V$
Configuration axis 3 positioning speed	$V_3 = D_3 / D_4 \times V$

- For the reference axis velocity specification, set velocity limit value is valid to the Velocity (Velocity) which is as the reference axis velocity. For details, refer to the following.

Page 377 Velocity Limit

- Note that the positioning speed of the axis whose movement amount is larger than that of the reference axis is larger than the set reference axis velocity.

(Ex.)

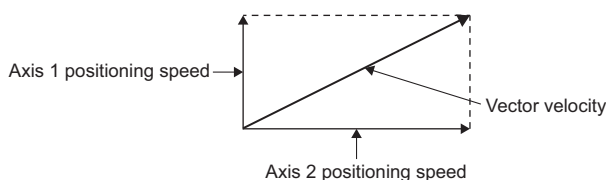
When setting a value like the following in the 2-axis linear interpolation, the positioning speed and the vector velocity of the configuration axis 2 exceed the velocity limit value.

The setting items and the setting values are shown below.

- Linear interpolation axes: Configuration axis 1, Configuration axis 2
- Configuration axis 1 movement amount: 100 [pulses]
- Configuration axis 2 movement amount: 200 [pulses]
- Reference axis velocity: 50 [pulses/s]
- Configuration axis 1 velocity limit value: 55 [pulses/s]

In the above case, the reference axis is the configuration axis 1, and control is carried out with the velocity limit value set to the configuration axis 1. The positioning speed and the vector velocity of each configuration axis are shown below.

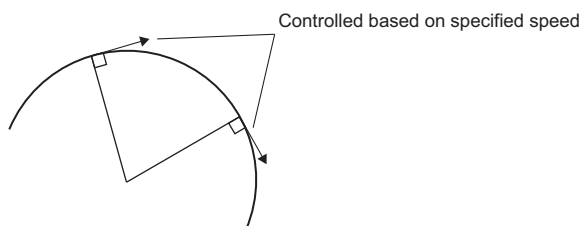
- Configuration axis 1 positioning speed: 50 [pulses/s]
- Configuration axis 2 positioning speed: $200 / 100 \times 50 = 100$ [pulses/s]
- Vector velocity: $\sqrt{(50^2 + 100^2)} = 111.8$ [pulses/s]



The positioning speed and the vector velocity of the configuration axis 2 become a value that exceeds the velocity limit value 55 of configuration axis 1.

Circular interpolation control

For the circular interpolation, the control is performed so that the positioning speed on the circular path becomes the specified speed.



The positioning speed for Blending of the multiple axes positioning control

This section explains operation when selecting BlendingLow, BlendingPrevious, BlendingNext, and BlendingHigh in Buffer mode (BufferMode) of the Motion control FB and setting different speed mode to the Velocity mode (VelocityMode) of the first FB (FB1) and the second FB (FB2) in the multiple axes positioning control.

- It can multiple start even when Velocity mode (VelocityMode) is different between FB1 and FB2.
- The control is carried out using the FB1 Velocity mode (VelocityMode) in FB1 and using the FB2 Velocity mode (VelocityMode) in FB2.
- During Blending of FB1 and FB2, the speed is not converted by the speed mode. The positioning speed value as the FB1 speed mode is used for Blending in the positioning speed as the FB2 speed mode.
- During Blending, when Velocity mode (VelocityMode) of FB1 and FB2 is different, the warning "Multiple Start Velocity Mode Specified Mismatch Warning" (warning code: 0D11H) will occur.
- Note that the speed of each axis and the vector velocity may rapidly change when Velocity mode (VelocityMode) of FB1 and FB2 is different during Blending.

Setting value	BufferMode	Description
2: mcBlendingLow	BlendingLow	At the end position of FB1, the speed becomes a lower value of Velocity (Velocity) between FB1 and FB2. When Velocity (Velocity) of FB2 is lower, at the end position of FB1, it operates with Velocity mode (VelocityMode) of FB1 and Velocity (Velocity) setting value of FB2.
3: mcBlendingPrevious	BlendingPrevious	At the end position of FB1, the speed becomes Velocity (Velocity) value of FB1. At the end position of FB1, it operates with Velocity mode (VelocityMode) of FB1 and Velocity (Velocity) setting value of FB1.
4: mcBlendingNext	BlendingNext	At the end position of FB1, the speed becomes Velocity (Velocity) value of FB2. At the end position of FB1, it operates with Velocity mode (VelocityMode) of FB1 and Velocity (Velocity) setting value of FB2.
5: mcBlendingHigh	BlendingHigh	At the end position of FB1, the speed becomes a higher value of Velocity (Velocity) between FB1 and FB2. When Velocity (Velocity) of FB2 is higher, at the end position of FB1, it operates with Velocity mode (VelocityMode) of FB1 and Velocity (Velocity) of FB2.

■Operation example for BlendingPrevious

Blending from the reference axis velocity specification to the vector velocity specification is as shown below.

It operates so that the FB1 reference axis velocity becomes the speed set to Velocity (Velocity) of FB1 (the reference axis velocity) at the FB1 target position. The reference axis velocity when reaching the FB1 target position is read as the current vector velocity value of FB2 without unit conversion, and it accelerates/decelerates the vector velocity set to Velocity (Velocity) of FB2.

- Axis setting, Axes group setting

Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the axes group	mm/s

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Linear Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100
Target position (Position[1])	100
Velocity (Velocity)	1000
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

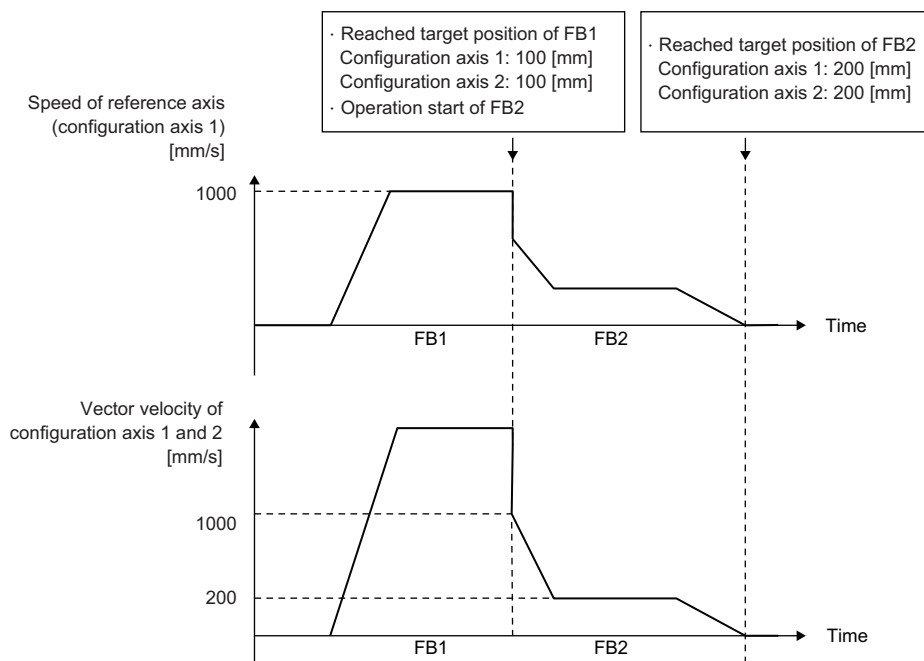
- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	200
Target position (Position[1])	200
Velocity (Velocity)	200
Velocity mode (VelocityMode)	0: Vector Velocity (VectorSpeed)
Buffer mode (BufferMode)	3: BlendingPrevious (mcBlendingPrevious)

Ex.

The following shows an operation example.

- Reaches the target position of FB1 at the reference axis velocity of 1000 [mm/s] of the configuration axis 1 that is the reference axis, and switches to FB2.
- FB2 starts operation at the vector velocity of 1000 [mm/s].
- Decelerates to the vector velocity of 200 [mm/s].
- Performs positioning to the target position of FB2.



■Operation example for BlendingNext

FB1: The reference axis velocity → FB2: The vector velocity

It operates so that the FB1 reference axis velocity becomes the speed set to Velocity (Velocity) of FB2 (the vector velocity) at the FB1 target position. The reference axis velocity when reaching the FB1 target position is read as the current vector velocity value of FB2 without unit conversion, and it accelerates/decelerates the vector velocity set to Velocity (Velocity) of FB2.

- Axis setting, Axes group setting

Setting item	Setting value
Position and velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the axes group	mm/s

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100
Target position (Position[1])	100
Velocity (Velocity)	1000
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

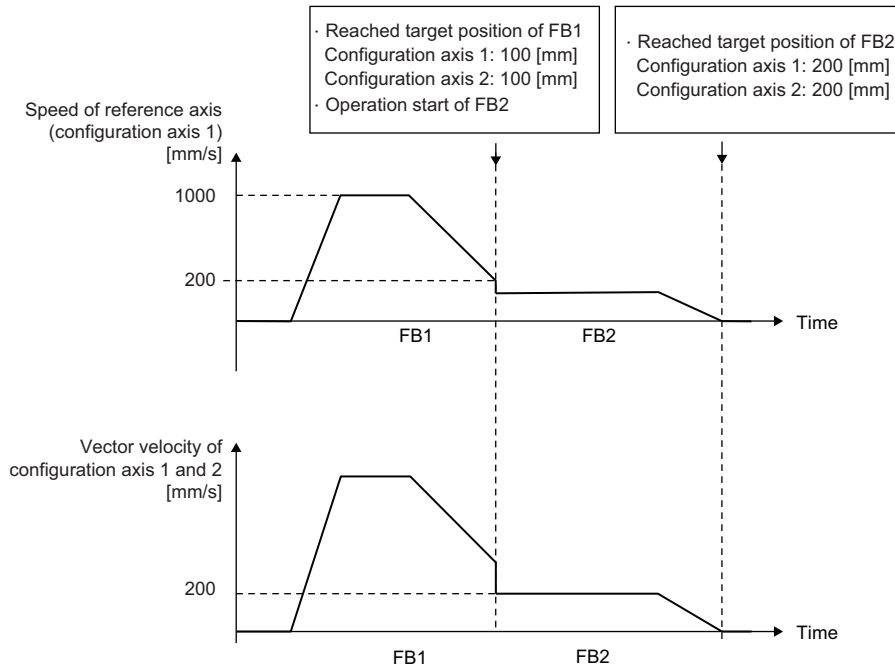
- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	200
Target position (Position[1])	200
Velocity (Velocity)	200
Velocity mode (VelocityMode)	0: Vector Velocity (VectorSpeed)
Buffer mode (BufferMode)	4: BlendingNext (mcBlendingNext)

Ex.

The following shows an operation example.

- Operates to the middle of the positioning to the target position of FB1 at the reference axis velocity 1000 [mm/s] of the configuration axis 1.
- The configuration axis 1 as a reference axis reaches the target position of FB1 at the reference axis velocity of 200 [mm/s], and switches to FB2.
- FB2 starts operation at the vector velocity 200 [mm/s].
- Performs positioning to the target position of FB2.



Command unit in the multiple axes positioning control

Command unit of the multiple axes positioning control

The command unit in the multiple axes positioning control differs depending on Velocity mode (VelocityMode) of the Motion control FB. For details and precautions, refer to the following.

📖 Page 79 Technical Units, 📖 Page 148 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 Buffer mode (BufferMode) of the Motion control FB, and the command unit is different between the first FB (FB1) and the second FB (FB2) in the multiple axes positioning control.

- It can multiple 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 "Velocity Command Unit Mismatch Warning" (warning code: 0D1EH) will occur.

Setting value	Buffer mode (BufferMode)	Description
2: mcBlendingLow	BlendingLow	At the end position of FB1, the speed becomes a lower value of Velocity (Velocity) between FB1 and FB2. When Velocity (Velocity) of FB2 is lower, the speed at the end position of FB1 is FB1 command unit and the value set in Velocity (Velocity) of FB2.
3: mcBlendingPrevious	BlendingPrevious	At the end position of FB1, the speed becomes Velocity (Velocity) value of FB1. The speed at the end position of FB1 is FB1 command unit and the value set in Velocity (Velocity) of FB1.
4: mcBlendingNext	BlendingNext	At the end position of FB1, the speed becomes Velocity (Velocity) value of FB2. The speed at the end position of FB1 is FB1 command unit and the value set in Velocity (Velocity) of FB2.
5: mcBlendingHigh	BlendingHigh	At the end position of FB1, the speed becomes a higher value of Velocity (Velocity) between FB1 and FB2. When Velocity (Velocity) of FB2 is higher, the speed at the end position of FB1 is FB1 command unit and the value set in Velocity (Velocity) of FB2.

■Operation example for BlendingPrevious

During Blending, it can multiple 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 velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the configuration axis 3	degree/min
Position and velocity command unit of the configuration axis 4	degree/min

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: mm/s from the command unit of the configuration axis 1)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100
Target position (Position[1])	100
Velocity (Velocity)	1000
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

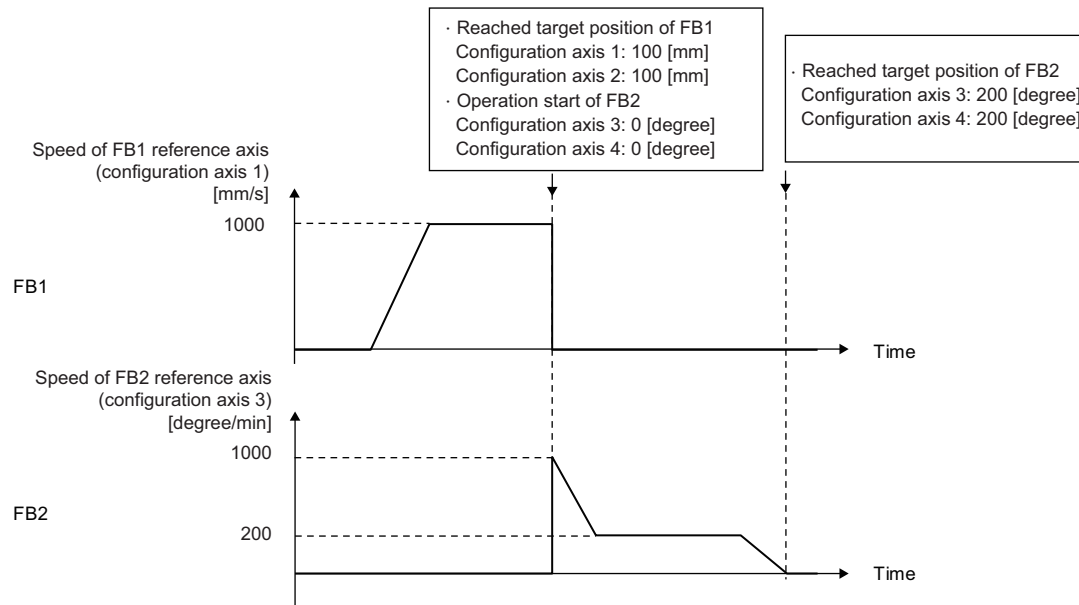
- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: degree/min from the command unit of the configuration axis 3)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	3
Linear interpolation axes (LinearAxes[1])	4
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[2])	200
Target position (Position[3])	200
Velocity (Velocity)	200
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)
Buffer mode (BufferMode)	3: BlendingPrevious (mcBlendingPrevious)

Ex.

The following shows an operation example.

- Configuration axis 1 as a reference axis reaches the target position of FB1 at the velocity of 1000 [mm/s], and switches to FB2.
- Configuration axis 3 as a reference axis starts operation from the current position of FB2 of [0 degree 0 degree] at the velocity of 1000 [degree/min].
- Configuration axis 3 as a reference axis decelerates to the velocity of 200 [degree/min].
- Performs positioning to the target position of FB2.



■ Operation example for BlendingNext

During Blending, it can multiple 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 velocity command unit of the configuration axis 1	mm/s
Position and velocity command unit of the configuration axis 2	mm/s
Position and velocity command unit of the configuration axis 3	degree/min
Position and velocity command unit of the configuration axis 4	degree/min

- FB1 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: mm/s)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	1
Linear interpolation axes (LinearAxes[1])	2
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[0])	100
Target position (Position[1])	100
Velocity (Velocity)	1000
Buffer mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)

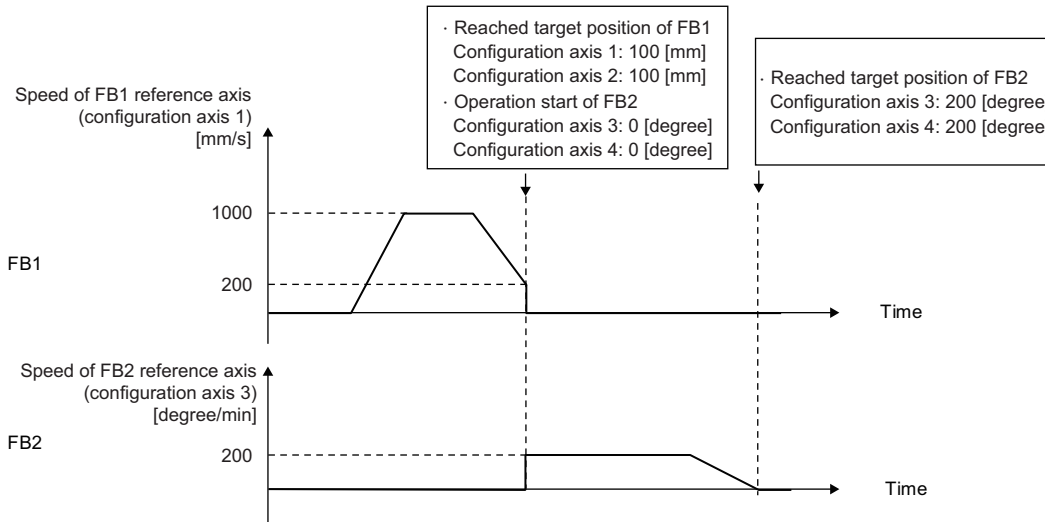
- FB2 input (MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control)) (Command unit: degree/min)

Setting item	Setting value
Linear interpolation axes (LinearAxes[0])	3
Linear interpolation axes (LinearAxes[1])	4
Linear interpolation axes (LinearAxes[2])	0
Target position (Position[2])	200
Target position (Position[3])	200
Velocity (Velocity)	200
Velocity mode (VelocityMode)	2: Reference Axis Velocity (ReferenceAxisSpeed)
Buffer mode (VelocityMode)	4: BlendingNext (mcBlendingNext)

Ex.

The following shows an operation example.

- Configuration axis 1 as a reference axis operates to the middle of the target position of FB1 at the velocity of [1000 mm/s].
- Configuration axis 1 as a reference axis reaches the target position of FB1 at the speed of [200 mm/s], and switches to FB2.
- FB2 with a configuration axis 3, as a reference axis, starts operation at the velocity of 200 [degree/min].
- Operates positioning to the target position of FB2.



Acceleration/deceleration processing

By Velocity mode (VelocityMode) of the Motion control FB, the relationship between the positioning speed and the acceleration/deceleration processing becomes as shown below.

- 0: Vector Velocity (VectorSpeed)

The acceleration/deceleration processing is applied to the vector velocity.

- 1: Long Axis Velocity (LongAxisSpeed)

The acceleration/deceleration processing is applied to the long axis velocity.

- 2: Reference Axis Velocity (ReferenceAxisSpeed)

The acceleration/deceleration processing is applied to the reference axis velocity.

There are the following two types of the acceleration/deceleration method. For details on each acceleration/deceleration processing function, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

Acceleration/deceleration method setting (Options (Options) bit0 to 2)	Description
0: Acceleration/deceleration specification method (mcAccDec) (Default)	Accelerates and decelerates using the acceleration, the deceleration, and the jerk specified in the FB.
1: Acceleration/deceleration time-fixed method (mcFixedTime)	Accelerates 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

Axes Group Status (AxesGroupName.Md.GroupStatus) of the axes group in the positioning control is "5: Operating (GroupMoving)". For Axes Group Status (AxesGroupName.Md.GroupStatus), refer to the following.

☞ Page 71 Axes group state transition

Linear interpolation control

Linear interpolation control specifies an axes group and performs interpolation control so that the path from the start point (move start point) to the end point becomes a straight line. In linear interpolation control, interpolation control using a maximum of 4 axes is performed.

Linear interpolation control includes the following two control methods.

Linear interpolation control	Description
Absolute value linear interpolation control	Specifies the target position of the absolute position, and executes linear interpolation control.
Relative value linear interpolation control	Specifies the relative movement amount from the current position, and executes linear interpolation control.

The absolute value linear interpolation control is executed with MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control).

The relative value linear interpolation control is executed with MCv_MoveLinearInterpolateRelative (Relative Value Circular Interpolation Control).

Operation chart

The following shows examples of interpolation control for each number of interpolation axes.

■1-axis linear interpolation control (absolute value)

1-axis linear interpolation is executed from the current position at start (start point address) to the address set to Target position (Position) (end point address).

Ex.

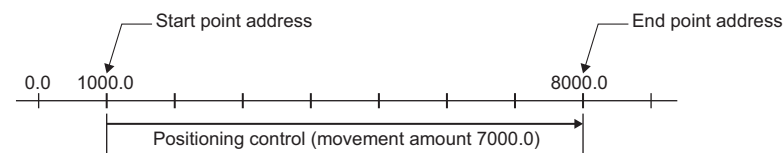
For the following conditions, the path of configuration axis 1 is as shown below.

LinearAxes[0]: 1

(LinearAxes[1]: 0)

Start point address of configuration axis 1: 1000.0

Position[0]: 8000.0



■1-axis linear interpolation control (relative value)

1-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement amount is positive (+): Positioning to the positive direction (address increasing direction)
- When the movement amount is negative (-): Positioning to the negative direction (address decreasing direction)

Ex.

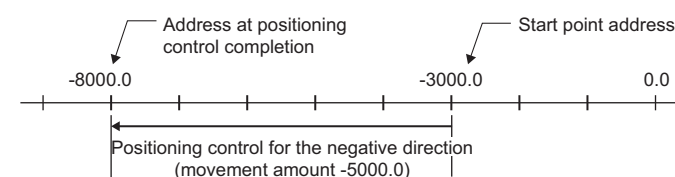
For the following conditions, the path of configuration axis 1 is as shown below.

LinearAxes[0]: 1

(LinearAxes[1]: 0)

Start point address of configuration axis 1: -3000.0

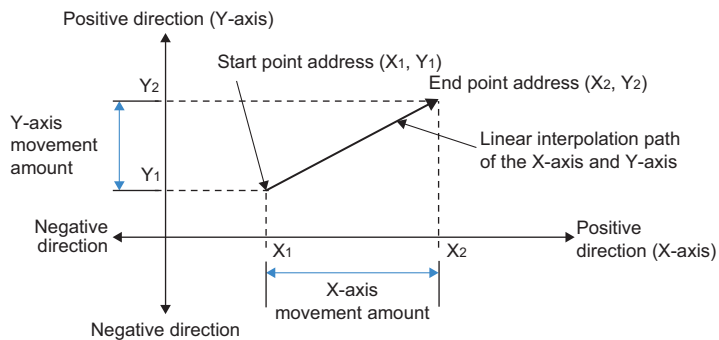
Distance[0]: -5000.0



■2-axis linear interpolation control (absolute value)

2-axis linear interpolation is executed from the current position at start (start point address) to the address set to Target position (Position) (end point address).

The movement direction is determined by the current position at start point address and the end point address of each axis.



Ex.

For the following conditions, the path of configuration axis 1 and configuration axis 2 are as shown below.

LinearAxes[0]: 1

LinearAxes[1]: 2

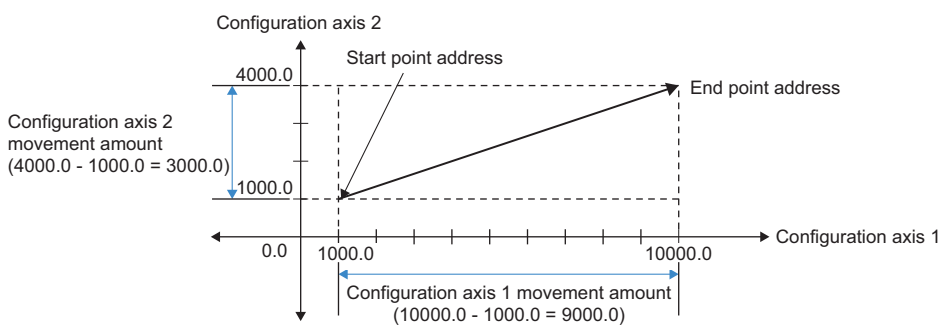
(LinearAxes[2]: 0)

Start point address of configuration axis 1: 1000.0

Start point address of configuration axis 2: 1000.0

Position[0]: 10000.0

Position[1]: 4000.0

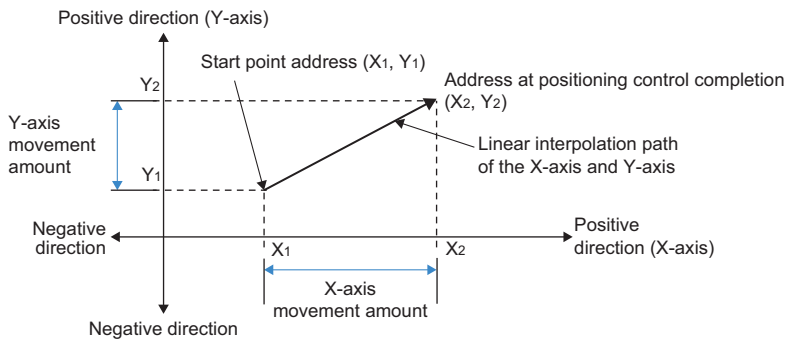


■2-axis linear interpolation control (relative value)

2-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement amount is positive (+): Positioning to the positive direction (address increasing direction)
- When the movement amount is negative (-): Positioning to the negative direction (address decreasing direction)



Ex.

For the following conditions, the path of configuration axis 1 and configuration axis 2 are as shown below.

LinearAxes[0]: 1

LinearAxes[1]: 2

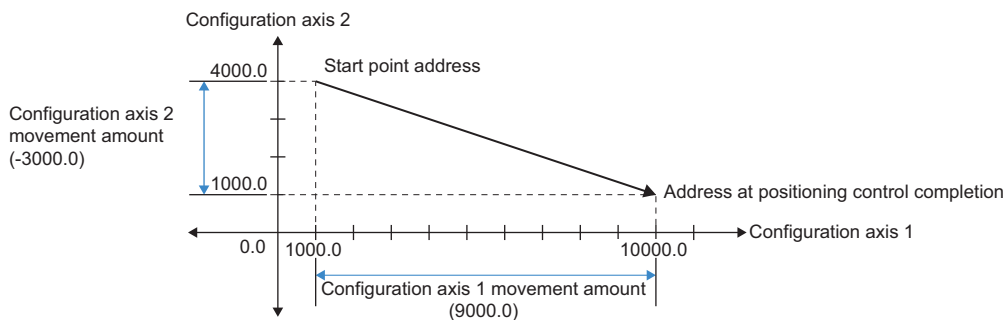
(LinearAxes[2]: 0)

Start point address of configuration axis 1: 1000.0

Start point address of configuration axis 2: 4000.0

Distance[0]: 9000.0

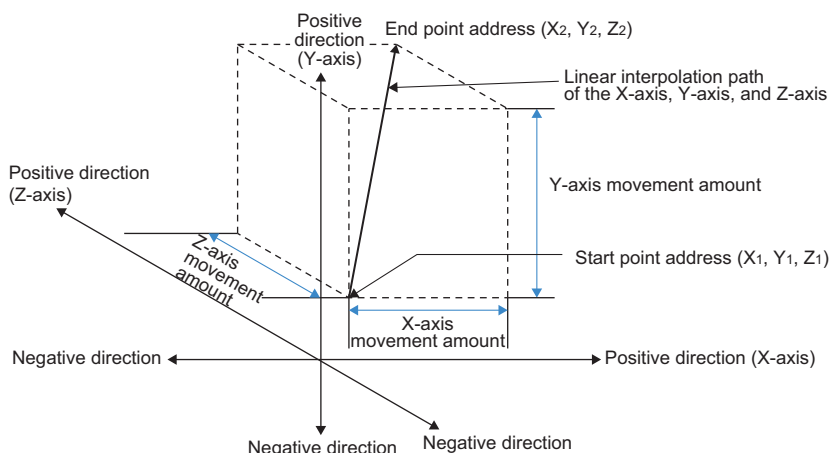
Distance[1]: -3000.0



■3-axis linear interpolation control (absolute value)

3-axis linear interpolation is executed from the current position at start (start point address) to the commanded position set to Target position (Position).

The movement direction is determined by the current position at start point address and the end point address of each axis.



Ex.

For the following conditions, the path of configuration axis 1, configuration axis 2, and configuration axis 3 are as shown below.

LinearAxes[0]: 1

LinearAxes[1]: 2

LinearAxes[2]: 3

LinearAxes[3]: 0

Start point address of configuration axis 1: 1000.0

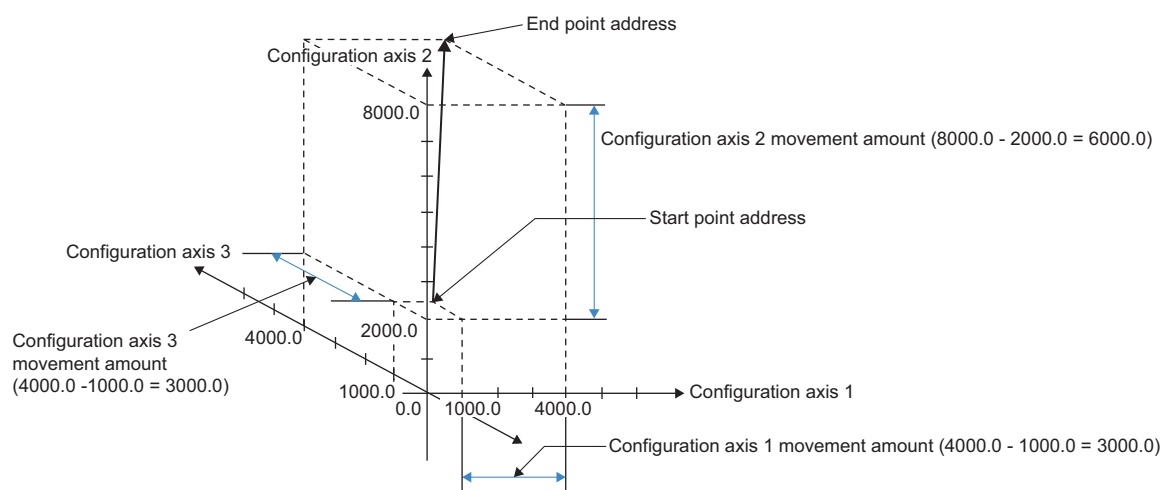
Start point address of configuration axis 2: 2000.0

Start point address of configuration axis 3: 1000.0

Position[0]: 4000.0

Position[1]: 8000.0

Position[2]: 4000.0

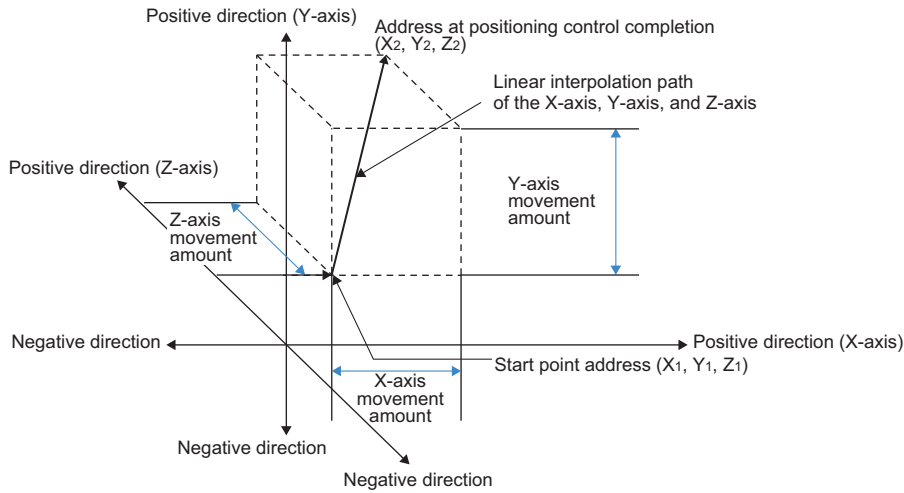


■3-axis linear interpolation control (relative value)

3-axis linear interpolation is executed by the movement amount set to Movement amount (Distance) from the current position at start (start point address).

The movement direction is determined by a sign (+/-) of the movement amount.

- When the movement amount is positive (+): Positioning to the positive direction (address increasing direction)
- When the movement amount is negative (-): Positioning to the negative direction (address decreasing direction)



Ex.

For the following conditions, the path of configuration axis 1, configuration axis 2, and configuration axis 3 are as shown below.

LinearAxes[0]: 1

LinearAxes[1]: 2

LinearAxes[2]: 3

LinearAxes[3]: 0

Start point address of configuration axis 1: 3000.0

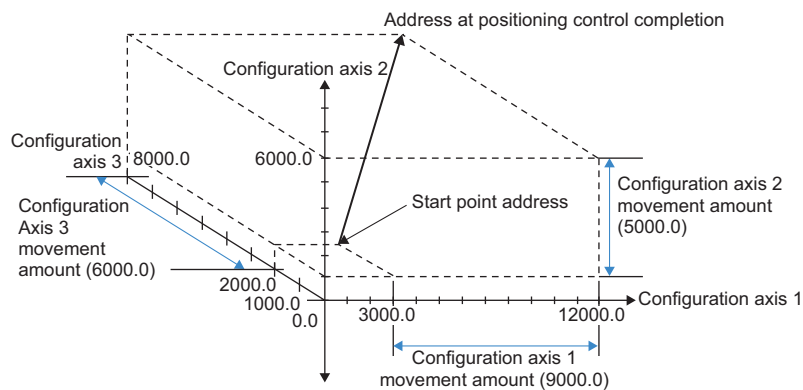
Start point address of configuration axis 2: 1000.0

Start point address of configuration axis 3: 2000.0

Distance[0]: 9000.0

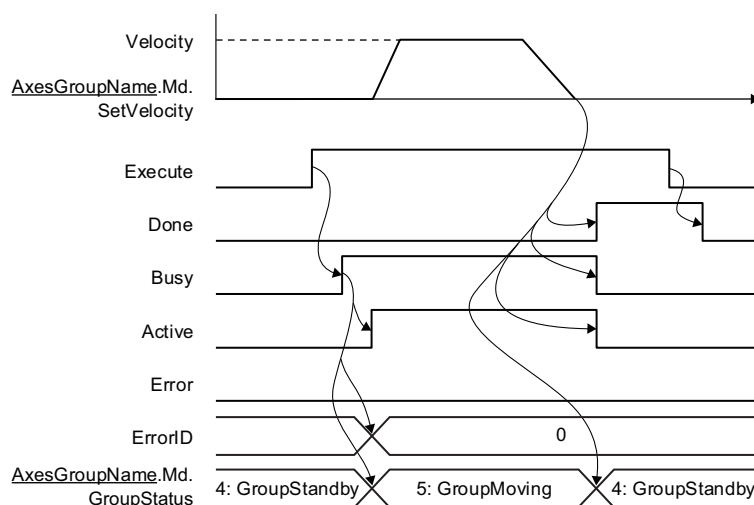
Distance[1]: 5000.0

Distance[2]: 6000.0



Timing chart

■When the FB is normally completed



■When an error occurs

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

Details of setting items

■Continuous update (ContinuousUpdate)

Continuous update of the FB enables the importing input variables again to the instance in execution without interrupting the operation.

Input variables that can be change in restart/continuous update are Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration).

For details, refer to the following.

☞ Page 133 Retrigger/Continuous Update, ☞ Page 348 RELEVANT FUNCTIONS TO VELOCITY

■Linear interpolation axes (LinearAxes)

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 Linear interpolation axes (LinearAxes) from the configuration axes of the axes group. Linear interpolation axes (LinearAxes) have 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 number of linear interpolation axes set must be equal to or less than 4 axes which are the maximum number of the interpolation axes for interpolation control.
- 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 Velocity mode (VelocityMode) is "2: Reference Axis Velocity (ReferenceAxisSpeed)", the configuration axis of the first element in Linear interpolation axes (LinearAxes) becomes the reference axis.
- When specifying as follows, the error "Linear Interpolation Axes 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 Linear interpolation axes (LinearAxes) is "0"
- When specifying the same index No. to Linear interpolation axes (LinearAxes) in duplicate
- When specifying the number of setting axes of Linear interpolation axes (LinearAxes) to exceed the maximum number of the interpolation axes

Ex.

When setting configuration axis 2, 3, 4 to the linear interpolation axes

```
LinearAxes[0]:= 2;
LinearAxes[1]:= 3;
LinearAxes[2]:= 4;
LinearAxes[3]:= 0;*1
:
LinearAxes[15]:= 0;*1
```

*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" can be omitted.

■Target position (Position)/Movement amount (Distance)

Set the target position of the absolute position or the movement amount from the current position at start by Target position (Position) or Movement amount (Distance). Target position (Position) or Movement amount (Distance) has 16 array elements.

- For the input range of Target position (Position), refer to the following.

☞ Page 221 Target position (Position)

- The input range of Movement amount (Distance) is as follow.
-10000000000.0 to 10000000000.0
- Position/Distance[0..15] indicates the target position or movement amount of the configuration axis 1 to 16. Set the position to the configuration axes set in Linear interpolation axes (LinearAxes).
- Target position (Position) / Movement amount (Distance) for the configuration axes which are not set to the linear interpolation axes is ignored.
- Target position (Position) / Movement amount (Distance) 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 2000.0, 3000.0, 4000.0 respectively

```
LinearAxes[0]:= 2;
LinearAxes[1]:= 3;
LinearAxes[2]:= 4;
LinearAxes[3]:= 0;*1
:
LinearAxes[15]:= 0;*1
Position[0]:= 2000.0;
Position[1]:= 3000.0;
Position[2]:= 4000.0;
Position[3]:= 0.0;*1
:
Position[15]:= 0.0;*1
```

*1 "LinearAxes[3]:= 0; to LinearAxes[15]:= 0;" and "Position[3]:= 0.0; to Position[15]:= 0.0;" can be omitted.

■Velocity (Velocity)

Specify the maximum speed of the way. For details, refer to the following.

☞ Page 254 Positioning speed in multiple axes positioning control

■Acceleration (Acceleration)

Specify the acceleration. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Deceleration (Deceleration)

Specify the deceleration. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Jerk (Jerk)

Specify the jerk. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

 Page 348 Acceleration/deceleration Processing Function

■Velocity mode (VelocityMode)

Specify the velocity mode in multiple linear interpolation control. When specifying "2: Reference Axis Velocity (ReferenceAxisSpeed)" in Velocity mode (VelocityMode), the reference axis becomes the configuration axis specified to the first elements of Linear interpolation axes (LinearAxes). For details, refer to the following.

 Page 254 Positioning speed in multiple axes positioning control

Setting value	Description
0: Vector Velocity (VectorSpeed)	Velocity (Velocity) specifies the vector velocity.
1: Long Axis Velocity (LongAxisSpeed)	Velocity (Velocity) specifies the speed of the long axis.
2: Reference Axis Velocity (ReferenceAxisSpeed)	Velocity (Velocity) specifies the speed of the reference axis.

Restriction

- When "0: Vector Velocity (VectorSpeed)" is specified to Velocity mode (VelocityMode) and the movement value of each axis exceeds "4,294,967,296.0 (= 2^{32})", the error "Out of Linear Movement Amount Range" (error code: 1ADEH) will occur and the axis will not start.
- When Aborting is specified to Buffer mode (BufferMode) and MCv_MoveLinearInterpolateAbsolute (Absolute Value Circular Interpolation Control) is executed by multiple start, specify "0: Vector Velocity (VectorSpeed)" to Velocity mode (VelocityMode). If other than "0: Vector Velocity (VectorSpeed)" is set, the error "Out of Velocity Mode Range" (error code: 1A61H) will occur.

■Direction selection (Direction)

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 selection (Direction) has 16 array elements.

- Direction [0..15] indicates the direction selection of the configuration axis 1 to 16. Set the value in the configuration axis set in Linear interpolation axes (LinearAxes).
- Direction selection (Direction) of the configuration axis which is not set as the linear interpolation axes 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 on operation of each direction selection, refer to the following.

 Page 222 Direction selection (Direction)

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.

■Buffer mode (BufferMode)

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

 Page 135 Buffer mode type

■Options (Options)

Set a function option with bit specification.

Bit details and the function are as the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 ^{*1}	Position selection during buffer mode Specify "0" for absolute value linear interpolation control. ^{*2} 0: Set position 1: Actual position This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode). For details, refer to the following.  Page 134 Multiple Start (Buffer Mode)
4 to 15	Empty (Specify "0".) ^{*2}
16 ^{*3}	The target position specification exceeding the ring counter value 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. Specify "0" for the relative value linear interpolation control. ^{*2} 0: Do not allow 1: Allow
17 to 31	Empty (Specify "0".) ^{*2}

*1 It is valid only when the relative value linear interpolation control.

*2 When specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs and the function does 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 start point (move start point) to the end point becomes an arc to a linear axis which is arranged mechanically orthogonally.

In circular interpolation control, interpolation control using arbitrary two axes from the configuration axes set to the axes group. Three types of the circular interpolation methods, the border point specification, the central point specification, and the radius specification, can be specified for circular interpolation control.

Circular interpolation control has the following two control methods.

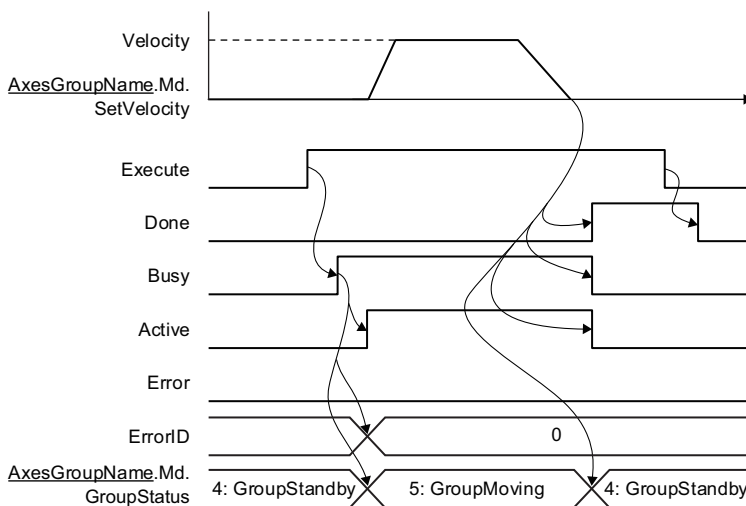
Circular interpolation control	Description
Absolute value circular interpolation control	Specifies the end point and the sub point of the absolute position, and executes 2-axis circular interpolation control.
Relative value circular interpolation control	Specifies the end point and the movement amount 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 (Absolute Value Circular Interpolation Control).

The relative value circular interpolation control is executed with MCv_MoveCircularInterpolateRelative (Relative Value Circular Interpolation Control).

Timing chart

■When the FB is normally completed



■When an error occurs

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

Details of setting items

■Continuous update (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 Velocity (Velocity), Acceleration (Acceleration), and Deceleration (Deceleration).

For details, refer to the following.

📖 Page 133 Retrigger/Continuous Update, 📖 Page 348 RELEVANT FUNCTIONS TO VELOCITY

■Circular interpolation axes (CircAxes)

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 Circular interpolation axes (CircAxes) from the configuration axes of the axes group. Circular interpolation axes (CircAxes) 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 does not have an axis is specified, the error "Circular Interpolation Axes Unset" (error code: 1A62H) occurs.

Ex.

When setting configuration axis 2, 3 to the circular interpolation axes

CircAxes[0]= 2

CircAxes[1]= 3

■Circular interpolation mode (CircMode)

In circular interpolation control, three types of the circular interpolation methods, the border point specification, the central point specification, and the radius specification, can be specified by Circular interpolation mode (CircMode). The definition of Sub point (AuxPoint) differs depending on Circular interpolation mode (CircMode).

Setting value	Sub point (AuxPoint)
0: Border Point Specification (mcBorder)	Sub point (AuxPoint) defines the border point on the arc connecting the start point and the end point.
1: Central Point Specification (mcCenter)	Sub point (AuxPoint) defines the center point of the arc.
2: Radius Specification (mcRadius)	Sub point (AuxPoint) defines the radius of the arc.

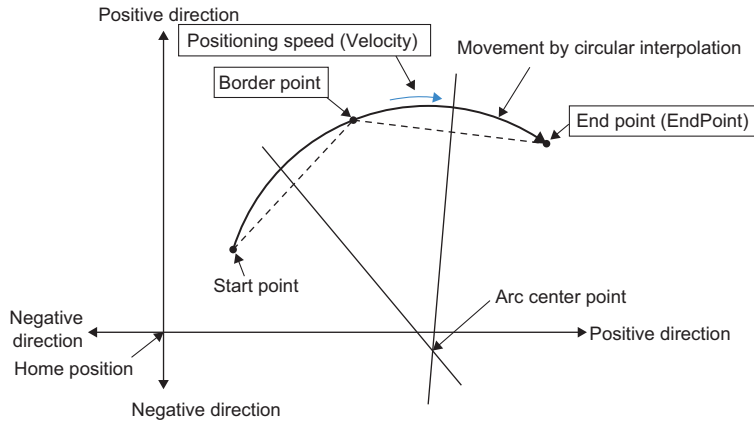
- Circular interpolation control with border point specification

When selecting "0: Border Point Specification (mcBorder)" in Circular interpolation mode (CircMode), positioning control is carried out in an arc path passing through the specified border point by using two configuration axes specified to Circular interpolation mode (CircMode).

- Absolute value circular interpolation control operation with "0: Border Point Specification (mcBorder)"

In absolute value circular interpolation control with border point specification, positioning is carried out from the current position at start (start point address) to the address set to End point (EndPoint) (end point address) in an arc path that passes through the address (border point address) set to Sub point (AuxPoint).

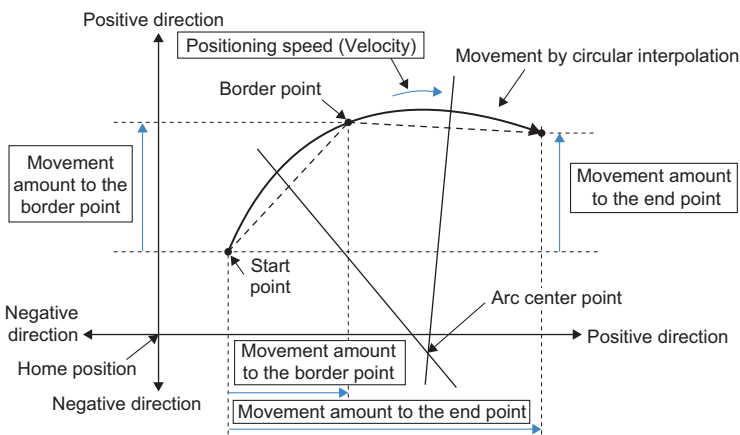
The resulting control path is an arc having as its center the intersection point of perpendicular bisectors of a straight line between the current position at start and the border point address, and a straight line between the border point address and the end point address. However, a perfect circle cannot be drawn with the border point specification. (End point (EndPoint), Positioning speed (Velocity), and Border point shown in the following figure indicate the data to be set.)



- Relative value circular interpolation control operation with "0: Border Point Specification (mcBorder)"

In relative value circular interpolation control with border point specification, positioning is carried out from the current position at start (start point address) to the address of the movement amount set to End point (EndPoint) in an arc path (end point address) that passes through the address of the movement amount set to Sub point (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. (Positioning speed, Border point, the movement amount to Border point, and the movement amount to the end point shown in the following figure indicate the data to be set.)



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 "1: Central Point Specification (mcCenter)"

When selecting "1: Central Point Specification (mcCenter)" in Circular interpolation mode (CircMode), two configuration axes specified in Circular interpolation axes (CircAxes) are used to carry out positioning control in an arc path having the specified center point as a center point.

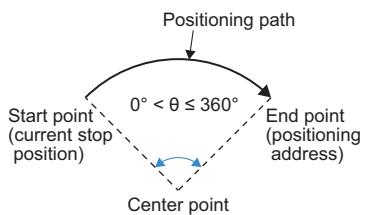
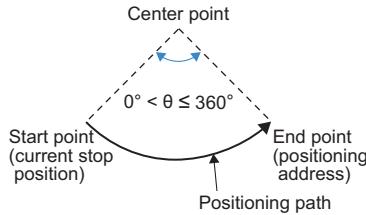
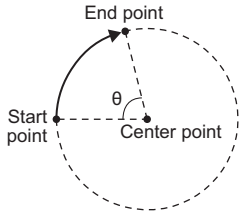
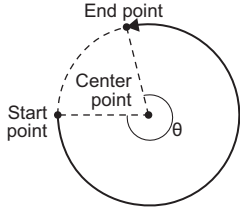
[Circular interpolation path]

The path in the circular interpolation control with the central point specification can be set by Path selection (PathChoice). The following table shows the setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice).

When the start point, end point, and center point are on one straight line, and when selecting "2: Shortcut (mcShortWay)" or "3: Detour (mcLongWay)", a semicircle is drawn in CW direction.

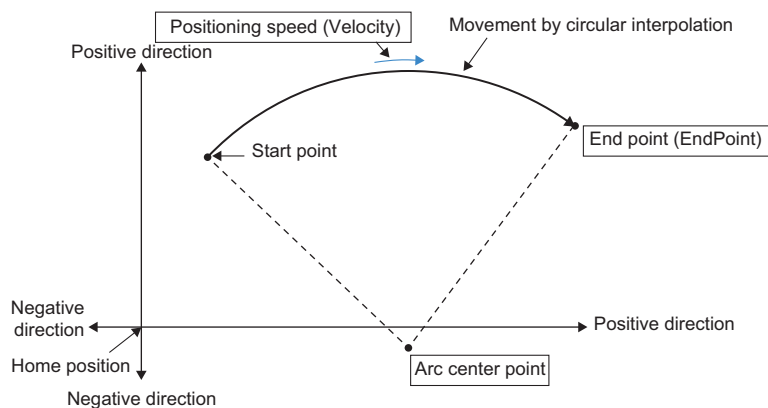
When the start point is same as the end point, and when selecting "2: Shortcut (mcShortWay)", an error occurs.

When the start point is same as the end point, and when selecting "3: Detour (mcLongWay)", a perfect circle is drawn in CW direction.

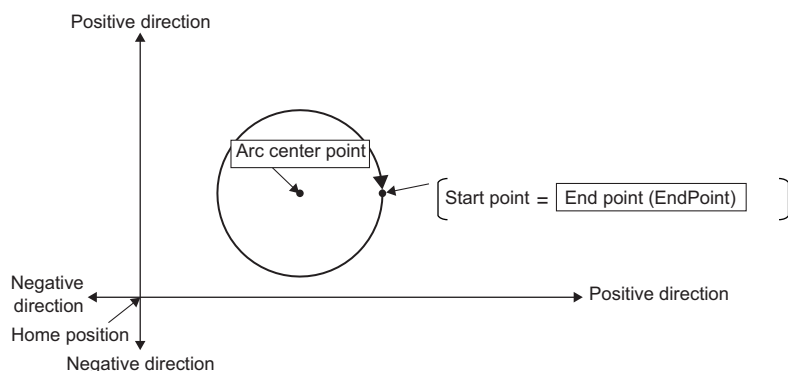
Setting value	Setting description	Arc center angle that can be controlled	Path
0: mcCW	CW	$0^\circ < \theta \leq 360^\circ$	
1: mcCCW	CCW	$0^\circ < \theta \leq 360^\circ$	
2: mcShortWay	Shortcut • When the start point, end point, and center point are on one straight line, a semicircle is drawn in CW direction. • When the start point is same as the end point, the error "Path Choice Setting Incorrect" (error code: 1AB7H) occurs.	$0^\circ < \theta \leq 180^\circ$	
3: mcLongWay	Detour • 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.	$180^\circ \leq \theta \leq 360^\circ$	

- Absolute value circular interpolation control operation with "1: Central Point Specification (mcCenter)"

In absolute value circular interpolation control operation with the central point specification, positioning is carried out from the current position at start (start point address) to the end position set to End point (EndPoint) in an arc path having the center point set in Sub point (AuxPoint) as its center. (End point (EndPoint), Positioning speed (Velocity), 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 End point (EndPoint) to the same address as the start point. (End point (EndPoint), and the center point of the arc shown in the following figure indicate the data to be set.)



Ex.

To specify End point (EndPoint) to the same as the start point, specify the set position of the configuration axes to be used in circular interpolation to End point (EndPoint) as the following.

AxesGroupName.Pr.Axis[1] = Axis0001.AxisRef

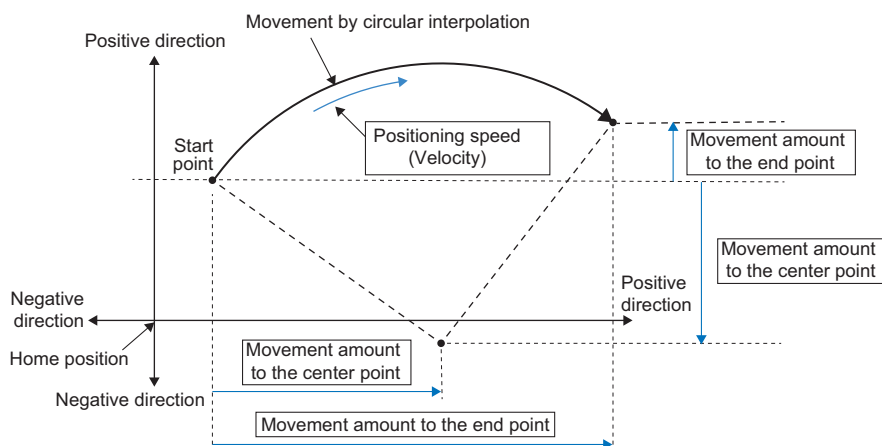
AxesGroupName.Pr.Axis[2] = Axis0002.AxisRef

EndPoint[0]= Axis0001.Md.SetPosition

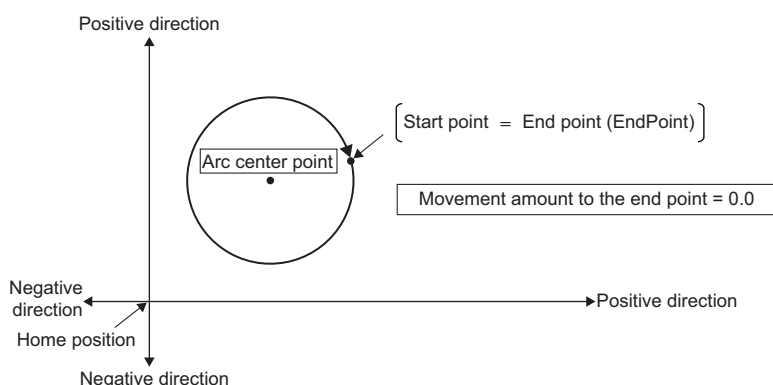
EndPoint[1]= Axis0002.Md.SetPosition

- Relative value circular interpolation control operation with "1: Central Point Specification (mcCenter)"

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 End point (EndPoint) (end point address) in an arc path having the address of the movement amount set in Sub point (AuxPoint) (center point address) as its center. (Positioning speed (Velocity), the movement amount to the center point, and the movement amount to the end point are shown in the following figure indicate the data to be set.)



The end point and the start point have the same address by setting "0.0" as the movement amount to the end point which is set to End point (EndPoint) and the positioning of a complete round with a radius from the start point address to the arc center point can be carried out. (The center point of the arc and the movement amount to the end point = 0.0 are shown in the following figure indicate the data to be set.)



Restriction

2-axis circular interpolation control cannot be set in the following cases.

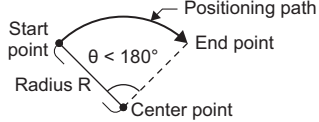
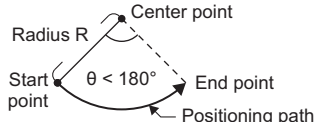
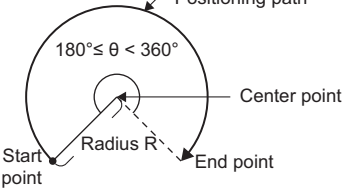
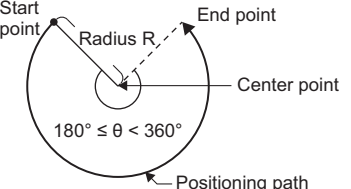
- When the radius exceeds 2147483647.0 (the maximum radius for which 2-axis circular interpolation control is possible is 2147483647.0): The error "Out of Radius Range" (error code: 1A6CH) will occur at positioning start.
- When the center point address exceeds positioning range: The error "Out of Center 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 "2: Radius Specification (mcRadius)"

When selecting "2: Radius Specification (mcRadius)" in Circular interpolation mode (CircMode), two configuration axes specified in Circular interpolation axes (CircAxes) are used to carry out positioning control in an arc path having the specified radius.

[Circular interpolation path]

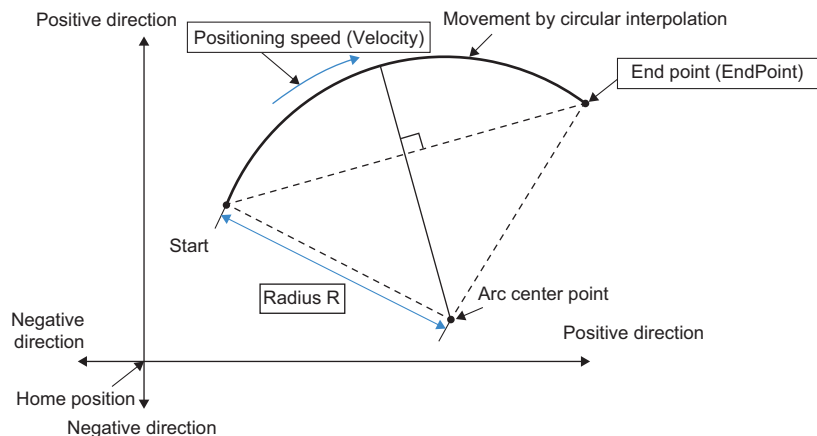
The path in the circular interpolation control with the radius specification can be set by Path selection (PathChoice). The following table shows the setting value, setting description, arc center angle that can be controlled, and path of Path selection (PathChoice). When setting "4: CW Detour (mcCWLongWay)" and "5: CCW Detour (mcCCWLongWay)", and when the start point, end point, and center point are on one straight line, a semicircle is drawn. When setting "0: CW (mcCW)" and "1: CCW (mcCCW)", the error "Path Choice Setting Incorrect" (error code: 1AB7H) will occur and a semicircle can not be drawn.

Setting value	Setting description	Arc center angle that can be controlled	Path
0: mcCW	CW	$0^\circ < \theta < 180^\circ$ Shortcut	
1: mcCCW	CCW	$0^\circ < \theta < 180^\circ$ Shortcut	
4: mcCWLongWay	CW Detour	$180^\circ \leq \theta < 360^\circ$ Detour	
5: mcCCWLongWay	CCW Detour	$180^\circ \leq \theta < 360^\circ$ Detour	

- Absolute value circular interpolation control operation with "2: Radius Specification (mcRadius)"

In absolute value circular interpolation control operation with the radius specification, positioning is carried out from the current position at start (start point address) to the address set to End point (EndPoint) (end point address) in an arc path having the radius set in Sub point (AuxPoint).

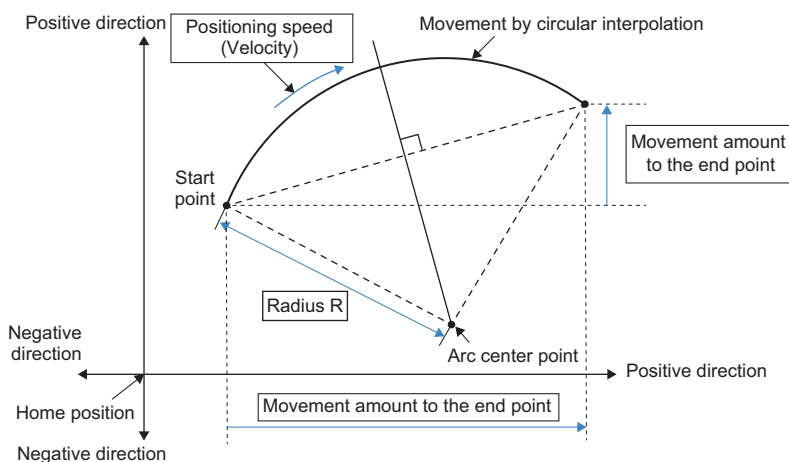
The resulting control path is an arc with the intersection of the perpendicular bisector of the current position at start and the end point address, and the specified radius as the center point. (End point (EndPoint), Positioning speed (Velocity), and radius R shown in the following figure indicate the data to be set.)



- Relative value circular interpolation control operation with "2: Radius Specification (mcRadius)"

In relative value circular interpolation control operation with the radius specification, positioning is carried out from the current position at start (start point address) to the address of the movement amount set to End point (EndPoint) (end point address) in an arc path having the radius set in Sub point (AuxPoint).

The resulting control path is an arc with the intersection of the perpendicular bisector of the current position at start and the end point address, and the specified radius as the center point. (The movement amount to the end point, Positioning speed (Velocity), and radius R shown in the following figure indicate the data to be set.)



2-axis circular interpolation control cannot be set in the following cases.

- When the radius exceeds 2147483647.0 (the maximum arc for which 2-axis circular interpolation control is possible is radius): 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.

■Sub point (AuxPoint)

Sub point (AuxPoint) has 16 array elements. Setting details of Sub point (AuxPoint) differ depending on Circular interpolation mode (CircMode) as shown below.

Setting value	Sub point (AuxPoint) setting
0: Border Point Specification (mcBorder)	AuxPoint[0..15] indicates the border point/center point of the configuration axis 1 to 16. It is set by the absolute position or the relative position. • Sub point (AuxPoint) for the configuration axes which are not set to the circular interpolation axes are ignored. • Sub point (AuxPoint) after all of the configuration axes which are set to the circular interpolation axes can be omitted.
1: Central Point Specification (mcCenter)	
2: Radius Specification (mcRadius)	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 2000.0, 3000.0 respectively.

```
CircAxes[0]:= 2;  
CircAxes[1]:= 3;  
AuxPoint[0]:= 2000.0;  
AuxPoint[1]:= 3000.0;  
AuxPoint[2]:= 0.0;*1  
:  
AuxPoint[15]:= 0.0;*1
```

*1 "AuxPoint[2]:= 0.0; to AuxPoint[15]:= 0.0;" can be omitted.

■End point (EndPoint)

Set the end point position of the absolute position or the movement amount from the current position at start to the end point by End point (EndPoint). End point (EndPoint) has 16 array elements.

EndPoint[0..15] indicates the end point of the configuration axis 1 to 16.

- End point (EndPoint) for the configuration axes which are not set to the circular interpolation axes are ignored.
- End point (EndPoint) after all of the configuration axes which are set to the circular interpolation axes can be omitted.

■Path selection (PathChoice)

Set rotation direction in circular interpolation. For rotation direction, the first element of the array set in Circular interpolation axes (CircAxes) is regarded as the reference axis.

■Velocity (Velocity)

Specify the maximum speed of the way. For details, refer to the following.

☞ Page 254 Positioning speed in multiple axes positioning control

■Acceleration (Acceleration)

Specify the acceleration. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Deceleration (Deceleration)

Specify the deceleration. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

■Jerk (Jerk)

Specify the jerk. The setting details differ depending on Acceleration/deceleration method setting (Options (Options) bit0 to 2). For details, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

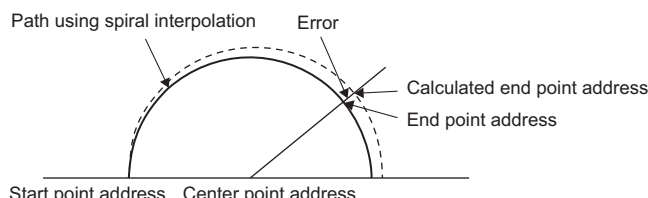
■Circular interpolation error tolerance (CircularErrorTolerance)

In circular interpolation control with the central point specification, the arc path calculated from the start position and center position may deviate from the end position set in End point (EndPoint).

Circular interpolation error tolerance (CircularErrorTolerance) sets allowable width of an error between the calculated arc path and the end position.

- Calculated error $\leq$ Circular interpolation error tolerance (CircularErrorTolerance)

Circular interpolation control to the set end point address is carried out while the error compensation is carried out by spiral interpolation.



- Calculated error $>$ Circular interpolation error tolerance (CircularErrorTolerance)

At the positioning start, 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.

■Buffer mode (BufferMode)

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

☞ Page 135 Buffer mode type

■Options (Options)

Set a function option with bit specification.

Bit details and the function are as the following table.

Bit	Function description
0 to 2	Acceleration/deceleration method setting 0: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) Refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
3 ^{*1}	Position selection during buffer mode Specify "0" for absolute value circular interpolation control. ^{*2} 0: Set position 1: Actual position This bit is valid when specifying "0: Aborting (mcAborting)" of Buffer mode (BufferMode). For details, refer to the following. ☞ Page 134 Multiple Start (Buffer Mode)
4 to 31	Empty (Specify "0".) ^{*2}

*1 It is valid only when relative value circular interpolation controls.

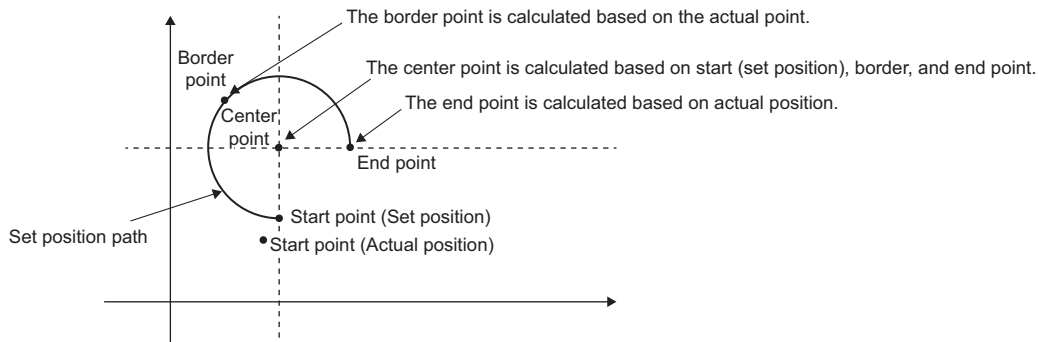
*2 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

When "1: Actual position" is selected at position selection during buffer mode in relative value circular interpolation control, the sub point (center point, border point) and the end point is calculated based on the actual position and the set position is used as the start point. The operation of each Circular interpolation mode (CircMode) is as follows.

[For the circular interpolation control in "0: Border Point Specification (mcBorder)"]

The border point and the end point are calculated based on the actual position.

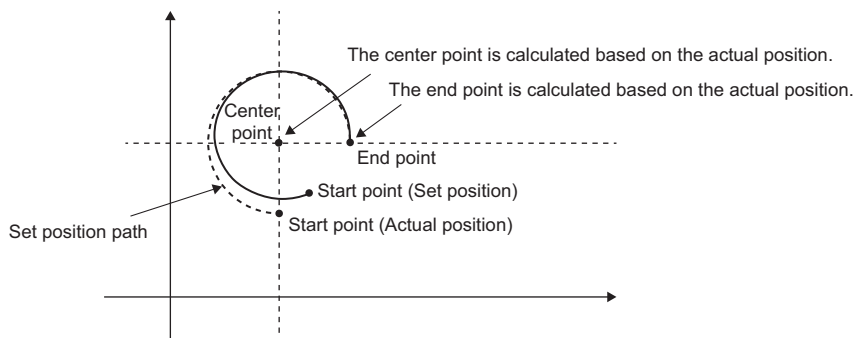
The center point is determined by the start point (set position), the border point, and the end point.



[For the circular interpolation control in "1: Central Point Specification (mcCenter)"]

The center point and the end point are calculated based on the actual position.

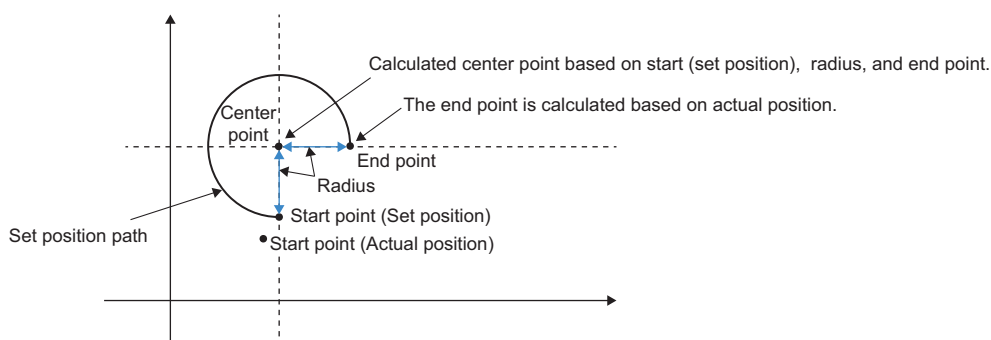
The circular path may be ellipse.



[For the circular interpolation control in "2: Radius Specification (mcRadius)"]

The end point is calculated based on the actual position.

The center point is determined by the start point (set position), the radius, and the end point.



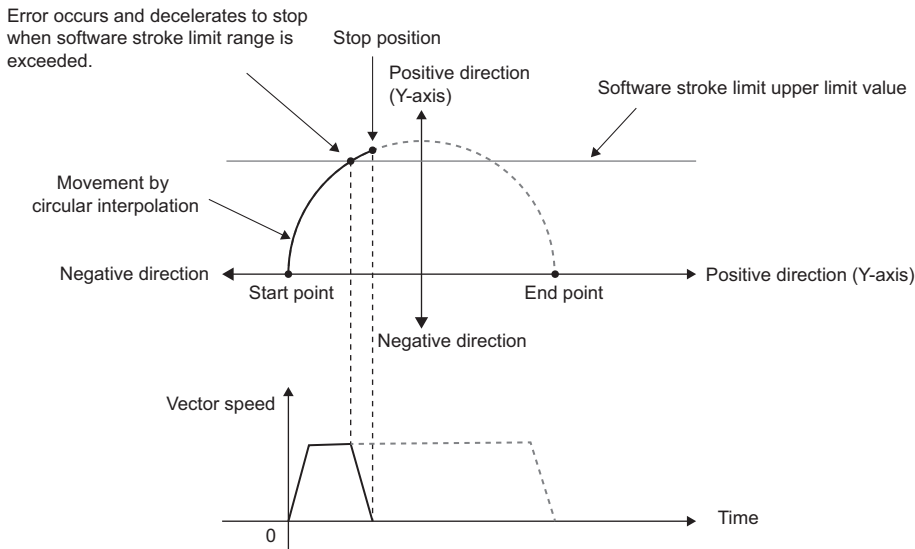
Precautions

- Circular interpolation including an axis whose stroke limit is set to invalid cannot be carried out. The error "Software 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 stop.

Ex.

When the upper limit of the software stroke limit is exceeded in the positive direction of the Y-axis

For an immediate stop, stops at the same time that the error occurs. For a deceleration stop, decelerates to a stop along the arc of the circle as shown below.



Necessary slave object

When using multiple axes positioning control, set the following slave objects for all configuration axes in the specified axes group.

- Target position (607AH)

If there is a configuration axis present that does not have the slave object set, "Necessary Slave Object Unset (error code: 1AA8H)" occurs and the axis will not start.

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

📖 Page 56 Axis Assignment

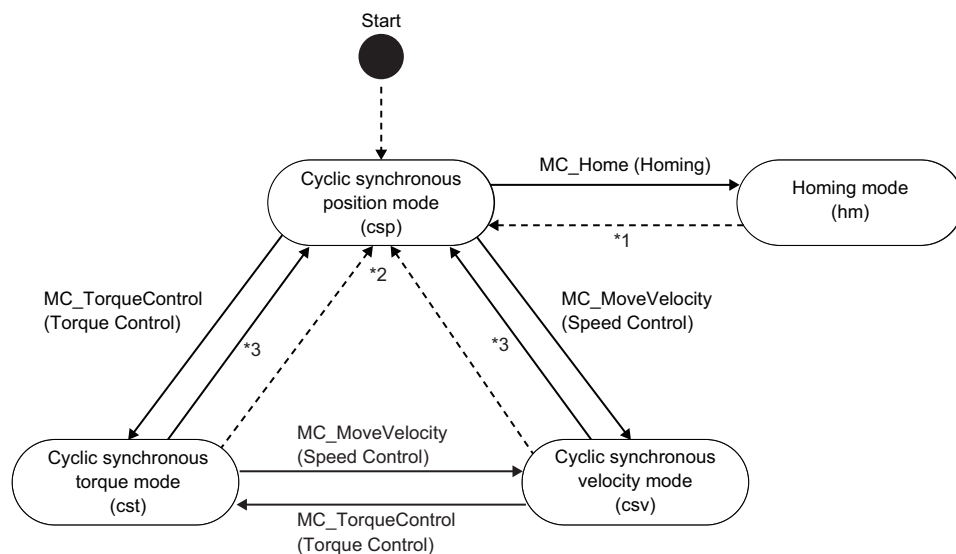
7 DIRECT CONTROL

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	Cyclic synchronous position mode (csp)	MCv_SpeedControl (Speed Control (Including Position Loop))	This function outputs the commanded position based on the set velocity for each control cycle.
	Cyclic synchronous velocity mode (csv)	MC_MoveVelocity (Speed Control)	This function outputs the set velocity for each control cycle. (Excluding the position loop.)
Torque control	Cyclic synchronous torque mode (cst)	MC_TorqueControl (Torque Control)	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 the 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 (Speed Control) and MC_TorqueControl (Torque Control).

Point

Switch to the continuous operation to torque control mode for the usage such as pressing a workpiece. Using the continuous operation to torque control mode can switch the operation smoothly from the cyclic synchronous position mode or the cyclic synchronous velocity mode to the pressing operation. Therefore, reducing load to a machine and molding high in quality are provided as the velocity and torque do not change abruptly.

For details, refer to the following.

📖 Page 798 Relevant functions

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

Variable/Structure name	Name	Details
AxisName.Md.		
SetVelocity	Set Velocity	The velocity calculated from the difference of the set position updated by the follow up.
SetAcceleration	Set Acceleration	A value calculated from the difference of the set velocity
TargetVelocity	Target Velocity	Actual set velocity whose override and the velocity limit value are considered to Velocity (Velocity)
ActualVelocity	Actual Velocity	Actual velocity (same as positioning control)
Io_TargetVelocity	Object Data_TargetVelocity	The velocity command to send to slave devices.
Io_VelActualValue	Object Data_VelActualValue	Feedback of the velocity which is received from slave devices.

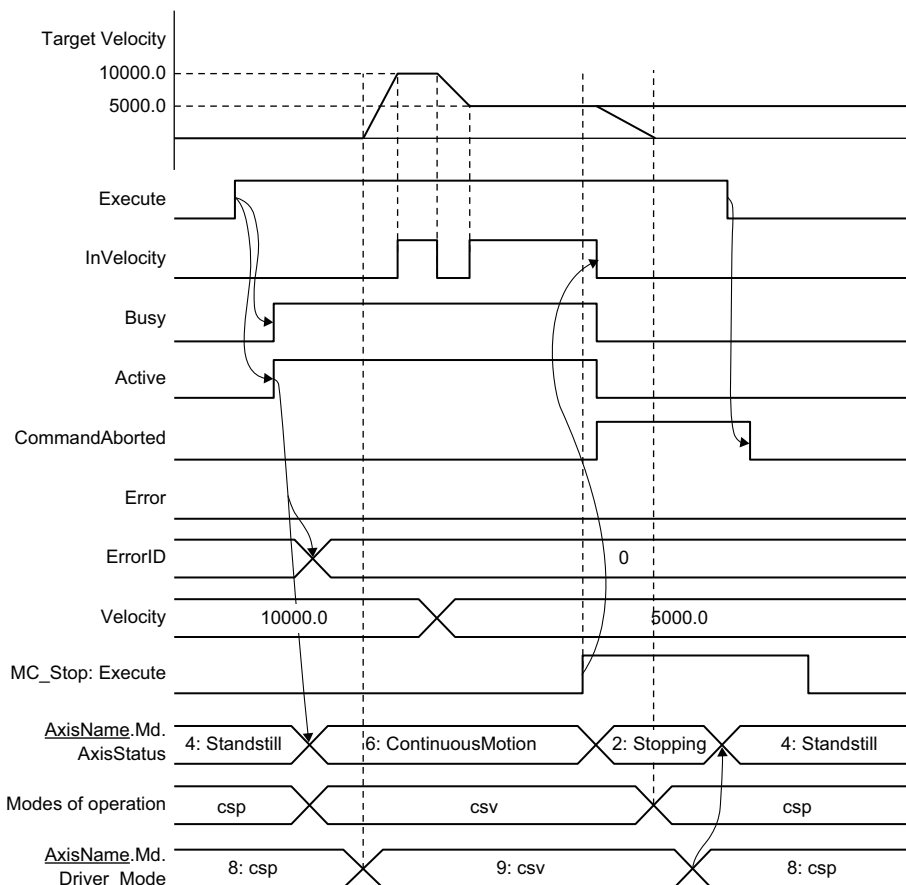
Relevant FB

MC_MoveVelocity

Item	Description		
Function overview	The driver is switched to the csv, and the velocity control is executed based on the specified velocity.		
Symbol [Structured Ladder]	MC_MoveVelocity DUT : Axis B : Execute B : ContinuousUpdate L : Velocity L : Acceleration L : Deceleration L : Jerk ENUM : Direction ENUM : BufferMode UD : Options Axis : DUT InVelocity : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW		
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 27 Execute command (Execute) type/Enable (Enable)

■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 754 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 velocity, the acceleration, and the deceleration.
Velocity	Velocity	LREAL	↑/R/C	0.0, ±0.0001 to ±2500000000.0	0.0	Sets the commanded velocity. When the velocity is negative, the axis moves to the negative direction. When 0.0 is set, the axis does not operate, however, Axis Status (AxisName.Md.AxisStatus) changes to "6: During continuous operation (ContinuousMotion)".
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the acceleration.
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the deceleration.

Name	Variable name	Data type	Import	Setting range	Default value	Description
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	0.0	Sets the jerk.
Direction selection	Direction	MC_DIRECTION	↑	1 to 2	0	Sets the direction selection. MC_DIRECTION definition can be used. 1: Positive Direction (mcPositiveDirection) 2: Negative Direction (mcNegativeDirection) When selecting "2: Negative Direction (mcNegativeDirection)" and Velocity (Velocity) is negative, the movement direction of the motor will be positive. When this setting is omitted, the error "Out of Direction Selection Range" (error code: 1A37H) occurs.
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 1	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) For details, refer to the following. ☞ Page 296 BufferMode
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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following. ☞ Page 348 Acceleration/deceleration method
3 to 15	Empty (Specify "0".)*1
16, 17	Velocity initial value selection 0: Set velocity 1: Actual velocity 2: Automatic selection
18 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■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. When the target velocity has been changed due to change at Continuous update (ContinuousUpdate) TRUE, it becomes 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 execution has been aborted because of other FBs. Becomes TRUE when this FB is stopped by an error or this FB is started during an error occurrence. Becomes FALSE when Execute command (Execute) is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 711 List of Error Codes

Control details

MC_MoveVelocity (Speed Control) switches the driver control mode to the csv (cyclic synchronous velocity mode) and executes control. This function controls the set velocity based on the specified Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk). To finish this FB, start MC_Stop (Forced Stop).

Velocity initial value selection

Set the Velocity initial value selection (Options bit16, 17) when switching the following control mode.

- The csp (cyclic synchronous position mode)→The csv (cyclic synchronous velocity mode)

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 slave object "Velocity actual value (606CH)" is not mapped, motor speed received from the drive unit at switching is not used. (Speed initial value selection becomes "0".)

*2 When slave object "Velocity actual value (606CH)" 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 csv (cyclic synchronous velocity mode) and the process when each cause occurs.

Cause No.	Stop cause	Axis Status (<u>AxisName</u> .Md.AxisStatus)		Stop process
		During deceleration stop	After stop	
1	"Forced stop input" is FALSE	—	1: Stopping on error (ErrorStop)	Immediate stop ^{*1}
2	Drive unit power supply is FALSE	—	1: Stopping on error (ErrorStop)	Immediate stop ^{*1}
	Drive unit network disconnection detection			
	Drive unit			
	Forced stop input to the drive unit			
	Enable (Enable) of MC_Power (Operation Available) is FALSE			
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (<u>AxisName</u> .Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)") ^{*2}			
3	Hardware stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Hardware Stroke Limit Error Occurrence (<u>AxisName</u> .Pr.StopMode_HwStrokeLimit)) After stopping, switch to the csp.
4	CPU module error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at All Axes Stop Cause Occurrence (System.Pr.StopMode_All)) After stopping, switch to the csp.
	PLC READY [Y0] is OFF			
5	Software stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Software Stroke Limit Error Occurrence (<u>AxisName</u> .Pr.StopMode_SwStrokeLimit)) After stopping, switch to the csp.
6	Axis error detection ^{*3}	1: Stopping on error (ErrorStop)	1: Stopping on error (ErrorStop)	Deceleration stop/Immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxisName</u> .Pr.StopMode_General)) After stopping, switch to the csp.
7	Execute command (Execute) of MC_Stop (Forced Stop) is TRUE	2: Decelerating to stop (Stopping)	2: Decelerating to stop (Stopping) ^{*4}	Deceleration stop (Follows the deceleration speed set in the FB) After stopping, switch to the csp.
8	"Stop signal (STOP)" of external input signal is TRUE	No change	4: Standby (Standstill)	Deceleration stop/Immediate stop (Follows Stop Selection at Stop Cause Occurrence (<u>AxisName</u> .Pr.StopMode_General)) After stopping, switch to the 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 Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.

📖 Page 166 Relevant variables

*3 If an axis error (the error that transits the state into the "1: Stopping on error (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 command (Execute) of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

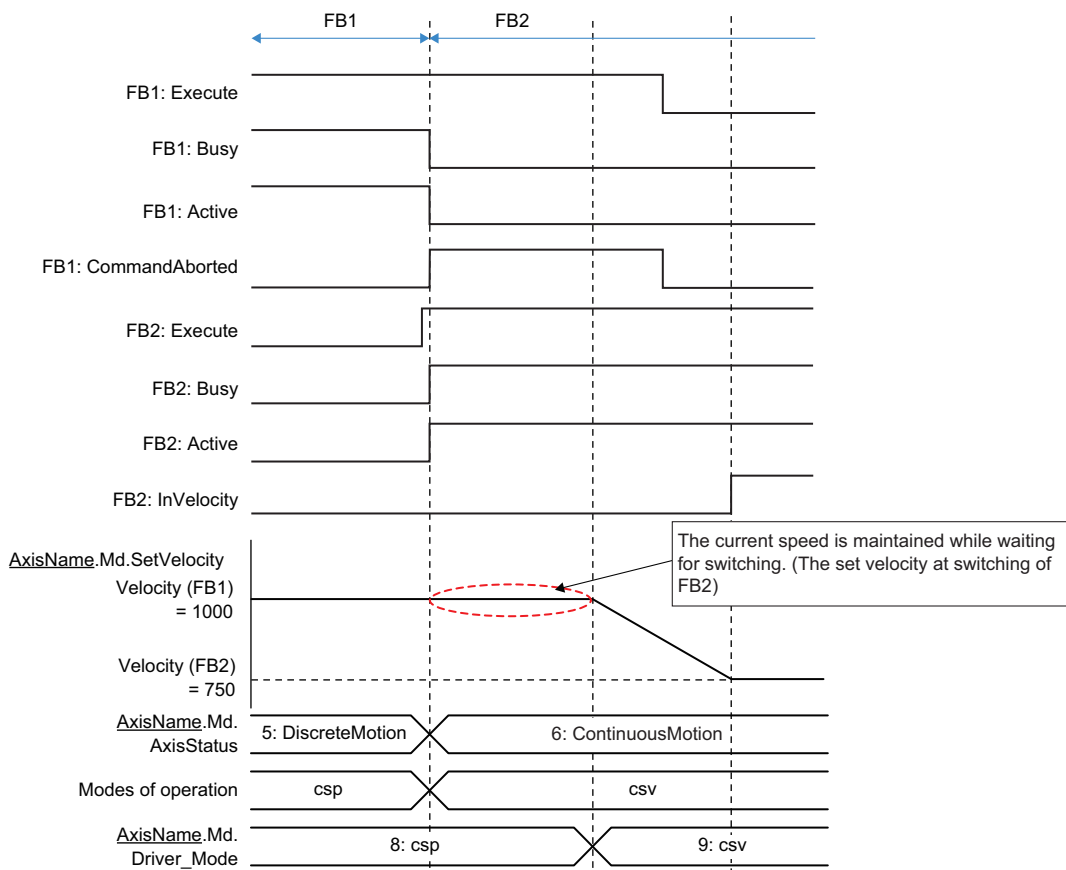
BufferMode

When starting this FB during another instruction execution

■Single axis position control (FB1) → Velocity control (FB2)

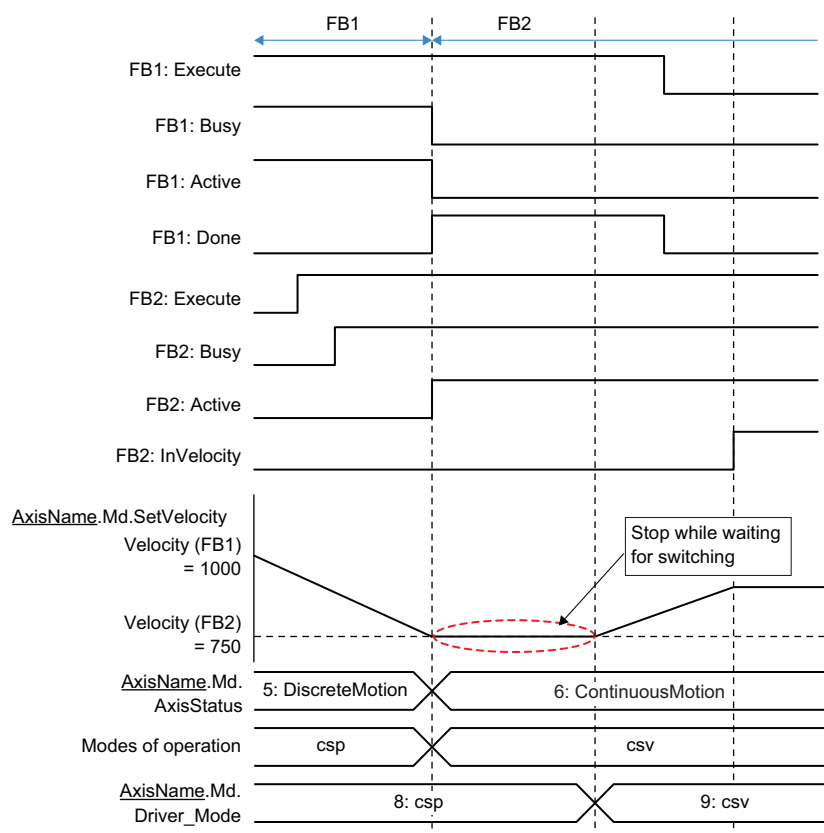
[0: Aborting (mcAborting)]

1. Input variables are analyzed, and a switching request to 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, Target Velocity (TargetVelocity) is obtained based on the actual velocity and the acceleration/deceleration process is started again.



[1: Buffered (mcBuffered)]

1. Input variables are analyzed, and the axis waits until the previous instruction is completed.
2. When the previous instruction is completed, a switching request to 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 control FB 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 device specifications. If switching to csp is not completed within 1 [s], the error "Control Mode Switching Error" (error code: 1A1DH) occurs for the timeout, and the axis stops.)
3. While waiting, velocity control is continued with the set velocity when Execute command (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 to the csp. In this case, the axis operates based on Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

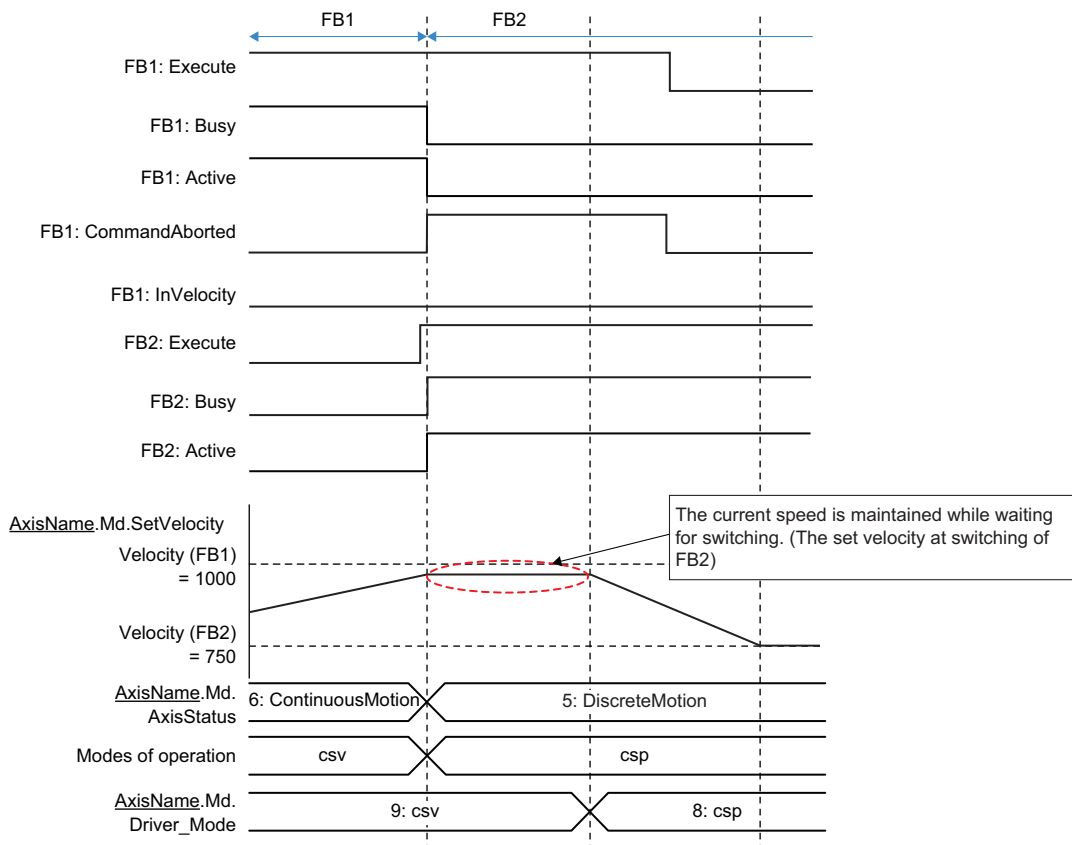
For operation at the overrun occurrence, refer to the following.

👉 Page 134 Multiple Start (Buffer Mode)

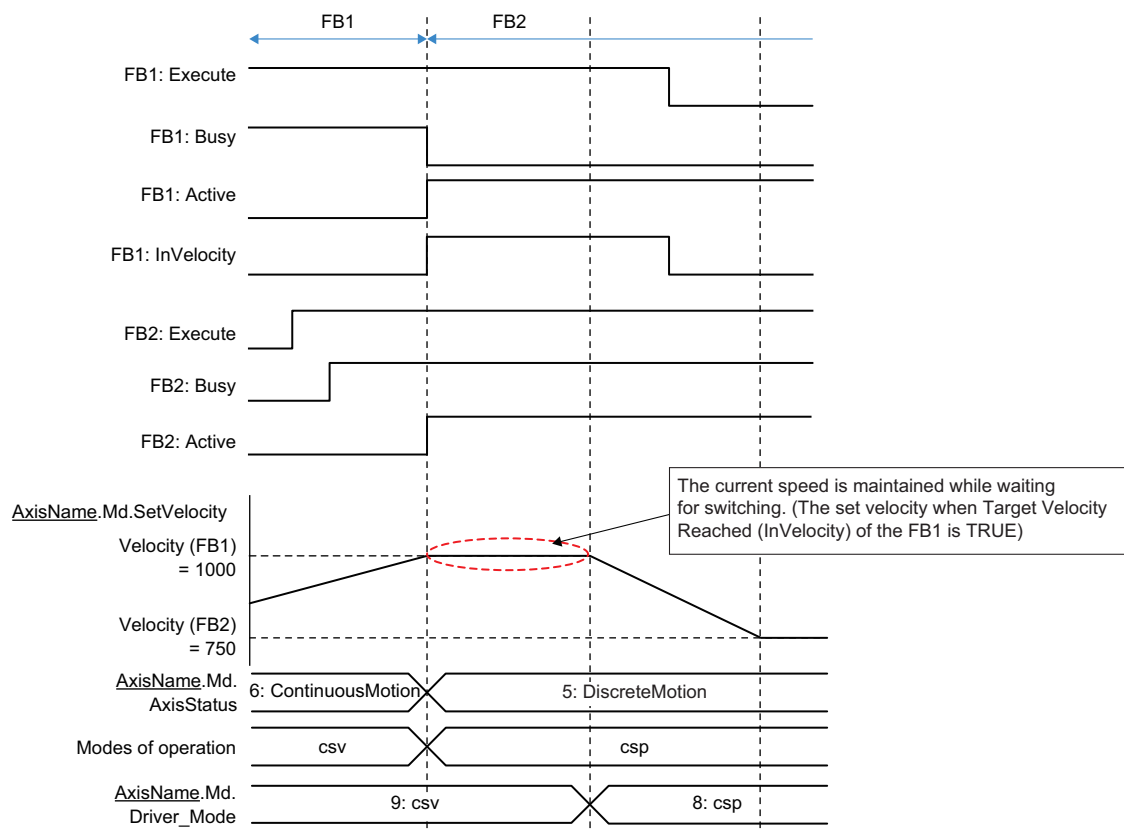
Precautions

If the axis overruns while waiting for switching, it will stop immediately after switching to csp.

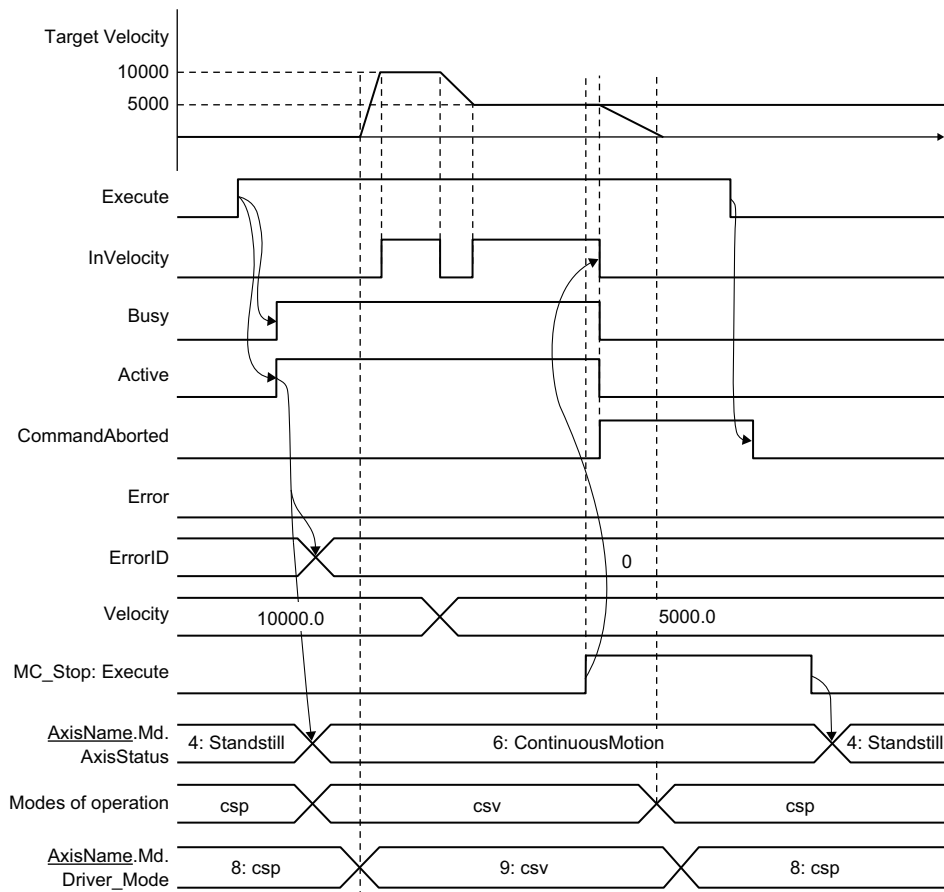
[0: Aborting (mcAborting)]



[1: Buffered (mcBuffered)]

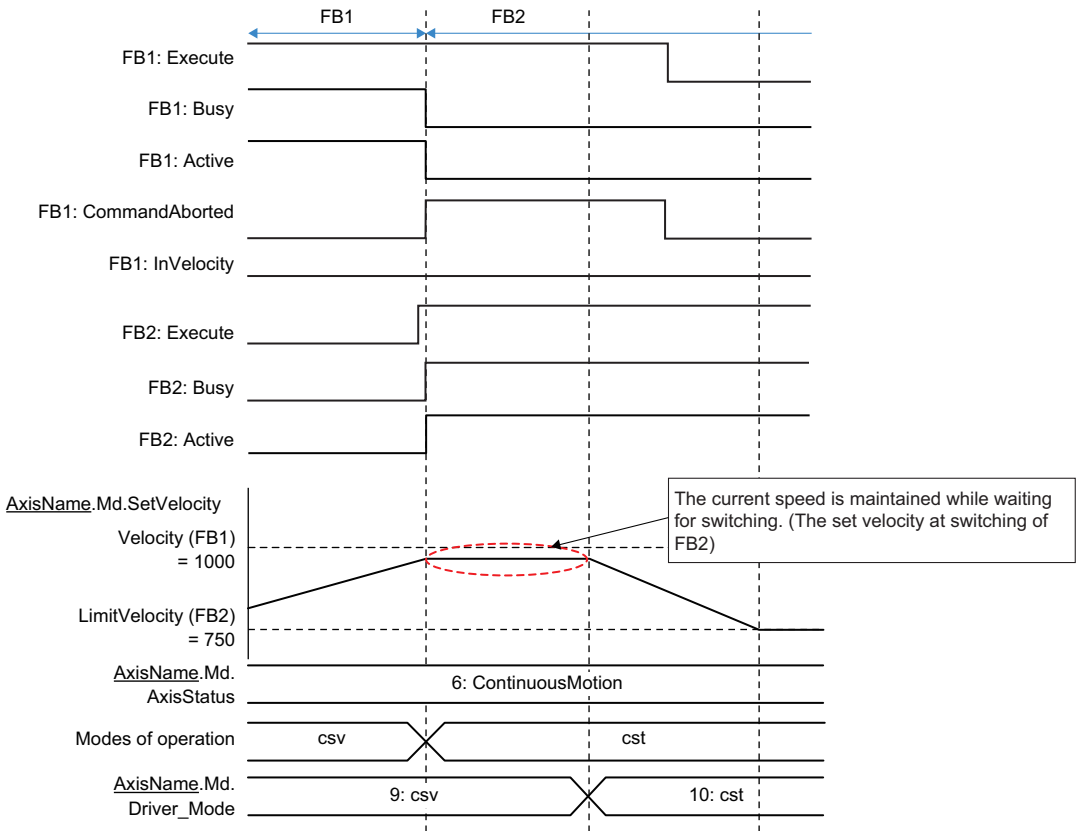


■ Velocity control → Stop instruction (MC_Stop (Forced Stop))

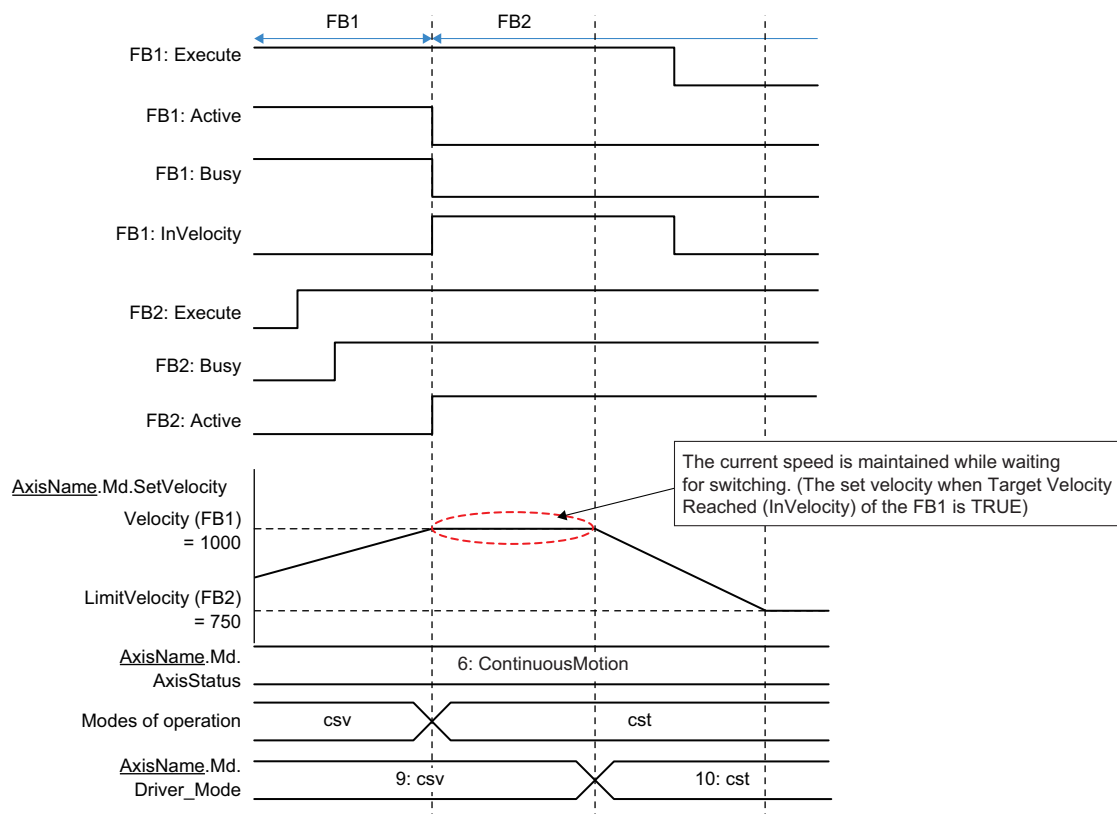


■Velocity control → Torque control

- 1. Switching request to the cst is executed to the driver.
 - 2. Started torque control is analyzed, and the axis waits until the driver switches to the cst.
- [0: Aborting (mcAborting)]



[1: Buffered (mcBuffered)]



7

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

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
- The set position and the machine feed value are updated by follow up.
- Switching time to the control mode depends on the specifications of the driver device.
- When the stop cause occurs during the control mode switching, the axis will stop immediately.
- Do not start the positioning control FB during the control mode switching. Start the positioning control FB after confirming that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "9: csv".
- When switching from the csp to the csv or from the csv to the csp without waiting for stop of the motor by using the MR-J5(W)-G, note the following.
 - 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.
 - For the setting value of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following.

Page 784 Setting methods

7.2 Torque Control

In torque control, the driver control mode is switched to cst and the control is carried out.

Relevant variables

Variable/Structure name	Name	details
AxisName.Md		
SetVelocity	Set Velocity	The velocity calculated from the difference of the set position updated by the follow up.
SetAcceleration	Set Acceleration	A value calculated from the difference of the set velocity
TargetVelocity	Target Velocity	Stores value set to the limit velocity (LimitVelocity)
ActualVelocity	Actual Velocity	Actual velocity (same as positioning control)
Cst_SetTorque	Set Torque at Torque Control	Stores set torque at the cyclic synchronous torque mode
Cst_TargetTorque	Target Torque at Torque Control	Stores target torque at the cyclic synchronous torque mode
Io_TargetVelocity	Object Data_TargetVelocity	The velocity command to send to slave devices.
Io_VelActualValue	Object Data_VelActualValue	Feedback of the velocity which is received from slave devices.

Relevant FB

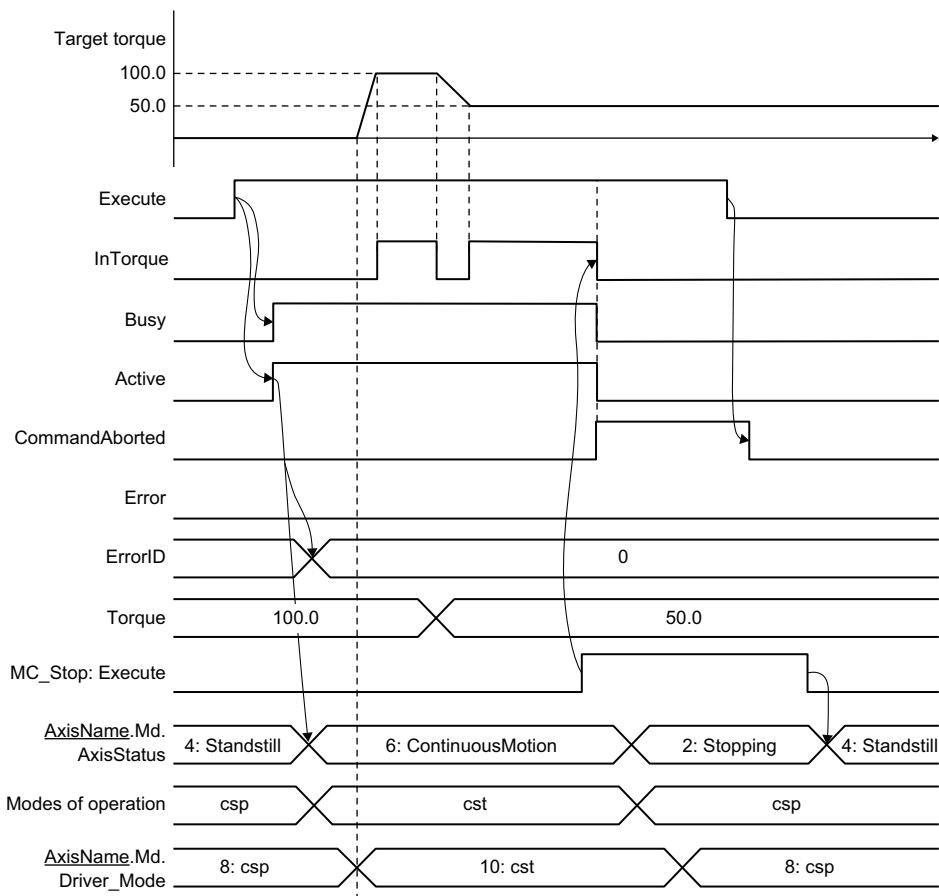
MC_TorqueControl

Item	Description
Function overview	The driver is switched to the cst, 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 27 Execute command (Execute) type/Enable (Enable)

■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 754 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 Target torque (Torque), Limit velocity (LimitVelocity), Torque positive direction ramp (TorquePositiveRamp), Torque negative ramp (TorqueNegativeRamp), Acceleration (Acceleration), and Deceleration (Deceleration).
Target torque	Torque	LREAL	↑/R/C	-1000.0 to 1000.0 [%]	0.0	Sets the target torque. Sets the ratio as a percentage to the rated torque of the servo motor used. 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 a negative value.
Torque positive direction ramp	TorquePositiveRamp	LREAL	↑/R/C	☞ Page 307 Control details	0.0	☞ Page 307 Control details
Torque negative direction ramp	TorqueNegativeRamp	LREAL	↑/R/C		0.0	
Limit velocity	LimitVelocity	LREAL	↑/R/C	0, 0.0001 to 2500000000.0	0.0	Sets the velocity limit value at the cyclic synchronous torque mode. For the velocity limit value, refer to the driver manual. [When using MR-J5(W)-G] Uses slave object "Velocity limit value (2D20H)" as velocity limit value. When slave object "Velocity limit value (2D20H)" is not mapped, the velocity command of the controller will not be enabled. (The servo parameter "Speed limit (PT67)" set value is enabled.)
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the acceleration and acceleration/ deceleration time used until the limit velocity is reached. For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	Sets the deceleration used until the limit velocity is reached. For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	0.0	Sets the jerk used until the limit velocity is reached. For details, refer to the following. ☞ Page 348 Acceleration/deceleration Processing Function When 0.0 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, the error "Out of Direction Selection Range" (error code: 1A37H) will occur.)

Name	Variable name	Data type	Import	Setting range	Default value	Description
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0 to 1	0	Selects the buffer mode. 0: Aborting (mcAborting) 1: Buffered (mcBuffered) For "0: Aborting (mcAborting)", the control mode is immediately switched to the torque control. For "1: Buffered (mcBuffered)", the control mode is switched to the torque control after the previous FB is completed. If the previous FB is MC_TorqueControl (Torque Control), the control mode is switched when Target torque reached (InTorque) is TRUE. For details, refer to the following.  Page 311 BufferMode
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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 to 15	Empty (Specify "0").*1
16, 17	Torque ramp function selection 0: Ramp method 1: Time constant method 2: Fixed time method
18	Torque initial value selection 0: Target torque 1: Actual torque
19	Control mode switching selection*2 0: cst (cyclic synchronous torque mode) 1: ct (continuous operation to torque control mode)
20, 21	Velocity initial value selection at continuous operation to torque control mode switching*3 0: Set velocity 1: Actual velocity 2: Automatic selection For details, refer to the following.  Page 294 Velocity initial value selection
22 to 31	Empty (Specify 0).*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs and the function will not start.

*2 When bit20 of slave object "Supported drive modes (6502H)" is TRUE, the mode can be switched to the continuous operation to torque control mode. If "1: ct (continuous operation to torque control mode)" is set when it is FALSE, the error "Driver Control Mode Unsupported" (error code: 1AE9H) occurs.
For details, refer to the following.

 Page 799 Continuous operation to torque control mode

*3 It is valid only when "1: ct (continuous operation to torque control mode)" is set for control mode switching selection (Options (Options) bit19).

■Output variables

Name	Variable name	Data type	Default value	Description
Target torque reached	InTorque	BOOL	FALSE	Indicates that the target torque has reached the specified value. If the target torque is changed due to the change etc. when Continuous update (ContinuousUpdate) is TRUE, it is FALSE until it reaches to the changed target torque.
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 has been aborted because of other FBs. Becomes TRUE when this FB is stopped by an error or this FB is started during an error occurrence. Becomes FALSE when Execute command (Execute) is FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

Control details

MC_TorqueControl (Torque Control) switches the driver control mode to the cst (cyclic synchronous torque mode) and executes control. This function controls the set torque based on the specified Torque positive direction ramp (TorquePositiveRamp) and Torque negative ramp (TorqueNegativeRamp). To finish this FB, start MC_Stop (Forced 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)".

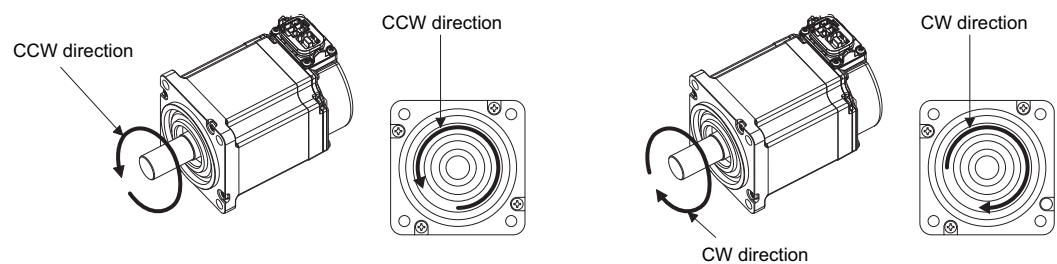
- When the servo parameter (extension setting) "Torque POL reflection selection (PC29.3)" is set to "0: Enabled"

Setting value of "Travel direction selection (PA14)"	Set torque	Torque generation direction of servomotor
0: Positioning address increasing CCW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1
1: Positioning address increasing CW rotation	Positive value (positive direction)	CW direction*1
	Negative value (negative direction)	CCW direction*1

- When the servo parameter (extension setting) "Torque POL reflection selection (PC29.3)" is set to "1: Disabled" (Initial value)

Setting value of "Travel direction selection (PA14)"	Set torque	Torque generation direction of servomotor
0: Positioning address increasing CCW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1
1: Positioning address increasing CW rotation	Positive value (positive direction)	CCW direction*1
	Negative value (negative direction)	CW direction*1

*1 For details, refer to the following illustration.



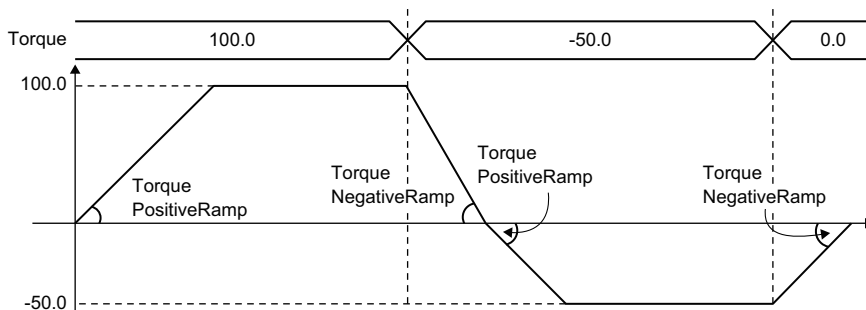
Torque ramp function selection (Options (Options) bit16, 17)

Torque positive direction ramp (TorquePositiveRamp) and Torque negative ramp (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.

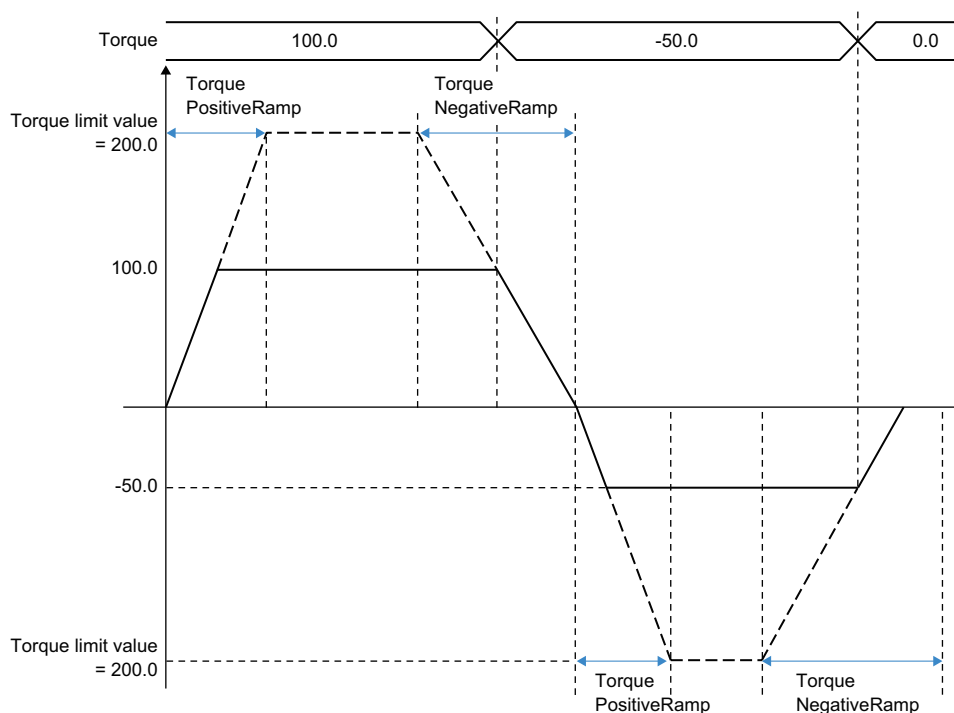
Setting range: 0.0 to 1000.0 [%/s]



- For "1: Time constant method"

Set the time until the set torque reaches the positive/negative torque limit value from "0".

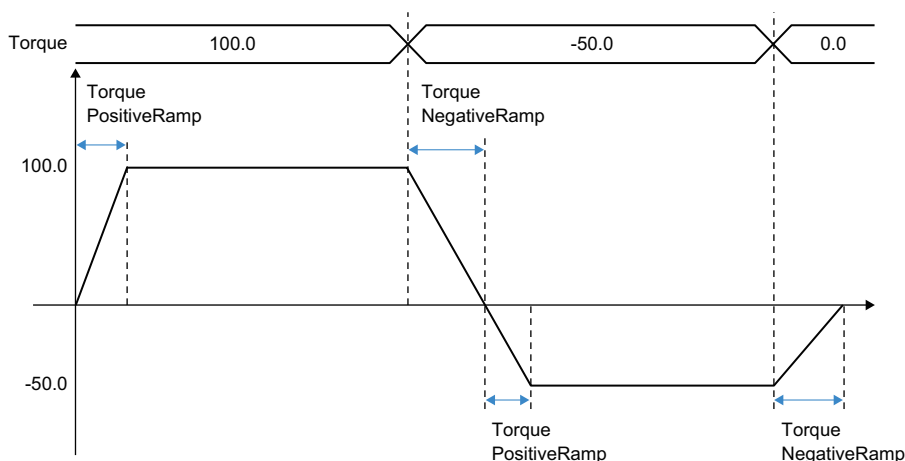
Setting range: 0.0 to 8400.0 [s]



- For "2: Fixed time method"

Set the time from the current set torque until the target torque is reached.

Setting range: 0.0 to 8400.0 [s]



When the output torque direction is changed due to the target torque change, the set torque becomes 0 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 0.0, the value reaches the target torque in 1 operation cycle.

Torque initial value selection (Options (Options) bit18)

Set the torque initial value when switching to the cst (cyclic synchronous torque 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" to this bit. Set "1: Actual torque" only when switching the control mode immediately after the command to the motor is completed without waiting for the servo motor to stop.

Operation at stop cause occurrence

The following shows stop causes during the cst (cyclic synchronous torque mode) and the process when each cause occurs.

Cause No.	Stop cause	Axis Status (<u>AxisName</u> .Md.AxisStatus)	Stop process
		After stop	
1	"Forced stop input" is FALSE	1: Stopping on error (ErrorStop)	Immediate stop ^{*1}
2	Drive unit power supply is FALSE	1: Stopping on error (ErrorStop)	Immediate stop ^{*1}
	Drive unit network disconnection detection		
	Drive unit		
	Forced stop input to the drive unit		
	Enable (Enable) of MC_Power (Operation Available) is FALSE		
	Servo ON request (ServoON) of MC_Power (Operation Available) is FALSE (When Process Selection at Servo OFF Command During Operation (<u>AxisName</u> .Pr.StopMode_ServoOff) is "4: Servo OFF After Immediate Stop (ServoOffAfterImmediateStop)", "5: Servo OFF After Deceleration to Stop (ServoOffAfterDecelStop)") ^{*2}		
3	Hardware stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	The limit velocity is changed to 0, and an immediate stop is performed. ^{*5} After the stop, the control mode is changed to csp.
4	CPU module error occurrence	1: Stopping on error (ErrorStop)	
	PLC READY [Y0] is OFF		
5	Software stroke limit upper/lower limit error occurrence	1: Stopping on error (ErrorStop)	
6	Axis error detection ^{*3}	1: Stopping on error (ErrorStop)	
7	Execute command (Execute) of MC_Stop (Forced Stop) is TRUE	2: Decelerating to stop (Stopping) ^{*4}	The limit velocity is changed to 0, and an immediate stop is performed. ^{*5} After the stop, the control mode is changed to csp. (Not based on the deceleration of MC_Stop (Forced Stop))
8	"Stop signal (STOP)" of external input signal is TRUE	4: Standby (Standstill)	The limit velocity is changed to 0, and an immediate stop is performed. ^{*5} After 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 Process Selection at Servo OFF Command During Operation (AxisName.Pr.StopMode_ServoOff). For details, refer to the following.

 Page 166 Relevant variables

*3 If an axis error (the error that transits the state into the "1: Stopping on error (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 command (Execute)" of MC_Stop (Forced Stop) is FALSE at stop completion, Axis Status (AxisName.Md.AxisStatus) after stop will be "4: Standby (Standstill)".

*5 The set torque value is not changed. Note that it may take time to reach velocity 0 depending on the torque command value that is currently specified.

BufferMode

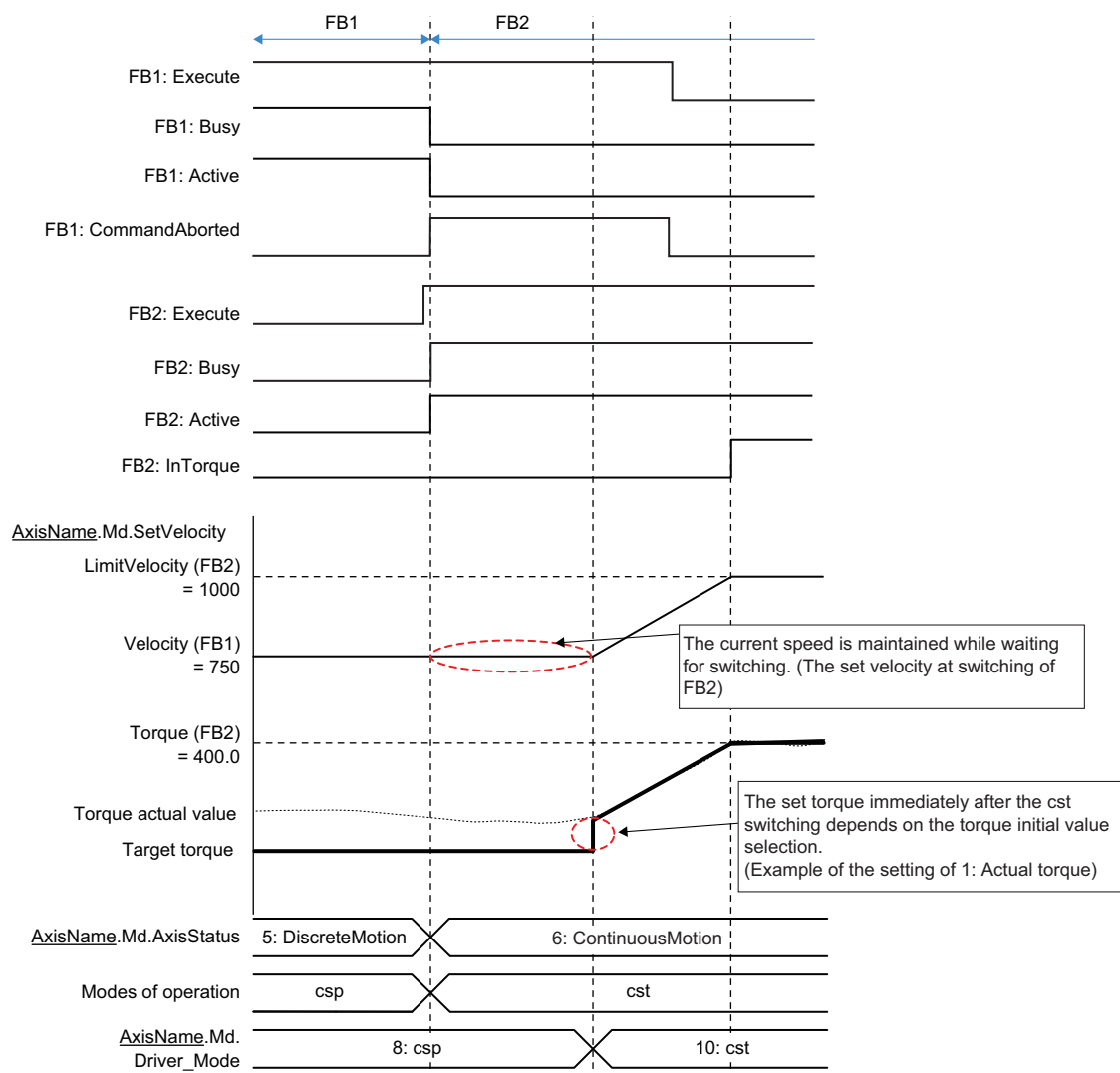
When starting this FB during another instruction execution

While this FB is executed, only Aborting and Buffered are supported.

■Position control (FB1) → Torque control (FB2)

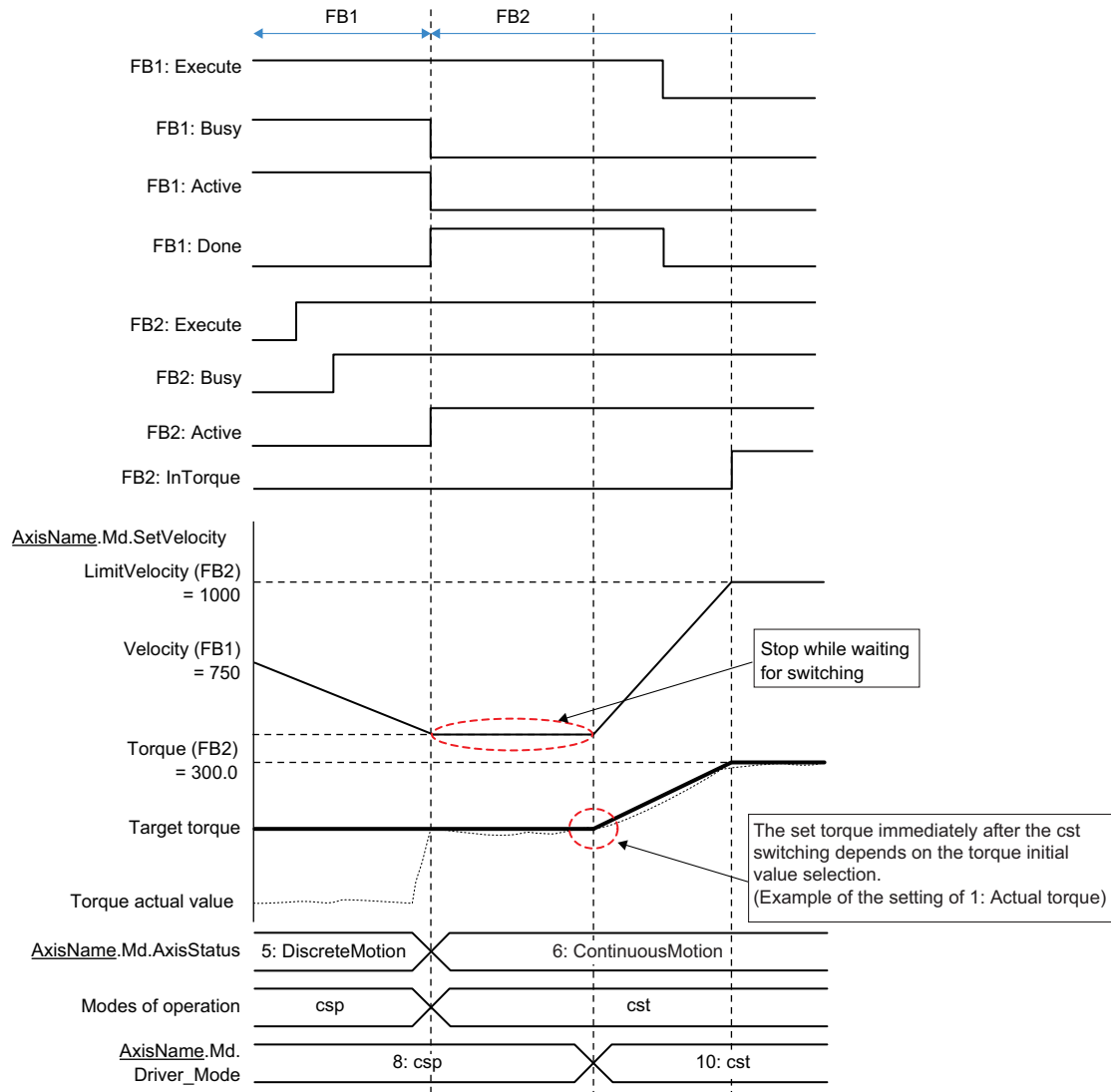
[0: Aborting (mcAborting)]

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 velocity limit value from the current set velocity starts.



[1: Buffered (mcBuffered)]

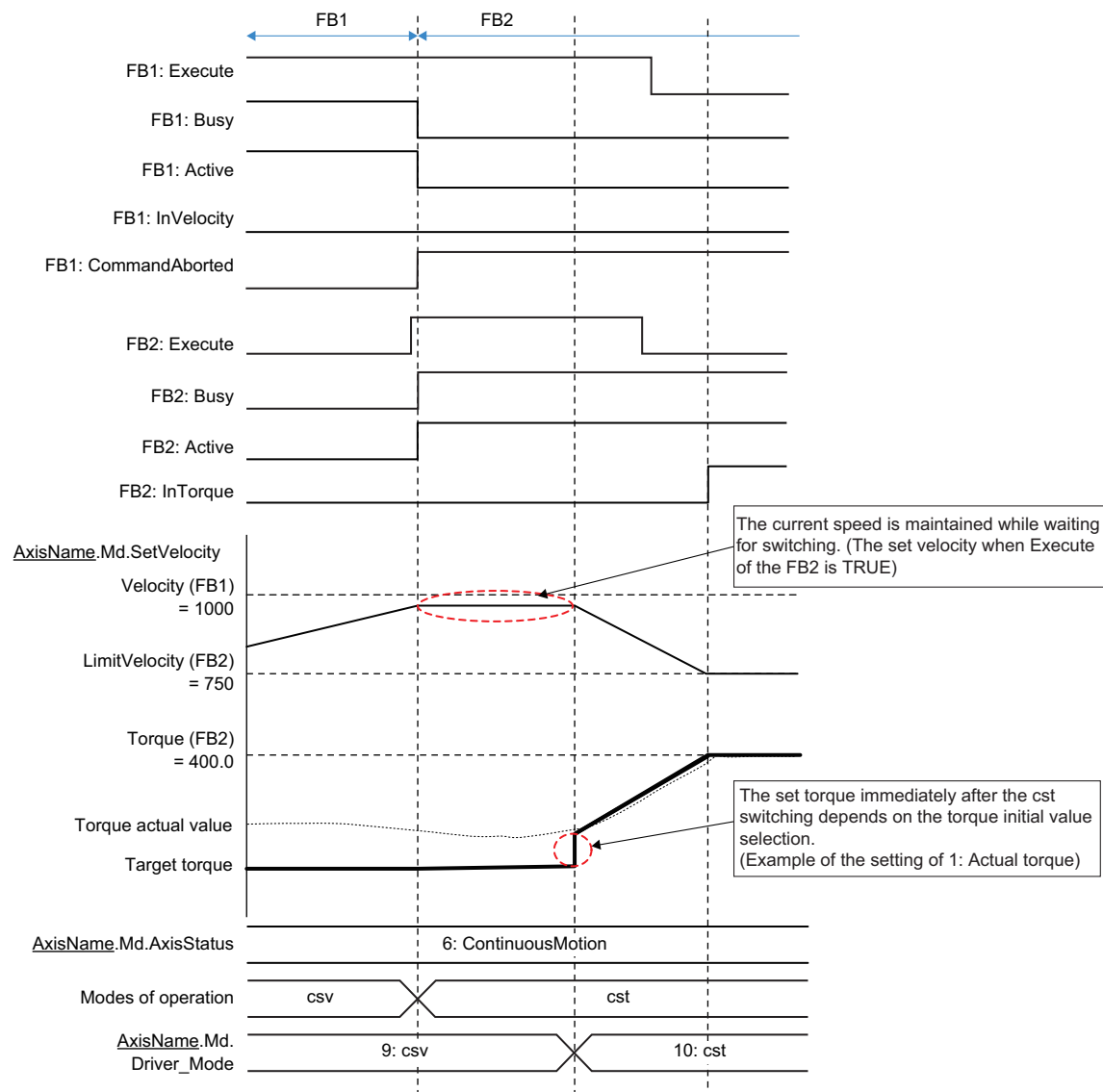
1. When the first instruction is completed, a cst change request is issued to the driver.
2. When the driver mode turns to the cst, the acceleration/deceleration process of the torque and the velocity is started from the current actual torque and the set velocity.



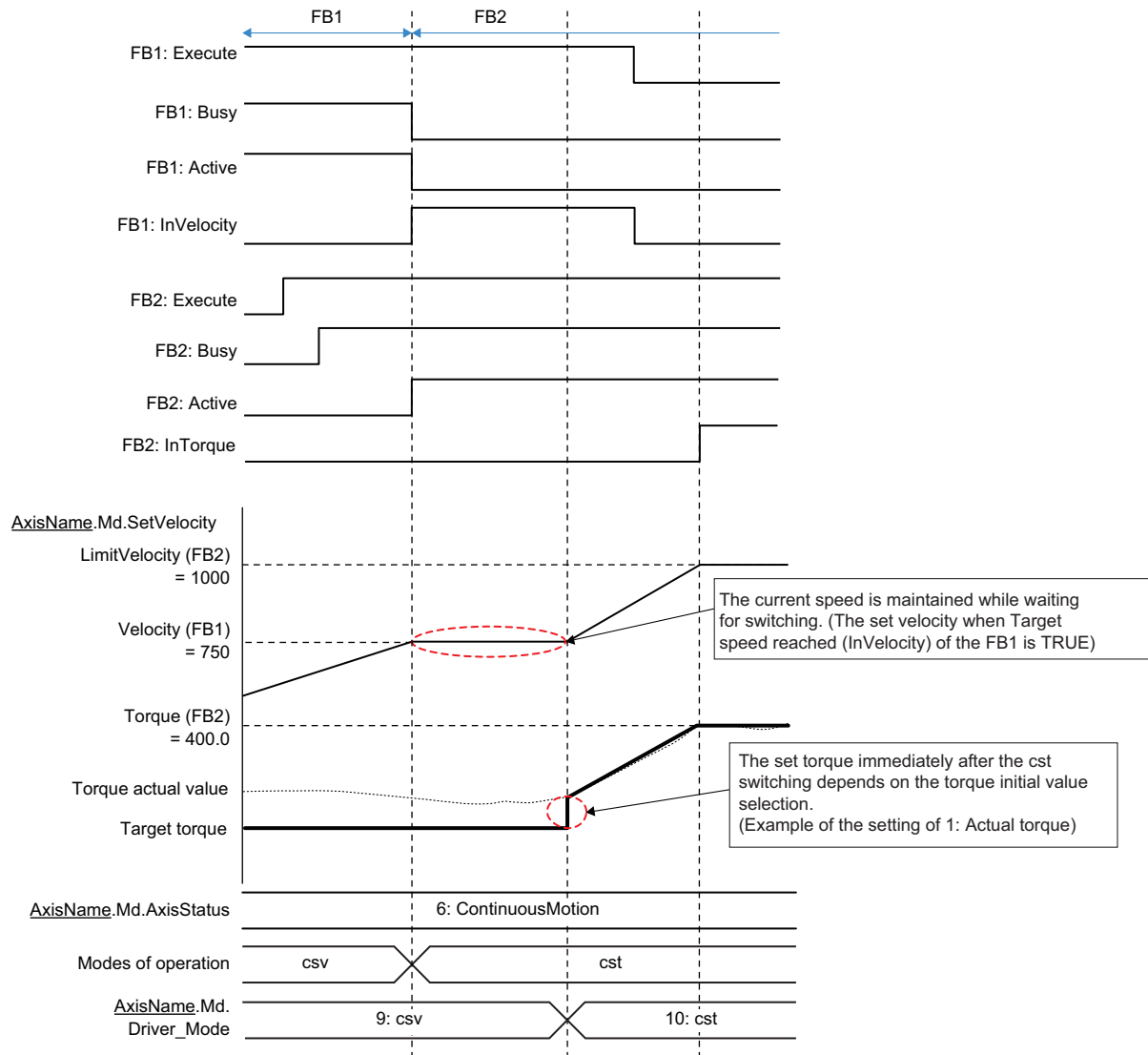
■Velocity control (FB1) → Torque control (FB2)

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.

[0: Aborting (mcAborting)]

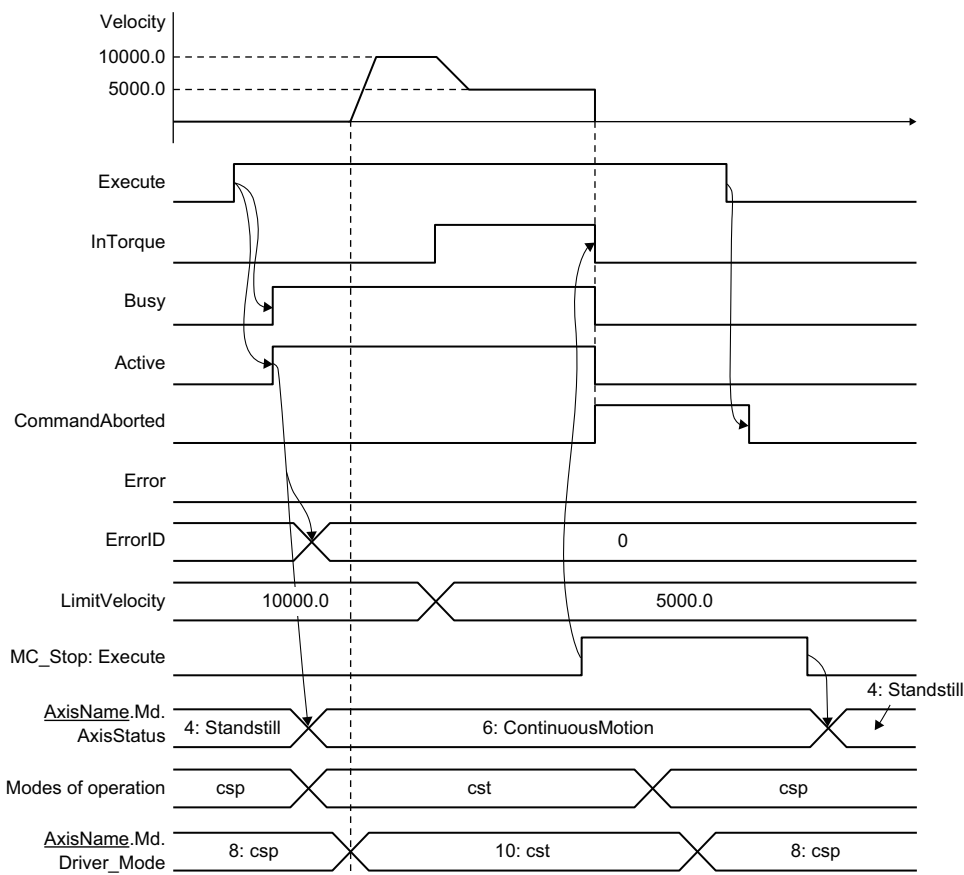


[1: Buffered (mcBuffered)]



When starting another instruction during this FB execution

■Torque control → Stop instruction (MC_Stop (Forced Stop))



■Torque control → Positioning (Absolute value/Relative value positioning)

1. A csp change request is issued to the driver.
2. Started positioning control FB 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 device specifications. If switching to the csp is not completed within 1 second [s], the error "Control Mode Switching Error" (error code: 1A1DH) occurs due to a timeout and the axis stops.)
3. While waiting for switching, torque control is continued with the torque and the limit velocity at switching.
4. When the 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 Operation Setting at Overrun (AxisName.Pr.OverrunOperation).

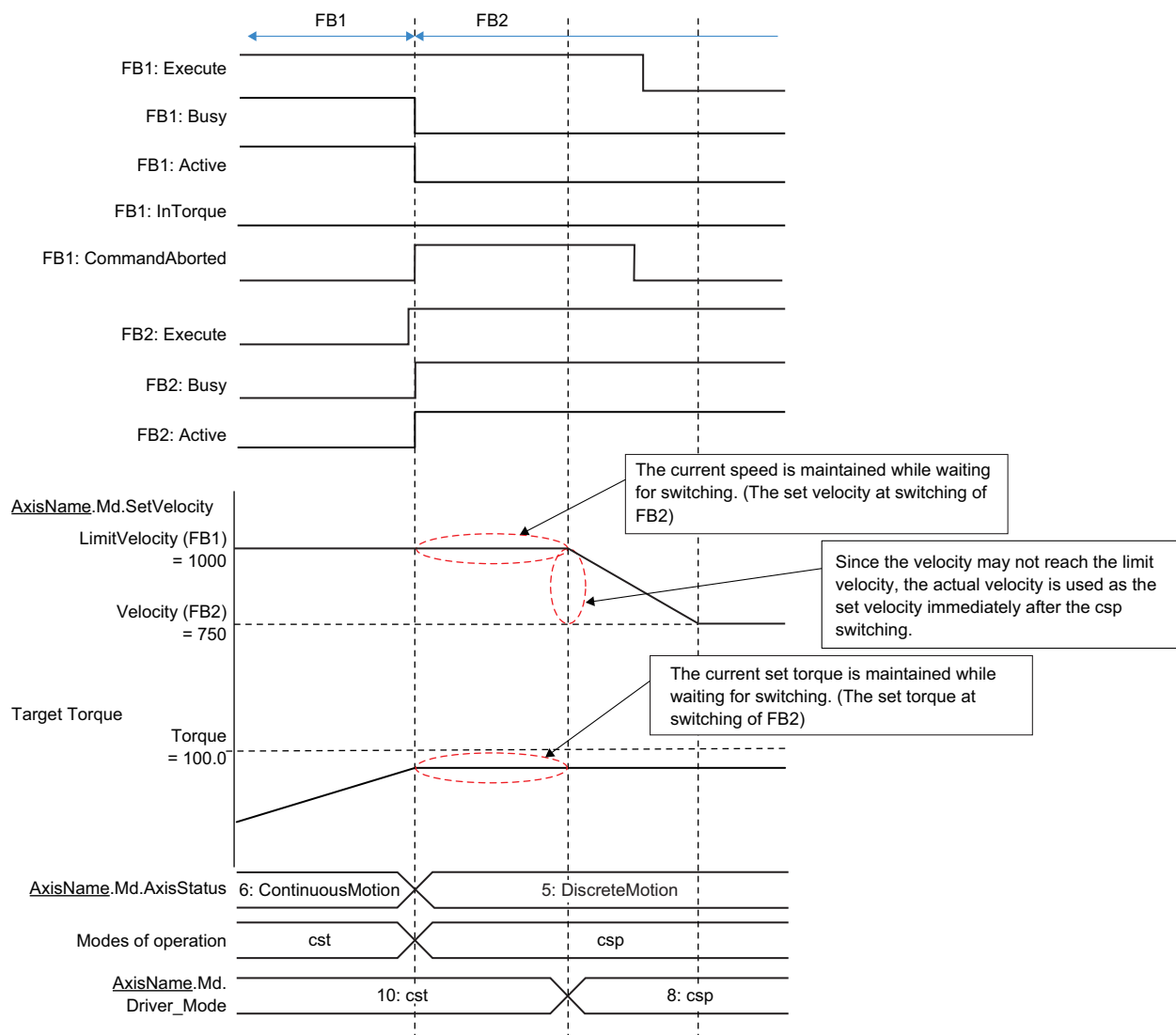
For operation at the overrun occurrence, refer to the following.

➡ Page 134 Multiple Start (Buffer Mode)

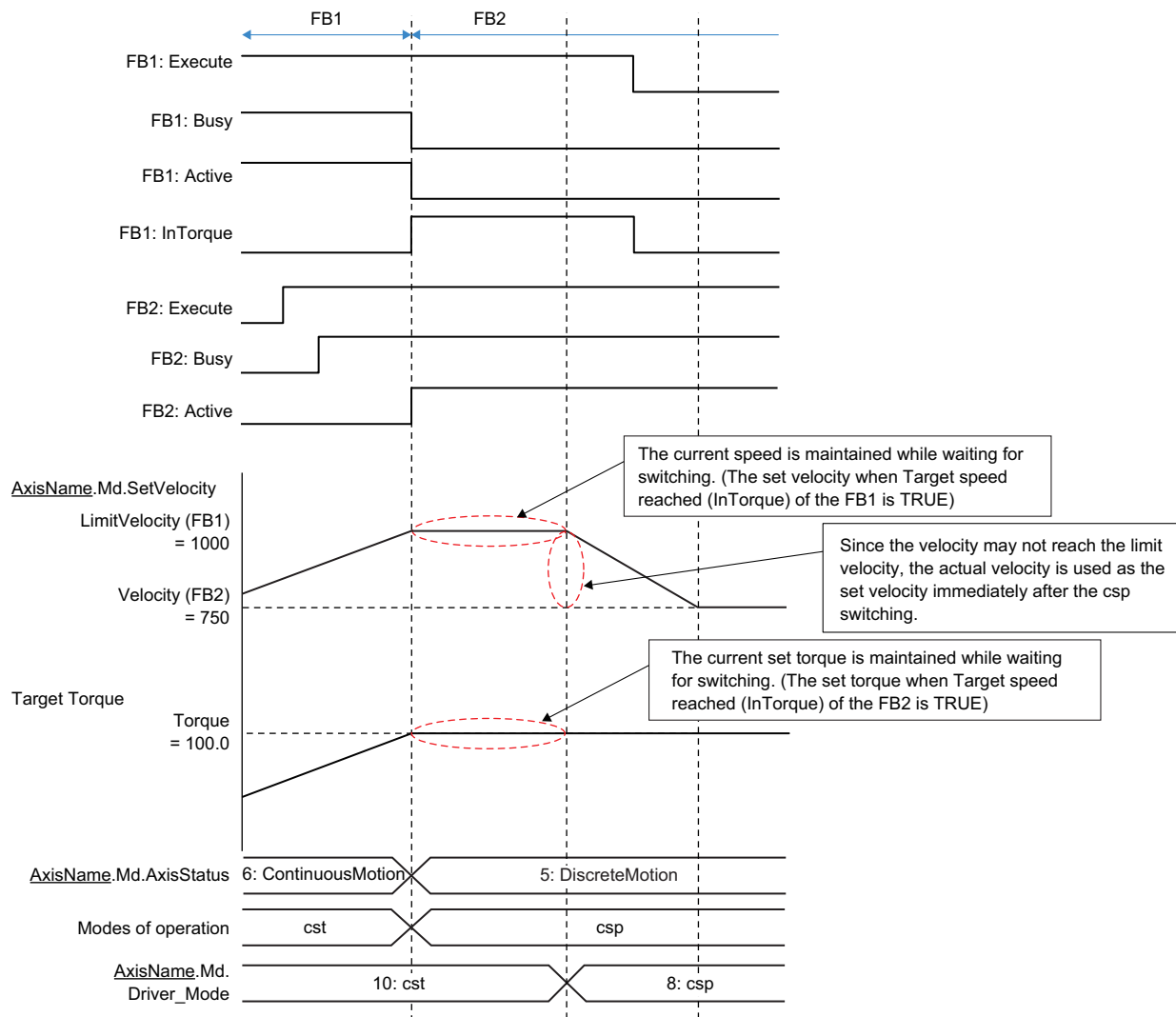
Precautions

If the axis overruns while waiting for switching, it will stop immediately after switching to csp.

[0: Aborting (mcAborting)]



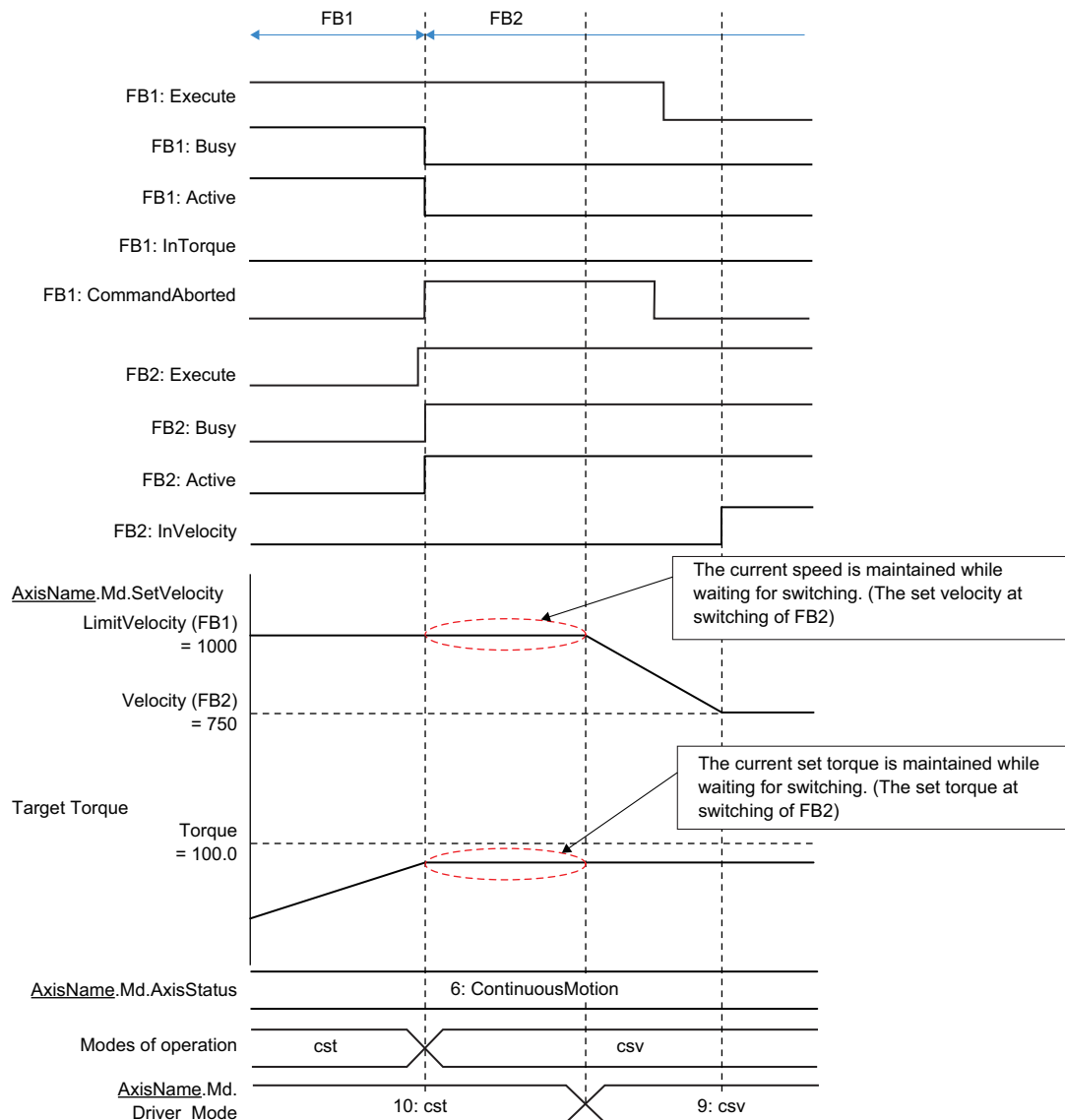
[1: Buffered (mcBuffered)]



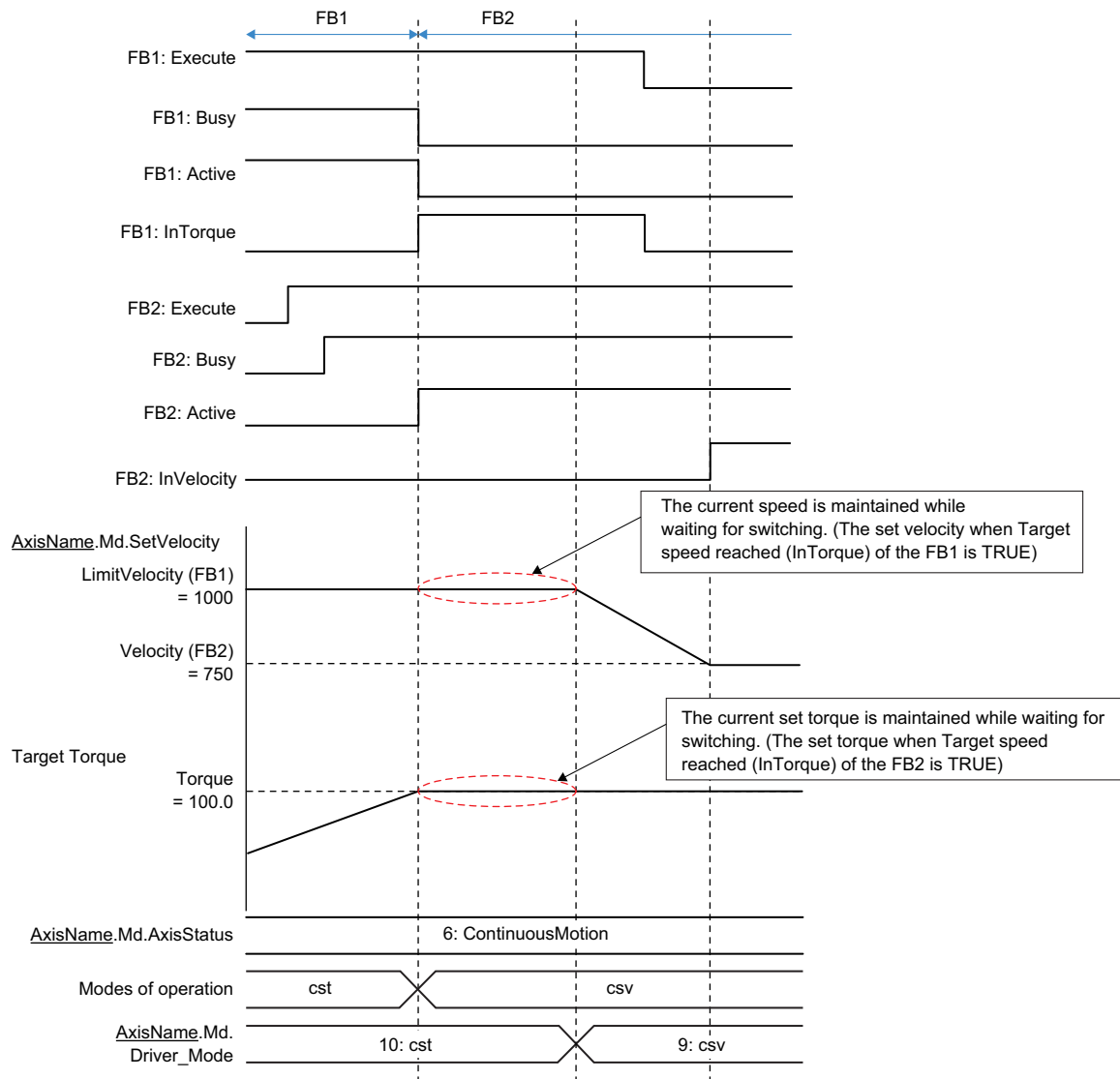
■ Torque control (FB1) → Velocity control (FB2)

1. A csv switching request is issued to the driver.
2. Started positioning control FB 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 device specifications. If switching to the csv is not completed within 1 [s], the error "Control Mode Switching Error" (error code: 1A1DH) occurs due to a 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: Aborting (mcAborting)]



[1: Buffered (mcBuffered)]



7

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

- Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride) are valid.
 - The set position and the machine feed value are updated by follow up.
 - Time until the control mode is switched depends on the specifications of the driver device.
 - When the stop cause occurs during the control mode switching, the axis will stop immediately.
 - Do not start the positioning control FB during the control mode switching. Start the positioning control FB after confirming that Driver Control Mode (AxisName.Md.Driver_Mode) is switched to "10: cst".
 - When switching from the csp to the cst or from the cst to the csp without waiting for stop of the motor by using the MR-J5(W)-G, 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.
 - For the setting value of the servo parameter "Electronic gear numerator (PA06)" and "Electronic gear denominator (PA07)", refer to the following.
-  Page 784 Setting methods

Torque limit change during the cst (cyclic synchronous torque mode)

At restart or continuous update, if the target torque is changed to a value bigger than the torque limit value (Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive), Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative)), 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 Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed to a value smaller than the target torque, the target torque will be changed to the torque limit value. In this case, the set torque is changed at 1 cycle.

8 RELEVANT FUNCTIONS to POSITION

8.1 Current Position Change Function

- This function executes control to change the set position and the cumulative current position to an arbitrary address. The current position change method includes a method of changing the set position at control execution (MC_SetPosition (Current Position Change)) and a method of changing to the set position corrected at the trigger input signal detection timing (MCv_SetPositionTriggered (Trigger Current Position Change)). (The machine feed value is not changed.)
- The "absolute position set" and the "relative position set" can be specified in the address to change.
- This function can be executed only while Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)".
- A method of changing the set position at control execution can be performed even though the axis is in operation. However, it cannot be performed while Axes Group Status (AxesGroupName.Md.GroupStatus) is "5: Operating (GroupMoving)".
- 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 473 SYNCHRONOUS CONTROL

Point

When a current position change is completed, that "the current position change is executed" is recorded in the event history.

Targets to be changed and corresponding FBs

Target to be changed		Corresponding FB
Position	Current value	MC_SetPosition (Current Position Change)
		MCv_SetPositionTriggered (Trigger Current Position Change)
	Limit value (Software stroke limit)	—*1
	Limit value (Software stroke limit) Maximum value of the limit value	—*2

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, 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]	<pre> graph LR subgraph MC_SetPosition direction LR DUT[Input: DUT : Axis] --- Axis[Output: Axis : DUT] B[Input: B : Execute] --- Done[Output: Done : B] L[Input: L : Position] --- Busy[Output: Busy : B] BR[Input: B : Relative] --- CA[Output: CommandAborted : B] ENUM[Input: ENUM : ExecutionMode] --- Error[Output: Error : B] UD[Input: UD : Options] --- ErrorID[Output: ErrorID : UW] Cancel[Output: CancelAccepted : B] end </pre>
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 position selection (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 position selection (Relative) is FALSE, the current position is changed to the target position (absolute position).
- This FB is executed when Execute command (Execute) becomes TRUE, and Executing (Busy) becomes TRUE when the processing is normally started.
- When the processing is completed and the current position is changed, Execution completion (Done) becomes TRUE.
- After starting this FB when Execution mode (ExecutionMode) turned "1: Execute at Completion of Previous One (mcQueued)", if Axis Status (AxisName.Md.AxisStatus) turns "0: Axis disabled (Disabled)" / "1: Stopping on error (ErrorStop)" before processing completion, the error "MC_SetPosition Instruction Error" (error code: 344EH) will occur.
- When an error has occurred in the FB, this FB changes Error (Error) to TRUE and stores an error code in Error code (ErrorID).
- For details on error codes, refer to the following.

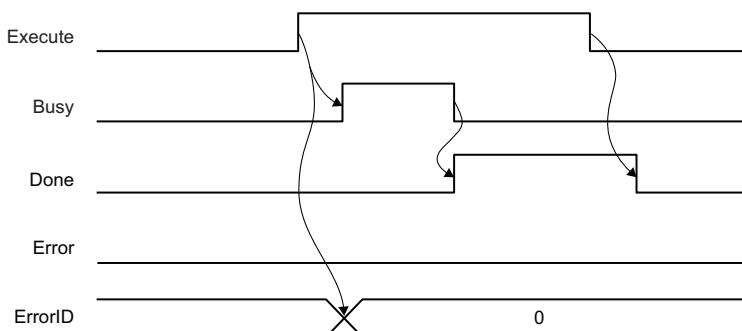
📖 Page 711 List of Error Codes

Precautions

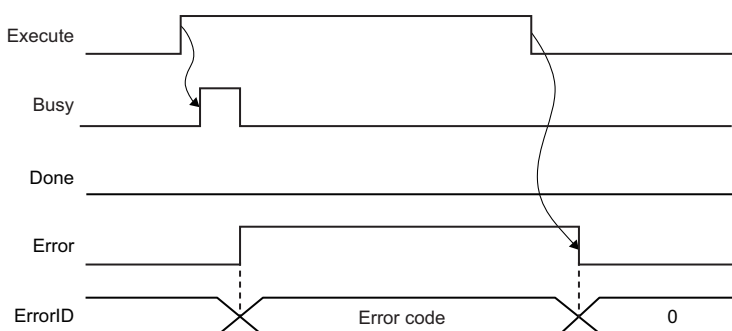
A current position change can be executed during axis operation. If the current position is changed during axis operation, the target position of the on-going FB will not change, but since the current position is changed, the operation to the target value will be changed.

■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 754 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 327 Target position (Position) setting range	0.0	Sets the target position value.
Relative position selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	The current position change with relative distance is set when Relative position selection (Relative) is TRUE. The current position change with absolute position is set when Relative position selection (Relative) is FALSE.
Execution mode	ExecutionMode	MC_EXECUTION_MODE	↑	1 to 3	3	1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively) When "1: Execute at Completion of Previous One (mcQueued)", it executes after the previous FB is completed. When "3: Execute Speculatively (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 (Specify "0").*1
16	Cancel accepted after FB start Specifies whether cancel is allowed or not after FB is started. 0: Do 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) occurs, and the function will not start.

■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 has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

MCv_SetPositionTriggered (Future support planned)

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]	MCv_SetPositionTriggered DUT : Axis DUT : TriggerInput B : Execute L : Position B : Relative UD : Options Axis : DUT TriggerInput : DUT InTrigger : B Done : B Busy : B CommandAborted : B Error : B ErrorID : UW CancelAccepted : B
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 Trigger input signal (TriggerInput) is detected. When the processing is completed, Execution completion (Done) becomes TRUE.
- When Relative position selection (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 position selection (Relative) is FALSE, the current position is changed to the target position (absolute position).
- This FB is executed when Execute command (Execute) becomes TRUE, and Executing (Busy) becomes TRUE when the processing is normally started.
- When an error has occurred in the FB, this FB changes Error (Error) to TRUE and stores an error code in Error code (ErrorID).
- For details on error codes, refer to the following.

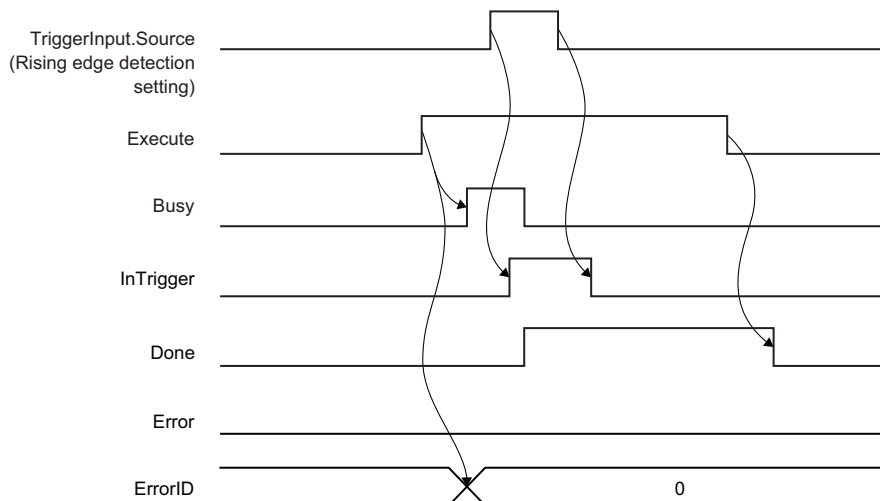
📖 Page 711 List of Error Codes

Precautions

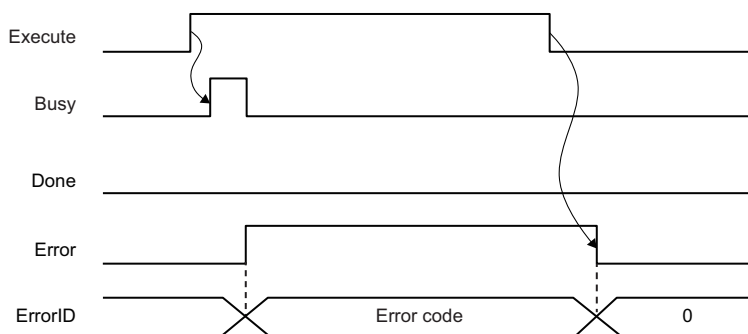
This FB can be executed only when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)". If it is other than "4: Standby (Standstill)", an error occurs and it cannot be executed.

■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 754 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission not possible	Page 439 External Signal Selection Only "RisingEdge", "FallingEdge", and "BothEdges" can be selected for Signal Detection Method (Detection). A value within the range of "-5.0 to 5.0 [s]" can be specified to Compensation Time (CompensationTime) when Relative position selection (Relative) is FALSE. Set "0.0" when Relative position selection (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 327 Target position (Position) setting range	0.0	Sets the target position value.
Relative position selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	When Relative position selection (Relative) is 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 (Specify "0".)*1
16	Cancel accepted after FB start Specifies whether cancel is allowed or not after FB is started. 0: Do 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) occurs, and the function does not start.

■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 has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

Target position (Position) setting range

Values that can be specified in Target position (Position) differs depending on whether Relative position selection (Relative) is FALSE or TRUE. Specify within each of the following range.

Relative position selection (Relative)	Target position (Position) setting range
FALSE	- When the ring counter is disabled $-10000000000.0 \leq \text{Setting value} \leq 10000000000.0$ - When the ring counter is enabled $\text{Ring counter lower limit value} \leq \text{Setting value} < \text{Ring counter upper limit value}$
TRUE	- When the ring counter is disabled $-10000000000.0 \leq \text{Setting value} \leq 10000000000.0$ - When the ring counter is enabled $-(\text{Ring counter upper limit value} - \text{Ring counter lower limit value}) / 2 \leq \text{Setting value} \leq (\text{Ring counter upper limit value} - \text{Ring counter lower limit value}) / 2$

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 (Current Position Change).

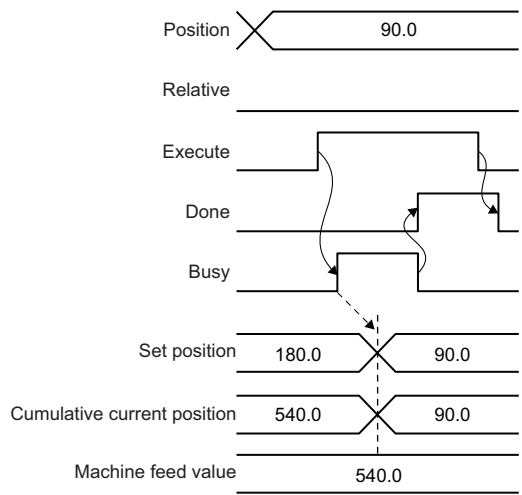
Execution when the axis stops

The current position change operation starts at rising edge detection of Execute command (Execute). In the current position change, the set position and the cumulative current position are changed to the position specified in Target position (Position). Target position (Position) is "Relative position set" when Relative position selection (Relative) is TRUE, and it is "Absolute position set" when Relative position selection (Relative) is FALSE.

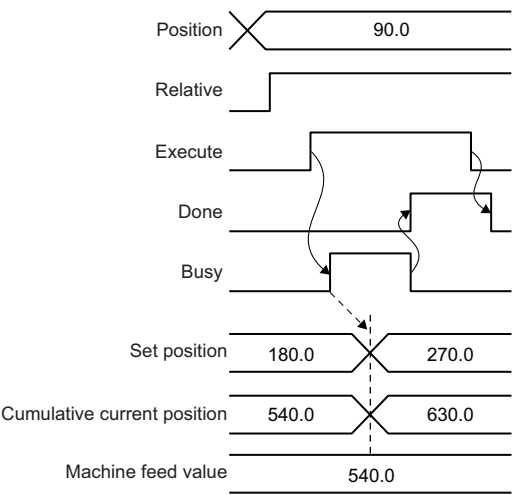
Ex.

When executing the current position change to 90.0 while the axis stops with the ring counter lower limit value of 0.0, the ring counter upper limit value of 360.0, and the set position of 180.0 (the cumulative current position of 540.0).

<When Relative position selection (Relative) is FALSE>



<When Relative position selection (Relative) is TRUE>



Execution during axis operation

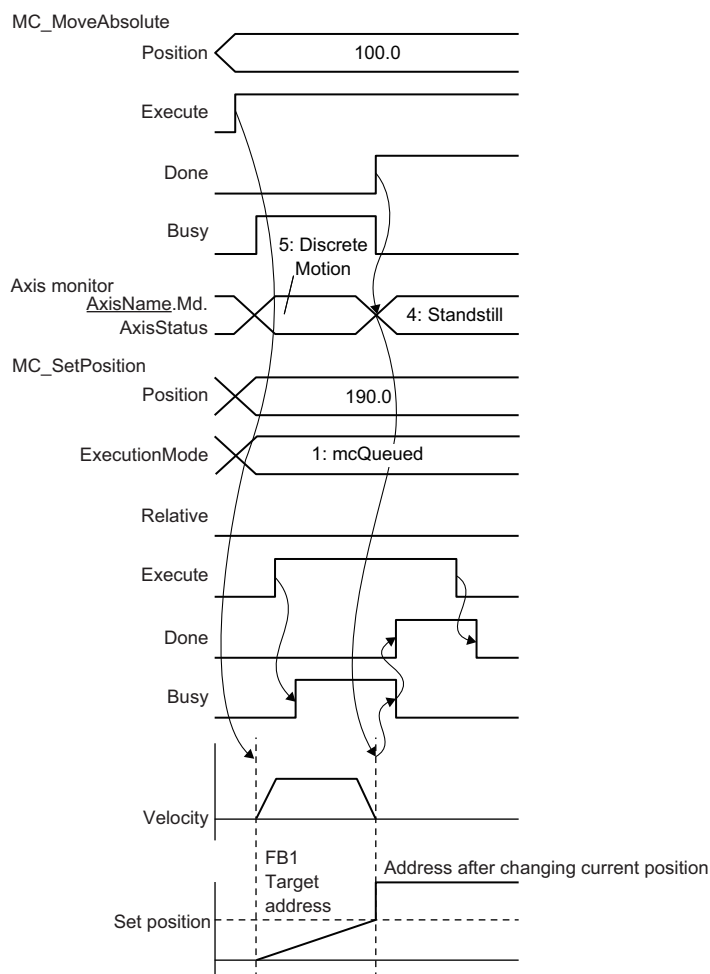
■Execute at Completion of Previous One

When "1: Execute at Completion of Previous One (mcQueued)" is set in Execution mode (ExecutionMode), this FB is executed after the on-going FB is completed.

Executing (Busy) turns TRUE by rising edge detection of Execute command (Execute), and this FB waits until Axis Status (AxisName.Md.AxisStatus) turns "4: Standby (Standstill)".

As soon as Axis Status (AxisName.Md.AxisStatus) turns "4: Standby (Standstill)", the current position change operation will start.

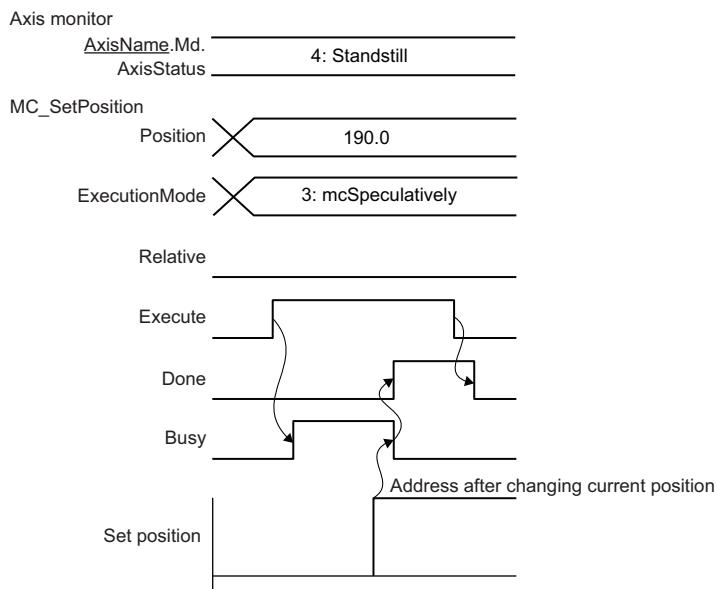
Ex.



■ Speculative execution

When "3: Execute Speculatively (mcSpeculatively)" is specified to Execution mode (ExecutionMode), the current position change can be performed only when Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" at the rising edge detection of Execute command (Execute). If Axis status (AxisName.Md.AxisStatus) of relevant axis is not "4: Standby (Standstill)", or FB instruction is being executed, the error "MC_SetPosition Instruction Error" (error code: 344EH) occurs, and the current position change is not performed.

Ex.



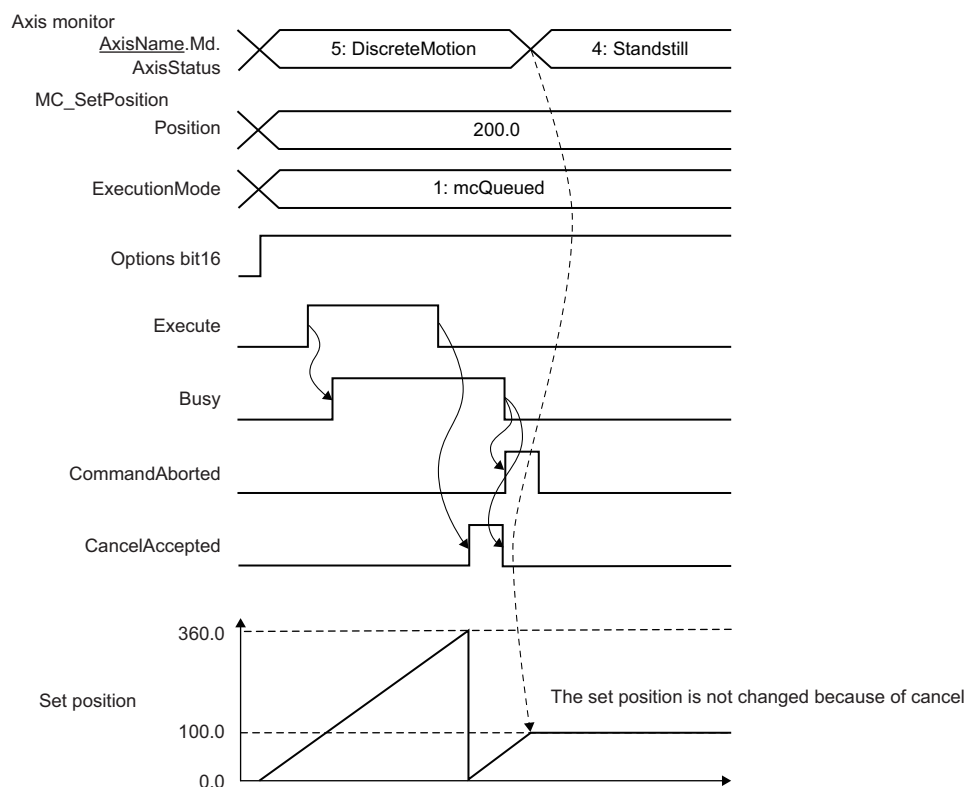
Cancel

Current position change that is in the standby status can be canceled after FB execution.

- To enable cancel, execute the FB with the status of "Cancel accepted after FB start" (Options (Options) bit16) set to "1: Allow".
- Cancel is started at falling edge detection of Execute command (Execute).
- Cancel is accepted only when Executing (Busy) of the output pin is TRUE.
- When FB accepts cancel, Cancel acceptance (CancelAccepted) of the output pin becomes TRUE.
- When cancel is completed, Abortion of execution (CommandAborted) of the output pin becomes TRUE.
- When cancel was carried out, the set position is not changed.

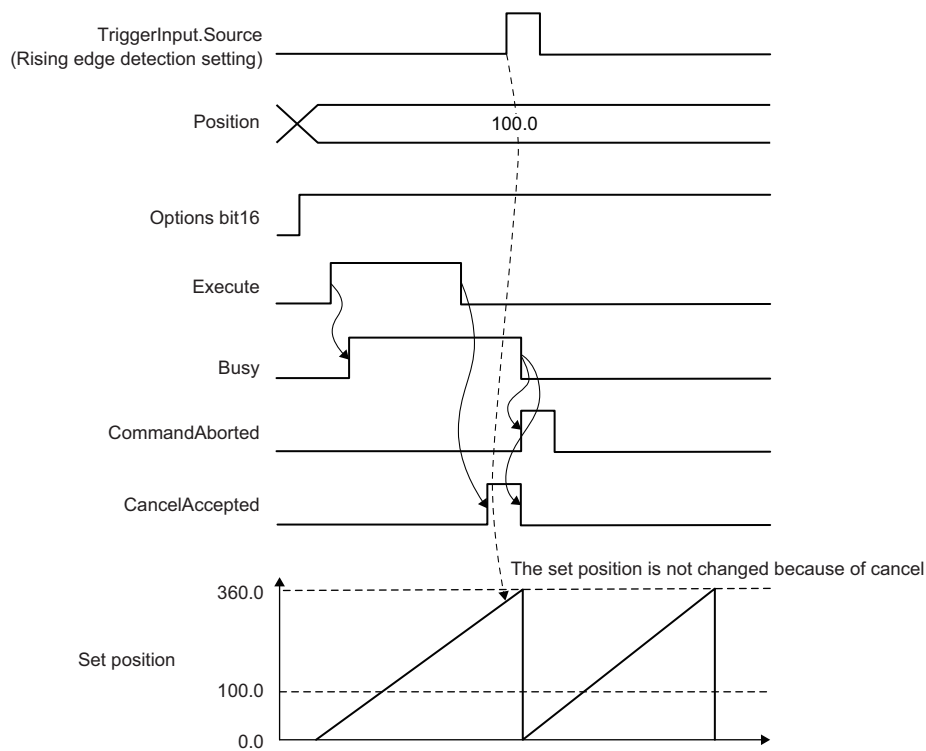
Ex.

When canceling while Axis Status (AxisName.Md.AxisStatus) is waiting for switching to "4: Standby (Standstill)" after starting MC_SetPosition (Current Position Change) with "1: Execute at Completion of Previous One (mcQueued)" in Execution mode (ExecutionMode)



When canceling while the axis status is waiting for detecting a trigger signal after starting MCv_SetPositionTriggered (Trigger Current Position Change)

MCv_SetPositionTriggered



8.2 Command In-position

The command in-position function checks the remaining distance to the target position, and changes 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 changes Command In-position (AxisName.Md.CmdInPos) to TRUE when the remaining distance to the target position became Command In-position Width (AxisName.Md.CmdInPos_Width) or less.

It changes Command In-position (AxisName.Md.CmdInPos) to FALSE when the axis starts and when the FB is switched by multiple start.

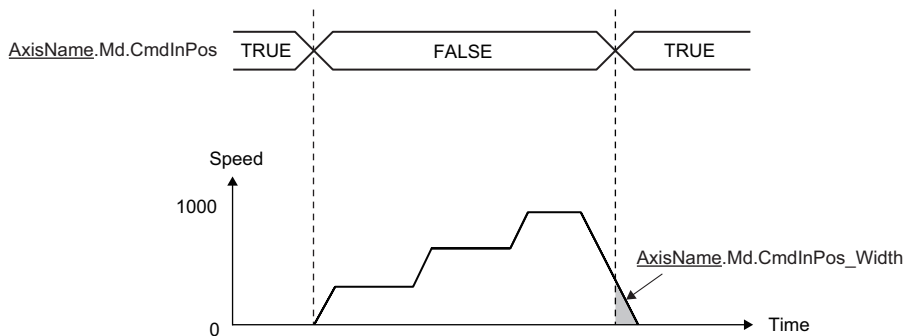
Relevant variables

Variable/Structure name	Name	Details
<u>AxisName</u> .Pr.		
CmdInPos_Width	Command In-position Width	Sets the command in-position width. [Setting range] • 0.0: Function disabled • 0.000000001 to 10,000,000,000.0: Function enabled^{*1}
<u>AxisName</u> .Md.		
CmdInPos_Width	Command In-position Width	Displays the command in-position width. • The value imports the setting value of Command In-position Width (<u>AxisName</u>.Pr.CmdInPos_Width). • When Command In-position Width (<u>AxisName</u>.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 Command In-position Width (<u>AxisName</u> .Md.CmdInPos_Width) or less.
<u>AxesGroupName</u> .Pr.		
CmdInPos_Width	Command In-position Width	Sets the command in-position width on the composite axis of the axes group. [Setting range] • 0.0: Function disabled • 0.000000001 to 10,000,000,000.0: Function enabled^{*1}
<u>AxesGroupName</u> .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 Command In-position Width (<u>AxesGroupName</u>.Pr.CmdInPos_Width). • When Command In-position Width (<u>AxesGroupName</u>.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 Command In-position Width (<u>AxesGroupName</u> .Pr.CmdInPos_Width) or less.

*1 If positive numbers less than 0.000000001 are set, it imports 0.0

Command in-position width check

$(\text{Remaining distance}) \leq (\text{Command In-position Width } (\text{AxisName.Md.CmdInPos\_Width}))$



A command in-position width check is carried out every operation cycle.

However, while the axis stops, Command In-position (`AxisName.Md.CmdInPos`) is not refreshed.

When Command In-position Width (`AxisName.Md.CmdInPos_Width`) is 0.0, a command in-position width check is not carried out.

For an axes group, the remaining distance on the composite axis (line/arc) is checked based on Command In-position Width (`AxesGroupName.Md.CmdInPos_Width`). When the long axis velocity specification and the reference axis speed specification are specified on the linear interpolation control, the remaining distance on the long axis and the reference axis are checked.

The flag is stored in Command In-position (`AxesGroupName.Md.CmdInPos`).

During axes group operation, the command in-position function of the configuration axes is disabled. Command In-position (`AxisName.Md.CmdInPos`) of the configuration axes is not changed to TRUE during axes group operation. (It is changed to FALSE when the axes group is started.)

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 "machine feed value" 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 Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target).

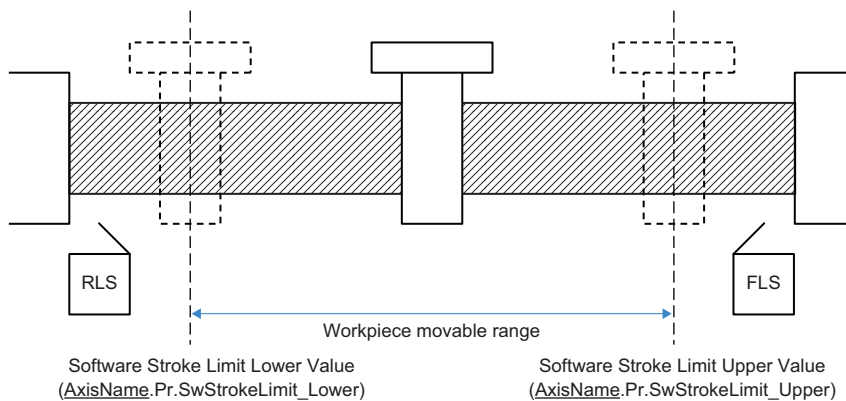
Relevant variables

Variable/Structure name	Name	Details
<u>AxisName</u> .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.
<u>AxisName</u> .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.
<u>AxisName</u> .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 machine feed value

The following drawing shows the movable range of the workpiece when the software stroke limit function is used.

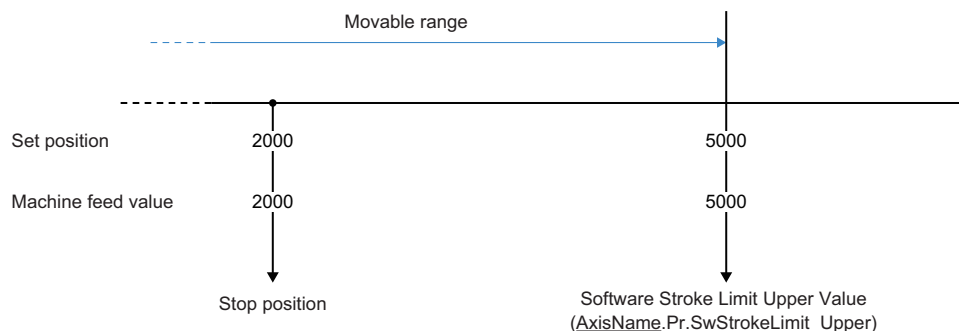


The set position or the machine feed value can be specified in the software stroke limit. (The cumulative current position cannot be specified.)

The following drawing shows the differences in the operation when the set position is used or when the machine feed value is used in the movable range limit check.

- Conditions

Assume the current value is 2000, and Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) is set to 5000.

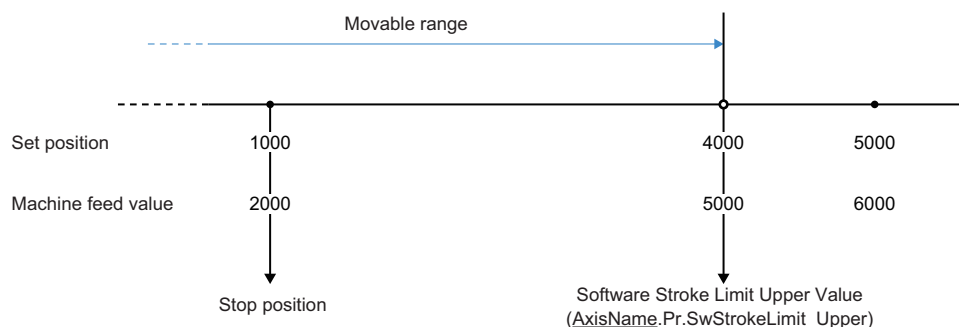


- Current value changing

When the current value is changed by a new current value command from 2000 to 1000, the set position will change to 1000, but the machine feed value will stay the same at 2000.

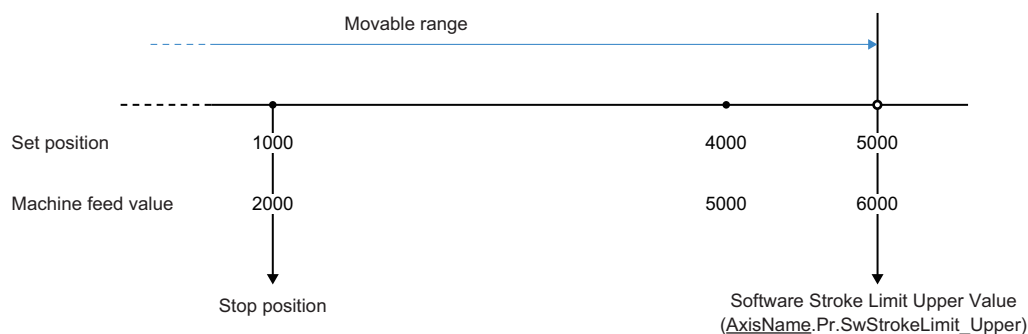
[When the machine feed value is set at the limit]

The set position of 4000 (machine feed value: 5000) becomes the upper stroke limit.



[When the set position is set at the limit]

The set position of 5000 (machine feed value: 6000) becomes the upper stroke limit.



Point

When "3: Machine Feed Value (FeedMachinePosition)" is set in Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target), the movable range becomes an absolute range referenced on the home position. When "1: Set Position (SetPosition)" is set, the movable range becomes the relative range from the set position.

■When selecting the set position when the ring counter is valid

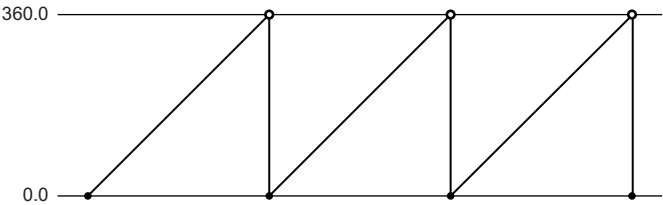
- Set position

The storing range of the set position upper/lower limit value is shown below.

Monitor data	Storing range
Set Position (<u>AxisName</u> .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

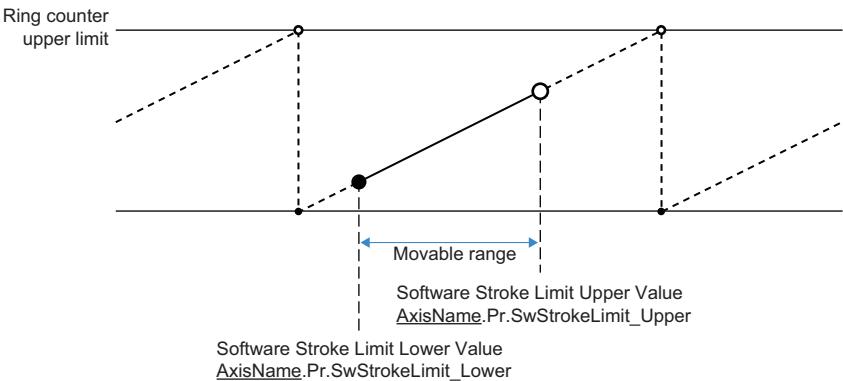
The setting range of the software stroke limit upper/lower value is shown below.

Parameter	Setting range
Software Stroke Limit Upper Value (<u>AxisName</u> .Pr.SwStrokeLimit_Upper)	Ring counter lower value < Setting value ≤ Ring counter upper value
Software Stroke Limit Lower Value (<u>AxisName</u> .Pr.SwStrokeLimit_Lower)	Ring counter lower value ≤ Setting value < Ring counter upper value

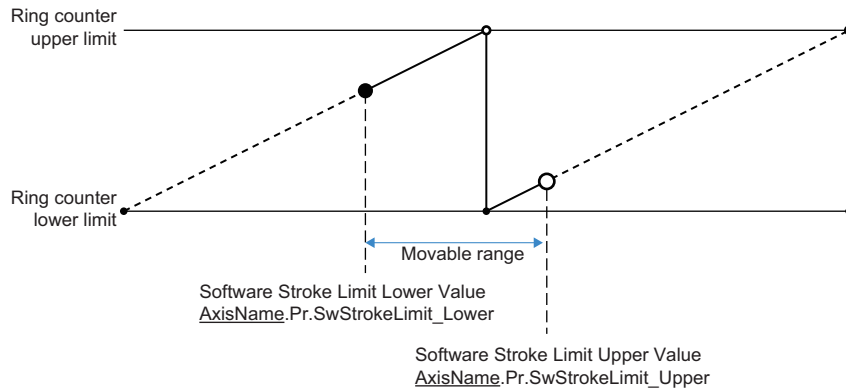
Movable range: Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) ≤ Set position < Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)

- Details of the movable range

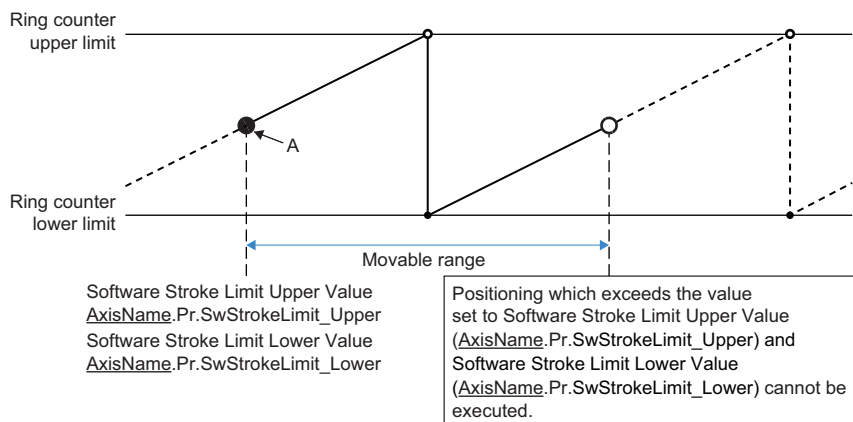
The movable range varies as shown below depending on the relationship between Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).
[Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) > Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)]



[Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) < Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)]



[Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) = Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)]



When "Set position = Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) = Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)", the operation within the "valid range" above is available, as the set position is considered being at the software stroke limit lower value (at the A position above).

■When selecting the set position or the machine feed value when the ring counter is invalid

- Machine feed value

The storing range of the machine feed value upper/lower limit value are shown below.

Monitor data	Storing range
Machine Feed Value (<u>AxisName.Md.FeedMachinePosition</u>)	$10000000000.0 \leq \text{Machine feed value} < 10000000000.0$

- Setting the software stroke limit

The setting range of the software stroke limit upper/lower value is shown below.

Parameter	Setting range
Software Stroke Limit Upper Value (<u>AxisName.Pr.SwStrokeLimit_Upper</u>)	Software Stroke Limit Lower Value (<u>AxisName.Pr.SwStrokeLimit_Lower</u>) < Setting range ≤ 10000000000.0
Software Stroke Limit Lower Value (<u>AxisName.Pr.SwStrokeLimit_Lower</u>)	$-10000000000.0 \leq \text{Setting range} < \text{Software Stroke Limit Upper Value } (\text{AxisName.Pr.SwStrokeLimit\_Upper})$

Movable range: Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) $\leq$ Machine feed value < Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper)

Invalidating the software stroke limit

To invalidate the software stroke limit, set "-1: Invalid" in Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target). By setting "-1: Invalid (Invalid) ", the software stroke limit check is not executed in all controls regardless of the setting values of Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).

Returning from outside the software stroke limit range

The axis cannot start outside the software stroke limit range while the software stroke limit is valid.

After setting ONLY_INSIDE (Check disabled for movement returning to the range) or DISABLE (Check disabled) in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), execute the axis operation to return to the movable range. Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) is case-sensitive

Point

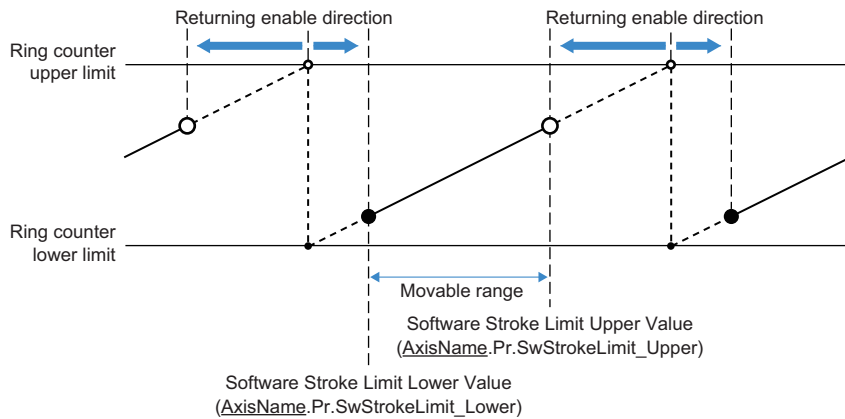
- In Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), the software stroke limit can be temporarily disabled without changing the settings of Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) and Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower).
- In Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), only the check in the returning enable direction can be disabled from outside the software stroke limit range. By disabling it only in the 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 Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), that "the axis operation is started while the software stroke limit is disabled by software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override)" is recorded in the event history.

■Returning enable direction to the movable range

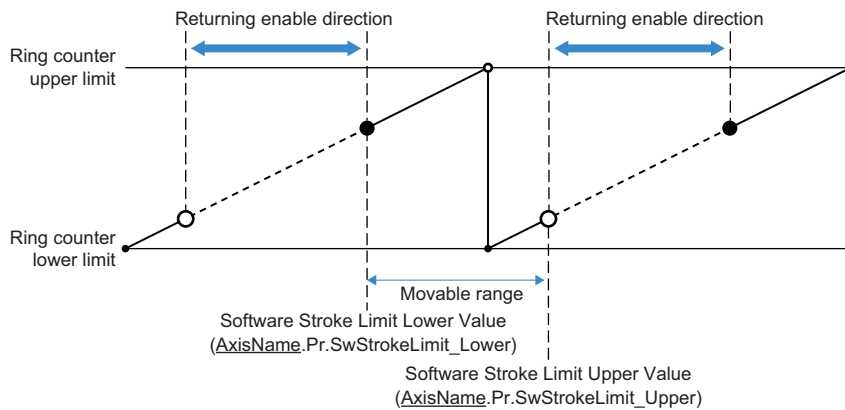
- When setting ONLY_INSIDE (Check disabled for movement returning to the range) in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override), movement in the returning enable direction from outside the software stroke limit range to the movable range is allowed.
- The returning enable direction 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 (Check disabled) in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override) and carry out a move to the movable range.

■Returning enable direction when setting ONLY_INSIDE (Check disabled for movement returning to the range) in Software Stroke Limit Override (AxisName.Cd.SwStrokeLimit_Override)

- Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) > Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)



- Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) < Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower)



Checking the software stroke limit enabled disabled

- In the monitor Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override), the software stroke limit check enabled/disabled status can be checked.
- Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) imports setting values of Software Stroke Limit Override (AxisName.Md.SwStrokeLimit_Override) at PLC READY [Y0] from OFF to ON, at start, and at multiple start, and updates as in the table below.

Software Stroke Limit Target (<u>AxisName.Pr.SwStrokeLimit_Target</u>)	Software Stroke Limit Override (<u>AxisName.Cd.SwStrokeLimit_Override</u>)	Software Stroke Limit Override (<u>AxisName.Md.SwStrokeLimit_Override</u>)
-1: Invalid (Invalid)	—	DISABLE: Check disabled
1: Set position (SetPosition) 3: Machine feed value (FeedMachinePosition)	Other than the following: No disable request DISABLE: Check disabled ONLY_INSIDE: Check disabled for movement returning to the range	Display is blank: No disable request DISABLE: Check disabled ONLY_INSIDE: Check disabled for movement returning to the range

Specifications of the software stroke limit check

The software stroke limit check is carried out at executing the motion FB and during control.

The following table shows the check details of the software stroke limit.

Check details	Check timing	Processing when an error occurs
An error shall occur if the target address is outside the software stroke limit range.	When executing the motion FB 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 executing the motion FB	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.

The checking details of the following function is different from the above.

- Homing control

For details, refer to the following.

 Page 206 HOMING

Precautions

- Homing must be executed beforehand for the software stroke limit function to function properly.
- If Software Stroke Limit Upper Value (AxisName.Pr.SwStrokeLimit_Upper) or Software Stroke Limit Lower Value (AxisName.Pr.SwStrokeLimit_Lower) is outside the setting range, 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 "3: Machine Feed Value (FeedMachinePosition)" is set as the setting value of Software Stroke Limit Target (AxisName.Pr.SwStrokeLimit_Target) to the axis type which does not have Machine Feed Value (AxisName.Md.FeedMachinePosition), 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.
- To use the hardware stroke limit function, the add-on ExternalSignal must be valid. In case the add-on is not installed or invalid, the axis does not stop nor an error is not outputted even if the signal is inputted.

For details on the signals that can be used in the hardware stroke limit, refer to the following.

 Page 439 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. The specific setting and the operation of this signal are shown below. • I/O No. (StartIO) Ignores the input value. • Target (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 "Out of Parameter Range (Axis)" (error code: 1D80H) is output. • Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) • Compensation Time (CompensationTime) Ignores the input value. • Filter Time (FilterTime) Setting range is 0.0 to +5.0 [s]. When a value outside the range is set, the warning "Out of Filter Time Setting Range of Each Axis Signal Warning" (warning code: 0D24H) is output, and operates at the filter time 0.0. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following.  Page 440 SIGNAL_SELECT structure

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. The specific setting and the operation of this signal are shown below. • I/O No. (StartIO) Ignores the input value. • Target (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 "Out of Parameter Range (Axis)" (error code: 1D80H) is output. • Signal Detection Method (Detection) The specification is allowed at the following level detection only. When edge detection specification is set, the error "Out of Parameter Range (Axis)" (error code: 1D80H) is output. 0: Detection at TRUE (HighLevel) 1: Detection at FALSE (LowLevel) • Compensation Time (CompensationTime) Ignores the input value. • Filter Time (FilterTime) Setting range is 0.0 to +5.0 [s]. When a value outside the range is set, the warning "Out of Filter Time Setting Range of Each Axis Signal Warning" (warning code: 0D24H) is output, and operates at the filter time 0.0. The fetch timing of the label is at the system start, and the detection timing of the signal is the axis operation cycle. For details on SIGNAL_SELECT type, refer to the following.  Page 440 SIGNAL_SELECT structure
<u>AxisName.Md.</u>		
HwStrokeLimit_FlsStatus	Upper Limit Signal Status	Displays the detection status of the FLS signal. • TRUE: Detecting the FLS signal • FALSE: Not detecting the FLS signal Displays the detection state which reflects the signal detection method or the filter time but not the signal input state.
HwStrokeLimit_RlsStatus	Lower Limit Signal Status	Displays the detection status of the RLS signal. • TRUE: Detecting the RLS signal • FALSE: Not detecting the RLS signal Displays the detection state which reflects the signal detection method or the filter time but not the signal input state.
HwStrokeLimit_Override	Hardware Stroke Limit Override	Displays the acceptance status of the enabled/disabled switching command of the hardware stroke limit.
<u>AxisName.Cd.</u>		
HwStrokeLimit_Override	Hardware Stroke Limit Override	Switches the enabled/disabled of the hardware stroke limit.

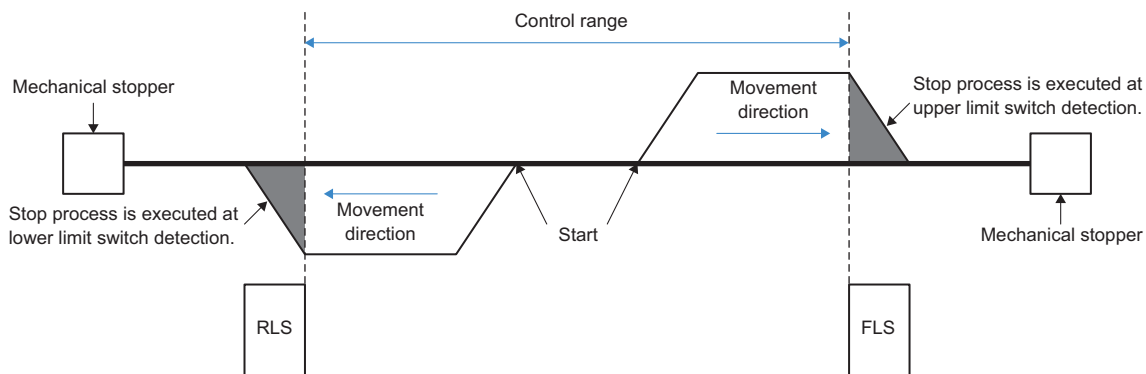
Hardware stroke limit check details

The check of hardware stroke limit range is carried out during executing and controlling the motion FB.

The following table shows the check details of the hardware stroke limit.

Check details	Check timing	Processing when an error occurs
Signal input from the 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 (Check disabled for movement returning to the range) or DISABLE (Check disabled) in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), execute the axis operation to return to the controllable range.

Point

- When setting an item other than ONLY_INSIDE (Check disabled for movement returning to the range) and DISABLE (Check disabled) in Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), the axis operates with "No disable request".

Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is case-sensitive.

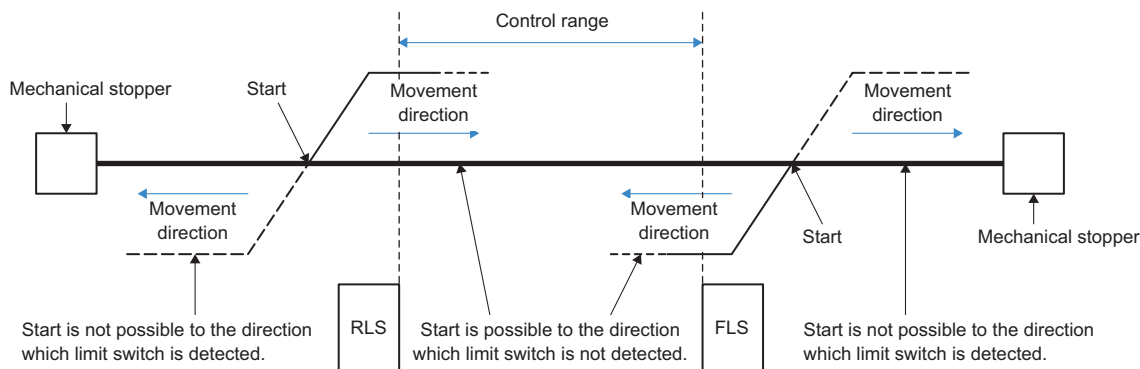
- If the axis operation is started while the hardware stroke limit is disabled by Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override), that "the axis operation is started while the hardware stroke limit is disabled by Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override)" is recorded in the event history.

Precautions

Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) is valid only in the hardware stroke limit processing on the Motion module side. The stroke limit processing on the drive module side is not affected by Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override).

When setting ONLY_INSIDE (Check disabled for movement returning to the range)

The axis can start to the direction in which the limit switch has not been detected.



When setting DISABLE (Check disabled)

The axis can start regardless of the limit switch detection status.

Checking the hardware stroke limit enabled/disabled

- In Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override), the hardware stroke limit check enabled/disabled status can be checked.
- Hardware Stroke Limit Override (AxisName.Md.HwStrokeLimit_Override) imports the setting value of Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override) at start and at multiple start, and updates as in the table below.

Hardware Stroke Limit Override (<u>AxisName</u> .Cd.HwStrokeLimit_Override)	Hardware Stroke Limit Override (<u>AxisName</u> .Md.HwStrokeLimit_Override)
DISABLE (Check disabled)	DISABLE (Disabling hardware stroke limit check)
ONLY_INSIDE (Check disabled for movement returning to the range)	ONLY_INSIDE (Disabling hardware stroke limit check, only the movement toward the range.)
Other than the above	No display (No disabling request. Hardware stroke limit check is enabled.)

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 FLS/RLS signal detected on the Motion module can be sent to the servo amplifier. For details on the setting method at connecting MR-J5(W)-G, refer to the following.

 Page 786 Using methods

- The Motion module sends the signals as "FALSE: Detecting the signal", "TRUE: Not detecting the signal" to the servo amplifier. Therefore, the servo amplifier side must be set by using "the negative logic (b-contact)" to receive the signal.
 - When labeling the data sent from the Motion module, the sent data is overwritten with the label value and the detection state cannot be sent to the servo amplifier. To send the data to the servo amplifier, do not label the data.
- The LSP/LSN signal input to the servo amplifier when connecting to MR-J5(W)-G can be set as the hardware stroke limit signal. For details on the setting method, refer to the following.

 Page 786 Using methods

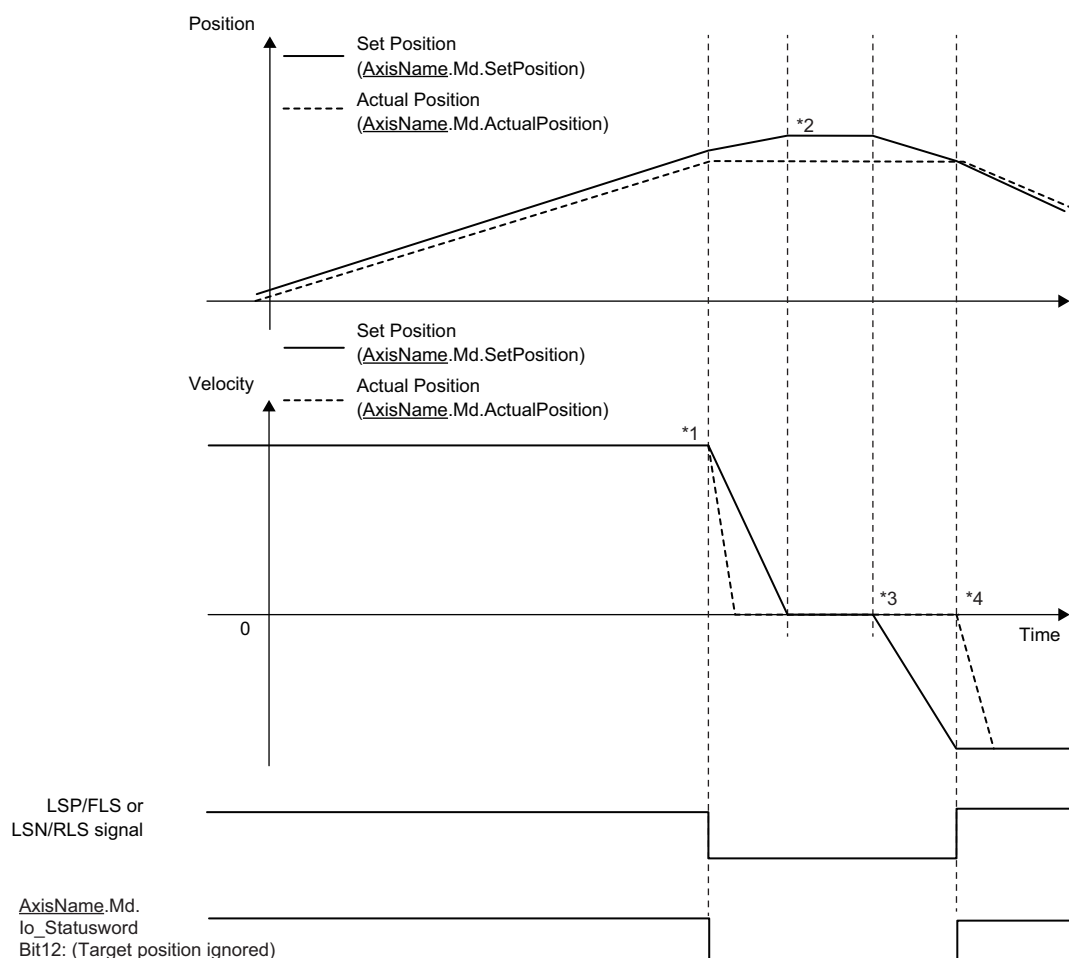
- Depending on the setting of "Limit switch enabled status selection" (PD41.2) of the servo parameter "Function selection D-4(PD41)" when connecting to MR-J5(W)-G, the operation differs at LSP/FLS or LSN/RLS signal detection.

Setting	Operation
When "0: Limit switch always enabled"	The drive unit side executes the stop processing, and then turns to servo-lock status (Statusword Bit12: OFF) and the drive unit will ignore the motion system command. The motion system can stop the command by enabling Driver Command Discard Detection Setting (<u>AxisName</u> .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 to set "1: Enabled only for homing mode", and "Sensor input method selection (PD41.3)" to "1: Input from controller". When setting "0: Limit switch always enabled", the command on the Motion module side needs to be stopped, be sure to enable Driver Command Discard Detection Setting (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 Driver Command Discard Detection Setting (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 on the setting, refer to the following.
[Page 165 Stop](#)
- *2 After completion of the stop process on the motion system side, it stops with the status where Actual Position (AxisName.Md.ActualPosition) deviates from Set Position (AxisName.Md.SetPosition). (The position command from the motion system to the outside of the stroke limit is ignored in the drive unit.)
- *3 After stopped and when axis control is performed to the direction toward the inside of the stroke limit, the position command (the set position and machine feed value) 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.

- 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.

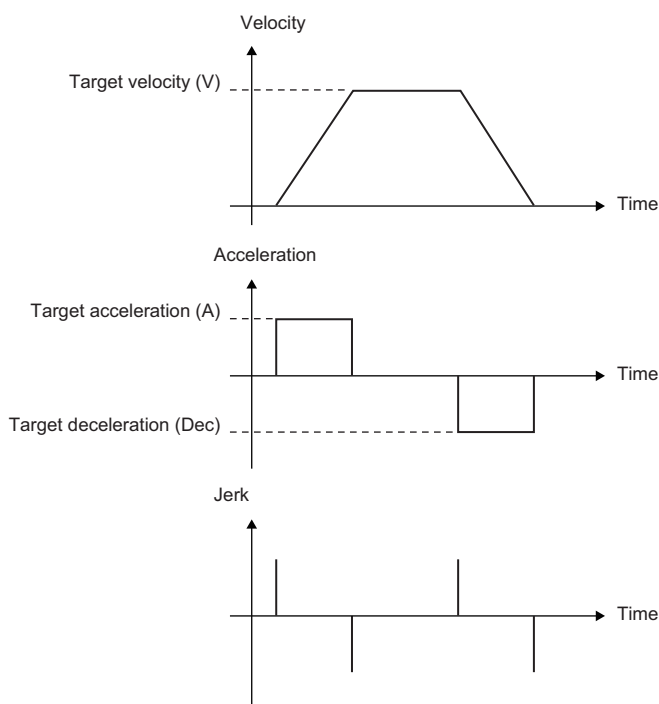
Acceleration/deceleration method

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 Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) specified in the FB.
Acceleration/deceleration time-fixed method	An acceleration/deceleration method using the acceleration/deceleration time specified in the FB regardless of the velocity.

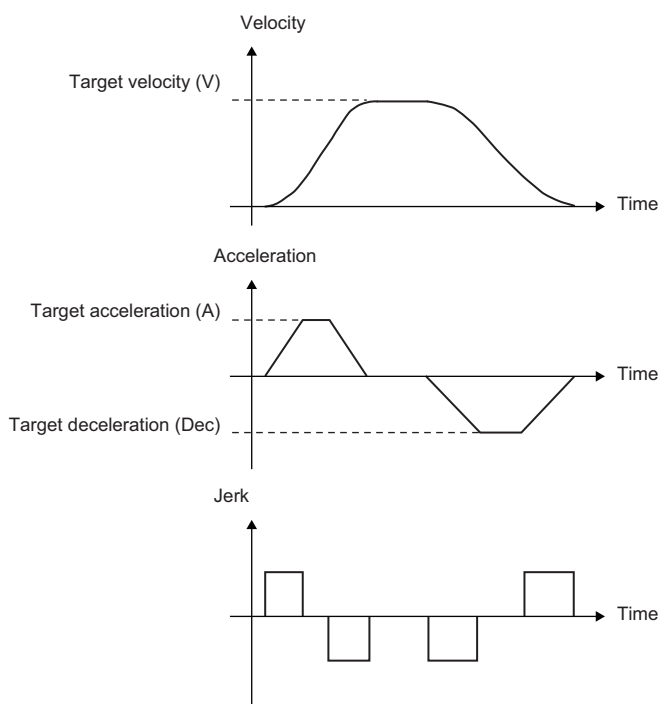
■Trapezoidal acceleration/deceleration

When "0.0" is set in the jerk, the curve is called the trapezoidal acceleration/deceleration. The velocity shows a trapezoidal waveform.



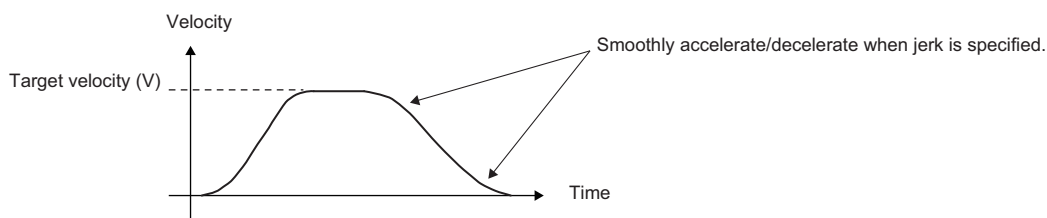
■ Jerk acceleration/deceleration

When a value other than "0.0" is set in the jerk, the curve is called the jerk acceleration/deceleration. The velocity shows a S-shaped waveform.



Jerk

Jerk is the temporal change ratio of the acceleration or deceleration. The unit is "command unit (U)/s³". When the jerk is set, since the velocity waveform shows a S-shape and the axis can smoothly accelerate and decelerate at the start and the end of acceleration and deceleration, it can reduce the burden on the motor and impact on the machine.



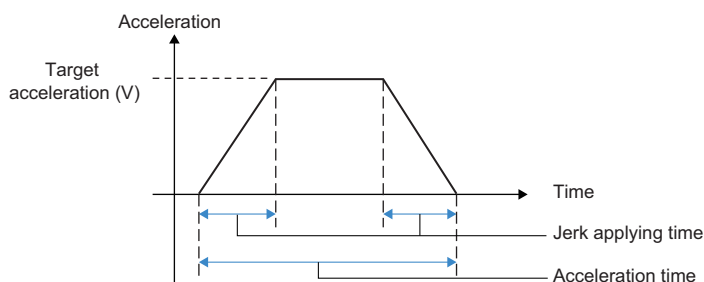
- Jerk applying time/Jerk applying ratio

The sum of the time required to reach the target acceleration after startup and the time from the target acceleration to the acceleration 0 at the end of acceleration is called the jerk applying time. The ratio of jerk applying time to acceleration (deceleration) time is called the jerk applying ratio.

The jerk applying time and the jerk applying ratio can be calculated with the following formula.

Jerk applying time = $2 \times \text{Target acceleration} \div \text{Jerk}$

Jerk applying ratio = $(\text{Jerk applying time} \div \text{Acceleration time}) \times 100 [\%]$



Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Pr.</u>		
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Sets the positive direction velocity limit value. For details, refer to the following.  Page 377 Velocity Limit
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Sets the negative direction velocity limit value. For details, refer to the following.  Page 377 Velocity Limit
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Sets the operation at velocity limit value exceeded. For details, refer to the following.  Page 377 Velocity Limit
AccelerationLimit	Acceleration Limit Value	Sets the acceleration limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s ² ¹ • When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it 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 ¹ • When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it doesn't limit the deceleration. • When "0.0000" is set, it does not limit the deceleration.
JerkLimit	Jerk Limit Value	Sets the jerk limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s ³ ¹ • When "0.0000" is set, it does not limit the jerk.
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Selects behavior when "0.0" is set as the acceleration, the deceleration, or the acceleration/deceleration time at start. -1: Error (Not Started) (ACCError) 1: Maximum Acceleration/Deceleration (MaximumAcceleration)
OverrunOperation	Operation Setting at Overrun	Automatically adjusts the deceleration to stop at the target position. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)
<u>AxesGroupName.Pr.</u>		
VelocityLimit	Velocity Limit Value	Sets the velocity limit value. For details, refer to the following.  Page 377 Velocity Limit
AccelerationLimit	Acceleration Limit Value	Sets the acceleration limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s ² ¹ • When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it limits the 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 ¹ • When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it limits the deceleration calculated from the specified acceleration/deceleration time. • When "0.0000" is set, it does not limit the acceleration.
JerkLimit	Jerk Limit Value	Sets the jerk limit value. Range: 0.0000, positive numbers from 0.0001 to 2147483647.0 U/s ³ ¹ • 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: Error (Not Started) (ACCError) 1: Maximum Acceleration/Deceleration (MaximumAcceleration)
OverrunOperation	Operation Setting at Overrun	Automatically adjusts the deceleration to stop at the target position. 1: Immediate Stop (ImmediateStop)
<u>AxisName.Md.</u>		

Variable/Structure name	Name	Details
CommandedAcceleration	Commanded Acceleration	Stores the acceleration specified by users. Unit: U/s^2 - When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it stores the specified acceleration/deceleration time. Unit: s - During axes group operation, stores "0.0" in Commanded Acceleration (<u>AxisName.Md.CommandedAcceleration</u>) of the configuration axis.
CommandedDeceleration	Commanded Deceleration	Stores the deceleration specified by users. Unit: U/s^2 - When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it is an illegal value. - During axes group operation, stores "0.0" in Commanded Deceleration (<u>AxisName.Md.CommandedDeceleration</u>) 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 Target Acceleration (<u>AxisName.Md.TargetAcceleration</u>) 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 Target Deceleration (<u>AxisName.Md.TargetDeceleration</u>) of the configuration axis.
SetAcceleration	Set Acceleration	- Stores the command output acceleration. It is the acceleration/ deceleration calculated from the difference of set velocity.*2 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 Commanded Jerk (<u>AxisName.Md.CommandedJerk</u>) of the configuration axis.
InVelocity	Target Velocity Reached	TRUE: Reached FALSE: Not reached During axes group operation, stores FALSE in Target Velocity Reached (<u>AxisName.Md.InVelocity</u>) of the configuration axis.
AutoDeceleration	Automatically Decelerating	TRUE: During auto deceleration FALSE: Not during auto deceleration - TRUE is stored while the auto deceleration processing is executed. - When the multiple start is executed, TRUE is set while the auto deceleration processing is executed during the last positioning point execution. - FALSE is set when the control change is performed. - During axes group operation, stores FALSE in Automatically Decelerating (<u>AxisName.Md.AutoDeceleration</u>) of the configuration axis.
<u>AxisGroupName.Md.</u>		
CommandedAcceleration	Commanded Acceleration	Stores the acceleration specified by users. Unit: U/s^2 When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is set in the acceleration/deceleration method, it stores the acceleration/ deceleration time.
CommandedDeceleration	Commanded Deceleration	Stores the deceleration specified by users. Unit: U/s^2 When "1: Acceleration/deceleration time-fixed method (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 Acceleration	- Stores the command output acceleration. It is the acceleration/ deceleration calculated from the difference of set velocity.*2 - Unit: U/s² - 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/s³
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 multiple start is executed, TRUE is set while the auto deceleration processing is executed during the last positioning point execution. - FALSE is set when the control change is performed.

*1 When a real number less than 0.0001 is set, the value is imported as 0.0000.

*2 The Values to be stored include the error, because the floating point type error occurs.

Settings of motion FB

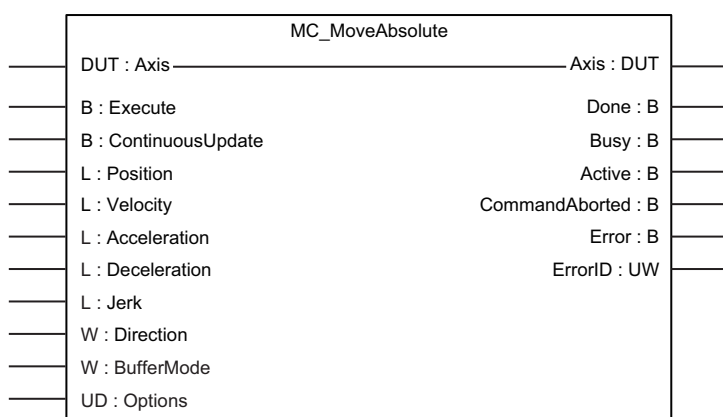
The acceleration/deceleration method can be selected in Options (Options) of the motion FB.

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: Acceleration/deceleration specification method (mcAccDec) 1: Acceleration/deceleration time-fixed method (mcFixedTime) For details, refer to the following.  Page 348 Acceleration/deceleration Processing Function
3 to 15	Empty (Specify "0") ^{*1}
16 to 31	The function differs depending on the FB.

^{*1} If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

Whether a method can be selected or not differs depending on the FB. For details, refer to the specifications of each FB.



Input variables to use

Variable/ Structure name	Name	Details
Velocity	Velocity	Specifies the commanded velocity in the FB. Unit: For details, refer to the following.  Page 79 Technical Units Range: For details, refer to the following.  Page 89 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: Acceleration/deceleration specification method (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: Acceleration/deceleration time-fixed method (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: Acceleration/deceleration specification method (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: Acceleration/deceleration time-fixed method (mcFixedTime)" Not used.
Jerk	Jerk/Jerk ratio	Specifies the jerk in the FB. • When the acceleration/deceleration method is "0: Acceleration/deceleration specification method (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: Acceleration/deceleration time-fixed method (mcFixedTime)" Not used.
Options	Options	Specifies the option information in the FB.

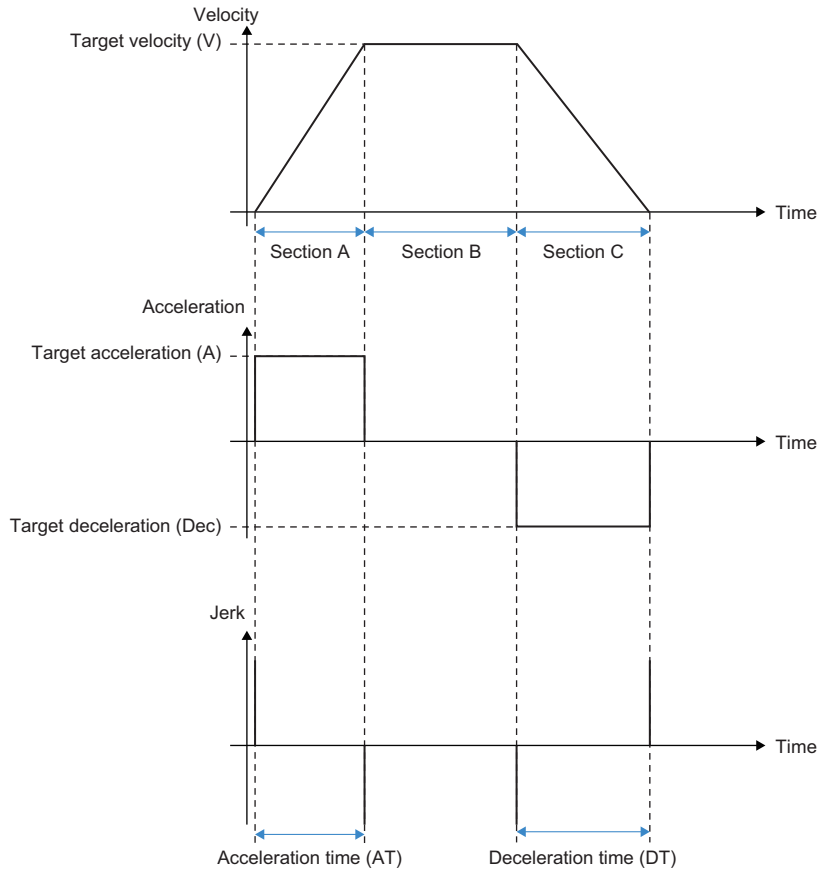
^{*1} Operation varies according to Operation Selection at Start Acceleration/Deceleration 0 (AxisName.Pr.AccelerationZeroBehavior) at start. A change is not accepted during a acceleration change and a deceleration change.

Acceleration/deceleration method

Acceleration/deceleration specification method

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in the Acceleration/deceleration method setting (Options (Options) bit0 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	
			Accelera tion	Decelera tion
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.	×	○

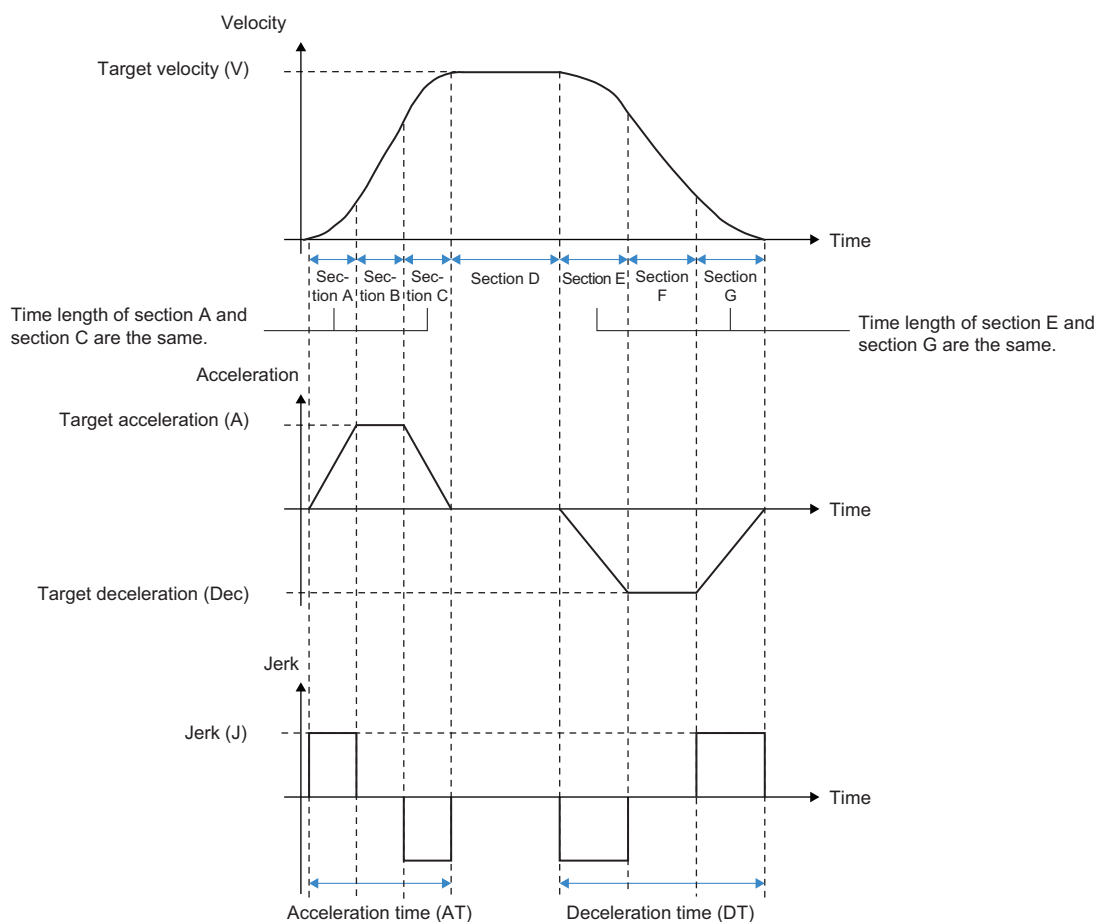
• Acceleration/deceleration time parameter calculation

○: Operation possible, ×: Operation not possible

Type	Item	Abbreviation	Description	Calculation formula	Operation	
					Accelera tion	Decelera tion
Specified value	Target velocity	V	—	—	○	○
	Target acceleration	A	—	—	○	×
	Target deceleration	Dec	—	—	×	○
Calculated value	Acceleration section time	AT	Time from the velocity 0.0 to the target velocity	$V \div A^{*1}$	○	×
	Deceleration section time	DT	Time to decelerate from the target velocity to the velocity 0.0	$V \div Dec^{*1}$	×	○

*1 This is the calculation formula when unit of V is [U/s]. When other than [U/s], calculate by converting into [U/s].

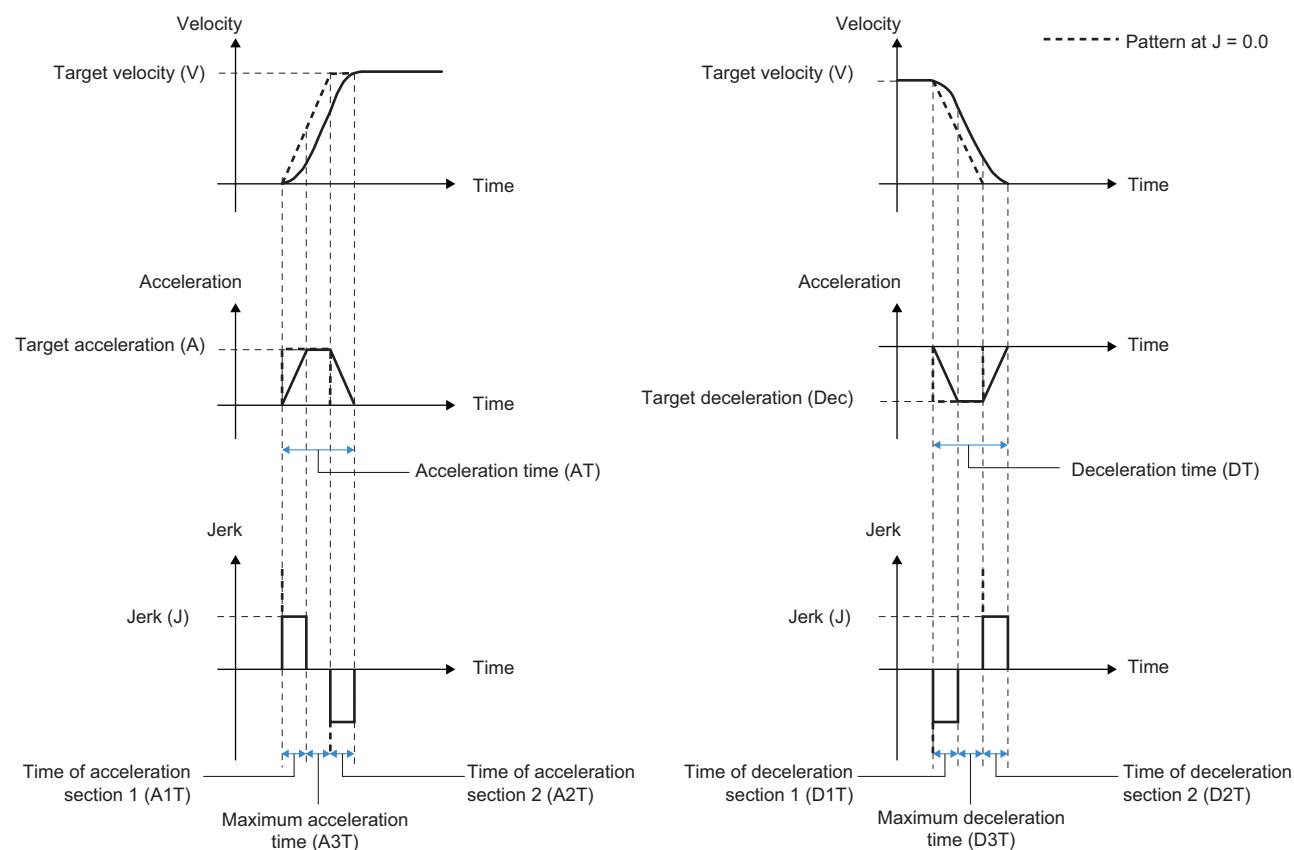
■ Jerk acceleration/deceleration



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Accelera tion	Decelera tion
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	$A \div J$	○	×
	Acceleration section 2 time	A2T	Time obtained by dividing the jerk applying time of the acceleration section by 2	$A \div J$	○	×
	Maximum acceleration section time	A3T	Time of the maximum acceleration section.	$(V \div A) - (A \div J)^2$	○	×
	Acceleration time ^{*1}	AT	Time from velocity 0.0 to the target velocity	$A1T + A2T + A3T = (V \div A) + (A \div J)^2$	○	×
	Deceleration section 1 time	D1T	Time obtained by dividing the jerk applying time of the deceleration section by 2	$Dec \div J$	×	○
	Deceleration section 2 time	D2T	Time obtained by dividing the jerk applying time of the deceleration section by 2	$Dec \div J$	×	○
	Maximum deceleration section time	D3T	Time of the maximum deceleration section.	$(V \div Dec) - (Dec \div J)^2$	×	○
	Deceleration time ^{*1}	DT	Time to decelerate from the target velocity to velocity 0.0	$D1T + D2T + D3T = (V \div Dec) + (Dec \div J)^2$	×	○

*1 Acceleration time and deceleration time may be limited. For details, refer to the following.

☞ Page 365 Limit of acceleration time/deceleration time

*2 This is the calculation formula when unit of V is [m/s]. When other than [m/s], calculate by converting into [m/s].

*3 Target acceleration/target deceleration may be adjusted by acceleration/deceleration waveform adjustment. For details, refer to the following.

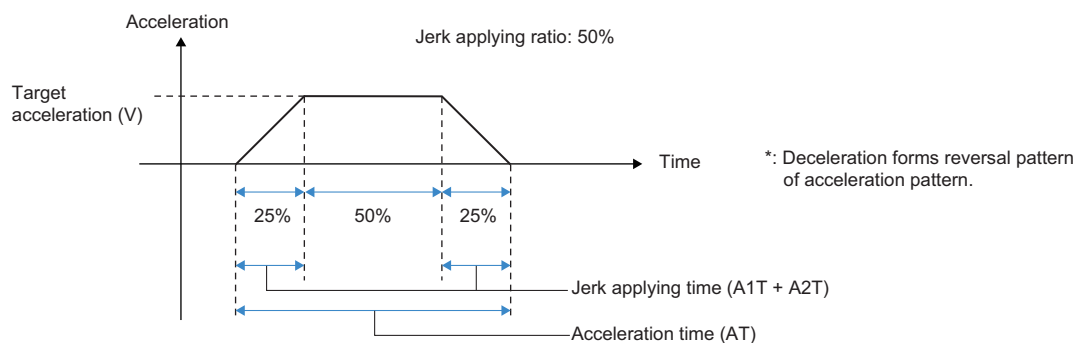
☞ Page 361 Acceleration/deceleration waveform adjustment when specifying jerk

- Jerk calculation

When the velocity and the acceleration of operation are fixed, the jerk can be calculated with the following formula by specifying the jerk applying ratio.

$$\text{Jerk (J)} = \frac{(2 - \text{Jerk applying ratio}) \times (\text{the square of acceleration (A)})}{\text{Jerk applying ratio} \times \text{Speed (V)}}$$

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.

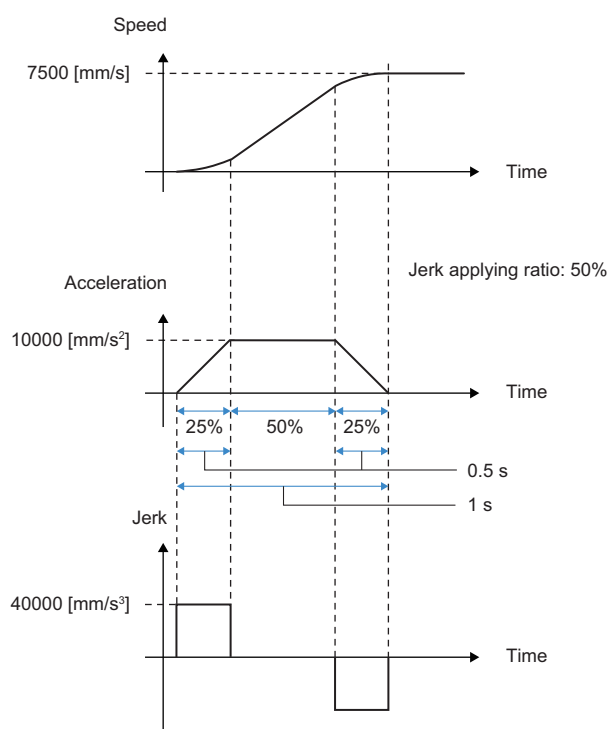
The jerk when the velocity is 7500 [mm/s], the acceleration is 10000 [mm/s²], and the jerk applying ratio is 0.5 (50%) can be calculated with the following formula.

$$\text{Jerk (J)} = \frac{(2 - 0.5) \times 10000^2}{0.5 \times 7500} = 40000 \text{ [mm/s}^3\text{]}$$

The acceleration time can be calculated when the velocity, the acceleration, and the jerk are fixed. For details, refer to the following.

☞ Page 355 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 velocity 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 velocity may be reached before the target acceleration is reached.

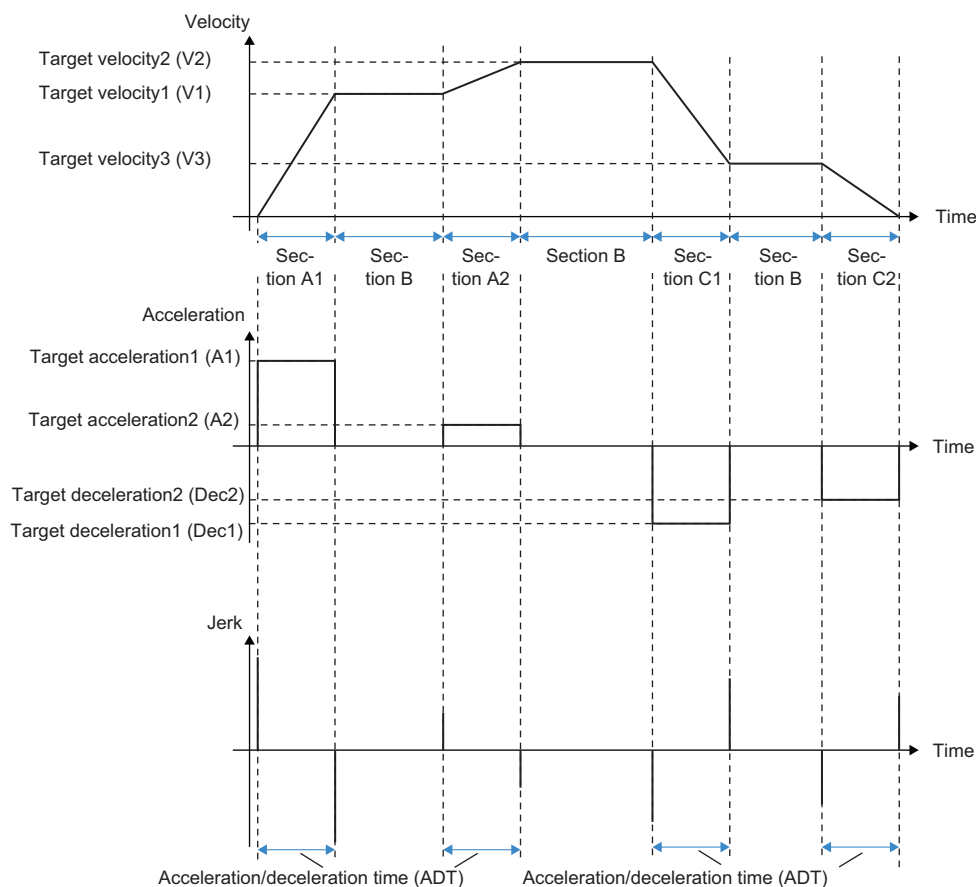
For details, refer to the following.

 Page 361 Acceleration/deceleration waveform adjustment when specifying jerk

Acceleration/deceleration time-fixed method

When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in the Acceleration/deceleration method setting (Options (Options) bit0 to 2) of the FB, the acceleration/deceleration time can be set in Acceleration (Acceleration), Deceleration (Deceleration), and Jerk (Jerk) are not used.

Calculates acceleration and deceleration from the acceleration/deceleration time at acceleration/deceleration. When a value smaller than one operation cycle other than 0.0000 is set as the acceleration/deceleration time, the target velocity is reached within one operation cycle.



○: Operation possible, ×: Operation not possible

Section		Process description	Operation	
			Accelera tion	Decelera tion
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 parameter calculation

○: Operation possible, ×: Operation impossible

Section	Item	Abbreviation	Description	Calculation formula	Operation	
					Acceleration	Deceleration
Specified value	Target velocity	V	—	—	○	○
	Acceleration/deceleration time ^{*4}	ADT	—	—	○	○
Calculated value	Current velocity	Vnow	The set velocity at target acceleration and target deceleration calculation	—	○	○
	Target acceleration ^{*1}	A	Acceleration from the current velocity to the target velocity ^{*2}	$(V - Vnow) \div ADT^{*3}$	○	×
	Target deceleration ^{*1}	Dec	Deceleration to decelerate from the current velocity to the target velocity ^{*2}	$(V - Vnow) \div ADT^{*3}$	×	○

*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 364 Acceleration limit value/deceleration limit value

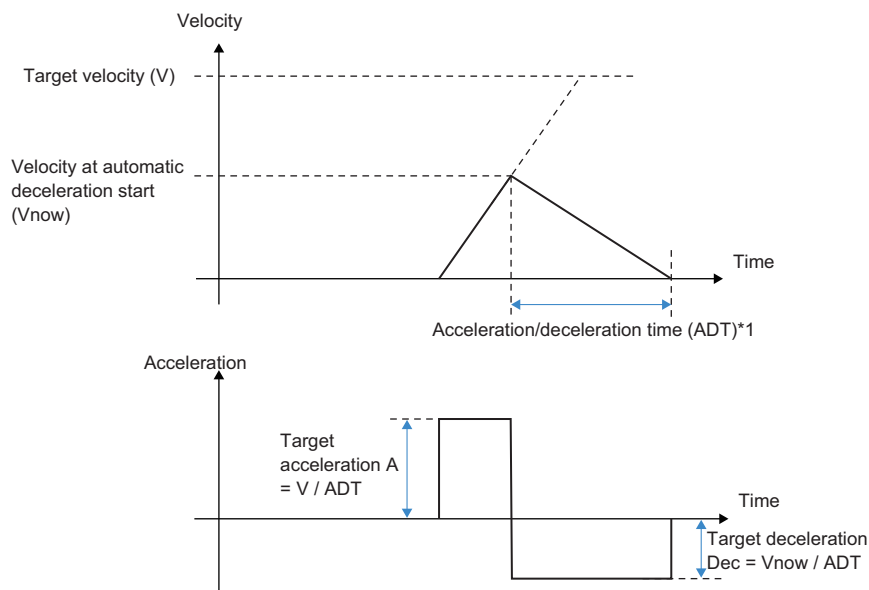
*2 The target velocity will be 0 at stop.

*3 This is the calculation formula when unit of V is [s]. When other than [U/s], calculate by converting into [U/s].

*4 The deceleration time at automatic deceleration may be longer than the specified acceleration/deceleration time (ADT) due to the compensation of the remaining distance.

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.



Acceleration/deceleration waveform adjustment when specifying jerk

When the jerk acceleration/deceleration ($J \neq 0.0$) 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.

$$\text{For acceleration: } V \geq \frac{A^2}{J}, \quad \text{For deceleration: } V \geq \frac{Dec^2}{J}$$

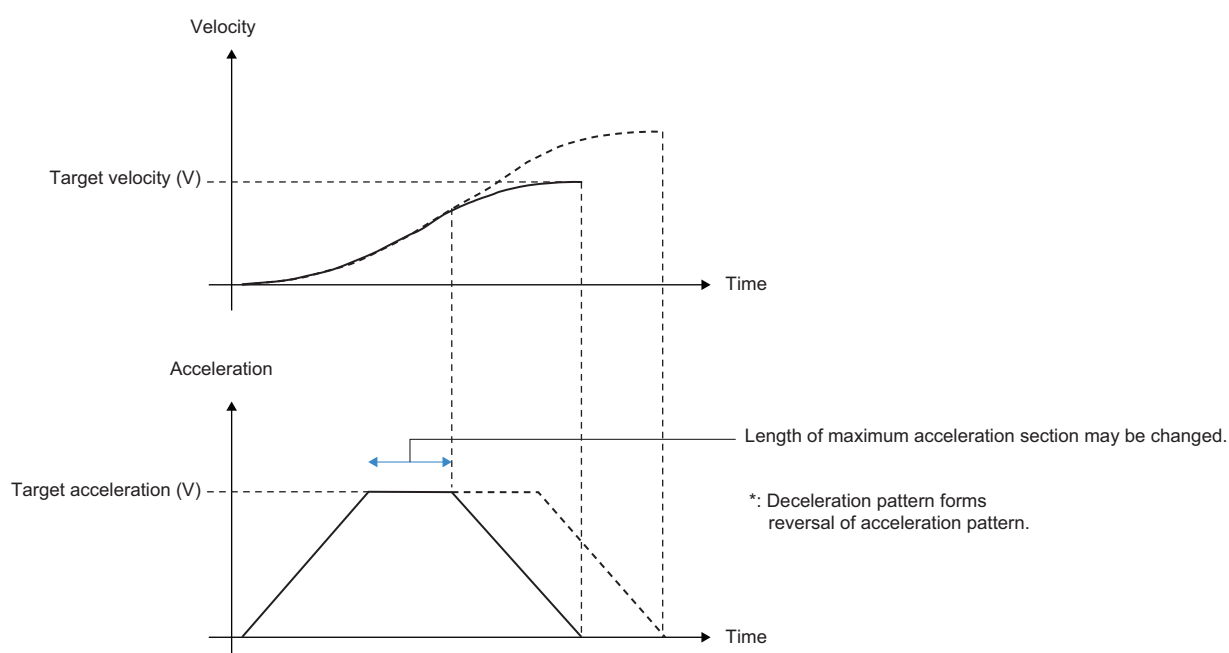
When the condition is satisfied

The target acceleration (deceleration) can be reached.

The maximum acceleration section time and the maximum deceleration section time are adjusted by the velocity, the acceleration, the deceleration, and the jerk, and the waveform changes to reach the target velocity at the end of acceleration.

For the acceleration time and the deceleration time, refer to the following.

☞ Page 354 Acceleration/deceleration method

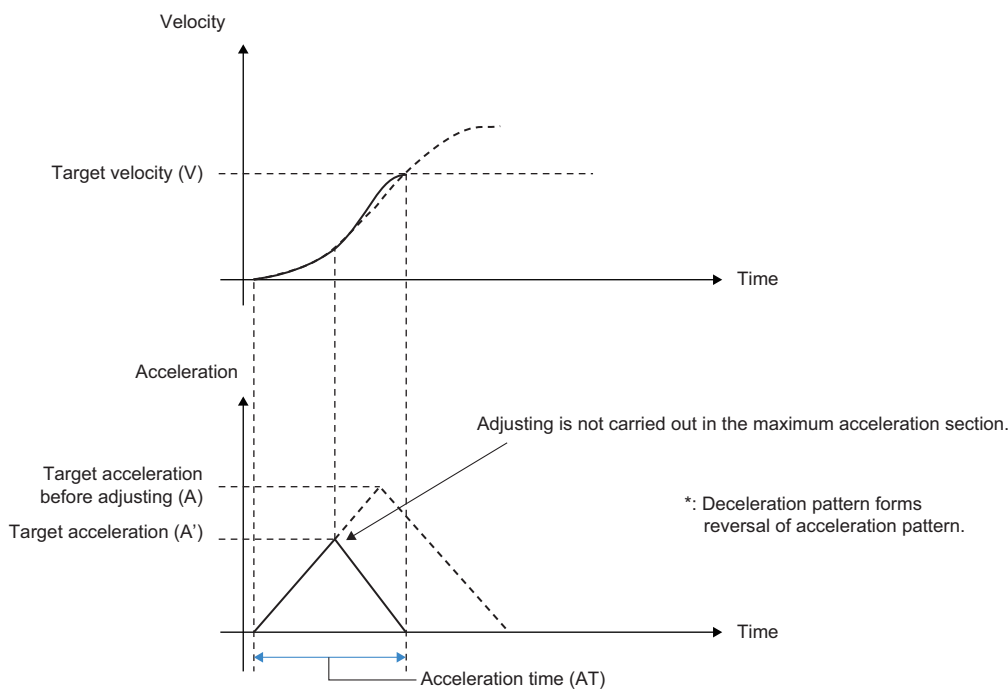


When the condition is not satisfied

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	Abbrevia tion	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.

$$A' = \sqrt{V \times J} \quad , \quad Dec' = \sqrt{V \times J}$$

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.

$$\text{Acceleration time (AT)} = (V \div A') + (A' \div J)$$

$$\text{Deceleration time (DT)} = (V \div Dec') + (Dec' \div J)$$

Operation when specifying acceleration/deceleration 0

When "0.0" is specified for the acceleration/deceleration, the operation differs at startup and the rest.

When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in Acceleration/deceleration method setting (Options (Options) bit0 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

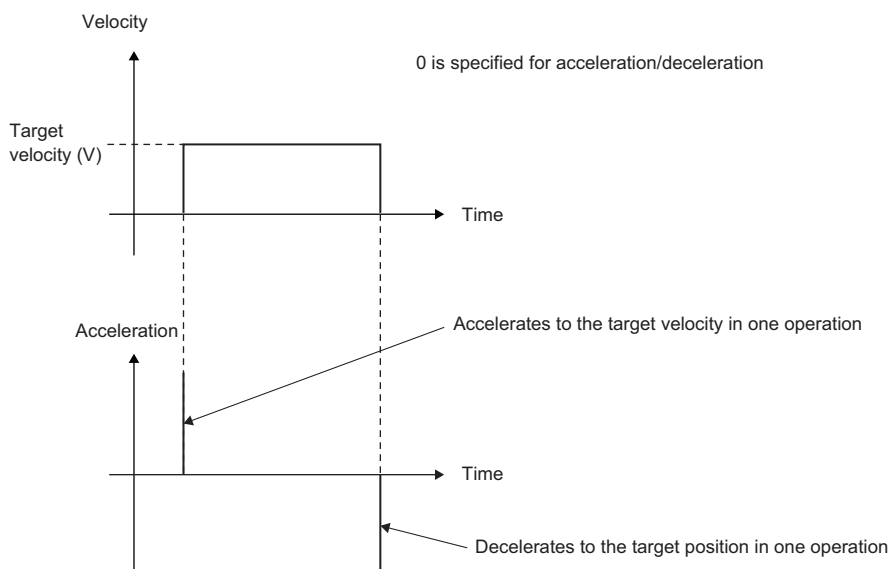
Select the operation when "0.0" is specified for the acceleration and the deceleration in Operation Selection at Start Acceleration/Deceleration 0 (AxisName.Pr.AccelerationZeroBehavior). To operate by the vector velocity at interpolation control, follow Operation Selection at Start Acceleration/Deceleration 0 (AxesGroupName.Pr.AccelerationZeroBehavior).

■When selecting "-1: Error (Not Started) (ACCError)"

The error "Acceleration/Deceleration 0 Specified Operation Error at Start" (error code: 1A0CH) occurs, and the axis does not start.

■When selecting "1: Maximum Acceleration/Deceleration (MaximumAcceleration)"

If "0.0" is specified for the acceleration or the deceleration, an error will not occur. For acceleration, even if the jerk is set, trapezoidal acceleration/deceleration is operated and the acceleration/deceleration is performed in one operation cycle. In these cases, acceleration/deceleration is performed exceeding the acceleration limit value and deceleration limit value.



Precautions

Pay full attention when setting "1: Maximum Acceleration/Deceleration (MaximumAcceleration)", because operation is rapid motion.

Point

Operation when specifying acceleration/deceleration 0 is applied to acceleration/deceleration after override.

Specifying 0.0 other than at start

■At the acceleration change/At the deceleration change

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 (Forced Stop)/MC_GroupStop (Group Forced Stop) and the deceleration at stop setting, when "0.0" is specified for the deceleration, the axis immediately stops without an acceleration/deceleration.

Acceleration limit value/deceleration limit value

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bit0 to 2) of the FB, acceleration/deceleration is limited by the acceleration/deceleration limit value.

When "1: Acceleration/deceleration time-fixed method (mcFixedTime)" is selected in Options of the FB, it is not limited. When "0.0" is specified for the acceleration/deceleration limit value, it is not limited as well.

Specify acceleration limit value and deceleration limit value in Acceleration Limit Value (AxisName.Pr.AccelerationLimit) and Deceleration Limit Value (AxisName.Pr.DecelerationLimit). To operate by the vector velocity at interpolation control, follow Acceleration Limit Value (AxesGroupName.Pr.AccelerationLimit) and Deceleration Limit Value (AxesGroupName.Pr.DecelerationLimit).

Operation

This operation is for the FB which has Acceleration (Acceleration) and Deceleration (Deceleration) of input variables. Acceleration/deceleration is limited at the following timing.

■At start

If exceeding the acceleration limit value or the deceleration limit value, 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 exceeding 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 162 Precautions

■At stop processing

- When decelerating stop by MC_Stop (Forced Stop) / MC_GroupStop (Group Forced Stop)
When exceeding the deceleration limit value, the error "Deceleration Limit Value Over" (error code: 1A39H) occurs and the axis stops according to Stop Selection at Stop Cause Occurrence (AxisName(AxesGroupName).Pr.StopMode_General).
- When decelerating stop by Deceleration at Stop (AxisName(AxesGroupName).Pr.StopMode_Deceleration)
When exceeding the deceleration limit value, the warning "Deceleration Limit Value Over Warning" (warning code: 0D07H) occurs and the target deceleration becomes the deceleration limit value.

Jerk limit value

When the jerk acceleration/deceleration is ($J \neq 0.0$), Jerk is limited by a value specified in Jerk limit value (JerkLimit). When "0.0" is specified for the jerk limit value, the jerk is not limited.

Specify the jerk limit value in Jerk Limit Value (AxisName.Pr.JerkLimit). To operate by the vector velocity at interpolation control, follow Jerk Limit Value (AxesGroupName.Pr.JerkLimit).

Operation

This operation is for the FB which has Jerk (Jerk) of input variables.

Jerk is limited at the following timing.

■At start

If the specified jerk at start 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 162 Precautions

Limit of acceleration time/deceleration time

The acceleration time and the deceleration time are limited by 8400.0 [s].

When "0: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bit0 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 354 Acceleration/deceleration specification method

Operation

■At start

See Acceleration/deceleration method setting (Options (Options) bit0 to 2) as follow.

[When "0: Acceleration/deceleration specification method (mcAccDec)"]

If the acceleration time or the deceleration time exceeds 8400.0 [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 start.

[When "1: Acceleration/deceleration time-fixed method (mcFixedTime)"]

When acceleration time and deceleration time exceeding 8400.0 [s] are specified, the error "Out of Acceleration/Deceleration Time Range" (error code: 1A0DH) occurs, and the axis will not start.

■At control change

Limits time from the issuance of the control change instruction until Acceleration/deceleration method setting (Options (Options) bit0 to 2) as follow.

[When "1: Acceleration/deceleration time-fixed method (mcFixedTime)"]

Carrying out a velocity change, an acceleration change, or a deceleration change may exceed 8400.0 [s]. 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 operates as below.

- In the case of warning "Acceleration Time Limit Over Warning" (warning code: 0D04H), changes to the velocity and deceleration are not accepted. It keeps operating with the previous velocity and deceleration.
- In the case of warning "Deceleration Time Limit Over Warning" (warning code: 0D05H), changes to the velocity and deceleration are not accepted. It keeps operating with the previous velocity and deceleration.

[When "1: Acceleration/deceleration time-fixed method (mcFixedTime)"]

When the acceleration/deceleration time change exceeding 8400.0 [s] is performed, the error "Out of Acceleration/Deceleration Time Range Warning" (error code: 0D19H) occurs, and the axis will not accept the acceleration/deceleration time change.

When the velocity change is performed at the same time, the axis operates with previous acceleration time and deceleration time. If the velocity change is not performed at the same time, the axis keeps the current acceleration/deceleration operation during accelerating/decelerating.

■When the acceleration time/deceleration time is within one operation cycle

When the acceleration time or the deceleration time is less than one operation cycle due to the specified velocity, acceleration, deceleration, and jerk, the velocity reaches the target velocity within one operation cycle regardless of the jerk.

Automatic deceleration

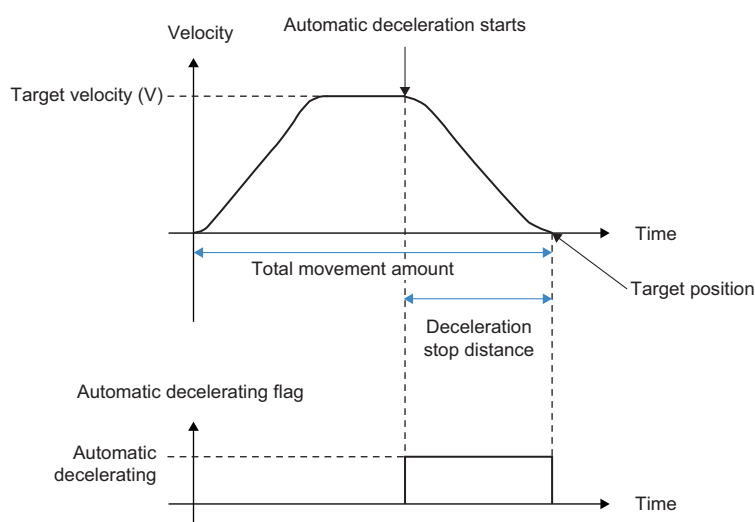
Decelerating to a velocity of "0.0" to stop at the specified target position is called automatic deceleration.

During automatic deceleration, Automatically Decelerating (AxisName.Md.AutoDeceleration) is TRUE.

When automatic deceleration is performed, the deceleration may go ahead or behind the target deceleration. Therefore, Set Acceleration (AxisName.Md.SetAcceleration) may exceed Target Deceleration (AxisName.Md.TargetDeceleration).

Besides, the current velocity may 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, Set Acceleration (AxisName.Md.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.

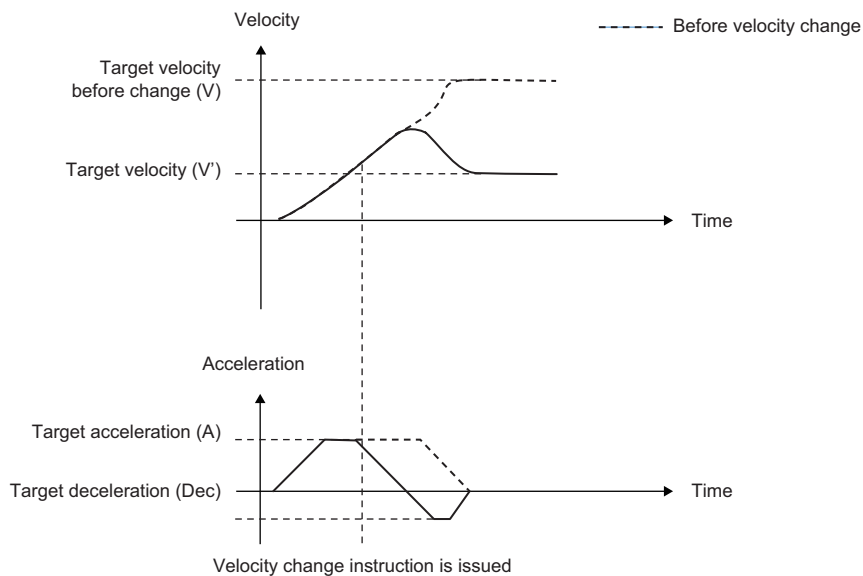
Deceleration stop distance > Total movement amount - Cumulative movement amount - Next Δ movement amount

- 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 ($J \neq 0.0$), 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.



Term	Description
Velocity change	Indicates the following operations • For retrigger/continuous update the velocity input variables • For executing the velocity override factor change
Acceleration change	Indicates the following operations • For retrigger/continuous update the acceleration input variables • For executing the acceleration override factor change
Deceleration change	Indicates the following operations • For retrigger/continuous update the deceleration input variables • For executing the acceleration override factor change

The following shows the specific operation of the jerk acceleration/deceleration during control change.

Target position change

The specific acceleration/deceleration operation of jerk acceleration/deceleration is shown below. For the basic control description, refer to the following.

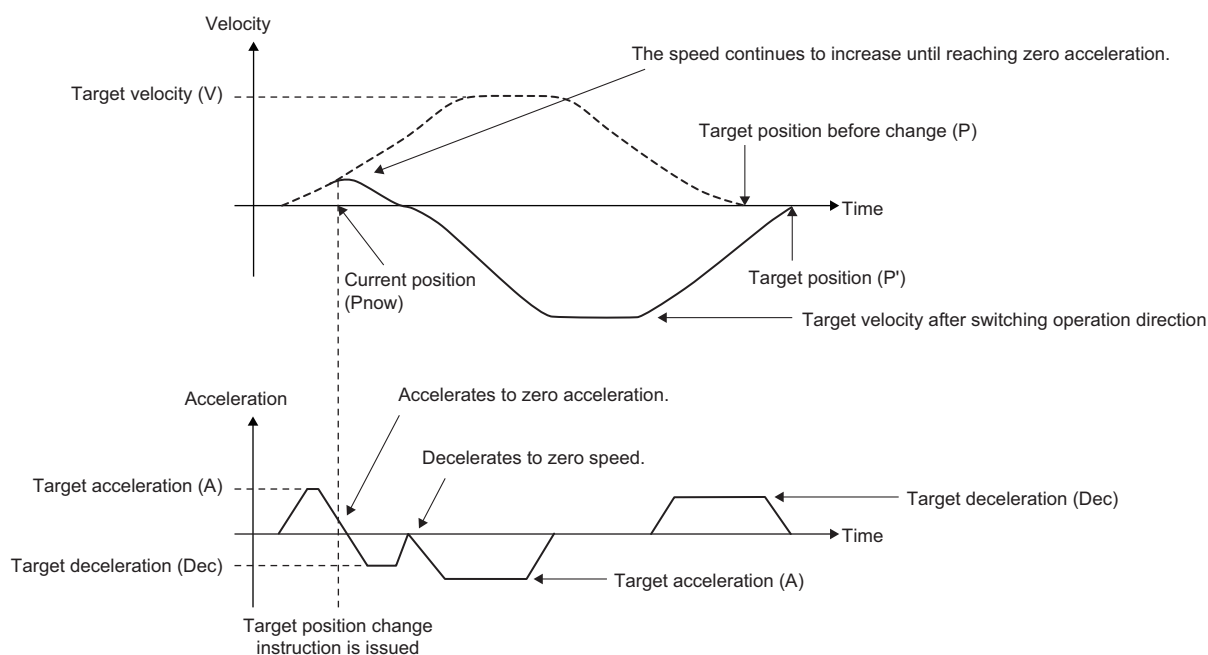
Page 434 Target position/movement distance change

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 velocity 0. When the velocity reaches 0, the operation direction is reversed and acceleration/deceleration is performed to the target position.

■For the acceleration/deceleration specification method



Velocity change

The specific acceleration/deceleration operation of jerk acceleration/deceleration is shown below. For the basic control description, refer to the following.

☞ Page 437 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.

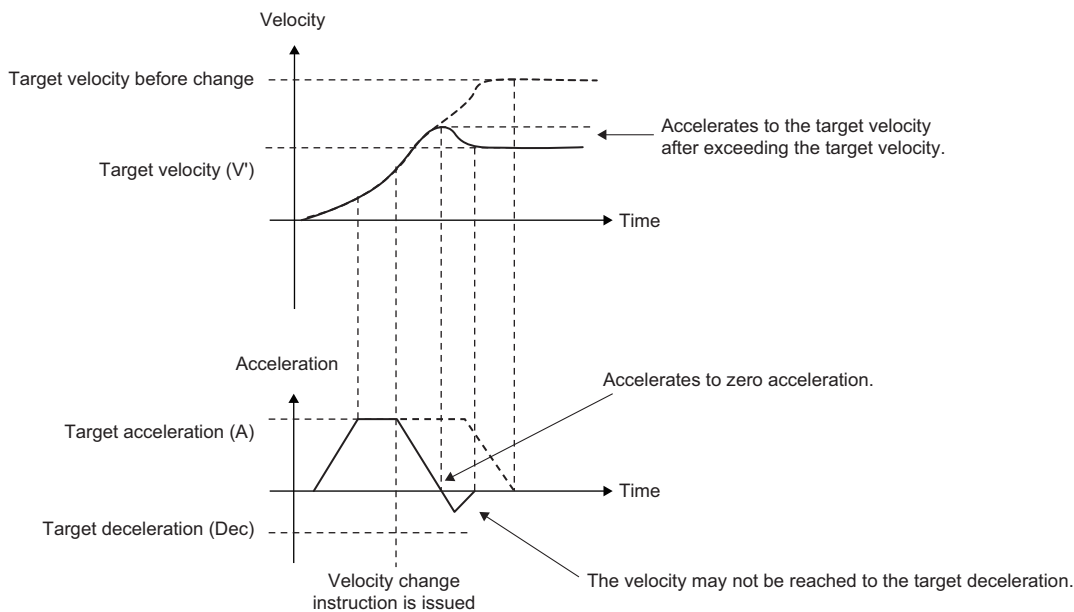
☞ Page 361 Acceleration/deceleration waveform adjustment when specifying jerk

■When exceeding the target acceleration

If velocity is changed to a value smaller than the target velocity before change during acceleration, the target velocity may be exceeded. The axis accelerates to acceleration 0 after the velocity change instruction is issued but 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: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bit0 to 2) of the FB, acceleration change is performed.

When selecting "1: Acceleration/deceleration time-fixed method (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 361 Acceleration/deceleration waveform adjustment when specifying jerk

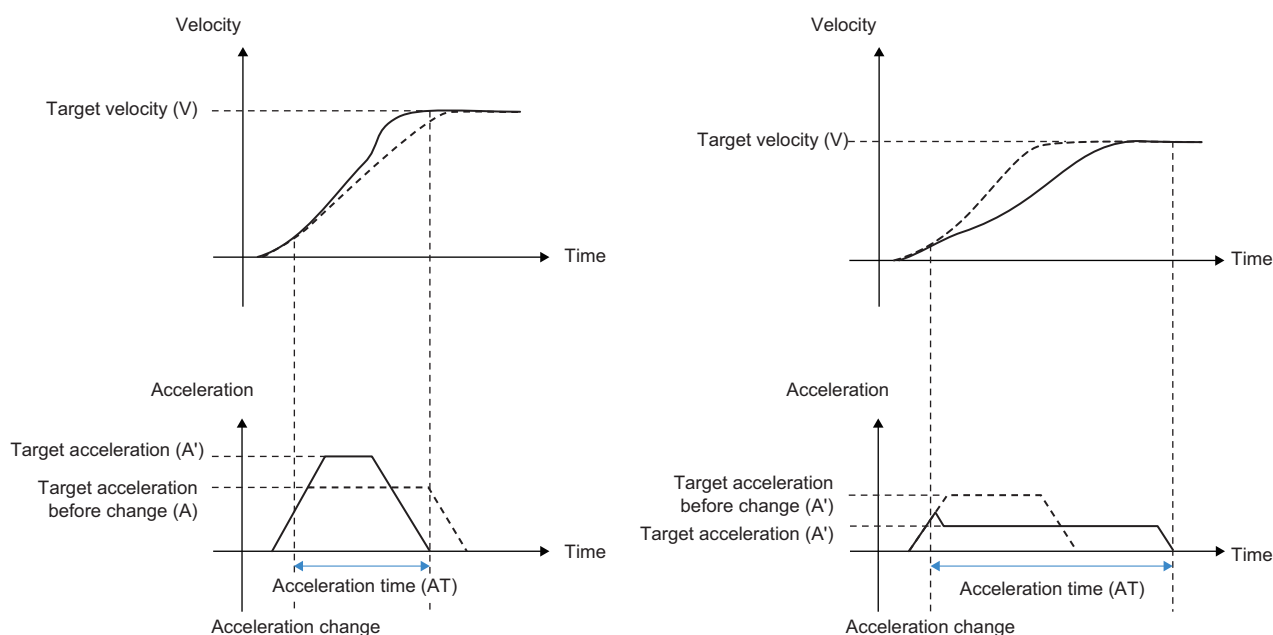
Also, when velocity change and acceleration change are simultaneously performed, the target acceleration may not be reached because the target velocity is given priority.

■Acceleration change

The acceleration change pattern can be classified based on the operation status when acceleration change is performed.

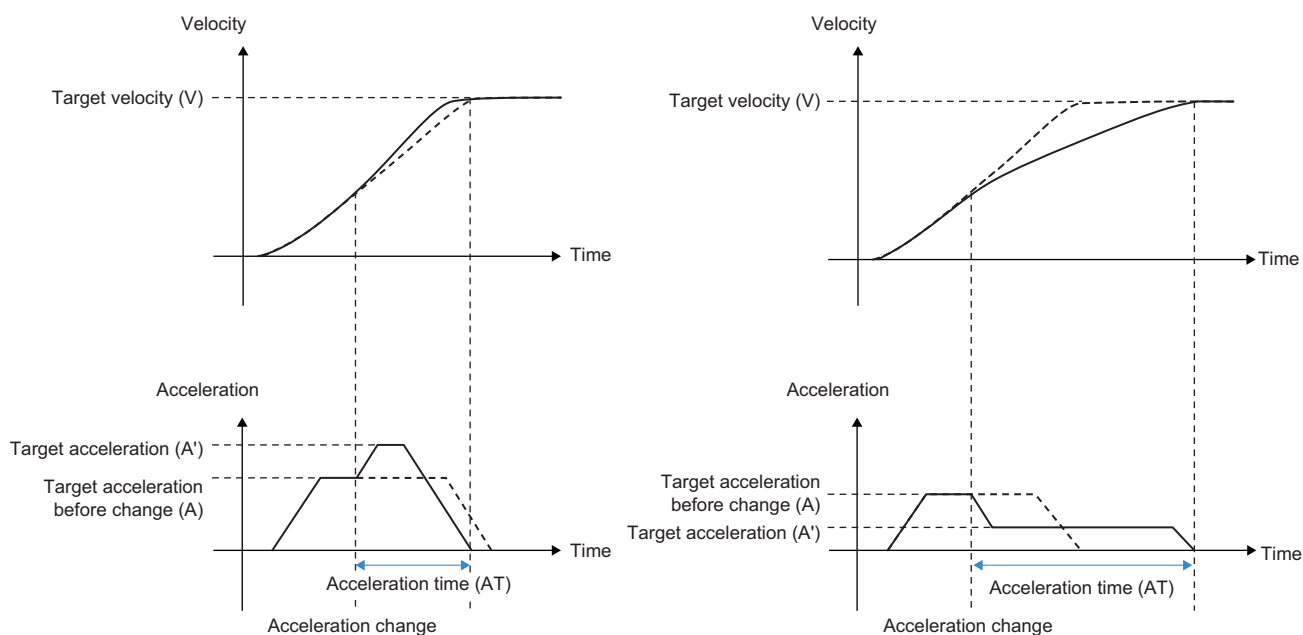
[When executing acceleration change in the acceleration section 1]

Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the velocity and the acceleration immediately before the acceleration change.



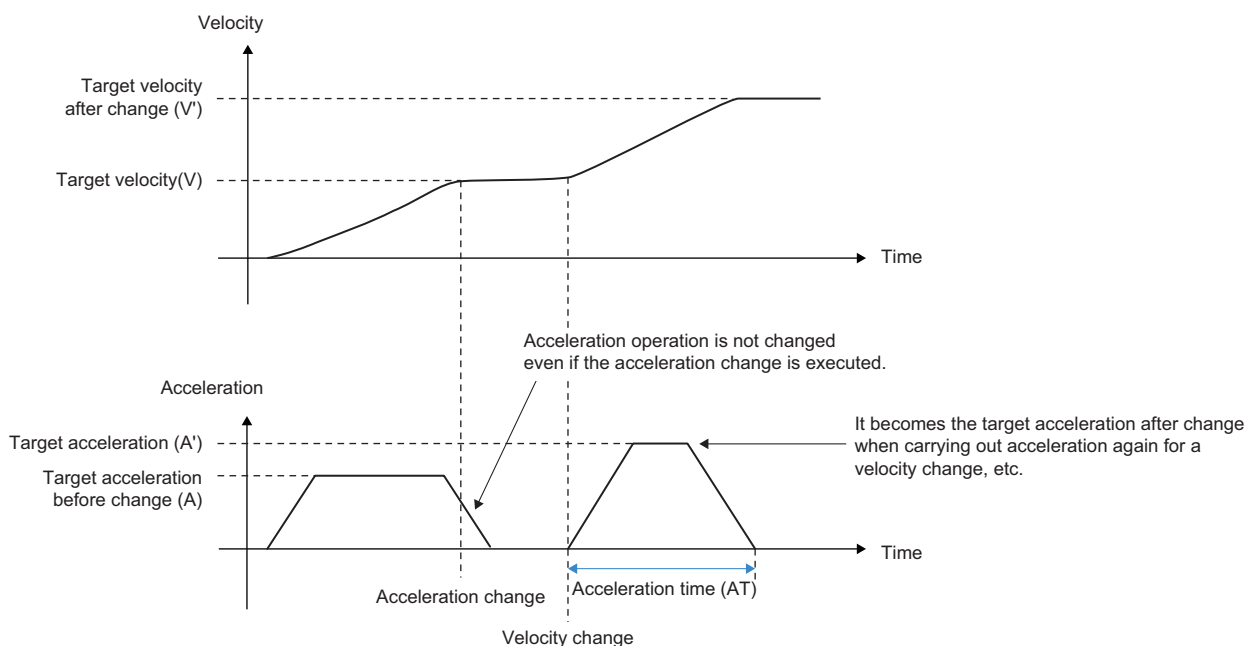
[When executing acceleration change in the maximum acceleration section]

Acceleration is increased or decreased to the target acceleration after change by using jerk, and taking over the velocity and the acceleration immediately before the acceleration change.



[When executing acceleration change in the acceleration section 2 or during fixed-speed, deceleration, 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: Acceleration/deceleration specification method (mcAccDec)" is selected in Acceleration/deceleration method setting (Options (Options) bit0 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 Operation Setting at Overrun (AxisName(AxesGroupName).Pr.OverrunOperation).

[When executing deceleration change in the acceleration section or fixed-speed section]

The deceleration change is accepted, however the operation during execution does not change. When deceleration is performed, the axis decelerates with the deceleration after change.

[When executing deceleration change in deceleration other than the automatic deceleration]

The basic operation is the same as the acceleration change and the acceleration/deceleration time change. Refer to the following.

☞ Page 370 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.

Acceleration/deceleration method and multiple start

This section describes the acceleration/deceleration operation specific to the acceleration/deceleration method. For the basic operation of the buffer mode, refer to the following.

☞ Page 134 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

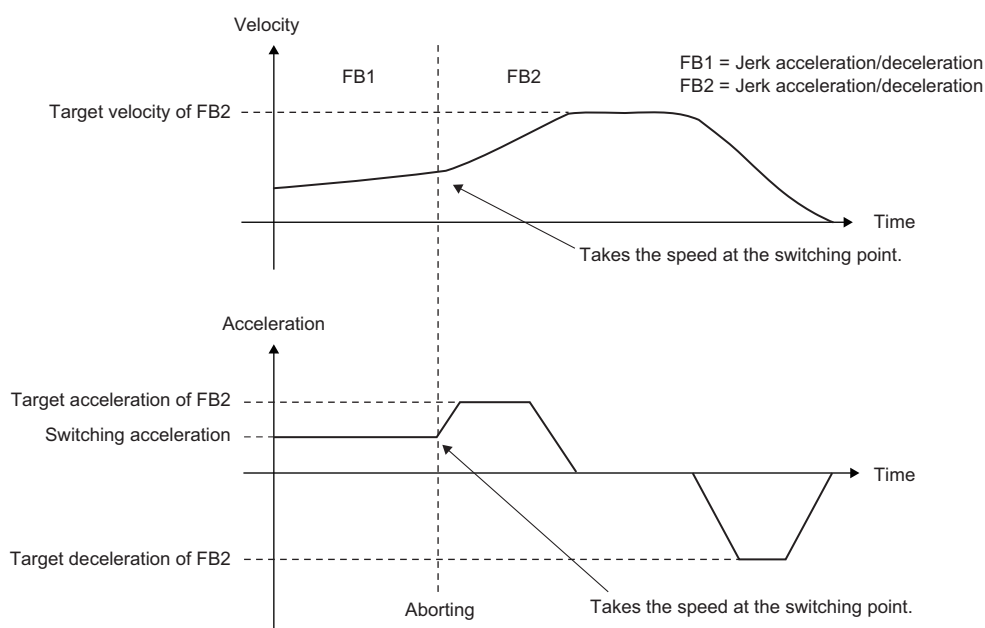
The error "Acceleration/Deceleration Method Mismatched" (error code: 1A0EH) occurs and the axis stops. Specify the same acceleration/deceleration method in the FBs.

■When the acceleration/deceleration methods are the same between the on-going FB and the next FB

- When switching "from the jerk acceleration/deceleration to the another jerk acceleration/deceleration"

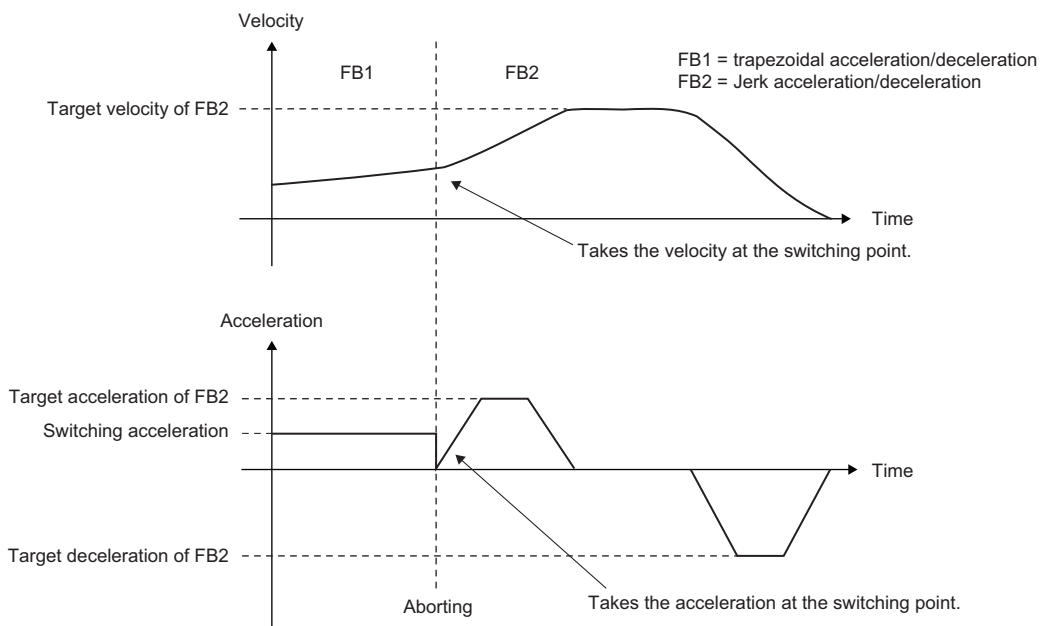
The axis accelerates/decelerates taking over the velocity and the acceleration (deceleration) at the switching point.

Also, after reaching the switching point during acceleration (deceleration), the on-going velocity waveform continues in case all settings of the target velocity, the acceleration, the deceleration, and the jerk are the same between the on-going FB and the next FB. If there is a different setting in any of those, the velocity change is performed to the target velocity of the next FB.



- Switching from other than "the jerk acceleration/deceleration to the another jerk acceleration/deceleration"
In the following case, the acceleration (deceleration) is not taken over at the switching point.

-
- Switching from the jerk acceleration/deceleration to the trapezoidal acceleration/deceleration
 - Switching from the trapezoidal acceleration/deceleration to the another trapezoidal acceleration/deceleration
 - Switching from the trapezoidal acceleration/deceleration to the jerk acceleration/deceleration
-



Precautions

When the acceleration calculated from the acceleration and the acceleration time after acceleration override exceeds the range of 0 or 0.0001 to 2,147,483,647.0 [U/s²], the warning "Out of Acceleration Range Clamping Warning" (warning code: 0D35H) occurs, and the acceleration will be as follows.

- When acceleration after acceleration override > 2,147,483,647.0 [U/s²]
The acceleration will be 2,147,483,647.0 [U/s²].
- When 0 < acceleration after acceleration override < 0.0001
The acceleration will be 0. For operation, refer to the following.

☞ Page 363 Operation when specifying acceleration/deceleration 0

When the deceleration calculated from the deceleration and the deceleration time after acceleration override exceeds the range of 0 or 0.0001 to 2,147,483,647.0 [U/s²], the warning "Out of Deceleration Range Clamping Warning" (warning code: 0D36H) occurs, and the deceleration will be as follows.

- When deceleration after acceleration override > 2,147,483,647.0 [U/s²]
The deceleration clamps at 2,147,483,647.0 [U/s²].
- When 0 < deceleration after acceleration override < 0.0001
The deceleration will be 0. For operation, refer to the following.

☞ Page 363 Operation when specifying acceleration/deceleration 0

When the acceleration time (deceleration time) after acceleration override exceeds 8400.0 [s], the warning "Out of Acceleration/Deceleration Time Range Clamping Warning" (warning code: 0D37H) occurs and the acceleration time (deceleration time) will be 8400.0 [s].

Restrictions

To perform floating-point operation, the lower limit value of commanded acceleration, commanded deceleration, and commanded jerk are limited by the following restrictions.

- Lower limit restrictions of acceleration/deceleration

The set velocity may not change as information error occurs if the values of calculation cycle converted velocity and acceleration differ greatly. Therefore, the values of velocity and acceleration need to be set staying within a valid digit (approximately 15 digits) of a number of floating-points (64 bit). When the calculation cycle converted acceleration is smaller than the set velocity, the warning "Out of Operation Cycle Converted Acceleration Range Warning" (warning code: 0D38H) occurs. Check the set velocity. If it is not changed, either increasing the acceleration and deceleration or extending the operation cycle is needed.

Ex.

Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) HFD000300 [/ms]

When control change is performed with the following settings during fixed-speed by operation cycle 0.125 [ms] and velocity 2499999999.9

Velocity: 2500000000.0
Acceleration: 62.0

Acceleration/deceleration specification method (Trapezoidal acceleration/deceleration)

Calculation cycle converted velocity upper limit value = $2500000000.0 \text{ [pulse/ms]} \times 0.125 \text{ [ms]} = 312500000.0 \text{ [pulse]}$

Calculation cycle converted acceleration = $62.0 \text{ [pulse/s}^2\text{]} \times (0.125 \text{ [ms]} \div 1000)^2 = 9.6875\text{E-}07 \text{ [pulse]}$

In above case, the warning "Out of Operation Cycle Converted Acceleration Range Warning" (warning code: 0D38H) occurs because the calculation cycle converted acceleration lower limit value is $1\text{E-}06 \text{ [pulse]}$.

- Lower limit restriction of jerk

The set velocity or set acceleration may not change as information error occurs if the value of jerk to the values of calculation cycle converted velocity and acceleration differ greatly. Therefore, the value of jerk needs to be set staying within a valid digit (approximately 15 digits) of a number of floating-points (64 bit). When the calculation cycle converted jerk is smaller than the velocity and the acceleration, the warning "Out of Operation Cycle Converted Jerk Range Warning" (warning code: 0D3AH) occurs. Check the set velocity or set acceleration. If they are not changed, either increasing the jerk or extending the operation cycle is needed.

Ex.

Velocity Command Unit (AxisName(AxesGroupName).Pr.Unit_Velocity) HFD000300 [/ms]

When started with the following settings by operation cycle 0.125 [ms]

Velocity: 100000.0
Acceleration: 30000.0
Deceleration: 30000.0
Jerk: 20.0

The acceleration/deceleration method (jerk acceleration/deceleration)

Calculation cycle converted velocity upper limit value = $100000.0 \text{ [pulse/ms]} \times 0.125 \text{ [ms]} = 12500.0 \text{ [pulse]}$

Calculation cycle converted acceleration = $30000.0 \text{ [pulse/s}^2\text{]} \times (0.125 \text{ [ms]} \div 1000)^2 = 0.00046875 \text{ [pulse]}$

Calculation cycle converted jerk = $20.0 \text{ [pulse/s}^3\text{]} \times (0.125 \text{ [ms]} \div 1000)^3 = 3.90625\text{E-}11 \text{ [pulse]}$

In above case, the calculation cycle converted acceleration lower limit value will be $4.0\text{E-}11 \text{ [pulse]}$. Also, the warning "Out of Operation Cycle Converted Jerk Range Warning" (warning code: 0D3AH) occurs because the calculation cycle converted jerk lower limit value will be the same value $4.0\text{E-}11 \text{ [pulse]}$.

When the calculation cycle converted jerk is too small, the warning "Jerk Acceleration/Deceleration Disabled Warning" (warning code: 0D3BH) occurs and operates as Trapezoidal acceleration/deceleration.

Ex.

Velocity Command Unit (AxisName(AxesGroupName)).Pr.Unit_Velocity) H00000300 [/s]

When started with the following settings at operation cycle 31.25 [μ s]

Velocity: 0.4

Acceleration: 0.005

Deceleration: 0.005

Jerk: 0.0001

In above case, the warning "Jerk Acceleration/Deceleration Disabled Warning" (warning code: 0D3BH) occurs because the calculation cycle converted jerk is 3.05176E-18.

9.2 Velocity Limit

The "velocity limit function" limits the set velocity to a value within the velocity limit value setting range when the set velocity during control exceeds the velocity limit value. By limiting the set velocity within the preset velocity limit value setting range, even if an incorrect command or unexpected operation occurs, damage to the machine can be prevented.

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Pr.</u>		
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Sets the address increasing direction velocity limit value for each axis.
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Sets the address decreasing direction velocity limit value for each axis.
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Sets the operation when the velocity limit value during control is exceeded. 0: Ignore (Ignore) 3: Immediate Stop (ImmediateStop)
<u>AxesGroupName.Pr.</u>		
VelocityLimit	Velocity Limit Value	Sets the velocity limit value of the axes group.

How to set the velocity limit function

Velocity limit value for each axis

Set Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), for each axis.

Setting item	Setting range	Setting details
Positive Direction Velocity Limit Value (<u>AxisName.Pr.VelocityLimit_Positive</u>)	$0.0001 \leq \text{Setting value} \leq 2500000000.0$	Sets the velocity limit value (the maximum velocity during control) for the positive direction operation.
Negative Direction Velocity Limit Value (<u>AxisName.Pr.VelocityLimit_Negative</u>)		Sets the velocity limit value (the maximum velocity during control) for the negative direction operation.

Velocity limit value for each axes group

Set Velocity Limit Value (AxesGroupName.Pr.VelocityLimit), for each axes group.

Setting item	Setting range	Setting details
Velocity Limit Value (<u>AxesGroupName.Pr.VelocityLimit</u>)	$0.0001 \leq \text{Setting value} \leq 2500000000.0$	Sets the velocity limit value (the maximum velocity during control) of the axes group.

Operation when the velocity limit value is exceeded

The operation when specifying the velocity exceeding the velocity limit value differs depending on single axis control, single axis synchronous control and interpolation control.

For single axis operation

Executes the velocity 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 velocity limit value (Positive Direction Velocity Limit Value

(AxisName.Pr.VelocityLimit_Positive) for the positive direction and Negative Direction Velocity Limit Value

(AxisName.Pr.VelocityLimit_Negative) for the negative direction) of each axis, the error "Velocity Limit Value Over" (error code: 1A07H) will occur, and the axis will not start.

- During control

The velocity limit is not executed.

- During control (At velocity change)

If exceeding the velocity limit value of each axis is specified by the override function and input label change in execution, the warning "Velocity Limit Value Over Warning" (warning code: 0D03H) will occur, and the operation continues at the velocity before change.

For details on the override function and input label change in execution, refer to the following.

📖 Page 380 Override Function, 📖 Page 433 Input Variable Change in Execution

For single axis synchronous control

Executes the velocity limit to the set velocity of the slave axis.

- At start

The velocity limit is not executed.

- During control

If the set velocity exceeds the velocity limit value (Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive)

for the positive direction and Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) for the negative

direction) of each axis, follow Operation Setting at Velocity Limit Value Exceeded

(AxisName.Pr.VelocityLimit_OverOperation).

If the absolute value of the set velocity exceeds the maximum velocity, the error "Velocity Range Over during Controlling" (error code: 1AE8H) will occur and stop the operation.

For interpolation control

For the velocity limit at the interpolation control, Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive),

Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative), and Velocity Limit Value

(AxesGroupName.Pr.VelocityLimit) are used.

The operation when the target velocity exceeds the velocity limit value is as follows.

- At start

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Negative) ^{*1}	Velocity is not restricted.	Long axis velocity is restricted by velocity limit value of long axis. ^{*2}	Reference axis velocity is restricted by velocity limit value of reference axis. ^{*2}	Velocity is not restricted.
Velocity Limit Value (<u>AxesGroupName</u> .Pr.VelocityLimit)	Velocity is restricted for vector velocity. ^{*2}	Velocity is not restricted.	Velocity is not restricted.	Velocity is restricted for vector velocity. ^{*2}

- During control

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Negative) ^{*1}	Velocity is restricted for set velocity of each configuration axis. When the velocity limit value is exceeded, it follows Operation Setting at Velocity Limit Value Exceeded (<u>AxisName</u> .Pr.VelocityLimit_OverOperation).			
Velocity Limit Value (<u>AxesGroupName</u> .Pr.Velocity Limit)	Velocity is not restricted.			

- During control (At velocity change)

Variable to be used	Linear interpolation control			Circular interpolation control
	Vector velocity specification	Long axis velocity specification	Reference axis velocity specification	
Positive Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (<u>AxisName</u> .Pr.VelocityLimit_Negative) ^{*1}	Velocity is not restricted.	Long axis velocity is restricted by velocity limit value of long axis. ^{*3}	Reference axis velocity is restricted by velocity limit value of reference axis. ^{*3}	Velocity is not restricted.
Velocity Limit Value (<u>AxesGroupName</u> .Pr.Velocity Limit)	^{*3}	Velocity is not restricted.	Velocity is not restricted.	^{*3}

*1 About either Positive Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Positive) or Negative Direction Velocity Limit Value (AxisName.Pr.VelocityLimit_Negative) is restricted according to the movement direction at the limit value check.

*2 When the velocity limit value is exceeded, it will not start. The error "Velocity Limit Value Over" (error code: 1A07H) is output.

*3 When the velocity limit value is exceeded, the velocity change will not accepted. The warning "Velocity Limit Value Over Warning" (warning code: 0D03H) is output.

Operation setting at velocity limit value exceeded

The operation when the velocity of any axis exceeds the velocity limit value during control can be specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation).

The following two types can be selected for the operation when the velocity exceeds the velocity limit value.

- 0: Ignore (Ignore)
- 3: Immediate Stop (ImmediateStop)

When the multiple axes exceed the limit value, the priority is "3: Immediate Stop (ImmediateStop)" > "0: Ignore (Ignore)".

Control continuation

When "0: Ignore (Ignore)" is specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation), the warning "Velocity Limit Value Over Warning" (warning code: 0D03) occurs at the time of detecting the set velocity exceeding the velocity limit value, and the command exceeding the velocity limit value is output as it is.

Control stop

When "3: Immediate Stop (ImmediateStop)" is specified in Operation Setting at Velocity Limit Value Exceeded (AxisName.Pr.VelocityLimit_OverOperation), the error "Velocity Limit Value Over during Controlling" (error code: 1A36H) occurs at the time of detecting the set velocity exceeding the velocity 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.
- There are two methods of changing the override factor, the method using the dedicated FB and the method using the control data.

Change method	Description
Change using a dedicated FB	MC_SetOverride (Override Value Setting), MC_GroupSetOverride (Axes Group Override Value Setting)
Change using control data	Velocity Override Factor (<u>AxisName</u> .Cd.VelocityOverride), Velocity Override Factor (<u>AxesGroupName</u> .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
- The override factor does not reflect immediately during deceleration stop after stop causes occur. It reflects at the timing which causes other stop causes.

Point

It is as follows when the value after the velocity override is lower than the lower limit value.

- The velocity is 0 when it is $0 < (\text{The velocity after override}) < \text{The lower limit value of the velocity (0.0001)}$.

It is as follows when the value after the acceleration override is higher than the upper limit value.

- The acceleration is the acceleration upper limit value (2147483647.0) when Acceleration Limit Value (AxisName(AxesGroupName).Pr.AccelerationLimit) is 0.
- The deceleration is the deceleration upper limit value (2147483647.0) when Deceleration Limit Value (AxisName(AxesGroupName).Pr.DecelerationLimit) is 0.

It is as follows when the value after the acceleration override is lower than the lower limit value.

[For the acceleration/deceleration method in which acceleration/deceleration is specified]

- The acceleration is 0 when it is $0 < (\text{The deceleration after override}) < \text{the deceleration lower limit value (0.0001)}$.
- The deceleration is 0 when it is $0 < (\text{The acceleration after override}) < \text{the acceleration lower limit value (0.0001)}$.

[For the acceleration/deceleration method in which acceleration/deceleration time is specified]

- The acceleration/deceleration time is 0 when it is $0 < (\text{The acceleration/deceleration time after override}) < \text{the acceleration/deceleration time lower limit value (0.000001)}$.

Targets to be changed and corresponding FBs, control data

Targets to be changed		Corresponding FB	Corresponding control data
Velocity	Current value	MC_MoveVelocity (Speed Control) MC_SetOverride (Override Value Setting) MC_GroupSetOverride (Axes Group Override Value Setting)	Velocity Override Factor (<u>AxisName</u> .Cd.VelocityOverride, Velocity Override Factor (<u>AxesGroupName</u> .Cd.VelocityOverride
	Limit value	—*1	—*1
	Limit value	Maximum value of the limit value	—*2

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, it cannot be changed during control.

*2 The maximum value of the limit value cannot be changed.

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.Cd.</u> <u>AxesGroupName.Cd.</u>		
VelocityOverride	Velocity Override Factor	Sets the velocity override factor.
AccelerationOverride	Acceleration Override Factor	Sets the acceleration override factor.
<u>AxisName.Md.</u> <u>AxesGroupName.Md.</u>		
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 (Override Value Setting) and MC_GroupSetOverride (Axes Group Override Value Setting).

Relevant FBs

MC_SetOverride

Item	Description
Function overview	Changes the target velocity, the target acceleration and the target deceleration of the specified axis.
Symbol [Structured Ladder]	MC_SetOverride DUT : Axis Axis : DUT B : Enable Enabled : B L : VelFactor Busy : B L : AccFactor Error : B L : JerkFactor ErrorID : UW
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

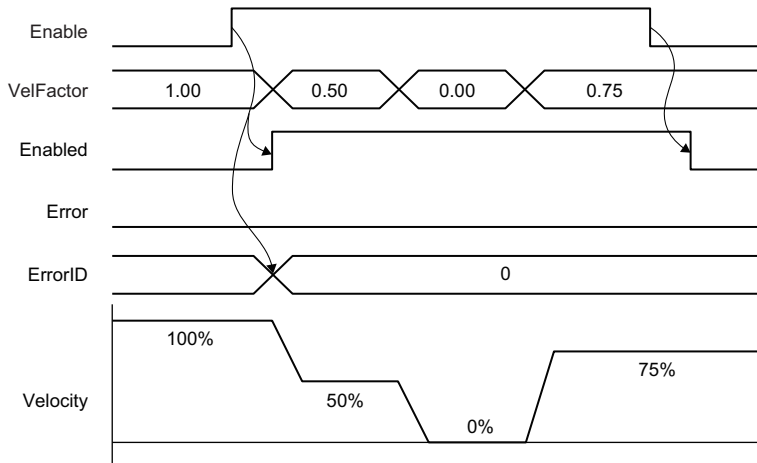
- This FB changes the target velocity, the target acceleration and the target deceleration of the specified axis.
- The values are changed to each value obtained by multiplying the override factor to the target velocity, the target acceleration and the target deceleration respectively.
- The FB is executed when Enable (Enable) is TRUE. Enabled (Enabled) becomes TRUE while the override factor is valid.
- If the override factor value is changed while Enable (Enable) is TRUE, the new override factor is reflected.
- When an error has occurred in the FB, this FB changes Error (Error) to TRUE and stores an error code in Error code (ErrorID). For details on error codes, refer to the following.
 Page 711 List of Error Codes
- When "0.00" is set to Velocity override factor (VelFactor), the axis stops without changing Axis Status (AxisName.Md.AxisStatus) to "4: Standby (Standstill)".
- When "0.00" is set to Acceleration override factor (AccFactor), the acceleration override factor is not changed, and the previous acceleration override factor is maintained.

Precautions

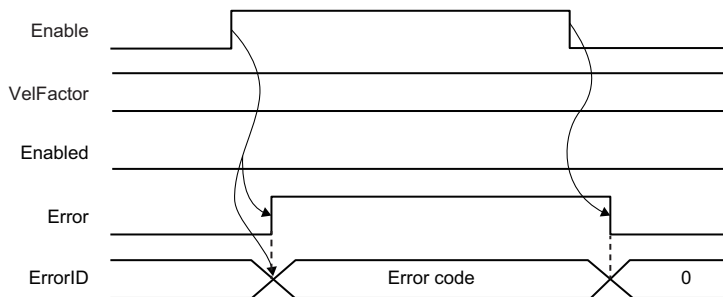
This FB changes Velocity Override Factor (AxisName.Cd.VelocityOverride) and Acceleration Override Factor (AxisName.Cd.AccelerationOverride).

■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 754 Axis variables

■Input variables

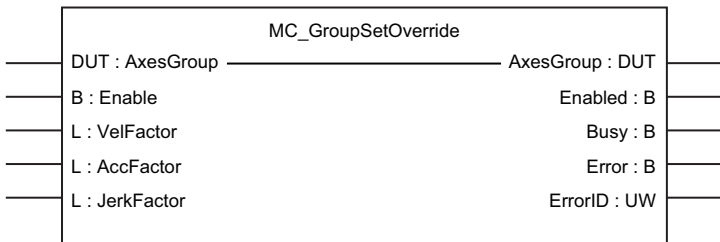
Import □: Always

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	0.0	While Enable (Enable) is TRUE, values are always imported. Sets the velocity override factor.
Acceleration override factor	AccFactor	LREAL	□	0, 0.01 to 10.00	0.0	While Enable (Enable) is TRUE, values are always imported. Sets override factor for the acceleration and the deceleration. When "0.0" is set, the acceleration override factor is not changed, and the control is performed with the previous value.
Jerk override factor (Reserved)	JerkFactor	LREAL	□	0.0	0.0	Set "0.0". (A value other than "0.0" causes the error "Out of Jerk Override Factor (JerkFactor) Range" (error code: 349EH).)

■Output variables

Name	Variable name	Data type	Default value	Description
Enabled	Enabled	BOOL	FALSE	Becomes 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)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

MC_GroupSetOverride

Item	Description
Function overview	Changes the target velocity, the target acceleration and the target 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

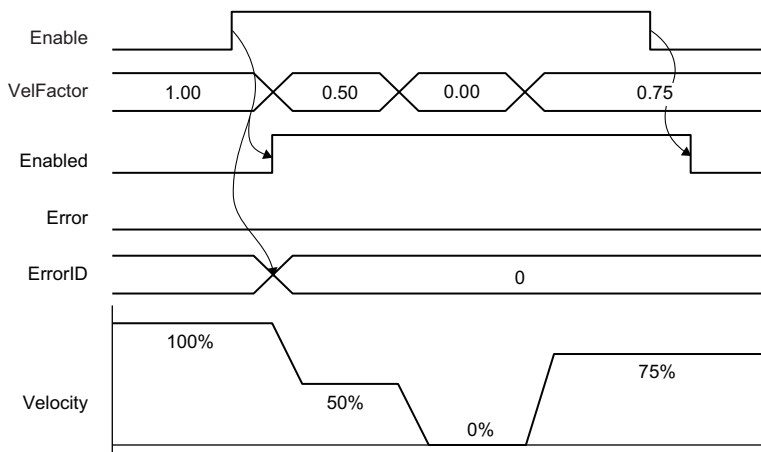
- This FB changes the target velocity, the target acceleration and the target deceleration of the specified axes group.
- The values are changed to each value obtained by multiplying override factor to the velocity, the acceleration and the deceleration respectively.
- The FB is executed when Enable (Enable) is TRUE. Enabled (Enabled) becomes TRUE while the override factor is valid.
- If the override factor value is changed while Enable (Enable) is TRUE, the new override factor is reflected.
- When an error has occurred in the FB, this FB changes Error (Error) to TRUE and stores an error code in Error code (ErrorID). For details on error codes, refer to the following.
 Page 711 List of Error Codes
- When "0.00" is set to Velocity override factor (VelFactor), the axis stops without changing Axes Group Status (AxesGroupName.Md.GroupStatus) to "4: Standby (Standstill)".
- When "0.00" is set to Acceleration override factor (AccFactor), the acceleration override factor is not changed, and the previous acceleration override factor is maintained.

Precautions

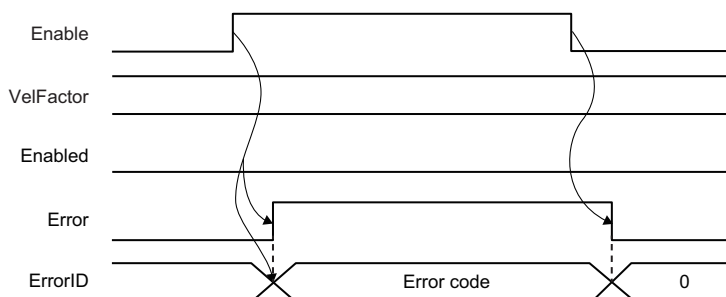
This FB changes Velocity Override Factor (AxesGroupName.Cd.VelocityOverride) and Acceleration Override Factor (AxesGroupName.Cd.AccelerationOverride).

■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 758 Axes group variables

■Input variables

Import □: Always

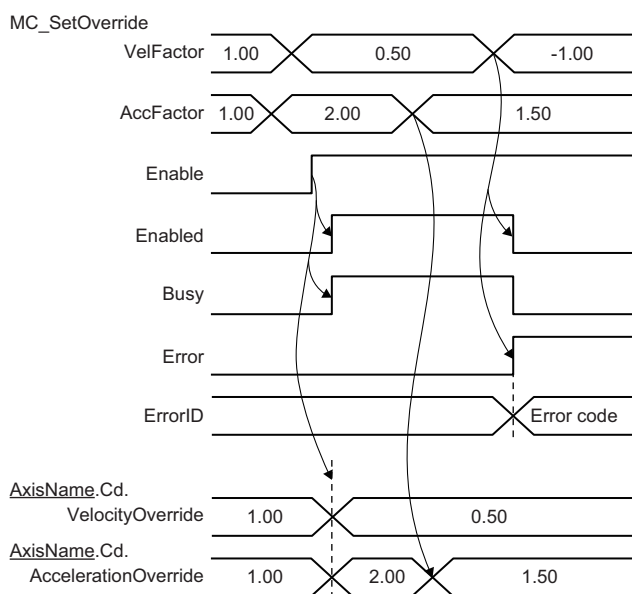
Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	□	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Velocity override factor	VelFactor	LREAL	□	0.0.0 to 10.0.0	0.00	While Enable (Enable) is TRUE, values are always imported. Sets the velocity override factor.
Acceleration override factor	AccFactor	LREAL	□	0.00, 0.01 to 10.0.0	0.00	While Enable (Enable) is TRUE, values are always imported. Sets override factor for the acceleration and the deceleration. When "0.0.0" is set, the acceleration override factor is not changed, and the control is performed with the previous value.
Jerk override factor (Reserved)	JerkFactor	LREAL	□	0.0	0.0	Set "0.0". (A value other than "0.0" causes the error "Out of Jerk Override Factor (JerkFactor) Range" (error code: 349EH).)

Output variables

Name	Variable name	Data type	Default value	Description
Enabled	Enabled	BOOL	FALSE	Becomes 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)	0	The error code generated in the FB is returned. For details, refer to the following. Page 711 List of Error Codes

Operation overview

In MC_SetOverride (Override Value Setting) and MC_GroupSetOverride (Axes Group Override Value Setting), Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride) and Acceleration Override Factor (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 (Enable) again.

Precautions

- Do not arrange two or more MC_SetOverride (Override Value Setting) and MC_GroupSetOverride (Axes Group Override Value Setting) in the same axis or the same axes group. Operation is not guaranteed when two or more of the FBs are arranged.
- In the single axis control, only the override factor set with the axis control data affects. In the axes group control, only the override factor set with the axes group control data affects.
- Do not operate Velocity Override Factor (AxisName.Cd.VelocityOverride) or Acceleration Override Factor (AxisName.Cd.AccelerationOverride) directly during performing MC_SetOverride (Override Value Setting).
- Do not operate Velocity Override Factor (AxesGroupName.Cd.VelocityOverride) or Acceleration Override Factor (AxesGroupName.Cd.AccelerationOverride) directly during performing MC_GroupSetOverride (Axes Group Override Value Setting).
- When the velocity after the velocity override is out of the range, refer to the following.
[Page 88 Velocity Range](#)
- When the acceleration, deceleration, acceleration time, and deceleration time after the acceleration override are out of the range, refer to the following.
[Page 348 Acceleration/deceleration Processing Function](#)

How to change control data

Override factor setting range

The following shows each override factor setting range.

Variable/Structure name	Name	Setting range
<u>AxisName.Cd.</u>		
<u>AxesGroupName.Cd.</u>		
VelocityOverride ^{*1}	Velocity Override Factor	0.0 (0%) ≤ Setting value ≤ 10.0 (1000%)
AccelerationOverride ^{*2}	Acceleration Override Factor	0.01 (1%) ≤ Setting value ≤ 10.0 (1000%)
JerkOverride (Reserved)	Jerk override factor	1

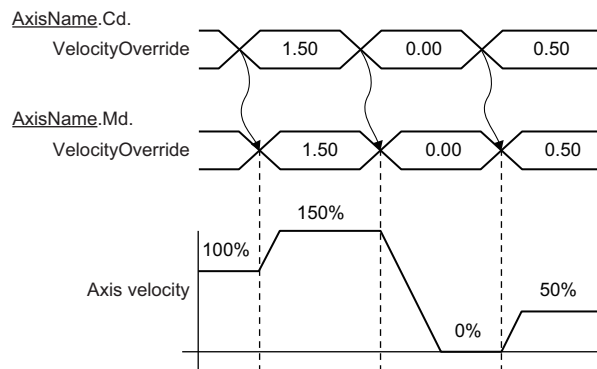
*1 Registers "velocity override "0"" in the event history when "0" is set to velocity override.

*2 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 Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride).

When "0.0" is set in Velocity Override Factor (AxisName(AxesGroupName).Cd.VelocityOverride), the axis is stopped without moving to the "4: Standby (Standstill)" status.

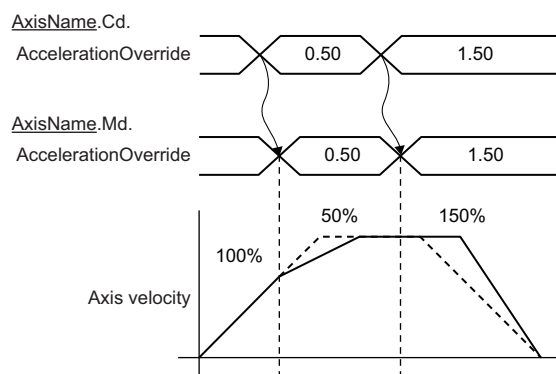


Operation when the acceleration override factor is changed

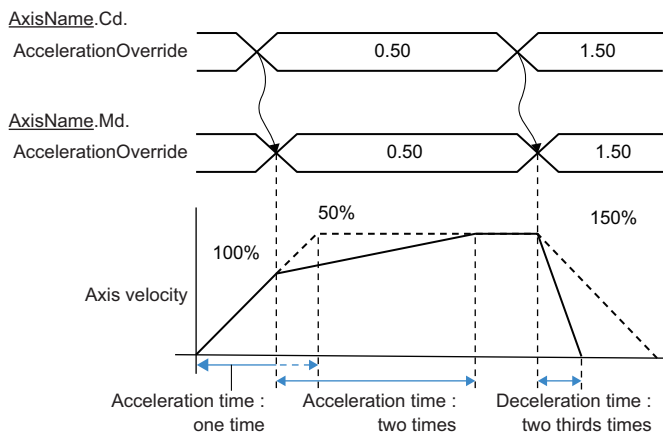
Change the acceleration/deceleration by changing Acceleration Override Factor

(AxisName(AxesGroupName).Cd.AccelerationOverride).

■Acceleration/deceleration method specifying acceleration/deceleration



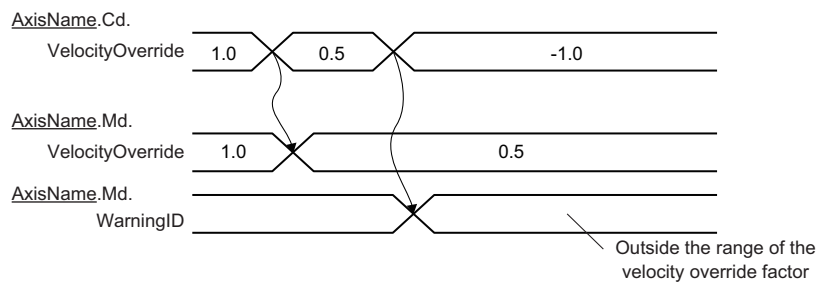
■Acceleration/deceleration method specifying acceleration/deceleration time



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 Velocity Override Factor Range Warning" (warning code: 0D0BH)
- The warning "Out of Acceleration Override Factor Range Warning" (warning code: 0D0CH)

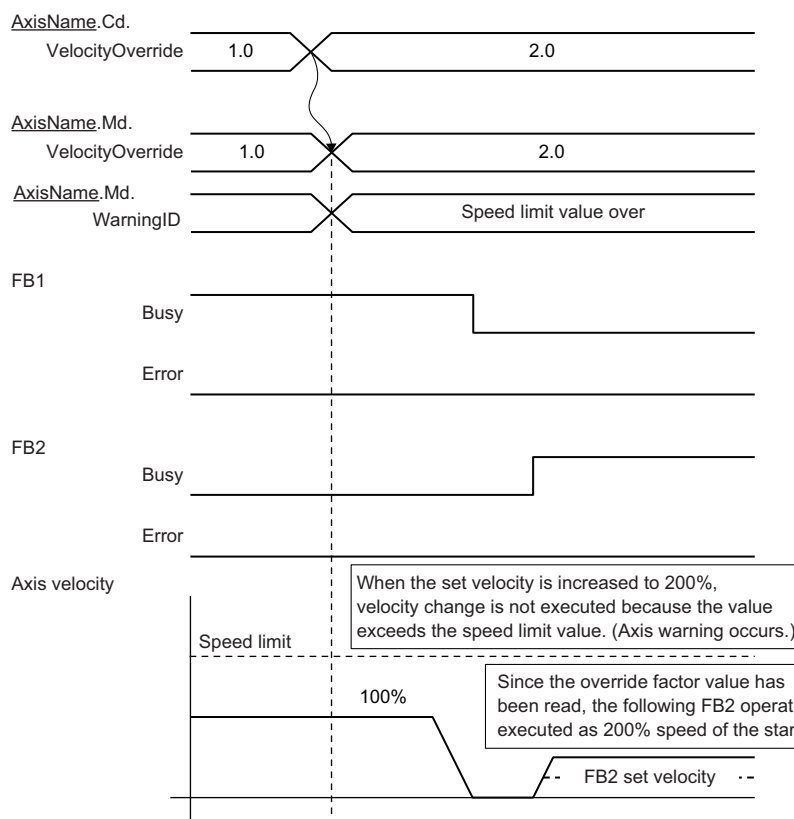


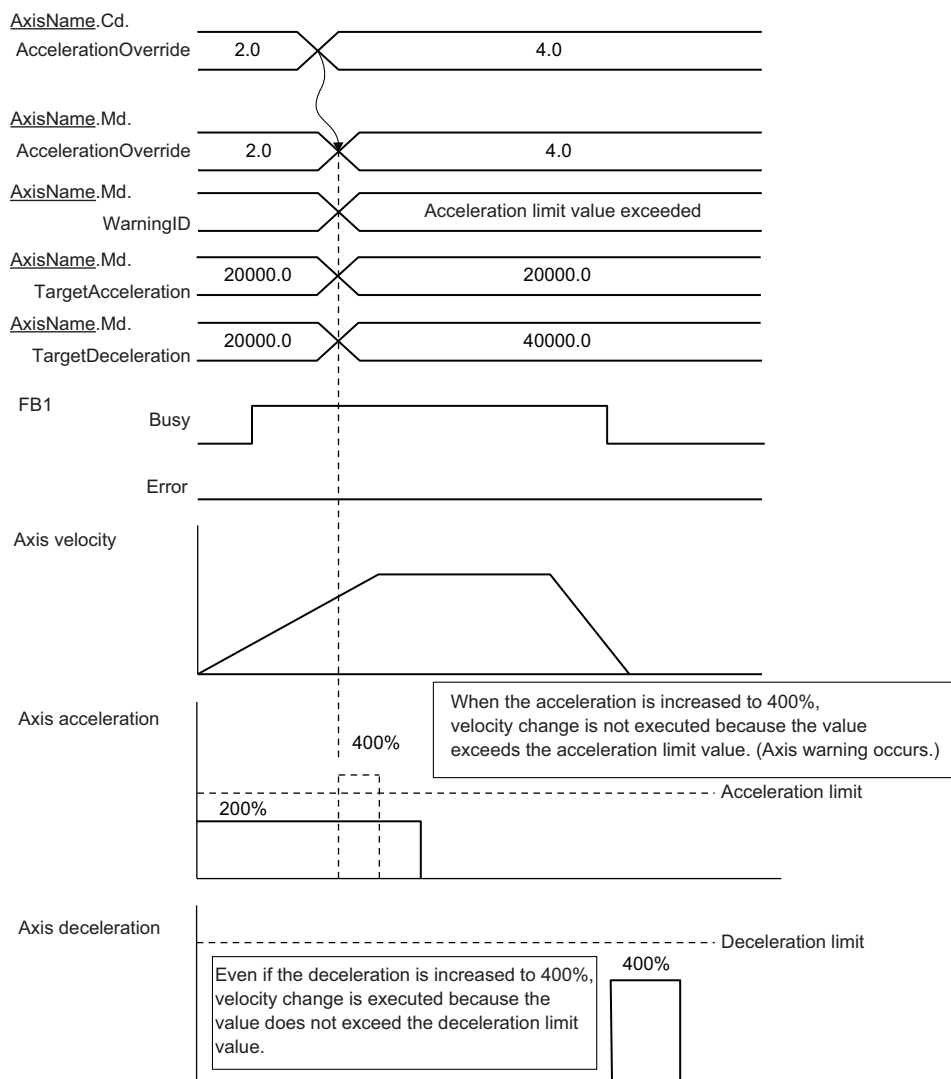
Operation at velocity/acceleration/deceleration limit value over by override

■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.)



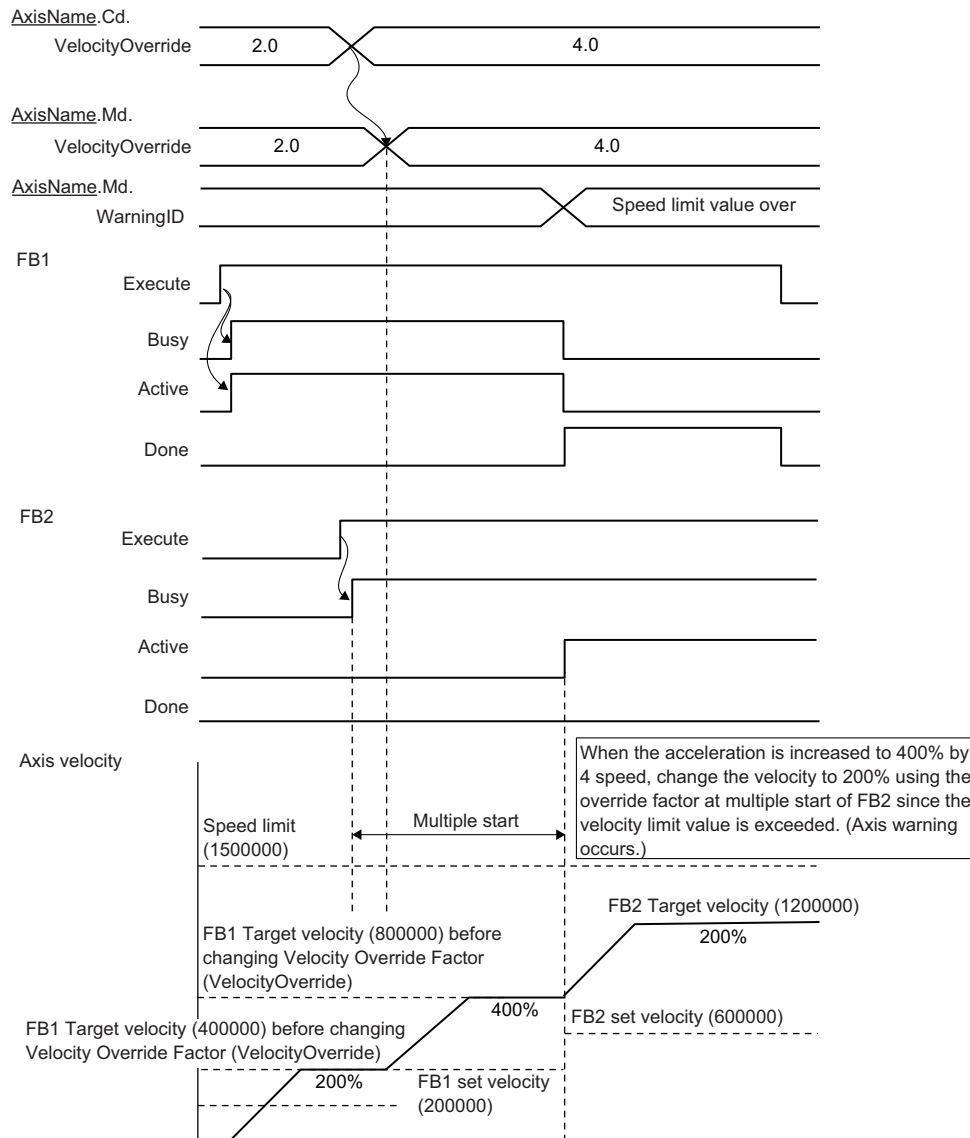


■When velocity/acceleration/deceleration limit value over occurs at switching of FB by buffer mode

The control change of buffering FB is executed at switching of FB.

When the control is changed at switching of FB, velocity/acceleration/deceleration limit value over may occur. When velocity/acceleration/deceleration limit value over occurs, velocity/acceleration/deceleration and override factor at multiple start are used to control.

Also when velocity/acceleration/deceleration limit value over occurs at switching of FB, the import of override factor is executed. If the limit value is not exceeded at the next control change, the override factor after change will be operated.



10 RELEVANT FUNCTIONS TO TORQUE

10.1 Torque limit

10

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 (Torque Control), etc."
- The torque limit value can be changed by changing the values of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative). When changing the torque limit value, specifies a value less than or equal to Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max) setting value. For details, refer to the following.

📖 Page 393 Torque Limit Value Change Function

- The torque limit value that is currently valid can be checked with Positive Direction Torque Limit Value (AxisName.Md.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Md.TorqueLimit_Negative).
- The torque limit value when connecting a driver, Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are set.

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
TorqueLimit_Max	Torque Limit Maximum Value	Sets the maximum value that can be specified as the torque limit value. (Common in the positive direction and the negative direction)
TorqueLimit_PositiveInitial	Positive Direction Torque Limit Initial Value	Sets the initial value of Positive Direction Torque Limit Value (<u>AxisName.Cd.TorqueLimit_Positive</u>).
TorqueLimit_NegativeInitial	Negative Direction Torque Limit Initial Value	Sets the initial value of Negative Direction Torque Limit Value (<u>AxisName.Cd.TorqueLimit_Negative</u>).
<u>AxisName.Cd.</u>		
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.
<u>AxisName.Md.</u>		
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 56 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 (Torque Control), 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.
- For MR-J5(W)-G: 📖 MR-J5 User's Manual (Function)

Torque limit value setting range

Set the settings of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) for each axis.

The setting values are used in the "setting of the torque limit value used in the driver" and the "control to suppress the command torque in MC_TorqueControl (Torque Control), etc."

The torque limit value can be changed by changing the setting values. For details, refer to the following.

 Page 393 Torque Limit Value Change Function

When the power supply turns ON, the setting values of Positive Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_PositiveInitial) and Negative Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_NegativeInitial) are stored. In this time, if Positive Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_PositiveInitial) and Negative Direction Torque Limit Initial Value (AxisName.PrConst.TorqueLimit_NegativeInitial) are set with the larger value than Torque Limit Maximum Value (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
Positive Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Positive)	0.0 (0%) ≤ Setting value ≤ Torque Limit Maximum Value (<u>AxisName</u> .PrConst.TorqueLimit_Max)
Negative Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Negative)	

Torque limit maximum value setting range

Set the settings of Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max) for each axis.

The torque limit maximum value is used as the upper limit value of the torque limit.

Even if a 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
Torque Limit Maximum Value (<u>AxisName</u> .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 Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max).

Precautions

When the axis control is stopped by torque limiting, the droop pulse will remain in the deviation counter. If the load torque is eliminated, operation for the amount of droop pulses will be 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 (Torque Limit Value)
Change using control data	Positive Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Positive), Negative Direction Torque Limit Value (<u>AxisName</u> .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 Torque Limit Maximum Value (AxisName.PrConst.TorqueLimit_Max).

Targets to be changed and corresponding FBs, control data

Target to be changed		Corresponding FB	Corresponding control data
Torque	Current value	MC_TorqueControl (Torque Control)	—
	Limit value	MCv_SetTorqueLimit (Torque Limit Value)	Positive Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Positive) Negative Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Negative)
	Limit value	Maximum value of the limit value	—*1

*1 Axis parameters can be changed by MC_WriteParameter (Parameter Write). However, it cannot be changed during control.

Relevant variables

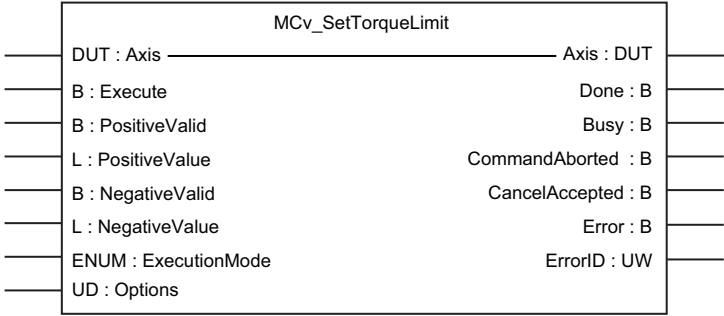
For variables used in a method of changing control data, refer to the following.

☞ Page 391 Relevant variables

Relevant FB

MCv_SetTorqueLimit

To simultaneously change a positive/negative direction torque limit value, use MCv_SetTorqueLimit (Torque Limit Value).

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

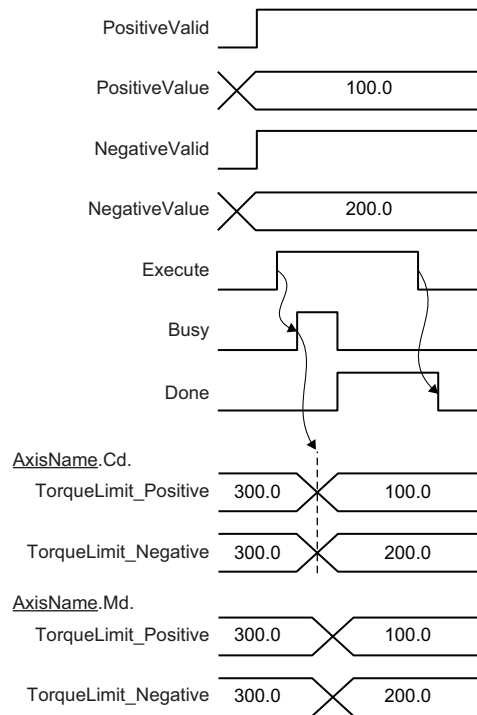
- This FB changes a positive/negative direction torque limit value.
- When Positive direction torque limit valid (PositiveValid) is TRUE, a positive direction torque limit value is changed to Positive direction torque limit value (PositiveValue).
- When Negative direction torque limit valid (NegativeValid) is TRUE, a negative direction torque limit value is changed to Negative direction torque limit value (NegativeValue).
- This FB is executed when Execute command (Execute) is TRUE, and Executing (Busy) becomes TRUE when the processing is normally started.
- The torque limit value change timing is set in Execution mode (ExecutionMode).
- When the process is completed and the torque limit value is changed, Execution completion (Done) becomes TRUE.
- After this FB is started with Execution mode (ExecutionMode) is "1: Execute at Completion of Previous One (mcQueued)", if Axis Status (AxisName.Md.AxisStatus) turns "0: Axis disabled (Disabled)"/"1: Stopping on error (ErrorStop)" before processing completion, the processing will be interrupted and Abortion of execution (CommandAborted) will become TRUE.
- When an error has occurred in the FB, this FB changes Error (Error) to TRUE and stores an error code in Error code (ErrorID). For details on error codes, refer to the following.
☞ Page 711 List of Error Codes
- When both of Positive direction torque limit valid (PositiveValid) and Negative direction torque limit valid (NegativeValid) are FALSE, the torque limit value will not change and Execution completion (Done) will be TRUE.

Precautions

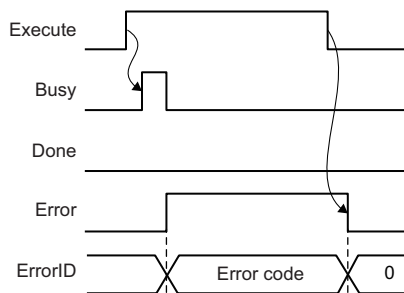
This FB changes Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative).

■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 754 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 401 Positive/Negative direction torque limit value setting range	0.0	Imports when Positive direction torque limit valid (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 401 Positive/Negative direction torque limit value setting range	0.0	Imports when Negative direction torque limit valid (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: Execute Immediately (mcImmediately) 1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively)
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 (Specify "0".)*1
16	Cancel accepted after FB start Specifies whether or not to allow a cancel after FB is executed. 0: Do not allow 1: Allow
17 to 31	Empty (Specify "0".)*1

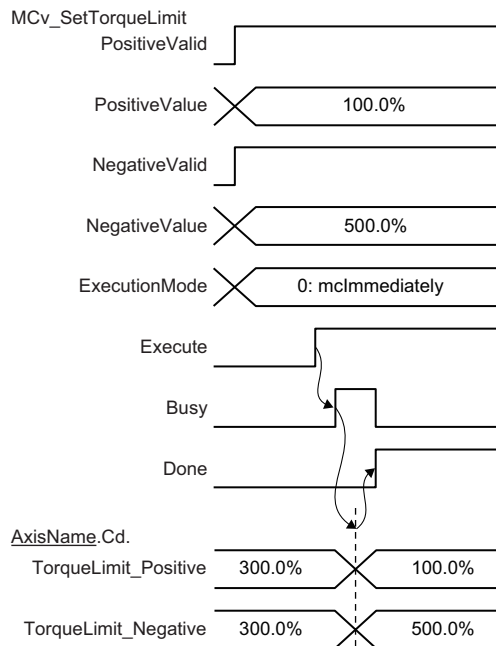
*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■ Output variables

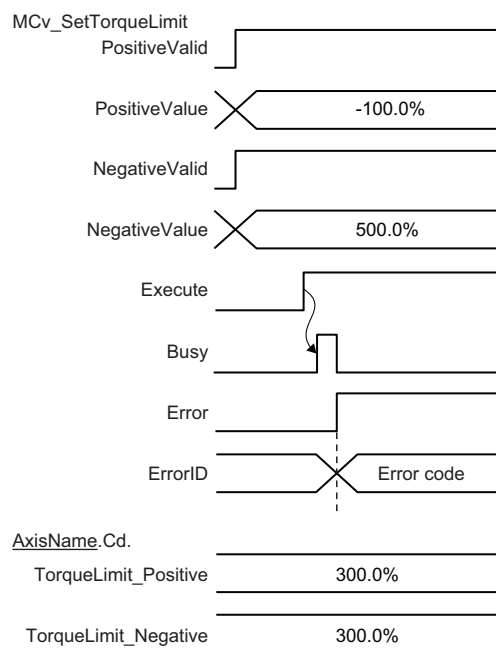
Name	Variable name	Data type	Default value	Description
Execution completion	Done	BOOL	FALSE	Indicates that a torque limit value change is normally completed.
Executing	Busy	BOOL	FALSE	When TRUE, it indicates that the FB is in execution.
Abortion of execution	CommandAborted	BOOL	FALSE	When TRUE, it indicates that execution has been aborted.
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)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes

■ Operation overview

In MCv_SetTorqueLimit (Torque Limit Value), Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed.



If a value outside the range is set in Positive direction torque limit value (PositiveValue) or Negative direction torque limit value (NegativeValue) and Execute command (Execute) is changed to TRUE, an error will occur in the FB, and Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (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 Execution mode (ExecutionMode) setting value of the input variable.

- "0: Execute Immediately (mcImmediately)"

The change is immediately executed regardless of Axis Status (AxisName.Md.AxisStatus).

Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed at rising edge of Execute command (Execute).

- "1: Execute at Completion of Previous One (mcQueued)"

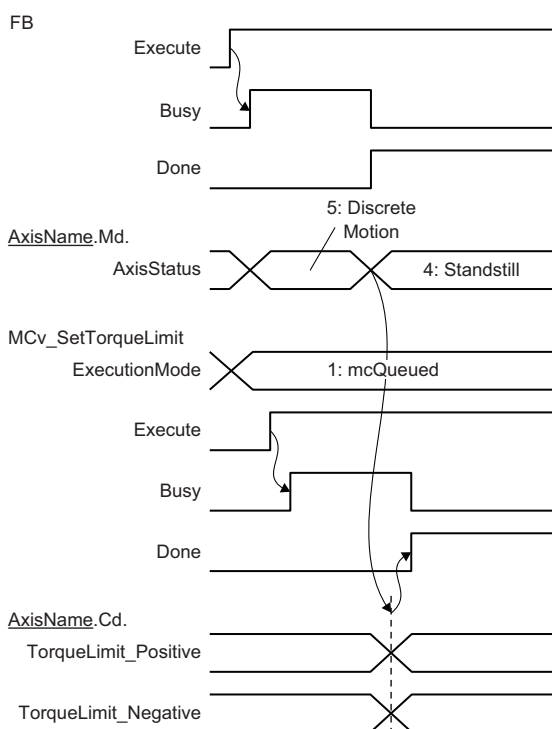
The change is executed after the being executed is completed.

Executing (Busy) becomes TRUE at rising edge detection of Execute command (Execute), and the FB waits until Axis Status (AxisName.Md.AxisStatus) turns "4: Standby (Standstill)".

As soon as Axis Status (AxisName.Md.AxisStatus) turns "4: Standby (Standstill)", Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed.

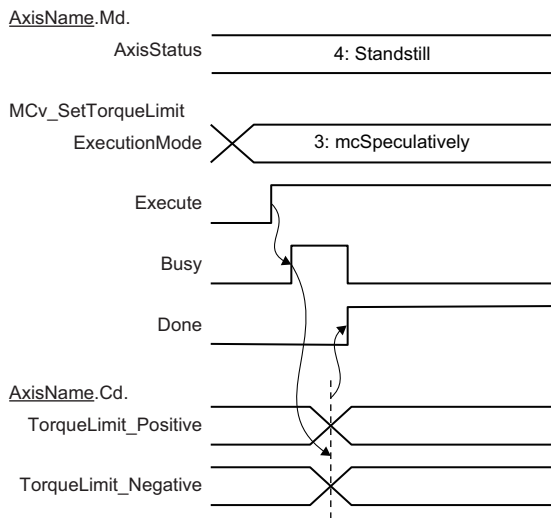
When Axis Status (AxisName.Md.AxisStatus) is "4: Standby (Standstill)" at rising edge detection of Execute command (Execute), the FB is immediately executed.

If Axis Status (AxisName.Md.AxisStatus) turns "0: Axis disabled (Disabled)"/"1: Stopping on error (ErrorStop)" before processing is completed, the processing will be interrupted and Abortion of execution (CommandAborted) will become TRUE.



- "3: Execute Speculatively (mcSpeculatively)"

The torque limit value can be changed only when Axis Status (AxisName.Md.AxisStatus) of the relevant axis is "4: Standby (Standstill)" at the rising edge detection of Execute command (Execute). If Axis Status (AxisName.Md.AxisStatus) of the relevant axis is not "4: Standby (Standstill)", or if the FB instruction is in execution, the error "MCv_SetTorqueLimit Instruction Error" (error code: 3450H) occurs, and the torque limit value change is not performed.



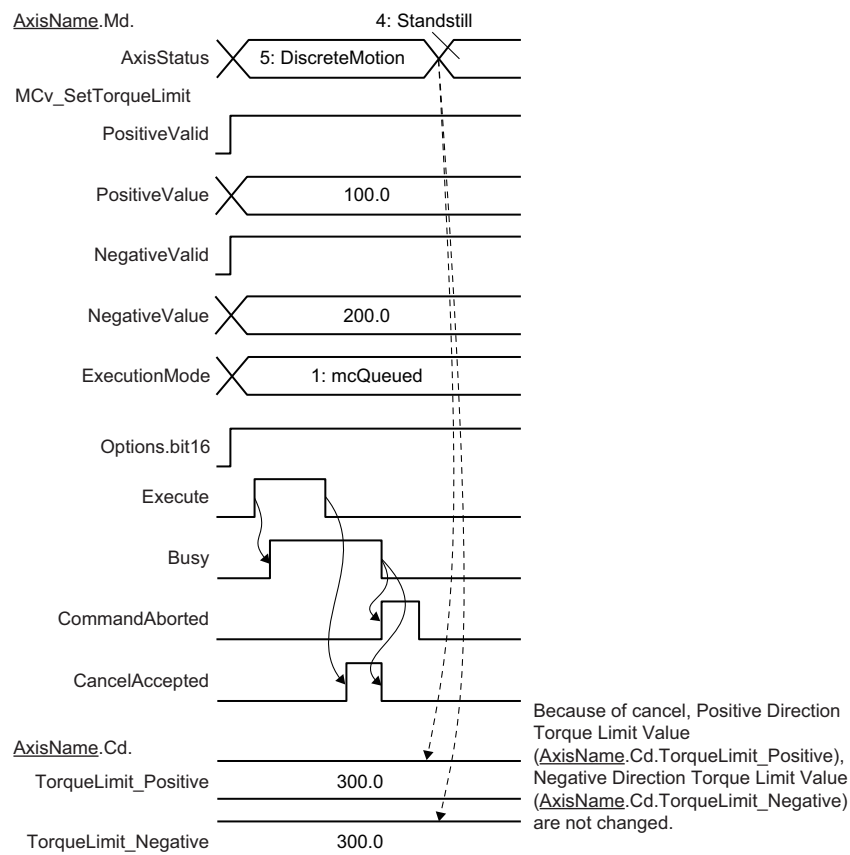
■Cancel

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 (Options) bit16) set to "1: Allow".
- Cancel is started at falling edge detection of Execute command (Execute).
- Cancel is accepted only while Executing (Busy) of the output pin is TRUE.
- When FB accepts cancel, Cancel acceptance (CancelAccepted) of the output pin will be TRUE.
- When cancel is completed, Abortion of execution (CommandAborted) of the output pin will be TRUE.
- When cancel was carried out, Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are not changed.

Ex.

When canceling while Axis Status (AxisName.Md.AxisStatus) is waiting for switching to "4: Standby (Standstill)" after starting MCv_SetTorqueLimit (Torque Limit Value) with "1: Execute at Completion of Previous One (mcQueued)" of Execution mode (ExecutionMode)



How to change control data

Positive/Negative direction torque limit value setting range

The setting range of Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) is as the following table.

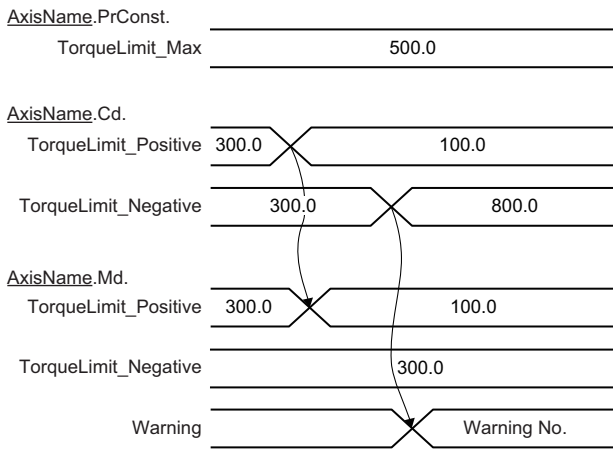
Control data	Setting range
Positive Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Positive)	0.0 (0%) ≤ Setting value ≤ Torque Limit Maximum Value (<u>AxisName</u> .PrConst.TorqueLimit_Max)
Negative Direction Torque Limit Value (<u>AxisName</u> .Cd.TorqueLimit_Negative)	

Torque limit value change timing

A torque limit value can be changed by changing Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative).
If a value outside the setting range is set, 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 Positive Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Positive) and Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) are changed.

Ex.

When a warning occurs after Negative Direction Torque Limit Value (AxisName.Cd.TorqueLimit_Negative) changes 300.0 to 800.0 in the status where Torque Limit Maximum Value (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 machine feed value 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.

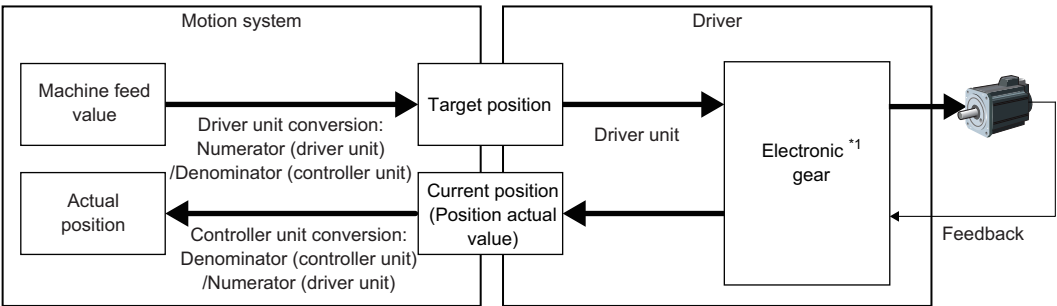
The conversion formulas are shown below.

Target position = Machine feed value (Motion system command value) × Driver unit conversion numerator / Denominator

Actual position = Current position × Driver unit conversion denominator / Numerator



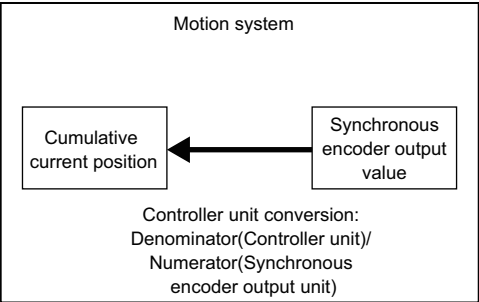
When the driver has the electronic gear, it is recommended to set the ratio to 1:1.



*1 According to the system configuration, if the resolution should be adjusted in the driver side, setting with the electronic gear of the driver side is possible.

- Real encoder axis/Virtual encoder axis

Executes the driver unit conversion to the synchronous encoder output value and calculate the cumulative current position.



Control details

Set Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum) and Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen) 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 67108864 [pulse/rev]

Set the number of pulses required to rotate a motor once (the encoder resolution) in Driver Unit Conversion Numerator (AxisName.Pr.Drive_UnitConvRatioNum), and set the transfer distance of the machine per motor rotation in Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen).

AxisName.Pr.Drive_UnitConvRatioNum = 67108864 [pulses]

AxisName.Pr.Drive_UnitConvRatioDen = 20 [mm]

In this example, the movement amount per pulse is 0.00000298 [mm]. For instance, when the movement amount of 22 [mm] is set, the command will be 73819750.4 [pulses] and a fraction of 0.4 [pulses] will appear. In this case, the movement amount of 67108864 [pulses] is output to the 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 [μ m] 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 [μ m]

$$\frac{\text{Number of pulses [pulse]}}{\text{Movement amount } [\mu\text{m}]} = \frac{1}{0.05} = \frac{20}{1.0}$$

AxisName.Pr.Drive_UnitConvRatioNum = 20 [pulses]

AxisName.Pr.Drive_UnitConvRatioDen = 1 [μ m]

Point

- Set the driver unit conversion multiplying factor within the following range.
|The range upper limit of the controller command value $\times$ (Driver unit conversion numerator / denominator)|
< 8000000000000000000
For the range upper limit of the controller command value, refer to the following.
📖 Page 85 Positioning Range
If setting a value outside the range, the error "Driver Unit Conversion 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 Conversion 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].
 - Axis Status (AxisName.Md.AxisStatus) is "0: Axis disabled (Disabled)"
 - Follow-up Disabled (AxisName.Md.FollowupDisable) is FALSE

Precautions

- Values less than one which could not be output during machine movement are managed in the motion system, and the cumulated values will be output when the value reaches one pulse or more.
- When machine homing is completed, the function clears the cumulative values of less than one pulse which could not be output to "0".
- When the driver unit conversion numerator/denominator is changed, the homing request flag becomes TRUE.
- Double-precision floating-point type variables are used for calculation of the cumulative current value and the target position that is sent to the 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 $\times$ 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 sends 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 (" $1 \times$ 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 Driver Unit Conversion Denominator (AxisName.Pr.Drive_UnitConvRatioDen), and set [μ m] in Position Command Unit (AxisName.Pr.Unit_Position). (20.0 [mm] $\rightarrow$ 20000.0 [μ m])

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.

The command filter control FB is Enable (Enable) type of synchronous control FB and has Filter disable (FilterDisable) and Filter cumulated value (FilterPool).

Operation of this function for each system status

○: Possible, ×: Not possible

System status	Function operation
STOP	×
RUN	○
Moderate error	×
Major error	×

Relevant FBs

MCv_SmoothingFilter

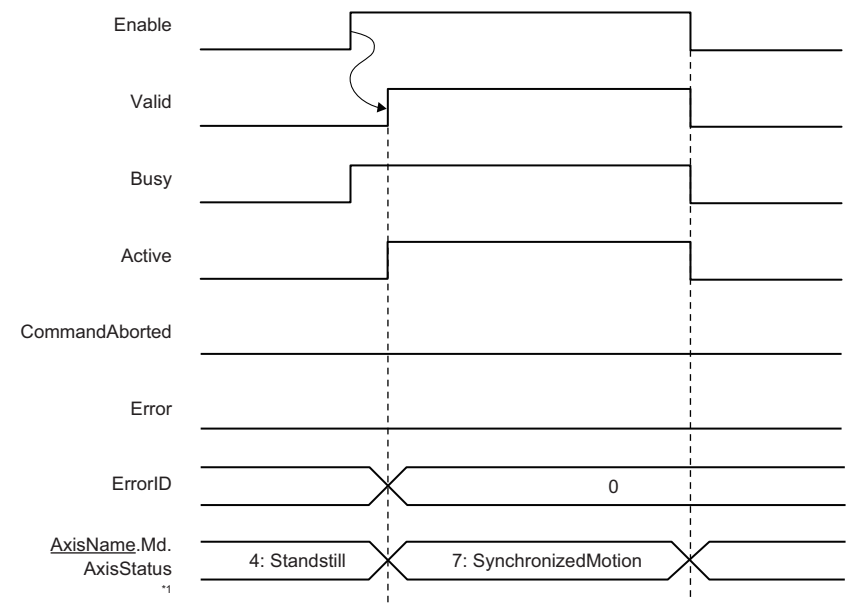
Item	Description
Function overview	Executes filter processing based on the specified frequency.
Symbol [Structured Ladder]	MCv_SmoothingFilter DUT : Master DUT : Slave B : Enable B : FilterDisable L : Frequency B : FilterPurge ENUM : MaserValueSource UD : Options Master : DUT Slave : DUT Valid : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW ValidFrequency : L FilterPool : L

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 Slave axis (Slave).

[When an error occurs]

For details upon completion with an error, refer to the following.

📖 Page 27 Execute command (Execute) type/Enable (Enable)

■ 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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	 Page 754 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 Master axis (Master) is transmitted to Slave axis (Slave) 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 475 Master Axis Data Source Selection
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Set "00000000H". (A value other than "00000000H" causes the error "Out of Options Range" (error code: 1A4EH).)

■ 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 has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes
Valid frequency	ValidFrequency	LREAL	0.00	Indicates valid frequencies.
Filter cumulated value	FilterPool	LREAL	0.0	Indicates the movement amount cumulated at filter processing.

■ Public variables

Name	Variable	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0.0	Stores disposed Filter cumulated value (FilterPool) by turning Filter disable (FilterDisable) to TRUE.

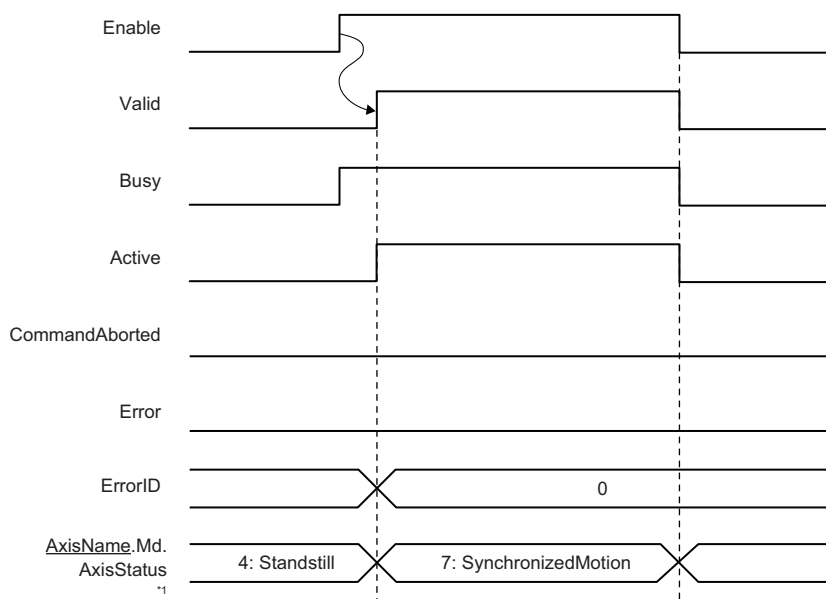
MCv_DirectionFilter

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 Slave axis (Slave).

[When an error occurs]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 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 Master axis (Master) is transmitted to Slave axis (Slave) 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, 2, 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 475 Master Axis Data Source Selection
Options	Options	DWORD(HEX)		00000000H	00000000H	Set "00000000H". (A value other than "00000000H" causes the error "Out of Options Range" (error code: 1A4EH).)

■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 has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0	The error code generated in theFB is returned.For details, refer to the following.  Page 711 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0.0	Indicates the movement amount cumulated at filter processing.

■Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0.0	Stores disposed Filter cumulated value (FilterPool) by turning Filter disable (FilterDisable) to TRUE.

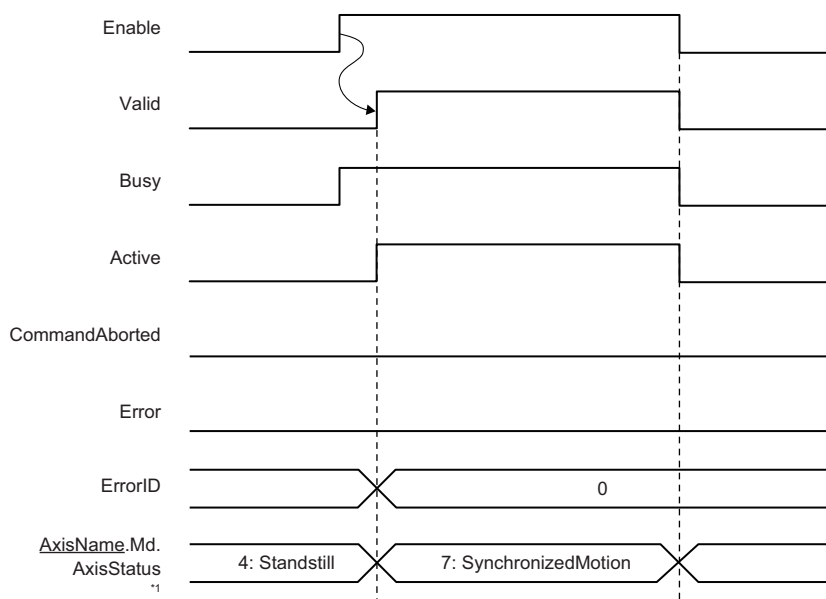
MCv_SpeedLimitFilter

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 Slave axis (Slave).

[When an error occurs]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 Axis variables

Input variables

Import : Always, : At start

Name	Variable name	Data type	Input 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 Master axis (Master) is transmitted to Slave axis (Slave) as it is.
Positive direction limit value	PositiveLimit	LREAL		0, 0.0001to 2500000000.0	0.0	Sets the velocity limit value for the positive direction.
Negative direction limit value	NegativeLimit	LREAL		0, 0.0001to 2500000000.0	0.0	Sets the velocity limit value for the negative direction.
Positive direction filter operation	PositiveFilter	MC_VELOCITY_LIMIT_MODE		0, 2, 4	2	Sets the filter operation for the direction exceeds the positive direction limit.
Negative direction filter operation	NegativeFilter	MC_VELOCITY_LIMIT_MODE		0, 2, 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 475 Master Axis Data Source Selection
Options	Options	DWORD(HEX)		00000000H	00000000H	Set "00000000H". (A value other than "00000000H" causes the error "Out of Options Range" (error code: 1A4EH).)

Output variables

Name	Variable name	Data type	Default value	Description
Output value valid	Valid	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 FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0.0	Indicates the movement amount cumulated at filter processing.

Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0.0	Stores disposed Filter cumulated value (FilterPool) by turning Filter disable (FilterDisable) to TRUE.

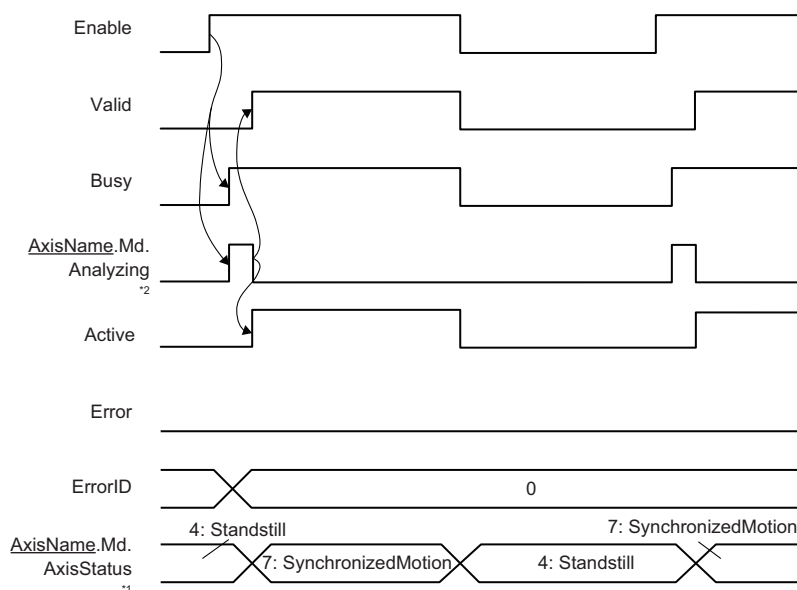
MCv_BacklashCompensationFilter

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 Slave axis (Slave).

*2 Analyzing Slave axis (Slave).

[When an error occurs]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 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 Master axis (Master) is transmitted to Slave axis (Slave) 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. When this setting is omitted, the error "Out of Backlash Compensation Direction Range" (error code: 34A0H) occurs.
Master axis data source selection	MasterValueSource	MC_SOURCE		1, 101	1	For details, refer to the following.  Page 475 Master Axis Data Source Selection
Options	Options	DWORD(HEX)		00000000H	00000000H	Sets a function option. Set "00000000H". (A value other than "00000000H" causes "Out of Options Range" (error code: 1A4EH).)

Output variables

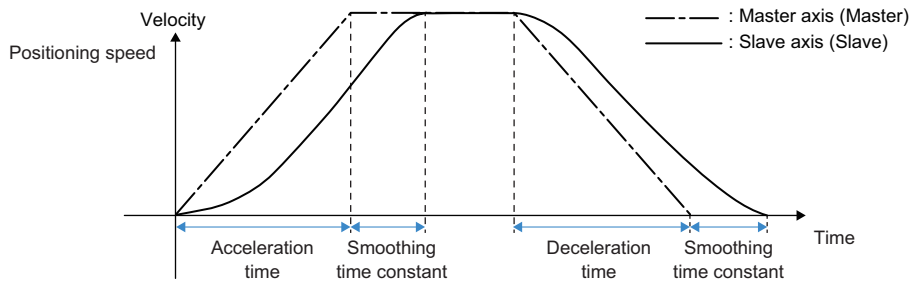
Name	Variable name	Data type	Default value	Description
Output value valid	Valid	BOOL	FALSE	During TRUE, it indicates that the output value is valid.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution has been aborted.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0	Returns the error code generated in the FB. For details, refer to the following.  Page 711 List of Error Codes
Filter cumulated value	FilterPool	LREAL	0.0	Indicates the movement amount cumulated at filter processing.

Public variables

Name	Variable name	Data type	Default value	Description
Disposed filter cumulated value	PurgedFilterPool	LREAL	0.0	Stores disposed Filter cumulated value (FilterPool) by turning Filter disable (FilterDisable) to TRUE.

Smoothing filter

- Smoothing filter removes frequencies higher than the set Frequency (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 axis (Master value) set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "7: During synchronous operation (SynchronizedMotion)" during smoothing filter execution.
- The time constant of smoothing is $1/\text{Frequency (Frequency) [s]}$, and the acceleration time and deceleration time become longer by the smoothing time constant. When Frequency (Frequency) is 10 [Hz], the smoothing time constant is 0.1 [s] = 100 [ms].

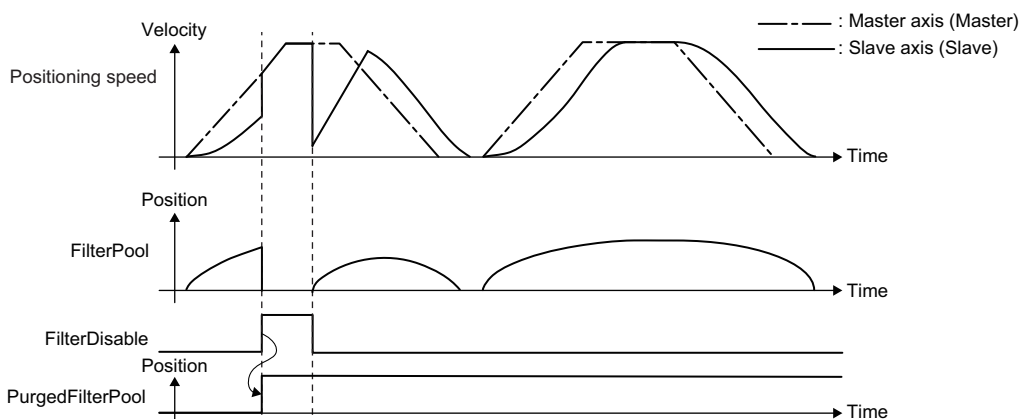


- If a smoothing filter is started while Slave axis (Slave) is in another operation instruction, the start request will be ignored, and the error "Start Not Possible" (error code: 1AADH) will occur. Start it when Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only function block that can be multiple started during smoothing filter execution.

Details of setting items

■ Filter disable (FilterDisable)

- When Filter disable (FilterDisable) is FALSE, the axis operates according to the filter setting.
- When Filter disable (FilterDisable) is TRUE, the filter is disabled, and Master axis (Master) is transmitted to Slave axis (Slave).
- When Filter disable (FilterDisable) is turned TRUE, Filter cumulated value (FilterPool) becomes "0", and stores the disposed Filter cumulated value (FilterPool) to the Disposed filter cumulated value (PurgedFilterPool).



■Frequency (Frequency)

- The following shows the range that can be set in Frequency (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 (Frequency), the error "Out of Frequency Specification Range" (error code: 1A85H) will occur.
- Valid frequencies can be checked in Valid frequency (ValidFrequency).
- To change Frequency (Frequency), change Frequency (Frequency) when Filter cumulated value (FilterPool) is "0.0". Even if it is changed in a status other than "0.0", the change will not be reflected until Filter cumulated value (FilterPool) becomes "0.0".
- Frequency (Frequency) cannot be changed to a frequency lower than Valid frequency (ValidFrequency). If it is set, the error "Out of Frequency Specification Range" (error code: 1A85H) will be output.
- Filter cumulated value (FilterPool) may become "0.0" while the master axis operates with the operation pattern which repeats positive/reverse rotation. When the value of Frequency (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 (Frequency), confirm the master axis stop and wait for the filter time constant before changing.

■Filter purge (FilterPurge)

- By Filter purge (FilterPurge) setting, operation when Enable (Enable) becomes FALSE can be specified with Filter cumulated value (FilterPool) other than "0.0".

Filter purge (FilterPurge)	Operation overview
TRUE	When Enable (Enable) becomes FALSE, the axis operates until Filter cumulated value (FilterPool) becomes "0.0" and stops. The diagram illustrates the behavior of the slave axis and the FilterPool when the master axis is stopped. The Enable signal transitions from high to low. The Valid signal transitions from high to low. The Busy signal transitions from high to low. The Active signal transitions from high to low. The Velocity of Master axis (Master) transitions from high to low. The Velocity of Slave axis (Slave) transitions from high to low with a delay and smoothing. The FilterPool transitions from high to low with a delay and smoothing. The time from the start of the plateau to the end of the fall is labeled 'Smoothing time constant'.

Filter purge (FilterPurge)	Operation overview
FALSE	When Enable (Enable) becomes FALSE, the slave axis immediately stops regardless of the Filter cumulated value (FilterPool) status. The diagram illustrates the following signals over time: Enable: A digital signal that transitions from FALSE to TRUE and then back to FALSE. Valid: A digital signal that becomes TRUE when Enable transitions to TRUE and returns to FALSE when Enable transitions back to FALSE. Busy: A digital signal that becomes TRUE when Valid is TRUE and returns to FALSE when Valid returns to FALSE. Active: A digital signal that becomes TRUE when Valid is TRUE and returns to FALSE when Valid returns to FALSE. Velocity of Master axis (Master): A continuous signal showing the master axis velocity profile, including acceleration, constant speed, and deceleration. Speed of Slave axis (Slave): A continuous signal showing the slave axis speed profile, which follows the master axis velocity but stops immediately when the master axis decelerates to zero. FilterPool: A continuous signal showing the cumulated filter value, which increases during the slave axis movement and is reset to zero when the slave axis stops.

Valid frequency (ValidFrequency)

- It indicates frequencies which are valid in filter processing.

Filter cumulated value (FilterPool)

- Filter cumulated value (FilterPool) indicates the slave axis movement amount cumulated by filter processing.
- Filter cumulated value (FilterPool) is cleared when Enable (Enable) is set to TRUE.
- If the Filter cumulated value (FilterPool) value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) will occur. When the warning is detected, the error of Filter cumulated value (FilterPool) may be large. For values of the positioning range, refer to the following.

➞ Page 85 Positioning Range

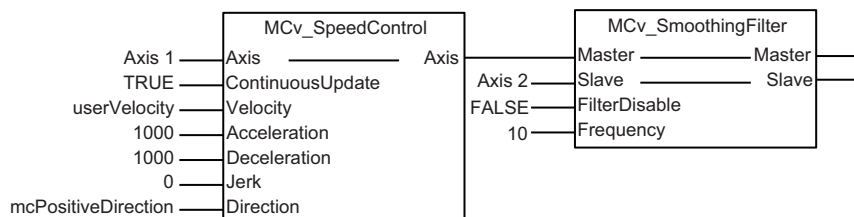
Disposed filter cumulated value (PurgedFilterPool)

- Disposed filter cumulated value (PurgedFilterPool), when Filter disable (FilterDisable) changes to TRUE, displays the disposed Filter cumulated value (FilterPool).
- Disposed filter cumulated value (PurgedFilterPool) does not cumulate.
- Disposed filter cumulated value (PurgedFilterPool) is 0 cleared at FB start.

Program examples

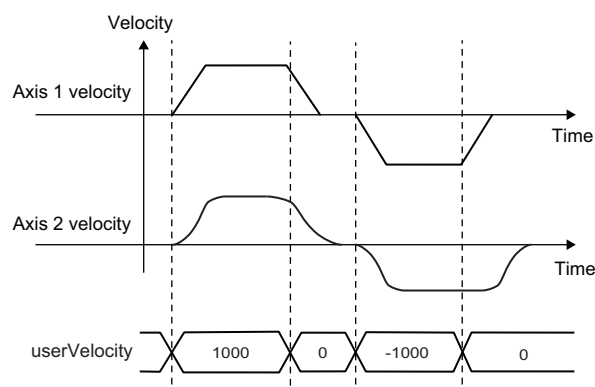
To turn the trapezoidal acceleration/deceleration into smooth acceleration/deceleration waveform

[Program]



[Operation]

As Frequency (Frequency) is set to 10.0, the smoothing time constant will be 0.1 [s].



Precautions

- An operation load increases in smoothing filter as the filter level increases. A rough standard of operation load when the filter level is 5000 is as follows.
RD78G: Approximately 380 [μs]
RD78GH: Approximately 240 [μs]
- Filter level can be calculated by the following formula. After the decimal point is rounded up/down to the nearest integer. However when the result is 0, the operation is carried out as 1 level.
Filter level = (1 / frequency [Hz]) / operation cycle [s]
- The smoothing filter secures the memory to use for filter processing at start. The memory usage can be calculated by the following formula. If memory is insufficient, change maximum RAM size
(System.PrConst.Addon_MotionControl_AxisFilter.RamSizeMax) of Addon MotionControl_AxisFilter parameter
Memory usage = Filter level x 8 bytes
- The operation error may increase when the movement amount of the master axis or the slave axis is large and the following case applies. Confirm the unit setting of the master axis and the slave axis and decrease the movement range. If the error increases, clear the synchronization status or change the current value change of absolute position specification.
When the total sum of the movement amount (following formula) equivalent to filter level at control exceeds the number of significant digits which can be represented by double-precision floating-point (approximately 15 digits)

$$\sum_{i=0}^{\text{Filter level} - 1} (i \text{ the position of master axis before operation cycle} - \text{the position of master axis at starting control})$$

- When the master axis operates in the positive and negative direction alternately every operation cycle, underflow occurs during internal operation and the position error of the master axis and the slave axis may occurs.

Necessary slave object

For details, refer to the following.

📖 Page 477 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 Master axis data source selection (MasterValueSource) to Slave.
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) will be "7: During synchronous operation (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 Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only function block that can be multiple started during movement direction limit filter execution.
- When turning Enable (Enable) to FALSE, execute while the slave axis is in stop status. If Enable (Enable) is turned to FALSE during the slave axis in operation, the slave axis will stop immediately.

Details of setting items

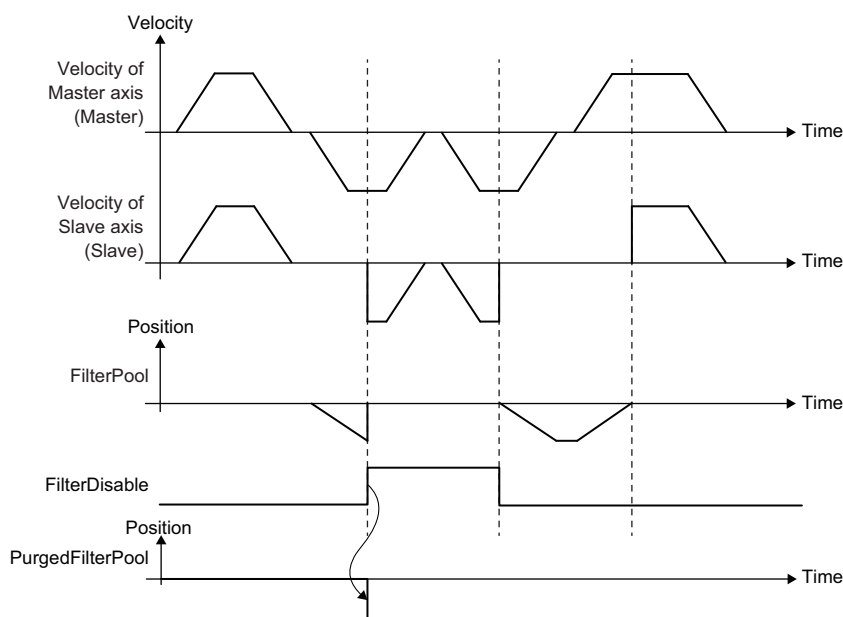
■ Filter disable (FilterDisable)

- When Filter disable (FilterDisable) is FALSE, the axis operates according to the filter setting.
- When Filter disable (FilterDisable) is TRUE, the filter becomes disabled, and Master axis (Master) is transmitted to Slave axis (Slave) as it is.
- When Filter disable (FilterDisable) is turned TRUE, Filter cumulated value (FilterPool) becomes "0.0", and stores the disposed Filter cumulated value (FilterPool) to the Disposed filter cumulated value (PurgedFilterPool).

Ex.

Examples of the following setting:

Input pin	Setting value
Filter operation (Filter)	4: Clamp (Without Ramp at Deceleration)
Positive direction limit (PositiveDisable)	FALSE
Negative direction limit (NegativeDisable)	TRUE



■Positive direction limit (PositiveDisable)/Negative direction limit (NegativeDisable)

- When Positive direction limit (PositiveDisable) is TRUE, Slave axis (Slave) does not operate at Master axis (Master) forward rotation operation.
- When Negative direction limit (NegativeDisable) is TRUE, Slave axis (Slave) does not operate at Master reverse rotation operation.
- When both Positive direction limit (PositiveDisable) and Negative direction limit (NegativeDisable) are set to TRUE, Slave axis (Slave) will not operate even if the Master axis (Master) is operated.

■Filter operation (Filter)

- Depending on Filter operation (Filter) setting, set the slave axis operation at control.

Filter	Operation overview
0: Ignore (Ignore)	• Travel direction is not restricted. • Filter cumulated value (FilterPool) is not updated
2: Truncate (Truncate)	• The movement amount to the restricted direction is ignored, and not added to Filter cumulated value (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 Positive direction limit (PositiveDisable) is FALSE, and Negative direction limit (NegativeDisable) is TRUE The value is not updated when Filter operation (Filter) is "2: Truncate (Truncate)"
4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)	• Adds movement amount of the restricted direction to Filter cumulated value (FilterPool). • Filter cumulated value (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 Filter cumulated value (FilterPool) "0.0" will not deviate. (Ex.) When Positive direction limit (PositiveDisable) is FALSE, and Negative direction limit (NegativeDisable) is TRUE The input travel value is accumulated as a filter cumulated value, and will be reflected when the input travel value moves in the enable direction.

- When setting the out of range value to Filter operation (Filter), the error "Out of Filter Operation Specification Range" (error code: 1A86H) is output.

■Filter cumulated value (FilterPool)

- Filter cumulated value (FilterPool) indicates the slave axis movement amount cumulated by filter processing.
- When Filter cumulated value (FilterPool) status is other than "0", and Enable (Enable) is set to FALSE, Filter cumulated value (FilterPool) holds the status at FALSE set. Filter cumulated value (FilterPool), is cleared when turning Enable (Enable) TRUE next time.
- If Filter cumulated value (FilterPool) value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) is output. When the warning is detected, the error of Filter cumulated value (FilterPool) may increase. For values of the positioning range, refer to the following.

☞ Page 85 Positioning Range

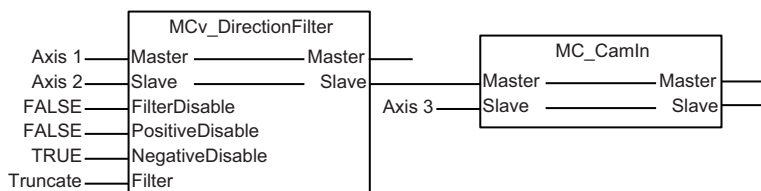
■Disposed filter cumulated value (PurgedFilterPool)

- Disposed filter cumulated value (PurgedFilterPool), when Filter disable (FilterDisable) is set to TRUE, displays the disposed Filter cumulated value (FilterPool).
- Disposed filter cumulated value (PurgedFilterPool) does not cumulate.
- Disposed filter cumulated value (PurgedFilterPool) is 0 cleared at FB start.

Program examples

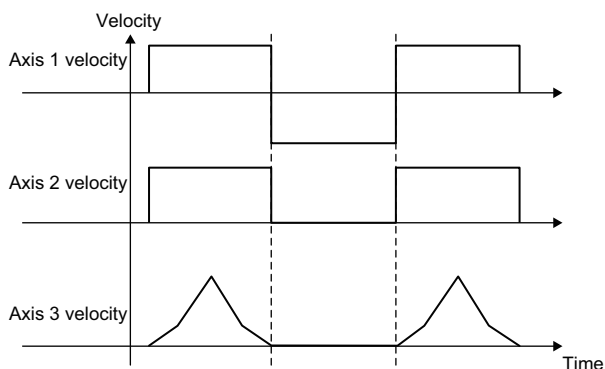
Cam operation direction restriction

[Program]



[Operation]

When MCv_DirectionFilter (Moving Direction Restriction Filter) Master axis (Master) moves to the negative direction, Slave axis (Slave) does not move to the negative direction.



Necessary slave object

For details, refer to the following.

☞ Page 477 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 axis (Master) value set in Master axis data source selection (MasterValueSource) to Slave axis (Slave).
- Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) will be "7: During synchronous operation (SynchronizedMotion)" during speed limit filter execution.
- If a speed limit filter is started while the slave axis is in another operation instruction, the start request will be ignored, and the error "Start Not Possible" (error code: 1AADH) will occur. Start when Axis Status (AxisName.Md.AxisStatus) of Slave axis (Slave) is "4: Standby (Standstill)".
- MC_Stop (Forced Stop) is the only function block that can be multiple started during speed limit filter execution.
- When turning Enable (Enable) to FALSE, execute while the slave axis is in stop status. If Enable (Enable) is turned to FALSE during the slave axis in operation, the slave axis will stop immediately.

Details of setting items

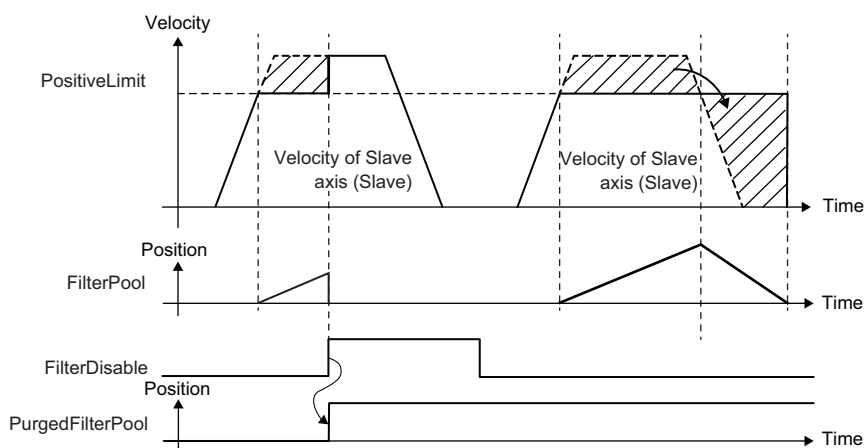
■Filter disable (FilterDisable)

- When Filter disable (FilterDisable) is FALSE, the axis operates according to the filter setting.
- When Filter disable (FilterDisable) is TRUE, the filter becomes disabled, and Master axis (Master) is transmitted to Slave axis (Slave).
- When Filter disable (FilterDisable) is turned TRUE, Filter cumulated value (FilterPool) becomes "0.0", and stores the disposed Filter cumulated value (FilterPool) to Disposed filter cumulated value (PurgedFilterPool).

Ex.

Examples of the following setting:

Input pin	Setting value
Positive direction filter operation (PositiveFilter)	4: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)

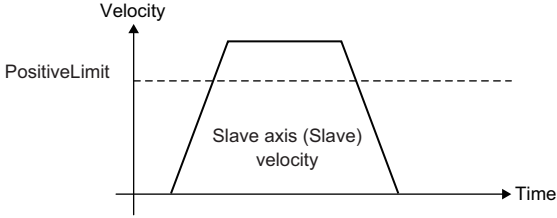
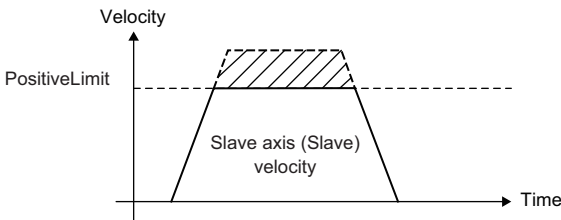
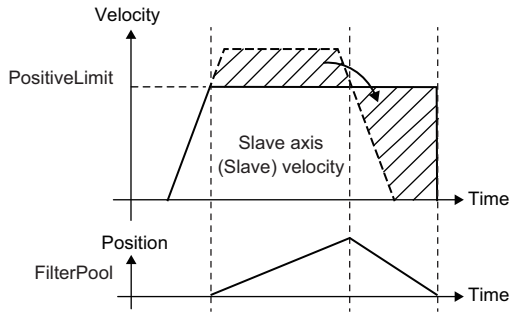
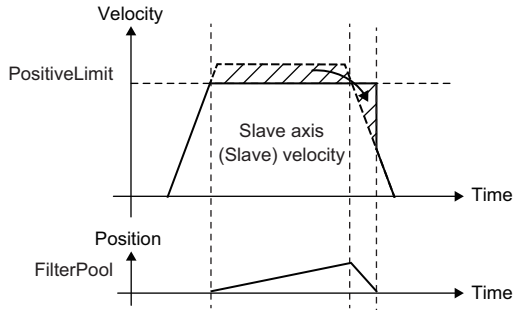


■Positive direction limit value (PositiveLimit)/Negative direction limit value (NegativeLimit)

- Positive direction limit value (PositiveLimit), to the Master axis (Master) positive direction input speed, sets the upper limit value of the speed output to Slave axis (Slave).
- Negative direction limit value (NegativeLimit), to the Master axis (Master) negative direction input speed, sets the upper limit value of the speed output to Slave axis (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 Positive direction limit value (PositiveLimit)/Negative direction limit value (NegativeLimit), the error "Out of Direction Limit Value Specification Range" (error code: 1A87H) is output.

■ Positive direction filter operation (PositiveFilter)/Negative direction filter operation (NegativeFilter)

- Depending on Positive direction filter operation (PositiveFilter) and Negative direction filter operation (NegativeFilter) setting, set the slave axis operation at control.

Filter operation	Operation overview
0: Ignore (Ignore)	- Speed is not limited. - Filter cumulated value (FilterPool) is not updated. 
2: Truncate (Truncate)	- The exceeded control value, is not output to Slave axis (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: Clamp (Without Ramp at Deceleration) (ClampWithoutRamp)	- The exceeded control value is cumulated as Filter cumulated value (FilterPool), and output later. Filter cumulated value (FilterPool) output does not operates deceleration. - When 0.0 is set to the control value, all the master axis input to the applicable direction will be cumulated as Filter cumulated value (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 Filter cumulated value (FilterPool) becomes 0.0. [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 Positive direction filter operation (PositiveFilter) or Negative direction filter operation (NegativeFilter), the error "Out of Filter Operation Specification Range" (error code: 1A86H) is output.

■Filter cumulated value (FilterPool)

- Filter cumulated value (FilterPool) indicates the slave axis movement amount cumulated by filter processing.
- When Filter cumulated value (FilterPool) status is other than "0", and Enable (Enable) is set to FALSE, Filter cumulated value (FilterPool) holds the status at FALSE set. Filter cumulated value (FilterPool), is cleared when Enable (Enable) is set to TRUE next time.
- If the Filter cumulated value (FilterPool) value exceeds the positioning range, the warning "Filter Cumulated Value Over Warning" (warning code: 0D13H) will occur. When the warning is detected, the error of Filter cumulated value (FilterPool) may increase. For values of the positioning range, refer to the following.

☞ Page 85 Positioning Range

■Disposed filter cumulated value (PurgedFilterPool)

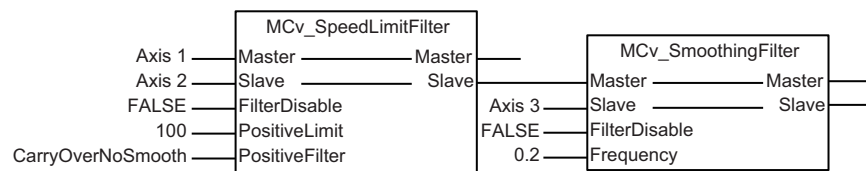
- Disposed filter cumulated value (PurgedFilterPool), when turns Filter disable (FilterDisable) TRUE, displays the disposed Filter cumulated value (FilterPool).
- Disposed filter cumulated value (PurgedFilterPool) does not cumulate.
- Disposed filter cumulated value (PurgedFilterPool), is 0 cleared at FB start.

Program examples

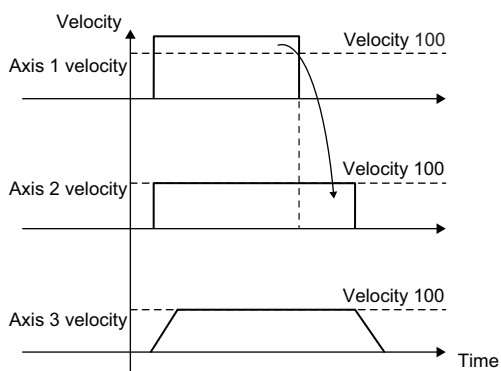
Synchronous encoder speed limit

[Program]

The axis 1 sets the synchronous encoder.



[Operation]



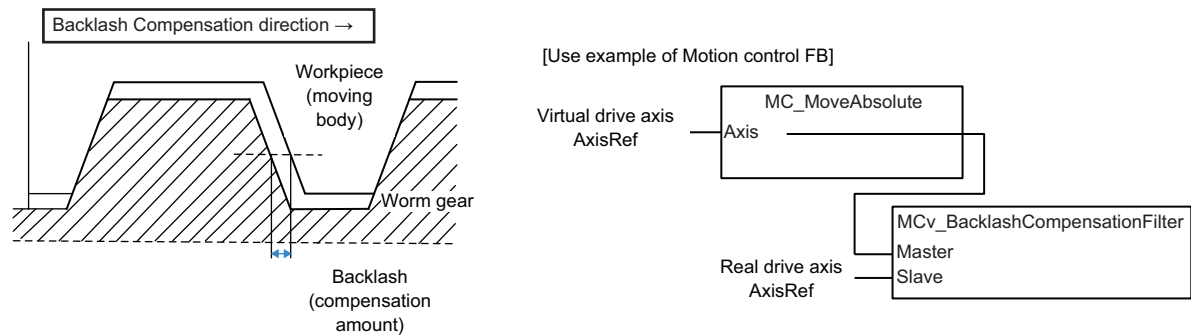
Necessary slave object

For details, refer to the following.

☞ Page 477 Required Slave Object

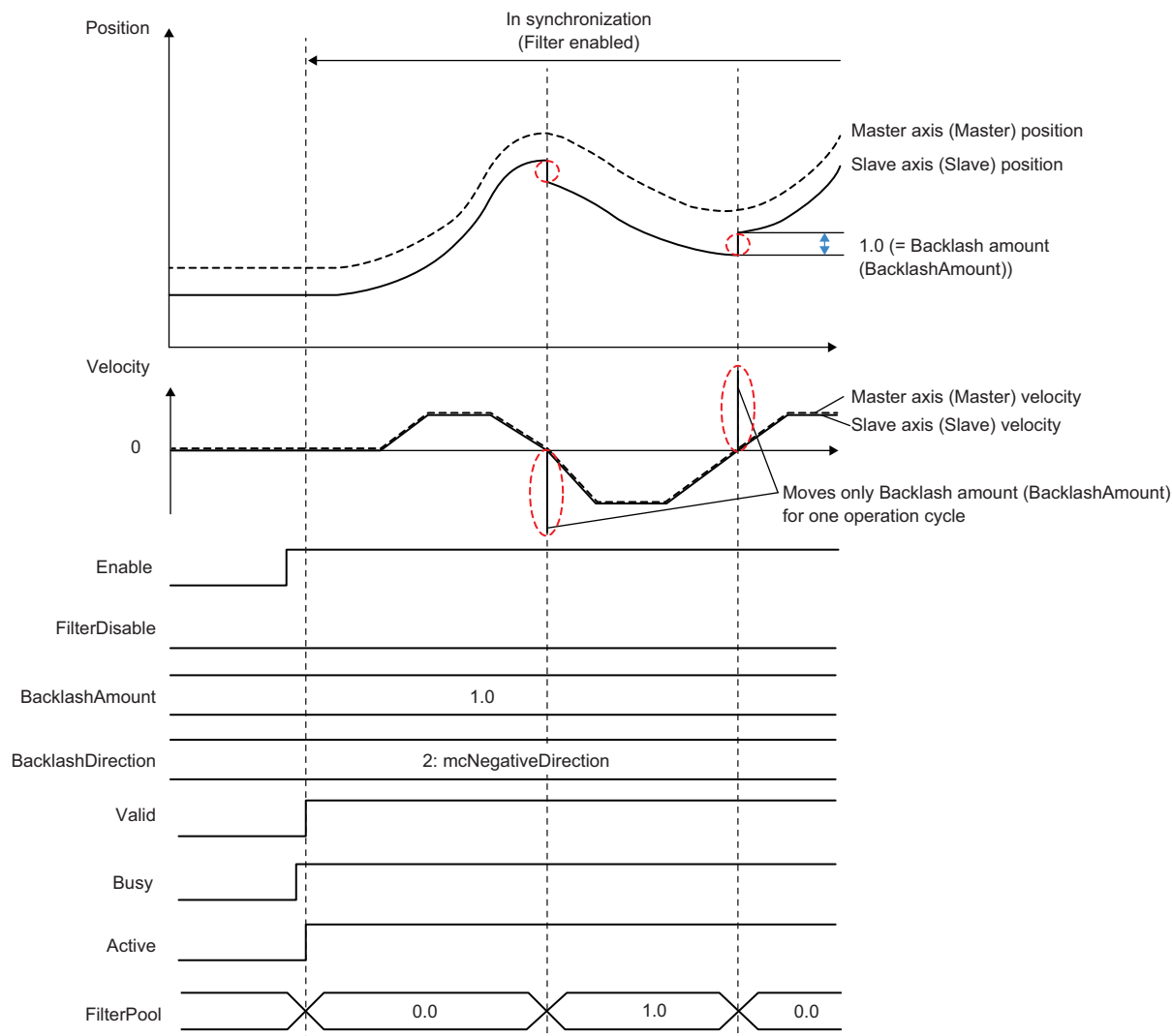
Backlash compensation filter

Backlash compensation filter, is used to compensate the backlash amount in the machine system.



When the movement direction of Master axis (Master) is the same as Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the position equivalent to the Master axis (Master) current position shifted in the Backlash direction (BacklashDirection) by the value of Backlash amount (BacklashAmount).

When the movement direction of Master axis (Master) is the reverse of Backlash compensation direction (BacklashDirection), Slave axis (Slave) synchronizes to the Master axis (Master) current position. Whenever the Master axis (Master) movement direction changes, backlash compensation is performed with the Slave axis (Slave) extra movement amount limited to only the value of Backlash amount (BacklashAmount).



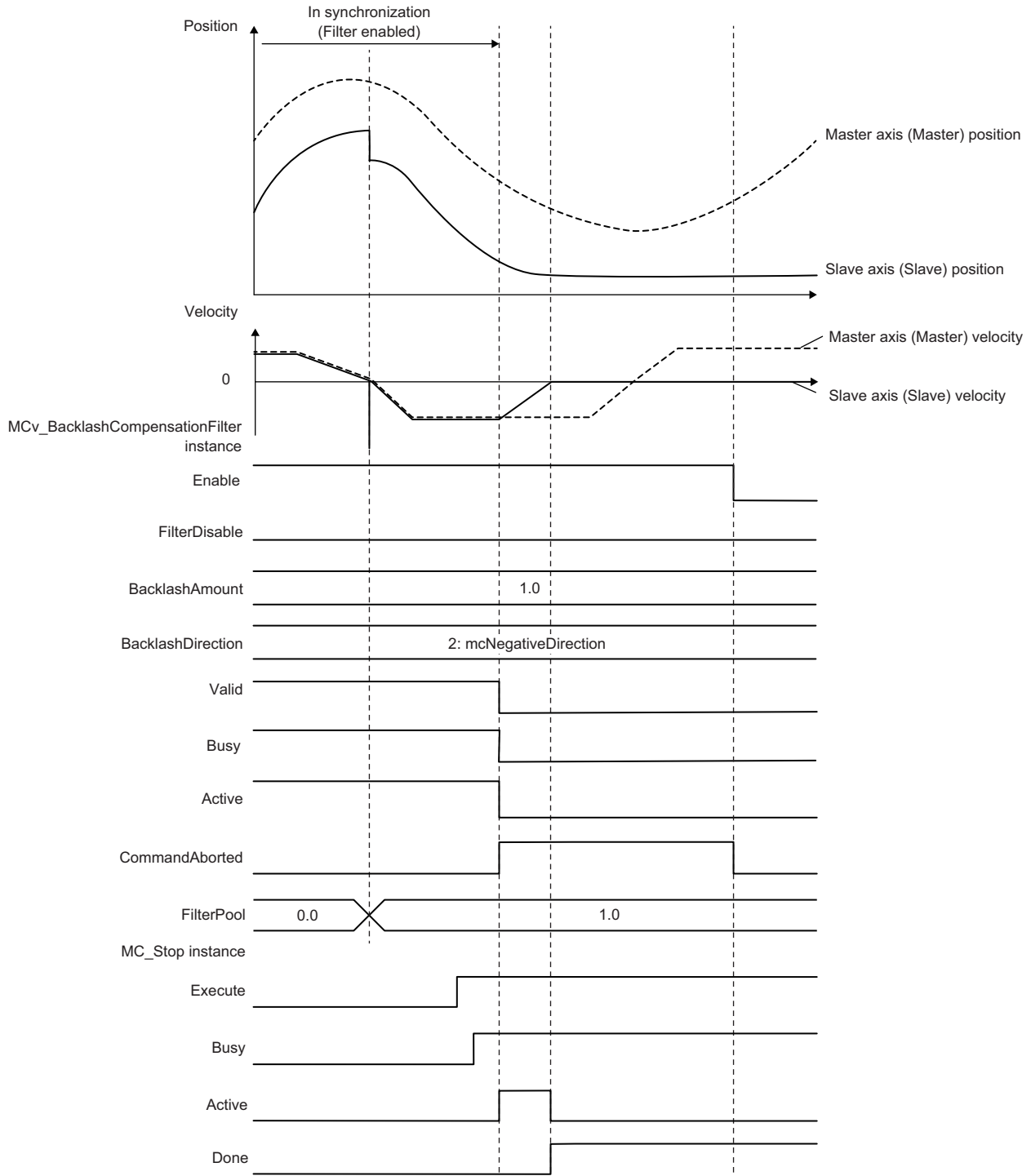
- Stop operation

For details, refer to the following.

☞ Page 476 Start and Stop Operation

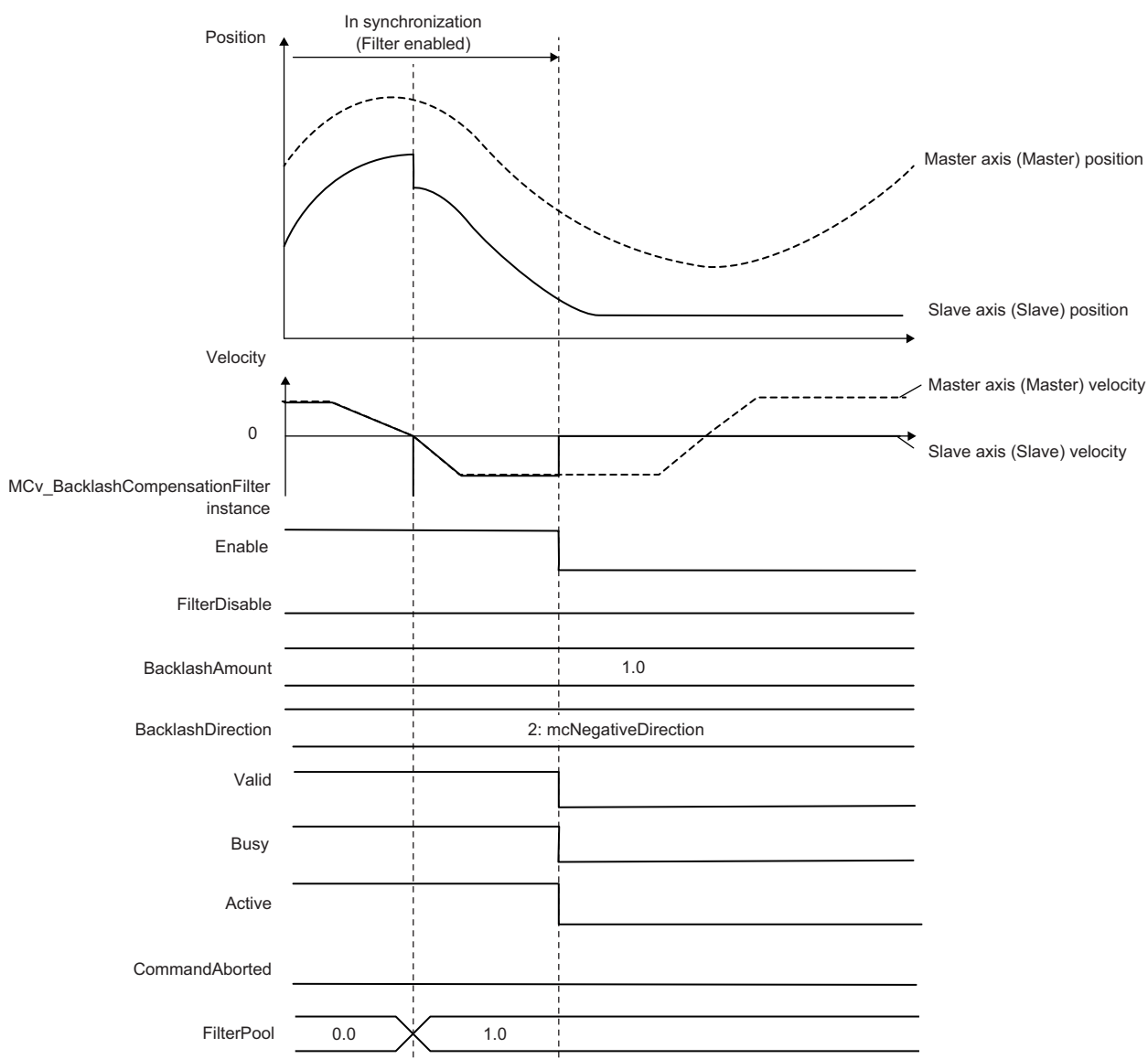
This section describes the specific operation of the backlash compensation filter.

When stop factor occurs to Slave axis (Slave), Slave axis (Slave) starts the stop operation from the synchronous position. The movement amount (Filter cumulated value (FilterPool) value) by the compensation will not be restored.



- Operation at Filter disabled (At Enable (Enable) falling edge)

Slave axis (Slave) stops immediately at the synchronous position when Enable (Enable) falling edge. The travel amount (Filter cumulated value (FilterPool) value) by the compensation will not be restored.



Details of setting items

■Filter disable (FilterDisable)

- When Filter disable (FilterDisable) is FALSE, the axis operates according to the filter setting.
- When Filter disable (FilterDisable) is TRUE, the filter becomes disabled, and Master axis (Master) is transmitted to Slave axis (Slave).
- When Filter disable (FilterDisable) is turned TRUE, Filter cumulated value (FilterPool) becomes "0", and stores the disposed Filter cumulated value (FilterPool) to the Disposed filter cumulated value (PurgedFilterPool).

■Backlash amount (BacklashAmount)

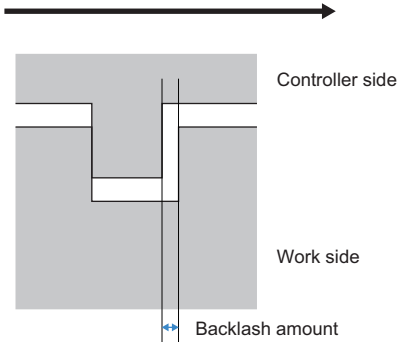
- Sets the backlash amount of the machine system.

■ Backlash compensation direction (BacklashDirection)

- Specifies the backlash compensation direction. Outputs the compensation amount to Slave axis (Slave) when Master axis (Master) movement direction is Backlash compensation direction (BacklashDirection). When backlash compensation filter is enabled (Started with Filter disable (FilterDisable) FALSE, or trail edged Filter disable (FilterDisable) during execution), compensates to the address increase direction of the Master axis (Master) set position that the backlash status of the machine system is in the following relation.

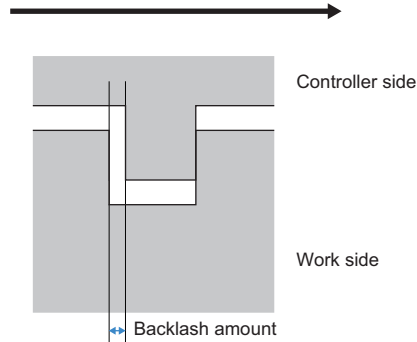
■ Set "1: Positive Direction (mcPositiveDirection)"

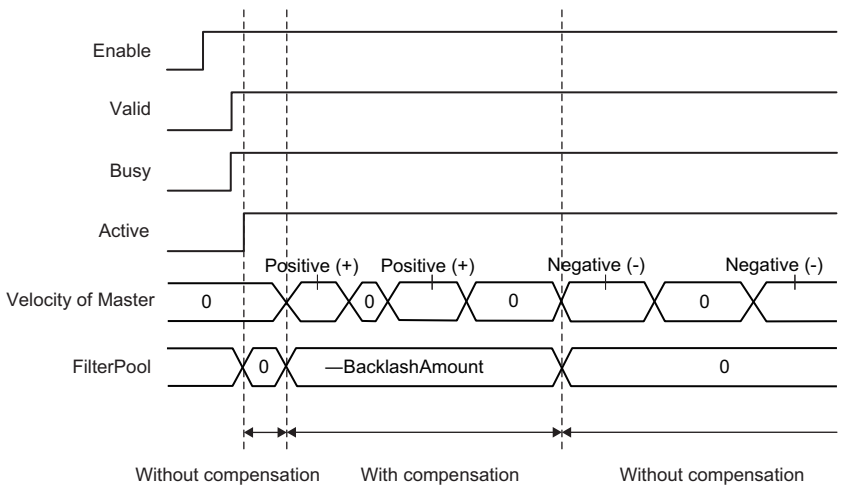
Address increase direction of the set position



■ Set "2: Negative Direction (mcNegativeDirection)"

Address increase direction of the set position



Backlash compensation direction (BacklashDirection)	Operation overview
1: Positive Direction (mcPositiveDirection)	When the travel direction of Master axis (Master) is positive direction, Slave axis (Slave) synchronizes to Master axis (Master) current direction shifts to the positive direction position equivalent to Backlash amount (BacklashAmount).  Without compensation With compensation Without compensation

Backlash compensation direction (BacklashDirection)	Operation overview
2: Negative Direction (mcNegativeDirection)	When the travel direction of Master axis (Master) is negative direction, Slave axis (Slave) synchronizes to Master axis (Master) current direction shifts to the negative direction position equivalent to Backlash amount (BacklashAmount). The diagram illustrates the operation of the backlash compensation filter. It shows the relationship between the Master axis velocity and the Slave axis position. The Master axis velocity is represented by a series of pulses, with negative pulses labeled 'Negative (-)' and positive pulses labeled 'Positive (+)'. The Slave axis position is represented by the FilterPool signal, which shows a period of BacklashAmount during the negative pulses. The diagram is divided into three regions: 'Without compensation' (before the filter is enabled), 'With compensation' (during the filter operation), and 'Without compensation' (after the filter is disabled). The Active signal indicates when the filter is active, and the Valid signal indicates when the filter output is valid. The Busy signal indicates when the filter is busy processing the input.

■Filter cumulated value (FilterPool)

- Filter cumulated value (FilterPool), describes the movement amount of the slave axis cumulated by the filter processing. For backlash filter, the reversed value of Filter cumulated value (FilterPool) positive/negative will be the compensation amount transmitted to the slave axis.

■Options (Options)

Sets the function option to be used by specifying bit.

For bit and function description, refer to the following.

Bit	Function description
0 to 15	Empty (Specify "0".)* ¹
16	Enable filter initial status selection* ¹ Selects the initial status of the backlash compensation filter at enable. 0: First compensation
17 to 31	Empty (Specify "0".)* ¹

*¹ If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs and the function does not start.

- Enable filter initial status selection

Selects the initial status of the backlash compensation filter at enable(When started with Filter disable (FilterDisable) FALSE, or trail edged Filter disable (FilterDisable) during execution).

Setting value	Description
0: First compensation	Despite Master axis (Master) current direction at filter enable, the filter operation starts following the position relation of Master axis (Master) and Slave axis (Slave) current position do not add the backlash compensation.

■Disposed filter cumulated value (PurgedFilterPool)

- Disposed filter cumulated value (PurgedFilterPool), when Filter disable (FilterDisable) is set to TRUE, displays the disposed Filter cumulated value (FilterPool).
- Disposed filter cumulated value (PurgedFilterPool) does not cumulate.
- Disposed filter cumulated value (PurgedFilterPool), is 0 cleared at FB start.

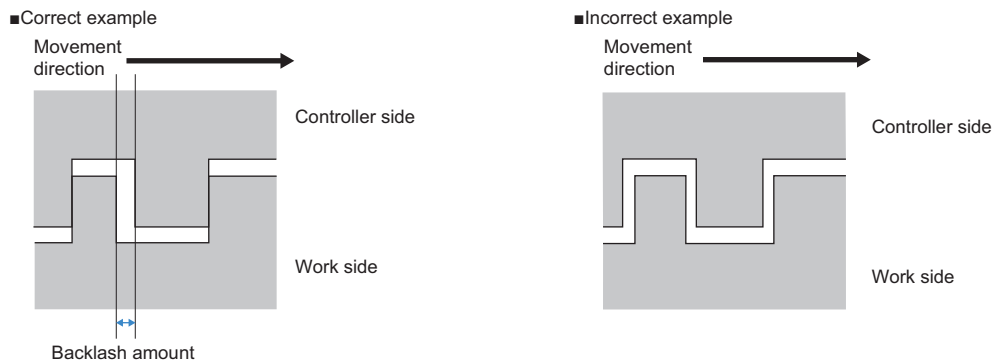
Backlash compensation filter enable procedure

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 maintain the status so that the backlash of the machine system is generated in only one direction as shown in the correct example below.

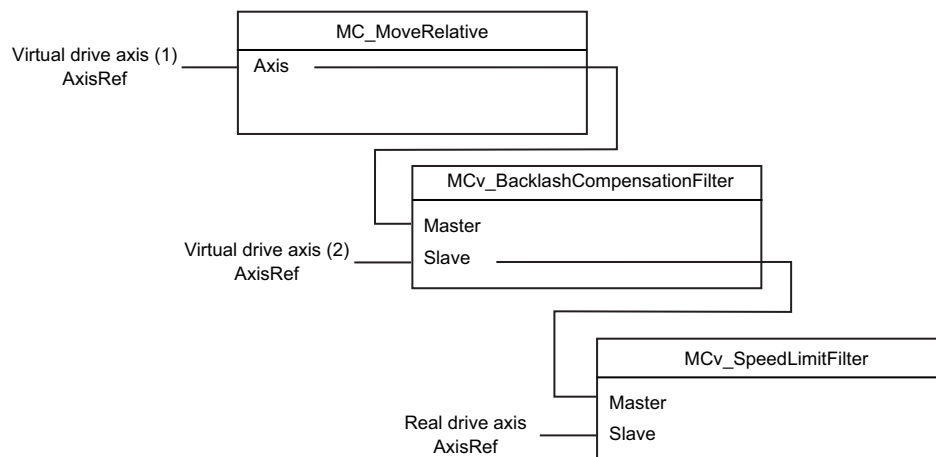


2. Match the Master axis (Master) set position with the real drive axis set position by using the current position change, etc.
3. Set Backlash compensation direction (BacklashDirection) so that it is the reverse direction of the direction that the real drive axis was moved to in Step 1., then start the backlash compensation filter. In addition, start any back part function blocks that are present.

Program example

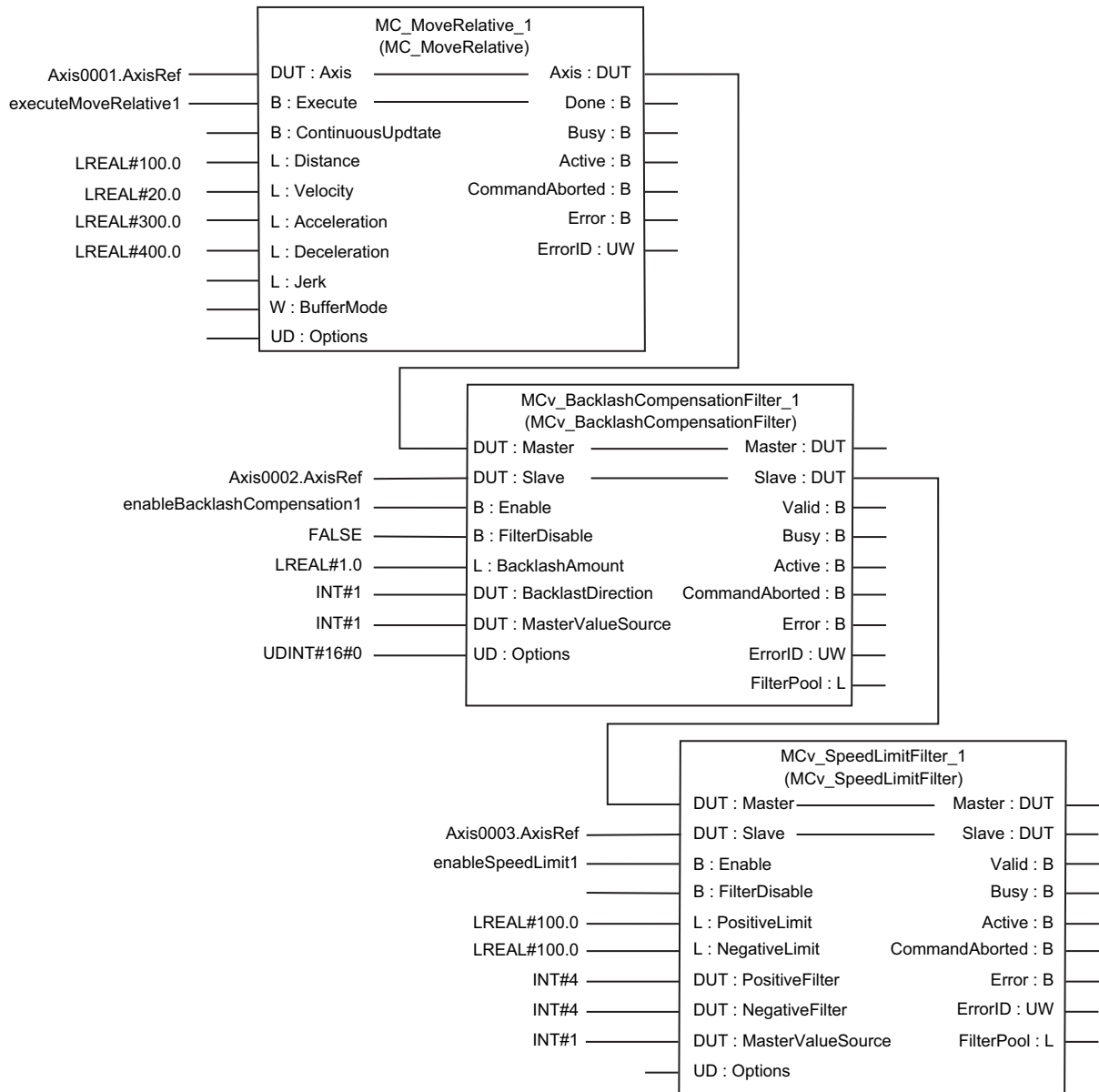
The usage examples of the backlash compensation filter in the program is shown below.

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)

```

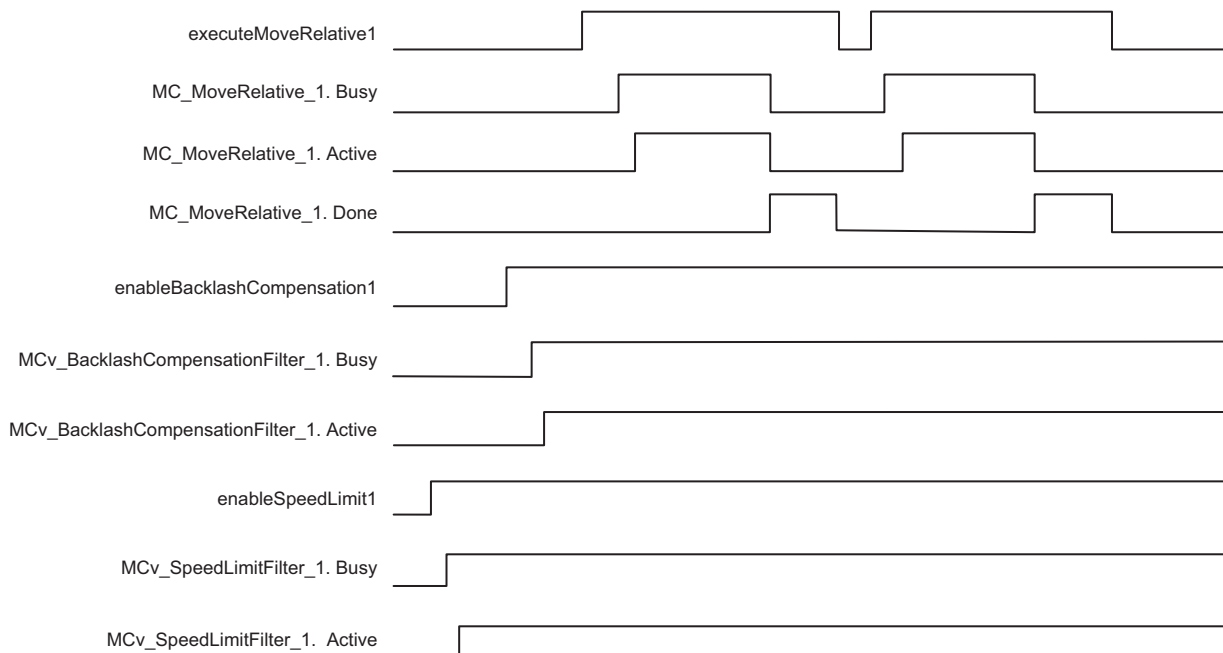
MC_MoveRelative_1.Axis := Axis0001.AxisRef;
MC_MoveRelative_1.Execute := executeMoveRelative1;
MC_MoveRelative_1.Distance := LREAL#100.0;
MC_MoveRelative_1.Velocity := LREAL#20.0;
MC_MoveRelative_1.Acceleration := LREAL#300.0;
MC_MoveRelative_1.Deceleration := LREAL#400.0;
MC_MoveRelative_1();
MCv_BacklashCompensationFilter_1.Master := 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 mechanism (such as rack and pinion mechanism) which the backlash amount changes depending on the machine position.
- Only Slave axis (Slave) Backlash amount (BacklashAmount) moves by one operation cycle at the time of Master axis (Master) movement direction changes. Depending on the value, it may exceed the command frequency that the velocity 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 axis (Slave) current position (such as set position, machine feed value etc.) will be the position that Backlash amount (BacklashAmount) compensation is added. Backlash amount (BacklashAmount) compensation will not be added to the Master axis (Master) current position.

Necessary slave object

For details, refer to the following.

 Page 477 Required Slave Object

Precautions

- Note that if Filter disable (FilterDisable) is switched during operation, Slave axis (Slave) velocity may change rapidly.
- After enabling the command filter, when Master axis (Master) command is not transmitted to Slave axis (Slave) or the back part synchronous control FB by stop factor occurs to Slave axis (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 command (Execute), data such as Target position (Position) and Velocity (Velocity) can be re-imported without interrupting the operation by Execute command (Execute) retrigger.
- When ContinuousUpdate is TRUE at start, data such as Target position (Position) and Velocity (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 on input variables that can be changed and the operation when changing input variables other than the above, refer to details on each FB.

Relevant variables

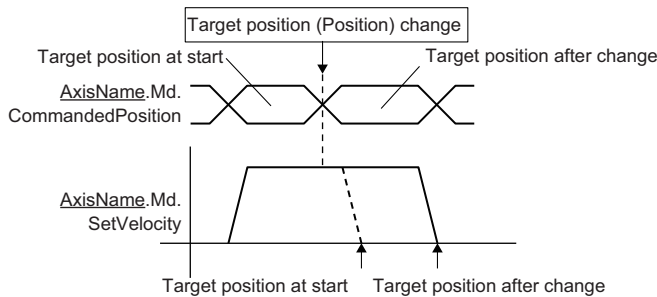
Variable/Structure name	Name	Details
<u>AxisName.Pr.</u>		
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. 1: Immediate Stop (ImmediateStop) 2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)
<u>AxesGroupName.Pr.</u>		
OverrunOperation	Operation Setting at Overrun	Sets operation when an overrun occurs during operation. 1: Immediate Stop (ImmediateStop)

Target position/movement distance change

This function changes the target position and the movement distance.

Target position change

The target position is changed.

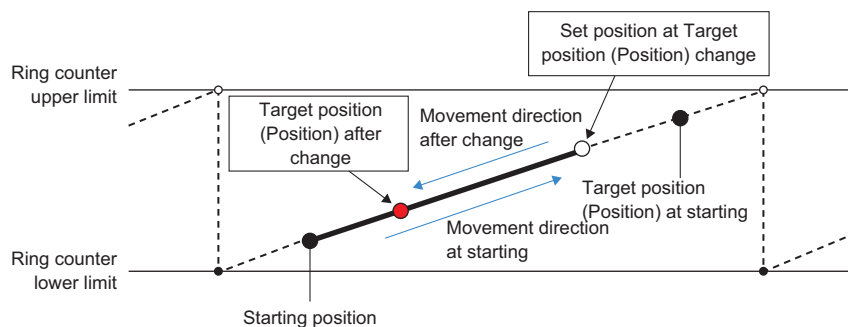


When Direction selection (Direction) can be set, the operation when changing the target position differs depending on the setting value.

■For the positive direction/negative direction/current direction

When the target position is changed, the target position will be calculated not from the set position at the change but from the start position and the direction specified by Direction selection (Direction).

When the target position is changed to between "start position and the set position at the target position change", the operation will be reversed to the target position after change, and the control will be performed according to the selection when having reverse rotation permission selection (Options (Options) bit5).



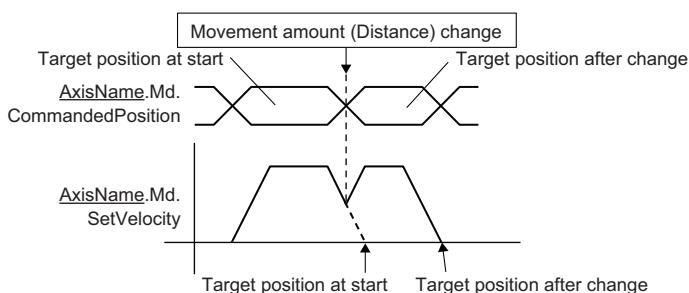
■For the shortest path

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 (Options) bit5).

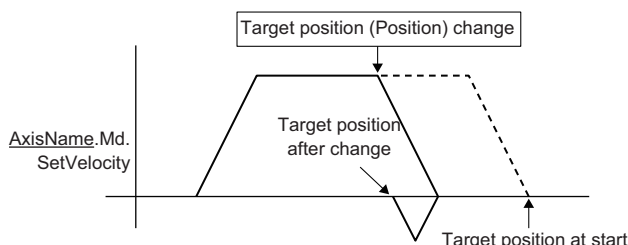
The deceleration distance is not kept by the target position/movement distance change

The control is performed according to the selection when having Operation Setting at Overrun

(AxisName(AxesGroupName).Pr.OverrunOperation) and reverse rotation permission selection (Options (Options) bit5).

■When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options (Options) bit5), a deceleration stop is performed once regardless of the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting. After the deceleration stop is completed, operation is started to the changed target position.

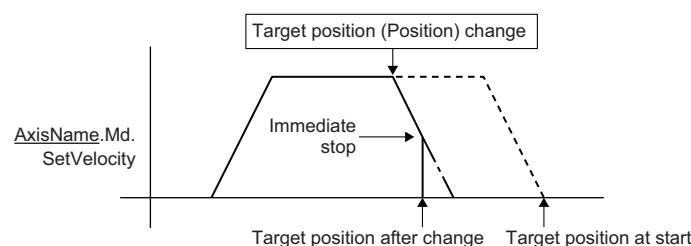


■When the reverse rotation is not allowed

When "1: Do not allow" is set to the reverse rotation permission selection (Options (Options) bit5), the axis operates according to the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting.

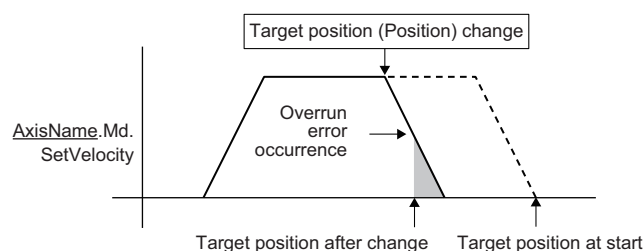
- When "1: Immediate Stop (ImmediateStop)" is set

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: Keep Current Acceleration/Deceleration (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 Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) when the error occurs. To stop the operation with the address which exceeds the stop address, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" in Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).

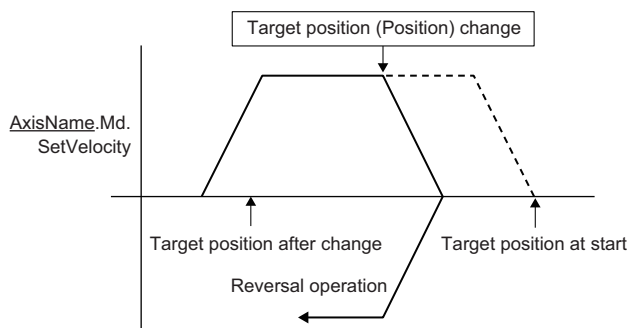


When an operation is reversed by changing the target position/movement distance

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 (Options) bit5).

■When the reverse rotation is allowed

When "0: Allow" is set to the reverse rotation permission selection (Options (Options) bit5), a deceleration stop is performed once. After the deceleration stop is completed, operation is started to the changed target position.

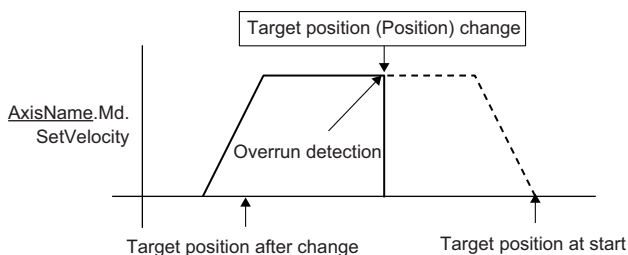


■When the reverse rotation is not allowed

When "1: Do not allow" is set to the reverse rotation permission selection (Options (Options) bit5), the axis operates following the Operation Setting at Overrun (AxisName.Pr.OverrunOperation) setting. When the target position/movement distance is changed, the error "Overrun Error" (error code: 1A7EH) is detected.

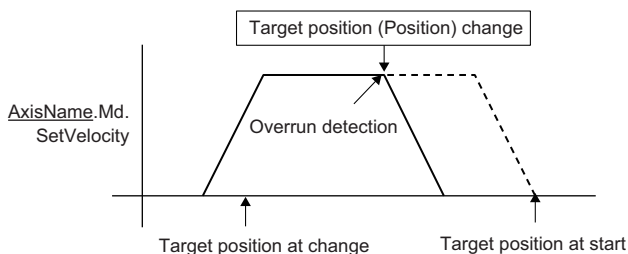
- When setting "1: Immediate Stop (ImmediateStop)"

When changing the target position/movement distance, the error "Overrun Error" (error code: 1A7EH) will be output, and immediately stops.



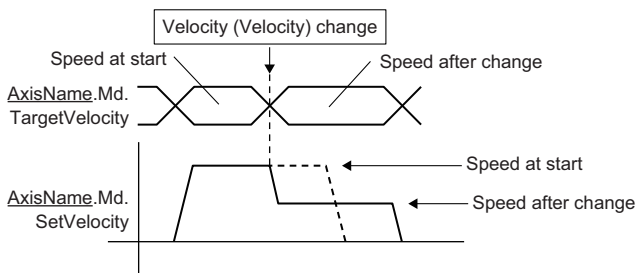
- When setting "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)"

When changing the target position/movement distance, the error "Overrun Error" (error code: 1A7EH) will be output, and stops the operation following the Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General) setting. To perform deceleration stop by current deceleration, set "2: Keep Current Acceleration/Deceleration (KeepCurrentAcc)" to Stop Selection at Stop Cause Occurrence (AxisName.Pr.StopMode_General).



Set velocity change

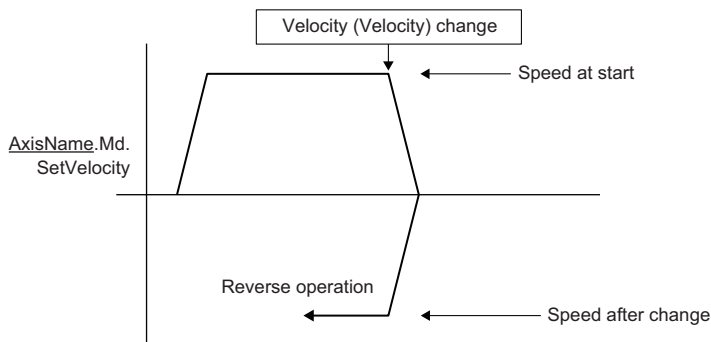
The set velocity is changed according to the acceleration/deceleration.



Set velocity sign inversion during speed control

The negative speed can be set in the speed control.

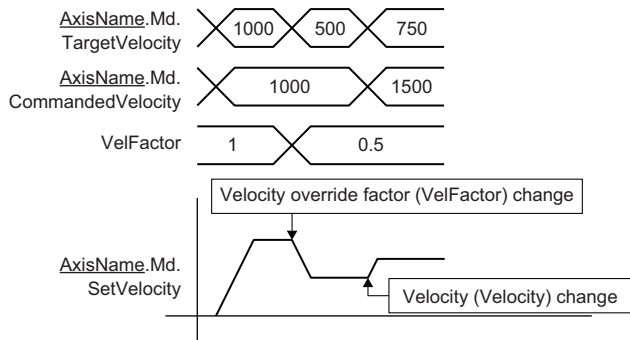
When the sign of set velocity is reversed, the reverse operation will start after a deceleration stop.



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.



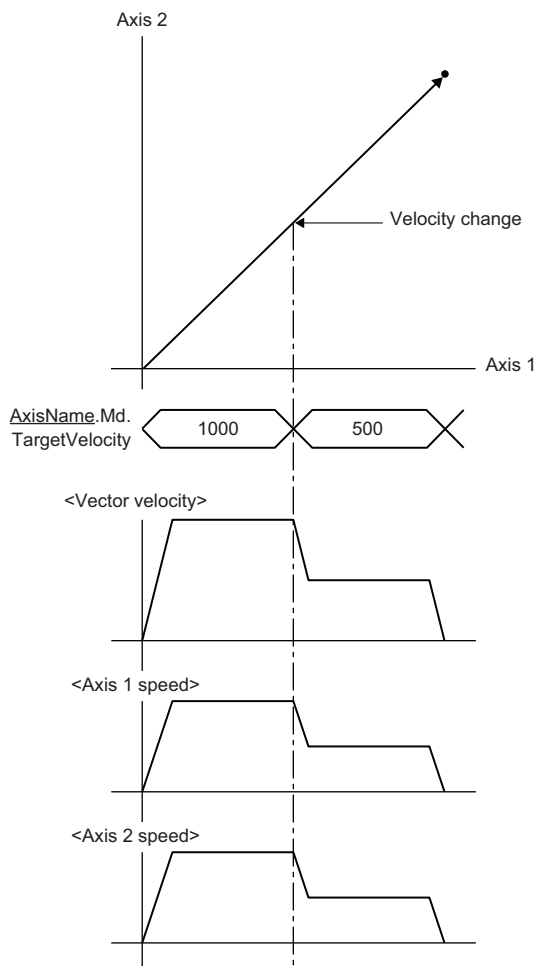
Operation during interpolation control

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 velocity 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 Operation Setting at Overrun

(AxisName(AxesGroupName).Pr.OverrunOperation).

For operation when changing the acceleration/deceleration and the acceleration/deceleration time, refer to the following.

☞ Page 348 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 on 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 200 Forced Stop
- Page 341 Hardware Stroke Limit

Operation of this function for each system status

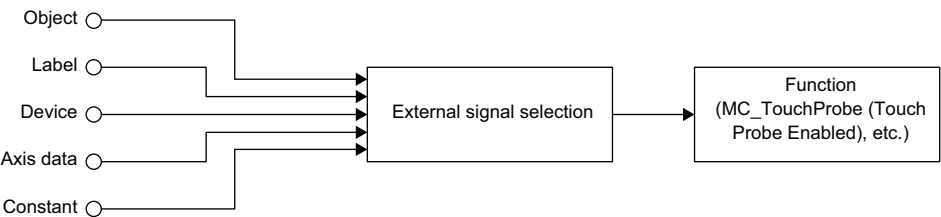
○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

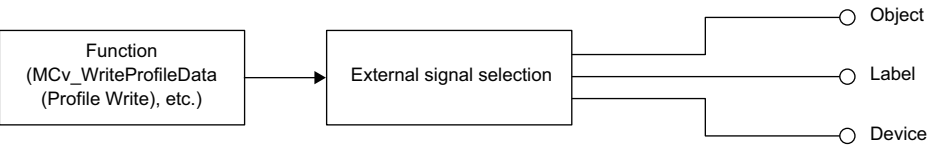
Overall block diagram

The relationship between an external signal selection and function is shown below.

Signal input



Signal output



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 753 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	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

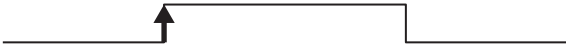
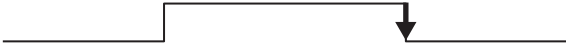
- Specify BOOL type signals which are used in control with the TARGET_REF structure. Data types of [VAR], [DEV], [CONST], and [OBJ] (mapped to cyclic communication) can be used.
- For operation when a signal which cannot be used is set, refer to each function.

Signal Logic

- Specify the signal logic with the MC_SIGNAL_LOGIC enumeration type. For details, refer to the following.

Page 748 ENUM enumerator

Bit input signals

Setting	Operation
0: Detection at TRUE (HighLevel)	When the corresponding signal is in the TRUE status, it operates as a signal input status. Input signal 
1: Detection at FALSE (LowLevel)	When the corresponding signal is in the FALSE status, it operates as a signal input status. Input signal 
2: Detection at FALSE → TRUE (Rising Edge) (RisingEdge)	When the corresponding signal turns from FALSE to TRUE, it operates as a signal input timing. Input signal 
3: Detection at TRUE → FALSE (Falling Edge) (FallingEdge)	When the corresponding signal turns from TRUE to FALSE, it operates as a signal input timing. Input signal 
4: Detection at Rising Edge/Falling Edge (BothEdges)	When the corresponding signal turns from FALSE to TRUE and vice versa, it operates as a signal input timing. Input signal 

Bit output signals

Setting	Operation
0: Detection at TRUE (HighLevel)	When the output command is TRUE, the corresponding signal is turned to TRUE. Output command  Output signal 
1: Detection at FALSE (LowLevel)	When the output command is TRUE, the corresponding signal is turned to FALSE. Output command  Output signal 
2: Detection at FALSE → TRUE (Rising Edge) (RisingEdge)	Must not be specified.
3: Detection at TRUE → FALSE (Falling Edge) (FallingEdge)	Must not be specified.
4: Detection at Rising Edge/Falling Edge (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 (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 63 characters can be stored in Target (Target). When specifying more than 63 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 (mapped to cyclic communication)	[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 <u>@Target modification</u> . Check the specification of the function. When using [OBJ], match the specified type with the object size. Some objects are available as the high-accuracy input. For details, refer to the following.  Page 445 External signal high-accuracy input An object whose size is 1 bytes is not available.	[OBJ]0x607A0020
[VAR]	Label of the motion system	[VAR] <u>Label name</u> Specify a label in the motion system includes in <u>Label name</u> . When specifying the local label, specify the POU ¹ name in <u>@Target modification</u> . 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] <u>MC_SOURCE</u> Specify a MC_SOURCE enumeration type enumerator in <u>MC_SOURCE</u> . Specifying the target data may be required in <u>@Target modification</u> . 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] <u>Device name</u> Specify a device in the module itself in <u>Device name</u> . Following devices can be set. • Buffer memory (G) • Link special relay (SB) • Link special register (SW) <u>@Target modification</u> cannot be specified. (It is ignored.)	[DEV]RWr10.5 [DEV]G11500000.1

Classification	Target	Specifying method of data name	Example
[CONST]	Constant	[CONST] <u>Constant</u> [CONST]0xConstant Specify <u>Constant</u> as floating decimal (E format is also available)/decimal integer/hexadecimal integer. The value can be changed for each cycle by specifying the @ <u>Target</u> <u>modification</u> . 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: Set Value (mcSetValue)	Set value of previous operation cycle	○	○
2: Actual Value (mcActualValue)	Actual value of previous operation cycle	○	×
101: Latest Set Value (mcLatestSetValue)	Set value of latest operation cycle	○	○
102: Latest Actual Value (mcLatestActualValue)	Actual value of latest operation cycle	○	×

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)G11500000, will be handled as [DEV](BOOL)G11500000.0.

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. When @POU is not written, the data is handled as a global label regardless of the setting which uses the same label name for a global label and a 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. When the data type is REAL or LREAL, this setting is invalid.		*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.

External signal high-accuracy input

When signals which is compatible with the external signal high-accuracy input are used for functions which have Trigger input signal (TriggerInput) as the input, high-accuracy control using signal detection time of input devices can be performed.

For usable signals and setting methods, refer to the following.

When the signal type is [OBJ]:  Connectable device to CC-Link IE TSN

List of function which is compatible with the external signal high-accuracy input

- Touch probe

Precautions

Relevant add-ons

The following add-on is required to use this function.

- SignalIO
- Axis^{*1}
- ServoDriver_CANopen^{*2}

^{*1} When using [AXIS] as the signal type

^{*2} When using [OBJ] as the signal type

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

12.2 Touch Probe

This function records (latches) arbitrary data at trigger input signal detection.

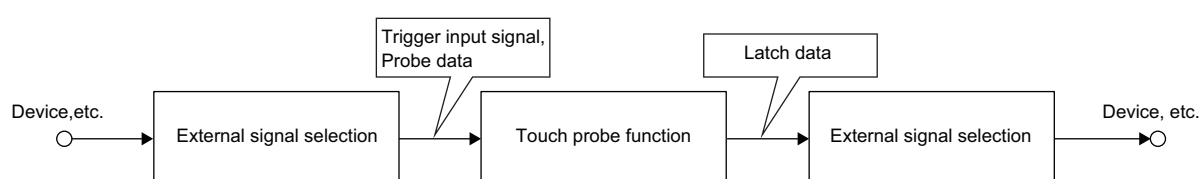
Operation of this function for each system status

○: Possible, ×: Not possible

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

Overall block diagram

The relationship between the touch probe function and other functions is shown below.



Relevant FBs

MC_TouchProbe

Item	Description
Function overview	Optional data will be recorded due to the trigger event occurrence.
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 754 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission not possible	Page 439 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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Continuous update	ContinuousUpdate	BOOL	↑	TRUE, FALSE	FALSE	During TRUE, it can continuously change Enabled window (WindowOnly), Lower limit position (FirstPosition), and Upper limit position (LastPosition).
Enabled window	WindowOnly	BOOL	↑/R/C	TRUE, FALSE	FALSE	When it is TRUE, triggers are detected only in the areas defined by lower limit position and upper limit position.
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 includes the upper limit position.
Probe data	ProbeData	TARGET_REF	↑	—	—	Sets the probe data.  Page 442 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: One Shot Mode (OneShot) 1: Frequency Specified Mode (RecordCount) 2: Ring Buffer Mode (RingBuffer)
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 Latch position (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 has been aborted because of an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated is returned. For details, refer to the following.  Page 711 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 754 Axis variables
Trigger input signal	TriggerInput	MC_TRIGGER_REF	↑	—	Omission possible	Page 439 External Signal Selection

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	TRUE, FALSE	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)	0	The error code generated in the FB is returned. For details, refer to the following. Page 711 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 (Touch Probe Enabled). To stop this function, execute MC_AbortTrigger (Touch Probe Disabled).

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 Trigger input signal (TriggerInput) (indicate trigger input signal as follows).
- When Enabled window (WindowOnly) is 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 Latch position (RecordedPosition) and Storage location of latch data (OutputBuffer) according to Latch mode (RecordMode), and Number of latch times (RecordedCounter) is updated.

■Estimated calculation

The prove data during operation cycle interval is calculated by estimation. The value calculated by estimation at the timing inputted Trigger input signal (TriggerInput) is the latch data. The value is calculated as the figure below.

[When the prove data is the WORD type]

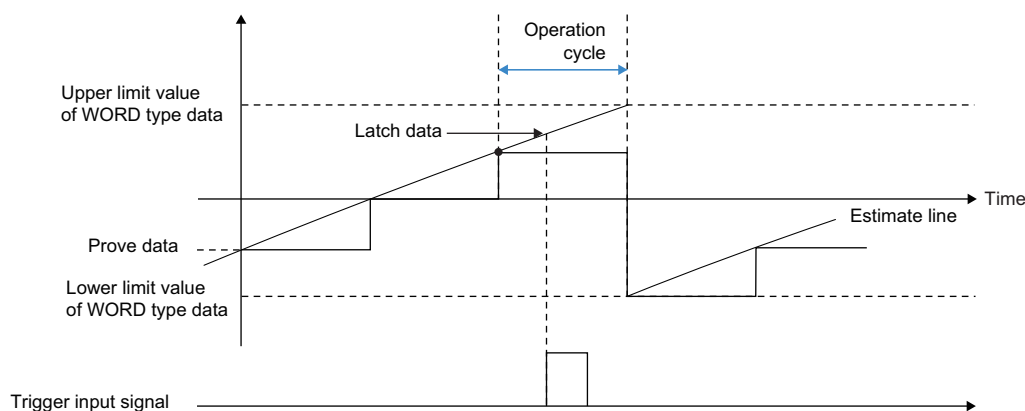
- When using the external signal high-accuracy input

Trigger input timing is when the signals are detected at the slave station.

For setting method of high-accuracy input of the external signal selection, refer to the following.

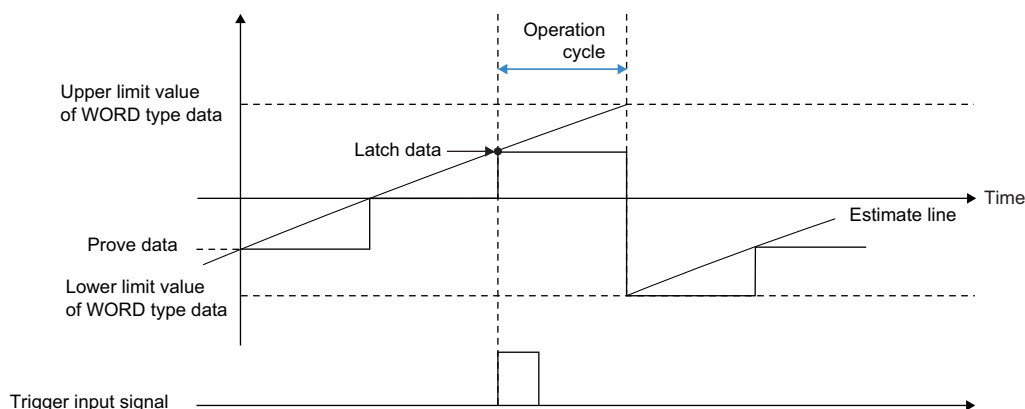
📖 Page 439 External Signal Selection

For accuracy of signal detection time, refer to the manual of the slave device to use.



- When the external signal high-accuracy input is not used

The trigger input timing is operation cycle.



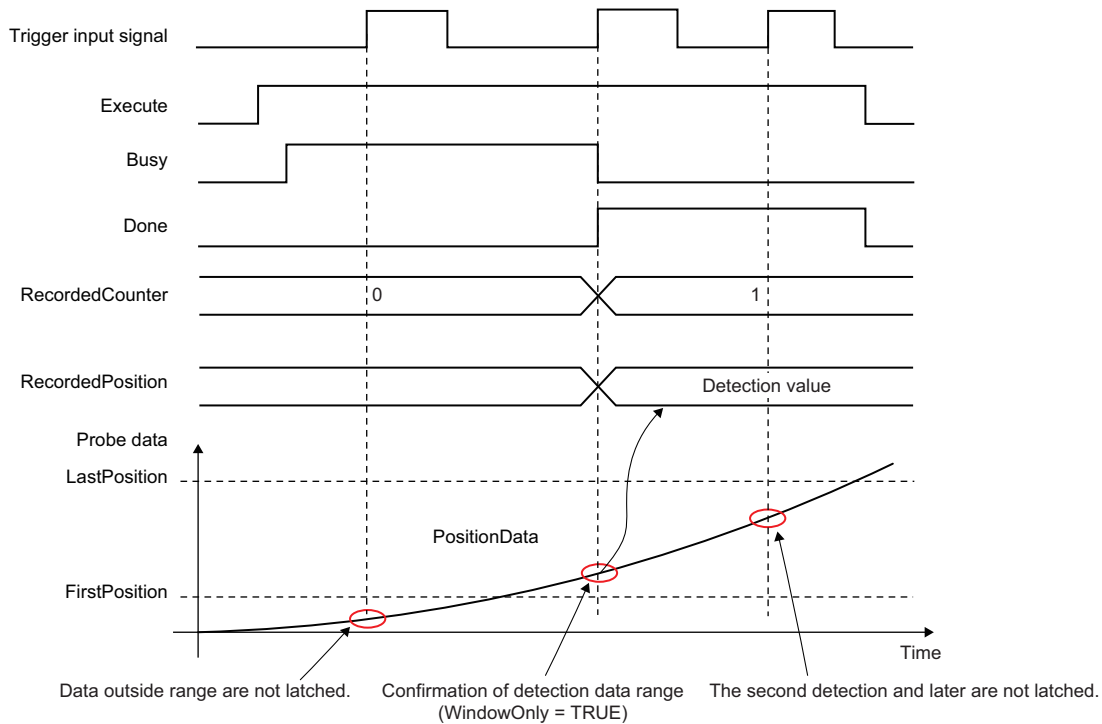
■Timing chart

[When the FB is normally completed]

The following shows examples of latch operation by Latch mode (RecordMode).

Ex.

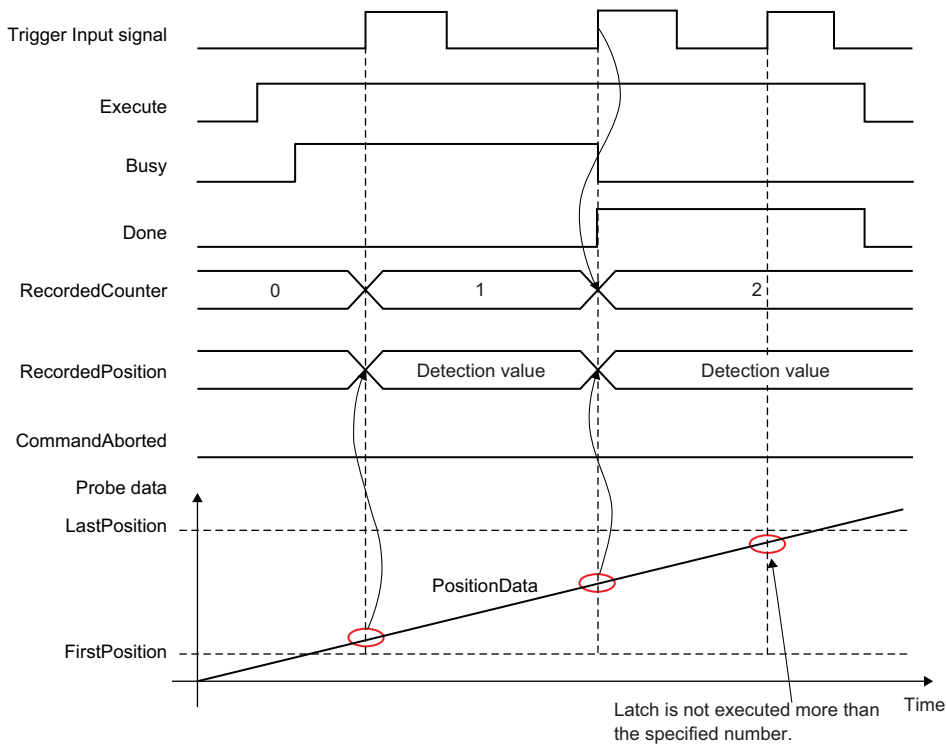
For Latch mode (RecordMode) = "0: One Shot Mode (OneShot)"



Ex.

For Latch mode (RecordMode) = "1: Frequency Specified Mode (RecordCount)"

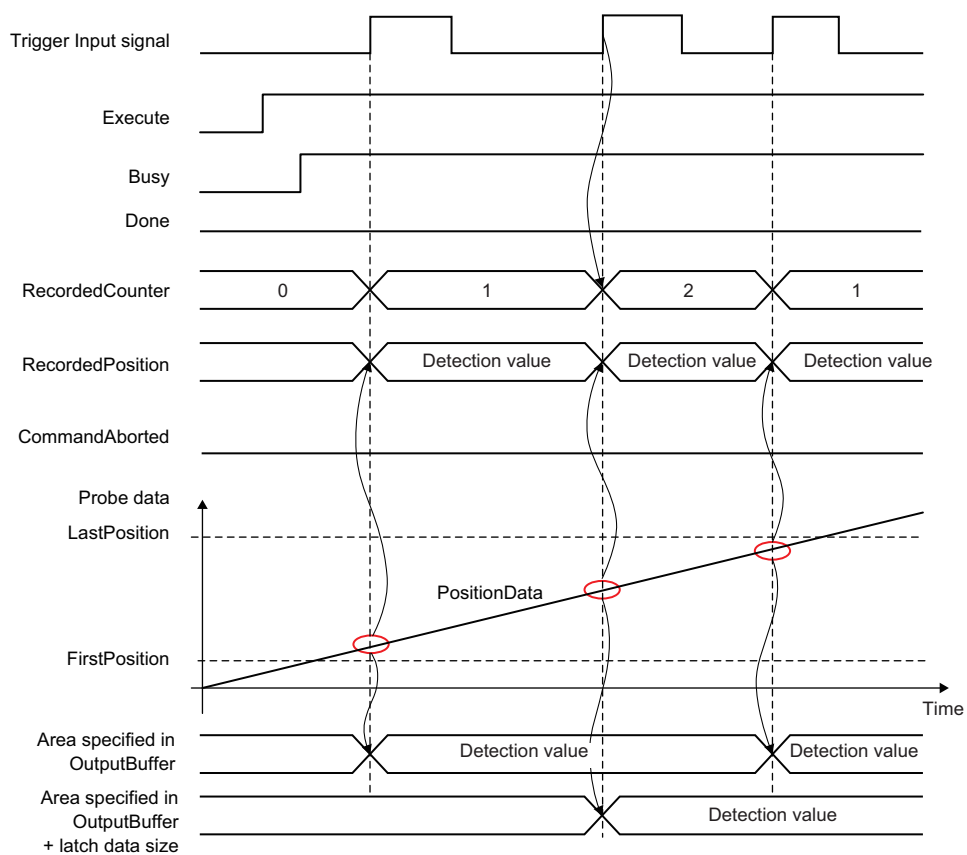
Number of latch times (RecordedCounter): 2



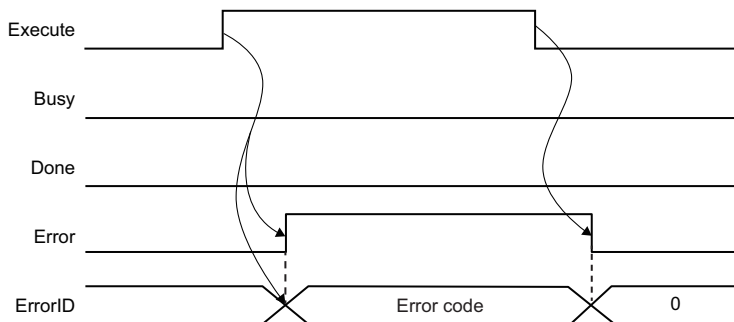
Ex.

For Latch mode (RecordMode) = "2: Ring Buffer Mode (RingBuffer)"

Number of latches: 2



[When an error occurs]



Details of setting items

■Trigger input signal (TriggerInput)

Trigger input signal is specified in MC_TRRIGER_REF structure.

Setting range of Trigger Signal (TriggerInput.Signal) is shown below.

Item	Setting range
TriggerInput.Signal	
Target (Source.Target)	Type which can be specified • BOOL Data type which can be used • [VAR] • [DEV] • [CONST] • [OBJ]
Signal detection method (Detection)	2: Detection at FALSE → TRUE (Rising Edge) (RisingEdge) 3: Detection at TRUE → FALSE (Falling Edge) (FallingEdge) 4: Detection at Rising Edge/Falling Edge (BothEdges)
Compensation time (CompensationTime)	-5.0 to 5.0 [s]
Filter Time (FilterTime)	0.0 to 5.0 [s]

When [OBJ] is specified and the target modification is omitted, the objects of Axis information (Axis) is referred. Note that if the axis of Axis information (Axis) does not have station address, or the station address is not set, an error occurs.

When [OBJ] is specified and the station address is specified by the target modification, Axis information (Axis) is ignored.

When the slave emulate function is enabled and the station address is set on the station referred at specifying [OBJ], the emulated objects are referred.

The external signal high-accuracy input is available for [OBJ]. For detail, refer to the following.

 Page 439 External Signal Selection

Point

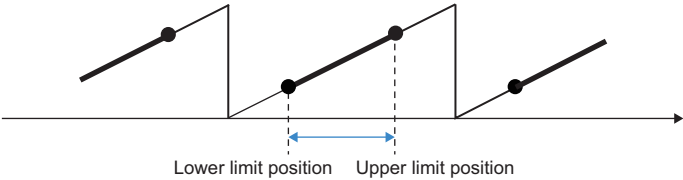
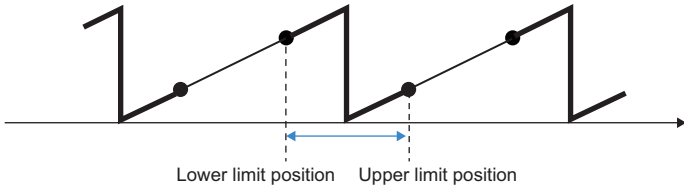
When using the external signal high-accuracy input, set 0 to Filter Time (TriggerInput.Signal.FilterTime). If a value other than 0 is set, the signal detection time cannot be acquired correctly.

If the input filter exists on slave devices, use the filter of slave devices.

If the input filter does not exist on slave devices, Use Enabled window (WindowOnly), Lower limit position (FirstPosition), and Upper limit position (LastPosition) of MC_TouchProbe (Touch Probe Enabled) together and prevent incorrect detection of the trigger signal because of noise.

■Enabled window (WindowOnly)/Lower limit position (FirstPosition)/Upper limit position (LastPosition)

When Enabled window (WindowOnly) is Valid (TRUE), triggers are detected only within the range between Lower limit position (FirstPosition) and Upper limit position (LastPosition) of the probe data. When it is Invalid (FALSE), the touch probe processing is executed to the all range.

Upper limit position (LastPosition), Lower limit position (FirstPosition) relation	Touch probe processing
Upper limit position (LastPosition) > Lower limit position (FirstPosition)	The touch probe processing is executed when the probe data is more than Lower limit position (FirstPosition) and less than Upper limit position (LastPosition). [Operation example] 
Upper limit position (LastPosition) < Lower limit position (FirstPosition)	The touch probe processing is executed when the probe data is less than Upper limit position (LastPosition) or more than Lower limit position (FirstPosition). [Operation example] 

■Probe data (ProbeData)

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 information (Axis) is referred. The Target modification of [AXIS] (@Position, etc.) needs to be specified.

When [OBJ] is specified and the target modification is omitted, the objects of Axis information (Axis) is referred. Note that if the axis of Axis information (Axis) does not have station address, or the station address is not set, an error occurs.

When specifying [VAR], [DEV], or [OBJ] (the station address is specified by the target modification), Axis information (Axis) is ignored.

When the slave emulate function is enabled and the station address is set on the station referred at specifying [OBJ], the emulated objects are referred.

[For the version of Add-on MotionControl_General, Ver. 1.15 or earlier]

When specifying the data other than LREAL type for Target (TARGET_REF.Target), note that the latched data is stored as the LREAL type and specify (LREAL) for the data type explicitly as the setting example below.

Ex.

Setting example of Target (TARGET_REF.Target)

[DEV](LREAL)G11500000

[VAR]OutputBufferData1(OutputBufferData1 is LREAL type instance)

[VAR](LREAL)OutputBufferData2(OutputBufferData2 is WORD type instance)

The data is updated as the ring counter. The upper limit value or the lower limit value of the ring counter differs depending on the data classification or the data type of Probe data (ProbeData).

When the data classification is [DEV] or [VAR], the upper limit value or the lower limit value of the ring counter is the maximum value/the minimum value of the data type.

Ex.

The data classification is [AXIS].

Modification	Ring counter upper limit value/lower limit value
@Position	The ring counter upper limit value/lower limit value of the axis
@CumulativePos	The positioning range upper limit value/lower limit value of the axis

The data classification is [VAR].

Label	Ring counter upper limit value/lower limit value
WORD type label	The maximum value/minimum value of the data type Ring counter upper limit value: 65535 Ring counter lower limit value: 0

Restriction

The change amount per 1 operation cycle should meet the following formula. If it does not meet the formula, the actual change amount of the probe data and the latched change amount may not match.

The change amount per 1 operation cycle < |(The ring counter maximum value) - (The ring counter minimum value) + 1| / 2

Precautions

If the operation cycle over occurs after Executing (MC_TouchProbe.Busy) is TRUE, accuracy of estimated calculation may deteriorate.

■ Compensation time (CompensationTime)

Delay time of a touch probe processing is compensated. Set this item to compensate a proper delay of the touch probe process separately from the compensation time for the trigger input signal. Set the positive value to compensate the delay, and negative value to compensate the process.

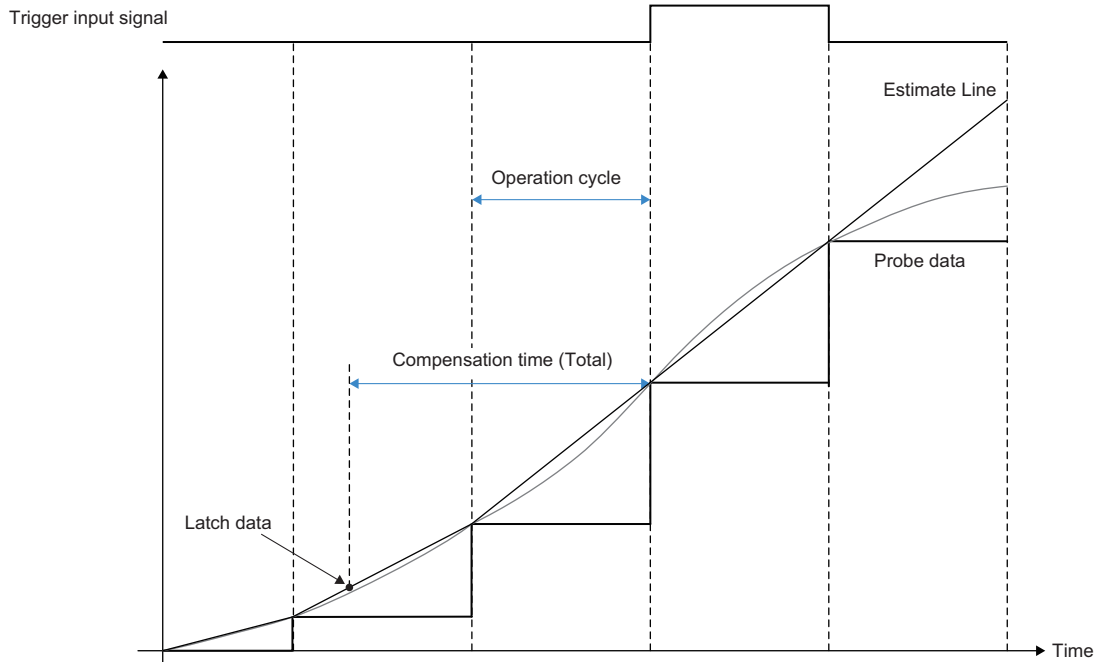
Total compensation time is Compensation time (CompensationTime) - Compensation Time (TriggerInput.Signal.CompensationTime).

Point

When compensating the delay time, the past value is used for latch data estimate calculation. Thus, at the time the compensation time from Executing (Busy) = TRUE timing is elapsed, the accuracy will be at the maximum. The compensation time and the operation cycle consume the memory amount as follows.
Memory consumption = 24 bytes × (total compensation time ÷ operation cycle)

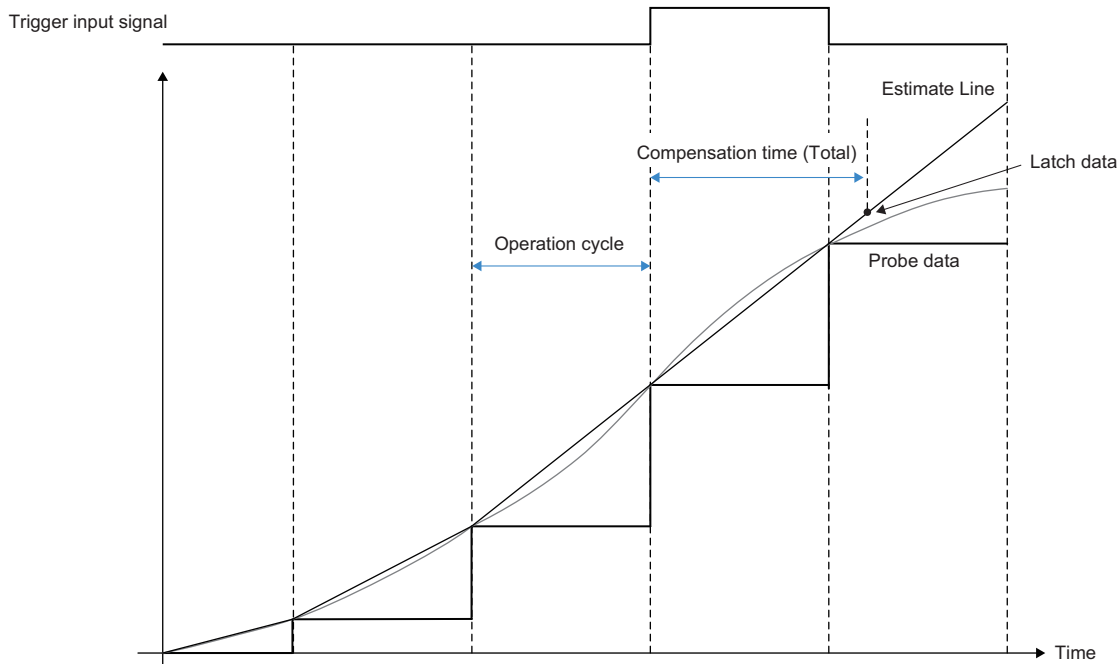
- When compensating for delays (When the total compensation time is positive value)

The estimate is calculated based on the operation cycle data after latching and before the compensation time is passed.



- When compensating for the progression (When the total compensation time is positive value)

The estimate is calculated based on the operation cycle data at latching.



■ Latch mode (RecordMode)

Latch method of data is specified by Latch mode (RecordMode).

[Latch mode (RecordMode) = "0: One Shot Mode (OneShot)"]

- Latch data is stored only one shot.

[Latch mode (RecordMode) = "1: Frequency Specified Mode (RecordCount)"]

- Latch data is stored for the setting value of Number of latch times (RecordCount).
- Latch data is stored in the area shifted for the latch data size per latch, to the storage location set in Storage location of latch data (OutputBuffer) in front.
- To stop touch probe function before completing latch for Number of latch times (RecordCount), execute MC_AbortTrigger (Touch Probe Disabled).

[Latch mode (RecordMode) = "2: Ring Buffer Mode (RingBuffer)"]

- Latch data is stored to the ring buffer for the setting value of Number of latch times (RecordCount). The latch operation is always carried out.
- Latch data is stored to the ring buffer for Number of latch times (RecordCount) after shifted for latch data size per latch, to the storage location set in Storage location of latch data (OutputBuffer) in front.
- To stop touch probe function before completing latch for Number of latch times (RecordCount), execute MC_AbortTrigger (Touch Probe Disabled).

Following value is stored for Number of latch times (RecordedCounter) and Latch position (RecordedPosition) by Latch mode (RecordMode).

Latch mode (RecordMode)	Number of latch times (RecordedCounter)	Latch position (RecordedPosition)
0: One Shot Mode (OneShot)	1 by latch operation.	Stores latch data only one shot.
1: Frequency Specified Mode (RecordCount)	+ 1 by latch operation.	Stores latest latch data by latch operation.
2: Ring Buffer Mode (RingBuffer)	+ 1 by latch operation. Returned 0 when more than Number of latch times (RecordCount).	Stores latest latch data by latch operation.

■ Number of latch times (RecordCount)

Following value is specified for Number of latch times (RecordCount) by Latch mode (RecordMode).

Latch mode (RecordMode)	Number of latch times (RecordCount)
0: One Shot Mode (OneShot)	Ignores.
1: Frequency Specified Mode (RecordCount)	Specifies number of latch times of data. When omitted, the error "Latch Count Incorrect" (error code: 3408H) occurs.
2: Ring Buffer Mode (RingBuffer)	Specifies number of ring buffer times of data. When omitted, the error "Latch Count Incorrect" (error code: 3408H) occurs.

■Storage location of latch data (OutputBuffer)

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 (TARGET_REF.Target LREAL).

Latch mode (RecordMode)	storage location
0: One Shot Mode (OneShot)	The area specified by Storage location of latch data (OutputBuffer)
1: Frequency Specified Mode (RecordCount)	Following area Area specified by Storage location of latch data (OutputBuffer)+ Number of latch times (RecordedCounter) × Latch data size
2: Ring Buffer Mode (RingBuffer)	

Storage location of latch data (OutputBuffer) can be omitted. When omitting, the latch data is stored only in Latch position (RecordedPosition).

A setting example of Target (TARGET_REF.Target) is shown below.

Ex.

When Latch mode (RecordMode) = "0: One Shot Mode (OneShot)" or Latch mode (RecordMode) = "1: Frequency Specified Mode (RecordCount)", Number of latch times (RecordCount) = 1 with "2: Ring Buffer Mode (RingBuffer)"

[DEV](LREAL)G11500000

[VAR]OutputBufferData1 (OutputBufferData1 is LREAL type instance)

When Latch mode (RecordMode) = "1: Frequency Specified Mode (RecordCount)", Number of latch times (RecordCount) = 100 with "2: Ring Buffer Mode (RingBuffer)"

[DEV](LREAL[1..100])G11500000

[VAR]OutputBufferData2 (OutputBufferData2 is LREAL[1..400] type instance)

[VAR](LREAL)OutputBufferData3 (OutputBufferData3 is WORD[1..100] type instance)

When the number of elements specified with Storage location of latch data (OutputBuffer) is less than the one specified with Number of latch times (RecordCount), the error "Latch Data Storage Shortage" (error code: 349FH) occurs. Also, when the out of range of the device and the label is accessed at latch operation, the error "Latch Data Storage Shortage" (error code: 349FH) occurs.

The relation of the setting value and operation of each item is shown below. For details, refer to the following.

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Latch mode (RecordMode)	Number of latch times (RecordCount)	Storage location of latch data (OutputBuffer)	Detection operation	Data storage location
0: One Shot Mode (OneShot)	Omit/Set	Omit	One shot	Latch position (RecordedPosition)
		Set		Latch position (RecordedPosition)/Buffer
1: Frequency Specified Mode (RecordCount)	Omit	Omit/Set	Error	—
	Set	Omit	Number of setting	Latch position (RecordedPosition)
		Set		Latch position (RecordedPosition)/Buffer
2: Ring Buffer Mode (RingBuffer)	Omit	Omit/Set	Error	—
	Set	Omit	Always	Latch position (RecordedPosition)
		Set		Latch position (RecordedPosition)/Buffer

Precaution

- Refresh of the Motion control FB I/O argument is carried out at the timing the FB is called, however, the control is executed by using operation cycle regardless of the FB call task (nomal/fixed cycle).
- This FB is executed even if the target axis is not connected or an error occurs.

Touch probe invalid

Touch probe is invalidated.

Control details

MC_TouchProbe (Touch Probe Enabled) which is specified in Touch probe ID (TouchProbeID) is invalidated.
When MC_AbortTrigger (Touch Probe Disabled) is executed, if the specified MC_TouchProbe (Touch Probe Enabled) specified Touch probe ID (TouchProbeID) is not running, the FB will immediately become Execution completion (Done) = TRUE.

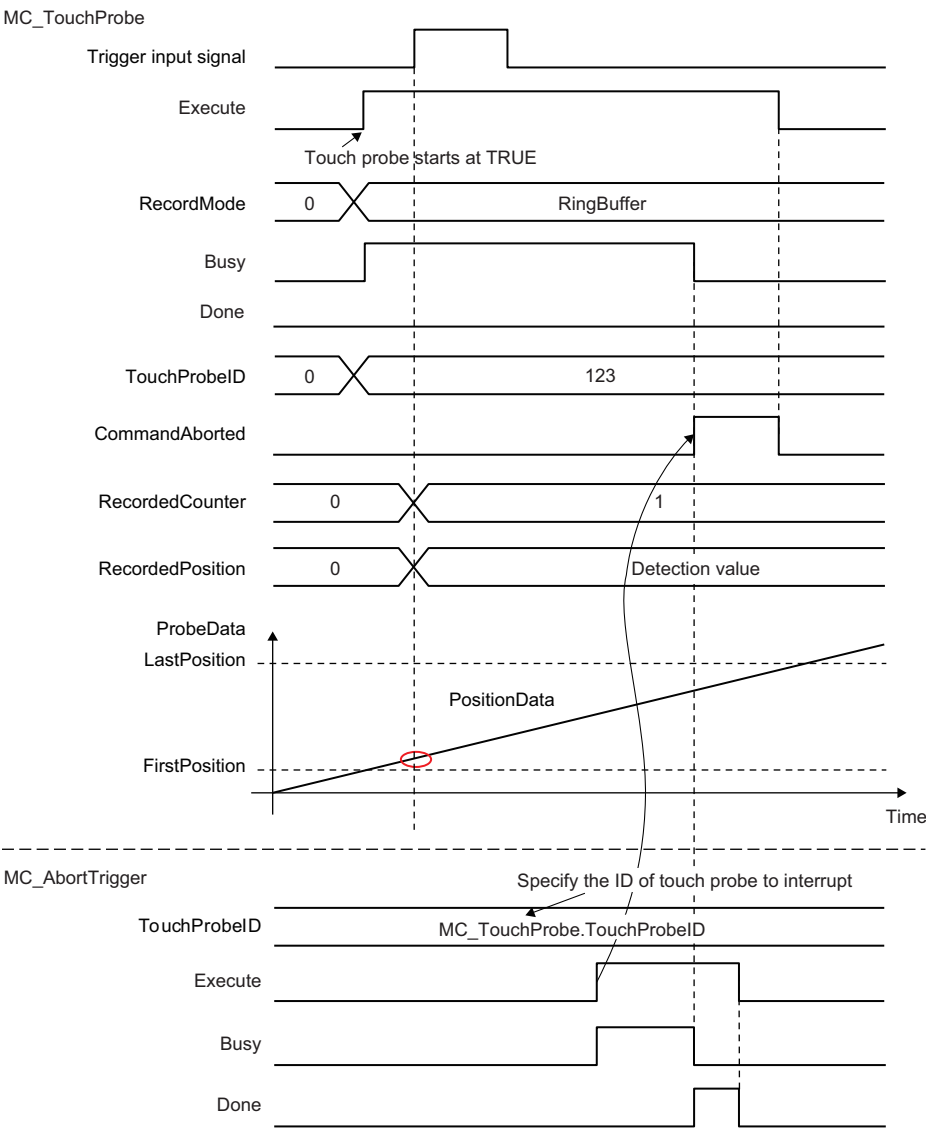
Axis information (Axis) and Trigger input signal (TriggerInput) can be omitted, because those are ignored.

■Timing chart

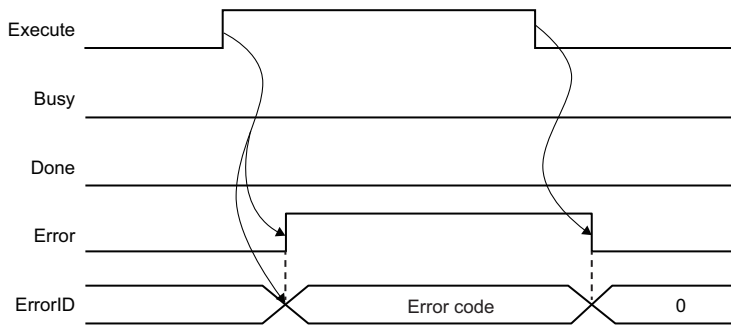
[When the FB is normally completed]

Ex.

For Latch mode (RecordMode) = "2: Ring Buffer Mode (RingBuffer)"



[When an error occurs]



Details of setting item

■Touch probe ID (TouchProbeID)

- Sets the proper ID of the touch probe to invalidate. Sets MC_TouchProbe (Touch Probe Enabled). Touch probe ID (TouchProbeID) after Execute command (MC_TouchProbe.Execute) rising of MC_TouchProbe (Touch Probe Enabled) to invalidate.

Precautions

Relevant add-ons

The following add-on is required to use this function.

- MotionControl_General
- SignalIO
- Axis^{*1}
- NetworkDriver_CCIETSN^{*2}
- ServoDriver_CANopen^{*2}

^{*1} For using the signal type [AXIS] of the external signals

^{*2} For using the signal type [OBJ] of the external signals

System memory capacity

■RAM Usage

Memory capacity of MC_TouchProbe (Touch Probe Enabled) differs depending on Compensation Time (CompensationTime). For details, refer to the following.

📖 Page 452 Details of setting items

■Backup RAM Usage

Backup RAM is not used.

12.3 Slave Emulation

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 "Application Settings" of Part 1 in the following manual.

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

Relevant variables

Variable/Structure name	Name	Details
<u>AxisName.PrConst.</u>		
SlaveEmulate_Enable	Slave Emulation Enabled	Sets whether the axis is used as an emulate axis. FALSE: Invalid TRUE: Valid
<u>AxisName.Md.</u>		
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 machine feed value at connection are as shown below.

- When Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) is "-1: Automatic Setting (Acquire from Connected Device) (Auto)" or "0: Disable Absolute Position System (ABSDisabled)"

Both the cumulative current position and the machine feed value are "0". (The set position is according to the ring counter setting)

- When "Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable)" is "1: Enable Absolute Position System (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 machine feed value are "0". (The set position is according to the ring counter setting)

Specification of the emulated slave station

While the emulate function is valid, following type of the servo amplifier and servo motor are tentatively connected.

Servo amplifier type	Servo motor type
MR-J5-10G	HK-KT13W

Specification of the emulated MR-J5(W)-G is as follows.

Function		Support	Description
Reception check	WDC check	×	Check of reception WDC (the master station → the slave station) is not carried out.
PDO-related	Emulation of feedback	○	Simulates feedback of MR-J5(W)-G. For details, refer to the following. 📖 Page 461 Feedback data specification
	Variable mapping	×	When the emulate function is valid, the default mapping of MR-J5(W)-G is used. For the default mapping, refer to MR-J5(W)-G manuals.
SLPM-related	Response data simulation	×	SLMP communication simulation is not supported.
Servo alarm-related	Servo alarm [AL. 035 Command frequency error] detection	○	Simulates servo alarm [AL. 035 Command frequency error] detection
	Alarm reset	○	Simulates alarm reset. (A delay to deactivate the alarm does not occur. The alarm is deactivated immediately.)
Motor type	Standard rotary type	○	Standard motor of MR-J5 (HK-KT13W) is available. A speed unit of the servo amplifier is fixed to 0.01 [r/min].
Operation mode	csp	○	Position control operation by csp is available.
	csv	○	Velocity control operation by csv is available.
	cst	○	Torque control operation by cst is available.
	hm	○	Homing by hm is available. The homing method supports the driver homing method (data set method) only.
	ct	○	Continuous operation to torque control by ct is available. (The operation is the same as cst.)
External signal-related	FLS	○	- Input via the controller is only available. (Stop operation of the slave station when the FLS is OFF is not simulated. By FLS detection, the command from the master station stops and then the servo motor stops as well. - In the case of input via the servo amplifier, the input value is always OFF.
	RLS	○	- Input via the controller is only available. (Stop operation of the slave station when the RLS is OFF is not simulated. By RLS detection, the command from the master station stops and then the servo motor stops as well. - In the case of input via the servo amplifier, the input value is always OFF.

Feedback data specification

No.	Object name	Object detail	Support	Remark
1	1D02h/01h: Watch dog counter UL	—	○	—
2	6061h/00h: Modes of operation display	—	○	—
3	6064h/00h: Position actual value	—	○	The value is always the same as the value of Target position.
4	606Ch/00h: Velocity actual value	—	○	—
5	60F4h/00h: Following error actual value	—	○	The value is always 0.
6	6041h/00h: Statusword	—	○	—
7	6077h/00h: Torque actual value	—	○	- The value is always 0 when set to a mode other than cst or ct. - The value is always the same as the value of Target position.
8	2A41h/00h: Current alarm	—	○	—

Precaution

- When executing the all axes emulate switching, it takes time to complete.
- If a motor is rotated when the slave station which is connected actually is set to emulation enabled, as it is switched to disabled, the position information is restored as the axis is recognized as it moves from the position which the axis moves during emulate enabled to the position of the connected slave station during power-OFF.
- In the emulation being disabled, when the slave station is used with the setting which Absolute Position Control Setting (AxisName.PrConst.PosRestoration_AbsPosEnable) is "-1: Automatic Setting (Acquire from Connected Device) (Auto)" and the connected device is used in the setting of Disable Absolute Position System, change to "1: Enable Absolute Position System (Enabled)" before switching emulation to enabled. When the emulation is enabled, "-1: Automatic Setting (Acquire from Connected Device) (Auto)" becomes "0: Disable Absolute Position System (ABSDisabled)", therefore the absolute position is erased next time, the emulation is switched to disabled.
- In the state which the add-on ServoDriver_CANopen is enabled, the axis always starts with the emulation enabled state if the add-on NetworkDriver_CCIETSN is disabled.

12.4 Inter-Module Synchronization Function

The inter-module synchronization function can synchronize the control timings among multiple modules on the same base.

Operation of this function for each system status

■System operation status

○: Possible, △: Possible (restricted), ×: Not possible

Status	Operation availability
STOP	△*1
RUN	○
Moderate error	△*1
Major error	×

*1 Operation is possible when the CPU module is RUN.

■Interrupt operation status

○: Possible, △: Possible (limited)

Status	Operation availability
STOP	△*1
RUN	○

*1 The inter-module synchronous interrupt program is not possible.

Control details

This function can synchronize the inter-module synchronous interrupt program (I44) execution cycle of the CPU module and the operation cycle of the Motion module.

For the parameter setting of the inter-module synchronization, refer to "CC-Link IE TSN Network Synchronous Communication Function" of Part 1 in the following,

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

or refer to the following.

📖 MELSEC iQ-R Inter-Module Synchronization Function Reference Manual

Point

When using the inter-module synchronous function, the EI instruction must be executed on the CPU module to enable the inter-module synchronous interrupt program (I44). When the status is changed to RUN while the inter-module synchronous interrupt program (I44) is disabled, the buffer memory refresh task is not executed. The error "Cycle Over" (error code: 320CH) may occur.

Operation using the multiple Motion module

When the multiple Motion module is the synchronous target, execution timing of a fixed cycle program can be synchronized among modules.*1

Note that the synchronization is applied only when the fixed scan interval setting of fixed cycle program is as follows.

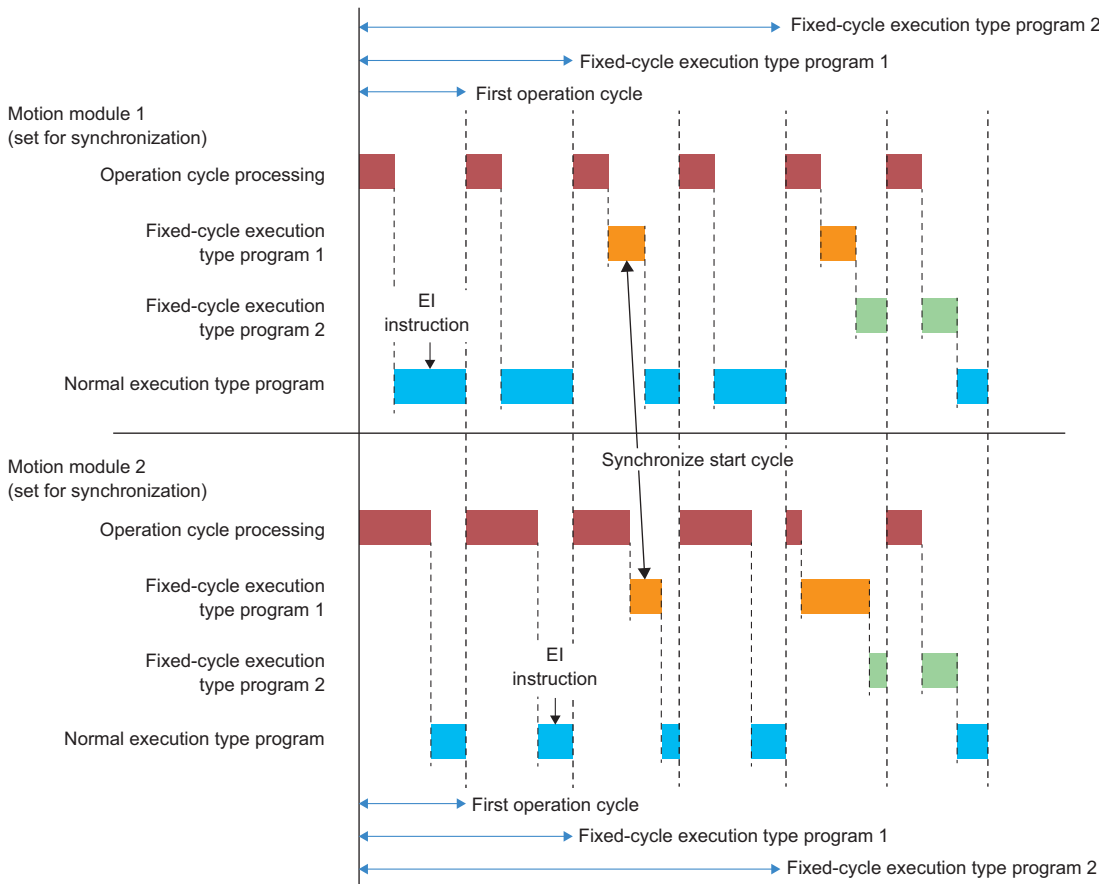
Communication cycle $\times 2^n$ (Up to 128 ms interval)*2

Other fixed cycle programs of the fixed scan interval setting may not be synchronized the execution timing among modules.

*1 Even if the Motion control FBs is started in the fixed cycle program, start timing differs from each module because analysis complete timing of the instruction is different. For the method to synchronize the start timing among multiple modules, refer to the following.

☞ Page 465 Synchronization of positioning control start timing using the function

*2 After enabling the interrupt program (after executing the EI instruction), the first execution of the fixed cycle program should needs to match among the modules so that the execution is performed after the cycle set in the fixed scan interval setting. (Up to 128 ms)



Synchronization of positioning control start timing using the function

The timing of positioning start can be synchronized among different modules. After the positioning is started, each Motion module operates independently. The setting and procedure are shown below.

■Setting

1. Set the Motion module which is synchronized the timing of positioning start as the synchronous target module.

For the parameter setting of the inter-module synchronization, refer to "CC-Link IE TSN Network Synchronous Communication Function" of Part 1 in the following manual.

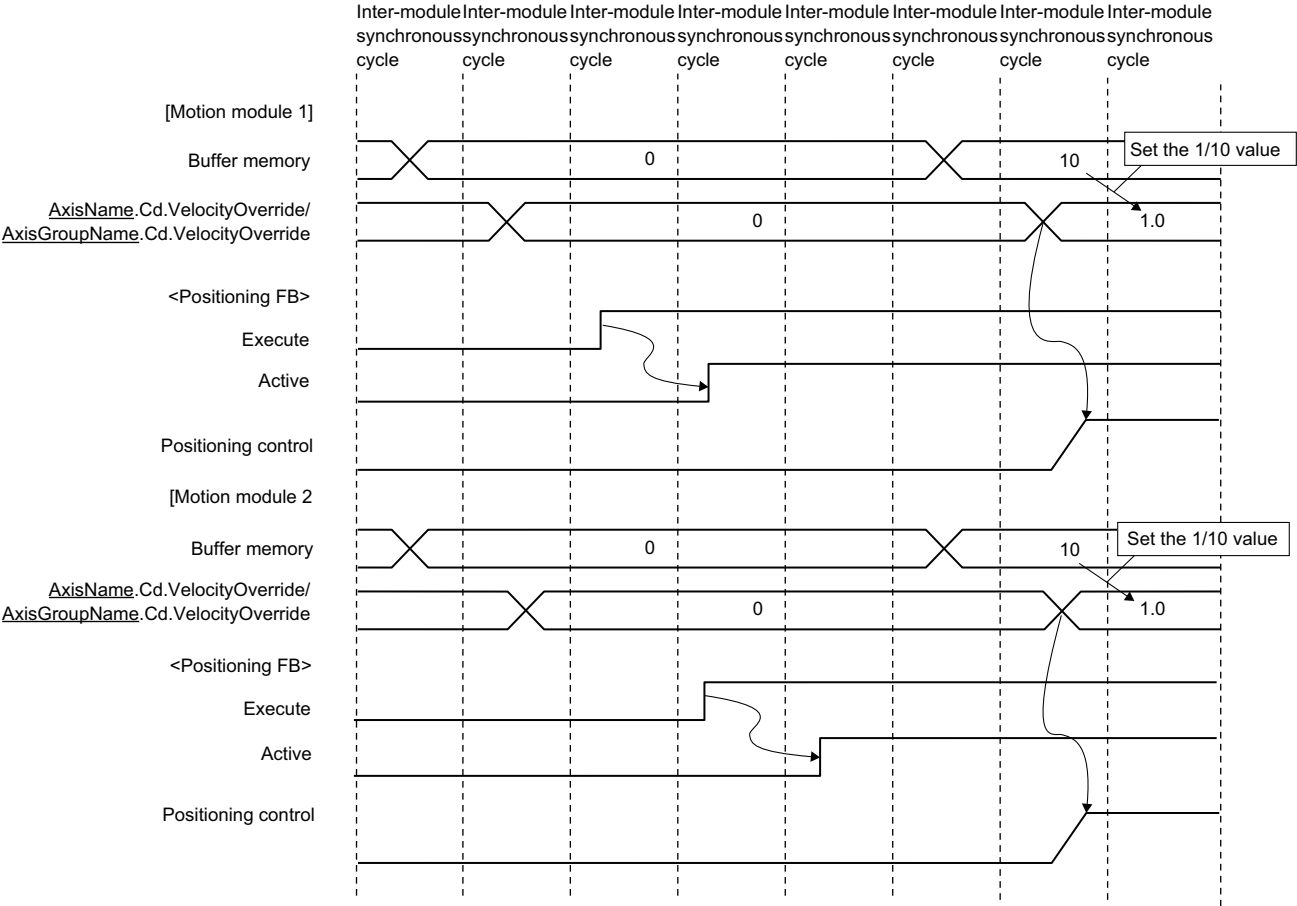
📖 MELSEC iQ-R Motion Module User's Manual (Network)

2. Set the same cycle between the inter-module synchronous cycle of the CPU module and the operation cycle of the Motion module. If not, the synchronization of the timing cannot be assured.

■Procedure example

1. Set the velocity override factor "0.00" in the arbitrary buffer memory (user setting area).
 2. Perform positioning start after setting the setting value of the buffer memory written in Step 1 to Velocity Override Factor (AxisName.Cd.VelocityOverride, AxesGroupName.Cd.VelocityOverride) by the fixed cycle program of the Motion module.
 3. Confirm Controlling (Active) of all Motion control FBs becomes ON, and set the velocity override factor "10.00" in the buffer memory used in Step 1 within the same inter-module synchronous cycle while the inter-module synchronous interrupt program (I44) is performed.
 4. Set the one-tenth value of the buffer memory setting value written in Step 3 to Velocity Override Factor (AxisName.Cd.VelocityOverride, AxesGroupName.Cd.VelocityOverride) by the fixed cycle program of the Motion module.
- *1 When using the time-fixed method, set "1: Maximum Acceleration/Deceleration (MaximumAcceleration)" to Operation Selection at Start Acceleration/Deceleration 0 (AxisName.Pr.AccelerationZeroBehavior, AxesGroupName.Pr.AccelerationZeroBehavior). When setting "1: Error (Not Started) (ACCError)", if Velocity Override Factor (AxisName.Cd.VelocityOverride) is set to "0.00", the error "Acceleration/Deceleration 0 Specified Operation Error at Start" (error code: 1A0CH) occurs and the axis will not start.
- *2 The processing time of operation cycle temporarily increases because the velocity of all axes is changed at the same time. Take actions such as reducing the number of the target axis, when the operation cycle is exceeded.

■Operation example



Synchronous control using inter-module synchronization

The synchronized operation synchronizing with the same input axis among different modules can be performed. The setting and procedure are shown below.

■Setting

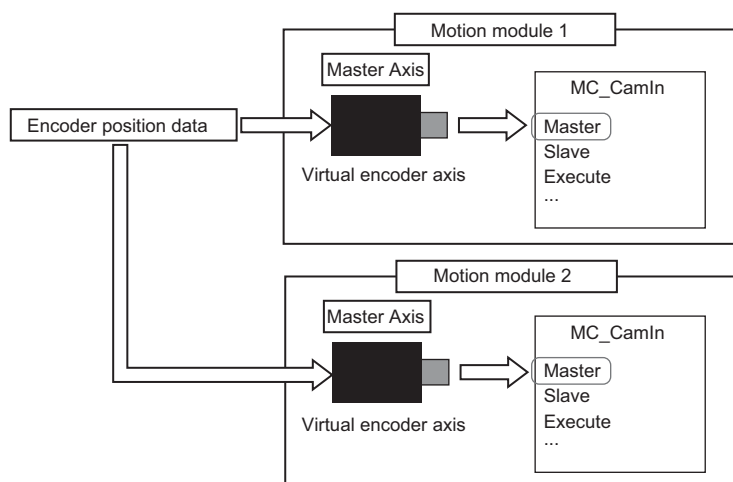
1. Set the Motion module used for the synchronized control as the inter-module synchronous target.
For the parameter setting of the inter-module synchronization, refer to "CC-Link IE TSN Network Synchronous Communication Function" of Part 1 in the following manual.

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

2. Set the same cycle between the inter-module synchronous cycle of the CPU module and the operation cycle of the Motion module. If not, the simultaneous start cannot be assured.

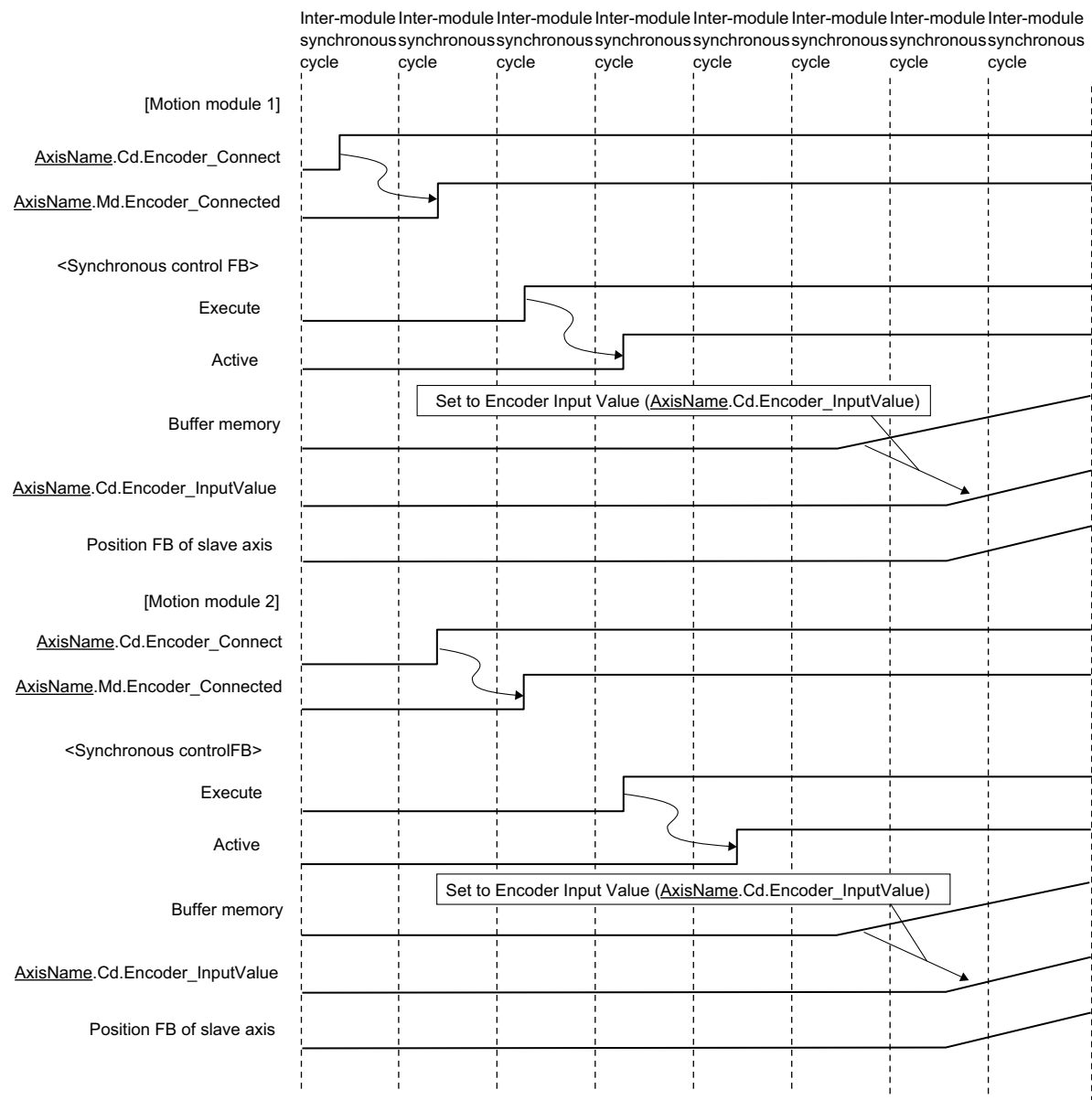
■Procedure example

1. Prepare the synchronous control FB set the virtual encoder axis as the master axis for each module.
2. Set Connection Command (AxisName.Cd.Encoder_Connect) and Connection Status (AxisName.Md.Encoder_Connected) as public labels.
3. Set Connection Command (AxisName.Cd.Encoder_Connect) of each module to TRUE. Confirm whether the virtual encoder axis of all modules is connected completely by checking Connection Status (AxisName.Md.Encoder_Connected).
4. Start the synchronous control FB of all modules.
5. Write arbitrary values (position data of the virtual encoder) into arbitrary buffer memory (user setting area) in the inter-module synchronous interrupt program (I44).
6. Write the setting values of the buffer memory written in Step 5 into Encoder Input Value (AxisName.Cd.Encoder_InputValue) by the fixed cycle program of the Motion module.



*1 The public label is refreshed at END except executing the inter-module synchronous interrupt program (I44) so that the things which are communicated by synchronizing with the inter-module synchronous cycle cannot be used as public labels, but the things which are not communicated in inter-module synchronous cycle can be used as public labels.

■Operation example



Program example

Simultaneous start with multiple modules

- Scan program [CPU module]

ST program

```
// PLC READY ON
Y10 := TRUE;
Y40 := TRUE;

// Interruption enabled
EI(TRUE);

// Confirm that Ready and Synchronization flag becomes ON
IF (X10 = TRUE) AND (X11 = TRUE) AND (X40 = TRUE) AND (X41 = TRUE) THEN
  // Servo ON
  MCv_AllPower_1.Enable := TRUE;
  MCv_AllPower_1.ServoON := TRUE;
  MCv_AllPower_2.Enable := TRUE;
  MCv_AllPower_2.ServoON := TRUE;
END_IF;

// Axes group enabled
IF (RD78_0040.Axis0001.Md.AxisStatus = 4) AND (RD78_0040.Axis0002.Md.AxisStatus = 4) THEN
  MC_GroupEnable_1.Execute := TRUE;
END_IF;

// Set the velocity override factor 0 to arbitrary buffer memory (user setting area)
IF (RD78_0010.Axis0001.Md.AxisStatus = 4) AND (RD78_0040.AxesGroup001.Md.GroupStatus = 4) AND (G_bAxisStart = FALSE) THEN
  U1%G11500000 := 0;
  U4%G11500000 := 0;
END_IF;

// Confirm that the velocity override factor is 0 and then execute the positioning start
IF (RD78_0010.Axis0001.Md.VelocityOverride = 0.0) AND (RD78_0040.AxesGroup001.Md.VelocityOverride = 0.0) THEN
  MC_MoveAbsolute_1.Execute := TRUE;
  MCv_MoveLinearInterpolateAbsolute_1.Execute := TRUE;
END_IF;

// Confirm that Active of all Motion control FBs becomes ON
IF (MC_MoveAbsolute_1.Active = TRUE) AND (MCv_MoveLinearInterpolateAbsolute_1.Active = TRUE) THEN
  G_bAxisStart := TRUE; // Set global labels of BOOL type to TRUE
END_IF;

// FB setting of the programmable controller
MCv_AllPower_1(
  Axis:= RD78_0010.Axis0001.AxisRef );
MCv_AllPower_2(
  Axis:= RD78_0040.Axis0001.AxisRef );
MC_GroupEnable_1(
  AxesGroup:= RD78_0040.AxesGroup001.AxesGroupRef );
MC_MoveAbsolute_1(
  Axis:= RD78_0010.Axis0001.AxisRef ,
  Position:= 10000.0 ,
  Velocity:= 1000.0 ,
  Acceleration:= 1000.0 ,
  Deceleration:= 1000.0 ,
  Direction:= 1 );
MCv_MoveLinearInterpolateAbsolute_1.LinearAxes[0] := 1;
MCv_MoveLinearInterpolateAbsolute_1.LinearAxes[1] := 2;
MCv_MoveLinearInterpolateAbsolute_1.Position[0] := 10000.0;
MCv_MoveLinearInterpolateAbsolute_1.Position[1] := 10000.0;
MCv_MoveLinearInterpolateAbsolute_1.Direction[0] := 1;
MCv_MoveLinearInterpolateAbsolute_1.Direction[1] := 1;
MCv_MoveLinearInterpolateAbsolute_1(
  AxesGroup:= RD78_0040.AxesGroup001.AxesGroupRef ,
  Velocity:= 1000.0 ,
  Acceleration:= 1000.0 ,
  Deceleration:= 1000.0 );
```

- Event (Inter-module synchronous interrupt program (I44)) [CPU module]

ST program

```
// Set the velocity override factor 10 to arbitrary buffer memory (user setting area)
IF G_bAxisStart = TRUE THEN
  // Actual setting value becomes one-tenth
  U1#G11500000 := 10;
  U4#G11500000 := 10;
END_IF;
```

- Normal program [Motion module 1] [Motion module 2]

ST program

```
// Interruption enabled
bElout := EI(TRUE);
```

- Fixed scan program [Motion module 1]

ST program

```
// Set the one-tenth value of the arbitrary buffer memory (user setting area) setting value to the velocity override factor
wVelocityOverride_10 := G11500000;
leVelocityOverride_10 := INT_TO_LREAL( wVelocityOverride_10 );
leVelocityOverride := leVelocityOverride_10 / 10.0;
Axis0001.Cd.VelocityOverride := leVelocityOverride;
```

- Fixed scan program [Motion module 2]

ST program

```
// Set the one-tenth value of the arbitrary buffer memory (user setting area) setting value to the velocity override factor
wVelocityOverride_10 := G11500000;
leVelocityOverride_10 := INT_TO_LREAL( wVelocityOverride_10 );
leVelocityOverride := leVelocityOverride_10 / 10.0;
AxesGroup001.Cd.VelocityOverride := leVelocityOverride;
```

Simultaneous control with multiple modules

- Scan program [CPU module]

ST program

```
// PLC READY ON
Y10 := TRUE;
Y40 := TRUE;

// Interruption enabled
EI(TRUE);

// Confirm that Ready and Synchronization flag becomes ON
IF (X10 = TRUE) AND (X11 = TRUE) AND (X40 = TRUE) AND (X41 = TRUE) THEN
  // Servo ON
  MCv_AllPower_1.Enable := TRUE;
  MCv_AllPower_1.ServoON := TRUE;
  MCv_AllPower_2.Enable := TRUE;
  MCv_AllPower_2.ServoON := TRUE;
END_IF;

// Set AxisName.Cd.Encoder_Connect to TRUE
RD78_0010.Axis0001.Cd.Encoder_Connect := TRUE;
RD78_0040.Axis0001.Cd.Encoder_Connect := TRUE;

// Start the synchronous control FB of all modules after AxisName.Md.Encoder_Connected becomes ON
IF (RD78_0010.Axis0001.Md.Encoder_Connected = TRUE) AND
  (RD78_0040.Axis0001.Md.Encoder_Connected = TRUE) AND
  (RD78_0010.Axis0001.Md.AxisStatus = 4) AND
  (RD78_0040.Axis0001.Md.AxisStatus = 4) AND
  (RD78_0010.Axis0002.Md.AxisStatus = 4) AND
  (RD78_0040.Axis0002.Md.AxisStatus = 4) THEN
  MC_CamIn_1.Execute := TRUE;
  MC_CamIn_2.Execute := TRUE;
END_IF;

// Confirm that Active and InSync of synchronous control FB of all modules become ON
IF (MC_CamIn_1.Active = TRUE) AND (MC_CamIn_1.InSync = TRUE) AND
  (MC_CamIn_2.Active = TRUE) AND (MC_CamIn_2.InSync = TRUE) THEN
  G_bAxisStart := TRUE; // Set global labels of BOOL type to TRUE
END_IF;

// FB of the programmable controller
MCv_AllPower_1( Axis:= RD78_0010.Axis0001.AxisRef );
MCv_AllPower_2( Axis:= RD78_0040.Axis0001.AxisRef );
MC_CamIn_1.CamTableID.ProfileID.Number := 1;
MC_CamIn_1(
  Master:= RD78_0010.Axis0001.AxisRef ,
  Slave:= RD78_0010.Axis0002.AxisRef );
MC_CamIn_2.CamTableID.ProfileID.Number := 1;
MC_CamIn_2(
  Master:= RD78_0040.Axis0001.AxisRef ,
  Slave:= RD78_0040.Axis0002.AxisRef );
```

- Event (Inter-module synchronous interrupt program (I44)) [CPU module]

ST program

```
// Write arbitrary values (position data of the virtual virtual encoder) into arbitrary buffer memory (user setting area)
IF G_bAxisStart = TRUE THEN
  IF dEncoderInputValue < 10000 THEN
    dEncoderInputValue := dEncoderInputValue + 1;
    U1\G11500000:D := dEncoderInputValue;
    U4\G11500000:D := dEncoderInputValue;
  END_IF;
END_IF;
```

- Normal program [Motion module 1] [Motion module 2]

ST program

```
// Interruption enabled
bEIout := EI(TRUE);
```

- Fixed scan program [Motion module 1] [Motion module 2]

ST program

```
// Write the setting value of arbitrary buffer memory (user setting area) into Encoder Input Value
Axis0001.Cd.Encoder_InputValue := G11500000:D;
```

Precautions

- When performing the simultaneous start using the inter-module synchronization, note that the inter-module synchronous cycle needs to be the same as the buffer memory refresh cycle.
When the inter-module synchronous cycle is different from the buffer memory refresh cycle, the data might be inconsistent. Perform mutual exclusion in a sequence program and a motion program.
- The maximum cycle is 128 ms assured by the inter-module synchronization. When using the instruction or the fixed cycle program which are operated in the cycle exceeded 128 ms, the synchronization among the modules are not assured.
- When using the inter-module synchronization in the multiple Motion module, even if PLC READY [Y0] is changed OFF to ON at the same timing, the number of axis to used and required time to analyze the program so that READY [X0] does not become ON simultaneously. When performing the simultaneous start using the inter-module synchronization, execute the positioning start after READY [X0] becomes ON in the all modules performing the simultaneous start.
- When the CPU module status is changed from RUN to STOP, the buffer memory may not be updated for few cycles.
- When the inter-module synchronization is enabled, the public labels are refreshed at END except executing the inter-module synchronous interrupt program (I44). The refresh setting of the module parameter (Motion module) is disabled.

Relevant add-ons

The following add-on is required to use this function.

- baseSystem, "Ver.1.16 or later"

The following boot software is required to use this function.

- Network boot software: "Ver.7 or later"
- Boot software: "Ver.7 or later"

When the Motion module installed the add-ons and the boot whose versions is earlier than the above is the target of the inter-module synchronization, an error occurs on the CPU modules.

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

Combination of the version

The versions of the engineering tool which is compatible with this function is as follows.

Engineering tool	Version
GX Works3	1.075D or later

Combination of the network modules

The network modules which are compatible with this function are as follows.

○: Supported, ×: Not supported

Inter-module synchronous master	Inter-module synchronous slave	Support information	Remark
RD78G(H)	RD78G(H)	○	—
	RJ71GN11-T2	×	The error "Inter-module Synchronization Master Setting Error" (error code: 3603H) occurs on the inter-module synchronous slave.
RJ71GN11-T2	RD78G(H)	○	—

13 SYNCHRONOUS CONTROL

13.1 Overview of Single Axis Synchronization Control FBs

Single axis synchronization control FBs enable to control mechanical systems such as gear, speed change gear, and cam with a software by transmitting the position information (command) of Slave axis (Slave) that is synchronized with Master axis (Master).

FB	Control details
MC_CamIn (Cam Operation Start)	Executes cam operation.
MC_GearIn (Gear Operation Start)	Sets the speed ratio between the master axis and the slave axis, and enters gear operation.
MC_CombineAxes (Addition/Subtraction Positioning)	Combines operations of two axes by a selectable combination method, and outputs it to the third axis.
MCv_ChangeCycle (Current Value Change per Cycle) MCv_ChangeCycleTriggered (Trigger Current Value Change per Cycle)	Changes the cam current value per cycle to the specified value during MC_CamIn (Cam Operation Start) 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 axis (Master), and outputs the result to Slave axis (Slave).  Page 405 Command Filter

Relevant term

Term	Description
Cam table	An operation profile used for cam control (Ex.) Operation profile data of cam data format or operation profile data of cam data format for rotary cutter
First point of cam table	The meaning is different depending on the interpolation method specification for the cam data • Specifying for each section, Spline interpolation: Point of Table No.1 • Linear interpolation: Point of No.1

13.2 Axis Configuration

The following shows axes that can be specified to Master axis (Master) and Slave axis (Slave) in the single axis synchronization control FBs. For the specifications of each axis type, refer to the following.

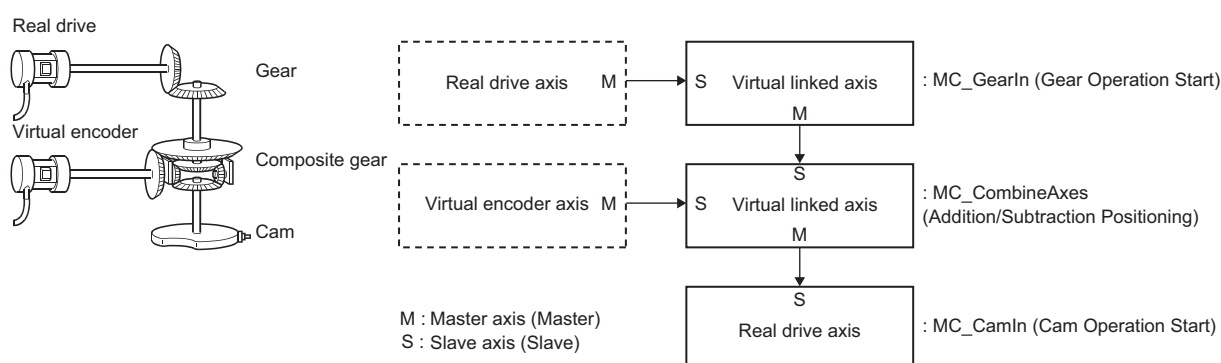
📖 Page 36 Axis, 📖 Page 56 Axis Assignment

Axis type		Used for Master axis (Master)	Used for Slave axis (Slave)	Remark
Real axis	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.
	Real encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs and it does not start.
Virtual axis	Virtual drive axis	○	○	Commands can be mainly created by positioning control, etc.
	Virtual encoder axis	○	×	It is used as Master axis (Master). When it is used as Slave axis (Slave), the error "Necessary Slave Object Unset" (error code: 1AA8H) occurs and it does not start.
	Virtual linked axis	○	○	It is used as an intermediate axis to transmit a command to the real drive axis. When using multiple motion FBs such as gear, assign virtual linked axes.

To combine and execute controls such as gear and cam, use the virtual linked axis like the following example.

Ex.

To process gear following the instruction of the real drive axis and perform cam control adding the instruction from the virtual encoder



Position command unit of the master axis and the slave axis

Settings of position command unit of the master axis and the slave axis (Position Command Unit (AxisName.Pr.Unit_Position) and Position Command Unit String (AxisName.Pr.Unit_PositionString)) do not affect the control. The result of the calculation performed to the position information of the master axis which has no unit information is used as an instruction of the slave axis.

Ex.

To add each master axis by gear ratio 1 : 1 using MC_CombineAxes (Addition/Subtraction Positioning)

The slave axis operates 3.0 [degree] with the following settings of position command unit of each axis when the master axis 1 is moved 1.0 [pulse] and the master axis 2 is moved 2.0 [mm].

- Position command unit of the master axis 1: pulse
- Position command unit of the master axis 2: mm
- Position command unit of the slave axis: degree

Current position change of the master axis

The set position of the slave axis does not change even when the current position change of the master axis is performed.

13.3 Master Axis Data Source Selection

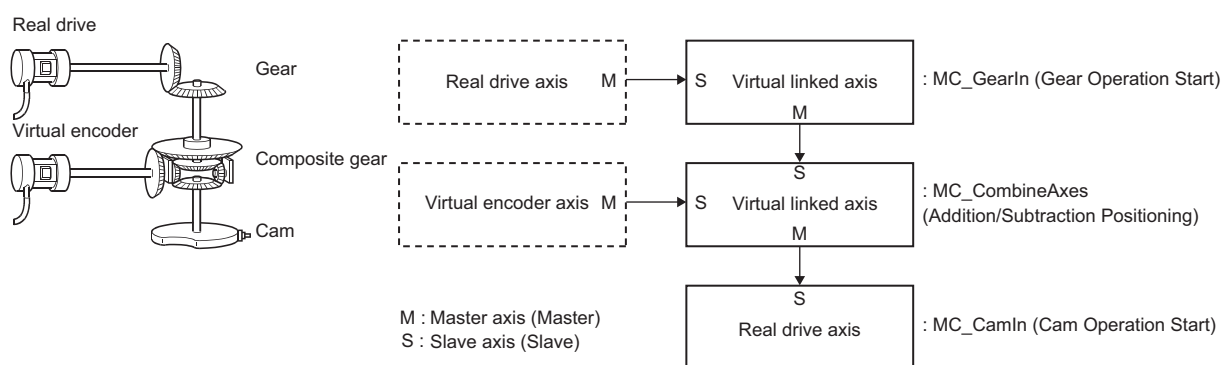
In the single axis synchronization control FB, a position type of the master axis whose the slave axis executes the single axis synchronous control can be selected by Master axis data source selection (MasterValueSource) of each FB.

When the actual position is specified for virtual axis (axis which does not have Actual Position (AxisName.Md.ActualPosition)), the FB operates by the value as the same with set value.

"101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" 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. Using "101: Latest Set Value (mcLatestSetValue)" and "102: Latest Actual Value (mcLatestActualValue)" can transmit the multiple Motion control FB command in the same operation cycle. In this case, set the first call order and linking order of the linked Motion control FB to be the same.

Ex.

When transmitting movement amount of the real drive axis and the virtual drive axis to cam to control in the same operation cycle.



When using the above combination of the single synchronous control FB (linked order), set the first call order as follows.

- First call order

 1. Motion control FB which moves the master axis (real drive axis) of MC_GearIn (Gear Operation Start)
 2. MC_GearIn (Gear Operation Start)
 3. MC_CombineAxes (Addition/Subtraction Positioning)
 4. MC_CamIn (Cam Operation Start)

- Master axis data source selection (MasterValueSource) of each single synchronous control FB
"101: Latest Set Value (mcLatestSetValue)"

Point

When Master axis data source selection (MasterValueSource) is set to "1: Set Value (mcSetValue)" or "101: Latest Set Value (mcLatestSetValue)" and the master axis becomes servo OFF by a servo alarm or forced stop, the amount of the value change may be too large. This can be prevented by setting Master axis data source selection (MasterValueSource) to "2: Actual Value (mcActualValue)" or "102: Latest Actual Value (mcLatestActualValue)".

Master axis data source selection (MasterValueSource)	Description
1: Set Value (mcSetValue)	Uses the commanded position of the master axis in the previous operation cycle.
2: Actual Value (mcActualValue)	Uses the actual position of the master axis in the previous operation cycle.
101: Latest Set Value (mcLatestSetValue)	Uses the commanded position of the master axis in the current operation cycle.
102: Latest Actual Value (mcLatestActualValue)	Uses the actual position of the master axis in the current operation cycle.

13.4 Start and Stop Operation

Slave axis (Slave) continues to control with the command transmitted by Master axis (Master) even if a stop cause occurs during execution of the synchronous control function blocks. The axis status of the slave axis does not change.

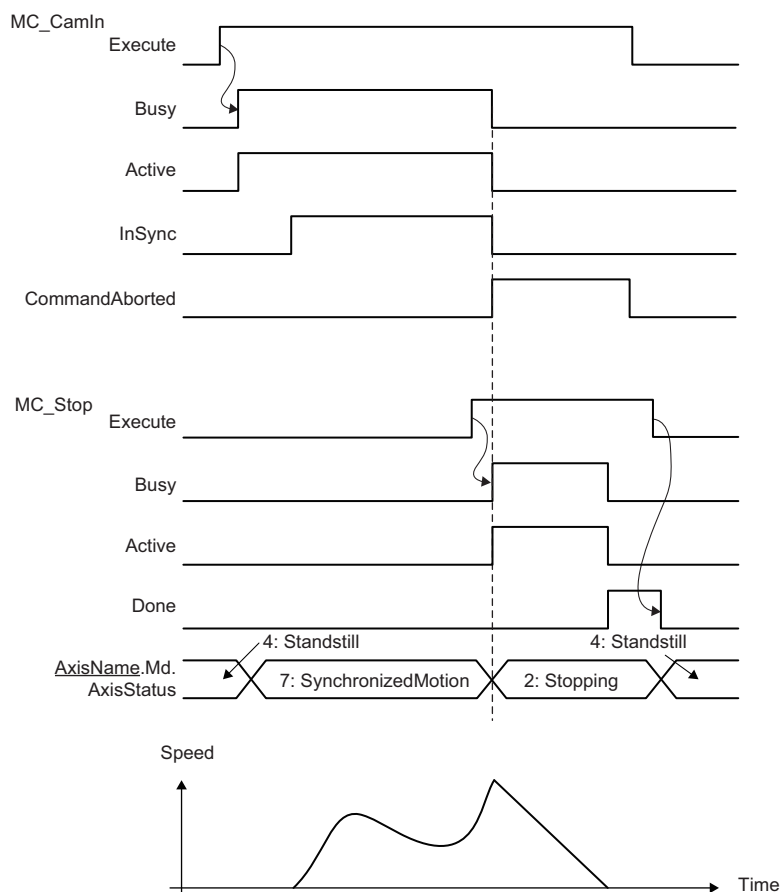
When a stop cause occurs to the slave axis, the axis status transits and the slave axis immediately stops or stops with deceleration according to the stop cause and its stop process. For axis control when a stop cause occurs, refer to the following.

☞ Page 173 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 (Forced Stop)) occurs during execution of the synchronous control FB



Point

When the master axis becomes servo OFF by the servo alarm or forced stop, stopping the operation of the synchronous control FB by using MC_Stop (Forced stop) is recommended because the slave axis may cause unexpected operation.

13.5 Required Slave Object

The following shows the setting condition of the slave object when using it as Slave axis (Slave) of the synchronous control FB.

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.

13.6 Restrictions

- When Master axis (Master) and Slave axis (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 synchronous control FB, if the master axis is specified to Slave axis (Slave) of the latter function block or more than 257 synchronous control FBs are linked, the error "Master Axis and Slave Axis Cyclic Reference" (error code: 1A3FH) will occur.

13.7 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 open area and set to a state where it can be controlled.

For the open method to the open area, and for data types that can be controlled in cam operation, refer to the following.

☞ Page 547 Operating operation profile data

☞ Page 534 Operation profile data types

Relevant variable

Variable/Structure name	Name	Details
AxisName.Md.		
ProfileID	Execution Profile ID No.	Stores the executing Cam tableID (CamTableID). The update timing is as follows. [Stores the specified Cam tableID (CamTableID)] • When executing MC_CamIn (Cam Operation Start) • When changing Cam tableID (CamTableID) The timing differs depending on the setting value of Start mode (StartMode). [Cleared to "0"] • When Cam cycle completion (EndOfProfile) becomes TRUE with the setting which Periodic (Periodic) is "FALSE: Non periodic" and Specifying operation after one cycle operation (Options (Options) bit 16) is "0: Complete" • When stop cause occurs

Relevant FB

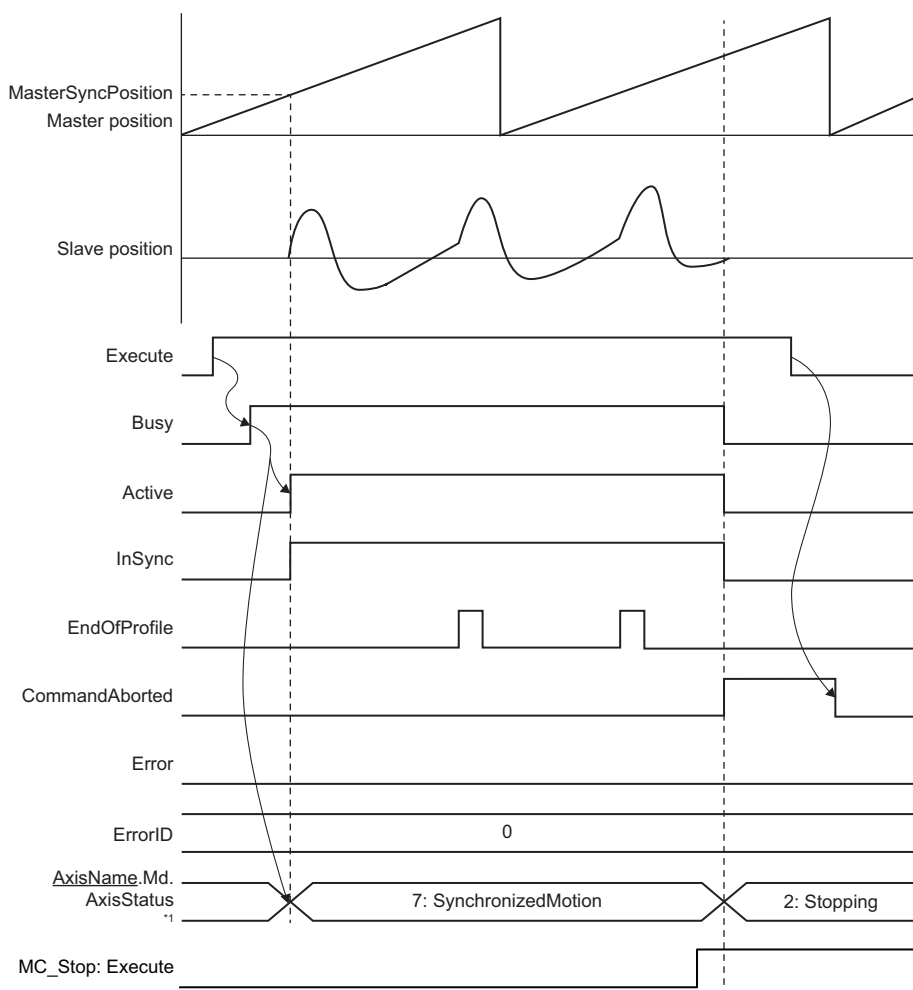
MC_CamIn			
Item	Description		
Function overview	Cam operation starts operation according to the specified cam table.		
Symbol [Structured Ladder]	MC_CamIn DUT : Master Master : DUT DUT : Slave Slave : DUT B : Execute InSync : B B : ContinuousUpdate Busy : B L : MasterOffset Active : B L : SlaveOffset CommandAborted : B L : MasterScaling Error : B L : SlaveScaling ErrorID : UW L : MasterStartDistance EndOfProfile : B L : MasterSyncPosition DUT : StartMode DUT : MasterValueSource DUT : CamTableID DUT : BufferMode UD : Options		
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]

Ex.

When Start mode (StartMode) is "1: Absolute (mcAbsolute)" and Master axis absolute coordinate (MasterAbsolute) is "FALSE: Relative coordinate"



*1 This is the state of Slave axis (Slave).

[When an error occurs]

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

📖 Page 27 Execute command (Execute) type/Enable (Enable)

■ 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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 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, Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), and Cam tableID (CamTableID) can be changed continuously.
Master axis offset	MasterOffset	LREAL	↑/R/C	-10000000000.0 to 10000000000.0	0.0	☞ Page 496 Master axis offset (MasterOffset)
Slave axis offset	SlaveOffset	LREAL	↑/R/C	-10000000000.0 to 10000000000.0	0.0	☞ Page 497 Slave axis offset (SlaveOffset)
Master axis scaling	MasterScaling	LREAL	↑/R/C	0.01 to 10.0	1.0	☞ Page 498 Master axis scaling (MasterScaling)
Slave axis scaling	SlaveScaling	LREAL	↑/R/C	0.01 to 10.0	1.0	☞ Page 499 Slave axis scaling (SlaveScaling)
Master axis follow-up distance	MasterStartDistance	LREAL	↑	-10000000000.0 to 10000000000.0	0.0	☞ Page 499 Master axis follow-up distance (MasterStartDistance)
Master axis synchronization start position	MasterSyncPosition	LREAL	↑	-10000000000.0 to 10000000000.0* ¹	0.0	☞ Page 499 Master axis synchronization start position (MasterSyncPosition)
Start mode	StartMode	MC_START_MODE	↑	0 to 2	0	☞ Page 499 Start mode (StartMode)
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 499 Master axis data source selection (MasterValueSource)
Cam table ID	CamTableID	MC_CAM_ID	↑/R/C	1 to 6000	0	☞ Page 499 Cam tableID (CamTableID)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 500 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	For details, refer to the following. ☞ Page 501 Options (Options)	0000000H	For details, refer to the following. ☞ Page 501 Options (Options)

*1 If specifying target of Master axis synchronization start position pass check (Option (Options) bit 21) is "1: Master axis set position, or the actual position", the valid range is within the ring counter range.

■Output variables

Name	Variable name	Data type	Default value	Description
In synchronization	InSync	BOOL	FALSE	 Page 501 In synchronization (InSync)
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 has been aborted because of other FBs. When this FB is stopped by an error or when this FB is started up while an error occurs, it becomes TRUE. Becomes FALSE when Execute command (Execute) becomes FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following.  Page 711 List of Error Codes
Cam cycle completion	EndOfProfile	BOOL	FALSE	 Page 501 Cam cycle completion (EndOfProfile)

■Public variables

Name	Variable name	Data type	Default value	Update timing	Description
Current value per cycle	InputsPerCycle	LREAL	0.0	Executing (Busy) = TRUE to the end of MC_CamIn (Cam Operation Start)	Stores the current value per cycle.
Reference value	Reference	LREAL	0.0	Executing (Busy) = TRUE to the end of MC_CamIn (Cam Operation Start)	Stores the reference value.
Output value	OutputData	LREAL	0.0	Executing (Busy) = TRUE to the end of MC_CamIn (Cam Operation Start)	Stores the output value.
Instance ID	InstanceID	WORD(UINT)	0	At instance generation	Instance ID that is automatically set when an instance is created. Used in FB input, etc.

Control details

MC_CamIn (Cam Operation Start) sets Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), Slave axis scaling (SlaveScaling), Master axis follow-up distance (MasterStartDistance), Master axis synchronization start position (MasterSyncPosition), Start mode (StartMode), Master axis data source selection (MasterValueSource), Cam tableID (CamTableID), and Buffer mode (BufferMode) and then executes the cam operation. To stop the operation, execute MC_Stop (Forced Stop).

Starting cam operation

Synchronous timing of the cam operation and reflection timing of the cam control data can be selected by setting of Start mode (StartMode).

■Cam operation synchronous timing

Settings of Start mode (StartMode), Master axis synchronization start position (MasterSyncPosition), and Master axis follow-up distance (MasterStartDistance)) decide the synchronous start timing of Current value per cycle (InputPerCycle), Reference value (Reference), and Output value (OutputData) as follows.

Start mode (StartMode)	Synchronous start timing	
	Current value per cycle (InputPerCycle)	Reference value (Reference), Output value (OutputData)
0: Immediate (mcImmediate)	When executing MC_CamIn (Cam Operation Start) (Ignores Master axis synchronization start position (MasterSyncPosition) and Master axis follow-up distance (MasterStartDistance))	
1: Absolute (mcAbsolute)	When the position ^{*2} of master axis passes ^{*3} Master axis synchronization start position (MasterSyncPosition) (Ignores Master axis follow-up distance (MasterStartDistance))	
2: Relative (mcRelative) ^{*1}	When the position ^{*2} of master axis passes ^{*3} Master axis synchronization start position (MasterSyncPosition) (Ignores Master axis follow-up distance (MasterStartDistance))	When the position ^{*2} of master axis passes ^{*3} Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)

*1 When using this setting, the error "Out of Start Mode Range" (error code: 1A47H) occurs.

*2 Set the position data to be used based on Specifying target of Master axis synchronization start position pass check (Option (Options) bit 21). For details, refer to the following.

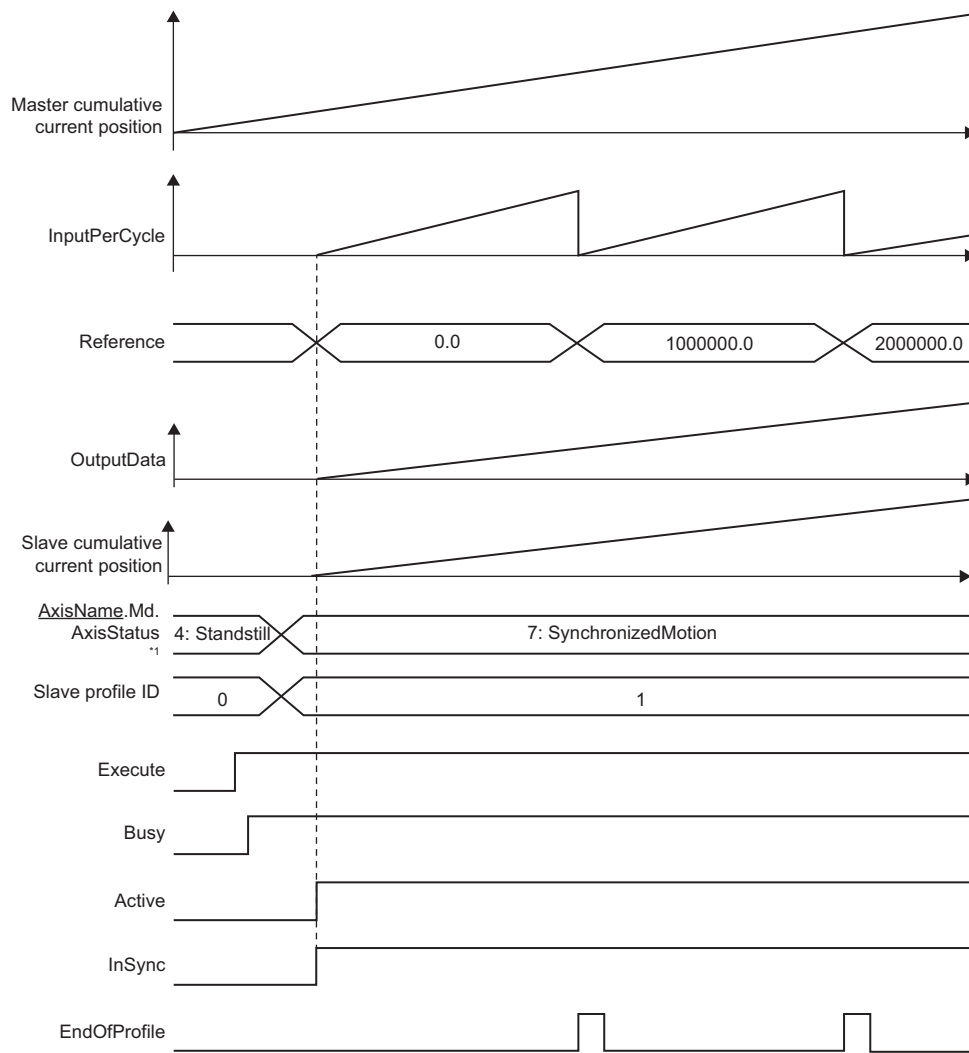
📖 Page 501 Options (Options)

*3 The position of the Master axis has crossed over Master axis synchronization start position (MasterSyncPosition)(or, the Master axis synchronization start position (MasterSyncPosition) + Master axis follow-up distance (MasterStartDistance)). When these values are the same, the Master axis is considered to have not passed, and should the Master axis move from this value, it will be considered to have passed.

After MC_CamIn (Cam Operation Start) is executed, Controlling (Active) becomes TRUE after Current value per cycle (InputPerCycle) is synchronized, and then In synchronization (InSync) becomes TRUE after Output value (OutputData) is synchronized.

■When "0: Immediate (mclmmediate)" is Start mode (StartMode)

The slave axis start moving after start of Execute command (Execute).

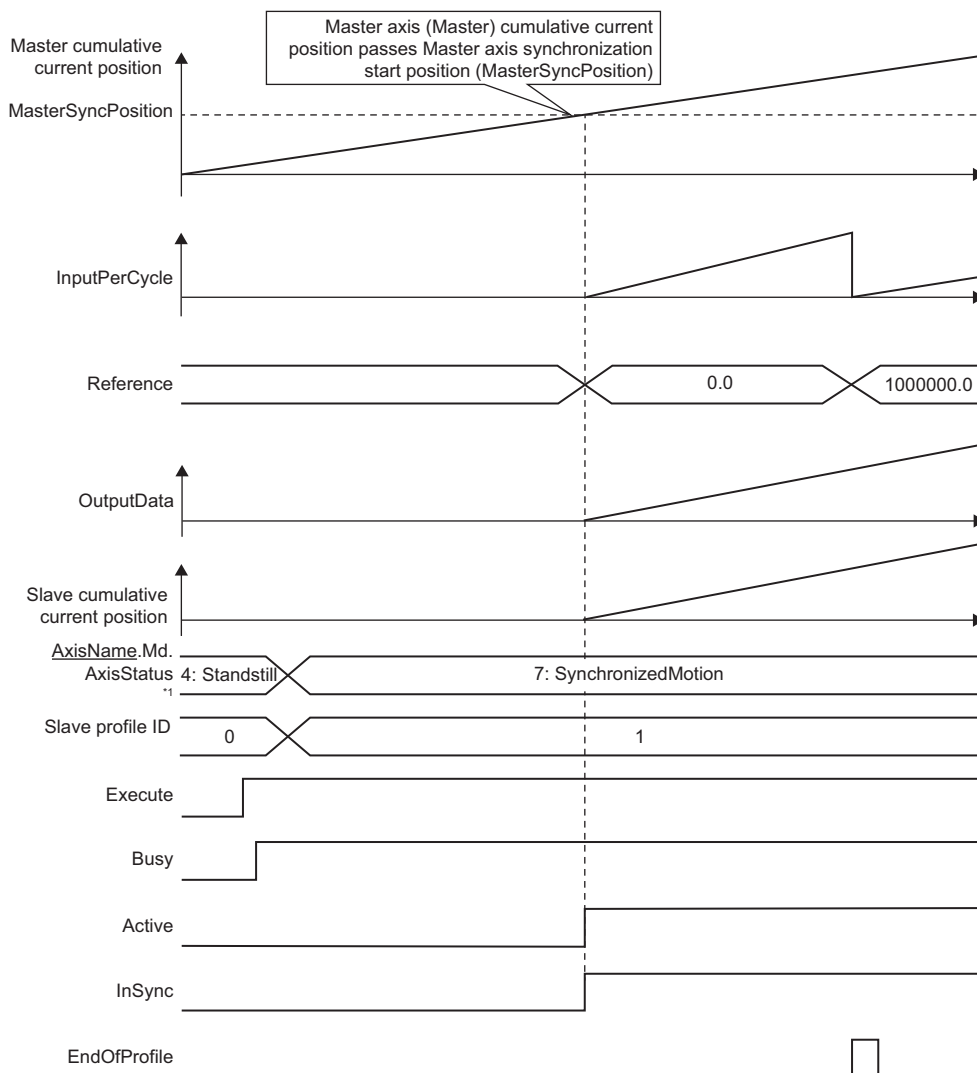


*1 This is the state of Slave axis (Slave).

■When Start mode (StartMode) is "1: Absolute (mcAbsolute)"

After start of Execute command (Execute), the slave axis start moving after the cumulative current position of the master axis passes Master axis synchronization start position (MasterSyncPosition).

Checking of whether the Master axis cumulative current position has passed the Master axis synchronization start position (MasterSyncPosition) begins at the point when the Slave axis status becomes "7: During synchronous operation (SynchronizedMotion)".



*1 This is the state of Slave axis (Slave).

■Timing of control change by FB restart/continuous update

Timing of reflecting changed parameters by FB restart/continuous update onto the control vary depending on Start Mode (StartMode) like the following.

Start Mode (StartMode)	Timing for reflecting parameters
0: Immediate (mcImmediate)	Immediate
1: Absolute (mcAbsolute)	When the current value per cycle (InputPerCycle) passes the first point on the CamTable

When the changed values exceed the range, the error is output and the control is maintained by keeping the value before.

Parameter	Error
Master axis offset (MasterOffset)	Out of Master Axis Offset Range (error code: 1A41H)
Slave axis offset (SlaveOffset)	Out of Slave Axis Range (error code: 1A42H)
Master axis scaling (MasterScaling)	Out of Master Axis Coefficient Range (error code: 1A43H)
Slave axis scaling (SlaveScaling)	Out of Slave Axis Coefficient Range (error code: 1A44H)
Cam tableID (CamTableID)	Out of Cam Table ID Range (error code: 1A40H)

Cam table

The following parameters are set as optional information by MC_CamTableSelect.

○: Used in control, ×: Not used in control

Name	Variable name	Interpolation Method Specification (Interpolate)		
		0: Linear interpolation	1: Specifying for each section	2: Spline interpolation
Periodic	Periodic	○	○	
Input absolute coordinate	MasterAbsolute	○	○	
Output absolute coordinate	SlaveAbsolute	○	○	
Interpolation method specification	Interpolate	○	○	
Length per cycle	CycleLength	○	○	
Stroke amount	Stroke	○	○	
Start point	StartPoint	×	×	
Initial stroke amount	StartStroke	×	○	

The cam operation when executing MC_CamIn (Cam Operation Start) using parameters is shown below.

■Periodic (Periodic)

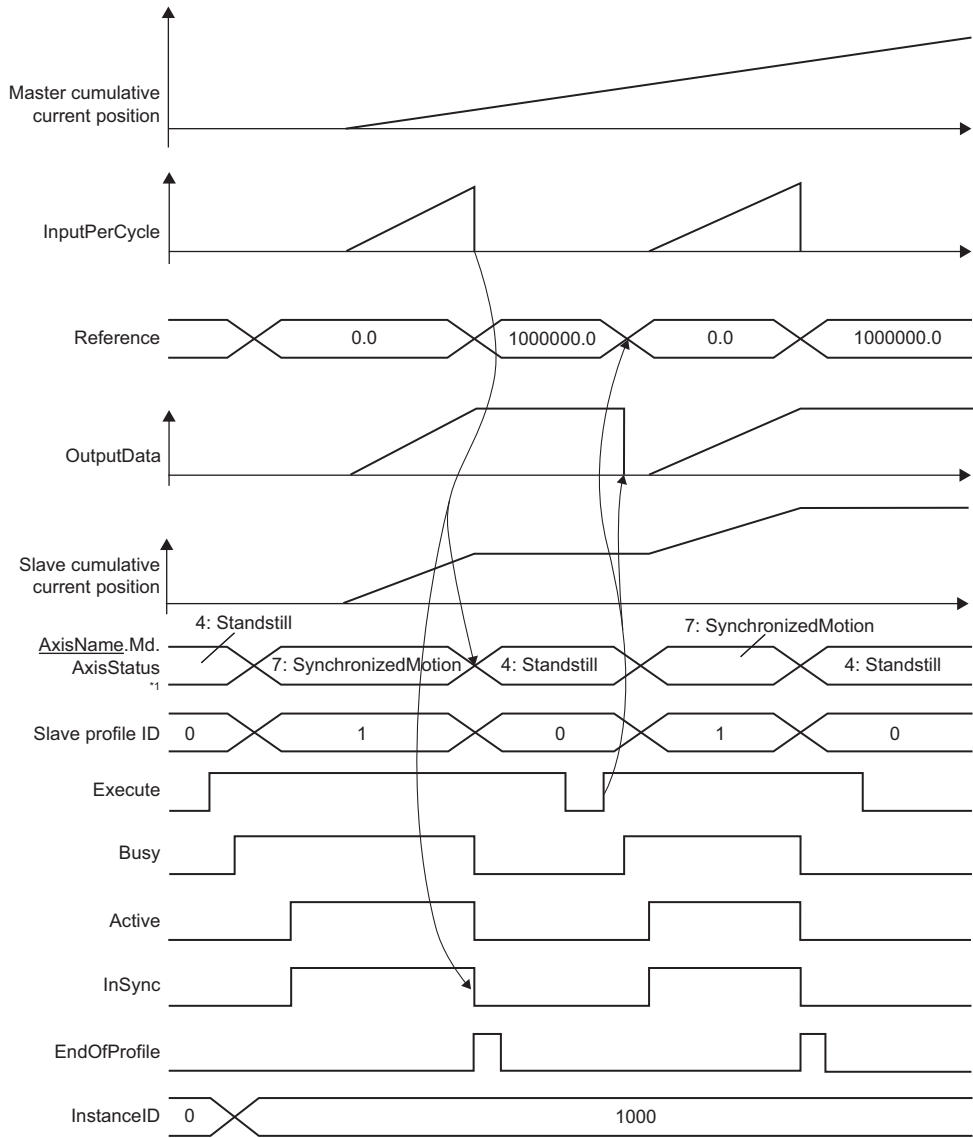
Periodic (Periodic) can set "FALSE: Non periodic" and "TRUE: Periodic (Periodic)". The following explains the operation when executing MC_CamIn (Cam Operation Start).

- Periodic (Periodic) "FALSE: Non periodic" is specified

Only one cycle operation is carried out after Controlling (Active) becomes TRUE. The next operation in Specifying operation after one cycle operation (Options (Options) bit 16).

Specifying operation after one cycle operation (Options (Options) bit 16)	Operation after cycle operation				Reference value (Reference), Output value (OutputData) at restart
	Executing (Busy)	Controlling (Active)	In synchronization (InSync)	Axis Status (<u>AxisName</u> .Md.AxisStatus)	
0: Complete	FALSE			"4: Standby (Standstill)"	Initialized
1: Wait for restart	TRUE			Maintains "7: During synchronous operation (SynchronizedMotion)"	Maintained

[When Specifying operation after one cycle operation (Options (Options) bit 16) is "0: Complete"]
 Synchronization status is cancelled after one cycle, and Reference value (Reference) and Output value (OutputData) change to 0.0 (Default value) when Execute command (Execute) is started again.



*1 This is the state of Slave axis (Slave).

[When Specifying operation after one cycle operation (Options (Options) bit 16) is "1: Wait for restart"]

Synchronization status is maintained after one cycle, and Reference value (Reference) and Output value (OutputData) keep their value when Execute command (Execute) is started again.

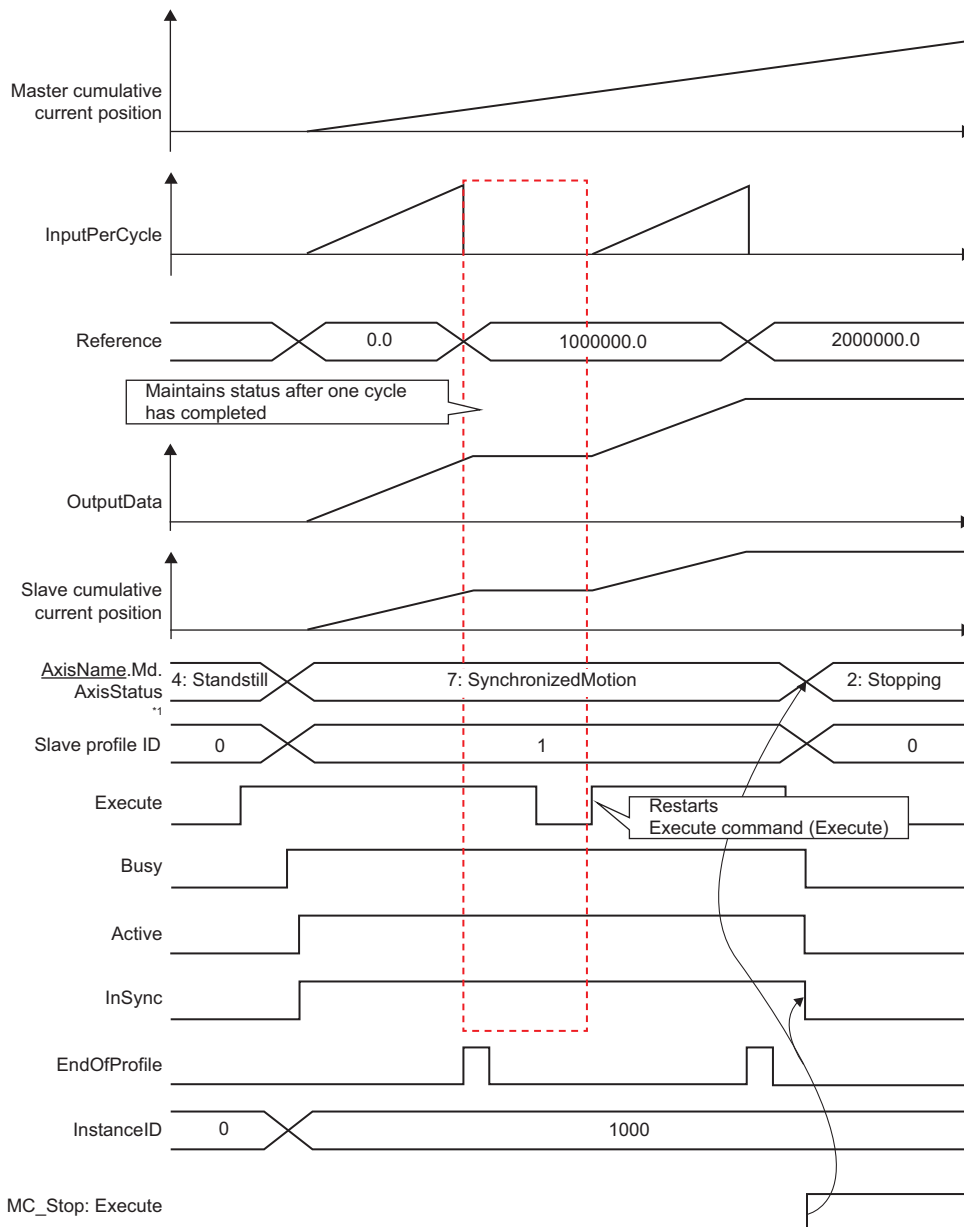
Input stop cause to the slave axis to cancel synchronization status.

During a restart after one cycle has completed, even when values of input labels where continuous update is possible are changed, any input information will not be imported until Execute command (Execute) is restarted.

If Execute command (Execute) is restarted, regardless of the Start mode (StartMode) settings, the slave axis will immediately start moving.

While waiting for a restart after one cycle has completed, if a change to the current value per cycle is executed, this will be valid from the next cycle.

The operation image while waiting for restart after one cycle has completed is shown below.

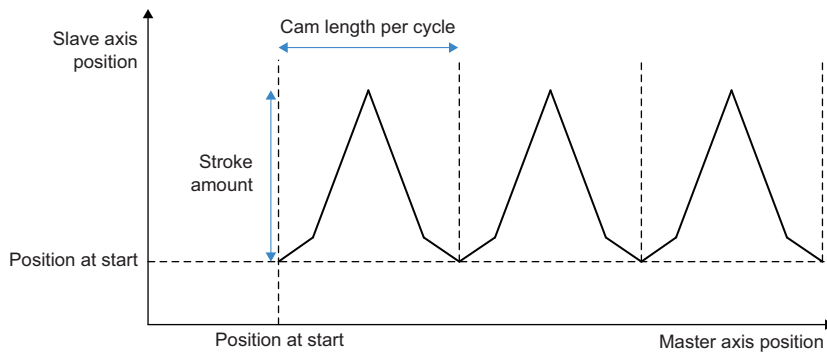


*1 Axis status of Slave axis (Slave).

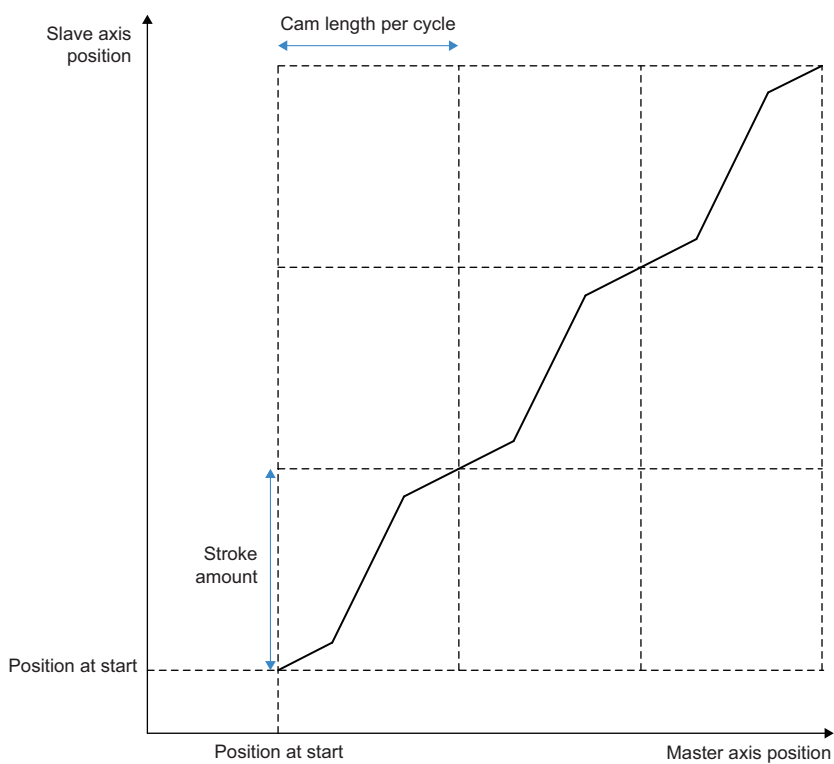
- Periodic (Periodic) "TRUE: Periodic" is specified

Cam table execution is repeated continuously. When the positions of Slave axis (Slave) at the cam table start point are the same each time by repeating, cam is operated as a two-way cam. When the set positions at the start point and the end point are different, cam is operated as a feed cam.

[Two-way cam operation]



[Feed cam operation]



■ Master axis absolute coordinate

The following explains the operation at Master axis absolute coordinate (MasterAbsolute) set by MC_CamTableSelect.

- "0: Relative coordinate" is specified to the master axis absolute coordinate

Master axis synchronization start position (MasterSyncPosition) becomes the start point of the cam table. When In synchronization (InSync) becomes TRUE, cam operation is executed corresponding to the relative movement amount of Master axis (Master).

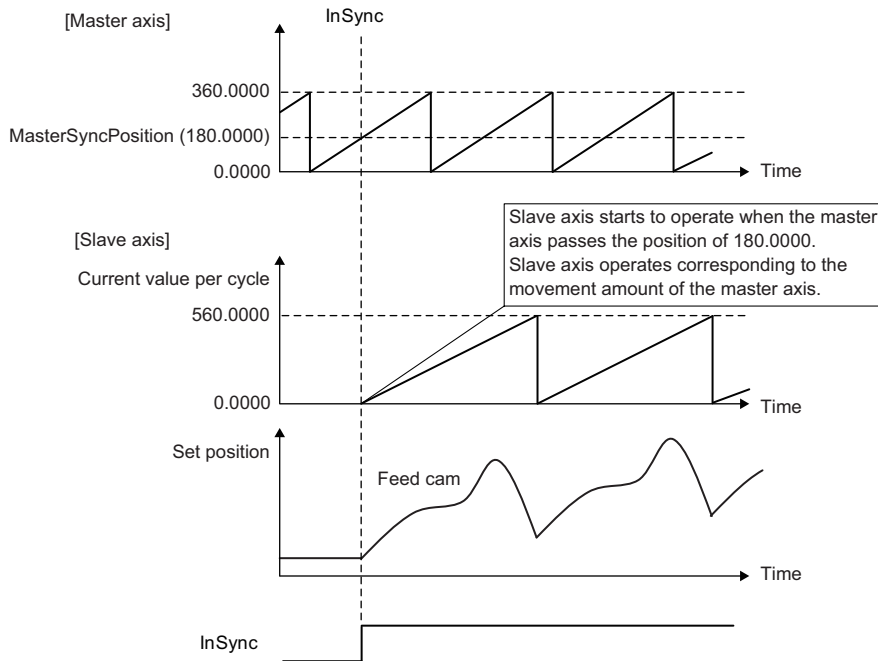
Cam operation is executed continuously, even when ring counters of Master axis (Master) and cam table are not matched.

Ex.

Master axis: Ring counter of the current value: 0.0000 to 360.0000 [degree]

Master axis synchronization start position (MasterSyncPosition): 180.0000 [degree]

Cam: Cam length per cycle: 540.0000 [degree]



- "1: absolute coordinate" is specified to Master axis absolute coordinate (MasterAbsolute)

When using this setting, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs.

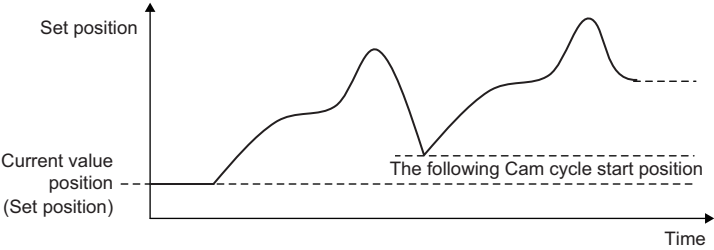
■Slave axis absolute coordinate

The following explains the operation at Slave axis absolute coordinate (SlaveAbsolute) set by MC_CamTableSelect (Cam Table Selection).

- "0: relative coordinate" is specified to Slave axis absolute coordinate (SlaveAbsolute)

When In synchronization (InSync) becomes TRUE, the slave axis starts the operation of the cam table from the current position (set position).

When Periodic (Periodic) of the cam table is set to "TRUE: Periodic", the next cycle starts from the stroke position (set position) where the last cycle completed.



- "1: absolute coordinate" is specified to Slave axis absolute coordinate (SlaveAbsolute)

The cam is operated within the ring counter range including current values of Slave axis (Slave) at the point when In synchronization (InSync) becomes TRUE.

Command is output per operation cycle to return the set position of Slave axis (Slave) to the start point of the cam table when In synchronization (InSync) and Cam cycle completion (EndOfProfile) become TRUE. If the command at this time is too large, the position command and velocity command to the drive unit also become too large, causing the servo error [AL.

035_Command frequency error] for the MR-J5(W)-G. The set position of Slave axis (Slave) will not output any values outside the ring counter range.

Status	Operation
When the stroke range is within the ring counter range of slave axis	The graph plots 'Slave axis cumulative current position' on the vertical axis against 'Time' on the horizontal axis. Horizontal dashed lines indicate the 'Ring counter upper limit value', 'Current value position (Set position)', 'Cam table start point', and 'Ring counter lower limit value'. The cam profile curve starts at the 'Cam table start point', rises to a peak, falls to a trough labeled 'Following one cycle start position', and then rises to another peak before leveling off at the 'Current value position (Set position)'.
When the stroke range is within the ring counter range of slave axis (Cam started on the 2nd cycle)	The graph plots 'Slave axis cumulative current position' on the vertical axis against 'Time' on the horizontal axis. Horizontal dashed lines indicate the 'Ring counter upper limit value', 'Current value position (Set position)', 'Cam table start point', and 'Ring counter lower limit value'. The cam profile curve starts at the 'Cam table start point', rises to a peak, falls to a trough labeled 'Following one cycle start position', and then rises to another peak before leveling off at the 'Current value position (Set position)'. A callout box points to the 2nd cycle, stating 'Controlled in the 2nd cycle ring counter range.'

Status	Operation
When the stroke range is outside the ring counter range of the slave axis ^{*1}	Slave axis cumulative current position Ring counter upper limit value Cam table start point Ring counter lower limit value Following one cycle start position Time
When current value per cycle is changed	Slave axis cumulative current position Ring counter upper limit value Cam table start point Ring counter lower limit value Following one cycle start position Time Range outside the ring counter range will be changed. Command values outside the ring counter range will not be output.

^{*1} If the version of ProfileControl version is "1.15 or earlier", command values outside of the ring counter range will also be output. Values outside of the ring counter range will be rounded so that they are within the range.

■Length per cycle

Set the input amount that is required for one cycle. For details, refer to the following.

☞ Page 493 Current value per cycle (MC_CamIn.InputPerCycle)

■Stroke amount

Set the stroke amount corresponding to its ratio 100%. For details, refer to the following.

☞ Page 496 Output value (MC_CamIn.OutputData)

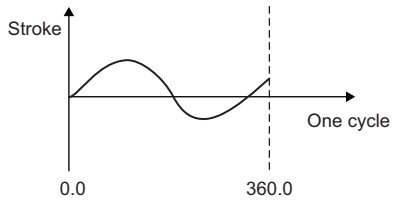
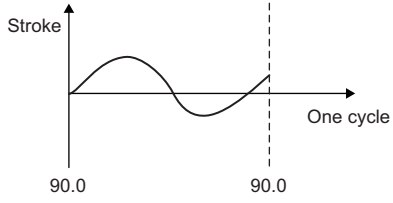
■Start point and Initial stroke amount

Start Point used for cam operation and the Initial stroke amount will differ depending on the interpolation method specification

Interpolation Method Specification (Interpolate)	Cam operation Start Point	Initial stroke amount for cam operation
0: Linear interpolation	Input value of the cam table start point	Output value of the cam table start point
1: Specifying for each section	Start Point (StartPoint) of the cam table start point	Initial stroke amount (StartStroke) of the cam table
2: Spline interpolation		

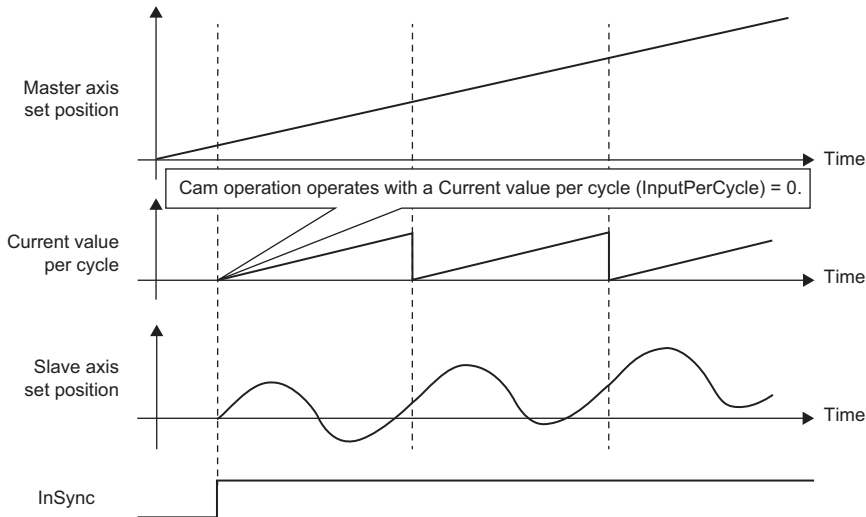
Cam operation operates with a Current value per cycle (InputPerCycle) = 0.

[Cam table]

Cam 1 (Cam operation Start Point "0.0")	
	• Specifying interpolation method: Specifying for each section • Length per cycle: 360.0 • Start Point: 0.0 • Initial stroke amount: 0.0
Cam 2 (Cam operation Start Point "90.0")	
	• Specifying interpolation method: Specifying for each section • Length per cycle: 360.0 • Start Point: 90.0 • Initial stroke amount: 0.0

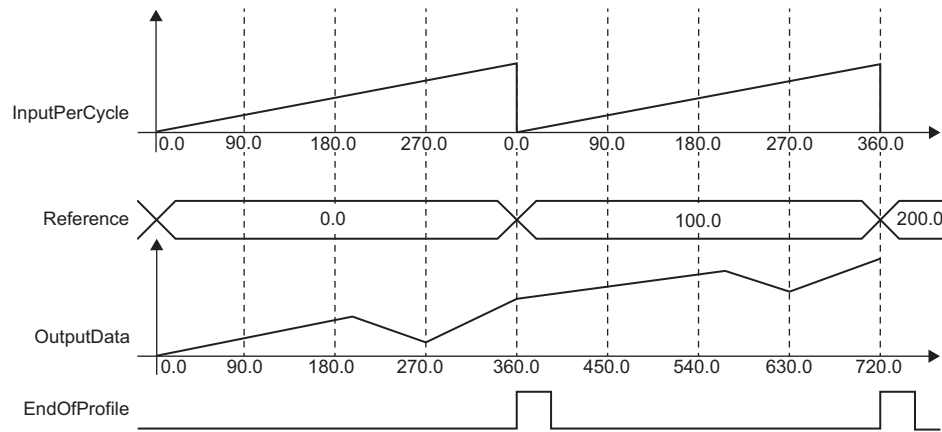
[Cam operation]

The operation in the following is performed regardless of whether cam 1 or cam 2 is used.

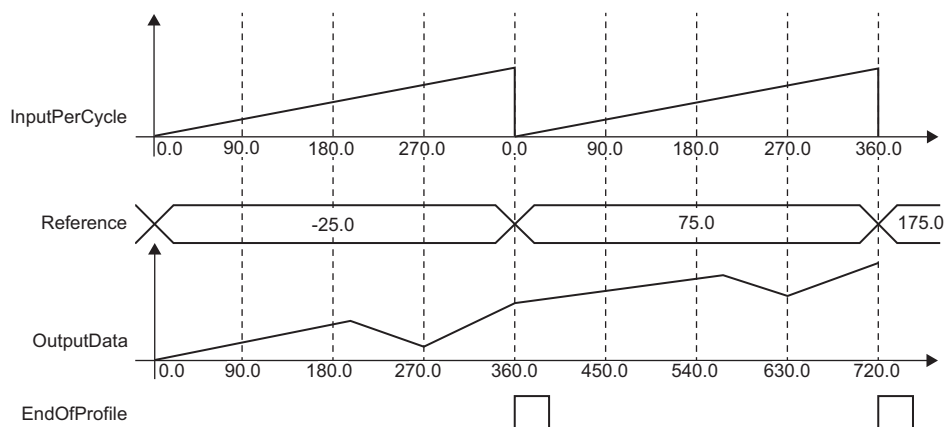


Operates so that the initial stroke amount equals Output value (OutputData) at the start of synchronization. Because the initial stroke amount of the cam operation stops the slave axis from operating, the initial stroke amount from Reference value (Reference) is decreased.

[When Initial stroke amount of cam operation is "0.0"]



[Initial stroke amount of cam operation is "25.0"]



Monitor data during cam operation

During control in MC_CamIn (Cam Operation Start), the current value per cycle, the reference value, and the output value can monitor in Current value per cycle (MC_CamIn.InputPerCycle), Reference value (MC_CamIn.Reference), and Output value (MC_CamIn.OutputData).

Name	Variable name	Data type	Refresh cycle
Current value per cycle	InputPerCycle	LREAL	Execution cycle of POU which calls FB (program component)
Reference value	Reference	LREAL	
Output value	OutputData	LREAL	
Instance ID	InstanceID	WORD(UINT)	

■Current value per cycle (MC_CamIn.InputPerCycle)

The initial value is 0.

The movement amount of Master axis (Master) is reflected after Controlling (Active) turns to TRUE as follows.

Current value per cycle = (Cumulative movement amount of the master axis + Master axis offset + Current value per cycle change value) MOD Length per cycle

The monitor value range is " $0 \leq \text{Current value per cycle (MC\_CamIn.InputPerCycle)} < (\text{One cycle length} \times \text{Master axis scaling})$ "

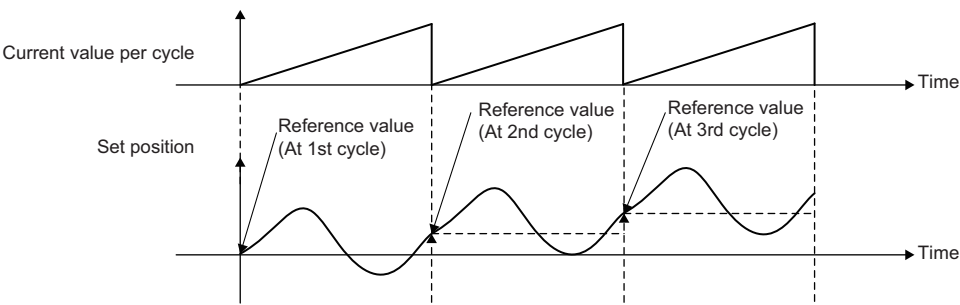
■Reference value (MC_CamIn.Reference)

When MC_CamIn (Cam Operation Start) is started to operate, cam reference value is calculated by the cam position for start (current value per cycle) based on set position where In synchronization (InSync) becomes TRUE. The formula for initial value is as follows because the Initial stroke amount during cam table is subtracted.

Slave axis absolute coordinate (SlaveAbsolute)	Calculation formula
FALSE: Relative coordinate	- ProfileControl version is "1.15 or later" - Reference value = Slave axis position when synchronization starts - (Stroke value based on the the cam position (current value per cycle) when In Synchronization (InSync) changes to TRUE + the initial stroke amount) $\times$ Slave axis scaling - ProfileControl version is "1.15 or earlier" - Reference value = 0 - (Stroke value based on the cam position (current value per cycle) when InSynchronization (InSync) changes to TRUE + the initial stroke amount) $\times$ Slave axis scaling
TRUE: Absolute coordinate	Reference value = The set position corresponding to the cumulative current position being 0 when In synchronization (In Sync) changes to TRUE.

When Two-way cam operation, or Slave axis absolute coordinate (SlaveAbsolute) is "TRUE: Absolute coordinate", the reference value is not updated. When Feed cam operation, as well as Slave axis absolute coordinate (SlaveAbsolute) are "FALSE: Relative coordinate", the reference value is calculated as shown below.

Calculation formula
Reference value = Original reference value + (Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)



Reference value is updated at the following timing

Update timing	The calculation formula of reference value
When Current value per cycle (InputsPerCycle) passes the last point of cam table	Original reference value + (Stroke value at the last point - Stroke value at the 1st point × Slave axis scaling)
When Current value per cycle (InputPerCycle) going in the address decreasing direction passes the first point of the cam table	Original reference value - ((Stroke value at the last point - Stroke value at the 1st point) × Slave axis scaling)
When changing current value per cycle (Execution completion (MCv_ChangeCycle.Done) is TRUE)	Original reference value - (Stroke value corresponding to current value per cycle after change × Slave axis scaling)

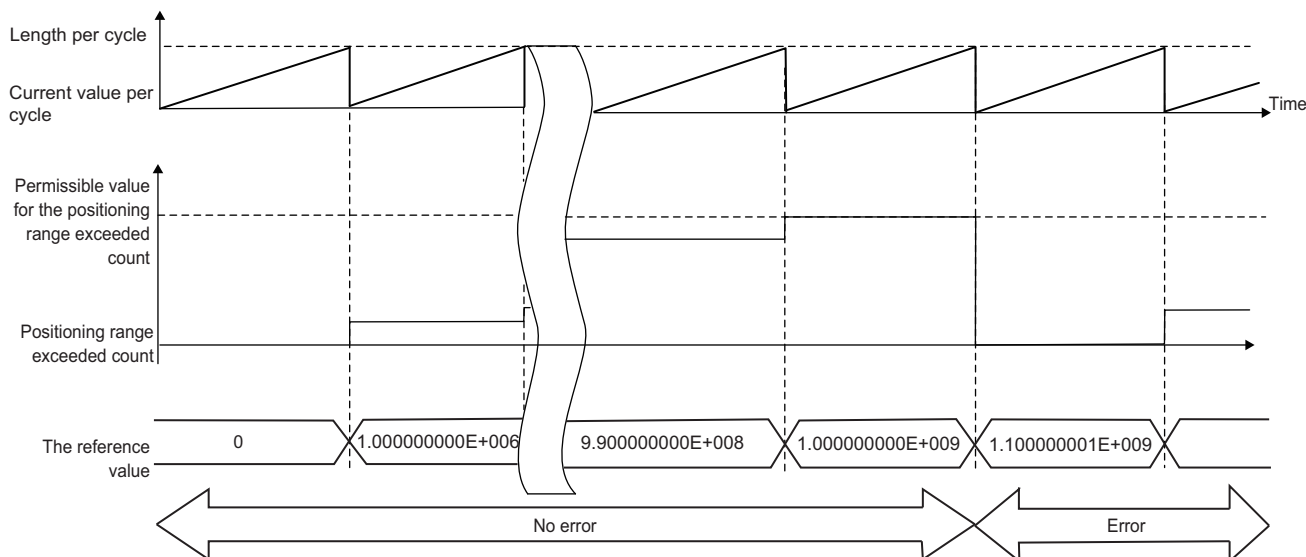
For the reference value error

Any of the following operation may cause the error of reference value.

- Condition 1: When the number of output TRUE of Cam cycle completion (EndOfProfile) after the feed cam and In synchronization (InSync) becomes TRUE exceeds the permissible value for the positioning range exceeded count.

Although the error does not occur unless positioning range exceeded count exceeds the permissible value for the positioning range exceeded count, if the value exceeds the permissible value, the error may occur.

(The operation is maintained regardless of the operation error occurrence or not.)



- Condition 2: When the feed cam and the following control parameter includes decimal
Stroke value at the last point - Stroke value at the 1st point
Slave axis coefficient
- Condition 3: When changing current value per cycle is repeated in relative specification

When the reference value error becomes too large, clear the synchronization status or reset it by executing current value change of absolute position specification.

For the error, refer to the following.

☞ Page 85 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) / the slave axis coefficient)

The limit value of the number of exceeding from maximum to minimum is 1000000000 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".

The monitor value range differs depending on ProfileControl version.

ProfileControl version	Monitor value range
Version is "1.15 or later"	Ring counter lower limit value of the slave axis ≤ Reference value < Ring counter upper limit value of the slave axis
Version is "1.15 or earlier"	Lower limit value of the positioning range ≤ Reference value < Upper limit value of the positioning range

■Output value (MC_CamIn.OutputData)

Reference value is the initial stroke amount during cam table. For details, refer to the following.

☞ Page 491 Start point and Initial stroke amount

While In synchronization (InSync) is TRUE, calculated as shown below.

Output value = Reference value + ((Stroke amount × Stroke ratio corresponding to the current value per cycle) × Slave axis scaling) + Slave axis offset

or

Output value = Reference value + (Output value corresponding to the current value per cycle) × Slave axis scaling) + Slave axis offset

The monitor value range differs depending on ProfileControl version.

ProfileControl version	Monitor value range
Version is "1.15 or later"	Ring counter lower limit value of the slave axis ≤ Output value < Ring counter upper limit value of the slave axis
Version is "1.15 or earlier"	Lower limit value of the positioning range ≤ Output value < Upper limit value of the positioning range

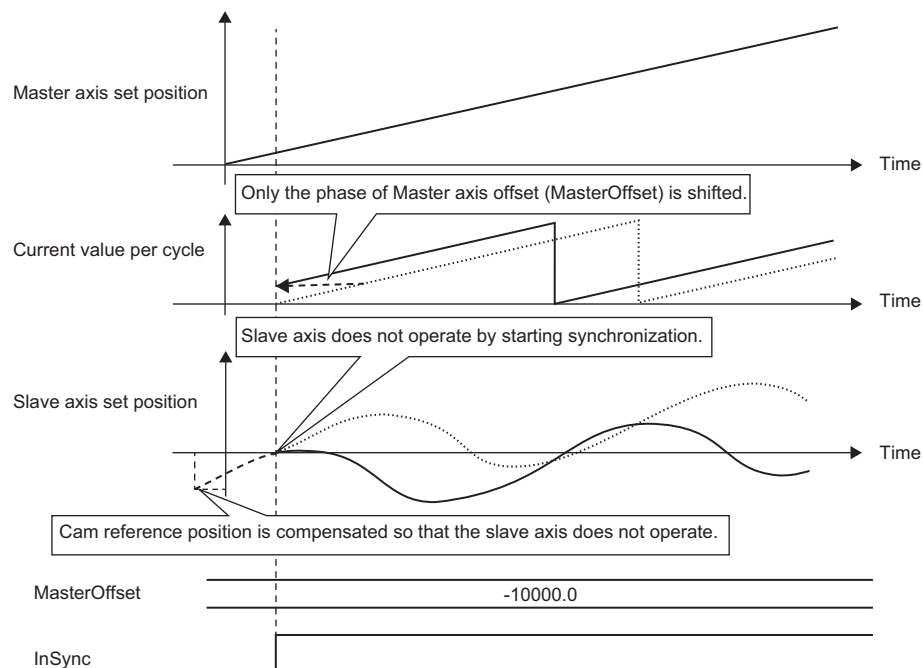
Details of setting items

■Master axis offset (MasterOffset)

The phase of the master axis can be shifted for the amount of offset by setting MasterOffset. (This does not affect Master axis follow-up distance (MasterStartDistance) or Master axis synchronization start position (MasterSyncPosition).)

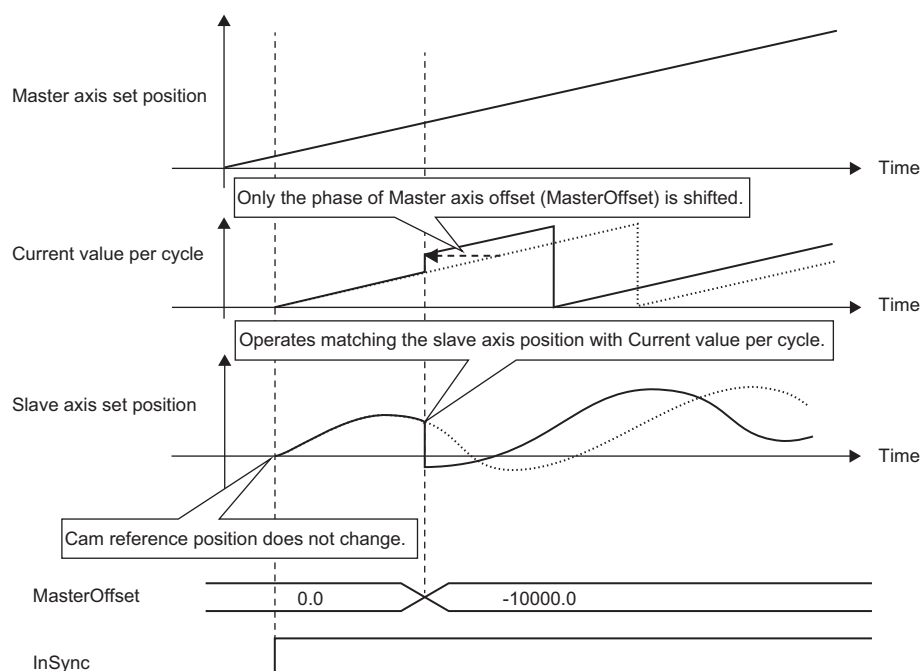
When other than "0" is set at operation start, the phase of master axis is changed to the cam position per cycle which is added the amount of offset for position of Master axis (Master) at rising edge of In synchronization (InSync). When this happens, Reference value (Reference) is compensated so that Slave axis (Slave) does not operate.

[When Start mode (StartMode) is "0: Immediate (mclmmediate)"]



When Master axis offset is changed while In Synchronization (InSync) is TRUE, operates matching the position of Slave axis (Slave) with the current value per cycle added Master axis offset.

Start mode (StartMode) is "0: Immediate (mclmmediate)"

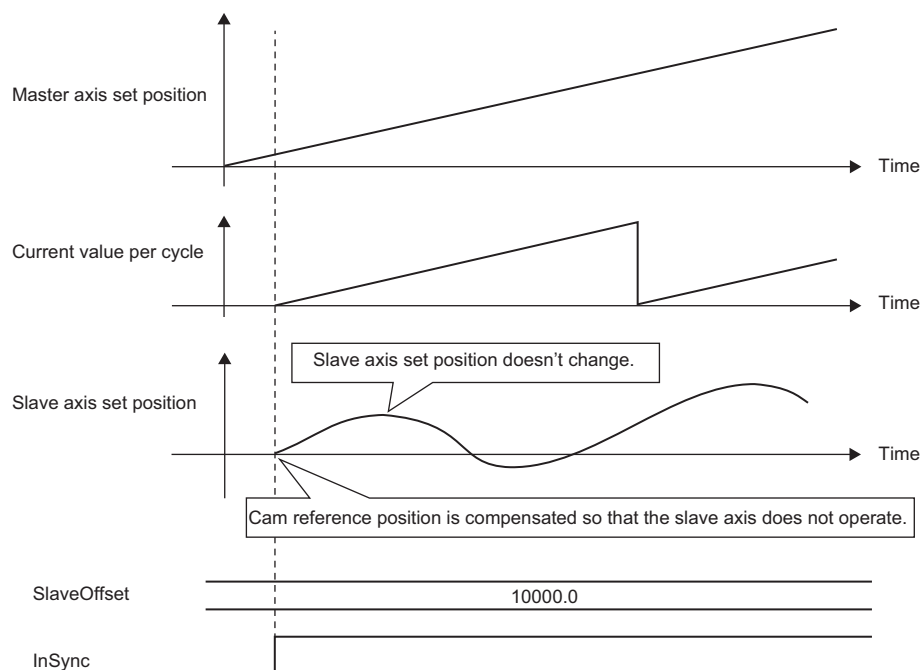


■ Slave axis offset (SlaveOffset)

The displacement of the Slave axis (Slave) is shifted for amount of offset.

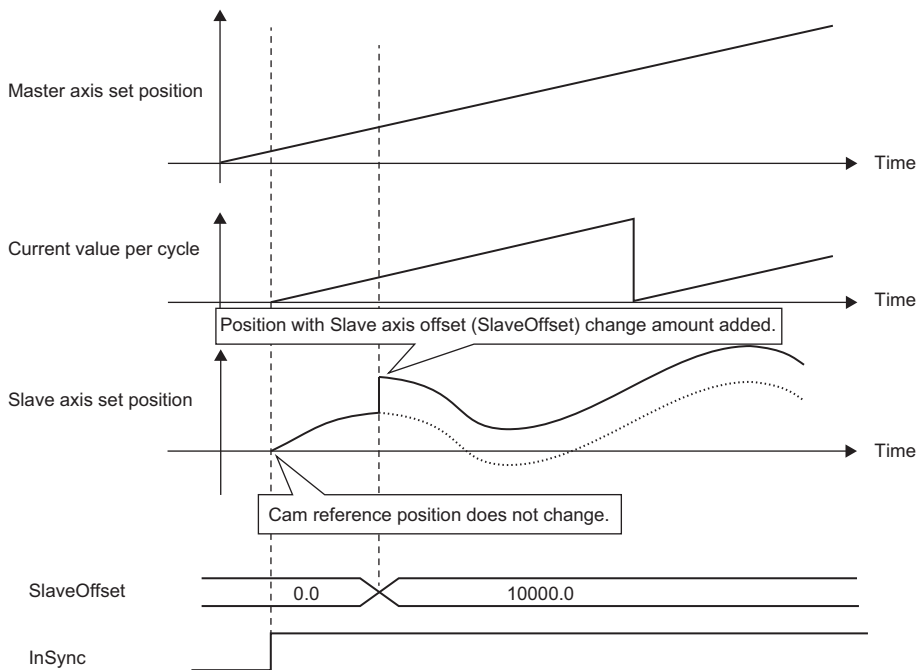
When other than "0" is set before rising of In synchronization (InSync), Reference value (Reference) is compensated so that Slave axis (Slave) does not operate at rising.

[When Start mode (StartMode) is "0: Immediate (mclmmediate)"]



When Slave axis offset is changed while In Synchronization (InSync) is TRUE, operates matching the position of Slave axis (Slave) with the position added the offset change amount.

[When Start mode (StartMode) is "0: Immediate (mclmmediate)"]

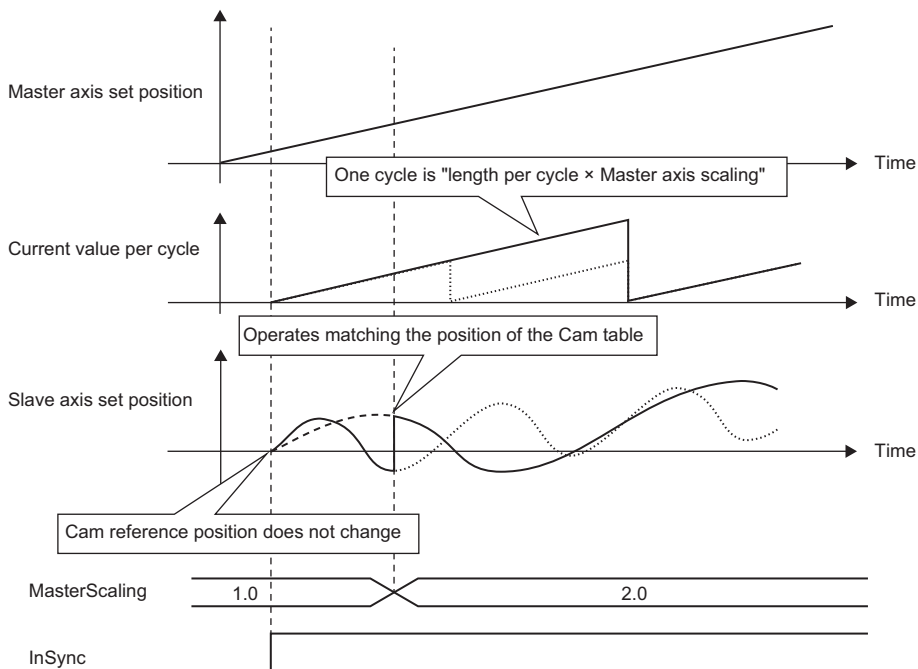


■ Master axis scaling (MasterScaling)

Expand/reduce the length per cycle of cam table.

When changing during synchronization, a command for the moving amount is output to adjust the position of Slave axis (Slave) to the position of the cam table.

[When Start mode (StartMode) is "0: Immediate (mclmmediate)"]

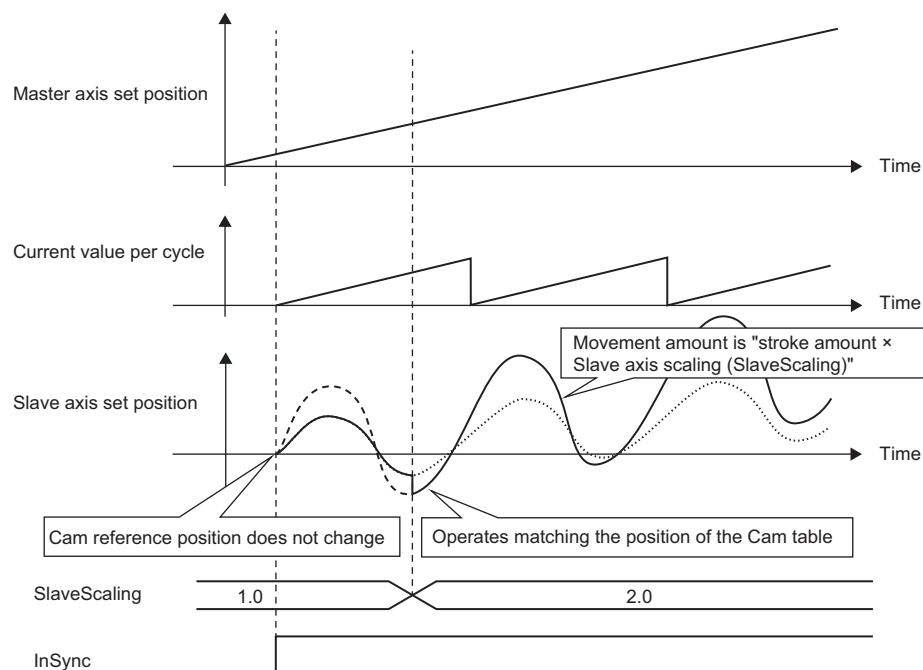


■Slave axis scaling (SlaveScaling)

Expand/reduce the stroke amount of the cam table.

When changing during synchronization, a command for the moving amount is output to adjust the position of Slave axis (Slave) to the position of the cam table.

[When Start mode (StartMode) is "0: Immediate (mcImmediate)"]



■Master axis follow-up distance (MasterStartDistance)

Output value (OutputData) sets the position of Master axis (Master) (the relative position from Master axis synchronization start position (MasterSyncPosition)) which starts synchronization. For details, refer to the following.

📖 Page 482 Starting cam operation

■Master axis synchronization start position (MasterSyncPosition)

Current value per cycle (MC_CamIn.InputPerCycle) sets the position of Master axis (Master) which starts synchronization. For details, refer to the following.

📖 Page 482 Starting cam operation

■Start mode (StartMode)

Select "0: Immediate (mcImmediate)" or "1: Absolute (mcAbsolute)". For details, refer to the following.

📖 Page 482 Starting cam operation

When "2: Relative (mcRelative)" is specified, the error "Out of Start Mode Range" (error code: 1A47H) occurs.

■Master axis data source selection (MasterValueSource)

Select the data source of Master axis (Master). For details, refer to the following.

📖 Page 475 Master Axis Data Source Selection

■Cam tableID (CamTableID)

Set the ID for cam. Open the cam ID to the open area by MC_CamTableSelect before use.

Set the following.

FB	Name	Variable name
MC_CamTableSelect	Cam tableID	MC_CAM_REF.ProfileData.ID

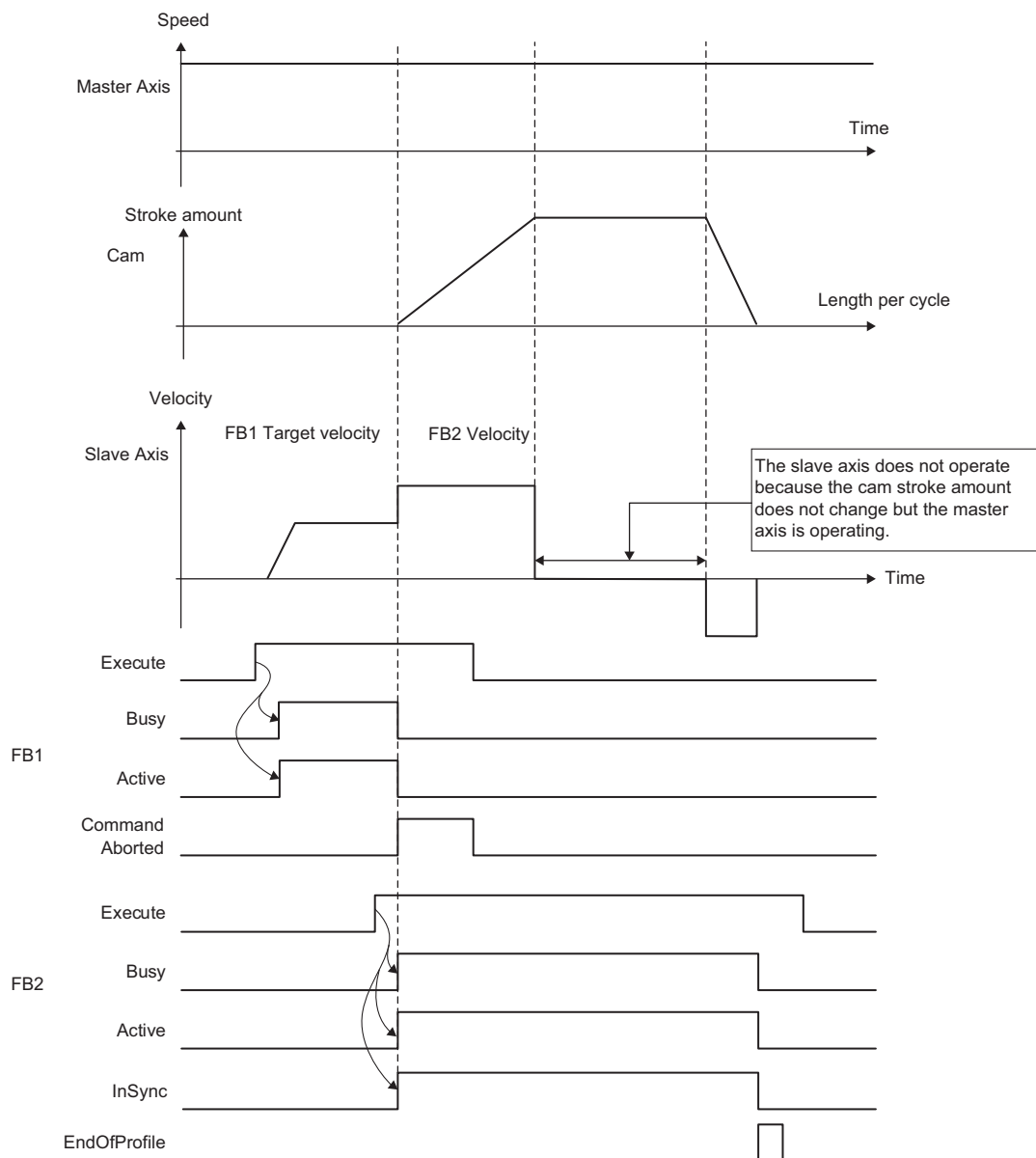
■Buffer mode (BufferMode)

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 cam table as the speed of MC_CamIn (Cam Operation Start) follows the synchronizing FB (the master axis). The switching condition at each mode is shown below.

Buffer mode (BufferMode)	Switching condition
Aborting	Always
Buffered	Cam cycle completion (EndOfProfile) = TRUE

An operation example when Aborting is executed in Start mode (StartMode) = "0: Immediate (mclImmediate)" to the on-going FB1 with the linked start FB2 (slave axis: MC_CamIn) is shown below.



The speed of FB2 occurs after In synchronization (InSync) becomes TRUE.

When Start mode (StartMode) is other than "0: Immediate (mclImmediate)", the speed becomes 0 until it turns from Executing (Busy) = TRUE to In synchronization (InSync) = TRUE because In synchronization (InSync) does not become TRUE immediately after it started.

For details on operation and the combination with the other FBs, refer to the following.

Page 135 Buffer mode type

■Options (Options)

Set the function options that are used in MC_CamIn (Cam Operation Start) by specifying the bit.

The details of bit and the functions are shown below.

Bit	Function description
0 to 15	Empty (Specify "0".)*1
16	Specifying the operation after one cycle operation. Periodic (Periodic) of the cam table specifies the operation after one cycle operation when "FALSE: Non periodic" is set. 0: Complete 1: Wait for restart For detail, refer to the following.  Page 485 Periodic (Periodic)
17 to 20	Empty (Specify "0".)*1
21	Specifying target of Master axis synchronization start position pass check Specifies the target of the Master axis synchronization start position (MasterSyncPosition) pass check. 0: Master axis cumulative current position, or where the actual position has been converted to the cumulative position. 1: Master axis set position, or the actual position.
22 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■In synchronization (InSync)

It becomes TRUE when Output value (OutputData) starts synchronization.

■Executing (Busy)

It becomes TRUE during execution of the FB.

■Controlling (Active)

It becomes TRUE when Current value per cycle (MC_CamIn.InputPerCycle) starts synchronization.

■Abortion of execution (CommandAborted)

It becomes TRUE if other FBs are started during execution of this FB.

■Error (Error)

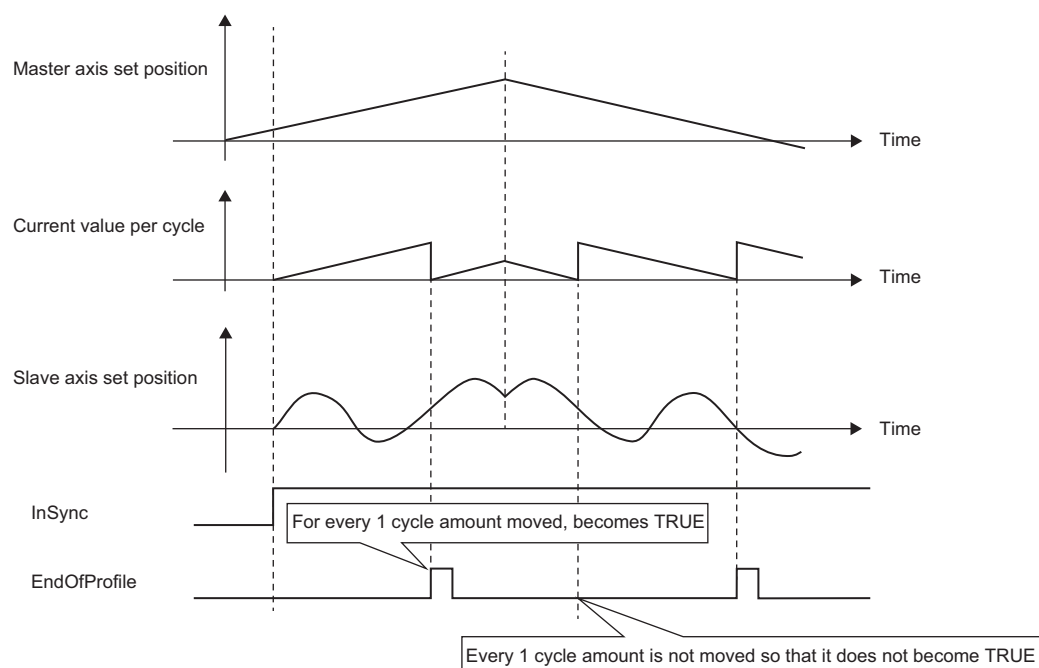
It becomes TRUE if an error occurs in this FB.

■Error code (ErrorID)

It returns an error code occurred in this FB.

■Cam cycle completion (EndOfProfile)

After controlling (Active) becomes TRUE, this variable becomes TRUE only for 1 execution cycle of the POU (Program Component) that calls FB each time movement equal to the cycle length occurs.



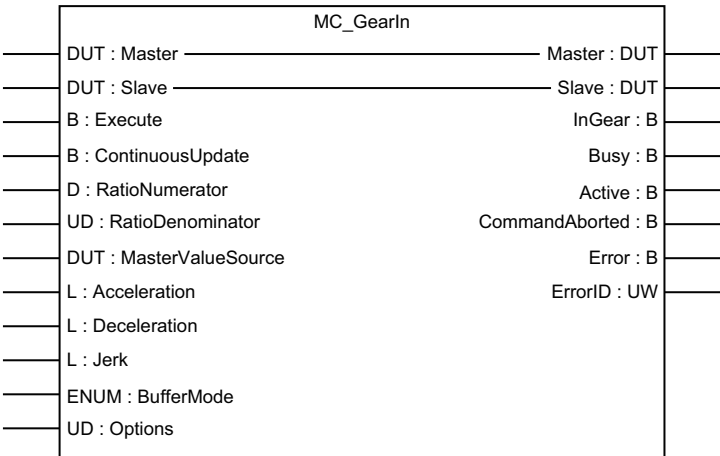
Precautions

- Changing Master axis offset (MasterOffset), Slave axis offset (SlaveOffset), Master axis scaling (MasterScaling), and Slave axis scaling (SlaveScaling) may give impact to the machine because the slave axis moves suddenly at the start of control or at control change. It is important to carefully check the setting values and the change timing.
- When monitoring the axis being cam controlled with the engineering tool, the position, velocity, etc. is based on the unit setting of the axis. Units for the cycle length, stroke amount, etc. set in the operation profile data are not used.

13.8 Gear Operation

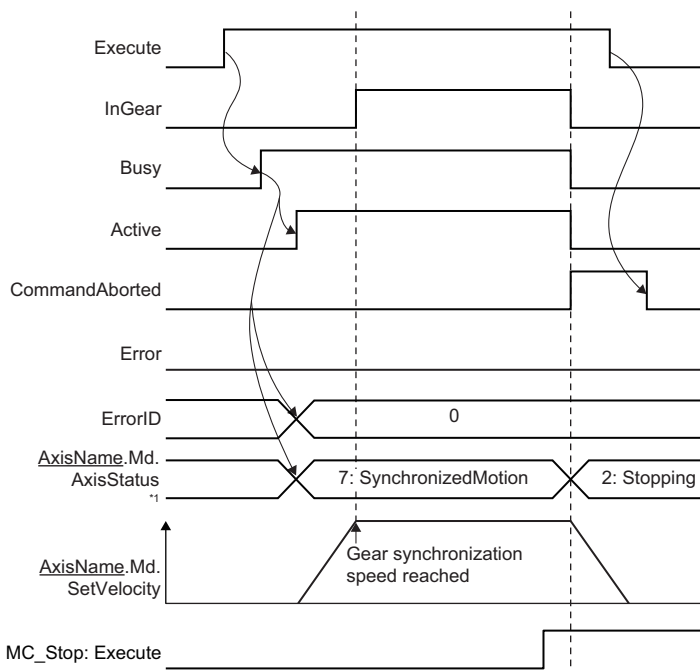
This function sets the speed ratio between the master axis and the slave axis, and starts gear operation.

Relevant FB

MC_GearIn			
Item	Description		
Function overview	Gear operation starts operation according to the specified gear ratio.		
Symbol [Structured Ladder]	 The diagram shows the MC_GearIn function block with the following connections: - Inputs: DUT : Master, DUT : Slave, B : Execute, B : ContinuousUpdate, D : RatioNumerator, UD : RatioDenominator, DUT : MasterValueSource, L : Acceleration, L : Deceleration, L : Jerk, ENUM : BufferMode, UD : Options. - Outputs: Master : DUT, Slave : DUT, InGear : B, Busy : B, Active : B, CommandAborted : B, Error : B, ErrorID : UW.		
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 (Slave).

[When an error occurs]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■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 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 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 Gear ratio numerator (RatioNumerator), Gear ratio denominator (RatioDenominator), Acceleration (Acceleration), and Deceleration (Deceleration).
Gear ratio numerator	RatioNumerator	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 507 Gear ratio numerator (RatioNumerator)
Gear ratio denominator	RatioDenominator	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 508 Gear ratio denominator (RatioDenominator)
Master axis data source selection	MasterValueSource	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 508 Master axis data source selection (MasterValueSource)
Acceleration	Acceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	☞ Page 508 Acceleration (Acceleration)
Deceleration	Deceleration	LREAL	↑/R/C	☞ Page 353 Input variables to use	0.0	☞ Page 508 Deceleration (Deceleration)
Jerk	Jerk	LREAL	↑	☞ Page 353 Input variables to use	0.0	☞ Page 508 Jerk (Jerk)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 508 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Sets "00000000H". (A value other than "00000000H" causes the error "Out of Options Range" (error code: 1A4EH).)

■Output variables

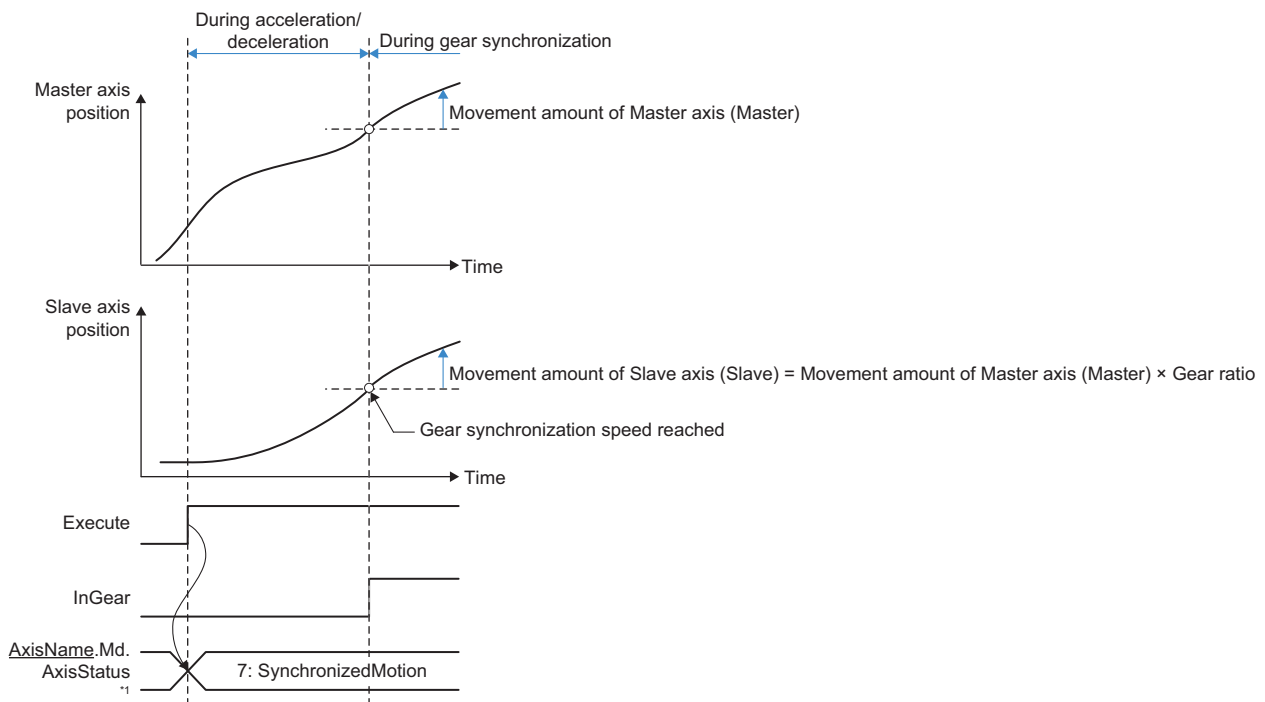
Name	Variable name	Data type	Default value	Description
Gear ratio reached	InGear	BOOL	FALSE	Indicates that the gear synchronization speed is reached.
Executing	Busy	BOOL	FALSE	Indicates that the FB is in execution.
Controlling	Active	BOOL	FALSE	Indicates that the FB is controlling the axis.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that execution has been aborted because of other FBs. When this FB is stopped by an error or when this FB is started up while an error occurs, it becomes TRUE. Becomes FALSE when Execute command (Execute) becomes FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 711 List of Error Codes

Control details

In the MC_GearIn (Gear Operation Start), Gear ratio numerator (RatioNumerator), Gear ratio denominator (RatioDenominator), Master axis data source selection (MasterValueSource), Acceleration (Acceleration), Deceleration (Deceleration), Jerk (Jerk), and Buffer mode (BufferMode) are set and the gear operation starts.

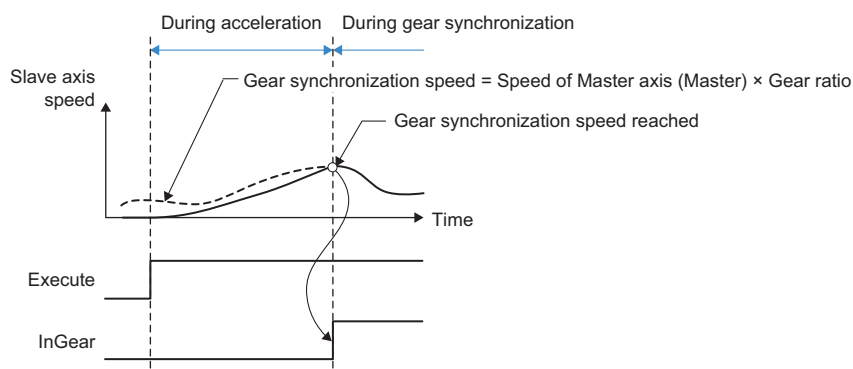
To stop the operation, execute the MC_Stop (Forced Stop).

After executing this FB, Slave axis (Slave) performs acceleration/deceleration until reaching the gear synchronization speed, the value of which is the velocity of Master axis (Master) converted by the gear ratio. After reaching the gear synchronization speed, Gear ratio reached (InGear) becomes TRUE, and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.



*1 This is axis state of Slave axis (Slave).

- When the speed of Master axis (Master) is changed during acceleration/deceleration, the gear synchronization speed is also updated.



Acceleration/deceleration until reaching the gear synchronization speed

- The acceleration/deceleration method for MC_GearIn (Gear Operation Start) is the acceleration/deceleration specification method.

For details of operation of the acceleration/deceleration specification method, refer to the following.

☞ Page 348 Acceleration/deceleration Processing Function

- Depending on the velocity of Slave axis (Slave) and the gear synchronization speed at operation start, one of the following four types of acceleration/deceleration is performed.

The type of acceleration/deceleration will not change even if the gear synchronization speed is updated during the acceleration/deceleration.

Velocity of Slave axis (Slave) and gear synchronization speed	Acceleration/deceleration operation
Velocity of Slave axis (Slave) < 0 < Gear synchronization speed or Velocity of Slave axis (Slave) > 0 > Gear synchronization speed	Deceleration is performed to velocity 0, then acceleration is performed from velocity 0 to the gear synchronization speed.
Velocity of Slave axis (Slave) (Absolute value) < Gear synchronization speed (Absolute value)	Acceleration is performed until reaching the gear synchronization speed.
Velocity of Slave axis (Slave) (Absolute value) > Gear synchronization speed (Absolute value)	Deceleration is performed until reaching the gear synchronization speed.

Velocity of SSlave axis (Slave) and gear synchronization speed	Acceleration/deceleration operation
Velocity of Slave axis (Slave) = Gear synchronization speed	Acceleration/deceleration is not performed. After operation is started, Gear ratio reached (InGear) becomes TRUE immediately and Slave axis (Slave) is controlled using a velocity equal to the velocity of Master axis (Master) converted by the gear ratio.

Details of setting items

■ Gear ratio numerator (RatioNumerator)

Set the numerator value for converting the speed of Master axis (Master) and transmitting.

The speed is converted as shown below.

$$\text{Master axis (Master) speed after conversion} = \text{Master axis (Master) speed before conversion} \times \frac{\text{Gear ratio numerator (RatioNumerator)}}{\text{Gear ratio denominator (RatioDenominator)}}$$

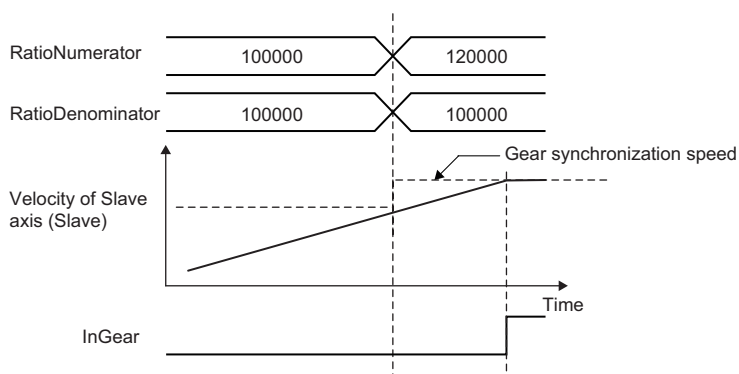
The speed direction can be reversed and transmitted by setting a negative value in Gear ratio numerator (RatioNumerator).

The velocity of Master after conversion can be set to "0" by setting the value of Gear ratio numerator (RatioNumerator) to "0".

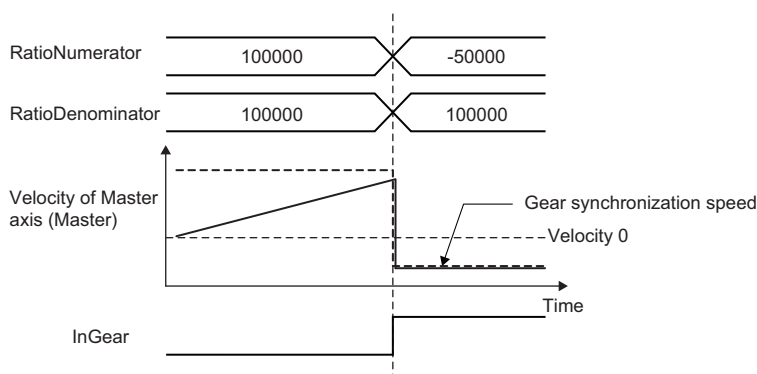
The gear synchronization speed is changed if the gear ratio is changed during acceleration/deceleration. Therefore, the speed of Slave axis (Slave) is changed directly and the gear operation may start because of the change of the gear synchronization speed.

[Changing the gear ratio during acceleration/deceleration]

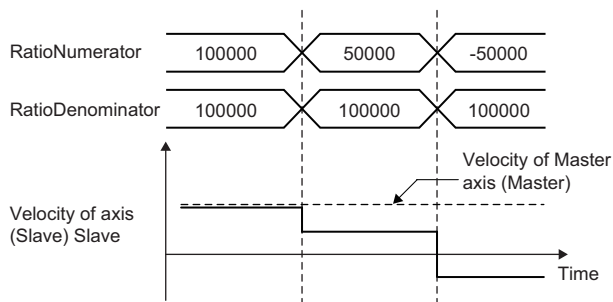
- Gear ratio increase (set to a value higher than the velocity of Slave axis (Slave))



- Gear ratio decrease (set to a value higher than the velocity of Slave axis (Slave))
- Gear ratio direction reverse (set the gear synchronization speed to a value lower than "0")



When the gear ratio is changed during gear synchronization, the velocity of Slave axis (Slave) is changed directly.
 [Changing the gear ratio during gear synchronization]



■Gear ratio denominator (RatioDenominator)

Set the denominator for converting the movement amount of Master axis (Master) and composing.

Set together with Gear ratio numerator (RatioNumerator).

Set a positive value in Gear ratio denominator (RatioDenominator).

■Master axis data source selection (MasterValueSource)

Select the data source of Master axis (Master) for transmitting the speed of Master axis (Master). For details, refer to the following.

📖 Page 475 Master Axis Data Source Selection

■Acceleration (Acceleration)

Set the acceleration for accelerating.

When reaching the gear synchronization speed, Gear ratio reached (InGear) becomes TRUE and Slave axis (Slave) is controlled with the speed which converted the speed of Master axis (Master) by the gear ratio.

■Deceleration (Deceleration)

Set the deceleration for decelerating.

When reaching the gear synchronization speed, Gear ratio reached (InGear) becomes TRUE and Slave axis (Slave) is controlled with the speed which converted the speed of Master axis (Master) by the gear ratio.

■Jerk (Jerk)

Set Jerk at acceleration/deceleration start.

■Buffer mode (BufferMode)

Select the buffer mode. Aborting and Buffered can be set. For details on operation, refer to the following.

📖 Page 135 Buffer mode type

■Gear ratio reached (InGear)

It becomes TRUE when reaching the gear synchronization speed.

■Executing (Busy)

It becomes TRUE during execution of the FB.

■Controlling (Active)

It becomes TRUE during controlling Slave axis (Slave).

■Abortion of execution (CommandAborted)

It becomes TRUE if other FBs are started during execution of this FB.

■Error (Error)

It becomes TRUE if an error occurs in this FB.

■Error ID (Error code)Error code (ErrorID)

It returns an error code occurred in this instruction.

Precautions

- When the gear ratio is changed, the speed of the slave axis is changed directly. To smooth the speed change, use with MCv_SmoothingFilter (Smoothing Filter).
- When Master axis (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 occurred, adjust and set Master axis (Master) speed after conversion, Acceleration (Acceleration) or Deceleration (Deceleration) to not exceed the acceleration/deceleration upper limit value, and restart the acceleration/deceleration operation.

13.9 Addition/Subtraction Positioning

This function combines the movement amount of 2 axes and transmits.

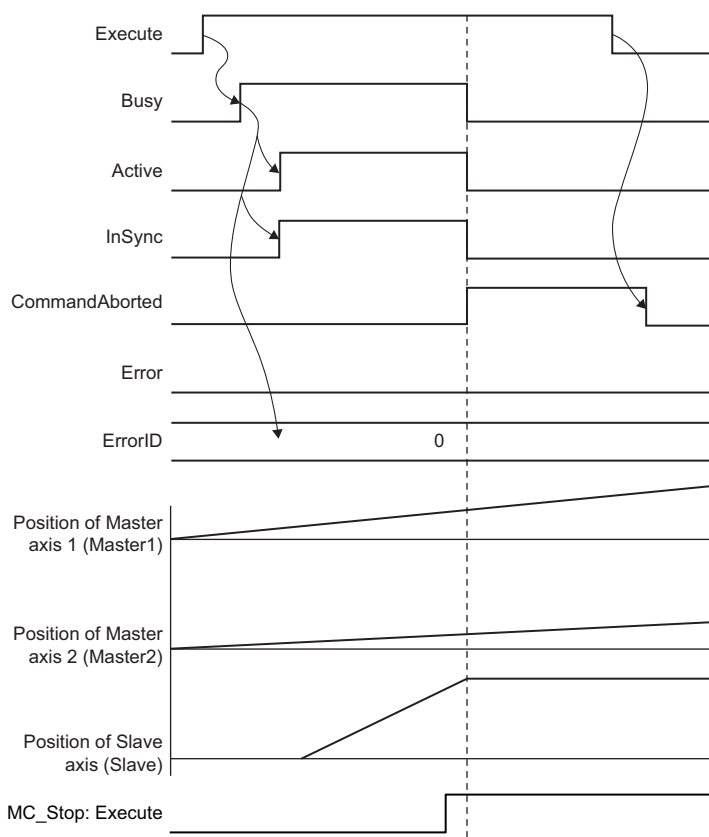
Relevant FB

MC_CombineAxes

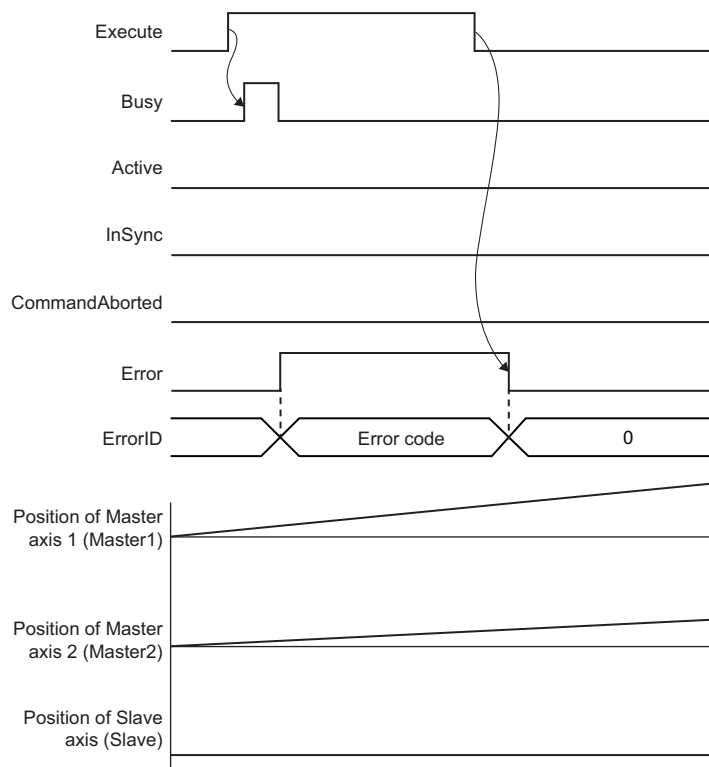
Item	Description		
Function overview	Added or subtracted value which the movement amount of the specified master axis 2-axis is set as the commanded position, and the positioning is executed.		
Symbol [Structured Ladder]	MC_CombineAxes DUT : Master1 DUT : Master2 DUT : Slave B : Execute B : ContinuousUpdate DUT : CombineMode D : GearRatioNumeratorM1 UD : GearRatioDenominatorM1 D : GearRatioNumeratorM2 UD : GearRatioDenominatorM2 DUT : MasterValueSourceM1 DUT : MasterValueSourceM2 DUT : BufferMode UD : Options Master1 : DUT Master2 : DUT Slave : DUT InSync : B Busy : B Active : B CommandAborted : B Error : B ErrorID : UW		
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 754 Axis variables
Master axis 2	Master2	AXIS_REF	↑	—	Omission not possible	☞ Page 754 Axis variables
Slave axis	Slave	AXIS_REF	↑	—	Omission not possible	☞ Page 754 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 Addition/subtraction method selection (CombineMode), Master axis 1 gear ratio numerator (GearRatioNumeratorM1), Master axis 1 gear ratio denominator (GearRatioDenominatorM1), Master axis 2 gear ratio numerator (GearRatioNumeratorM2), and Master axis 2 gear ratio denominator (GearRatioDenominatorM2).
Addition/subtraction method selection	CombineMode	MC_COMBINE_MODE	↑/R/C	0, 1	1	☞ Page 514 Addition/subtraction method selection (CombineMode)
Master axis 1 gear ratio numerator	GearRatioNumeratorM1	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 514 Master axis 1 gear ratio numerator (GearRatioNumeratorM1)
Master axis 1 gear ratio denominator	GearRatioDenominatorM1	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 514 Master axis 1 gear ratio denominator (GearRatioDenominatorM1)
Master axis 2 gear ratio numerator	GearRatioNumeratorM2	DINT	↑/R/C	-2147483648 to 2147483647	1	☞ Page 514 Master axis 2 gear ratio numerator (GearRatioNumeratorM2)
Master axis 2 gear ratio denominator	GearRatioDenominatorM2	DWORD(UDINT)	↑/R/C	1 to 2147483647	1	☞ Page 514 Master axis 2 gear ratio denominator (GearRatioDenominatorM2)
Master axis 1 data source	MasterValueSourceM1	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 514 Master axis 1 data source (MasterValueSourceM1)
Master axis 2 data source	MasterValueSourceM2	MC_SOURCE	↑	1, 2, 101, 102	1	☞ Page 514 Master axis 2 data source (MasterValueSourceM2)
Buffer mode	BufferMode	MC_BUFFER_MODE	↑	0, 1	0	☞ Page 515 Buffer mode (BufferMode)
Options	Options	DWORD(HEX)	↑	0000000H	0000000H	Sets "00000000H". (A value other than "00000000H" causes the error "Out of Options Range" (error code: 1A4EH).)

■Output variables

Name	Variable name	Data type	Default value	Description
In synchronization	InSync	BOOL	FALSE	☞ Page 515 In synchronization (InSync)
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 has been aborted because of other FBs. When this FB is stopped by an error or when this FB is started up while an error occurs, it becomes TRUE. Becomes FALSE when Execute command (Execute) becomes FALSE.
Error	Error	BOOL	FALSE	When TRUE, it indicates that an error has occurred in the FB.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned. For details, refer to the following. ☞ Page 711 List of Error Codes

Control details

In MC_CombineAxes (Addition/Subtraction Positioning), Addition/subtraction method selection (CombineMode), Master axis 1 gear ratio numerator (GearRatioNumeratorM1), Master axis 1 gear ratio denominator (GearRatioDenominatorM1), Master axis 2 gear ratio numerator (GearRatioNumeratorM2), and Master axis 2 gear ratio denominator (GearRatioDenominatorM2), Master axis 1 data source (MasterValueSourceM1), Master axis 2 data source (MasterValueSourceM2), and Buffer mode (BufferMode) are set and the addition/subtraction positioning is executed.

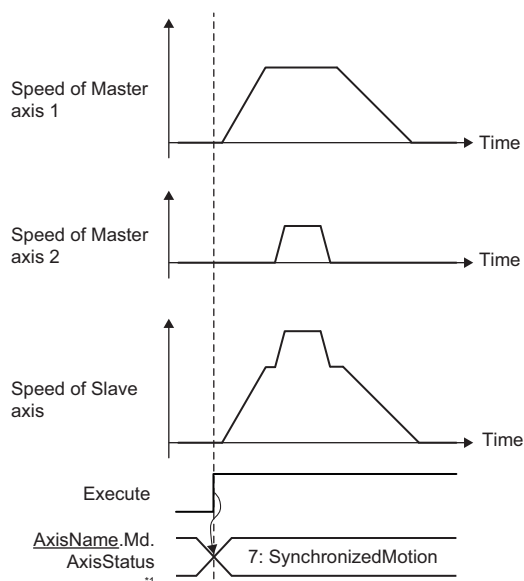
To stop the operation, execute MC_Stop (Forced Stop).

The movement amount of Master axis 1 (Master1) and Master axis 2 (Master2) are combined. Also, gear ratio can be set to each master axis.

Combining the movement amount calculates adding/subtracting regardless of the unit of Master axis 1 (Master1) and Master axis 2 (Master2).

When "0: mcAddAxes" is set to CombineMode

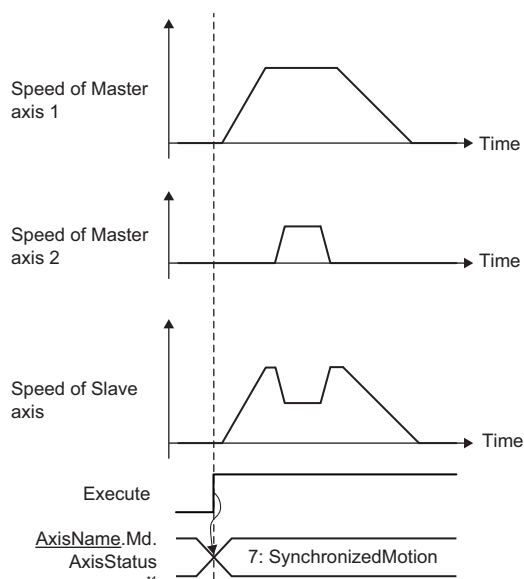
Movement amount of Slave axis (Slave) = Master axis 1 (Master1) + Movement amount of Master axis 2 (Master2)



*1 This is axis state of Slave axis (Slave).

When "1: mcSubAxes" is set to CombineMode

Movement amount of Slave axis (Slave) = Master axis 1 (Master1) - Movement amount of Master axis 2 (Master2)



*1 This is axis state of Slave axis (Slave).

Details of setting items

■ Addition/subtraction method selection (CombineMode)

Set the method to combine the movement amount of Master axis 1 (Master1) and Master axis 2 (Master2).

- 0: Add Positions of 2 Input Axes (mcAddAxes)

It adds the movement amount of Master axis 1 (Master1) and Master axis 2 (Master2) and outputs.

- 1: Subtract Positions of 2 Input Axes (mcSubAxes)

It subtracts the movement amount of Master axis 2 (Master2) from the movement amount of Master axis 1 (Master1) and outputs.

■ Master axis 1 gear ratio numerator (GearRatioNumeratorM1)

Set the value of numerator for when converting the movement amount of Master axis 1 (Master1) and combining.

The movement amount is converted as shown below.

$$\text{Master axis 1 (Master1) movement amount after conversion} = \text{Master axis 1 (Master1) movement amount before conversion} \times \frac{\text{Master axis 1 gear ratio numerator (GearRatioNumeratorM1)}}{\text{Master axis 1 gear ratio denominator (GearRatioDenominatorM1)}}$$

The movement amount can be reversed and combined by setting a negative value to Master axis 1 gear ratio numerator (GearRatioNumeratorM1).

To combine and have the movement amount of Master axis 1 (Master1) be "0" after conversion, set "0" as the setting value in Master axis 1 gear ratio numerator (GearRatioNumeratorM1).

■ Master axis 1 gear ratio denominator (GearRatioDenominatorM1)

Set the value of denominator for when converting the movement amount of Master axis 1 (Master1) and combining.

It is set with Master axis 1 gear ratio numerator (GearRatioNumeratorM1).

Set a positive value to Master axis 1 gear ratio denominator (GearRatioDenominatorM1).

■ Master axis 2 gear ratio numerator (GearRatioNumeratorM2)

Set the value of numerator for when converting the movement amount of Master axis 2 (Master2) and combining.

The movement amount is converted as shown below.

$$\text{Master axis 2 (Master2) movement amount after conversion} = \text{Master axis 2 (Master2) movement amount before conversion} \times \frac{\text{Master axis 2 gear ratio numerator (GearRatioNumeratorM2)}}{\text{Master axis 2 gear ratio denominator (GearRatioDenominatorM2)}}$$

The movement amount can be reversed and combined by setting a negative value to Master axis 2 gear ratio denominator (GearRatioDenominatorM2).

To combine and have the movement amount of Master axis 2 (Master2) be "0" after conversion, set "0" as the setting value in Master axis 2 gear ratio denominator (GearRatioDenominatorM2).

■ Master axis 2 gear ratio denominator (GearRatioDenominatorM2)

Set the value of denominator for when converting the movement amount of Master axis 2 (Master2) and combining.

It is set with Master axis 2 gear ratio numerator (GearRatioNumeratorM2).

Set a positive value to Master axis 2 gear ratio denominator (GearRatioDenominatorM2).

■ Master axis 1 data source (MasterValueSourceM1)

Select the data source of Master axis 1 (Master1) which is for the movement amount of Master axis 1 (Master1) to transmit.

For details, refer to the following.

 Page 475 Master Axis Data Source Selection

■ Master axis 2 data source (MasterValueSourceM2)

Select the data source of Master axis 2 (Master2) which is for the movement amount of Master axis 2 (Master2) to transmit.

For details, refer to the following.

 Page 475 Master Axis Data Source Selection

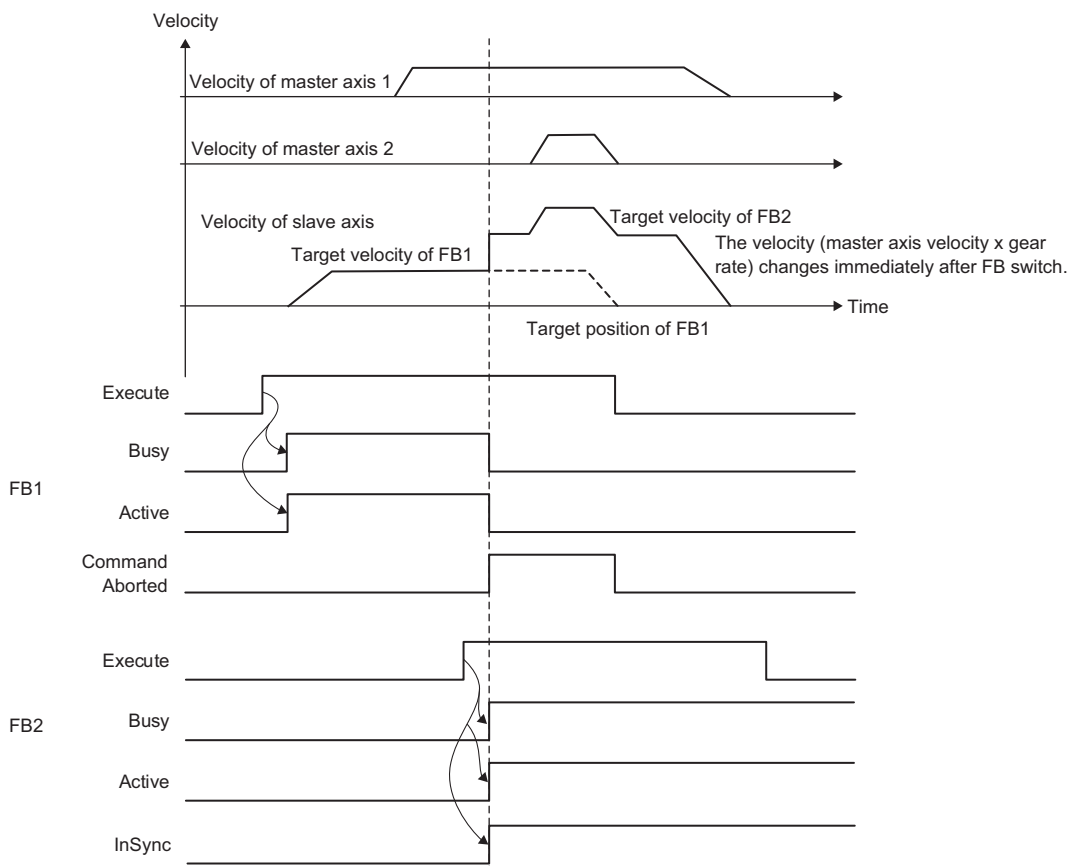
■Buffer mode (BufferMode)

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 (Addition/Subtraction Positioning) follows the synchronizing FB (master axis).

An operation example when Aborting is executed to the FB1 being executed with the linked start FB2 (slave axis: MC_CombineAxes (Addition/Subtraction Positioning)) is shown below.

Addition/subtraction method selection (CombineMode) = At "2: Add Positions of 2 Input Axes (mcAddAxes)"



The speed of FB2 occurs when In synchronization (InSync) becomes TRUE.

For details on operation, refer to the following.

📖 Page 135 Buffer mode type

■In synchronization (InSync)

It becomes TRUE when Slave axis (Slave) starts synchronizing.

■Executing (Busy)

It becomes TRUE during execution of the FB.

■Controlling (Active)

It becomes TRUE during controlling Slave axis (Slave).

■Abortion of execution (CommandAborted)

It becomes TRUE if other FBs are started during execution of this FB.

■Error (Error)

It becomes TRUE if an error occurs in this FB.

■Error code (ErrorID)

It returns an error code occurred in this FB.

13.10 Precautions

Relevant add-ons

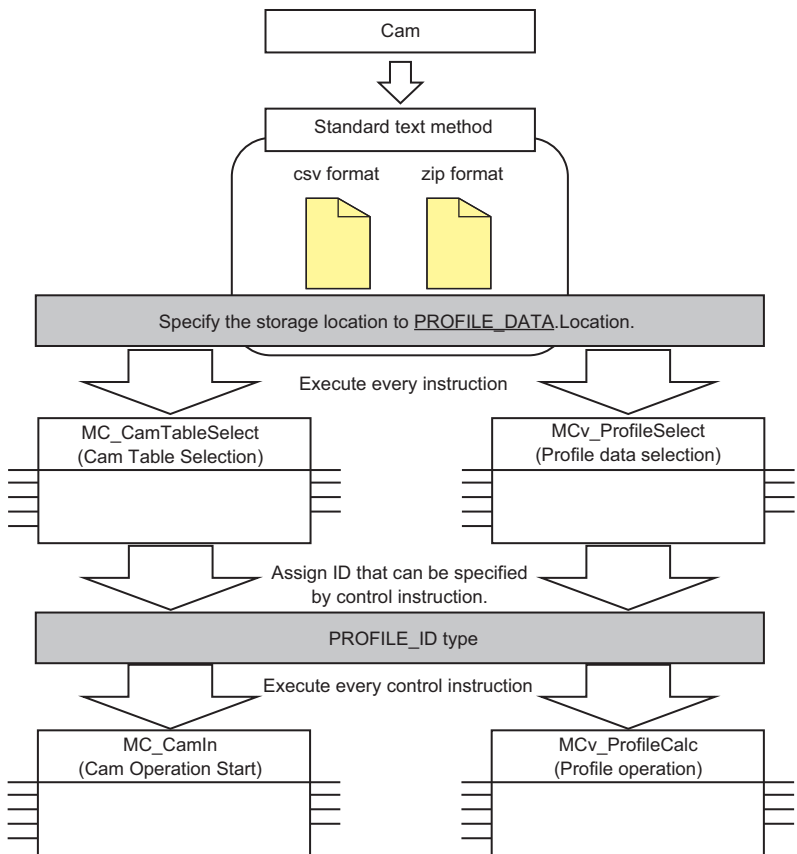
The following add-on is required to use this function.

- ProfileControl
- MotionControl_Sync
- MotionEngine
- Axis
- MotionControl_General

14 OPERATION PROFILE FUNCTION

14.1 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 terms

Term	Description
Master axis (input) absolute coordinate	Another term combining input variable Master axis absolute coordinate (MasterAbsolute) of MC_CamTableSelect (Cam Table Selection) and input variable Master axis absolute coordinate (MasterAbsolute) of MCv_ProfileSelect (Profile data selection)
Slave axis (output) absolute coordinate	Another term combining input variable Slave axis absolute coordinate (SlaveAbsolute) of MC_CamTableSelect (Cam Table Selection) and input variable Slave axis absolute coordinate (SlaveAbsolute) of MCv_ProfileSelect (Profile data selection)

Relevant variables

Variable/Structure name	Name	Details
PROFILE_DATA		
Location	Operation Profile Data Storage Location	FILE_LOCATION type
ID	Profile ID	PROFILE_ID type
FILE_LOCATION		
FileName	File Name	Specifies a file name. (Up to 63 characters including the extension can be set.)
Path	Folder Specification	Specifies the folder path in which the file is stored. (Up to 63 characters can be set. Set up to 127 characters (including Null string) in total for File name (FileName) and Folder specification (Path).)
PROFILE_ID		
Number	Profile ID No.	Profile ID No. (0 to 60000)
INSTANCE_ID		
Number	Instance ID No.	Instance ID No.

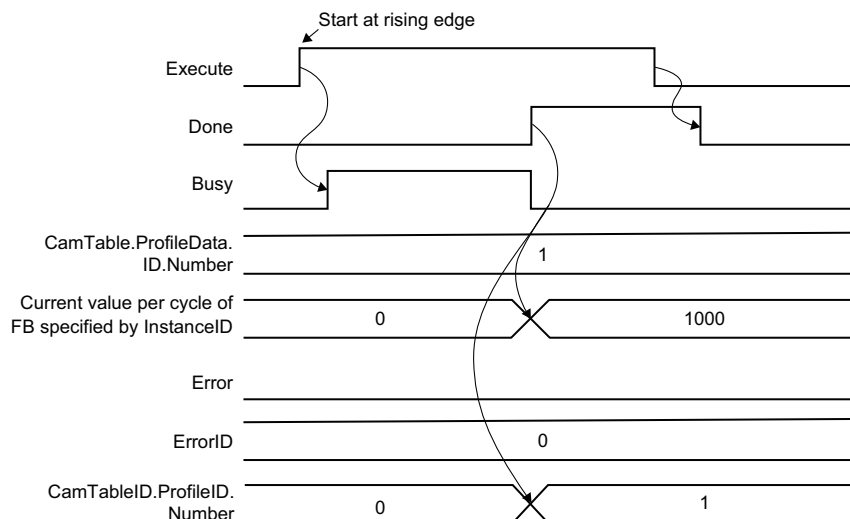
Relevant FBs

MC_CamTableSelect

Item	Description		
Function overview	Stores specified operation profile data in the open area.		
Symbol [Structured Ladder]	MC_CamTableSelect DUT : Master Master : DUT DUT : Slave Slave : DUT DUT : CamTable CamTable : DUT B : Execute Done : B B : Periodic Busy : B B : MasterAbsolute Error : B B : SlaveAbsolute ErrorID : UW ENUM : ExecutionMode CamTableID : DUT		
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]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■I/O variables

Input import ↑: At start

Name	Variable name	Data type	Input import	Setting range	Default value	Description
Master axis	Master	AXIS_REF	↑	—	Refer to description	When FB is used on the motion system side, omission is possible. The setting value is ignored. When FB is used on the CPU module side, set I/O No. (Master.StartIO). Axis No. (Master.AxisNo) is ignored.
Slave axis	Slave	AXIS_REF	↑	—	Refer to description	When FB is used on the motion system side, omission is possible. The setting value is ignored. When FB is used on the CPU module side, set I/O No. (Slave.StartIO). Axis No. (Slave.AxisNo) is ignored.
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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Periodic	Periodic	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Periodic FALSE: Non periodic
Master axis absolute coordinate	MasterAbsolute	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Absolute coordinate (When it is set, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs.) FALSE: Relative coordinate
Slave axis absolute coordinate	SlaveAbsolute	BOOL	↑	TRUE, FALSE	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: Execute Immediately (mcImmediately) 1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively) For details, refer to the following. ☞ Page 559 Control details

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	It indicates the control is completed. When Execute command (Execute) is TRUE at the operation completion, it will be TRUE until Execute command (Execute) becomes FALSE. When Execute command (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)	0	The generated error code is returned. For details, refer to the following.  Page 711 List of Error Codes
Cam table ID	CamTableID	MC_CAM_ID	0	Outputs the profile ID.

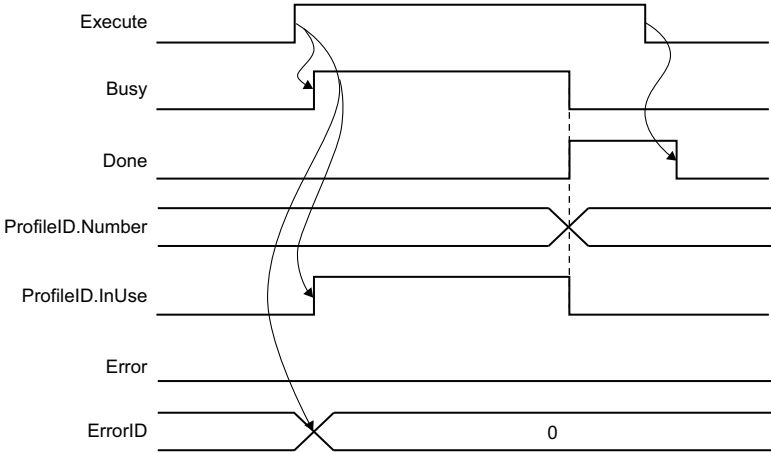
MCv_ProfileSelect (Future support planned)

Item	Description
Function overview	Stores specified operation profile data in the open area.
Symbol [Structured Ladder]	MCv_ProfileSelect DUT : ProfileData ProfileData : DUT B : Execute Done : B B : Periodic Busy : B B : MasterAbsolute Error : B B : SlaveAbsolute ErrorID : UW ENUM : ExecutionMode ProfileID : DUT
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

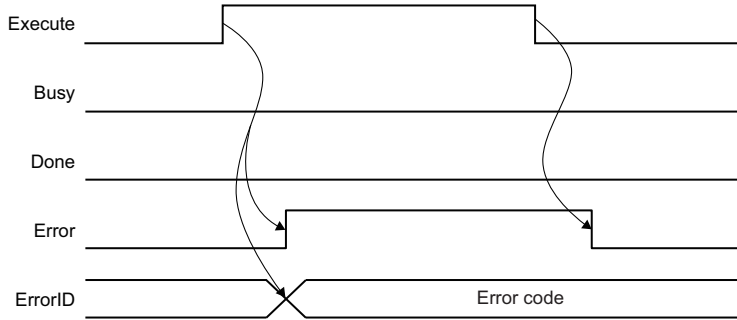
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Periodic	Periodic	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Periodic FALSE: Non periodic
Master axis absolute coordinate	MasterAbsolute	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Absolute coordinate (When it is set, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs.) FALSE: Relative coordinate
Slave axis absolute coordinate	SlaveAbsolute	BOOL	↑	TRUE, FALSE	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: Execute Immediately (mcImmediately) 1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively) For details, refer to the following.  Page 559 Control details

■ Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	It indicates the control is completed. When Execute command (Execute) is TRUE at the operation completion, it will be TRUE until Execute command (Execute) becomes FALSE. When Execute command (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)	0	The error code generated is returned. For details, refer to the following.  Page 711 List of Error Codes
Profile ID	ProfileID	PROFILE_ID	0	Outputs the profile ID.

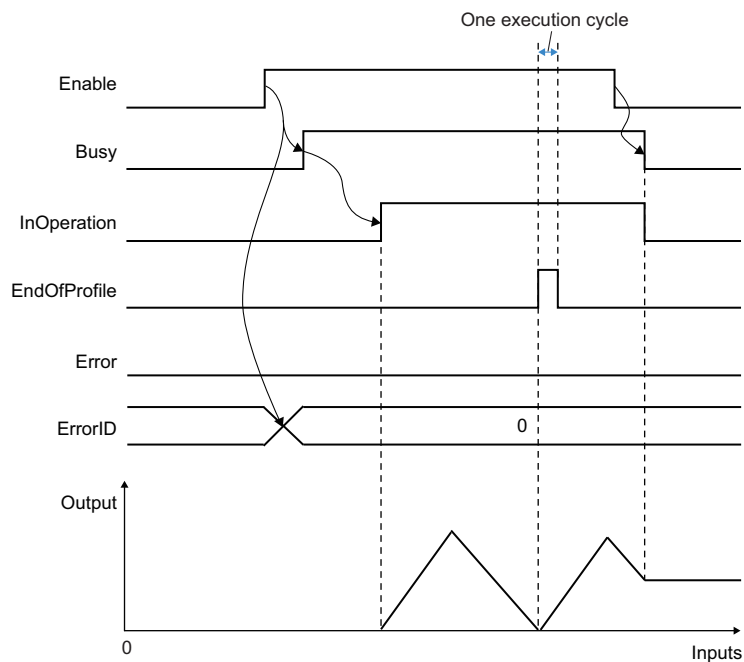
MCv_ProfileCalc (Future support planned)

Item	Description
Function overview	Calculates the output data to the input data following the specified operation profile data.
Symbol [Structured Ladder]	MCv_ProfileCalc DUT : Inputs DUT : Output B : Enable L : InputsOffset L : OutputOffset L : InputsScaling L : OutputScaling DUT : ProfileID Inputs : DUT Output : DUT InOperation : B Busy : B Error : B ErrorID : UW EndOfProfile : B
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

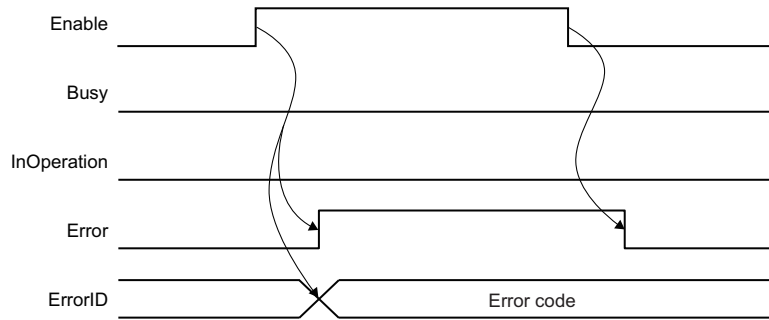
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■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[0..2]	☐	—	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	☐	TRUE, FALSE	FALSE	During TRUE, it executes the FB.
Input offset	InputsOffset	LREAL[0..2]	☐	 Page 85 Positioning Range	0.0	Shifts the phase of each input by the amount of offset. It can be specified for the number of Input data (Inputs) elements. (The number exceeding the number of elements is ignored)
Output offset	OutputOffset	LREAL	☐	 Page 85 Positioning Range	0.0	Shifts the phase of each output by the amount of offset.
Input coefficient	InputsScaling	LREAL[0..2]	☐	0.01 to 10.0	1.0	Widens/narrows the phase of each input. It can be specified for the number of Input data (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)	0	The error code generated is returned. For details, refer to the following.  Page 711 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 becomes TRUE.

■Public variables

Name	Variable name	Data type	Default value	Description
Current value per cycle	InputsPerCycle	LREAL[0..2]	 Page 85 Positioning Range	Variable that the current value per cycle is stored.
Reference value	Reference	LREAL	 Page 85 Positioning Range	Variable that the reference value is stored.
Output value	Output	LREAL	 Page 85 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.

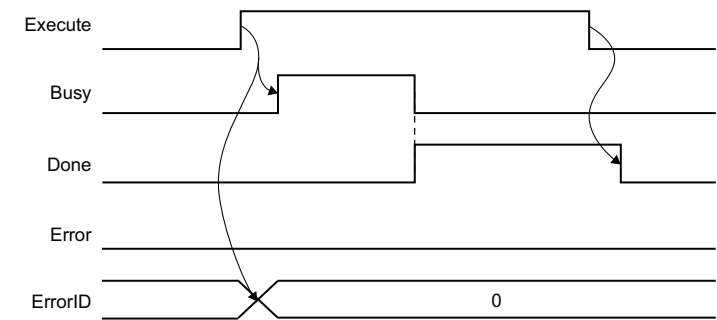
MCv_ReadProfileData

Item	Description
Function overview	Reads the specified operation profile data from the open area or the file.
Symbol [Structured Ladder]	MCv_ReadProfileData DUT : ProfileData ProfileData : DUT DUT : Data1 Data1 : DUT DUT : Data2 Data2 : DUT B : Execute Done : B UD : Offset Busy : B UD : Points Error : B DUT : Target ErrorID : UW
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]

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

Page 27 Execute command (Execute) type/Enable (Enable)

■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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Offset	Offset	DWORD(UDINT)	↑	0 to resolution	0	Specifies offset from the top of the operation profile data. To specify a value other than 0 to Offset (Offset), also set a value other than 0 to Number of read data (Points). (If a value "0" is set to Number of read data (Points), the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.)
Number of read data	Points	DWORD(UDINT)	↑	0 to resolution	0	Specifies the number of data points to read. Set 0.
Read destination	Target	WORD(UINT)	↑	0 to 1	0	Specifies the read destination of the operation profile data. 0: Open area (OpenArea) 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 command (Execute) is TRUE at the operation completion, TRUE remains until Execute command (Execute) becomes FALSE. When Execute command (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)	0	The error code generated is returned. For details, refer to the following.  Page 711 List of Error Codes

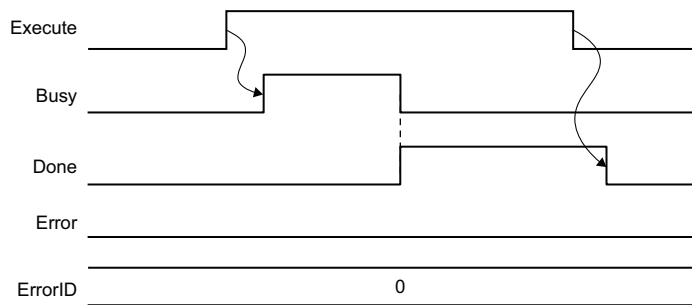
MCv_WriteProfileData

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]

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

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Offset	Offset	DWORD(UDINT)	↑	0 to resolution	0	Specifies offset from the top of the operation profile data. To specify a value other than 0 to Offset (Offset), also set a value other than 0 to Number of write data (Points). (If a value "0" is set to Number of write data (Points), the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.)
Number of write data	Points	DWORD(UDINT)	↑	0 to 4294967295	0	Specifies the number of data points to write.
Write destination	Target	WORD(UINT)	↑	0 to 1	0	Specifies the write destination of the operation profile data. 0: Open area (OpenArea) 1: File (File) To specify File (file) to the write destination, set Offset (Offset) and Number of write data (Points) 0. (If other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.)
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: Execute Immediately (mcImmediately) 1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively) For details, refer to the following.  Page 559 Control details

■Output variables

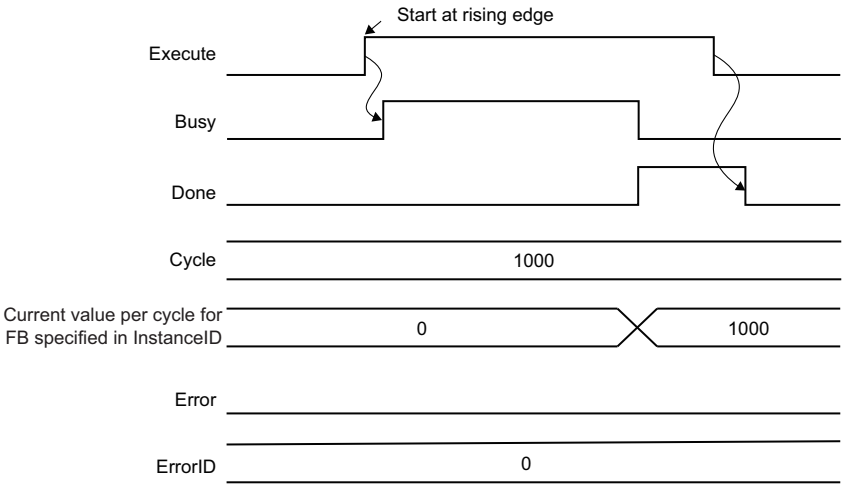
Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, TRUE remains until Execute command (Execute) becomes FALSE. When Execute command (Execute) is FALSE at the operation 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)	0	The error code generated is returned. For details, refer to the following.  Page 711 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]	MCv_ChangeCycle B : Execute DUT : InstanceID L : Cycle B : Relative ENUM : ExecutionMode UD : Options Done : B Busy : B CommandAborted : B Error : B ErrorID : UW CancelAccepted : B
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]

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

📖 Page 27 Execute command (Execute) type/Enable (Enable)

■Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Start	Execute	BOOL	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Instance ID	InstanceID	INSTANCE_ID	↑	1 to 65535	0	Specifies the instance ID of FB to change the current value per cycle.
Current value per cycle	Cycle	LREAL[0..2]	↑	 Page 566 Details of setting items	0.0	Specifies the current value per cycle to change. Specifies the absolute position when Relative position selection (Relative) = FALSE. Specifies the relative distance when Relative position selection (Relative) = TRUE.
Relative selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Relative distance FALSE: Absolute position
Start mode	ExecutionMode	MC_EXECUTION_MODE	↑	0 to 3	0	Specifies the execution timing of the FB. 0: Execute Immediately (mcImmediately) 1: Execute at Completion of Previous One (mcQueued) 3: Execute Speculatively (mcSpeculatively)
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 (Specify "0".)*1
16	Cancel accepted after FB start Specifies whether cancel is allowed or not after FB is started. 0: Do 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) occurs, and the function does not start.

■Output variables

Name	Variable name	Data type	Default value	Description
Completion	Done	BOOL	FALSE	Indicates that the control is completed. When Execute command (Execute) is TRUE at the operation completion, TRUE remains until Execute command (Execute) becomes FALSE. When Execute command (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 has been aborted because of an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0	The error code generated is returned. For details, refer to the following.  Page 711 List of Error Codes
Cancel acceptance	CancelAccepted	BOOL	FALSE	Indicates that the FB accepted cancel.

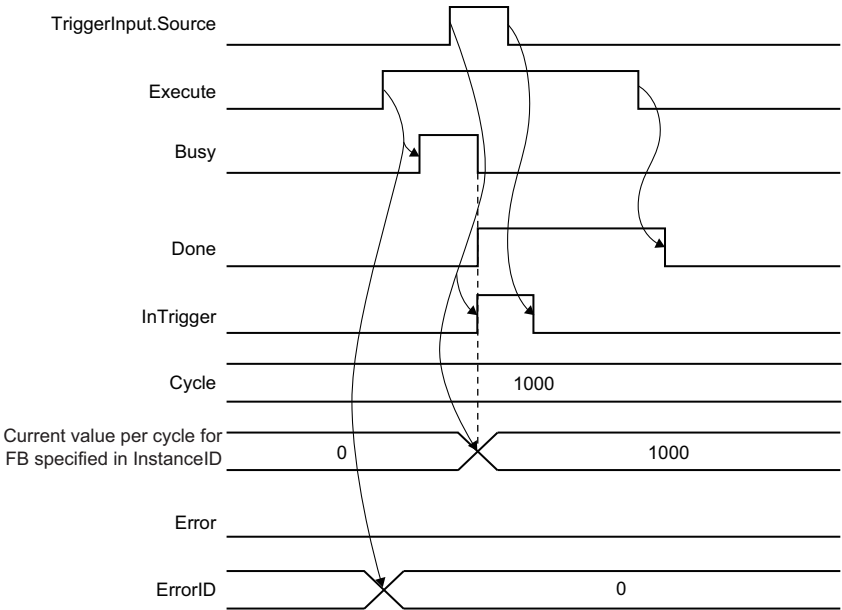
MCv_ChangeCycleTriggered (Future support planned)

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]	MCv_ChangeCycleTriggered DUT : TriggerInput B : Execute DUT : InstanceID L : Cycle B : Relative UD : Options TriggerInput : DUT InTrigger : B Done : B Busy : B CommandAborted : B Error : B ErrorID : UW CancelAccepted : B
Applicable hardware and software (Language)	RD78G(H) (Structured Text)

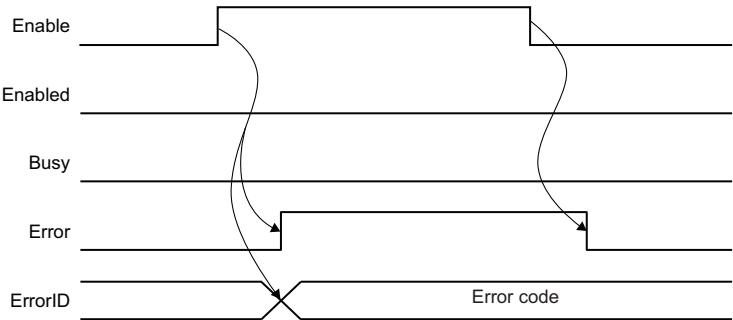
Number of input area points (byte)	Number of output area points (byte)	Compiling method	FB operation type
—	—	Subroutine type	Real-time execution

■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	↑	TRUE, FALSE	FALSE	When TRUE, it executes the FB.
Instance ID	InstanceID	INSTANCE_ID	↑	1 to 65535	0	Specifies the instance ID of the FB to change the current value per cycle.
Current value per cycle	Cycle	LREAL[0..2]	↑	—  Page 566 Details of setting items	0.0	Specifies the current value per cycle after change. Specifies the absolute position when Relative position selection (Relative) = FALSE. Specifies the relative distance when Relative position selection (Relative) = TRUE.
Relative selection	Relative	BOOL	↑	TRUE, FALSE	FALSE	TRUE: Relative distance FALSE: Absolute position
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 (Specify "0".)*1
16	Cancel accepted after FB start Specifies whether cancel is allowed or not after FB is started. 0: Do 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) occurs, and the function does not start.

■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 command (Execute) is TRUE at the operation completion, TRUE remains until Execute command (Execute) becomes FALSE. When Execute command (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 has been aborted because of an error or multiple start, etc.
Error	Error	BOOL	FALSE	Indicates that an error has occurred.
Error code	ErrorID	WORD(UINT)	0	The error code generated is returned. For details, refer to the following.  Page 711 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 Operation profile storage location (Location).)
3. When executing the operation profile data write FB, the control ID can be obtained in the profile ID type (standard/function specific) label.
4. Execute the control FB by using the profile ID type (standard/function specific) label.

■When using the operation profile data created outside

1. Store the operation profile data in an arbitrary place such as a user drive and an SD memory card.
2. Set the storage location in Operation profile storage location (Location) of the profile data type (standard/function specific) label.
3. When executing the open FB, the control ID can be obtained in the profile ID type (standard/function specific) label.
4. Execute the control FB by using the profile ID type (standard/function specific) label.

Creating method when using the engineering tool

When 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.



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 Operation profile storage location (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.

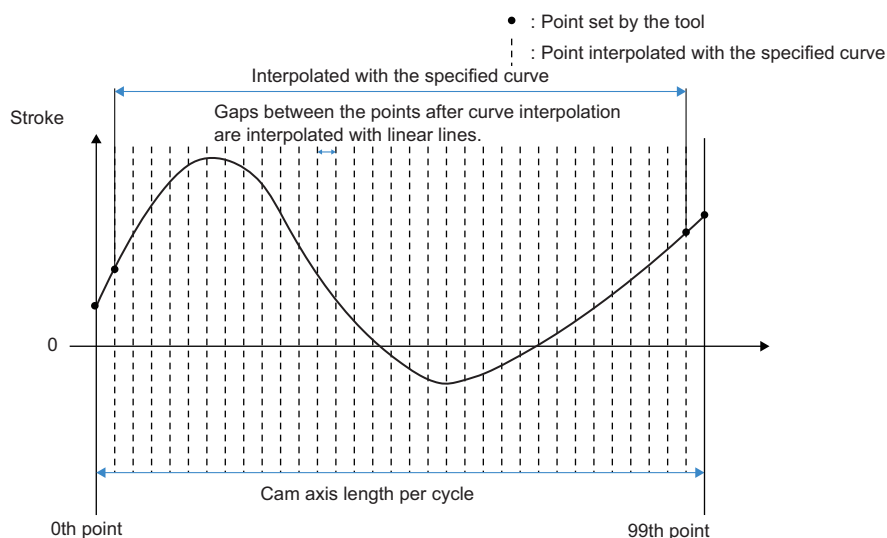
◎: Necessary, ○: Optional, —: Unnecessary

Setting items		Interpolation Method Specification (Interpolate)		
		0: Linear interpolation	1: Specifying for each section	2: Spline interpolation
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		—	○	—
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		○	○	○

- Interpolation Method Specification (Interpolate)

[1: Specifying for each section]

When "1: Specifying for each section" is set for the interpolation method specification 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.



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Point

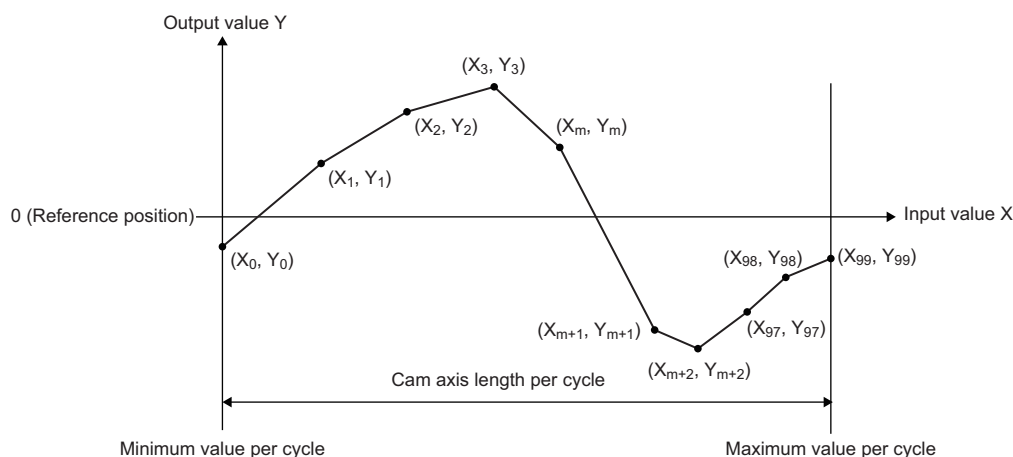
If the number of I/O data is not enough for the set resolution, cam data that is equally divided after interpolating the data in shortage according to the line set by the curve designation will be created.

[2: Spline interpolation]

When "2: Spline interpolation" is set for the interpolation method specification 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.

[0: Linear interpolation]

When "0: Linear interpolation" is set for the interpolation method specification 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 (Cam Table Selection) can be used in the control instruction (MC_CamIn (Cam Operation Start)) as the MC_CAM_ID type. ID can be specified with an arbitrary No.

- Resolution/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.



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.

Set "0.0". If other than "0.0" is set, the error "Operation Profile Data Incorrect" (error code: 3410H) occurs.

- Initial stroke amount

Set the stroke amount for the start point. When the output unit character string is "%", it will be a value corresponding to the 100% of stroke ratio.

- Initial velocity/End point velocity

Set the velocity at the start point/end point.

The unit for setting value is [pulse/s] when output unit string is [pulse].

The unit for setting value is [output unit character string/min] when output unit string is other than [pulse].

(Ex.) The unit for setting value is [degree/min] when output unit string is [degree].

- Initial acceleration/End acceleration

Set the acceleration at the start point/end point.

The unit for setting value is [pulse/s] when output unit string is [pulse/s²].

The unit for setting value is [output unit string/min²] when output unit string is other than [pulse].

(Ex.) The unit for setting value is [degree/min²] when output unit string is [degree].

- Length per cycle

Set the input amount that is required for one cycle.

- Maximum value per cycle/Minimum value per cycle

Set the maximum/minimum value per cycle. It is valid only when Interpolation Method Specification (Interpolate) is "0: linear interpolation".

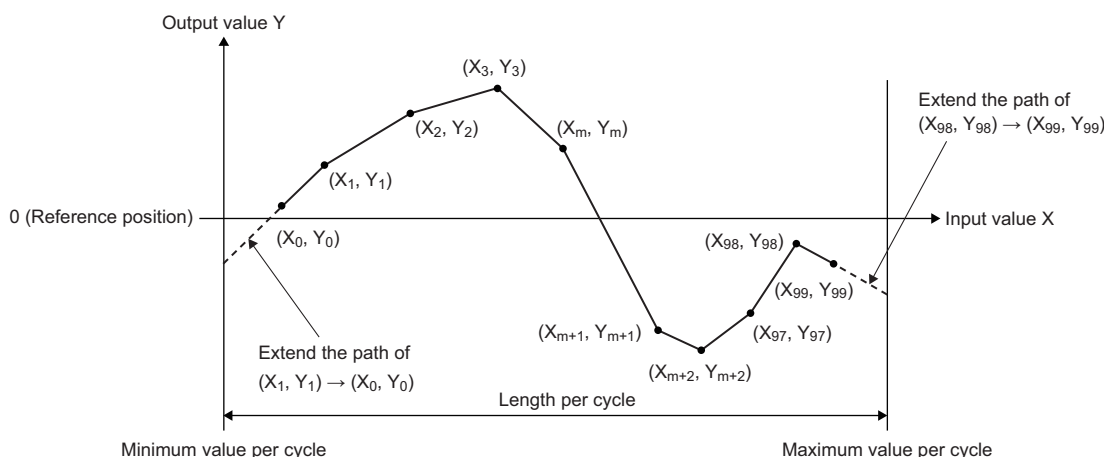
When Interpolation Method Specification (Interpolate) is "0: linear interpolation"

Set "0" to minimum value per cycle. If other than "0" is set to minimum value per cycle, the error "Operation Profile Data Incorrect" (error code: 3410H) occurs.

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

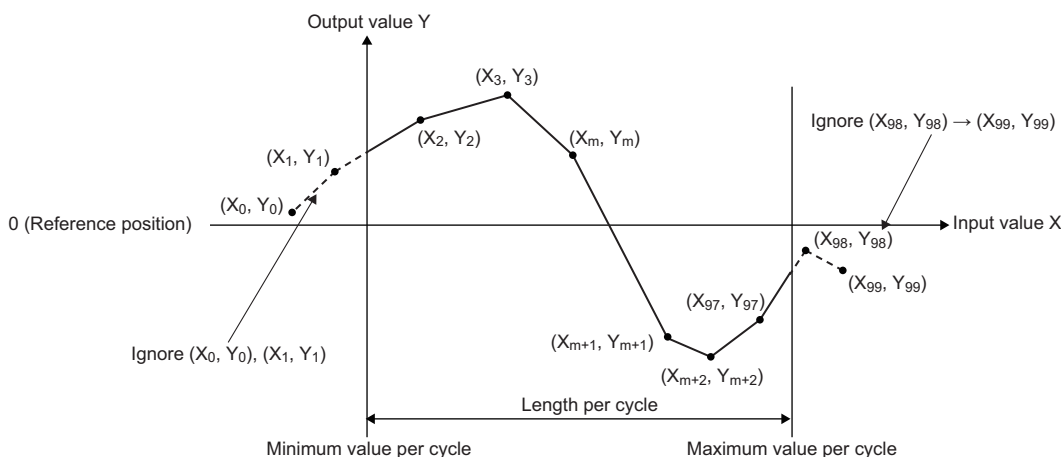
Ex.

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.

- End point

Set the end point of each section. End point should be set in ascending order.

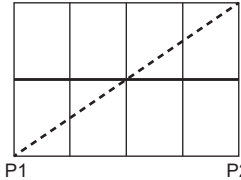
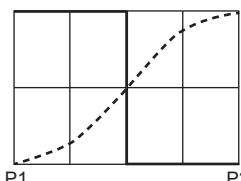
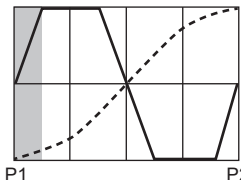
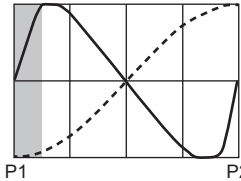
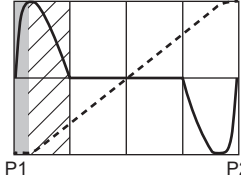
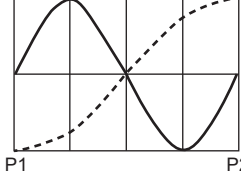
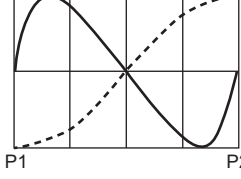
- Stroke

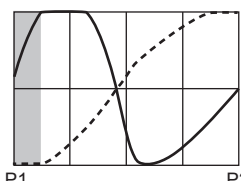
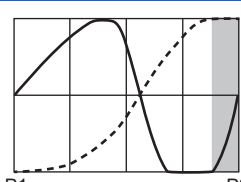
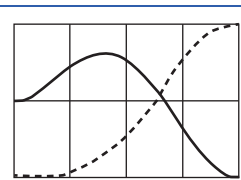
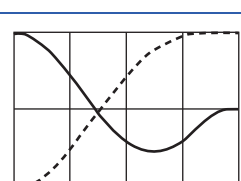
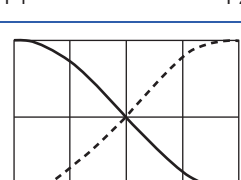
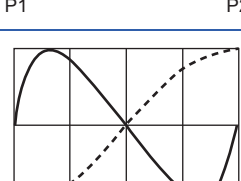
Set the stroke of each section.

- Cam curve types

A cam curve can be selected from the following curves.

- - - - : 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 velocity	Discontinuous		0.0 to 1.0	—	—	—	—
ConstantAcceleration(1)	Constant acceleration			0.0 to 1.0	—	—	—	—
DistortedTrapezoid(2)	Distorted trapezoid	Two-dwelling symmetrical		0.0 to 1.0	0.0001 < L1 < 0.2500 (0.125)	—	—	—
DistortedSine(3)	Distorted sine			0.0 to 1.0	0.0001 < L1 < 0.5000 (0.125)	—	—	—
DistortedConstantSpeed(4)	Distorted constant velocity			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		
Trapezoid(7)	Trapezoid	Two-dwelling asymmetrical		0.0 to 1.0	0.0001 < L1 < 0.2500 (0.125)	—	—	—
Reverse Trapezoid(8)	Reverse trapezoid			0.0 to 1.0	0.0001 < L1 < 0.2500 (0.125)	—	—	—
Double Hypotenuse(9)	Double hypotenuse	One-dwelling		0.0 to 1.0	—	—	—	—
Reverse Double Hypotenuse(10)	Reverse double hypotenuse			0.0 to 1.0	—	—	—	—
Single Hypotenuse(11)	Single hypotenuse	Non-dwelling curve		0.0 to 1.0	—	—	—	—
Fifth Curve Speed Designation(12)	5th Curve (Adj.)	Two-dwelling symmetrical		0.0 to 1.0	—	—	- 2500000 000.0 to 2500000 000.0	- 2147483 647.0 to 2147483 647.0

■Read/write data structure

Specify the following structures for [Data1, Data2] of MCv_ReadProfileData (Profile Read)/MCv_WriteProfileData (Profile Write).

- Read data 1/Write data 1 (Data 1)

Specify the PROFILE_CAM_DATA type structure.

PROFILE_CAM_DATA			Device offset	Description
Interpolate	Interpolation method specification	INT	+0	Set the interpolation method specification 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 8 to 65535

PROFILE_CAM_DATA			Device offset	Description
InputUnitString	Input unit character string	WSTRING(31)	+4	—
OutputUnitString	Output unit character string	WSTRING(31)	+36	—
StartPoint	Start point ^{*1}	LREAL	+68	Set the start point. (Set "0.0".)
StartStroke	Initial stroke amount ^{*1}	LREAL	+72	Set the stroke amount for the start point. (Stroke amount (Stroke) ≤ Initial stroke amount (StartStroke) ≤ Stroke amount (Stroke))
StartVelocity	Initial velocity ^{*3}	LREAL	76	Set the velocity for the start point. (-2500000000.0 ≤ Initial velocity (StarVelocity) ≤ 2500000000.0)
StartAcceleration	Initial acceleration ^{*3}	LREAL	80	Set the acceleration for the start point. (-2147483647.0 ≤ Initial acceleration (StartAcceleration) ≤ 2147483647.0)
CycleLength	Length per cycle ^{*1}	LREAL	+84	Set the input amount that is required for one cycle. (0.00000000000001 ≤ Length per cycle (CycleLength) ≤ 10000000000.0)
CycleMin	Minimum value per cycle	LREAL	+88	Set the minimum value per cycle. (Set "0.0".)
CycleMax	Maximum value per cycle	LREAL	+92	Set the maximum value per cycle. (Minimum value per cycle (CycleMin) < Maximum value per cycle (CycleMax) ≤ 10000000000.0)
CycleTime	Time per cycle ^{*3}	LREAL	+96	Set time per cycle. (0.001 < Time per cycle (CycleTime) ≤ 100000.0)
Stroke	Stroke amount	LREAL	+100	Set the stroke amount. (0.00000000000001 ≤ Stroke amount (Stroke) ≤ 10000000000.0)
NumberOfSections	Number of sections ^{*1}	DWORD(UDINT)	+104	1: Specifying for each section 1 to 360 2: Spline interpolation 3 to 360
Options	Options ^{*2}	DWORD(HEX)	+106	Specify options. ^{*4}
			Total size: 108 points	

^{*1} It is not used in the cam data format (Interpolation Method Specification (Interpolate) is "0: Linear interpolation"). (It is ignored.)

^{*2} Specify "0".

^{*3} Used only when cam curve is 5th Curve (Adj.). (Ignore for other curve)

^{*4} For bit and function description, refer to the following.

Bit	Function description
0	Periodic 0: Non periodic 1: Periodic For details, refer to the following.  Page 485 Periodic (Periodic)
1	Master axis (input) absolute coordinate 0: Relative coordinate 1: Absolute coordinate ^{*1} For details, refer to the following.  Page 489 Master axis absolute coordinate
2	Slave axis (output) absolute coordinate 0: Relative coordinate 1: Absolute coordinate For details, refer to the following.  Page 490 Slave axis absolute coordinate
3 to 31	Empty (Specify "0".) ^{*2}

^{*1} With this setting, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs, and the FB will not start.

^{*2} When specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the FB will not start.

Ex.

Setting example of Target (TARGET_REF.Target)

```
[DEV](PROFILE_CAM_DATA)G11500000
```

```
[VAR]CamData1 (CamData1 is PROFILE_CAM_DATA type instance)
```

- Read data 2 (Data2)/Write data 2 (Data 2)

For MCv_ReadProfileData (Profile Read), a structure specified in Write data 2 (Data2) differs depending on the Target. For MCv_WriteProfileData (Profile Write), it can be executed despite Read destination (Target).

If the number of array elements does not match the resolution/coordinate number, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) occurs.

○: Supported, —: Not supported

FB	Read destination/Write destination (Target)	Structure specified in Read data 2/Write data 2 (Data2)	Interpolation Method Specification (Interpolate)		
			0: Linear interpolation	1: Specifying for each section	2: Spline interpolation
MCv_ReadProfileData (Profile Read)	0: Open area (OpenArea)	LREAL[]	○	○*2	○*2
	1: File (File)	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1
MCv_WriteProfileData (Profile Write)	0: Open area (OpenArea)	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1
	1: File (File)	LREAL[]	○	—	—
		PROFILE_CAM_ELEMENT[]	—	○	○*1

*1 Used only by end point and Stroke amount (Stroke)

*2 The data of resolution + 1 point (a pair of current value per cycle and stroke) is read/written in the linear interpolation.

In this case, X of 1st point data is the value set in start point, and Y of 1st point data is the value set in initial stroke amount.

[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 Number of read data/Number of write data (Points) of FB. When reading or writing all of the operation profile data (Number of read data/Number of write data (Points) = 0), set the same number as Resolution (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.

Ex.

When setting the two-dimensional device/label of 100 resolution/coordinate number to Target (TARGET_REF.Target)

[Buffer memory specification]

TARGET_REF.Target := "[DEV](LREAL[1..100,1..2])G1150000"

[Label specification]

TARGET_REF.Target := "[VAR]CamData2"

The above "CamData2" declares the label of label name "CamData2" and data type LREAL[1..100,1..2] to the global label, and specifies a character string to Target.

Point

When executing MCv_WriteProfileData (Profile Write) whose Target (Target) is File (File) in the LREAL type array, Interpolation Method Specification (Interpolate) of the cam data format is output to the file as "0: linear interpolation".

[PROFILE_CAM_ELEMENT type 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 End point (EndPoint) is 0, it is invalid.) 0: Constant Velocity (ConstantSpeed) 1: Constant Acceleration (ConstantAcceleration) 2: Distorted Trapezoid (DistortedTrapezoid) 3: Distorted Sine (DistortedSine) 4: Distorted Constant Velocity (DistortedConstantSpeed) 5: Cycloid (Cycloid) 6: 5th curve (FifthCurve) 7: Trapecloid (Trapecloid) 8: Reverse Trapecloid (ReverseTrapecloid) 9: Double Hypotenuse (DoubleHypotenuse) 10: Reverse Double Hypotenuse (ReverseDoubleHypotenuse) 11: Single Hypotenuse (SingleHypotenuse) 12: 5th Curve (Adj.) (FifthCurve_SpeedDesignation)
EndPoint	End point ^{*2}	LREAL	+4	Set the position to the length per cycle (the current value per cycle). (0.0 < End point (EndPoint) ≤ Length per cycle)
Stroke	Stroke	LREAL	+8	Set the stroke position. (The absolute value of Stroke amount (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)
RangeP2	Curve applicable range (P2)	LREAL	+16	Set within the range of "P1 < P2". However, for "P1 = P2 = 0", "P1 = 0" and "P2 = 1" are applied.
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 ^{*3}	LREAL	+28	Set the end point velocity of the cam curve. (-2500000000.0 < End point velocity (EndVelocity) < 2500000000.0)
EndAcceleration	End point acceleration ^{*3}	LREAL	+32	Set the end point acceleration of the cam curve. (2147483647.0 < End point acceleration (EndAcceleration) < 2147483647.0)
			Total size: 36 points	

*1 The number of elements (n - m + 1), is required as many as Number of read data/Number of write data (Points) of FB. When reading or writing all of the operation profile data (Number of read data/Number of write data (Points) = 0), set the same number as Number of sections (PROFILE_CAM_DATA.NumberOfSections).

*2 When the end point exceeds the length per cycle before reaching the final section, the section number at the time is determined as the final section number and the end point is overwritten with the length per cycle.

*3 Setting items used for read/write differ depending on Interpolation Method Specification (Interpolate) of the operation profile data. For details, refer to the following.

☞ Page 534 Setting item

Ex.

Setting example of Target (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

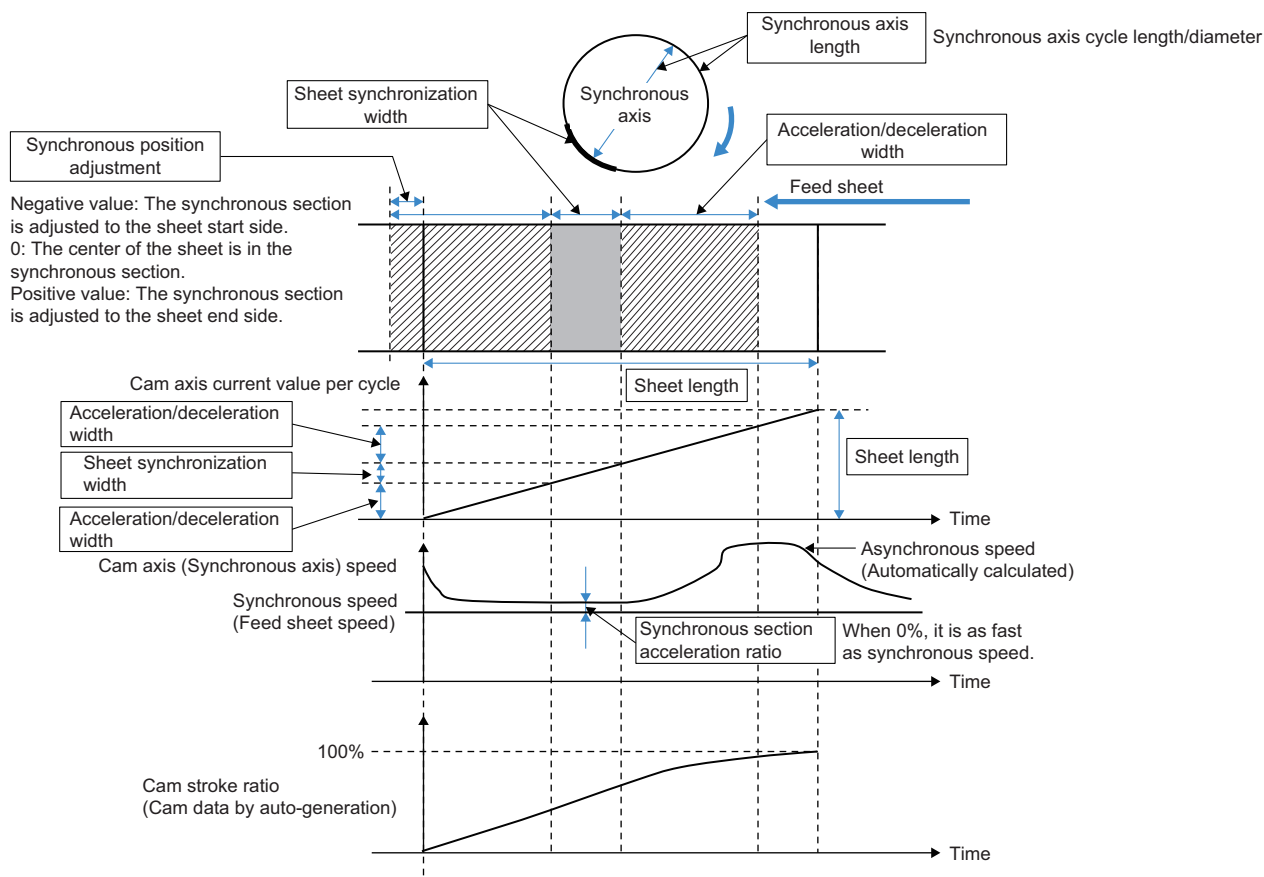
Generate cam data for the rotary cutter. The stroke data that is defined after equally dividing a cam pattern per cycle for rotary cutter by points of the resolution is opened in the open area.

When using this operation profile data format, install add-on PackagingApp.

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 options	◎
	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)



Read/write data structure

Specify the following structures for Read/Write data 1 (Data1) of MCv_ReadProfileData (Profile Read)/MCv_WriteProfileData (Profile Write). 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 534 Setting item

Cam for rotary cutter (Specifying a double-precision real number)

- Read data 1/Write data 1 (Data1)

Specify the PROFILE_ROTARY_CUTTER type structure.

PROFILE_ROTARY_CUTTER			Device offset	Description
Resolution	Resolution	DWORD(UDINT)	+0	Set the resolution for generating the cam. (8 to 32768)
InputUnitString	Input unit character string	WSTRING(31)	+2	—
Options	Options	DWORD(HEX)	+34	Specify Options.*1
AutoGenerationOptions	Auto-generation options	WORD(HEX)	+36	- bit0: Acceleration/deceleration method 0: Trapezoidal acceleration/deceleration 1: S-curve acceleration/deceleration - bit1: Synchronous axis length setting 0: Diameter 1: Cycle length - Set "0" for bit2 to 15.
NumberOfCutter	Number of cutter	WORD(UINT)	+37	Set the number of cutter. (1 to 256)
SyncSectionAccRatio	Synchronous section acceleration ratio	LREAL	+40	- Set when the synchronous speed in the synchronous section needs to be adjusted. - The speed is "Synchronous speed × (100% + Acceleration ratio)" in the synchronous section. (-50.0 to 50.0)
SheetLength	Sheet length	LREAL	+44	Set the sheet length. (0.0 < Sheet length (SheetLength) ≤ 10000000000.0)

PROFILE_ROTARY_CUTTER			Device offset	Description
SheetSyncWidth	Sheet synchronization width	LREAL	+48	- Set the sheet synchronization width (seal width). - When the synchronous speed section for retracting operation is required in front of and behind the sheet synchronization width, add the retracting width. $(0.0 < \text{Sheet synchronization width (SheetSyncWidth)} < \text{Sheet length (SheetLength)})$ $(0.0 < \text{Sheet synchronization width (SheetSyncWidth)} < \text{Cycle length / Number of cutter (NumberOfCutter)})$
SyncAxisLength	Synchronous axis length	LREAL	+52	- Set the rotary cutter axis length. - When the auto-generation options is set to "0: Diameter", it is calculated as "Cycle length = setting value $\times \pi$". - When the auto-generation options is set to "1: Cycle length", it is calculated as "Cycle length = setting value". $(0.0 < \text{Cycle length} < 1000000000.0)$
SyncPositionAdjustment	Synchronous position adjustment	LREAL	+56	Set the position adjustment of the synchronous section. Negative value: The synchronous section is adjusted to the sheet start side. 0: The center of the sheet is in the synchronous section. Positive value: The synchronous section is adjusted to the sheet end side. (The absolute value of Synchronous position tuning (SyncPositionAdjustment) < Sheet synchronization width (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. $(2 \times \text{Acceleration/deceleration width (AccDecWidth)} \leq \text{Sheet length (SheetLength)} - \text{Sheet synchronization width (SheetSyncWidth)})$
AsyncSpd	Asynchronous velocity result	LREAL	+64	When the auto-generation is successfully completed, the asynchronous speed is stored as the ratio of the synchronous speed.
			Total size: 68 points	

*1 For bit and function description, refer to the following.

Bit	Function description
0	Periodic 0: Non periodic 1: Periodic For details, refer to the following.  Page 485 Periodic (Periodic)
1	Master axis (input) absolute coordinate 1: Relative coordinate 0: Absolute coordinate *1 For details, refer to the following.  Page 489 Master axis absolute coordinate
2	Slave axis (output) absolute coordinate 0: Relative coordinate 1: Absolute coordinate For details, refer to the following.  Page 490 Slave axis absolute coordinate
3 to 31	Empty "0".

*1 With this setting, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs and the FB will not start.

*2 When specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs and the FB will not start.

- Read data 2/Write data 2 (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 (Profile data selection), and use the MCv_ProfileCalc (Profile operation).

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 (Cam Table Selection) can be used in the control instruction (MC_CamIn (Operation Available)) as the MC_CAM_ID type. ID can be specified with an arbitrary No.

- Resolution/coordinate number

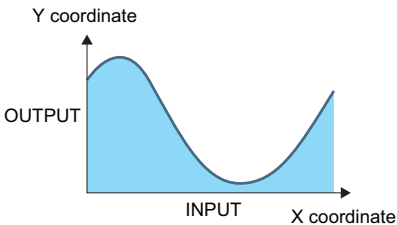
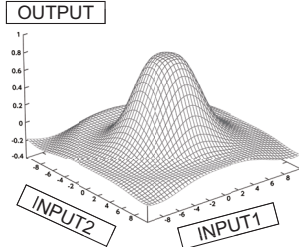
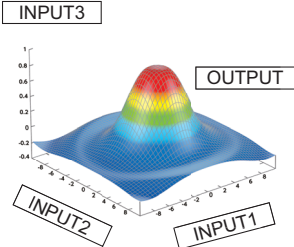
Specify the resolution/coordinate number of the number of input/output dimensions.

- 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

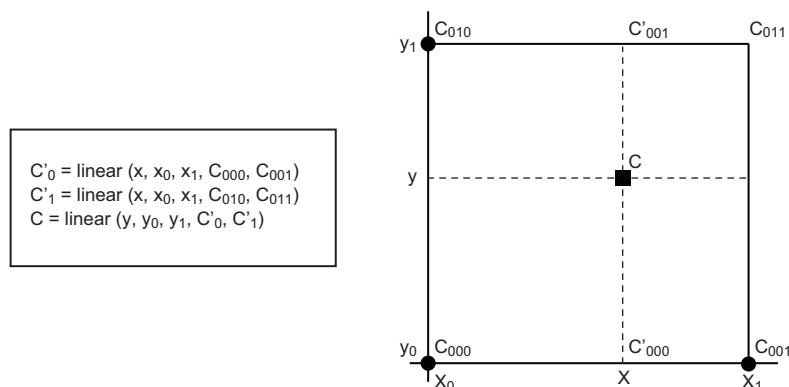
Set the input amount that is required for one cycle.

- Curve designation

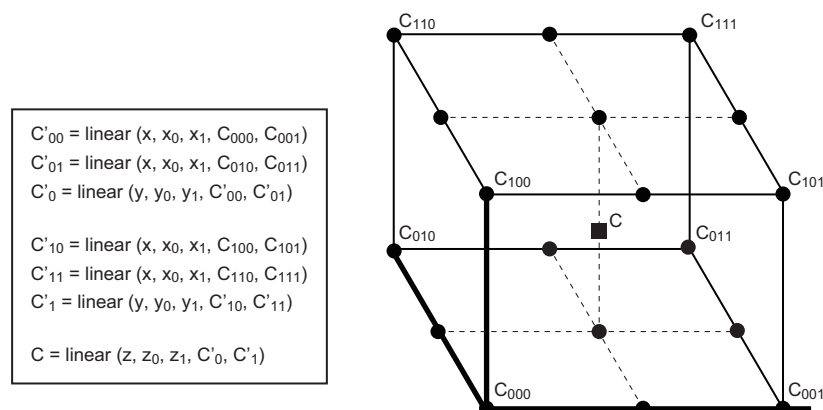
It is fixed with the linear interpolation.

For the multidimensional profile data, the output value to the input value is calculated by repeating the linear interpolation (linear: linear interpolation).

The following figure shows the case of the two-dimensional input.



The following figure shows the case of the three-dimensional input (linear: linear interpolation).



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.

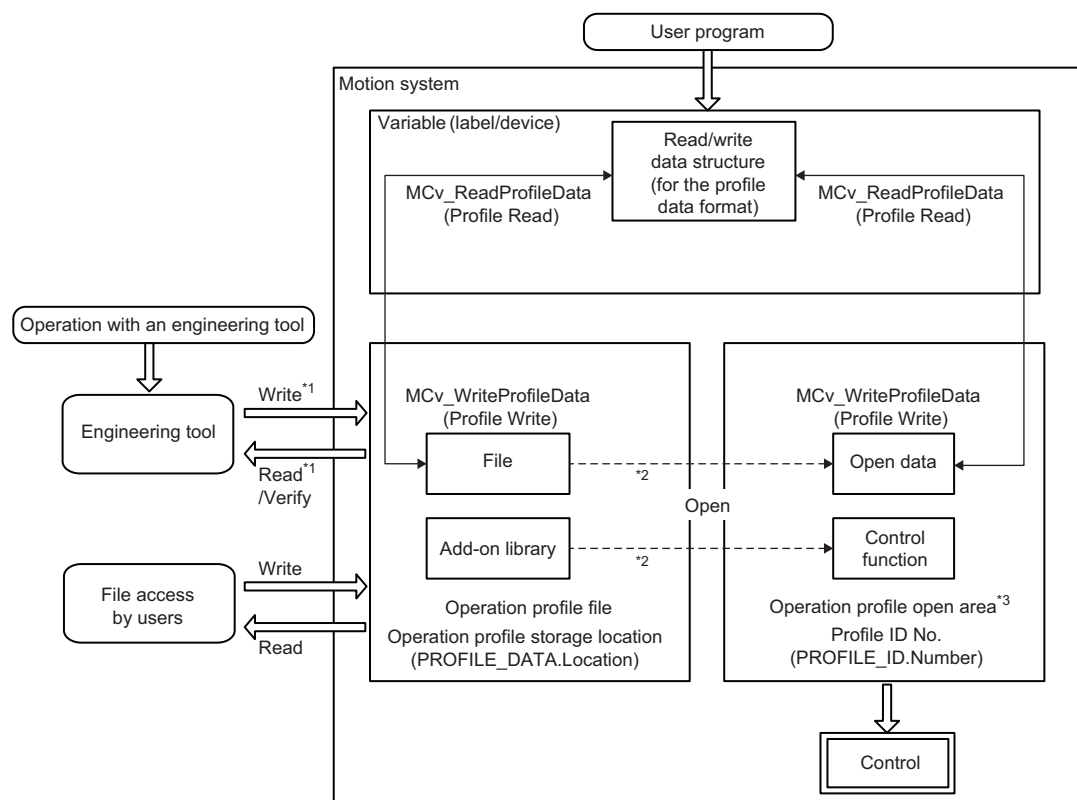
Specify the file path in Operation profile storage location (PROFILE_DATA.Location).

- "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 No. (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 (Profile Write) (file specification). Because the change is deleted when the power turns OFF, even if the data is changed in open area by MCv_WriteProfileData (Profile Write) (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 (Cam Operation Start), etc.). A unique No. is given by the operation profile data open FB (MC_CamTableSelect (Cam Table Selection) , 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 (Cam Table Selection)*1	MC_CamIn (Cam Operation Start)
Profile operation	PROFILE_DATA	PROFILE_ID	MCv_ProfileSelect (Profile data selection)	MCv_ProfileCalc (Profile operation)

*1 It can be opened with MCv_ProfileSelect (Profile data selection).

■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 Interpolation Method Specification (Interpolate) is "0: Linear interpolation": Management information (1K bytes) + Coordinate number $\times 8 \times 2$ (byte) - When Interpolation Method Specification (Interpolate) is "1: Specifying for each section" and "2: Spline interpolation": Management information (1K bytes) + Resolution $\times 8$ (byte)
	Cam data for rotary cutter	Management information (1K bytes) + Resolution $\times 8$ (byte)
Create csv file directly	Multidimensional profile data	- For "2 inputs 1 output": Management information (1K bytes) + X coordinate number $\times$ Y coordinate number $\times 8 \times 3$ (byte) - For "3 inputs 1 output": Management information (1K bytes) + X coordinate number $\times$ Y coordinate number $\times$ Z coordinate number $\times 8 \times 4$ (byte)

In operation profile open processing, temporarily twice the data size memory of open area will be used for cam data (Interpolation Method Specification (Interpolate) 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 Operation profile storage location (PROFILE_DATA.Location) in the open area by using operation profile data open FB (MC_CamTableSelect (Cam Table Selection) , MCv_ProfileSelect (Profile data selection)).

- 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 534 Operation profile data types

MCv_ProfileSelect (Profile data selection) can be opened regardless of the profile data type.

- When an error has occurred while opening the operation profile data, the open area in processing is discarded.

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 motion service processing. It may take time to open depending on the processing details and the operation profile data.
- When PROFILE_DATA.ID.Number (ProfileID), Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) are present as input arguments for the operation profile data open FB, the file setting values are ignored and the open is performed while referencing the input argument settings.
(The setting values of the file are not overwritten.)

■Details of setting items

- Master axis (Master)/Slave axis (Slave)/Axes Group (AxesGroup)

Ignores them.

- Cam table (CamTable)/Profile data (ProfileData)

Set the operation profile data with PROFILE_DATA type structure.

The value of Operation profile storage location (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 ID (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 ID No. (PROFILE_DATA.ID.Number). If an open FB whose Profile ID No. (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 Operation Profile Data 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 ID No. (PROFILE_DATA.ID.Number) at open and the open location area.

Value of Profile ID No. (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 Operation profile storage location (PROFILE_DATA.Location), the error "No Operation Profile Data" (error code: 340FH) will occur, and the open processing will not be carried out.

If operation profile data specified with Operation profile storage location (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.

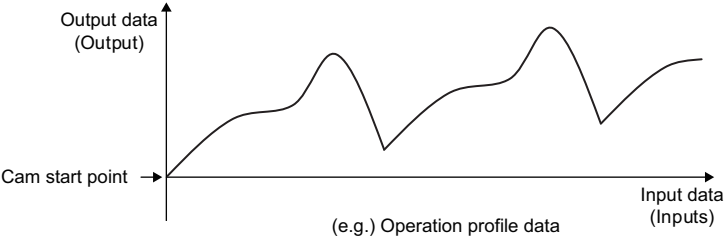
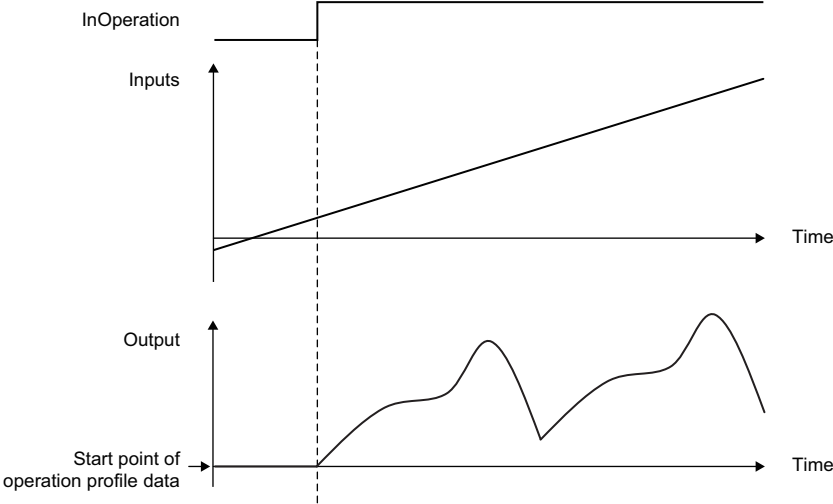
- Periodic (Periodic)

The following explains the operation at operation profile data control execution when Periodic (Periodic) is set.

Periodic (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.

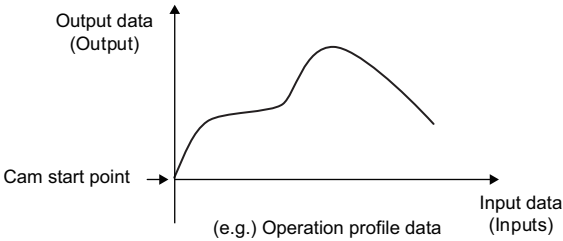
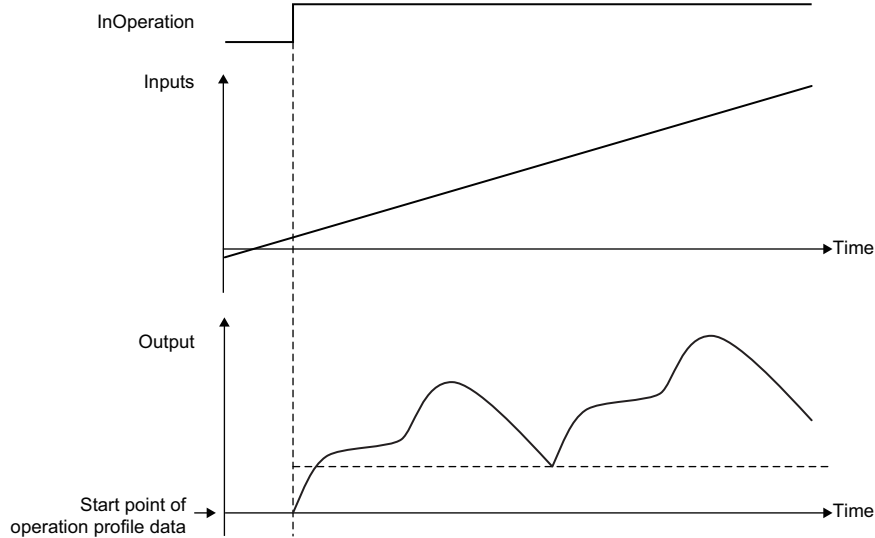
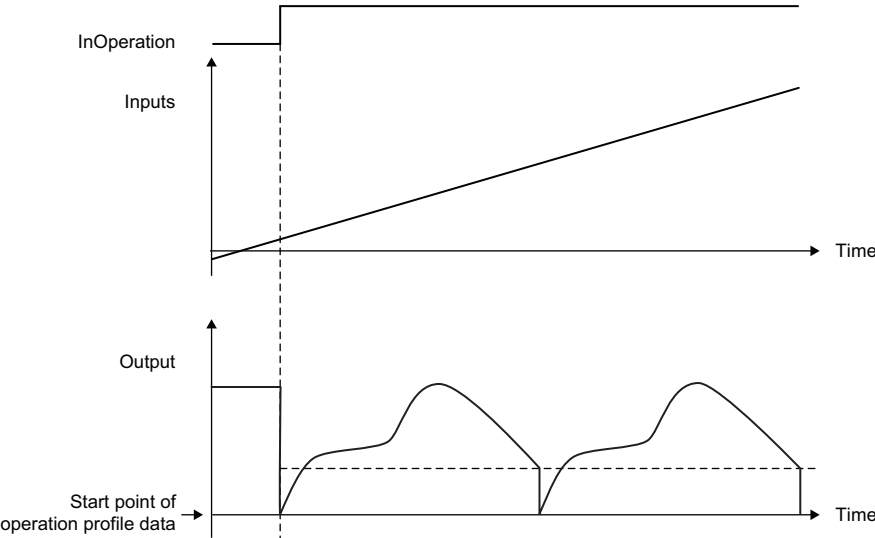
- Master axis absolute coordinate (MasterAbsolute)

The following explains the operation at operation profile data control execution when Master axis absolute coordinate (MasterAbsolute) mode is set. (When the input unit is time specification, it is ignored. (Fixed with relative coordinates)

Master axis absolute coordinate (MasterAbsolute)	Operation
(Example)	
When FALSE is set	The current Input data (Inputs) value becomes the start point of the operation profile data. When Execution completion (InOperation) becomes TRUE, Output data (Output) is calculated according to the relative movement amount of Input data (Inputs). 
When TRUE is set	When using this setting, the error "Out of MasterAbsolute Range" (error code: 341DH) occurs.

- Slave axis absolute coordinate (SlaveAbsolute)

The following explains the operation at operation profile data control execution when Slave axis absolute coordinate (SlaveAbsolute) mode is set.

Slave axis absolute coordinate (SlaveAbsolute)	Operation
(Example)	
When FALSE is set	When Execution completion (InOperation) becomes TRUE, Output data (Output) is calculated based on the current value. 
When TRUE is set	Calculates so that Output data (Output) at the time when Execution completion (InOperation) becomes TRUE always becomes the start point when one cycle of the operation profile data starts. When there is a limit on the Input data (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 stroke position in the operation profile data are different when Periodic (Periodic) = TRUE (Periodic), the command is output in one operation cycle in order to return to the first Output data (Output) at the next one cycle start. 

Auto expand 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 ID No. (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.
- No error such as out of the setting range in the open data.

Point

- When setting auto expand, Profile ID (PROFILE_DATA.ID.Number), Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) open the same parameters in the csv file which can be specified in operation profile data open FB.
- When there is an operation profile data which does not meet the requirement above during auto expand, Details of the error are registered in the event history without opening automatically the profile data. In this case, the operation continues until automatically opening the remaining operation profile data, without ending because of error.

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 (Profile Read)/MCv_WriteProfileData (Profile Write) 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 on the data structure for read/write of each operation profile data format, refer to the following.

 Page 534 Operation profile data format: Cam data

When an error has occurred while writing operation profile data, the open area and the file in processing is discarded.

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 (Profile Read).

- The file specified in Profile data (ProfileData) and Read destination (Target), or the operation profile data in open area are read for the number of points specified in Number of read data (Points) from data specified with Offset (Offset).
- To read the whole operation profile data, specify "0" in both Offset (Offset) and Number of read data (Points).
- Read data is stored in variables specified in Read data 1 (Data1) and Write data 1 (Data 1).

■Write operation profile data

Operation profile data can be written by using the MCv_WriteProfileData (Profile Write).

- The file specified in Profile data (ProfileData) and Write destination (Target), or the operation profile data in open area are written for the number of points specified in Write destination (Points) from data specified with Offset (Offset).
- To write the whole operation profile data, specify "0" in both Offset (Offset) and Write destination (Points).

■Details of setting items

- Profile data (ProfileData)

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 operate read/write operation.

If specifying operation profile data that does not correspond to read/write operation, the error "Operation Profile Data Read/Write Unsupported" (error code: 345EH) will occur.

- Read data 1/Write data 1 (Data 1)/Read data 2/Write data 2 (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 539 Read/write data structure

Ex.

When reading operation profile data of the cam data format for 10 points of buffer memory (Read data 1/Write data 1 (Data 1) is G11480000 or more and Read data 2/Write data 2 (Data 2) is G11483000 or more)

Data1.Target:= "[DEV](PROFILE_CAM_DATA)G11480000"

Data2.Target:= "[DEV](LREAL[1..10, 1..2])G11483000"

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 Profile data (ProfileData).

If Offset (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 (Offset), also set the value other than 0 to Number of read data/Number of write data (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 Write destination (Target = "1: File (File)"). (When other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

- Number of read data/Number of write data (Points)

Specifies the number of data points to read and the number of data points to write.

When Number of read data/Number of write data (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 Write destination (Target) = "1: File (File)". (When other than "0" is set, the error "Number of Offset/Read/Write Data Incorrect" (error code: 3465H) will occur.)

- Read destination/Write destination (Target)

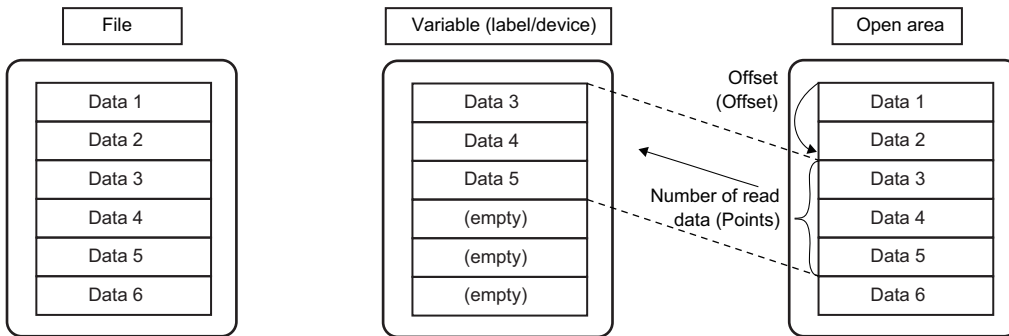
Operation profile data read: Specifies the destination of operation profile data read, and reading is performed for the structure of the data for read/write, Read data 1 (Data1) and Write data 1 (Data 1).

Operation profile data write: Specify the destination of operation profile data write, and writing is performed for the structure of the data for read/write, Read data 1 (Data1) and Write data 1 (Data 1) and the profile ID (PROFILE_ID) of the operation profile data open FB.

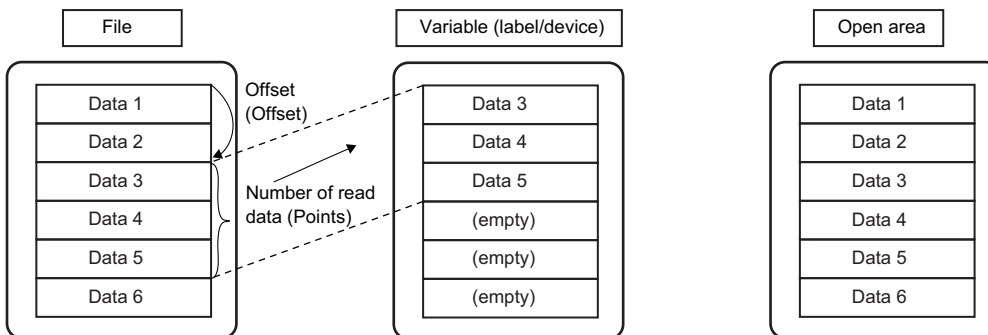
Target	Read operation	Write operation
0: Open area (OpenArea)	• The value of Profile ID (PROFILE_DATA.ID) is referred, and read is carried out to the operation profile data that the ID indicates in open area. • If operation profile data does not exist (unopened), the error "No Operation Profile Data" (error code: 340FH) will occur.	The value of Profile ID (PROFILE_DATA.ID) is referred, and write is carried out to the operation profile data that the ID indicates in open area. The operation is the same as open of operation profile depending on the specified value to Profile ID No. (PROFILE_DATA.ID.Number). For details, refer to the following. 📖 Page 550 Details of setting items
1: File (File)	• The value of Operation profile storage location (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 Operation Profile Data" (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 Operation profile storage location (PROFILE_DATA.Location) is referred, and write is carried out to the operation profile data that the file name and the path indicate. Writes value of the output variable Profile ID No. (ProfileID.Number) to Profile ID of the operation profile data. • 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 (Offset) and Number of write data (Points) are "0", and be written in Unicode (UTF-16 Little Endian with BOM). • When creating a new file, both Offset (Offset) and Number of write data (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.

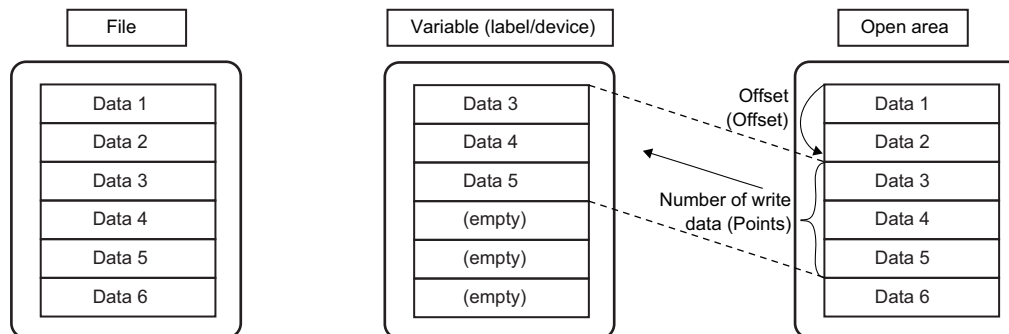
Read process when Read destination (Target = "0: Open area (OpenArea)"), Offset (Offset) = 2 and Number of read data (Points) = 3 are specified



Read process when Read destination (Target) = "1: File (File)", Offset (Offset) = 2 and Number of read data (Points) = 3 are specified



Write process when Write destination (Target) = "0: Open area (OpenArea)", Offset (Offset) = 2 and Number of write data (Points) = 3 are specified



- When Read destination/Write destination (Target) is "1: File (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 Read destination/Write destination (target) is "0: Open area (OpenArea)", read/write is carried out depending on the cycle of executed program.

Precautions

When the operation profile data is written in the open area or file area using MCv_WriteProfileData (Profile Write) Ver.12 or earlier, the setting values of Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute) will be FALSE. (Change of setting value is supported in Ver.12 or later)

To change the setting value, perform the following procedure.

1. Write operation profile data in the file area.
2. Specify the file in procedure 1 to MC_CamTableSelect (Cam Table Selection) , and set Periodic (Periodic), Master axis absolute coordinate (MasterAbsolute), and Slave axis absolute coordinate (SlaveAbsolute).

Control of operation profile data

Operation profile data is used to control.

Control details

The input data of operation profile data control FB is the PROFILE_ID type and the control is executed based on the specified operation profile data. The operation profile data control FB has the following public variables as the monitor data during control.

- Current value per cycle (InputPerCycle)
- Reference value (Reference)
- Output value (OutputData)
- Instance ID (InstanceID)

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.

Input data (Inputs), Output data (Output)Input offset (InputsOffset), Output offset (OutputOffset), Input coefficient (InputsScaling), Output coefficient (OutputScaling), and Profile ID (ProfileID) are set by using MCv_ProfileCalc (Profile operation), 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 Output data (Outputs) (Output data indicated as follows) is controled based on the signal set in Input data (Inputs) (Input data indicatd as follows) and the multidimensional profile data in Profile ID (ProfileID).

■Details of setting items

- Input data (Inputs)

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 data (Output)

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.

- Input offset (InputsOffset)/Output offset (OutputOffset)

The phase/displacement Input data (Inputs)/Output data (Output) can be shifted by setting Input offset (InputsOffset)/Output offset (OutputOffset).

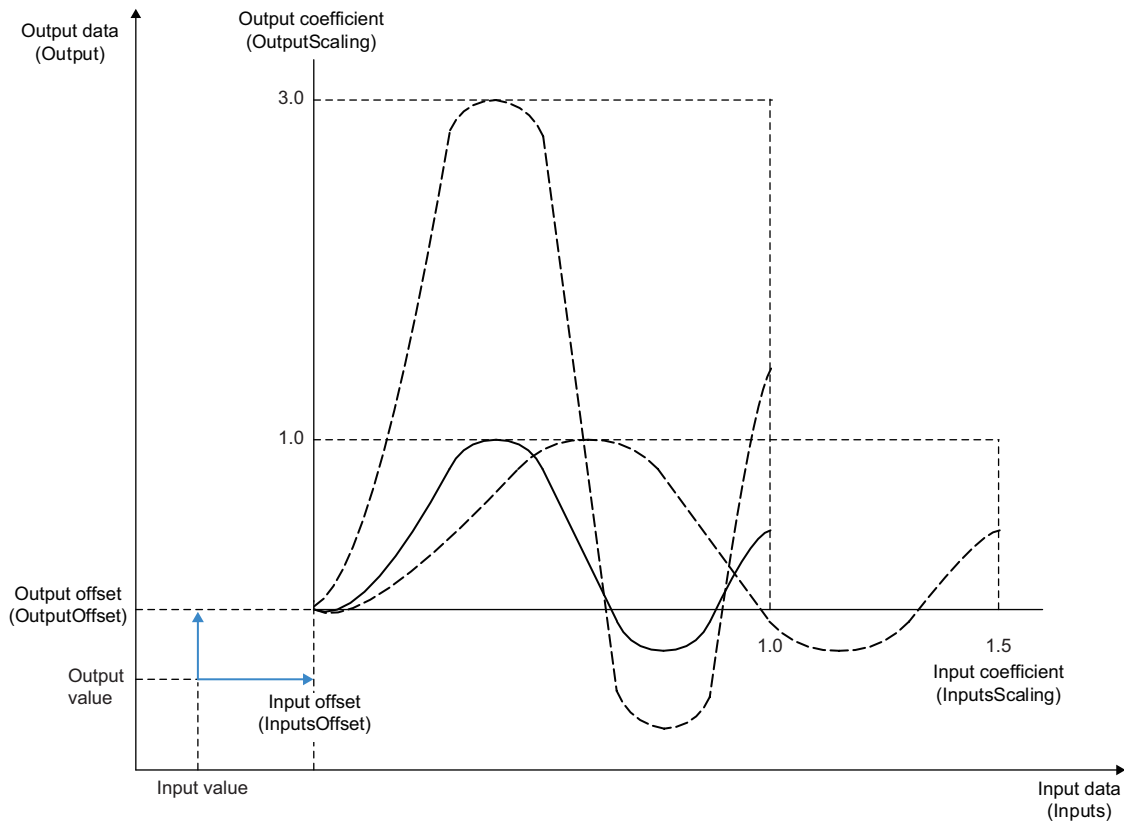
The phase of input value can be shifted by Input offset (InputsOffset).

Input offset (InputsOffset) can be specified as an array for each element of Input data (Inputs) respectively.

- Input coefficient (InputsScaling)/Output coefficient (OutputScaling)

The operation profile data can be enlarged or reduced by setting Input coefficient (InputsScaling)/Output coefficient (OutputScaling).

Input coefficient (InputsScaling) can be specified as an array for each element of Input data (Inputs) respectively.



- Profile ID (ProfileID)

Specify the multidimensional profile data ID with the PROFILE_ID structure.

Start mode

The following table shows the operation when simultaneously executing various FBs (open, write, read, control) that access to open areas of operation profile data to the same profile ID.

- Execution mode (ExecutionMode)

For the operation profile data open FB and the operation profile data write FB, the operation for simultaneous execution can be specified with Execution mode (ExecutionMode).

○: Execution possible, ×: Error

On-going FB	FB to be executed			
	Open/Write			Read/Control
	0: Execute Immediately (mcImmediately)	1: Execute at Completion of Previous One (mcQueued)	3: Execute Speculatively (mcSpeculatively)	
Open/Write	○	○	×	×
Read/Control	○	○	×	○

[0: Execute Immediately (mcImmediately)]

The description in the open area is immediately changed by an open FB and a write FB. The change may affect the control in execution.

However, if the operation profile format and the resolution do not match when executing open/write during FB execution, the error "Operation Profile Data Being Operated" (error code: 3411H) occurs.

[1: Execute at Completion of Previous One (mcQueued)]

Waits execution completion of on-going FB. When multiple FBs are waiting, the FBs will be executed in high priority task. For the same priority, the FBs will be executed in the order of the start.

The status of execution completion of each FB is shown below.

FB	Status
MC_CamTableSelect (Cam Table Selection)	Execution completion (Done) = TRUE
MCv_ReadProfileData (Profile Read)	Execution completion (Done) = TRUE
MCv_WriteProfileData (Profile Write)	Execution completion (Done) = TRUE
MC_CamIn (Cam Operation Start)	Periodic (MC_CamTableSelect.Periodic) = TRUE : Abortion of execution (MC_CamIn.CommandAborted) = TRUE Periodic (MC_CamTableSelect.Periodic) = FALSE : Abortion of execution (MC_CamIn.CommandAborted) = TRUE, Cam cycle completion (MC_CamIn.EndOfProfile) = TRUE

[3: Execute Speculatively (mcSpeculatively)]

The error "Operation Profile Data Being Operated" (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 Execution mode (ExecutionMode).

While the FB (open, write, read, control) that accesses open areas is in execution, Executing (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 Instance ID (MC_CamIn.InstanceID) of operation profile data control FB (Instance name indicates MC_CamIn as follows) in Instance ID (InstanceID).
- Public variables of MC_CamIn are shown below when current value per cycle change is performed.

Public variable	Updating value	Remark
Current value per cycle (InputsPerCycle)	Value specified in Current value per cycle (Cycle[])	—
Reference value (Reference)	Stroke value equivalent to Current value per cycle (Cycle[])	Reference value (MC_CamIn.Reference) is refreshed to fix Output value (MC_CamIn.OutputData).
Output value (OutputData)	Not updated	—

Point

Even if Slave axis absolute coordinate (MC_CamTableSelect.SlaveAbsolute) is TRUE (absolute coordinate), Reference value (Reference) is refreshed to fix Output value (OutputData) if current value per cycle change is performed.

- The method for current value per cycle change is as follows.

Method	Description
MCv_ChangeCycle (Current Value Change per Cycle)	Change it to the specified value at control execution.
MCv_ChangeCycleTriggered (Trigger Current Value Change per Cycle)	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 position selection (Relative).

■Current value per cycle change

Uses Current value per cycle (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 command (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 Execution mode (ExecutionMode).

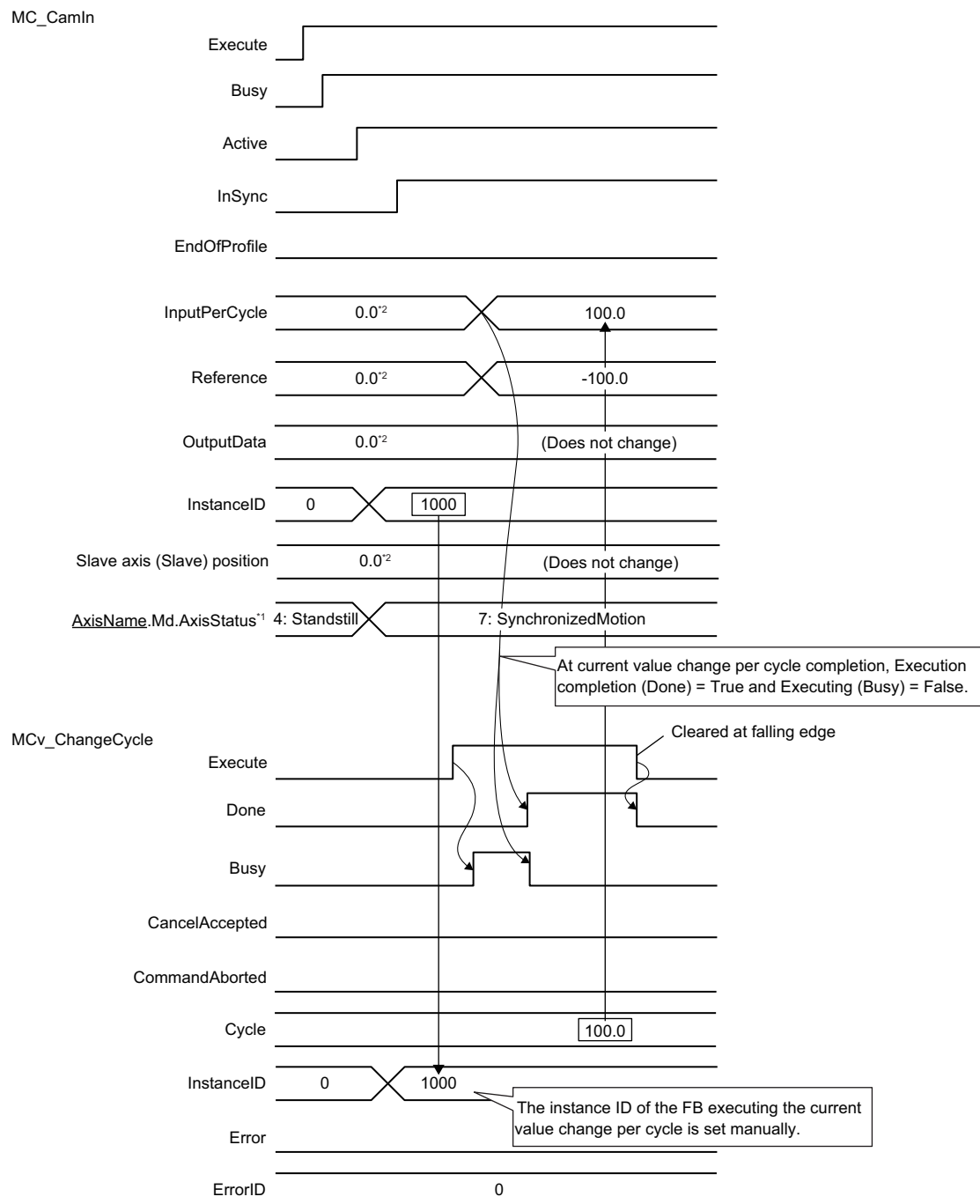
- Execution mode (ExecutionMode)

[0: Execute Immediately (mclImmediately)]

Executed immediately at rising edge detection of Execute command (Execute) with Executing (MC_CamIn.Busy) = TRUE.

Ex.

Sets Current value per cycle (Cycle) = 100.0 when Executing (MC_CamIn.Busy) = TRUE, and when executing current value per cycle change. (Current value of Master axis (Master) of MC_CamIn (Operation Available) shall not change.)



*1 This is axis state of Slave axis (Slave).

*2 Does not change because the master axis does not move.

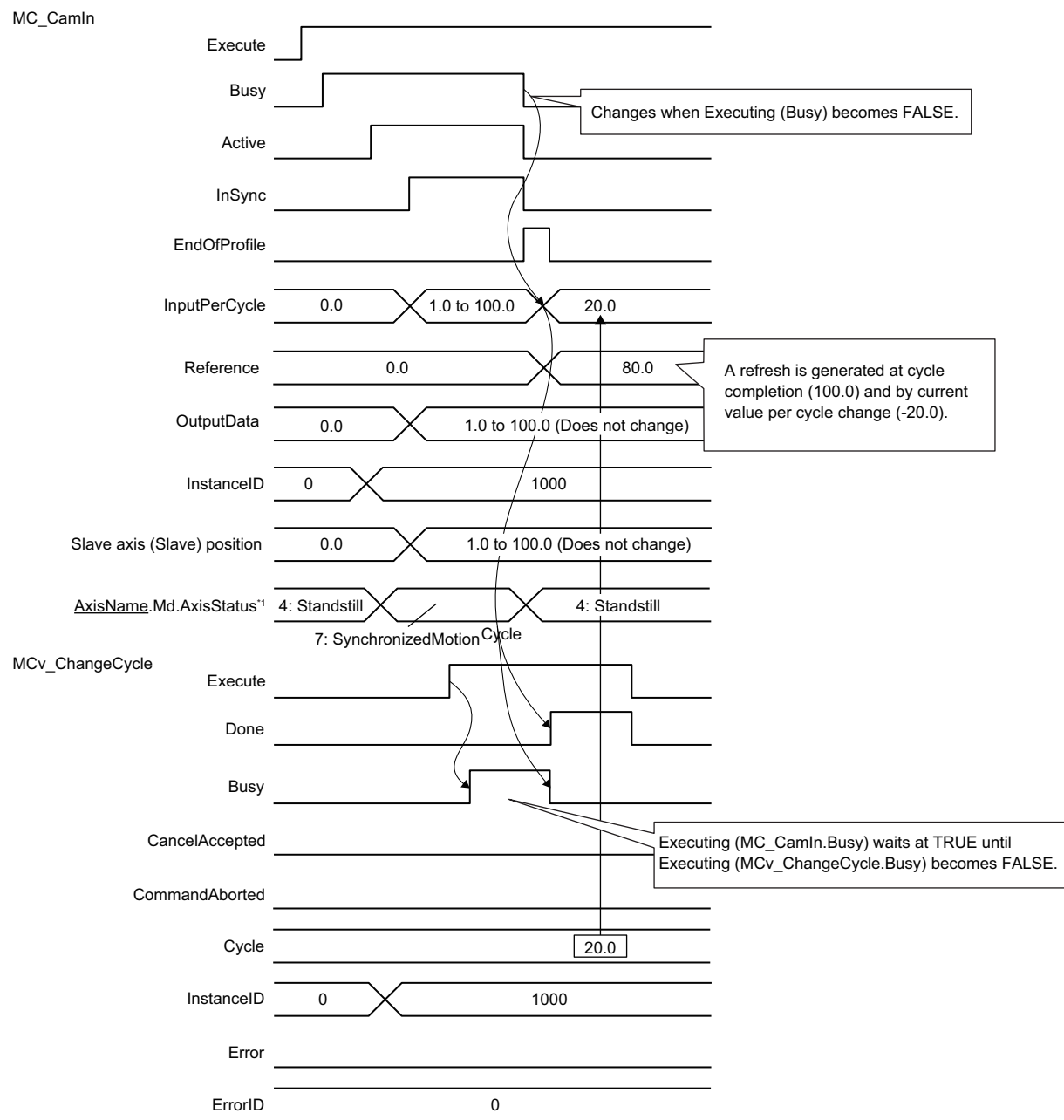
[1: Execute at Completion of Previous One (mcQueued)]

Becomes Executing (Busy) = TRUE at rising edge detection of Execute command (Execute).

Executed after waiting until Executing (MC_CamIn.Busy) = TRUE becomes FALSE.

Ex.

When setting Current value per cycle (Cycle) = 20.0, and executing current value per cycle change.

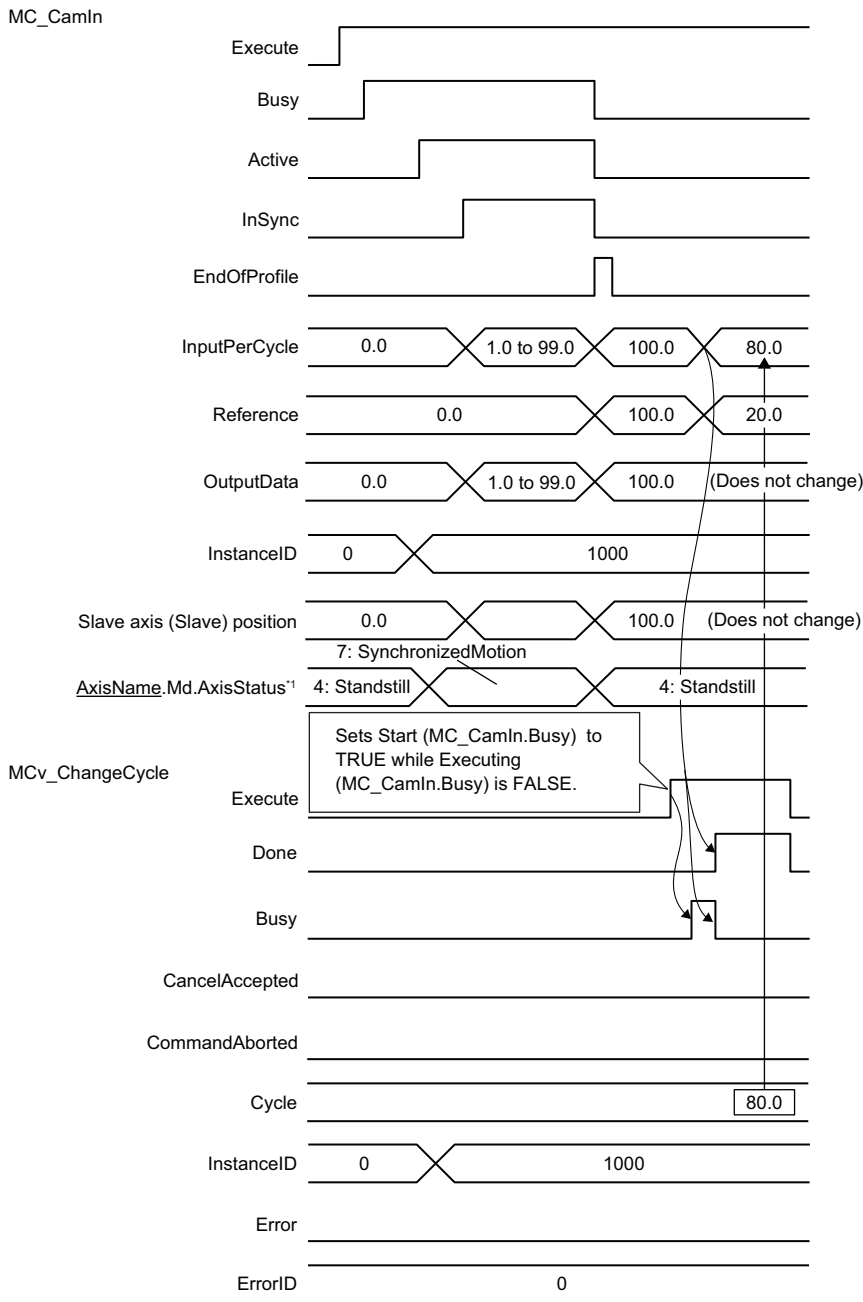


*1 This is axis state of Slave axis (Slave).

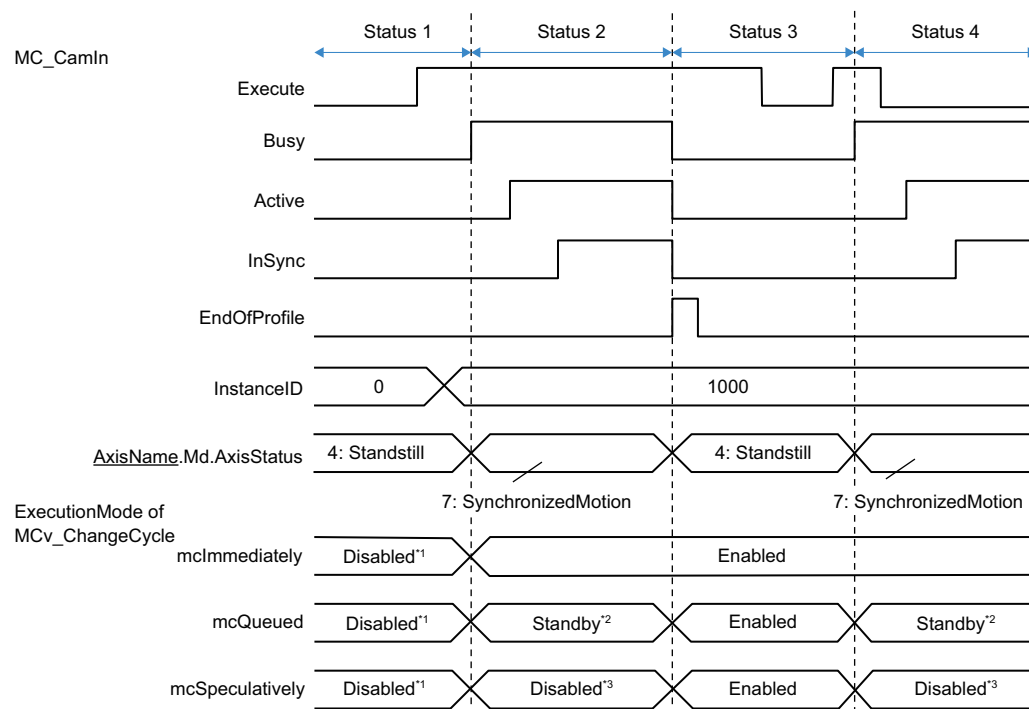
[3: Execute Speculatively (mcSpeculatively)]
Execute when Executing (MC_CamIn.Busy) = FALSE.

Ex.

When setting Current value per cycle (Cycle) = 80.0, and executing current value per cycle change



[Current value per cycle change timing by each value]



*2 The error "No Instance ID" (error code: 3468H) occurs.

*3 Standby until Axis Status (AxisName.Md.AxisStatus) turns to "4: Standby (Standstill)".

*4 The error "MCv_ChangeCycle Instruction Error" (error code: 3497H) (Detail Code: 0004H) occurs.

Status of FB of current value per cycle change target		Condition of state transition (Status change of the slave axis)		Operation of current value per cycle change
		Before transition	After transition	
Status 1	FB is not started	—(Initial status)	4: Standby (Standstill)	MCv_ChangeCycle (Current Value Change per Cycle) becomes the error "No Instance ID" (error code: 3468H) regardless of Execution mode (ExecutionMode).
Status 2	FB is starting	4: Standby (Standstill)	7: During synchronous operation (SynchronizedMotion)	*1
Status 3	FB after the control completed	7: During synchronous operation (SynchronizedMotion)	4: Standby (Standstill)	Current value per cycle change can be executed regardless of Execution mode (ExecutionMode). FB of change target is reflected by execution cycle. When waiting start mode "1: Execute at Completion of Previous One (mcQueued)" in Status 2, the target FB is reflected at the timing which Axis Status (<u>AxisName.Md.AxisStatus</u>) turns to "4: Standby (Standstill)".
Status 4	FB after restarting	4: Standby (Standstill)	7: During synchronous operation (SynchronizedMotion)	The operation is the same as Status 2. Repeats after that as Status 4 (Status 2) → Status 3 → ... Current value per cycle change operation is not affected even Execute command (Execute) has TRUE/FALSE differences in Status 2 and Status 4.

*1 Depending on Execution mode (ExecutionMode), the timing is as follows.

Start mode	Change timing
0: Execute Immediately (mclImmediately)	Current value per cycle change can be executed. The execution cycle of target FB is reflected.
1: Execute at Completion of Previous One (mcQueued)	Standby untill it turns to enable (Status 3). (No error occurs.)
3: Execute Speculatively (mcSpeculatively)	The error "MCv_ChangeCycle Instruction Error" (error code: 3497H) (Detail Code: 0004H) occurs.

■Trigger current value per cycle change

Uses MC_ChangeCycleTriggered (Trigger Current Value Change per Cycle).

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 command (Execute).

When Compensation Time (TriggerInput.Signal.CompensationTime) is a positive value, it is executed immediately.

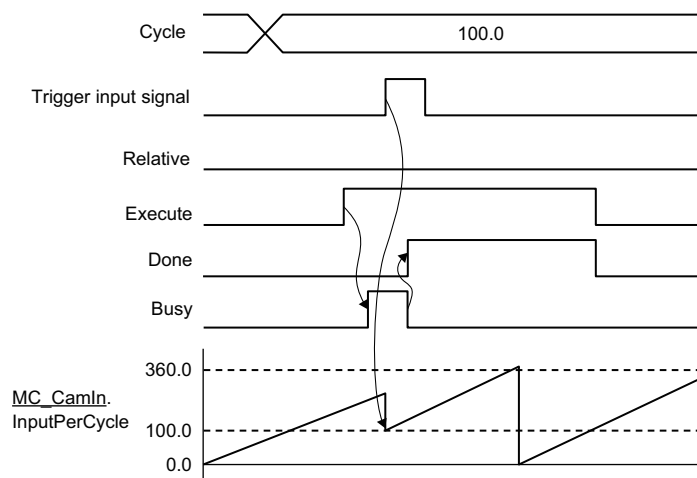
When Compensation Time (TriggerInput.Signal.CompensationTime) is a negative value, this FB waits for operation to start until the correction time has elapsed, and it is executed.

Current value per cycle (MC_CamIn.InputPerCycle) is estimated and changed so that the position will be a position set in Current value per cycle (Cycle) at Trigger signal detection timing.

Ex.

Operation example by Trigger input signal

When setting Current value per cycle (Cycle) = 100.0 during MC_CamIn operation, and executing current value per cycle change.



• Trigger Signal (TriggerInput.Signal)

Specifies Trigger input signal with the MC_TRIGGER_REF structure.

Setting range of Trigger Signal (TriggerInput.Signal) is shown below.

Item	Setting range
TriggerInput.Signal	
Signal (Source)	Type BOOL Data type [VAR] [DEV] [CONST] [OBJ]
Signal detection method (Detection)	2: Detection at FALSE -> TRUE (Rising Edge) (RisingEdge) 3: Detection at TRUE -> FALSE (Falling Edge) (FallingEdge) 4: Detection at Rising Edge/Falling Edge (BothEdges)
Compensation time (CompensationTime)	When Relative position selection (Relative) = TRUE: 0.0 When Relative position selection (Relative) = FALSE: -5.0 to 5.0 [s]

■Details of setting items

- Instance ID (InstanceID)

Specifies the instance ID of operation profile data control FB.

Instance ID is enabled from the controller power turns ON to OFF.

- Current value per cycle (Cycle)

Specifies the current value per cycle to be changed.

Settable Current value per cycle (Cycle) value differs depending on Relative position selection (Relative) being FALSE or TRUE. Specify the value within the setting range below. If a value outside the setting range is set, the error

"MCv_ChangeCycle Instruction Error" (error code: 3497H) (Detail Code: 0001H) occurs.

Current value per cycle (Cycle)	Relative position selection (Relative)	Setting range
Cycle[0]	FALSE	$0.0 \leq \text{Setting value} < \text{Length per cycle}$
	TRUE	$-(\text{Length per cycle}) / 2 \leq \text{Setting value} \leq (\text{Length per cycle}) / 2$
Cycle[1], Cycle[2]	FALSE/TRUE	0.0

- Relative position selection (Relative)

When Relative = TRUE, Current value per cycle (Cycle) is "Relative specification", when Relative position selection (Relative) = FALSE, Current value per cycle (Cycle) is "Absolute specification".

When Relative position selection (Relative) is TRUE, Current value per cycle (MC_CamIn.InputPerCycle) is changed to equal to Current value per cycle (Cycle) added to the presently set Current value per cycle (MC_CamIn.InputPerCycle). In this setting, exceeding the current value per cycle is possible when the current value per cycle is changed.

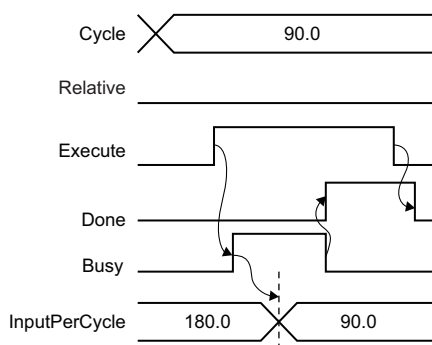
When Relative position selection (Relative) is FALSE, Current value per cycle (MC_CamIn.InputPerCycle) is changed to the value of Current value per cycle (Cycle).

Ex.

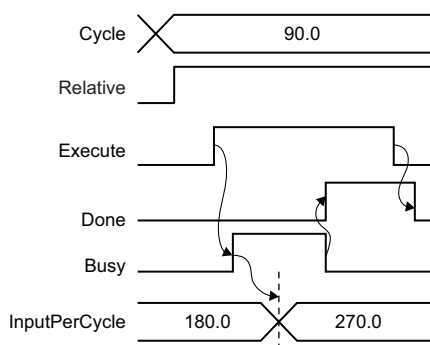
Operation example by Relative position selection (Relative)

When executing the current value per cycle change of Current value per cycle (Cycle) = 90.0 while it stops with Current value per cycle (MC_CamIn.InputPerCycle) = 180.0.

When Relative position selection (Relative) = FALSE



When Relative position selection (Relative) = TRUE

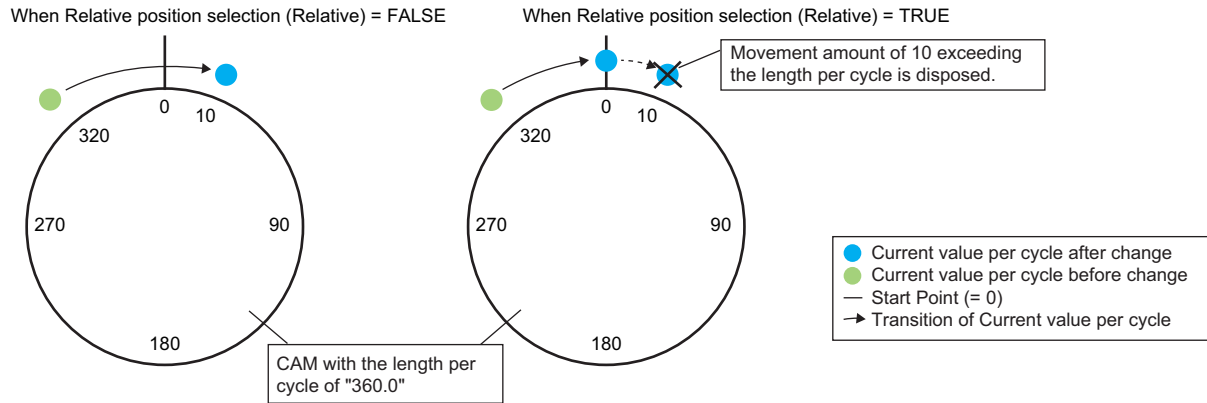


The following table shows whether or not exceeding the current value per cycle is possible when the current value per cycle is changed.

○: Possible, ×: Not possible

Relative position selection (Relative)	Relationship between 1 cycle and amount moved by the current value per cycle	Exceeding availability
TRUE	Length per cycle > Movement amount of the current value per cycle	○
	Length per cycle ≤ Movement amount of the current value per cycle	○*1
FALSE	Length per cycle > Movement amount of the current value per cycle	×

*1 The operation at exceeding is different depending on the setting value of Periodic (MC_CamTableSelect.Periodic).
When Periodic (Periodic) is TRUE, the current value per cycle is changed when exceeding the length per cycle.
When Periodic (Periodic) is FALSE, Movement amount exceeding the length per cycle is disposed.
The image when the current value per cycle is changed "from 320 to 10" is shown below.



• Options (Options)

Specify the function options.

Bit	Function description
0 to 15	Empty (Specify "0".)*2
16	Cancel accepted after FB start Specifies whether or not to allow a cancel after FB is executed. 0: Do not allow 1: Allow
17 to 31	Empty (Specify "0".)*2

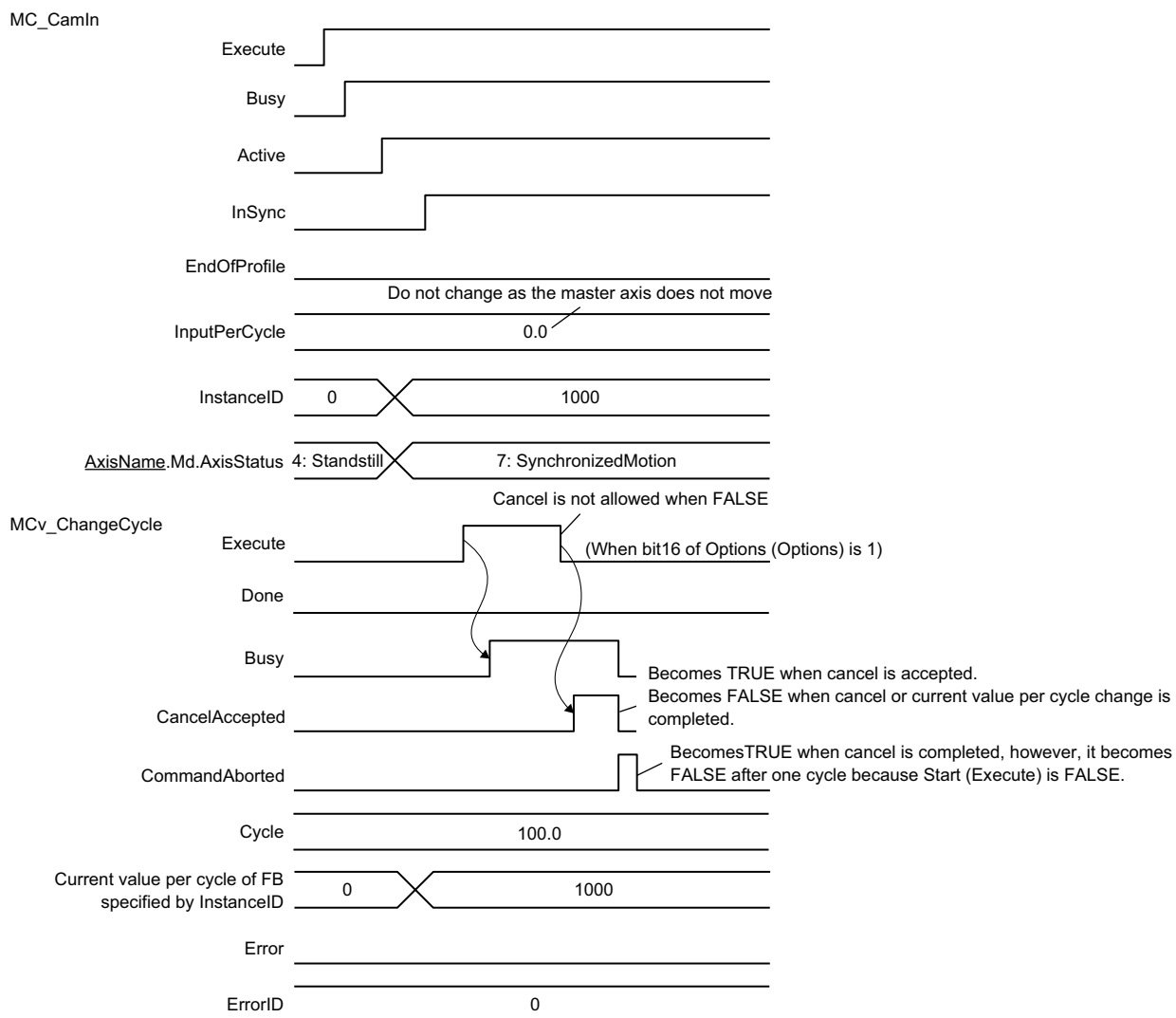
*2 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.
Current value per cycle change that is in the standby status can be canceled after FB execution by cancel enabled setting.

- Cancel is started at falling edge detection of Execute command (Execute).
- Cancel is accepted only when Executing (Busy) = TRUE.
- When FB accepts cancel, becomes Cancel acceptance (CancelAccepted) = TRUE.
- When cancel is completed, becomes Abortion of execution (CommandAborted) = TRUE.
- When cancel was carried out, Current value per cycle (InputsPerCycle) is not changed.

Ex.

Cancel operation example by MCv_ChangeCycle (Current Value Change per Cycle)

When canceling while Executing (MC_CamIn.Busy) = TRUE is waiting for switching to FALSE after starting Execution mode (ExecutionMode) with "1: Execute at Completion of Previous One (mcQueued)"

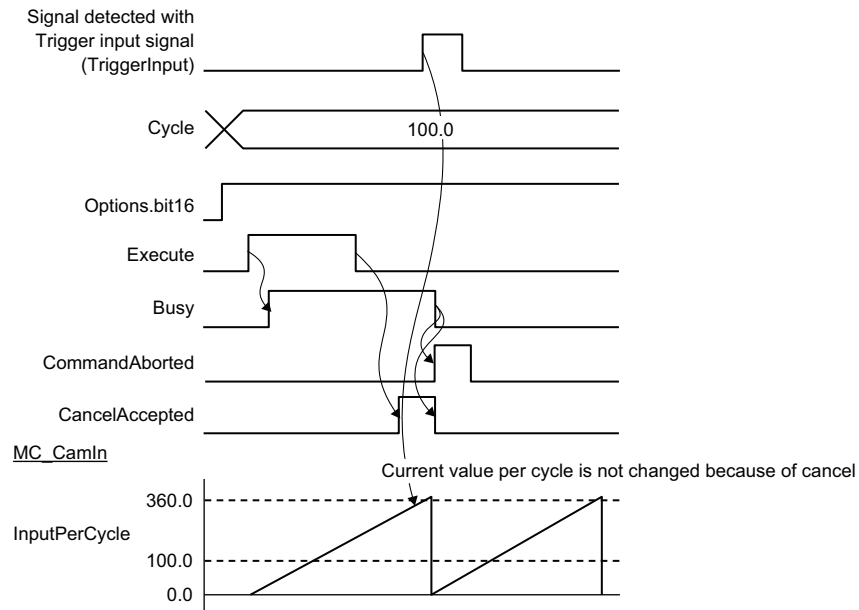


Ex.

Cancel operation example by MCv_SetPositionTriggered (Trigger Current Position Change)

When canceling while it is waiting for detecting a trigger input signal after starting

MCv_ChangeCycleTriggered



14.2 Operation Profile Data Format

This section describes csv file format of operation profile data.



- "/" 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/coordinate number
5	Start point, initial stroke amount, options
6	Number of sections
7 or later	Defined for each operation profile data format
N-2 ^{*1}	Length per cycle
N-1 ^{*1}	Stroke amount
N ^{*1}	Common footer (EOF)
N+1 ^{*1}	Common footer (CRC)

- *1 N is calculated as shown below by Interpolation Method Specification (Interpolate).
- "0: Linear interpolation": 7 (start row of previous step) + (coordinate number × 2)
 - "1: Specifying for each section": 7 (start row of previous step) + Number of sections
 - "2: Spline interpolation": 7 (start row of previous step) + Number of sections

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 517 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 517 Operation Profile Data	Integer	Specifies periodic.	0x0103
	3	Input absolute coordinate	○	☞ Page 517 Operation Profile Data	Integer	Specifies input absolute coordinate.	0x0103
	4	Output absolute coordinate	○	☞ Page 517 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 517 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/ coordinate number	×	☞ Page 517 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 accrrration	○	*1 99: Valid for the cam data format (specified for each section) Initial value: 0	Real number	Specifies the initial accrrration	0x0103
	5	Options	○	*2 Initial value: 0	Unsigned integer	Defines for each operation profile data format.	0x0103
6	1	Number of sections	×	*2 Initial value: 0	Unsigned integer	Specifies the number of sections for the data format that requires it. Specify "0" for the data format that does not require it.	0x0103

*1 Differs depending on the data format.

*2 Depends on the operation profile data format.

- (N-2)th line: Length per cycle

○: Omission possible

Line No.	Column No.	Item	Omission	Setting range (Initial value)	Setting format	Description	Supported file version
N-2	1	Length per cycle	○	0 or more ^{*1}	Real number	Specifies the length per cycle. Specify "0" for the data format that does not require it.	0x0103
	2	Unit setting	○	[Rules] F: An arbitrary unit Initial value: 0x0F For settable units, refer to the following.  Page 79 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 517 Operation Profile Data	0x0103
	3	Unit character string	○	Up to 31 characters Initial value: ""  Page 79 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	○	^{*2}	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	○	^{*2}	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 ^{*1}	Real number	Specifies the time per cycle. Specify "0" for the data format that does not require it.	0x0103

^{*1} The maximum value differs depending on the data format.

^{*2} Differs depending on the data format.

- (N-1)th line: Stroke amount (Stroke)

○: 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 79 Technical Units	Unsigned integer	Specifies the unit of stroke amount. Units that can be specified differ depending on the profile data type.  Page 517 Operation Profile Data	0x0103
	3	Unit character string	○	Up to 31 characters Initial value: ""  Page 79 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 (Interpolate)	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 85 Positioning Range	Real number	☞ Page 517 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 85 Positioning Range	Real number	☞ Page 517 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 (Interpolate)	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 517 Operation Profile Data	Integer	☞ Page 517 Operation Profile Data	0x0103
	2	End point	×	☞ Page 517 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 (Interpolate)	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 517 Operation Profile Data	Real number	 Page 517 Operation Profile Data	0x0103
	2	Stroke	×		Real number		0x0103
8	1-2	Same as line No.7					
⋮							
(For the number of sections)							

PART 3

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

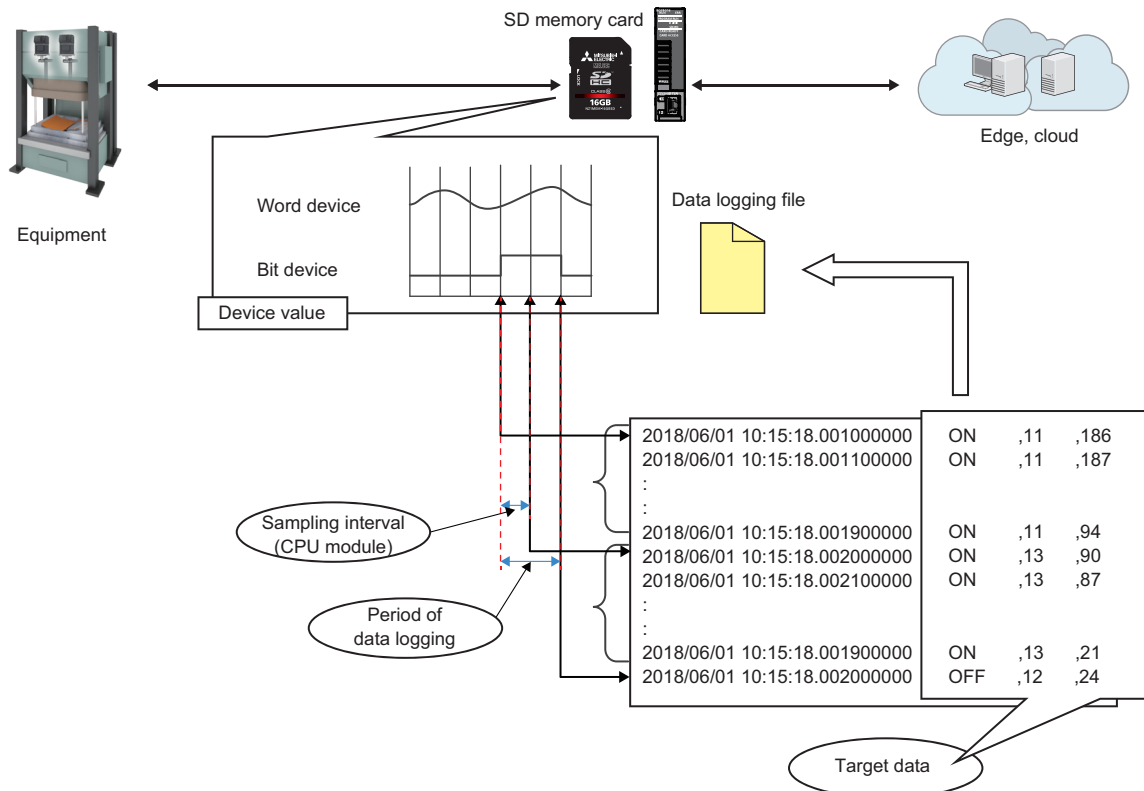
Variable/Structure name	Name	Details
System.LoggingRef[1..10].Cd.* ^{*1}		
SettingPath	Logging Setting Path	Sets the storage location path (folder name/file name) of logging setting.
StartLog	Logging Request	Requests the execution of logging. FALSE: STOP TRUE: RUN
Trigger	Trigger Request	Requests the 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.
TriggerCountIgnored	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
TriggerStatusword	Trigger Status Word	Reflects the same status as Trigger status (TriggerStatus[1..32]) variable to a bit (b0 to b31).
SaveStatus	Save Status	Indicates the save status to files of collected data. 0: Unsaved (UnSave) 1: Saving (Saving) 2: Saved (Saved) 3: All Files Saved (FullySaved)
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	Sets "Allow" or "Do not allow" of auto logging function when the logging setting file is stored in the SD memory card. 0: Disabled 1: 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

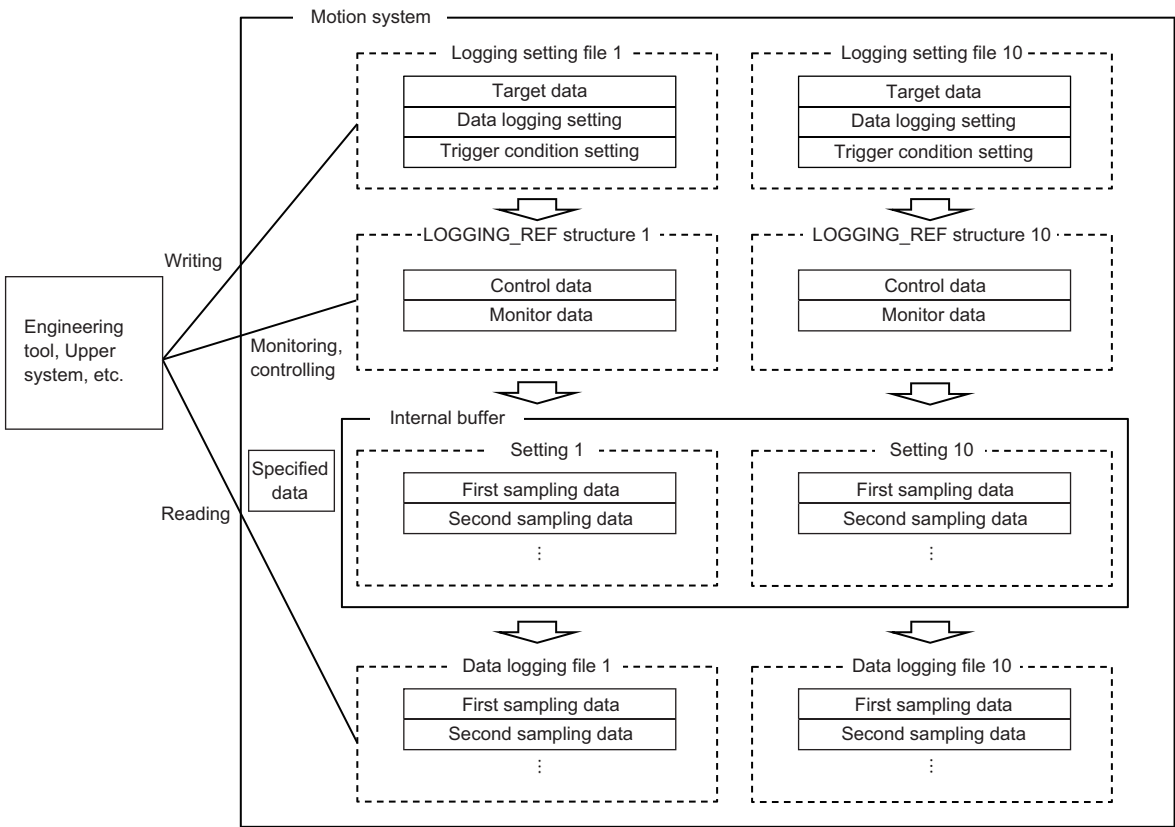
Real-time monitor

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.

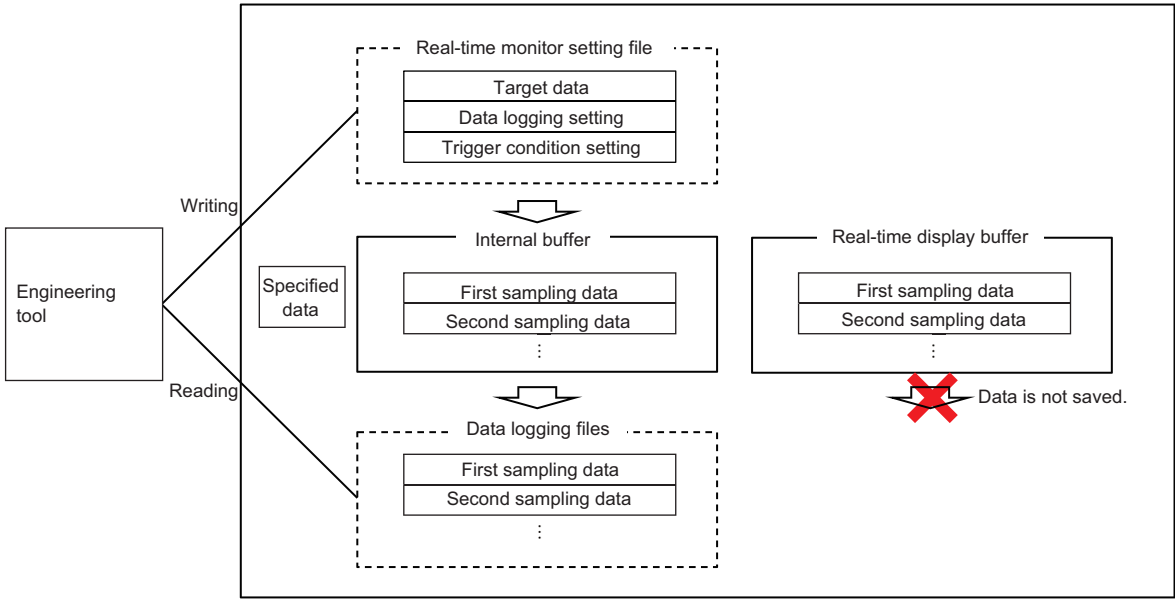


Real-time monitor

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

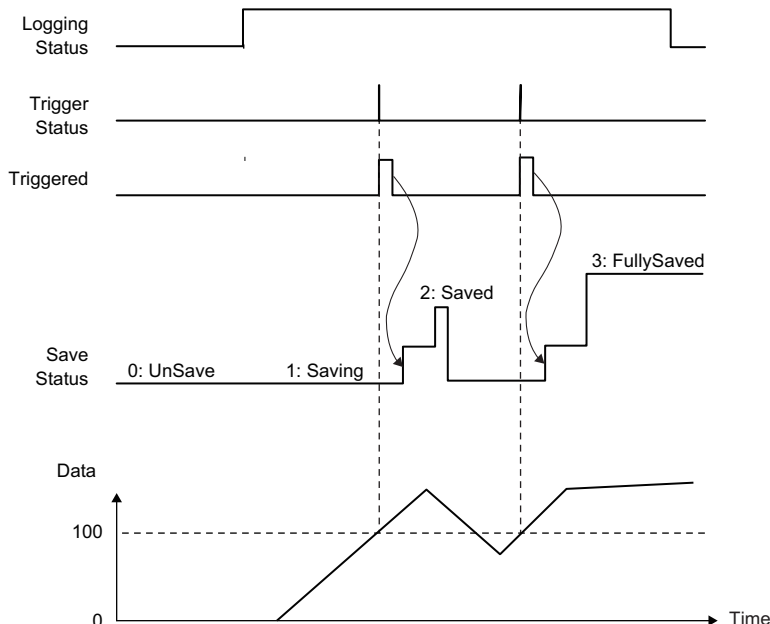
When the data collection is completed, the collected data in the internal buffer is saved and displayed in the engineering tool. Real-time monitor can start with new setting independently from data logging. Also, it can start based on the setting of the data logging in progress.



Status of logging

The status of logging in progress can be checked by Logging Status (System.LoggingRef[1..10].Md.LoggingStatus), Trigger Status (System.LoggingRef[1..10].Md.TriggerStatus[1..32]), Triggered (System.LoggingRef[1..10].Md.Triggered), and Save Status (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 becomes TRUE while trigger condition is processed for Trigger Status (System.LoggingRef[1..10].Md.TriggerStatus[1..32]), and after trigger condition is processed for Triggered (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 Save Status (System.LoggingRef[1..10].Md.SaveStatus) as follows.

Save Status (System.LoggingRef[1..10].Md.SaveStatus)	Description
3: All Files Saved (FullySaved)	- When the all records specified the number in "Number of file switching records" by continuous logging are saved to files - When the all records specified the number in "Number of trigger records after trigger" by trigger logging are saved to files and the only files specified the number in "Number of trigger logging"
2: Saved (Saved)	When the files are saved with the condition which is not met the condition of "3: All Files Saved (FullySaved)"

However, after the status becomes "2: Saved (Saved)" or "3: All Files Saved (FullySaved)", the status moves to be "0: Unsaved (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 (k bytes) = 100 + (The total number of the appropriate 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 appropriate words of the smaller type may be rounded up to the number of the appropriate 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 appropriate words is 12. (The number of the appropriate words for one word data is rounded up to 4.)
Total number of the appropriate words for each data	The number of the appropriate 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 an 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 442 TARGET_REF structure

To collect a mapped object to cyclic data, assign the object to the device label and set it. For how to assign the device label, refer to the following.

☞ Page 781 Connectable device to CC-Link IE TSN

Data type (TYPE)

The following shows data type that can be specified to the data name.

- Bit
- Word [unsigned]
- Double word [unsigned]
- Word [signed]
- Double word [signed]
- 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 , Logging Request (System.LoggingRef[1..10].Cd.StartLog) becomes TRUE and logging starts automatically. Logging can start and stop after the system starts by Logging Request (System.LoggingRef[1..10].Cd.StartLog).
Stop disabled after automatically start	When the motion system starts* ¹ , Logging Request (System.LoggingRef[1..10].Cd.StartLog) becomes TRUE and logging starts automatically. Logging cannot stop manually (Logging Request (System.LoggingRef[1..10].Cd.StartLog) changes to FALSE).
Starts by user operation	Logging can start and stop by Logging Request (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 591 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.

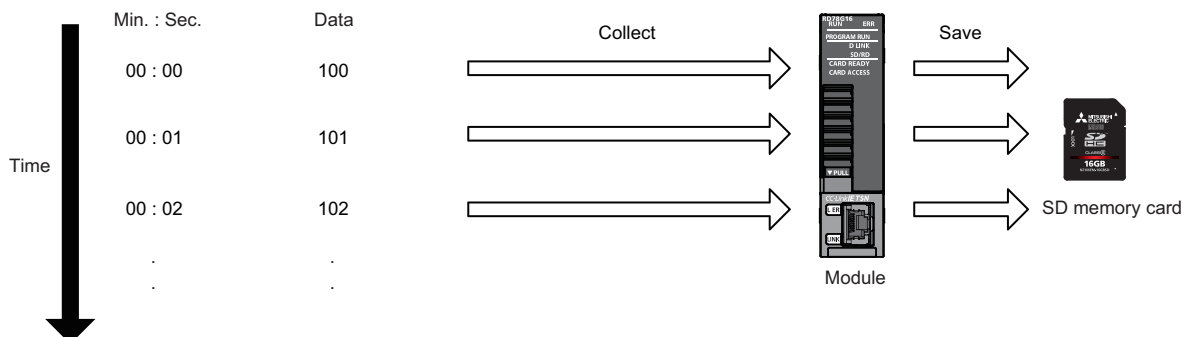
Data collection timing	Description
Operation cycle	Collects data in operation cycle interval. From the first to third operation cycles are available.
Time specification	Collects data at specified time interval ([ms]). (from 1 to 86400 [ms]) The closest cycle among cycles obtained by multiplying the first 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 6.0 [ms], 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 1.8 [ms], the actual interval is 1.75 [ms] (the first operation cycle × 7) • When specifying 1.9 [ms], the actual interval is 2.0 [ms] (the second operation cycle × 2) • When specifying 8.0 [ms], 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

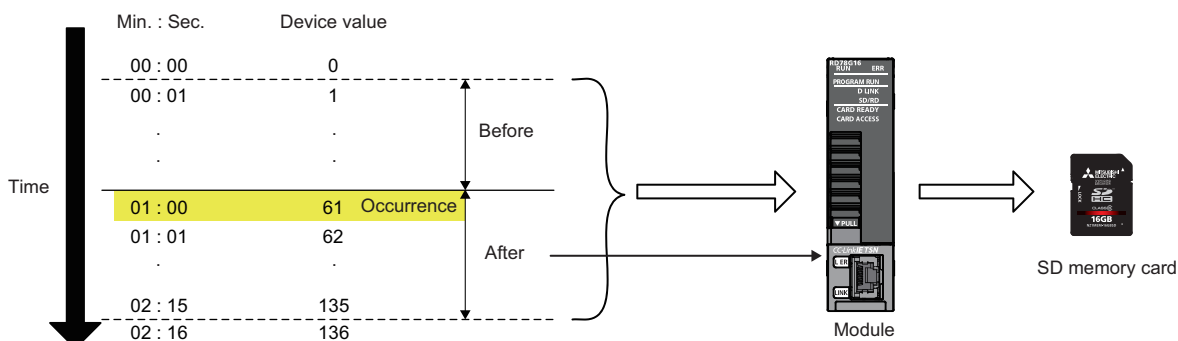
In continuous logging, the module collects specified data continuously and keeps saving the data logging file at file switching timing.



[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 Logging Request (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 Triggered (System.LoggingRef[1..10].Md.Triggered) and Trigger Status (System.LoggingRef[1..10].Md.TriggerStatus[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. Save Status (System.LoggingRef[1..10].Md.SaveStatus) changes to "2: Saved (Saved)" and "3: All Files Saved (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 Logging Request (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 free space of the operation folder may be insufficient. The place of the operation folder can be changed. For details, refer to the following.

☞ Page 592 Precautions

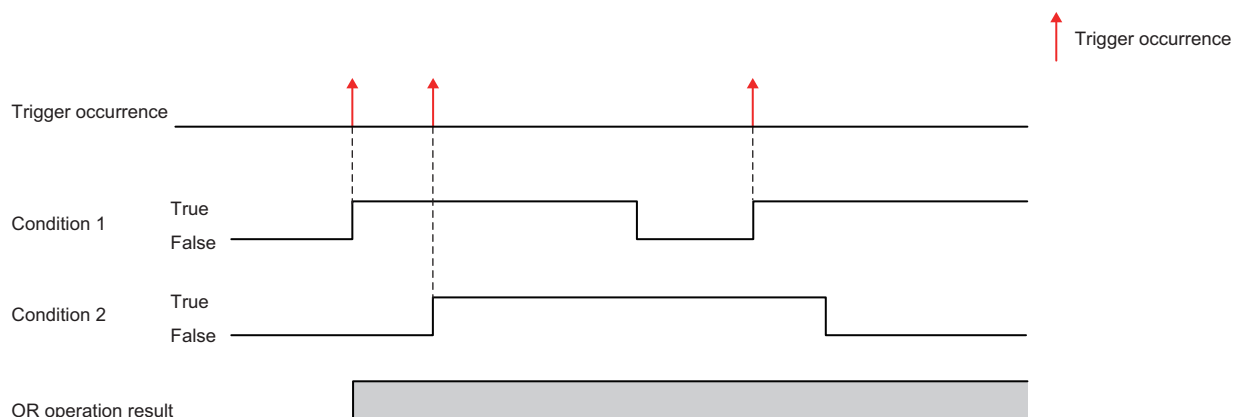
Trigger type (TRGCOMPTYPE)

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 Combination	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) (Condition is satisfied only at the changed timing) • Fixed cycle (Condition is satisfied only at the fixed cycle timing)
AND Combination	Up to 32	[The following conditions are regarded as an AND/OR condition is satisfied after a condition is satisfied once.] • System start • At trigger command execution • Event history

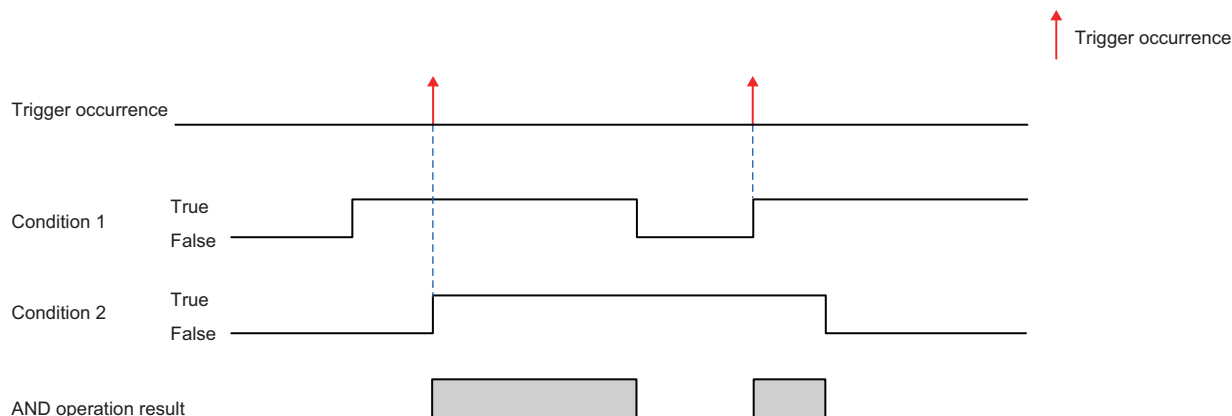
■OR Combination

When any of the set conditions is satisfied, the trigger occurs.



■AND Combination

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.

The file created in the storage location is overwritten when the file with the same file name already exists. It is recommended to specify a different storage location for each file when specifying the location in this setting and executing multiple logging settings simultaneously.

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 595 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. The file size will be smaller than CSV (Unicode) format. It can also be opened in GX LogViewer.

Point

- To display date and time in the 1st column by unit of 10 ns when opening CSV (Unicode) file by Excel®, import the file in text format, and specify the data format "character string" to the 1st column by text file wizard.
- A time and date data recorded in the data logging file is based on the system time (the time of control CPU module) at data collection. Therefore, the setup collection interval and display time may not match. Check the fixed periodicity (missing or not) of the data in INDEX column (reset to INDEX = 1 when missing occurs) instead of the display time.

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 Number of Saved Files (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, Number of Saved Files (System.LoggingRef[1..10].Md.LogDataSavedCount) becomes 0, after this the saved number of files is stored.



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 Saved Files (System.LoggingRef[1..10].Md.LogDataSavedCount).

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 582 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. (↑, ↓, at change)
Fixed cycle		A trigger occurs every specified cycle [ms].
System start		A trigger occurs at system start.
Trigger command		A trigger occurs when Trigger Request (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.

[Comparison]

- =: 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

[Value change]

- ↑: When the monitored data becomes FALSE to TRUE
- ↓: When the monitored data becomes TRUE to FALSE
- At change: When the current value of the monitored data changes

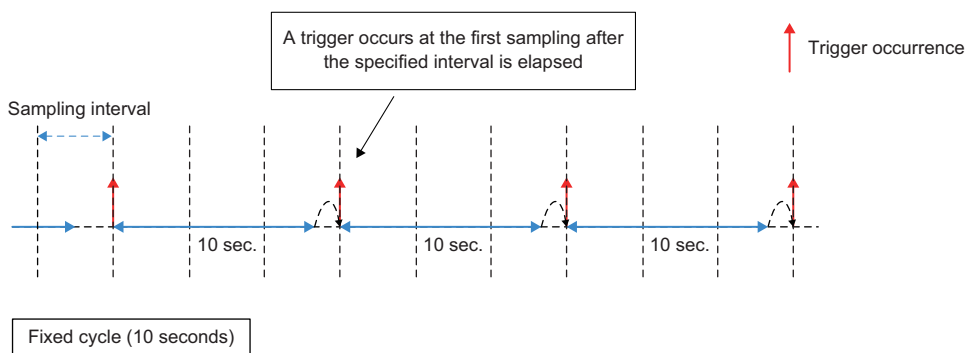
■Fixed Cycle

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 Trigger Request (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]

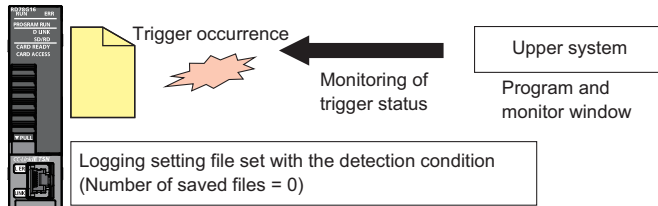
0x00000000-0xFFFFFFFF

Application function

Event detection

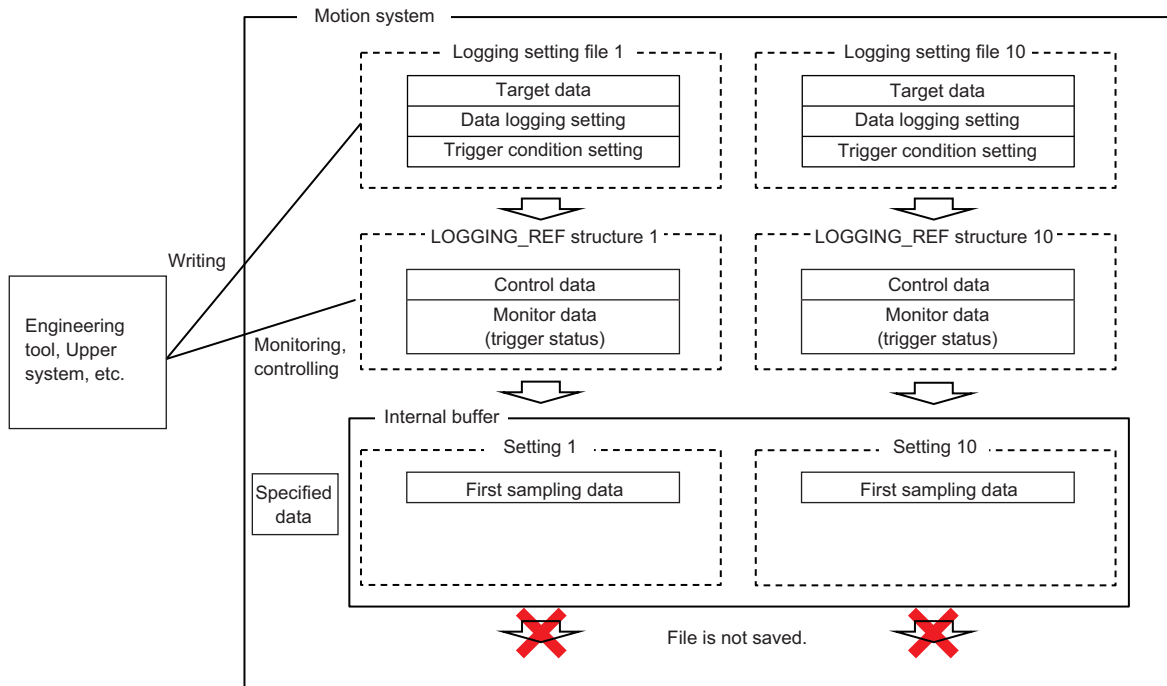
When File save setting is set to "Disabled" in the logging setting, only the trigger detection is executed without saving files. The following can be applied easily by using the trigger detection function of the logging function instead of description of the satisfied judgement processing of various 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.



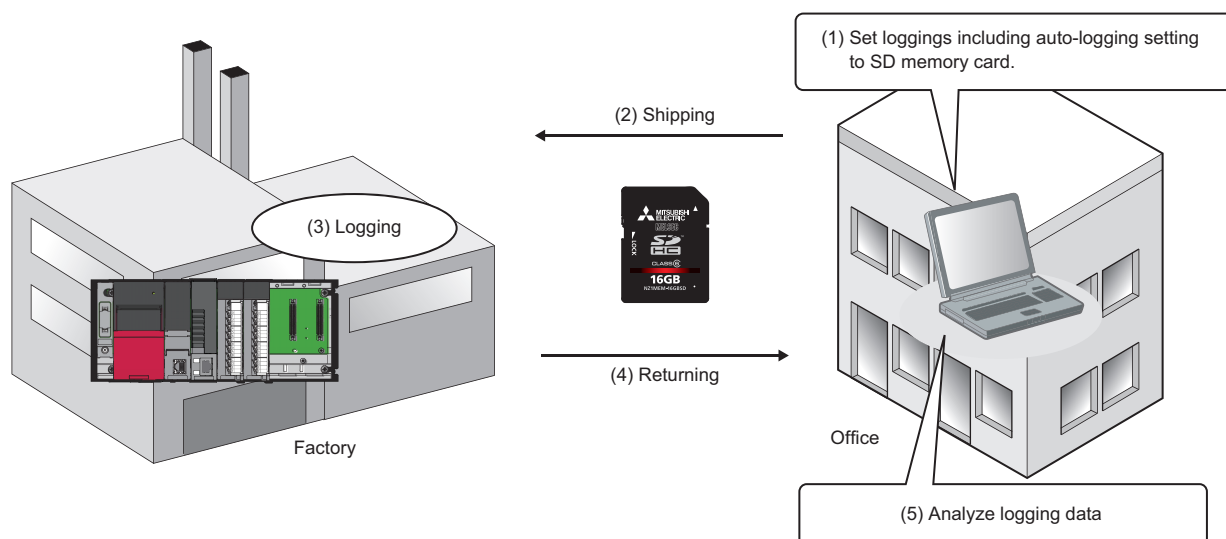
Procedures of event detection

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, Trigger Request (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 Logging Request (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 Auto Logging Enabled (System.PrConst.Logging_AutoLoggingEnable) to "1: Enabled" in advance and allow the auto logging function.
2. Write the following logging setting file. Set /sdcard/LOGGING□□.json or /sdcard/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. Logging Setting Path (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, Logging Request (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.)

Servo system recorder

The servo system recorder function automatically corrects the position command or actual position at an error occurrence, etc. of the drive unit connected to the servo system by using logging function.

The setting file of the servo system recorder function is automatically generated when using the function. For details, refer to the following.

☞ Page 616 Servo System Recorder

Precautions

The following describes precautions to take when using the logging function.

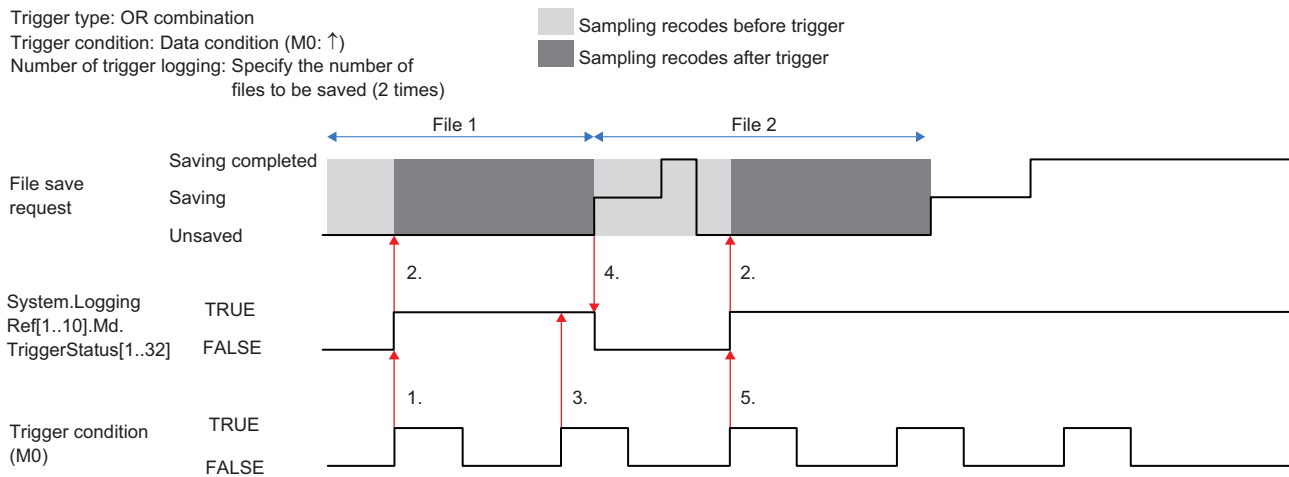
- When the AND condition is used, the condition at the motion system start is satisfied only once. Therefore, the trigger occurs at the first time only even if the trigger count is set to other than 1.
- The judgement of data condition is executed by the collected data in each set collecting interval.
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.
(** supports variables included in System.LoggingRef[1..10].Cd)
- 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. Trigger Status (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, Trigger Status (System.LoggingRef[1..10].Md.TriggerStatus[1..32]) becomes FALSE. (Preparation for the next logging operation)
5. Trigger Status (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. Trigger Status (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.

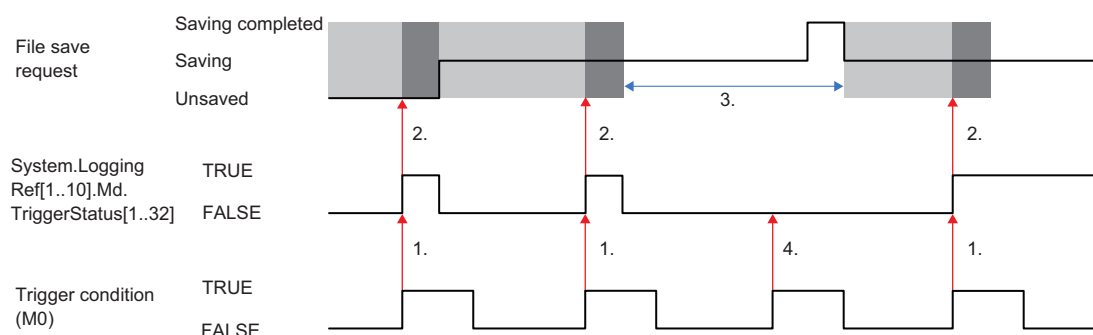
Trigger type: OR combination

Trigger condition: Data condition (M0: ↑)

Number of trigger logging: Specify the number of files to be saved (2 times)

Sampling recodes before trigger

Sampling recodes after trigger



- In logging, the folder which the environmental variable %TEMP% indicates is used as the operation folder. (/ram/temp by default) If the drive free space is insufficient due to many records, etc., consider changing the place of the operation folder. For details, refer to the following.

📖 Page 642 FILE CONTROL

- If the file is saved after the data collection, a logging error (error code: 4008H) occurs and stops the logging. By taking following the corrective actions, the error may be avoided or the frequency may be reduced.

- Specify the file storage location of the data logging file to the SD memory card.
- Set file format to JSON.
- Reduce the number of files in the file storage location of the data logging file.
- Set a longer data collection interval.
- Increase the number of buffer. Also, increase the assignment of the system memory (RAM) of the Add-on Logging if necessary.
- Increase the operation time of the motion service processing by executing such as setting longer operation cycle and decreasing the loading of the program execution. (The file saving is processed by the motion service processing.)

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 744 List of Logging Error Codes

Relevant add-ons

The following add-on is required to use this function.

- Logging
- SignalIO
- MotionEventHist*1

*1 For using "Event history" as the trigger conditions

System memory capacity

■RAM Usage

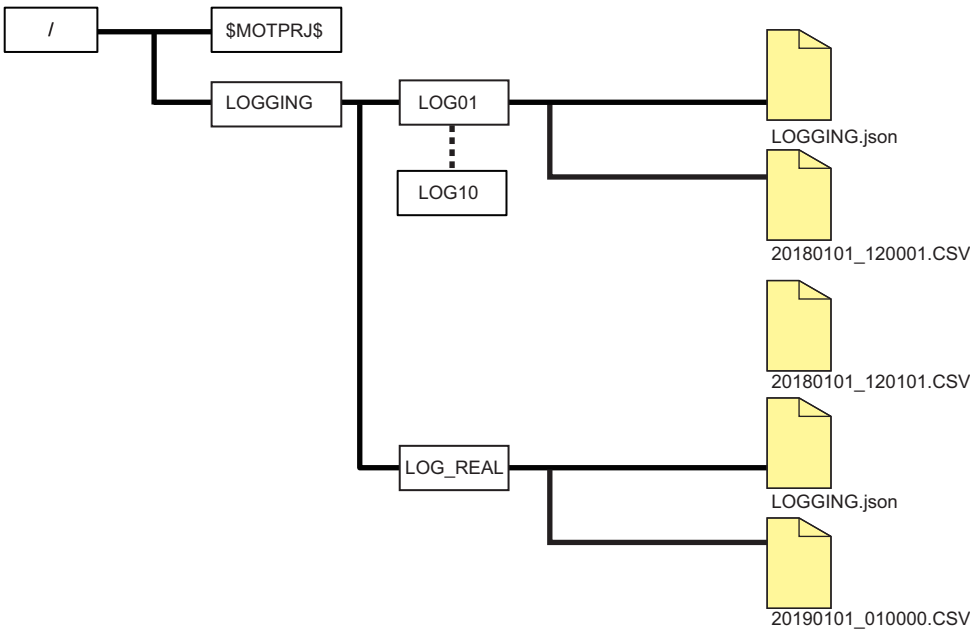
Refer to the following.
Page 582 Internal buffer

■Backup RAM Usage

Backup RAM is not used.

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 582 Logging setting, 📖 Page 597 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.sssssss]" ^{*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}
Double word [unsigned]	ULONG	Outputs in the format of "ULONG[DEC.0]". ^{*2}
Word [signed]	SHORT	Outputs in the format of "SHORT[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. <u>Device label</u> (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:sssssss" 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 Being treated as the setting file for the servo system recorder when it is ServoSystemRecorder or ServoSystemRecorder_*** (Arbitrary character string) For details, refer to the following.  Page 615 Precautions
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_UTF-16LE: CSV(Unicode)* ² CSV_UTF-16LE_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
Number of buffer	NUMBUFF	number	0: Automatic setting 2 to 10: Specified number of buffer

*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 8640000000000 [ns] Set an unit of ms (floating point) on display
Event code ^{*1}	EVENTCODE	string	Event code (0XXXXXXXX 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) UWORD: Word [unsigned]/Bit column (16 bits) UDWORD: Double word [unsigned]/Bit column (32 bits) SWORD: Word [signed] SDWORD: Double word [signed] FLOAT: Single-precision real number DFLOAT: Double-precision real number SQWORD: Long word [signed] ^{*1} UQWORD: Long word [unsigned] ^{*1}
Input method	INPUTMETHOD ^{*1}	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 ^{*1}	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
Motion unit	MOTIONUNIT ^{*1}	string	Specifies the unit information of the motion control data. Outputs the unit information to the logging data file based on this setting value. (Valid only when the label and the instance of the axis, etc. are specified. Other than this, it is ignored.) POSITION: Position VELOCITY: Velocity ACCELERATION: Acceleration JERK: Jerk TORQUE: Torque

^{*1} It is a unique setting item for the Motion module (Logger Module does not have this setting).

15.3 Logging Data (JSON format)

This section shows the JSON file of the logging result which is compatible with GX LogViewer.

Basic specifications

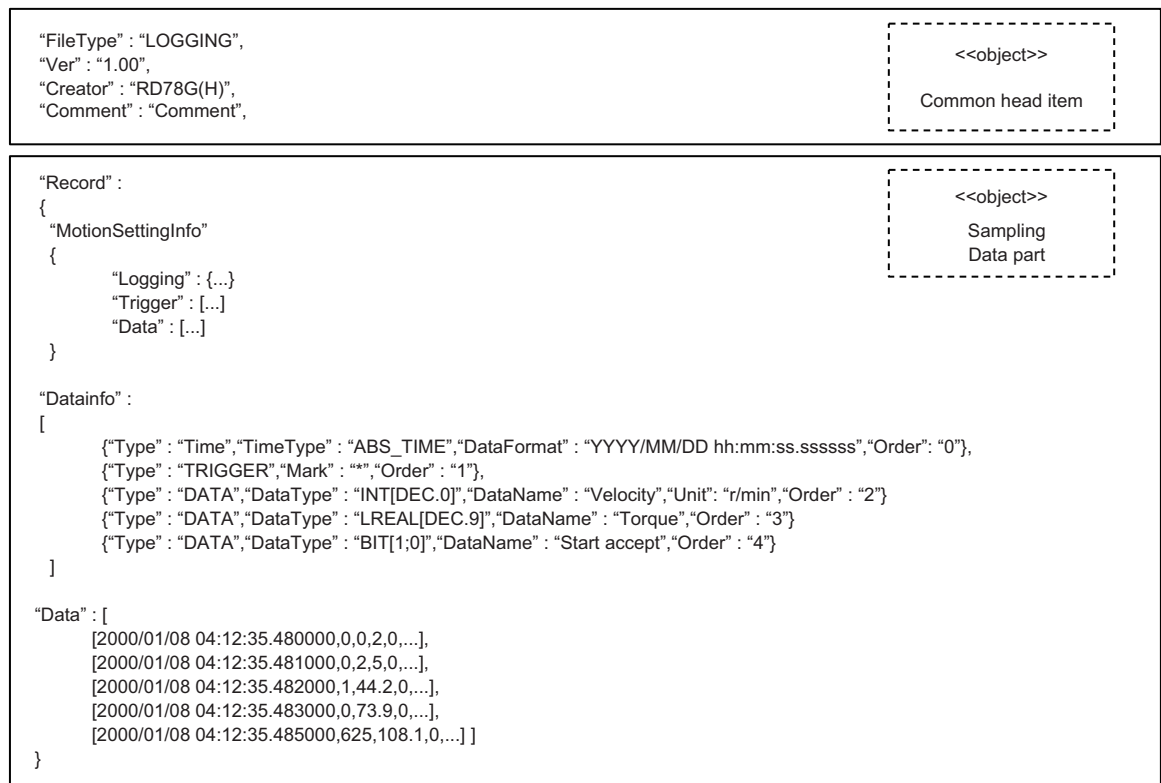
The following JSON files are supported.

- Unicode (UTF-8 with BOM.)
- With or without line break

Whole configuration

The logging setting file configuration is shown below. (The following figure is an image.)

[No group]



The number of data and limitation

GX LogViewer has a limitation to the number of data points and records it can read.

[No group]

- Only 1 Waveform data (Record)

Item	The maximum number
Number of data points (Data column information (DataInfo) type is DATA)	1024 points (BIT and WORD mixed)
Number of data	1000000 records

However, GX LogViewer cannot read 1024 data points × 1000000 records because much capacity is required. If more than 300M bytes file is read, the error occurs.

Data specification

Common items

Item name	Omission	Key name	Data type	Description
File type	Not possible	FileType	Character string	LOGGING fixed (To make the tool determine the logging data)
File version	Not possible	Ver	Character string	Major version, minor version ^{*1} 1.00 ^{*2} 3
File author ^{*1}	Not possible	Creator	Character string	For the Motion module (RD78): RD78G(H) , (a comma) is not allowed.
File comment	Possible	Comment	Character string	Arbitrary character string
Record	Not possible	Record	 Page 601 Waveform data (Record)	Waveform data
Status bar color	Possible	StatusBarColor	Color object	0x 112233 11 : Red, 22 : Green, 33 : Blue Hexadecimal color codes expressed as above

*1 Read is not allowed when the major version of GX LogViewer is other than 1. When its minor version is inconsistent, it reads within the supported range.

*2 This version remains the same even if the device dependent information is changed.

*3 GX LogViewer can read triple-digit minor version.

Waveform data (Record)

Item name	Omission	Key name	Data type	Description
Waveform data name	Not possible	Name	Character string	Arbitrary character string
Waveform data comment	Possible	Comment	Character string	Arbitrary character string (Comment as 1 record)
Device dependent information	Possible	Arbitrary key	 Page 603 Device dependent information	Refer to the specification document of each device.
Data column information	Not possible	DataInfo	 Page 602 Data column information (DataInfo)	Array of data column information
Data	Not possible	Data	 Page 603 Data (Data)	Array of waveform data
Device information	Possible	UnitName	Character string	Outputs when the actual logged device is different with the one outputted on Creator. (If this item does not exists, the device is regarded as the one which is actually logged by Creator.)

Data column information (DataInfo)

Item name	Omission	Key name	Data type	Description
Common				
Type	Not possible	Type	Character string	TIME: Time information TRIGGER: Triggered flag information DATA: Sampling data INDEX: Index information
Order	Arbitrary	Order	Value (starts from 1)	Corresponding column number in the Data part
When the type is time information				
Time information type	Not possible	TimeType	Character string	ABS_TIME: Absolute value
TimeType is ABS_TIME				
Time format	Not possible	DateFormat	Character string	Only when TimeType is absolute value (Ex.) YYYY/MM/DD hh:mm:ss.s
When the type is triggered flag information				
Trigger signal	Not possible	Mark	Character	(Ex.) "*"
When the type is index information (Used for determination of missing data)				
—	—	—	—	—
When the type is sampling data				
Data name	Not possible	DataName	Character string	—
Comment	Possible	DataComment	Character string	—
Data type	Not possible	DataType	Character string	(Corresponding with the type of EdgeCross) BOOL[1;0] <Integer type in decimal format> INT[DEC.0] UINT[DEC.0] DINT[DEC.0] UDINT[DEC.0] LINT[DEC.0] ^{*1} <Integer type in hexadecimal format> UINT[HEX] UDINT[HEX] ULINT[HEX] ^{*1} REAL[DEC.(number of digits after the decimal point)] LREAL[DEC.(number of digits after the decimal point)] REAL[EXP.(number of digits after the decimal point)] LREAL[EXP.(number of digits after the decimal point)] STRING[(data length)] ^{*1} WSTRING[(data length)] ^{*1}
Unit	Possible	Unit	Character string	Depends on items
Display color	Possible	LineColor	Value	RGB value

*1 This data format cannot be read by GX LogViewer.

Data (Data)

Array of value column according to Data column information (DataInfo)

■The type of Data column information (DataInfo) is "DATA"

The range for each data type is as follows.

Data type	Display of data type information row	Value range
BOOL type	BOOL[1;0]	1(ON), 0(OFF)
Integer type in decimal format	INT[DEC.0]	-32768 to 32767
	UINT[DEC.0]	0 to 65535
	DINT[DEC.0]	-2147483648 to 2147483647
	UDINT[DEC.0]	0 to 4294967295
	LINT[DEC.0]	-9,223,372,036,847,775,808 to 9,223,372,036,854,775,807
Integer type in hexadecimal format	UINT[HEX]	0 to FFFF
	UDINT[HEX]	0 to FFFFFFFF
	ULINT[HEX]	0 to FFFFFFFFFFFFFFFF
Real number	REAL[DEC.(number of digits after the decimal point)]	-3.40282346E+38 to -1.40129846E-45, 0, 1.40129846E-45 to 3.40282346E+38 "NaN" (outputs in string type), "Inf" (outputs in string type), "-Inf" (outputs in string type)
	REAL[EXP.(number of digits after the decimal point)]	
	LREAL[DEC.(number of digits after the decimal point)]	-1.7976931348923158E+308 to -4.9406564584124654E-324, 0, 4.9406564584124654E-324 to 1.7976931348923158E+308 "NaN" (outputs in string type), "Inf" (outputs in string type), "-Inf" (outputs in string type)
	LREAL[EXP.(number of digits after the decimal point)]	
Character string	STRING	—
	WSTRING	—

■The type of Data column information (DataInfo) is "INDEX"

The numerical values counted up from 1 in ascending order are output.

When the count exceeds 4294967295 which is the upper limit, it returns to 0 and starts a new count within the range from 0 to 4294967295.

If missing occurs in correcting data, index will be reassigned from 1 again.

When this value is continuing in 2 files, the graphs are drawn without missing at the joint when performing "Show Next/ Previous Graph" (combining graphs).

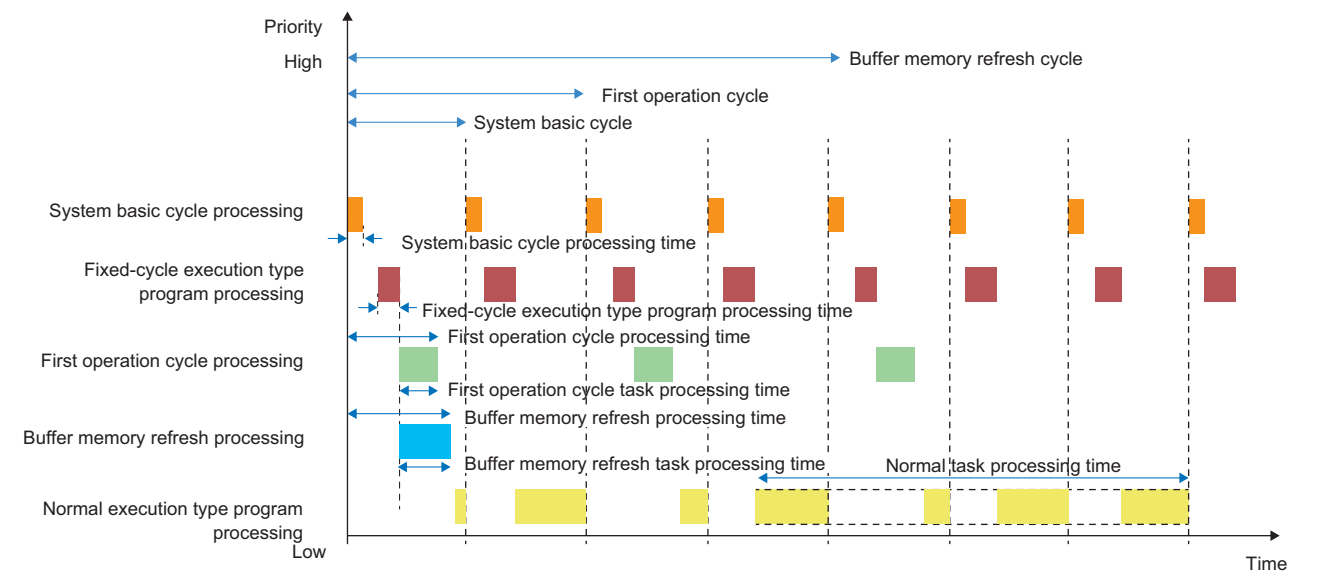
Device dependent information

For the motion system, the key name is MotionSettingInfo.

16 RAS FUNCTIONS

16.1 Execution Time Monitor

This function is used to monitor the operation cycle processing and the normal task execution time.



Operation of this function for each system status

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Variable/Structure name	Name	Details
System.PrConst.		
OperationCycle[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]	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 Setting (Cycle): 0 is always stored because the cycle setting is not existed. Cycle Over (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 112 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: Minor Error (MinorError) 3: Moderate Error (ModerateError)
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 on system basic cycle, refer to the following.

📖 Page 112 Operation Cycle

■System basic cycle setting

Stores the system basic cycle setting in Cycle Setting (System.Md.SystemBaseCycle.Cycle) with a unit of nanosecond [ns].

■System basic cycle processing time

Stores the system basic cycle processing time in Processing Time (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 Maximum Processing Time (System.Md.SystemBaseCycle.MaximumProcessingTime) with a unit of nanosecond [ns].

■System basic cycle over

For details, refer to the following.

📖 Page 608 System basic cycle over check

Normal task

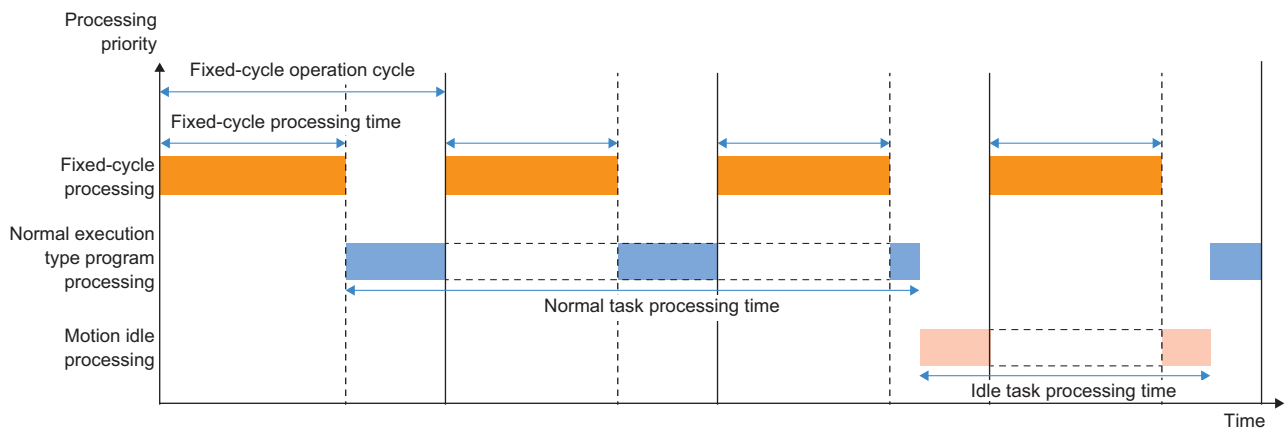
■Normal task processing time

Stores the normal task processing time in Processing Time (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 on the processing, refer to "Execution of programs" in the following manual.

📖 MELSEC iQ-R Programming Manual (Motion Control Function Blocks)



■Maximum processing time of normal task

Stores the maximum value of the normal task processing time in Maximum Processing Time (System.Md.Program_NormalTaskCycle.MaximumProcessingTime) with a unit of nanosecond [ns].

First operation cycle

For details, refer to the following.

📖 Page 112 Operation Cycle

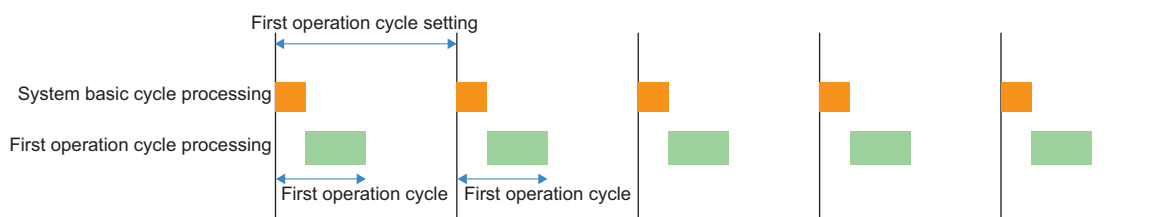
■First operation cycle setting

Stores the first operation cycle setting in Setting Cycle (System.Md.OperationCycle[1].Cycle) with a unit of nanosecond [ns].

■First operation cycle processing time

Stores the first operation cycle processing time in Processing Time (System.Md.OperationCycle[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 Maximum Processing Time (System.Md.OperationCycle[1].MaximumProcessingTime).

■First operation cycle over

For details, refer to the following.

📖 Page 608 Operation cycle over check

16

Buffer memory refresh

For details, refer to the following.

📖 Page 112 Operation Cycle

■Buffer memory refresh cycle setting

Stores the buffer memory refresh cycle setting in Setting Cycle (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 Processing Time (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 Maximum Processing Time (System.Md.BufferMemoryRefreshCycle.MaximumProcessingTime) with a unit of nanosecond [ns].

■Buffer memory refresh cycle over

For details, refer to the following.

📖 Page 609 Buffer memory refresh cycle over check

Processing time over check

System basic cycle over check

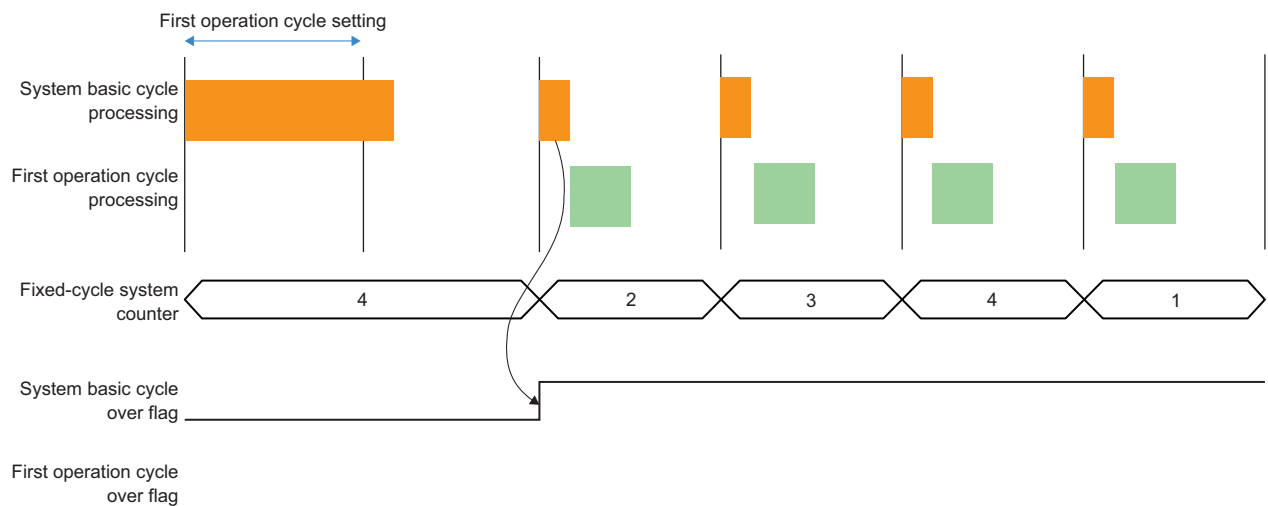
When the system basic cycle processing is not completed before the start of the next system basic cycle processing, the system basic cycle over flag becomes TRUE.

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

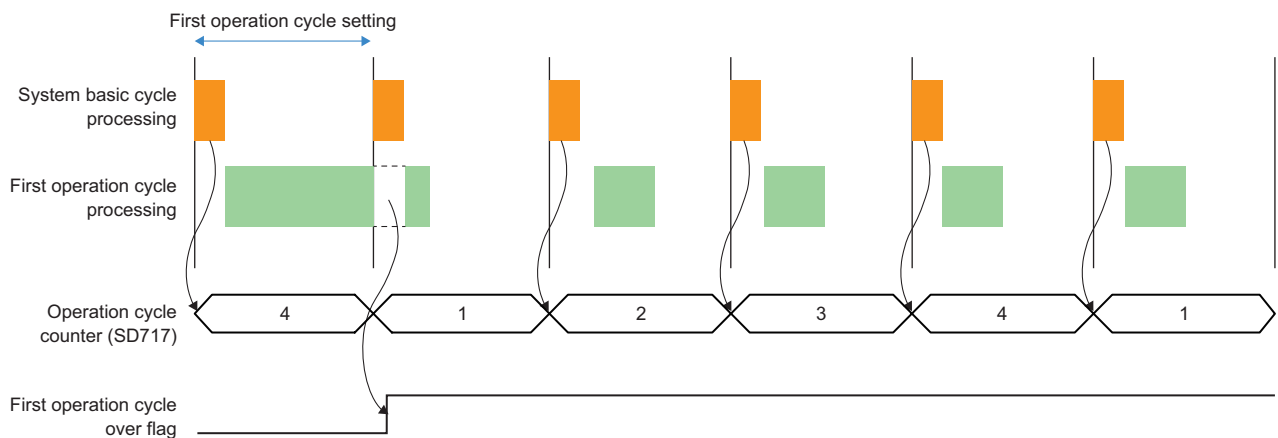


Operation cycle over check

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

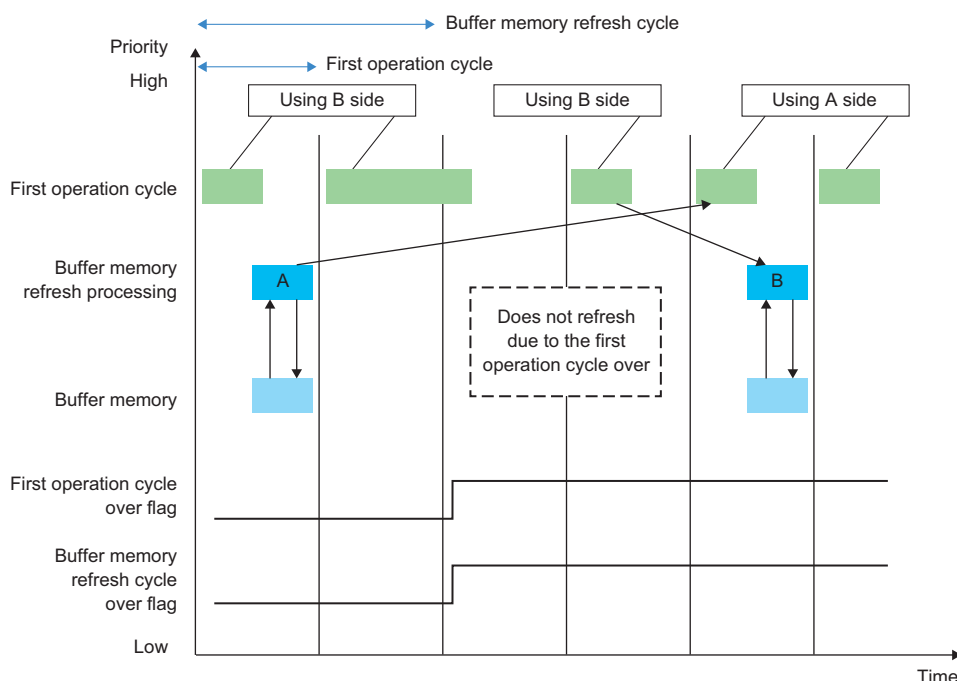
When the buffer memory refresh cycle is not completed before the start of the next cycle, the buffer memory refresh cycle over flag becomes TRUE.

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



16

Output of errors

WDT error detection

When the processing is stopped because the operation cycle or other processing is error, a WDT error occurs 1 [s] later.

When the WDT error is detected, the motion system stops following the process selected by Stop Selection at All Axes Stop Cause Occurrence (System.Pr.StopMode_All), 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 motion system stops following the process selected by Stop Selection at All Axes Stop Cause Occurrence (System.Pr.StopMode_All).

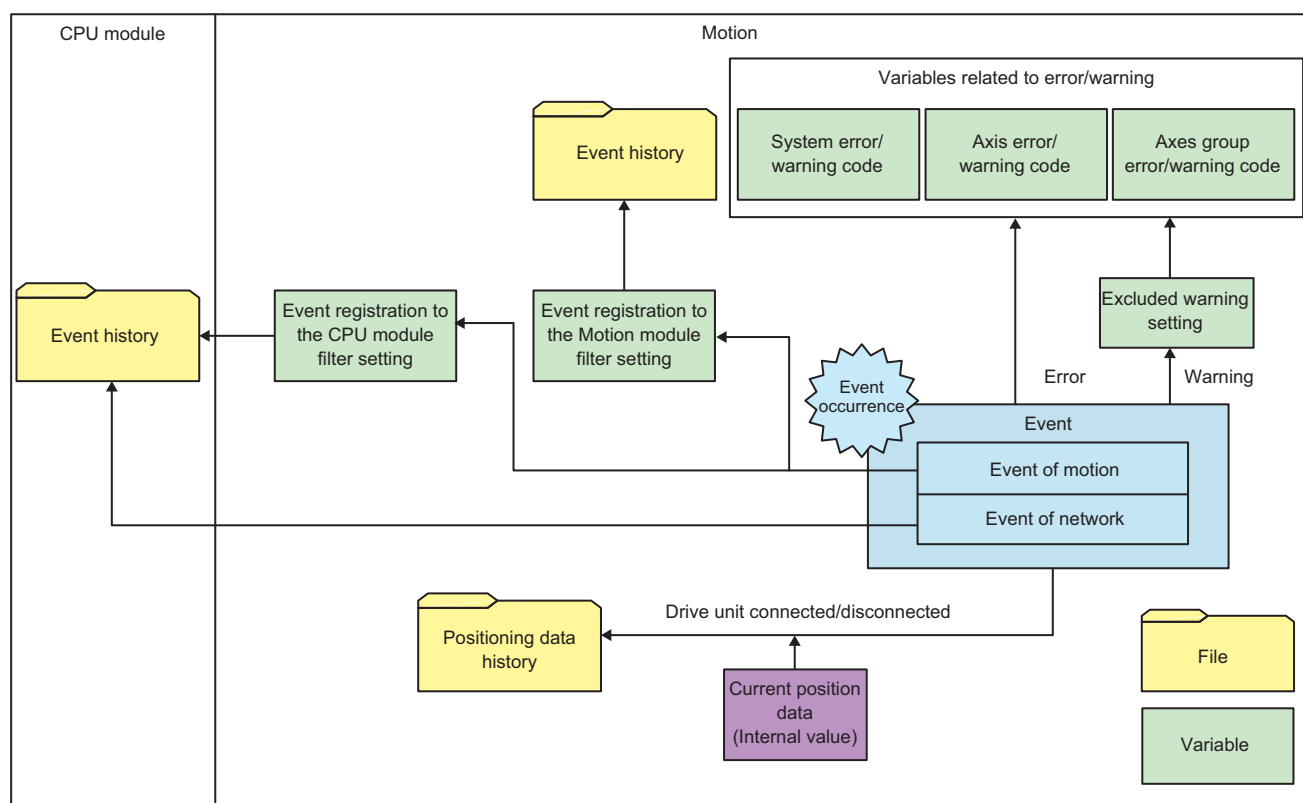
CAUTION

- 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.
- Depending on the system status, the axis cannot decelerate to stop at WDT error detection and may stop immediately.

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 system. In each event, the records of the CPU module and motion system can be set. The store destination of event records can be set according to event frequency or priority.

Figure related to history data



Operation of this function for each system status

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant variables

Event history filter setting

Variable/Structure name	Name	Details
System.PrConst.		
EventHistoryMotion_Exclude	Event Excluding Motion Event History	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: Waiting for Execution Request (Ready) 1: Executing (Executing) 2: Execution Completed (Done) -1: Error Occurrence (Error_)

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 on the event, refer to the following.

 Page 745 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 745 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 746 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 746 Operation	20000H to 27FFFH

■ Motion control FB execution and stop event

- The Motion control FB 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 Motion Event History Path (System.PrConst.EventHistoryMotion_Path). The file capacity is specified in Motion Event History Capacity (System.PrConst.EventHistoryMotion_Capacity) in k bytes.
When Motion Event History Path (System.PrConst.EventHistoryMotion_Path) is blank, the event history is saved to the latch drive.
- When the storage destination is the latch drive, the setting of the system memory (backup RAM) size and Motion Event History Capacity (System.PrConst.EventHistoryMotion_Capacity) whichever is smaller amount is the event history file size. To change the file capacity, confirm and change the system memory (backup RAM) size as well. To increase the file capacity, it is recommended to specify the storage destination to an SD memory card. For details on the system memory (backup RAM) size, refer to the following.
 Page 122 System Memory Settings
- If Motion Event History Path (System.PrConst.EventHistoryMotion_Path) and Motion Event History Capacity (System.PrConst.EventHistoryMotion_Capacity) are changed, the event registered before the change cannot refer.
- When saving the event history file fails, the error "Event History File Incorrect" (error code: 1C85H) occurs and the event history file update stops.
- When events frequently occur, 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.
- Event history file is updated periodically. When the power of the motion system is turned OFF or the system is reset before saving the event information to the event history file, the unsaved event information is erased.

■Display of the event history

The event history of the Motion module side can be displayed on the motion control 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 motion control 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 Motion Event History Clear Execution Request (System.Cd.EventHistoryMotion_Clear) to TRUE.
- Motion Event History Clear Execution Status (System.Md.EventHistoryMotion_ClearStatus) turns "1: Executing (Executing)" during the event history clear execution.
- Motion Event History Clear Execution Status (System.Md.EventHistoryMotion_ClearStatus) turns "2: Execution Completed (Done)" as the event history clear is completed. When executing the event history clear again, set Motion Event History Clear Execution Request (System.Cd.EventHistoryMotion_Clear) to FALSE and execute the clearing after confirming that Motion Event History Clear Execution Request (System.Cd.EventHistoryMotion_Clear) turns "0: Waiting for Execution Request (Ready)".
- When the event history clear is failed, Motion Event History Clear Execution Status (System.Md.EventHistoryMotion_ClearStatus) turns "-1: Error Occurrence (Error_)". When turning to "-1: Error Occurrence (Error_)", Motion Event History Clear Execution Request (System.Cd.EventHistoryMotion_Clear) set to FALSE temporarily and after a while, carry out the event history clear again after confirming that Motion Event History Clear Execution Status (System.Md.EventHistoryMotion_ClearStatus) turns "0: Waiting for Execution Request (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 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 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 system 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.

Event Excluding Motion Event History (System.PrConst.EventHistoryMotion_Exclude) and Event Excluding CPU Event History (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.

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

- 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 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 event which occurs frequently may short the memory life of the event history saving destination. It is recommended that unnecessary events are filtered.
- When the axis setting is not existed at the power ON, the positioning data history data of nonexistent axis is deleted.
- To clear the positioning data history, delete the positioning data history file by file transfer function and turn the power OFF to 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.

Relevant add-ons

The following add-on is required to use this function.

- MotionEventHist

System memory capacity

■Backup RAM Usage

Refer to the following.

 Page 612 Event history file of the Motion module side

16.3 Servo System Recorder

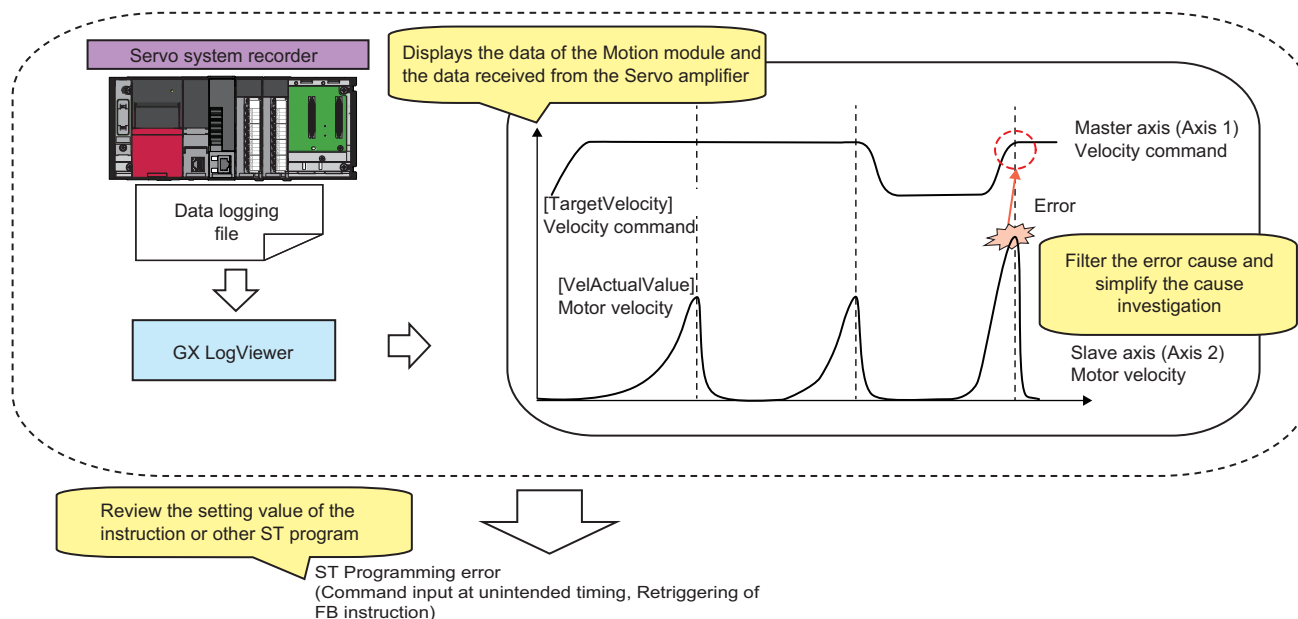
The servo system recorder generates a logging setting file which is optimal for analyzing of the error factors when Add-on ServoSystemRecorder Monitor is enabled. The logging setting file continuously monitors the error status of the motion system and supported slave devices. When an error is detected, the status before and after occurrence is recorded for a certain period of time and saved in the data logging file.

Logging setting file editing and data logging file analysis are possible from the engineering tool.

The collecting target is the real drive axis only. The collected data helps to investigate causes of factor which cannot be solved easily just by information of "Event history".

Ex.

When an error occurs to slave devices which are connected to the slave axis in cam control.



Operation of this function for each system state

○: Possible, △: Possible (Restricted), ×: Not possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	△ (Not possible if ready [X0] does not become TRUE)
Major error	×

Relevant variables

Variable/Structure name	Name	Details
System.PrConst.		
Addon_ServoSystemRecorder	Add-on ServoSystemRecorder Parameter	ADDON_PARAM structure
Logging_AutoLoggingEnable	Auto Logging Enabled	Sets "Disabled" and "Enabled" of the auto logging function when logging setting files are stored in the SD memory card. 0: Disabled 1: Enabled For details on the auto logging, refer to the following.  Page 591 Auto logging
System.Md.		
Addon_ServoSystemRecorder	Add-on ServoSystemRecorder Monitor	ADDON_MONI structure
ServoSystemRecorder_Enable	Servo System Recorder Enabled	Becomes TRUE when the logging collection is operating normally by the servo system recorder.
ADDON_PARAM		
RamSizeMax	Maximum RAM Size	Specifies the maximum amount of system memory (RAM) used in the Add-on ServoSystemRecorder in k bytes. When the operation cycle over is detected during the logging, increase the maximum RAM size of the add-on logging parameter.
BackupRamSizeMax	Maximum Backup RAM Size	Specifies the maximum amount of system memory (backup RAM) used in the Add-on ServoSystemRecorder in k bytes. When backup memory lacks its capacity during the logging, increase the maximum backup RAM size of the add-on logging parameter.
ADDON_MONI		
RamUsage	RAM Usage	Stores current amount of system memory (RAM) used in the Add-on ServoSystemRecorder in k bytes.
RamMaxUsage	RAM Usage Maximum	Stores the maximum amount of system memory (RAM) used in the Add-on ServoSystemRecorder in k bytes.
BackupRamUsage	Backup RAM Usage	Stores the current amount of system memory (backup RAM) used in the Add-on ServoSystemRecorder in k bytes.
BackupRamMaxUsage	Backup RAM Usage Maximum	Stores the maximum amount of system memory (backup RAM) used in the Add-on ServoSystemRecorder in k bytes.
Version	Version	Stores the version information of the Add-on ServoSystemRecorder.

Control details

Logging setting file auto generation

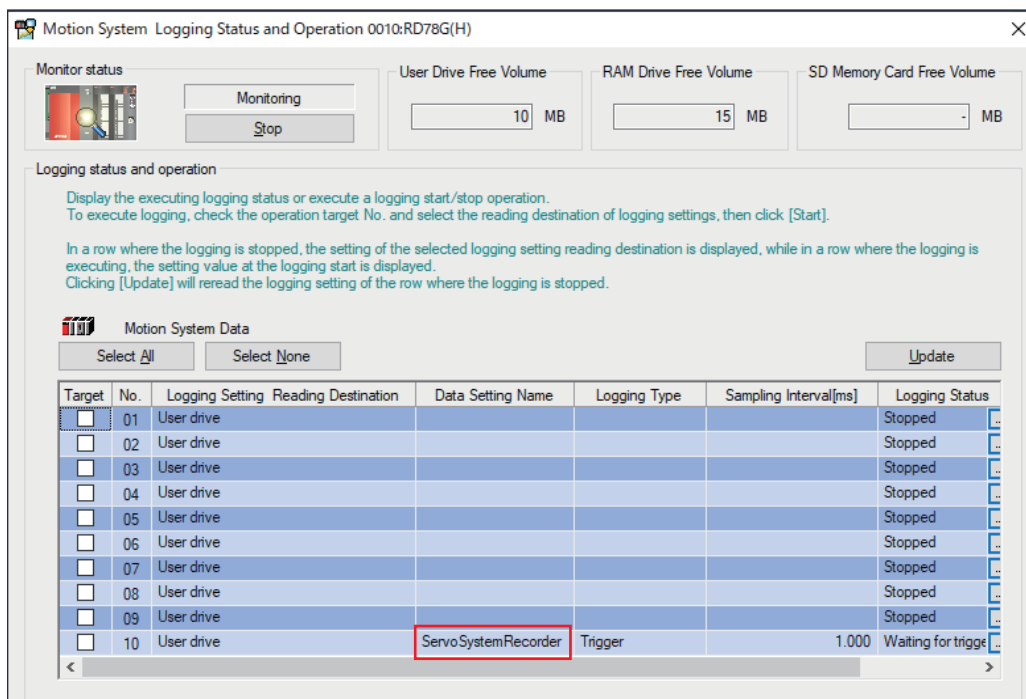
This add-on reads the axis setting in the project at the start of the motion system and automatically generates a logging setting file with collected data reflected with a number of axis setting required for error analysis.

The logging setting file is automatically generated every time the motion system is started so the data will be reflected at the start of the motion system even if the axis setting in the project is changed.

The data logging name which will be added in the file of the generated logging setting file will be "ServoSystemRecorder".

When the name starts with "ServoSystemRecorder", the data in the logging setting file is overwritten every time the motion system is started. When the name starts other than "ServoSystemRecorder", the data in the logging setting file is not be overwritten and the warning "Servo System Recorder Setting File Creation Disabled Warning" (warning code: 0F13H) occurs and the servo system recorder will not start.

The auto-generation can be confirmed if "ServoSystemRecorder" is shown on the "Motion System Logging Status and Operation" window as follow.



Also, the auto-generation completion can be confirmed if "007EE: Servo System Recorder Start" is shown in the event history.

Event History- [0010:RD78G64]

Refresh(U)

Number of Events:1242

Refine(D)

Events to Exclude

Refine

Match All the Conditions

Match Any One of the Conditions

1. Event Type

Including Next

2.

3.

☐ Include program errors (Allow jumping)

Start Refine

Clear Refine Conditions

No.	Occurrence Date	Event Type	Status	Event Code	Overview
00001	2020/06/24 09:08:08.723795768	System		007F0	MCFB Start (Control System)
00002	2020/06/24 09:08:08.568889312	System		007EE	Servo System Recorder Start
00003	2020/06/24 09:08:08.445867584	System		007FE	Homing Request OFF to ON
00004	2020/06/24 09:08:08.445862936	System		007FE	Homing Request OFF to ON
00005	2020/06/24 09:08:08.445858112	System		007FE	Homing Request OFF to ON
00006	2020/06/24 09:08:08.445853296	System		007FE	Homing Request OFF to ON
00007	2020/06/24 09:08:08.445848488	System		007FE	Homing Request OFF to ON

Precautions

- If the real drive axis does not exist in the project, the logging setting file is not generated.
- When starting the motion system without an SD memory card being inserted, the logging setting file is generated in the user drive. When the motion system is restarted with an SD memory card being inserted, both the user drive and the SD memory card will be in the state that the logging setting file is being generated. In this case, the logging is executed by prioritizing the logging setting saved in the SD memory card.

Restriction

If the add-on is disabled, the logging setting file with the data logging name which starts from "ServoSystemRecorder" does not execute the operation. If the file is not needed, delete it.
For how to delete files, refer to the following.

📖 Page 627 How to delete the logging setting file

Storage location

The logging setting file generated by this add-on is stored in an SD memory card or the user drive of the motion system. If the SD memory card is inserted, it is prioritized as a storage location of the logging setting file. (The storage location of the result file will be the same directory of the logging setting file.)

A logging function provides 10 logging setting file available for execution at the same time, and the following settings will be used in this add-on.

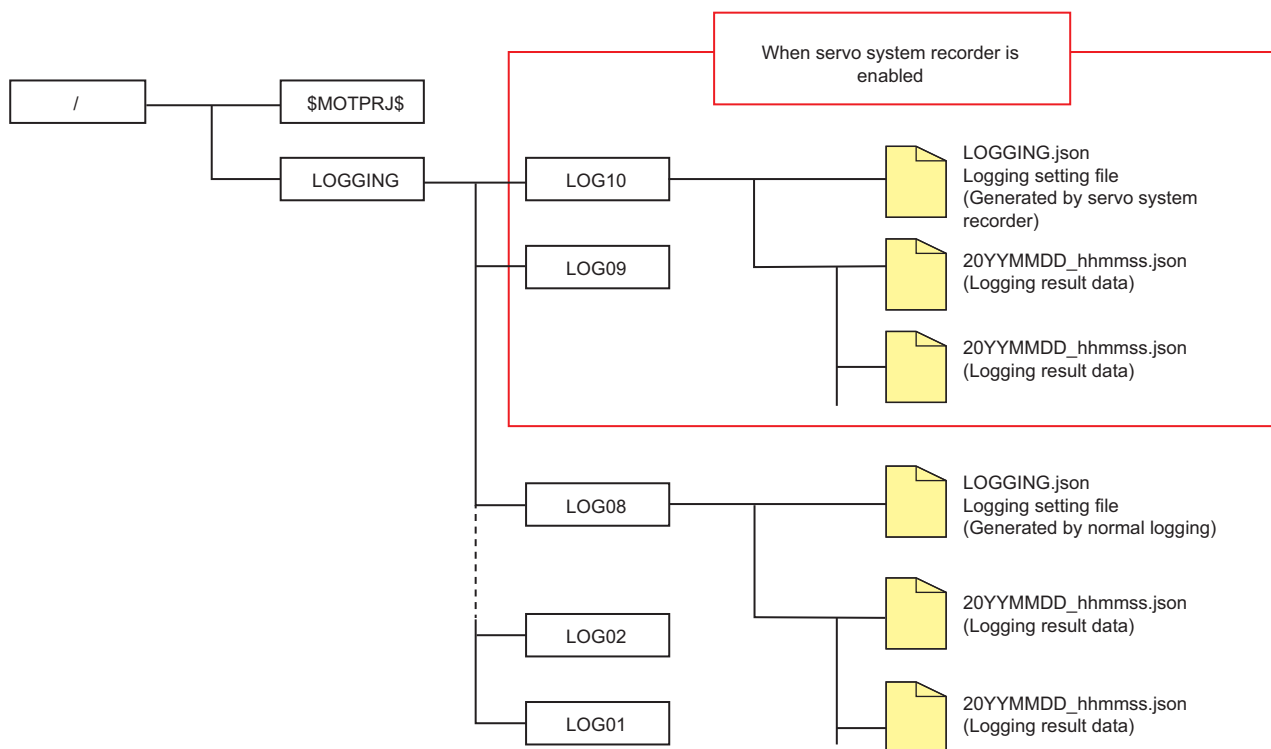
Number of real drive axis		Setting
When setting 1 to 128 axes		Logging setting 10 (LOG10)
When setting 129 to 256 axes	For 1 to 128 axes	Logging setting 10 (LOG10)
	For 129 to 256 axes	Logging setting 09 (LOG09)

16 RAS FUNCTIONS
16.3 Servo System Recorder

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■Folder configuration

The folder configuration is shown below.



Precautions

- When using this function, do not use the logging setting 10 and 09 by normal logging operation. The logging setting 09 can be used by normal logging operation depending on the number of set axis. In such a case, the motion system does not notify to the slave device.
- When the logging setting 10 and 09 are once created with this function, the logging setting 09 is not deleted even if the number of set axis is changed to 128 axes or less and the motion system is turned on again. Delete the specified logging setting by its tool.

Editing logging setting file

For the logging setting file generated by this add-on, changing the collected data, collection interval (rate), number of collection, and trigger detection position can be edited by the following procedure. In such a case, change the data logging name to "ServoSystemRecorder_****". By doing this, the logging setting file is not overwritten by this add-on even if the motion system power is turned on again.

1. Read the logging setting file (LOG10 or LOG09) in the motion system by logging setting tool.
2. Edit the logging setting file and change the data logging name to "ServoSystemRecorder_****".
("****" part in the data logging name can be arbitrarily set by the user)
3. Write from the logging setting tool to the motion system (LOG10 or LOG09).

By editing the logging setting file, adding the target data or deleting the unnecessary data is possible as necessary to the logging setting file generated automatically.

If the operation cycle over occurs, the processing time of the operation cycle can be shortened by reducing the number of target data.

When the edited logging setting file is no longer needed, delete it by logging setting tool. By doing so, the logging setting file is automatically generated by default when the motion system power is turned on.

Precautions

- If the logging setting file is edited, be sure to change the data logging name to "ServoSystemRecorder_****". If the change is not executed, the logging setting file is overwritten by default when the motion system power is turned on.
- If the data logging name starts other character string than "ServoSystemRecorder", the warning "Servo System Recorder Setting File Creation Disabled Warning" (warning code: 0F13H) occurs and the servo system recorder does not start.

Details of logging setting

The specifications of the logging setting generated by the Add-on ServoSystemRecorder are shown below.

- Logging setting file

Item	Specification / Description	
Logging setting file (Uses the last LOG10 and LOG09 from 1 to 10 areas.)	LOG10/LOGGING.json	1 to 128 axes Number of set axis in the motion system (real drive axis) Collected data of 1 to 128 axes
	LOG09/LOGGING.json	129 to 256 axes Number of set axis in the motion system (real drive axis) Collected data of 129 to 256 axes
Logging start condition	Stop disabled after automatically start	
Logging type	Trigger logging (The rows before and after the trigger are output)	
Data storage location	SD memory card (If an SD memory card is not inserted, the storage location of the data is in the user drive. The user drive is the ROM area of the motion system.)	

- Data logging file (result file)

Item	Specification	
Logging data file name	20YYMMDD_hhmmss.json (Date and time at the file being generated.)	
File size	Changes depending on the number of collected data (number of axis) and the data value.	
File format	JSON	
Collection interval	125.00 [μs] (When the operation cycle is 125.00 [μs] or more, the collection interval will be the operation cycle)	
Operation when the file exceeds the number of saved files	Overwrite	
Trigger type	OR combination	
Number of records	Number of real drive axis: 1 to 128	Number of LOG10 records Number of trigger records before trigger: 1434 [records] Number of trigger records after trigger: 614 [records]
	Number of real drive axis: 129 to 256	Number of LOG09 and LOG10 records Number of trigger records before trigger: 717 [records] Number of trigger records after trigger: 307 [records]
Number of saved files	Sets 16 when the storage location of the data is an SD memory card, and 2 for the user drive.	

■Collected data of the servo system recorder

The following data is set automatically. The setting details can be changed by logging setting tool.

○: Set in the collected data, —: Not set in the collected data

Item	Description	Setting number of the number of real drive axis	
		128 or less (LOG10 setting)	129 or more (LOG10 and LOG09 setting)
<u>AxisName.Md.</u>			
Object Data_TargetPos (Io_TargetPos)	Indicates a value of object data TargetPos (The position command to be sent to the slave device)	○	○
Object Data_PosActualValue (Io_PosActualValue)	Indicates a value of object data PosActualValue (The feedback of position to be received from the slave device)	○	○
Object Data_TorqueActualValue (Io_TorqueActualValue)	Indicates a value of object data TorqueActualValue (The feedback of torque to be received from the slave device)	○	○
Axis Error Code (ErrorID)	Displays the error code at axis error occurrence.	○	○
Axis Status (AxisStatus)	Displays the current status of the axis. When the axis starts, it transits to the axis status according to the command.	○	○
Object Data_VelActualValue (Io_VelActualValue)	Indicates a value of object data_VelActualValue. (The feedback of velocity to be received from the slave device) For the unit, refer to the manual of connected driver.	○	—*1
Object Data_TargetVelocity (Io_TargetVelocity)	Indicates a value of object data_TargetVelocity (The velocity command to be sent to the slave device) For the unit, refer to the manual of connected driver.	○	—*1

Item	Description
<u>System.Md.</u>	
Processing time (OperationCycle[1].ProcessingTime)*2	Stores the processing time of the first operation cycle in a unit of μs.
Cycle over (OperationCycle[1].CycleOver)*2	Becomes TRUE when the cycle over of the first operation cycle is detected.
Latest motion area system error code (ErrorID)	Stores the latest error code.
Network area error code (NetWorkErrorID)	Stores the error code when a network error occurs.

*1 To set Object Data_VelActualValue (Io_VelActualValue) and Object Data_TargetVelocity (Io_TargetVelocity) data even when there are 129 axes or more, add them by logging setting tool.

*2 CYCLE_MONI structure

Precautions

When the axis operation process fast operation mode is enabled, the sampled value is always 0 because the following monitors are not updated.

- Object Data_TargetPos (AxisName.Md.Io_TargetPos)
- Object Data_PosActualValue (AxisName.Md.Io_PosActualValue)
- Object Data_TargetVelocity (AxisName.Md.Io_TargetVelocity)
- Object Data_VelActualValue (AxisName.Md.Io_VelActualValue)
- Object Data_TorqueActualValue (AxisName.Md.Io_TorqueActualValue)

■Trigger condition(TRIGGERCONDITION)

No.	Specification
1	Event history (EVENTHISTORY) - An error occurrence that stops an axis is to be the trigger. For the target range of the events, refer to the following.  Page 623 Target error code to be triggered - An error occurrence in other than real drive axis is to be the trigger as well. - Saves the logging data file every time the event code which is different from the previous code is registered to the event history.
2	At trigger command execution (LOGTRG) The execution of Trigger Request (LOGGING_REF.Cd.Trigger) is to be the trigger.

■Target error code to be triggered

Error code	Name.	Remark
1A00H to 1BFFH	—	Minor error (Axis error)
1C41H	Watchdog Counter Error	Minor error (Network error)
1C43H	SLMP Communication Error	Minor error (Network error)
1C45H	SLMP Communication Error (Timeout)	Minor error (Network error)
1C80H	Cycle Over	Minor error (System error)
2000H to 32FFH	—	Moderate error
3C00H to 3FFFH	—	Major error

If an error which may stop the system occurs and the logging is being unable to continue, the logging data may not be collectable.

Restart from the logging interruption

If an error occurs in the logging while starting the servo system recorder using an SD memory card, the logging is interrupted. By inserting the SD memory card again, the logging can be restarted without turning the motion system power on again.

16

How to restart logging

1. After pressing down the SD memory card access control switch until CARD READY LED turns off, pull out the SD memory card.
2. CARD READY LED turns on as the SD memory card is inserted again.
3. Restart of the logging can be confirmed if the Servo System Recorder Enabled (System.Md.ServoSystemRecorder_Enable) of the system label is TRUE.

Logging restart conditions

- The servo system recorder is started with using an SD memory card.
- Auto Logging Enabled (System.PrConst.Logging_AutoLoggingEnable) is TRUE.
- The logging setting file of the servo system recorder is saved in LOG10 or LOG09 in an SD memory card.
- The write-protected in an SD memory card is cancelled.
- The error factors occurred in the logging are removed.

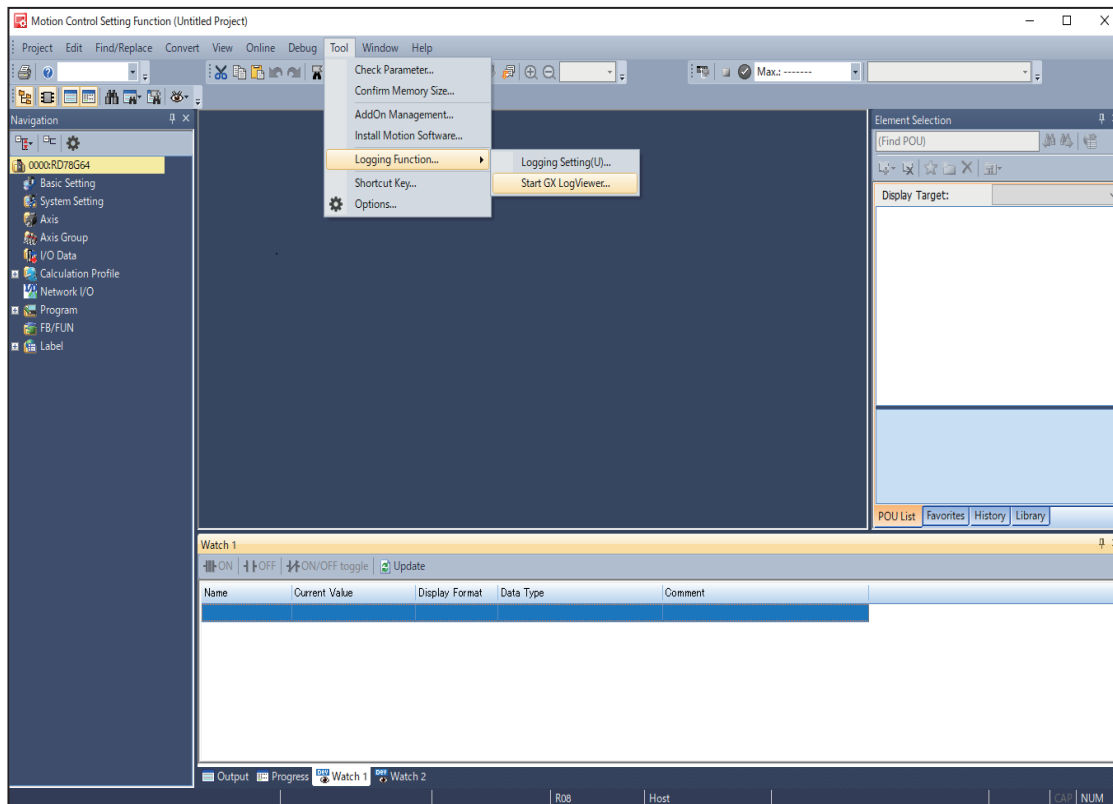
Precautions

- The logging cannot be restarted even if the Logging Request (System.LoggingRef[1..10].Cd.StartLog) of the system label is turned TRUE.
- The warning "Servo System Recorder Logging Execution Disabled Warning" (warning code: 0F14H) occurs when the logging in LOG10 or LOG09 is being executed at reinserting the SD memory card and the logging of the servo system recorder does not start.

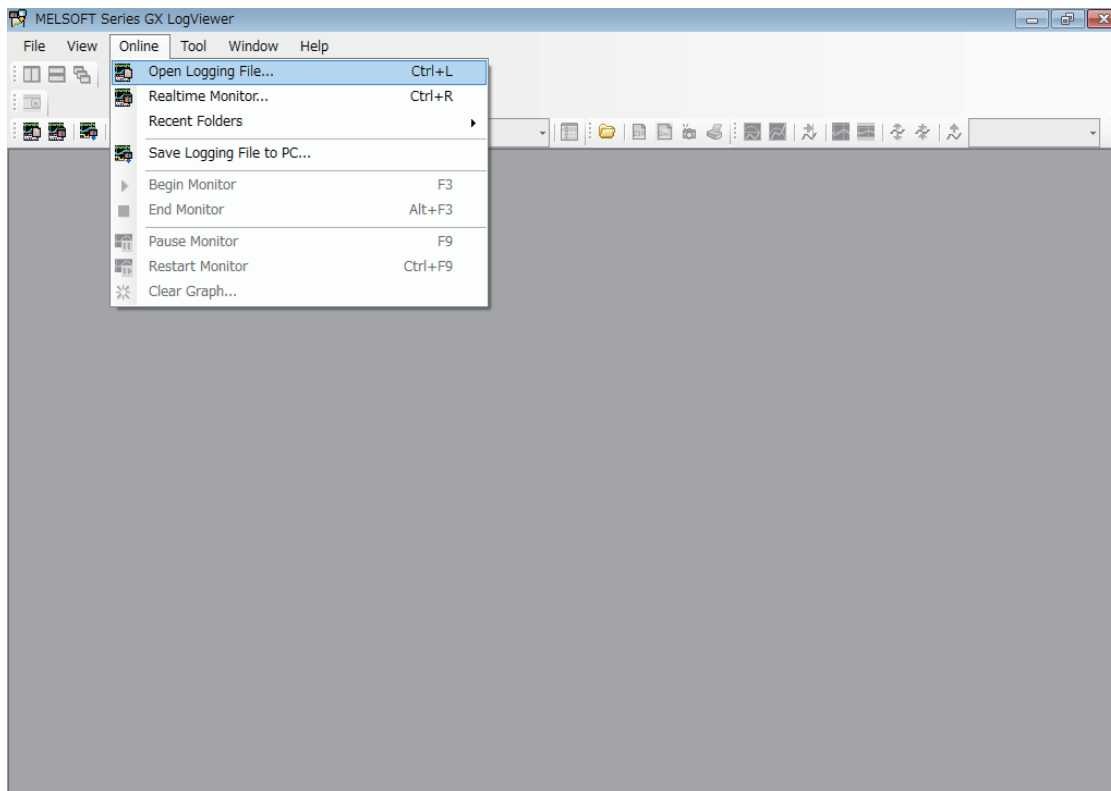
How to check the logging data

[To check the logging data in the motion system]

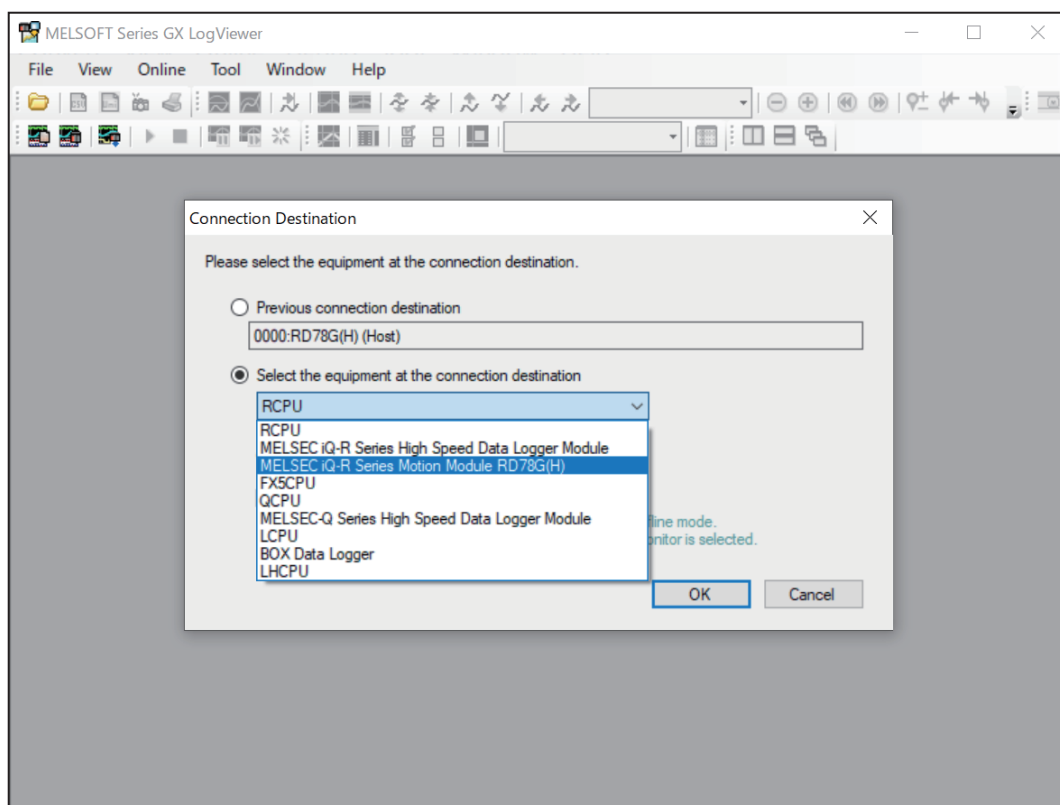
1. In "Motion Control Setting Function", start GX LogViewer by selecting [Tool] ⇒ [Logging Function] ⇒ [Start GX LogViewer].



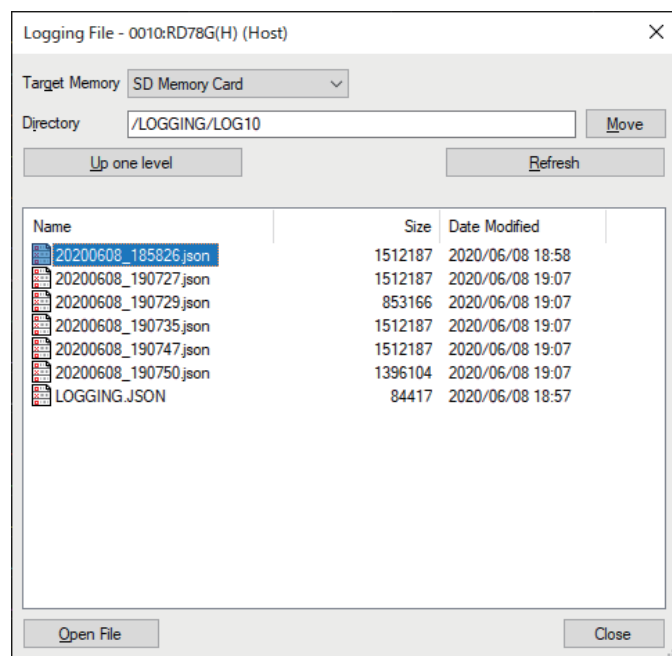
2. In "MELSOFT Series GX LogViewer", select [Online] ⇒ [Open Logging File].



3. In the "Connection Destination" window, select "MELSEC iQ-R Series Motion Module RD78G(H)".



4. In the "Logging File" window, specify the "Target Memory" (When the SD memory card is inserted, the storage location of the data logging file is the SD memory card.), select the logging data to be checked, and click [Open File] button. (Multiple selection is not allowed)



(The following procedure is required when the target axis for logging is 129 axes or more.)

5. In "MELSOFT Series GX LogViewer", select [Graph View] ⇒ [Change the Data to Draw Graphs].

6. In the "Change the Data to Draw Graphs" window, click [Add online files to the list] button.

Change the Data to Draw Graphs

No.	Data Name	Add to the Legends	Size	Data Type
	20200608_185826.json(RCPU(Host):(0010:RD78G(H)):/sdc/LO	☐		
001	System.Md.OperationCycle[1].ProcessingTime	☒	4	Double word[unsigned]
002	System.Md.OperationCycle[1].CycleOver	☒	1	Bit
003	System.Md.ErrorID	☒	2	Word[unsigned]
004	System.Md.NetWorkErrorID	☒	2	Word[unsigned]
005	Axis0001.Md.Io_TargetPos	☒	4	Double word[signed]
006	Axis0001.Md.Io_PosActualValue	☒	4	Double word[signed]
007	Axis0001.Md.Io_TorqueActualValue	☒	2	Word[signed]
008	Axis0001.Md.ErrorID	☒	2	Word[unsigned]
009	Axis0001.Md.AxisStatus	☒	2	Word[signed]
010	Axis0002.Md.Io_TargetPos	☒	4	Double word[signed]
011	Axis0002.Md.Io_PosActualValue	☒	4	Double word[signed]
012	Axis0002.Md.Io_TorqueActualValue	☒	2	Word[signed]
013	Axis0002.Md.ErrorID	☒	2	Word[unsigned]
014	Axis0002.Md.AxisStatus	☒	2	Word[signed]
015	Axis0003.Md.Io_TargetPos	☒	4	Double word[signed]
016	Axis0003.Md.Io_PosActualValue	☒	4	Double word[signed]
017	Axis0003.Md.Io_TorqueActualValue	☒	2	Word[signed]
018	Axis0003.Md.ErrorID	☒	2	Word[unsigned]
019	Axis0003.Md.AxisStatus	☒	2	Word[signed]
020	Axis0004.Md.Io_TargetPos	☒	4	Double word[signed]
021	Axis0004.Md.Io_PosActualValue	☒	4	Double word[signed]

When data name has the messy code, set the display language in the [Graph View]->[Set Language] after adding to the Legends.

The amount of drawing graphs : 32

7. Add data logging file by the same procedure as step 3 and 4.
8. Check "Add to the Legends" column in added data logging file.
Up to 32 data are available to draw at the same time. Change the target data of drawing if necessary.

Change the Data to Draw Graphs

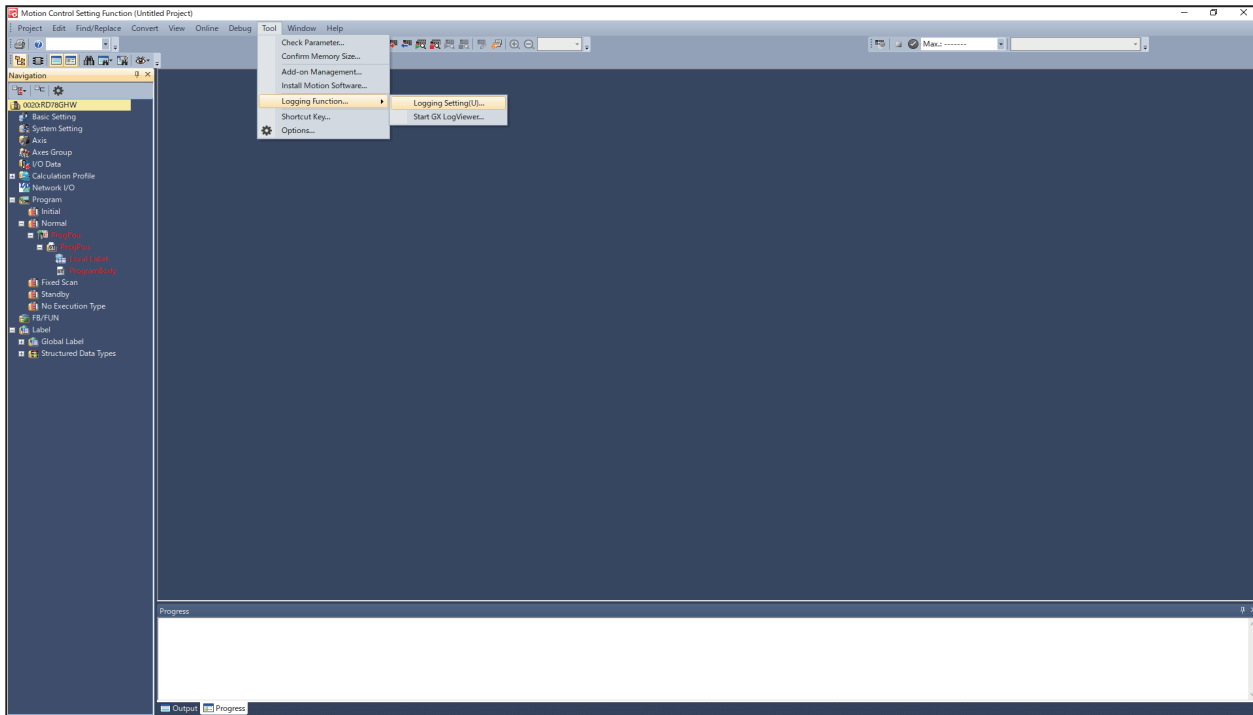
No.	Data Name	Add to the Legends	Size	Data Type
642	Axis0120.Md.Io_TorqueActualValue	☐	2	Word[signed]
643	Axis0128.Md.ErrorID	☐	2	Word[unsigned]
644	Axis0128.Md.AxisStatus	☐	2	Word[signed]
	20200608_185826.json(RCPU(Host):(0000:RD78G(H)):/sdc/LO	☒		
001	System.Md.OperationCycle[1].ProcessingTime	☐	4	Double word[unsigned]
002	System.Md.OperationCycle[1].CycleOver	☐	1	Bit
003	System.Md.ErrorID	☐	2	Word[unsigned]
004	System.Md.NetWorkErrorID	☐	2	Word[unsigned]
005	Axis0129.Md.Io_TargetPos	☒	4	Double word[signed]
006	Axis0129.Md.Io_PosActualValue	☒	4	Double word[signed]
007	Axis0129.Md.Io_TorqueActualValue	☒	2	Word[signed]
008	Axis0129.Md.ErrorID	☒	2	Word[unsigned]
009	Axis0129.Md.AxisStatus	☒	2	Word[signed]
010	Axis0130.Md.Io_TargetPos	☒	4	Double word[signed]
011	Axis0130.Md.Io_PosActualValue	☒	4	Double word[signed]
012	Axis0130.Md.Io_TorqueActualValue	☒	2	Word[signed]
013	Axis0130.Md.ErrorID	☒	2	Word[unsigned]
014	Axis0130.Md.AxisStatus	☒	2	Word[signed]
015	Axis0131.Md.Io_TargetPos	☐	4	Double word[signed]
016	Axis0131.Md.Io_PosActualValue	☐	4	Double word[signed]
017	Axis0131.Md.Io_TorqueActualValue	☐	2	Word[signed]
018	Axis0131.Md.ErrorID	☐	2	Word[unsigned]

When data name has the messy code, set the display language in the [Graph View]->[Set Language] after adding to the Legends.

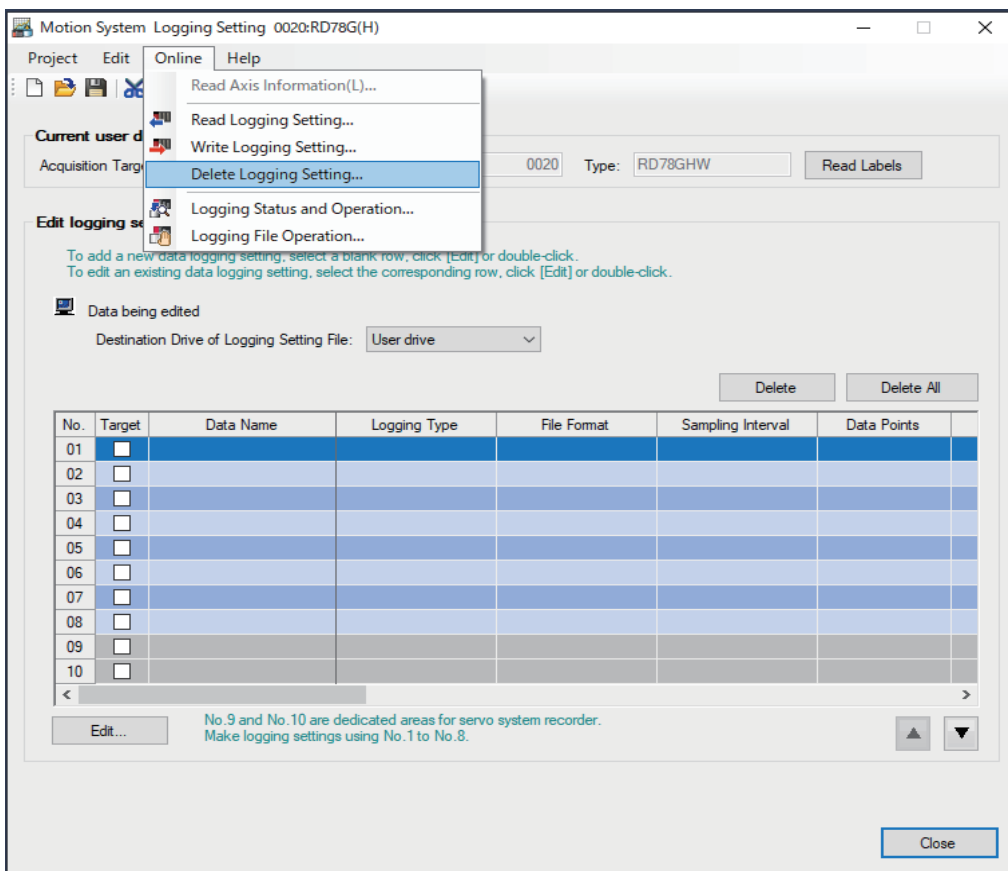
The amount of drawing graphs : 29

How to delete the logging setting file

1. In the "Motion Control Setting Function" window, select [Tool] ⇒ [Logging function] ⇒ [Logging Setting], and display "Motion System Logging Setting" window.

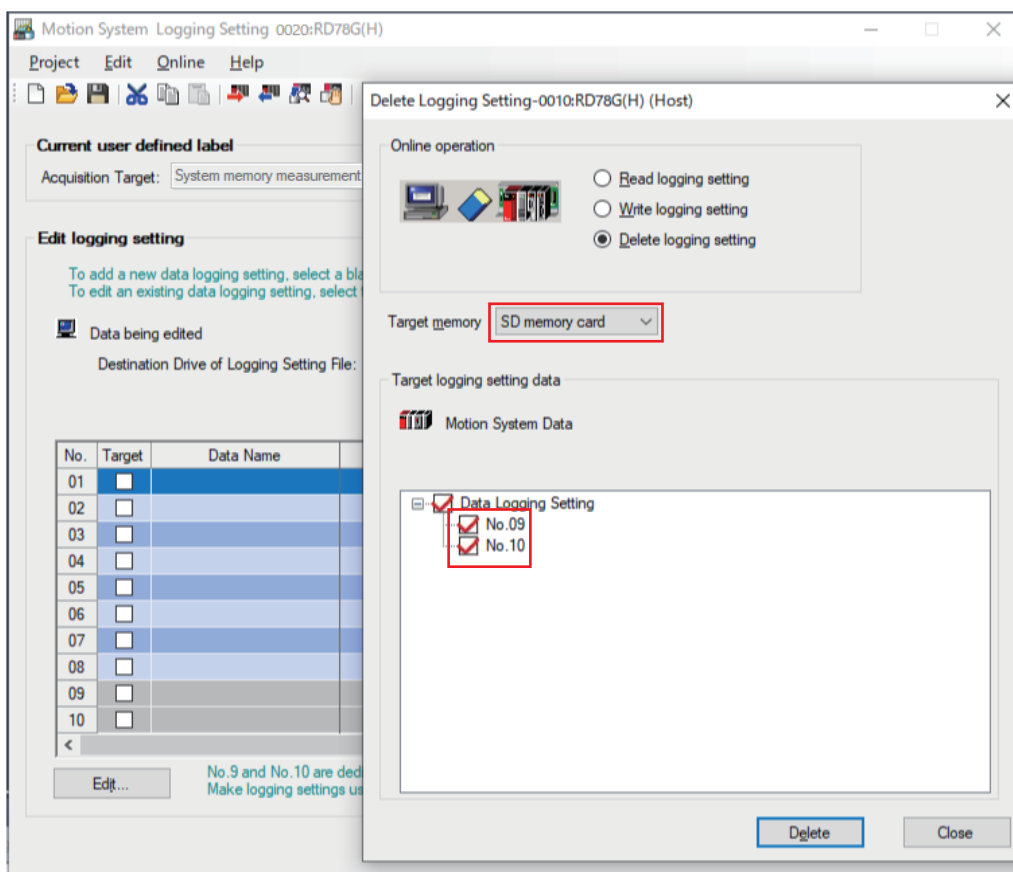


2. In the "Motion System Logging Setting" window, select [Online] ⇒ [Delete Logging Setting].



3. In the "Delete Logging Setting", select the memory which stores the logging setting file to be deleted from the target memory.

- When the stored logging setting file is displayed, check the logging setting file to be deleted, and click [Delete] button.

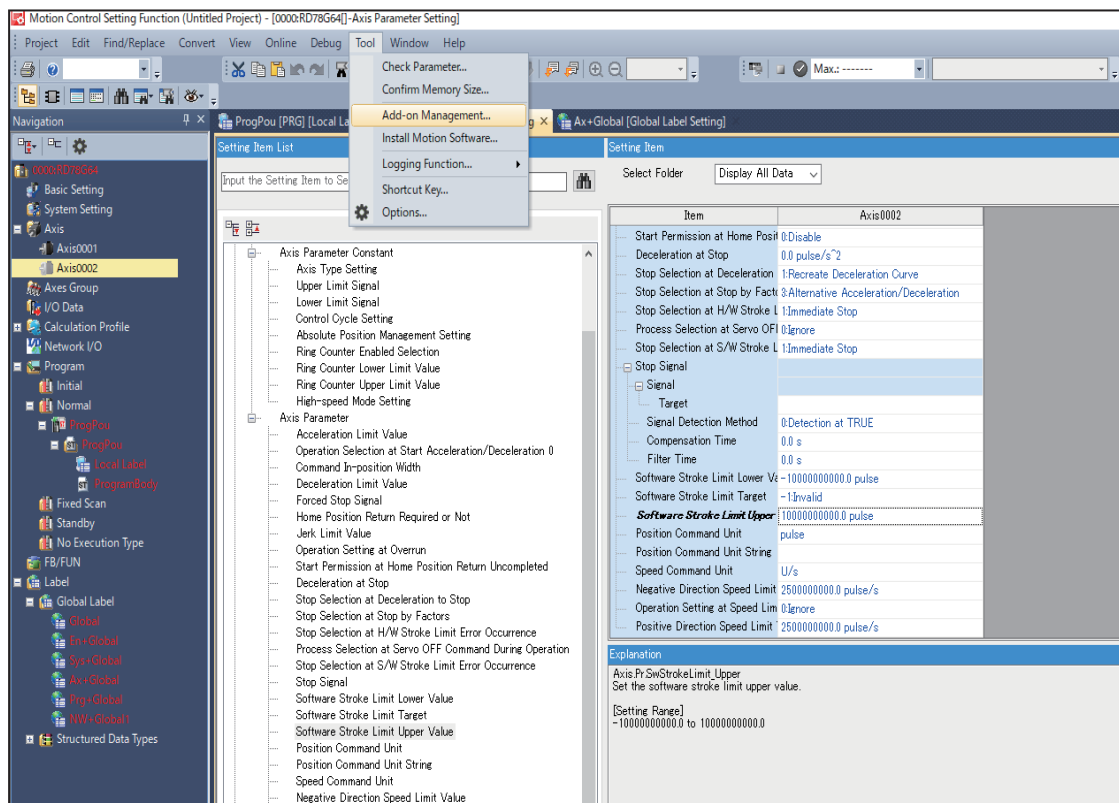


Precautions

If this function is not being used, disable the add-on library setting

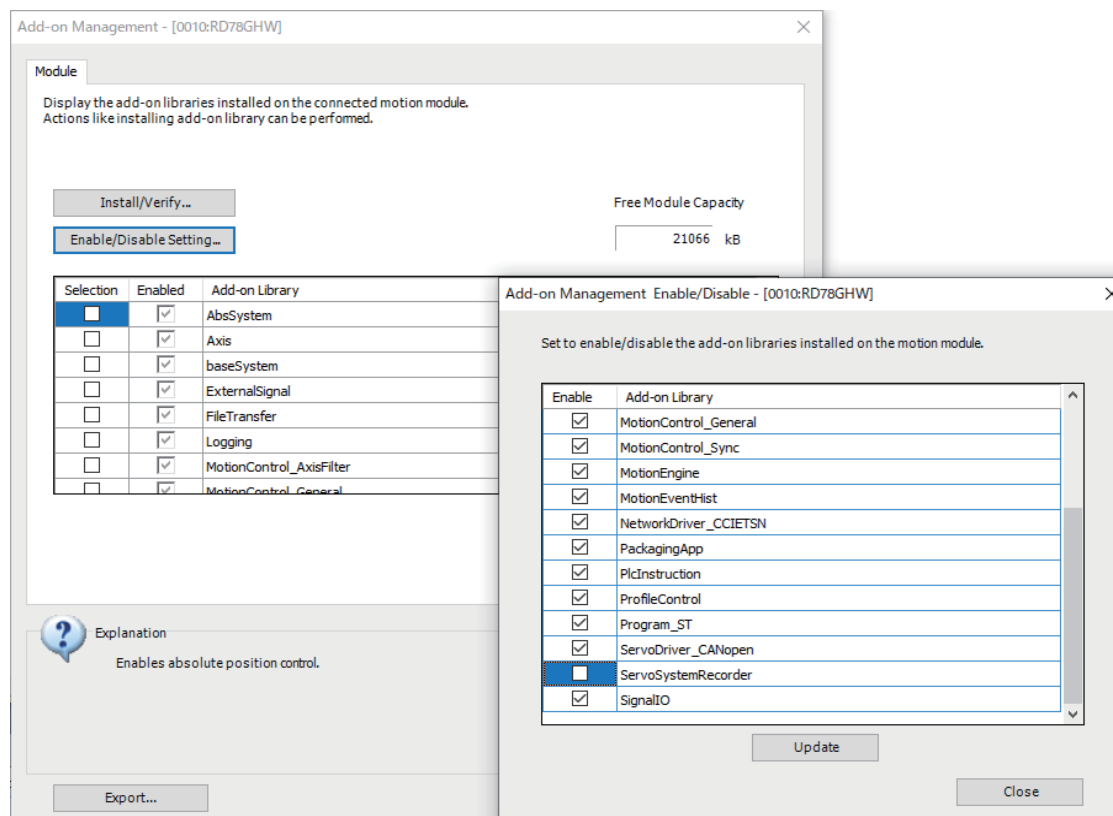
[Set the add-on library to disable setting]

1. In the "Motion Control Setting Function", select [Tool] ⇒ [Add-on Management] and open "Add-on Management".



2. Click [Enable/Disable Setting...] button, and display Add-on Management Enable/Disable window.

3. Uncheck the Enable column in ServoSystemRecorder, and click [Update] button.



When logging is executed by this add-on with all add-ons being enabled, the processing time of the operation cycle increases. A reference of the processing time of the operation cycle is shown below. (The processing time may change depending on the operation cycle and the device being used).

- RD78G64 (when 64 axes are being used): approximately 4.155 [ms]
- RD78GHW (when 256 axes are being used): approximately 4.961 [ms]

Relevant add-ons and versions

The following add-ons are required besides this add-on.

- Logging "Ver.1.7" or later
- Axis "Ver.1.7" or later

When the above add-ons are being disabled while this add-on is enabled, the warning "Servo System Recorder Inconsistency Incorrect Warning" (warning code: 0F10H) occurs.

System memory capacity

The memory capacity is used for generating the logging setting file by this add-on. By logging with generated setting, the Add-on Logging memory will be used. Both memory capacity are shown below.

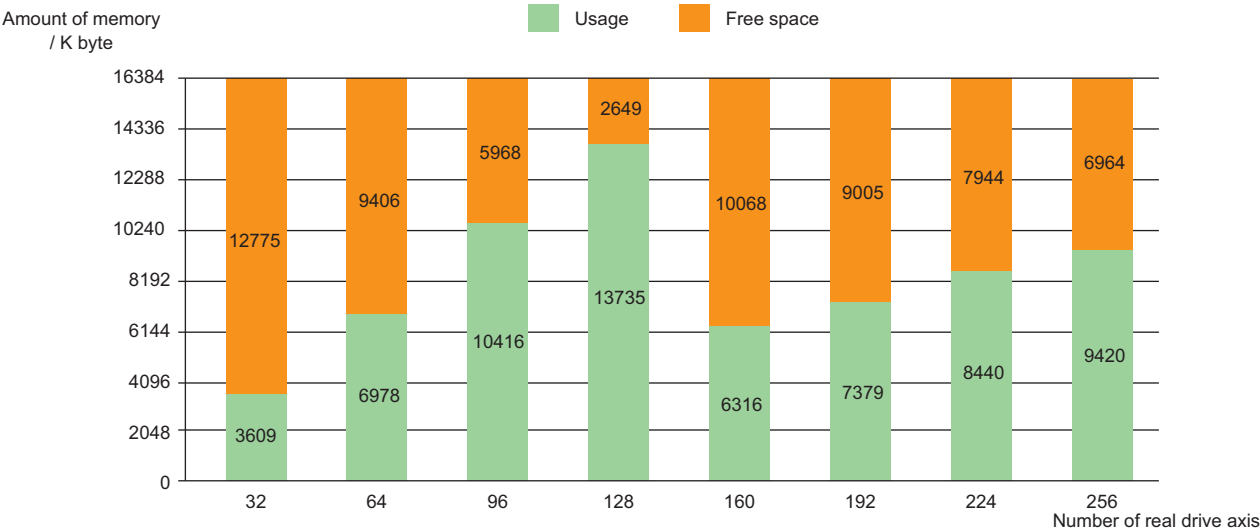
■Add-on ServoSystemRecorder

- [RamUsage]
- RD78G: 256K bytes
 - RD78GH: 512K bytes
- [BackupRamUsage]
- Backup RAM is not used.

■Add-on Logging

[RamUsage]

The memory capacity during the logging differs because on the number of collected data differs depending on the number of set axis setting. An example is shown below.



- The default memory usage setting of the logging is 16384K bytes.
- The memory usage is the memory capacity logged in the logging setting file output by the servo system recorder.
- When 129 axes or more are set, the memory capacity is less than setting 128 axes because the number of collected data points and the record points of axis are being reduced.

- [BackupRamUsage]
- Backup RAM is not used.

17 MOTION SERVICE PROCESSING

17.1 Operation Overview

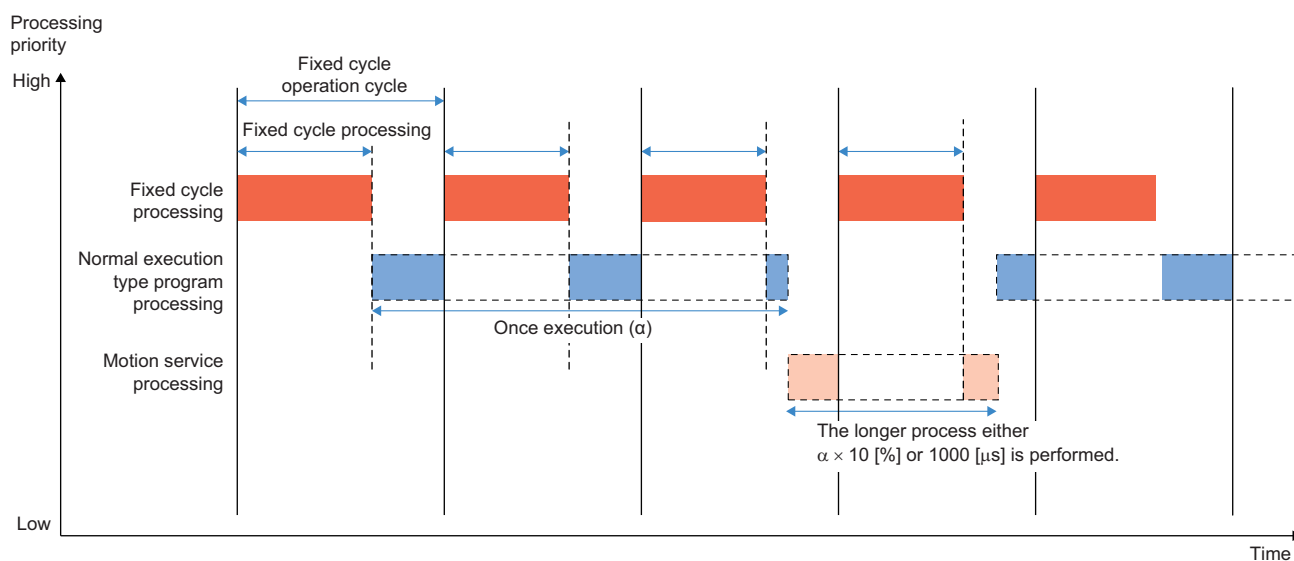
This section describes the motion service processing which executed in the service task.

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 motion 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 "Motion Module Program Creation" in the following manual.
📖 MELSEC iQ-R Programming Manual (Motion Control Function Blocks)
For the setting method from the C Controller module, refer to the following.
📖 MELSEC iQ-R C Controller Module User's Manual (Application)

Module label

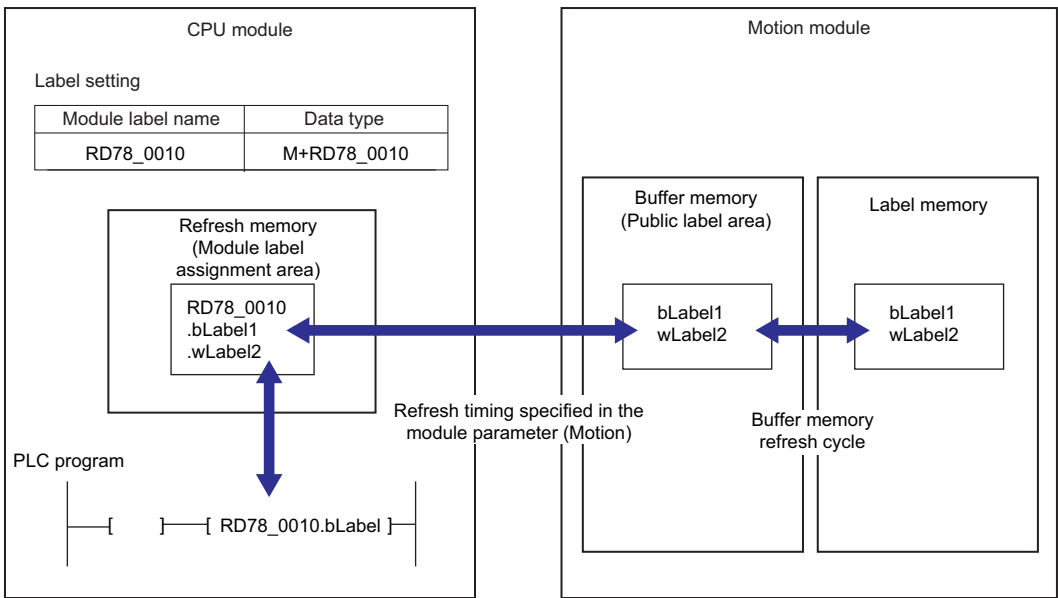
The global label in the Motion module is available as the module label from the CPU module.

■Using method

Follow the procedure below to create the module labels on the engineering tool.

1. In the label editor, set the "public label" of label to be made public as module label to the CPU module to "Enable".
2. Set "Motion Control Attribute" to decide direction of the label refresh.
3. Execute "Public label reflection" operation.

For details, refer to Help of the engineering tool.



When using the public labels, the data refresh is executed using the following memory area. For specifications such as the number of labels to be made public, refer to Help of the engineering tool.

Memory location	Name	Refresh timing
CPU module	Refresh memory (module label assignment area)	Specified in the module parameter (motion)
Motion module	Buffer memory (public label area)	Buffer memory refresh cycle

Point

The global labels to be made public 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 details, refer to the following.

👉 Page 112 Operation Cycle

■Motion control attribute

The public 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

- A string type or a structured data type include a string type is not made public. For other restrictions, refer to the following.

 GX Works3 Operating Manual

- If the different direction from the attribute is written (e.g. The public 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.

Therefore, label values (some Cd. etc.) with attribute "The CPU module → The Motion module" which are changed from the motion system cannot confirm the values are changed from the CPU module. Refer to the Md. which is compatible with the Cd. or use the FB which provides the same function without operating the Cd.

- The operation performance is improved and the memory capacity can be reduced by reducing the number of the public labels.
- When the program is carried out with mismatches between the CPU module and the Motion module for the setting of the public 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 public labels of the structure including the closed member (and vice versa). Especially, when setting the public labels for the I/O pin (the structure) of the FB, disclose the all member of the public 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.)
- When using the public labels, do not execute the software reboot. If it is executed, turn on the power of the motion system again

I/O signals

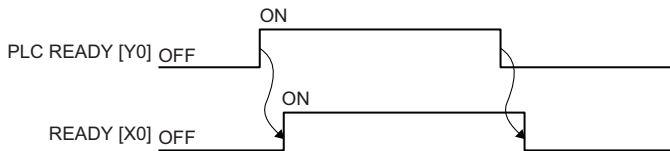
The Motion module uses 32 points of the input and 32 points of the output for exchanging data with the CPU module.

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 time 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 [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 [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

Do not use the other areas than the above.

18.2 Using Motion control FB

This section describes how to use the Motion control FB 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 Motion control FB.

Control details

The specifications of variables that are used for the Motion control FB of the CPU module side are shown below.

- Specifying AXIS_REF and AXES_GROUP_REF

When using the Motion control FB 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 Motion control FB.

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) are 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 Motion control FB of the CPU module side, the start I/O No. of the target Motion module has to be specified for the I/O variables (StartIO (AxisName.AxisRef.StartIO), etc.) used in the Motion control FB.

Each Motion control FB definitely defines one input variable that requires the StartIO setting. For the input variables that require the I/O No. (StartIO) setting, refer to the following.

 MELSEC iQ-R Programming Manual (Motion Control Function Blocks)

For the Motion control FB that can input multiple variables whose member includes I/O No. (StartIO), the setting of I/O No. (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.

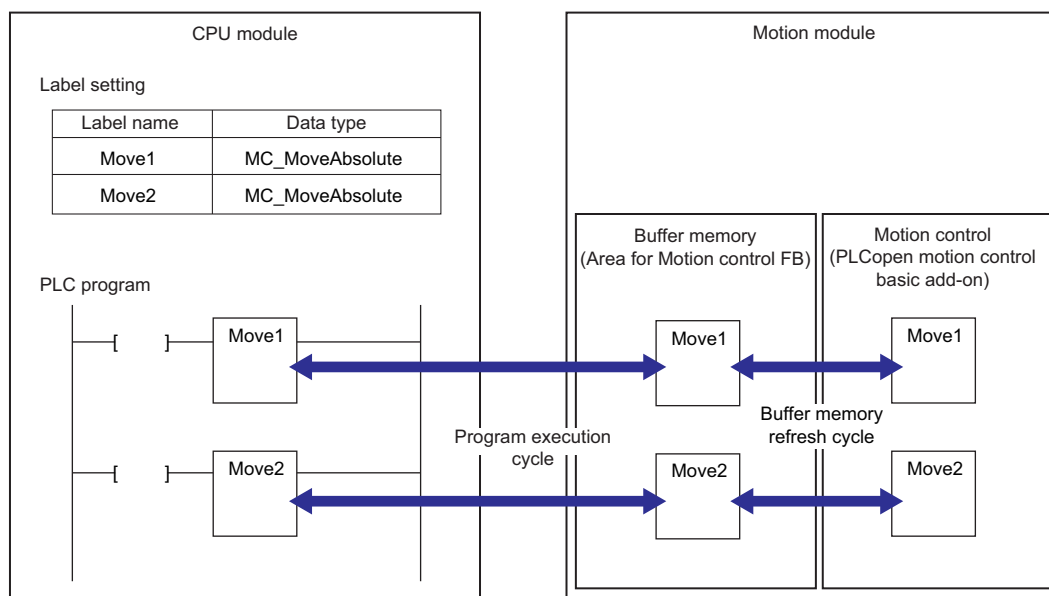
Be sure to establish I/O No. (StartIO) of each Motion control FB before the FB is called for the first time.

- Specifying file names and variables (label, device)

The files and the variables when using the FILE_LOCATION type structure (for specifying file names) or the TARGET_REF type structure (for specifying variables such as labels and devices) in a sequence program of the CPU module, they are the files and the variables used in the Motion module, not used in the CPU module.

Generating Motion control FB instance

Control corresponding to the Motion control FB can be carried out in the Motion module side by instantiating the Motion control FB as a global label or a local label on the CPU module and calling the Motion control FB on the PLC program.



When using the Motion control FB of the CPU module side, the following memory areas are used. The number of available Motion control FB 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 774 List of FBs	Check by using the engineering tool
Motion module	Buffer memory (Area for Motion control FB)		Buffer Memory MCFB Communication Area Free Size (System.Md.BuffermemoryFreeMcfbArea)
	Memory for PLCopen motion control basic add-on		RAM Usage Maximum (System.PrConst.Addon_MotionControl_General.RamSizeMax) RAM Usage (System.Md.Addon_MotionControl_General.RamUsage)

Point

- The buffer memory (area for the Motion control FB) and the memory for the motion control add-on are hold when the Motion control FB 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 Motion control FB is called for the first time, and the Motion control FB will not be executed.
- Even if the Motion control FB of the CPU module side is deleted, the memory on the Motion module side is not released. Therefore, if the Motion control FB 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 Motion control FB

- Operation conditions

The conditions (available conditions) to operate the Motion control FB of the CPU module side are shown below.

CPU module	Motion module	
	RUN	Other than RUN
RUN	Available	Unavailable
Other than RUN	Available* ¹	the Motion control FB in execution is stopped

*¹ This state occurs when PLC Ready (System.Cd.SequenceReady) is being RUN by operated directly, and the stop error is not occurring in the CPU module.
In this case, execute such as an axis stop in the Motion module program if necessary because the Motion module cannot be controlled from the CPU module. For details, refer to the following.

☞ Page 131 Relevant variables

- Processing order

The processing order of the operation cycle in the Motion module corresponding to the Motion control FB instance of the CPU module side is the order when the Motion control FB is called for the first time.

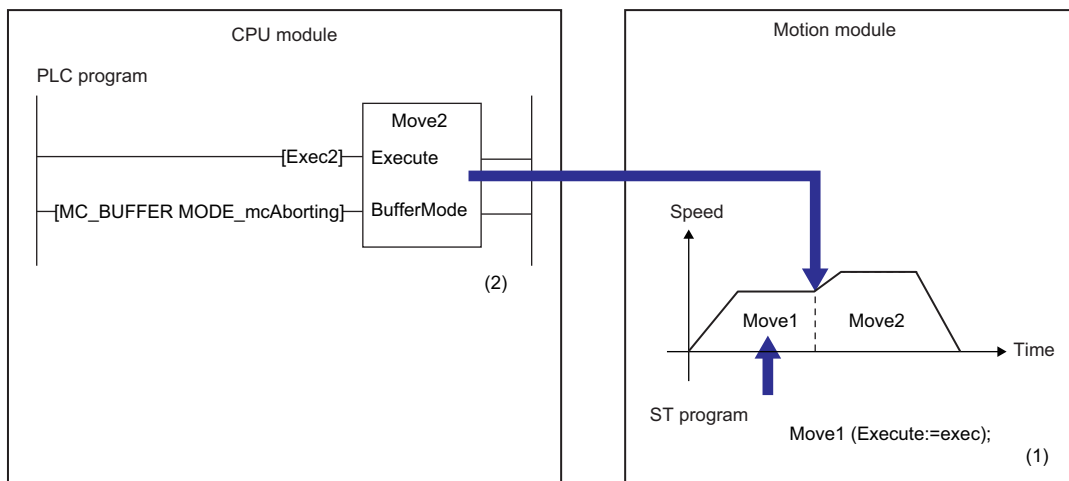
- Mix of the Motion control FB of CPU module side and the Motion control FB of the Motion module side.

When the Motion control FB of the CPU module side and the Motion control FB 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 Motion control FB of the CPU module side and the Motion control FB of the Motion module side, these are treated as different control FBs in the Motion module.

Ex.

When executing Aborting to the on-going Motion control FB in the Motion module side by the Motion control FB of the CPU module side

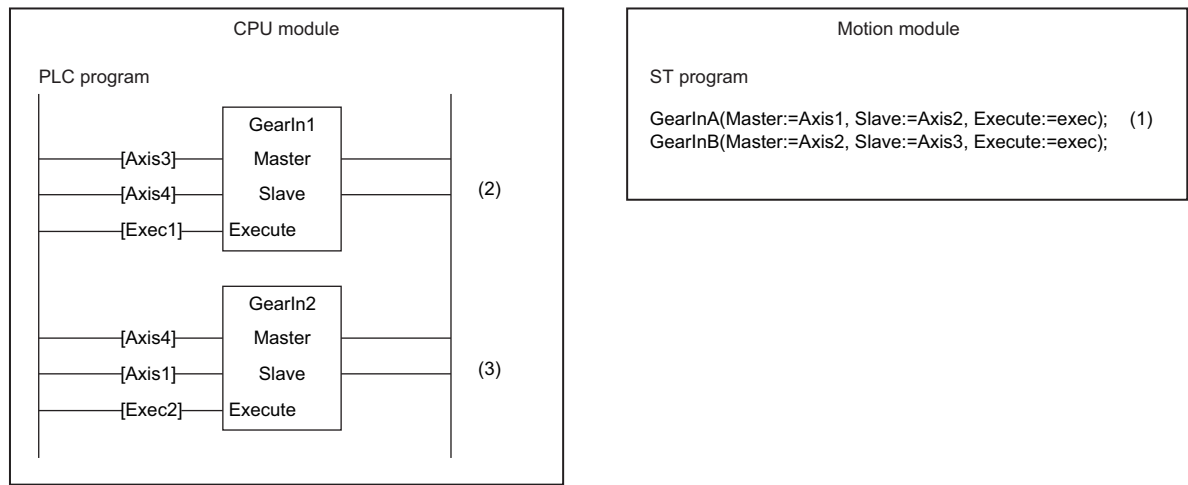


(1) Execute the Move1 of the Motion module side.

(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 Motion control FBs of the single axis synchronous control in the Motion module side and the CPU module side



- (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 and public variables

The refresh response time of I/O variables and public variables for the Motion control FB of the CPU module side is as shown below.

Motion control FB call cycle in the CPU module + Buffer memory refresh cycle × 2

- Interlock of I/O variables when using Execute command (Execute) type FBs

Refer to the following.

☞ Page 27 Execute command (Execute) type/Enable (Enable)

Note that there is the difference in some of the specification as follows.

Difference of the specification with the Motion control FBs of the Motion module side.	After the falling edge of Execute command (Execute), Abortion of execution (CommandAborted) is reset from 1 to a few scans behind. When re-executing after the Motion control FBs have stopped, execute after confirming the reset of Execution completion (Done), Error (Error), and Abortion of execution (CommandAborted) have been performed.

- Interlock of I/O variables when using Enabled (Enabled) type FBs

Refer to the following.

☞ Page 27 Execute command (Execute) type/Enable (Enable)

Precautions

Refer to the following.

 Page 32 Precautions

The followings are the precautions only for the Motion control FB in a sequence program of the CPU module.

- When executing the Motion control FBs in the interrupt program of the CPU module, the Motion control FBs may not start. Use them with the following special relay ON.*1

Note that the completion signal of all dedicated instructions is maintained with ON at instruction completion by the following special relay ON so that the process which the completion signal is set to OFF should be created in a program when the program which is needed to set ON for only one cycle exists.

Number	Name
SM752	Dedicated instruction End bit control flag

*1 For details of the special relay, refer to the following.

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

- When writing the Motion control FB in the control syntax such as the IF statement or the MC instruction, the Motion control FBs may not start.

Do not write the Motion control FB in the control syntax.

- When using the Motion control FB in the CPU module side, do not execute the software reboot. If it is executed, turn on the power of the motion system again.
- The number of steps of FBs built into a program is different depending on the CPU module to use, the I/O definition, or Options setting of GX Works3. For Options setting of GX Works3, refer to the following.

 GX Works3 Operating Manual

- This FB uses the index register Z1. When using the interrupt program, do not use this index register. When the index register is used in the interrupt program, the FB may not operate correctly. When using the index register in the interrupt program, do not assign this index register as the local index register.
- Even if a warning of duplicated coil may occur in compiling, this is not particular problem in use.
- When using the subroutine type FBs in a ladder program, connect the I/O labels to both input and output sides.
- This FB uses the label initial value for each program. When specifying the program file using this FB by boot settings, specify the label initial value for each program by boot settings in the boot operation of the CPU module.

Point

- Errors (including warnings) of the CPU module side during Motion control FB execution are output as errors of the Motion module. For the error code output to Error code (ErrorID) of the Motion control FB, refer to the following.

 Page 30 Error processing

However, when the I/O No. ( Page 637 Relevant variable) of the Motion module specified with the Motion control FB argument is not correct and the Motion module to execute the FB cannot be specified, no operation is performed or the error code is output in the CPU module side.

- The Motion control FBs do not include an error recovery process. Create the error recovery process separately according to the user setting system or required operation.
- The Motion control FBs do not detect the alarms and the warnings which occurred in the servo amplifier. Create the monitoring process of the alarms and the warnings which occurred in the servo amplifier separately. For the alarms and the warnings which occurred in the servo amplifier, refer to the manuals of the servo amplifier in use.

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.
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 system is called "Drive". The following shows available drives of the motion system.

○: 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. For details, refer to each function.

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 free space 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 Flash ROM Write Count Index Value (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 system.

- 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 system operation is checked at factory acceptance test, the initial value of the write count index is not 0.
- Since a motion system 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 643 Drive, 📄 Page 647 Storage files

Ex.

/sd/\$MOTPRJ\$/calc_profile/cam0001.csv

- Relative path

Paths that do not start with "/" are relative paths. 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 %PROJECT_ROOT%^*1	Specified root drive %PROJECT_ROOT_DRIVE%^*1
Motion module (internal memory)	/rom/\$MOTPRJ\$/	/rom
Motion module (SD memory card)	/sd/\$MOTPRJ\$/	/sd

*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.

sd/\$MOTPRJ\$/calc_profile/cam0002.csv

Ex.

When the \$MOTPRJ\$ path has been specified to /sd/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.

/sd/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 /sd/\$MOTPRJ\$/ and the following path is specified

Relative path: ../cam0002.csv

The actual accessed file is as follows.

/sd/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. For details, refer to the following.

📖 Page 661 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 645 Path setting

File lists

The following shows the list of files to be used in the motion system.

■%PROJECT_ROOT%

File name	Usage	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	○	×
PRG.PRM	Program setting	○	×
/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	○	×
PosHist.bin	Position data history file	×	○
filelog.txt	File transfer log file	×	○
filelog.bak	File transfer log backup file	×	○

rom

File name	Usage	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)	×
time.json	Time zone information	×
SimpleMotionRom.bin	For the Simple motion mode (Data saving of flash)	○
\$MOTPRJ_\$	Folder for Simple motion mode	○
GLBLINF.IFG	Global label setting	○
GLBLINF.LBS	Global label setting	○
GLBLINF.LID	Global label initial value setting	○
MTNSTR.MLB	Member definition	○
MTNSTR.STR	Structure type definition	○
PRG.PRM	Program setting	○

sys

File name	Usage
/	
*.smpk	Motion module software
*.mpk	Motion module add-on
/disabled	Temporary disabled file

ram

File name	Usage
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	Usage
abs_axis.bin	Axis absolute position data
EVENT.LOG	Motion event history
SimpleMotionFram.bin	For the Simple motion mode (Data saving of FRAM)

sdc

File name	Usage
\$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 647 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 module (SD memory card)	SD memory card drive of Motion module (/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.

Data backup

Data saving/restoration in each drive to the outside the motion system can be executed by user operation using such as file transfer function.

Some data may be saved incorrectly if saving/restoration set procedure is not being followed. Also, when transferring drive data of the Motion module by using file transfer function by user operation, read/write of the target drive needs to be permitted in access control setting in advance. For details, refer to the specifications of each function.

To secure the consistency of the backup data, it is recommended to execute data saving (backup) and restoration (restored) while the drive unit is not connected and PLC ready [Y0] is OFF.

Data saving (backup)

The saving (backup) procedure of all data in the motion system by user operation is shown below.

1. To save the label values, reflect the description of the labels (user defined labels, each type of Pr and PrConst) to the label default value file (specified to store in the root path) by using "Filing" command of the file transfer function.
For details, refer to the following.
 Page 664 Filing
2. If function such as the absolute position system which uses latch drive is being used, use Backup/Restore Request (System.Cd.BackupRestore) to stop the data update of the latch drive.
For details, refer to the following.
 Page 106 Saving (backup) and restoration (restored) of the absolute position data
3. Execute saving of all files under the root path, in the latch drive, and in the system drive to the outside using the file transfer function. For details, refer to the following.
 Page 663 Data copy / Data move
Note that saving RAM drive is not required as it is used only to store temporary operation files.
4. If the data update of the latch drive is stopped following procedure 2, resume the update using Backup/Restore Request (System.Cd.BackupRestore). For details, refer to the following.
 Page 106 Saving (backup) and restoration (restored) of the absolute position data

Data restoration (restored)

The restoration (restored) procedure of all data in the motion system by user operation is shown below.

1. If function such as the absolute position system which uses latch drive is being used, use Backup/Restore Request (System.Cd.BackupRestore) to stop the data update of the latch drive. For details, refer to the following.
 Page 106 Saving (backup) and restoration (restored) of the absolute position data
2. By using the file transfer function, restore files stored outside drive to the original drive. For details, refer to the following.
 Page 663 Data copy / Data move
3. If the files in the latch drive are changed following procedure 2, execute restored data saving request by using Backup/Restore Request (System.Cd.BackupRestore). For details, refer to the following.
 Page 106 Saving (backup) and restoration (restored) of the absolute position data
4. Reboot (software reboot or hardware reboot) the motion system.

Point

- Data saving/restoration can be executed with the saving/restoration functions of the engineering tool. For details, refer to Help of the engineering tool.
- The Motion module does not hold either network or driver device parameters. To execute saving/restoration, check the specifications of CPU module and the driver device and execute it.

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 space 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 system 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 motion system 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 754 Axis variables

Input variables

Import $\square$: Always, $\uparrow$: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Enable	Enable	BOOL	$\uparrow$	TRUE, FALSE	FALSE	When TRUE, the FB is executed.
Parameter No.	ParameterNumber	DWORD(HEX)	$\square$	00010000H to FFFFFFFFH	00000000H	Indicates the objects of the slave devices.
Number of reading times	ReadCount	WORD(UNIT)	$\square$	0 to 65535	0	Indicates the number of reading times of parameters. Carries out continuous read until Enable (Enable) becomes FALSE as 0 is set. Reload is executed at the timing which the Parameter No. is changed.
Options	Options	DWORD(HEX)	$\square$	*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 (Specify "0".)*1
16	Specifies unsigned Indicates whether read value of integer data is stored without a sign. 0: signed 1: unsigned
17 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

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)	0	The error code generated in the FB is returned.
Transient error code	SDOErrorID	DWORD(HEX)	0	The response code (SDO Abort Code) generated by transient communication is returned.
Read value	Value	LREAL	0.0	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
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 Number of reading times (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 0: Unexecuted transient transmission 1: Accepting transient transmission
9	Empty (Specify "0".)*1
10	Issuing SLMP 0: Unexecuted SLMP 1: Issuing SLMP
11 to 15	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

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 754 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)	↑	00010000H to FFFFFFFFH	00000000H	Indicates the objects of the slave devices.
Setting value	Value	LREAL	↑	—	0.0	Indicates a setting value of the specified parameter.
Execution mode	ExecutionMode	MC_EXECUTION_MODE	↑	0, 1	0	Indicates writing method of the specified parameter. As it is set to "0: Execute Immediately (mcImmediately)", writes immediately. As it is set to "1: Execute at Completion of Previous One (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 (Specify "0".)*1
16	Specifies unsigned Indicates whether the setting value of integer data is defined as the integer value without a sign. 0: signed 1: unsigned
17 to 31	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

■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)	0	The error code generated in the FB is returned.
Transient error code	SDOErrorID	DWORD(HEX)	0	The response 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 0: Unexecuted transient transmission 1: Accepting transient transmission
9	Empty (Specify "0".)*1
10	Issuing SLMP 0: Unexecuted SLMP 1: Issuing SLMP
11 to 15	Empty (Specify "0".)*1

*1 If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

Control Details

Slave object (Transient)

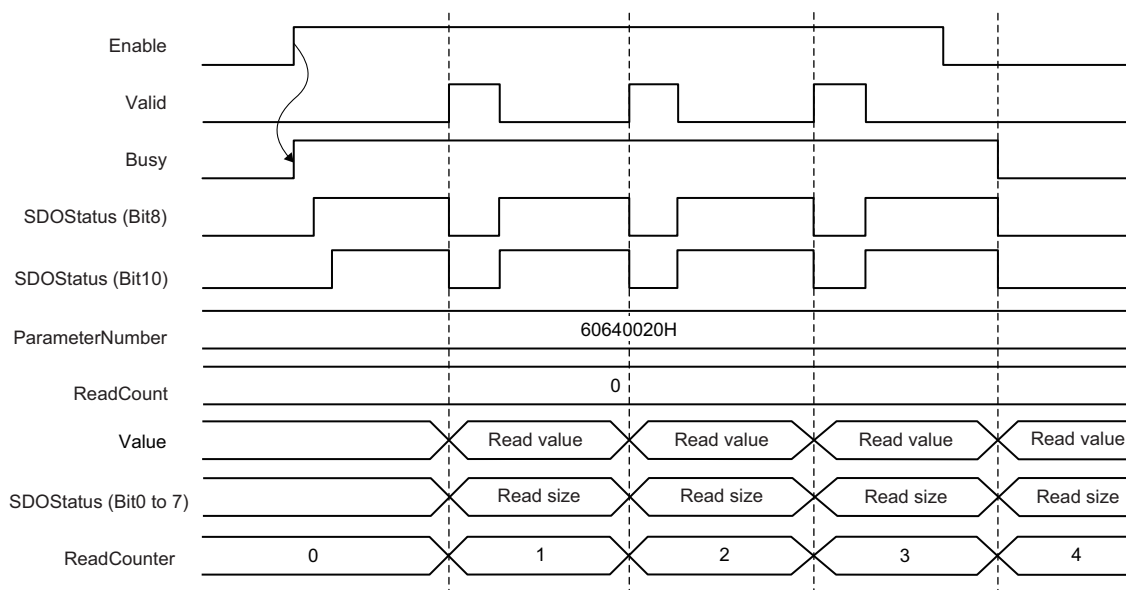
Slave objects can be read/written by indicating 00010000H or later to the parameter No. In this case, object data is sent/received by using the transient transmission function.

When the error (response code (SDO Abort Code)) for transient request is received from the slave device, Error (Error) becomes TRUE and then the error "SDO Communication Error" (error code: 1800H) is stored to Error code (ErrorID) and the response code (SDO Abort Code) from slave device is stored to Transient error code (SDOErrorID).

■The timing of send/receive

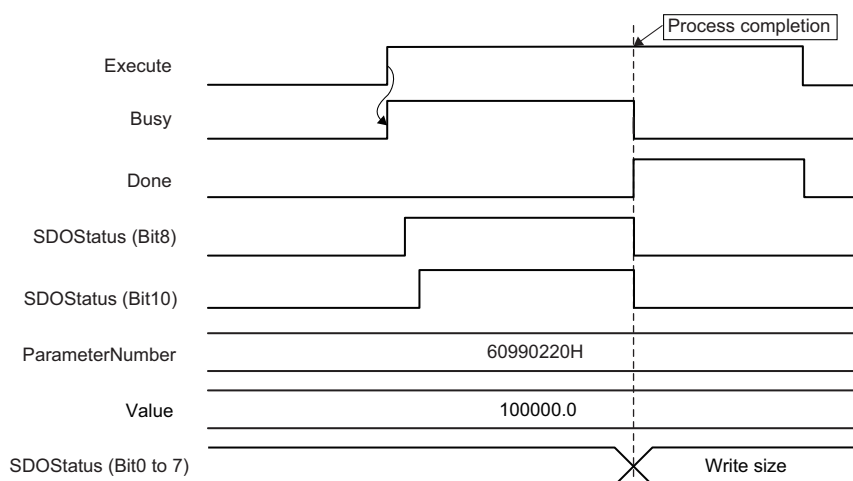
[At successful completion]

- For executing parameter read



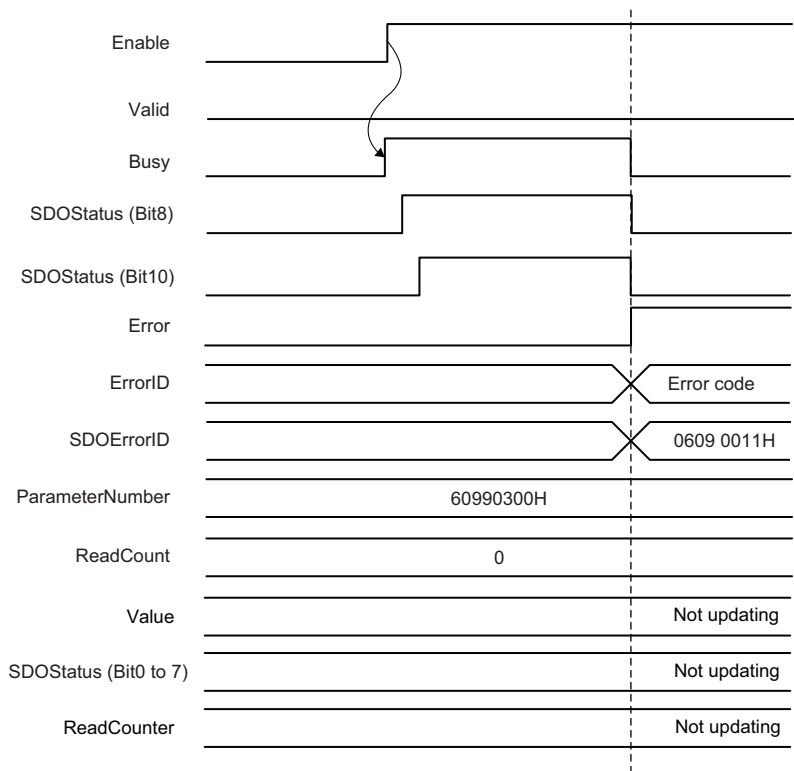
Executes read for a designated number which is indicated with Number of reading times (ReadCount) until Enable (Enable) becomes FALSE. (Executes continuously until Enable (Enable) becomes FALSE when Number of reading times (ReadCount) is set to "0".)

- For executing parameter write

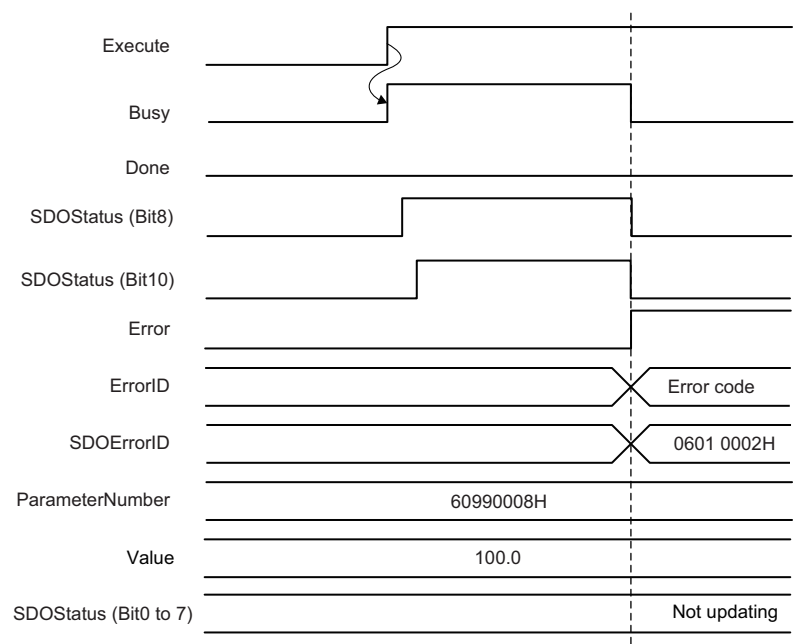


[At unsuccessful completion (SDO communication error has occurred.)]

- For executing parameter read

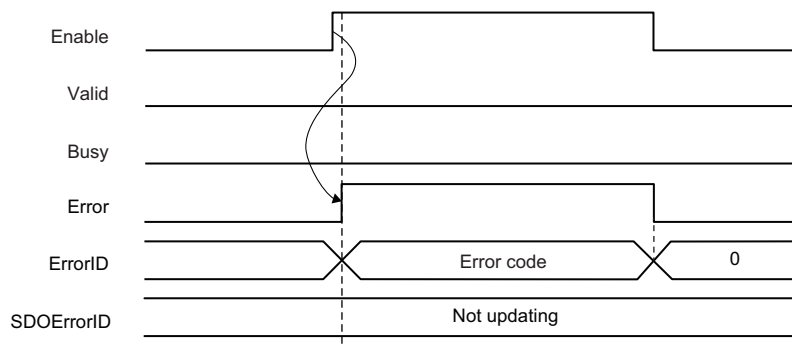


- For executing parameter write

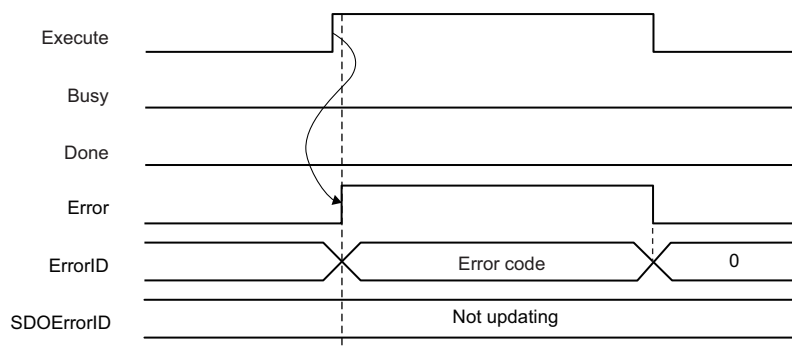


[At unsuccessful completion (the I/O variables and the Input variables are abnormal)]

- For executing parameter read



- For executing parameter write



Setting details

■Parameter No. (ParameterNumber)

The Parameter No. specified at the parameter read/write is below.

- 00010000H to FFFFFFFFH: the objects of the slave device

For specifying the objects of the slave device, do as follows.

ParameterNumber = XXXXYZZZH

XXXX...Specify the object index.

YY...Specify the object sub index.

ZZ...Specify the object size (Number of bit).

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 Parameter No. (ParameterNumber) differs from default size of the slave objects, the operations vary depending on the specifications of the driver device.

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)

For details, refer to the manuals of each drive unit.

For MR-J5(W)-G: MR-J5 User's Manual (Parameters)

■Execution mode (ExecutionMode)

At executing the parameter write, set the timing of write in Execution mode (ExecutionMode).

If "0: Execute Immediately (mcImmediately)" is specified, write is executed immediately. The axis operations might be affected because the reflection timing depends on each parameter.

If "1: Execute at Completion of Previous One (mcQueued)" is specified, write is executed after the axis stops (Axis Status (AxisName.Md.AxisStatus) is "0: Axis disabled (Disabled)" or "4: Standby (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	Action
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 MC_ReadParameter (Parameter Read)/MC_WriteParameter (Parameter Write) for the slave object is executed toward the axis which is already executing four transient transmissions, the error "Parameter Reading And Writing FB Execution Disabled Error" (error code: 34A1H) occurs and the next FB is not executed. (The FB 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 for the slave object is executed when MC_Home (Homing) is carried out, the error "ABS Reference Point Read Error" (error code: 1AAAH) might occur in MC_Home (Homing).
- When reading/writing the integer type/BOOL type parameters or slave objects, the setting value of MC_WriteParameter (Parameter Write) is converted into integer type or BOOL type and taken. Also, the written value in MC_ReadParameter (Parameter Read) is respectively converted into LREAL type or BOOL type and output.

Ex.

Write parameters by specifying two bytes size with MC_WriteParameter (Parameter Write).

Setting value (Value) (Data type: LREAL)	Write value (2 bytes data)	
	Specifies unsigned (Options (Options): bit16 "0: Signed")	Specifies unsigned (Options (Options): bit16 "1: Unsigned")
10000.5	10000.0	10000.0
-10000.4	-10000.0	55536.0
65535.0	-1.0	65535.0
-65535.0	1.0	1.0
63356.0	0.0	0.0
131701.0	-1.0	65535.0

Read parameters by specifying two bytes size with MC_ReadParameter (Parameter Read).

Parameter value	Read value (Value) (Data type: LREAL)	
	Specifies unsigned (Options (Options): bit16 "0: Signed")	Specifies unsigned (Options (Options): bit16 "1: Unsigned")
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 manual for slave devices about the parameter saving method.

- When slave devices in transient transmission disconnected, all the transient requests for disconnected slave devices are failed, and the error "SDO Communication Error" (error code: 1800H) occurs.

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 File Transfer Command (System.Cd.FileTransfer_Command) by setting TRUE in File Transfer Execution Request (System.Cd.FileTransfer_Execute). While the file transfer is executed, File Transfer Executing State (System.Md.FileTransfer_State) is set to Executing (Executing).

The execution of file transfer is registered in the event history (type: system).

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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 (Files in Latch Drive)	Specifies the access control to files in the latch drive. For details, refer to the following. ☞ Page 662 Access control setting
FileTransfer_AcFile_ram	File Transfer Access Control (Files in RAM Drive)	Specifies the access control to files in the RAM drive. For details, refer to the following. ☞ Page 662 Access control setting
FileTransfer_AcFile_rom	File Transfer Access Control (Files in User Drive)	Specifies the access control to files in the user drive. For details, refer to the following. ☞ Page 662 Access control setting
FileTransfer_AcFile_sdc	File Transfer Access Control (Files in SD Memory Card)	Specifies the access control to files in the SD memory card. For details, refer to the following. ☞ Page 662 Access control setting
FileTransfer_AcFile_sys	File Transfer Access Control (Files in System Drive)	Specifies the access control to files in the system drive. For details, refer to the following. ☞ Page 662 Access control setting
FileTransfer_AcLabel	File Transfer Access Control (Label)	Specifies the access control to labels. For details, refer to the following. ☞ Page 662 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 663 Command format
System.Md.		
FileTransfer_State	File Transfer Executing State	Displays the execution state of file transfer. 0: Waiting for Execution Request (Ready) 1: Executing (Executing) -1: Error Occurrence (Error_)

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 (Specify "0".)* ¹

*¹ If specifying other than "0", the error "Out of Options Range" (error code: 1A4EH) occurs, and the function does not start.

- For details on 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 specified 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 specified 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.	• When a file with the same name exists in the specified path destination, the file is overwritten. • Uses the operation folder during command execution.
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. • Uses the operation folder during command execution.
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 on 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 on path that can be specified as an argument, refer to the following.
 Page 645 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, File Transfer Executing State (System.Md.FileTransfer_State) turns "-1: Error Occurrence (Error_)" and the execution ends.
- When the command format is abnormal, File Transfer Executing State (System.Md.FileTransfer_State) turns "-1: Error Occurrence (Error_)" and the execution ends.
- For the operation to the file set with the read only attribute, refer to the following.
 Page 647 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 space 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 on the environmental variable to be specified, refer to the following.  Page 646 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 753 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 753 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.

- 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. An error does not occur if a value out of setting range is written at backup. Do not write the value of the out of setting range. It may cause an unexpected operation of the system.
- When files before the import are specified as the target data, they may cause filing failure (such as when local labels are specified before PLC READY [Y0] is ON). Execute it after the import.
- 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
```

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 *.pm) 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, File Transfer Executing State (System.Md.FileTransfer_State) turns "-1: Error Occurrence (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 File Transfer Log Capacity (System.PrConst.FileTransfer_LogCapacity) and the operation depends on the setting value as follows.

File Transfer Log Capacity (FileTransfer_LogCapacity)	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 [k bytes]	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. After the warning is output, the file transfer execution is maintained without log files.

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 File Transfer Execution Request (System.Cd.FileTransfer_Execute) and File Transfer Command (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.
- Some commands such as compression use the operation folder. The error may occur due to the insufficient capacity of the operation folder caused by large files and folder compression, etc. In such a case, change the operation folder to an SD memory card, etc. (The operation folder can be specified by changing the environmental variable %TEMP%).

Relevant add-ons

The following add-on is required to use this function.

- FileTransfer

19.4 SD Memory Card

This section describes functions using an SD memory card.

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.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 free space after formatting.)
FreeSpace	Free Space	Stores the free space 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 642 Memory and File

Installation and removal of SD memory card

For details, refer to "Installation and Removal of SD Memory Card" of Part 1 in the following manual.

 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 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 details, refer to "Security" of Part 1 in the following manual. 📖MELSEC iQ-R Motion Module User's Manual (Network)
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 details, refer to "Security" of Part 1 in the following manual. 📖MELSEC iQ-R Motion Module User's Manual (Network)

20

Operation of this function for each system status

○: Possible

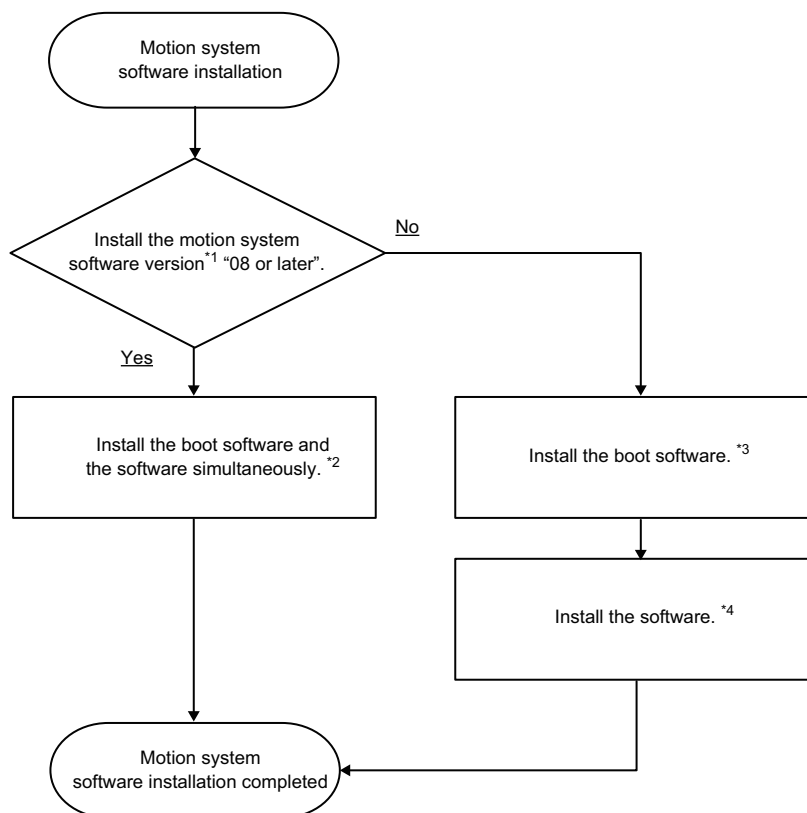
Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

MEMO

21 MODULE SOFTWARE INSTALLATION

How to install software of the motion system is explained in this chapter.

To install the motion system software, follow the flow below and execute.



*1 Indicates a version of motion system software to be installed. It is not a version of the installed motion system software.

*2 For details, refer to the following.

📖 Page 674 How to batch install the motion system software

*3 For details, refer to the following.

📖 Page 682 How to update the boot software

*4 For details, refer to the following.

📖 Page 678 How to install the software

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 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 "Add-on 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 or reference below.

☞ 27 List of Add-on Library

If the combination of the software version does not match, the error "Add-on Library Load Error" (error code: 3205H) occurs and the system does not start. Execute installation again with the correct combination of the software version.

Operation of this function for each system status

○: Possible, △: Possible (Restricted)

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	△ (Operation may not be possible according to the error status)

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

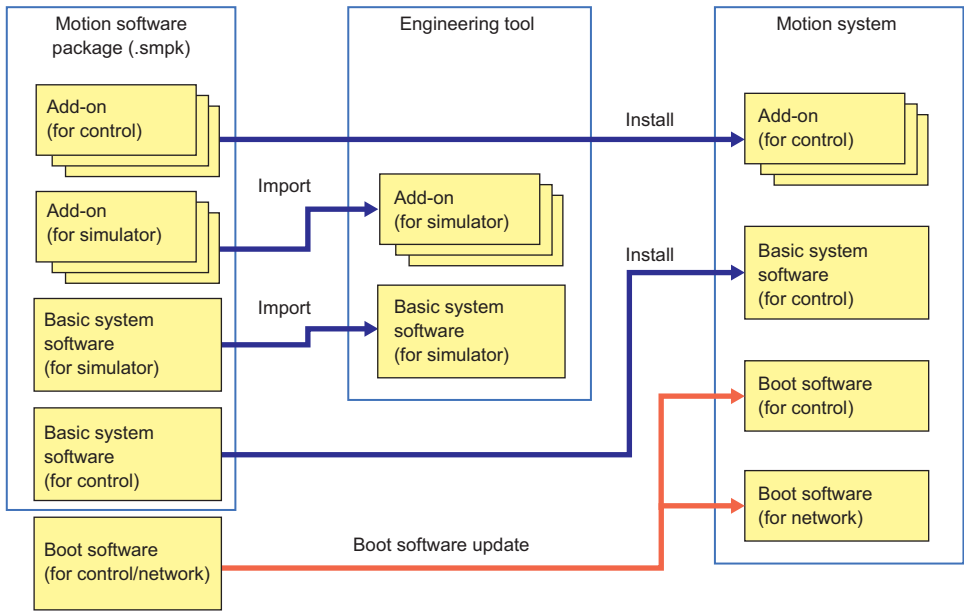
Software file configuration of motion system

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 119 Add-on 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.

How to batch install the motion system software

This section describes how to install motion system software downloaded from the MITSUBISHI ELECTRIC FA Global Website.

To install the version of motion system software, "08 or later", install the software and the boot software simultaneously by batch installation.

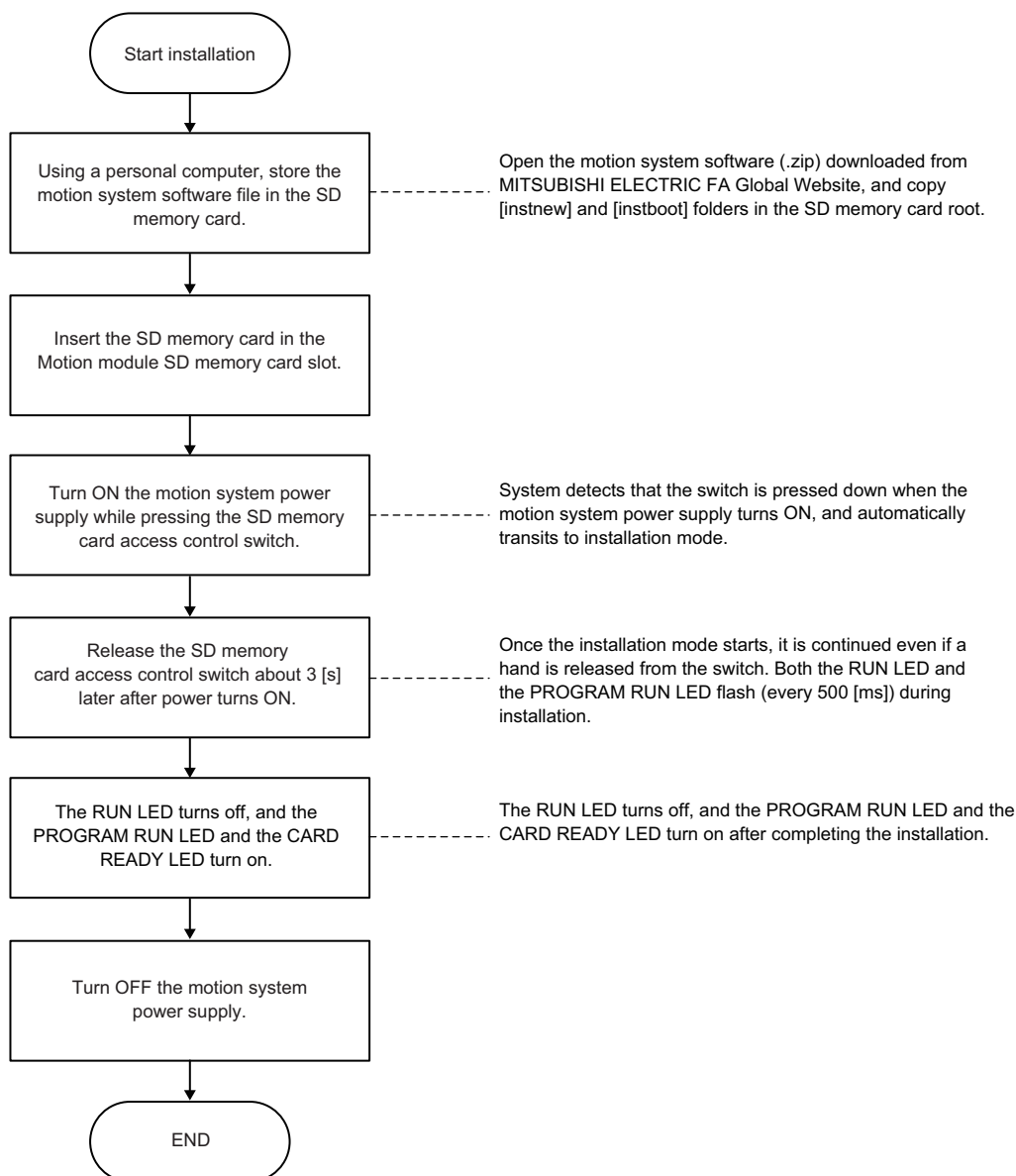
The batch installation can be executed only from the SD memory card. When the batch installation is executed, the separate installation of the software and the boot software is not required.

To install the version of motion system software, "07 or earlier", install the software and the boot software separately because the batch installation is not supported. For the installation, refer to the following.

☞ Page 678 How to install the software, ☞ Page 682 How to update the boot software

Point

To install the software separately, update the boot software first, and then install the software.



- Do not install the folder combined [instnew] and [instboot] in the different motion software packages.
- 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 are flashing (every 200 [ms]). After dealing with the error, carry out installation again. When reading the SD memory card is abnormal, check the 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.
- The ready [X0] and the synchronization flag [X1] do not turn ON during installation execution from the SD memory card.

□: OFF, ■: ON, ●: Flashing

Motion system status	LED display	Description	Action
Normal operation	RUN● P RUN● C RDY□	Flashing (every 500 [ms]): Executing the installation	Wait until the installation is completed.
	RUN□ P RUN■ C RDY■	Turning on: the installation is normally completed	Turn the power of motion system OFF to ON, and check that the CPU module can be normally turned RUN/STOP.
Operation failure	RUN□ P RUN● C RDY●	Flashing (every 200 [ms]): the installation is completed with an error.	Turn the power of motion system OFF to ON, and execute the installation again.

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 Basic System Software Version (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.



When the version of motion system software is "1.7 or earlier", only the version (2 digits from the left) of the boot software (for network) is displayed immediately after start (add-on loading) of the Motion module.

The screenshot shows the 'Product Information List' window. It contains a table with columns: Module Configuration, Control CPU, Network Information (Port 1), Network Information (Port 2), IP Address (Port1 IPv4), IP Address (Port2 IPv4), Module Synchronious Status, Firmware Version, and Production information. The 'Firmware Version' column shows '00' for the 'Basic-CPU' and '020103' for the 'Basic-I/O 1' module. The 'Production information' column shows a barcode for the 'Basic-I/O 1' module. A callout box points to the '020103' version string, explaining its components: '02' is the boot software (for network) version (two digits), '01' is the boot software (for control) version (two digits), and '03' is the basic system software version (two digits). Another callout box points to the 'Production information' column, stating it is the production information of the Motion module.

Module Configuration	Control CPU	Network Information (Port 1)	Network Information (Port 2)	IP Address (Port1 IPv4)	IP Address (Port2 IPv4)	Module Synchronious Status	Firmware Version	Production information
Basic-Power Supply	Power Supply	-	-	-	-	-	-	-
Basic-CPU	CPU	-	-	192.168.3.3	-	-	00	-
Basic-I/O 0	-	-	-	-	-	-	-	-
Basic-I/O 1	CC-Link	1-0	-	192.168.3.2	-	-	020103	-
Basic-I/O 2	-	-	-	-	-	-	-	-
Basic-I/O 3	-	-	-	-	-	-	-	-
Basic-I/O 4	-	-	-	-	-	-	-	-

020103

The boot software (for network) version (two digits) — 02 —
The boot software (for control) version (two digits) — 01 —
The basic system software version (two digits) — 03 —

Production information of the Motion module

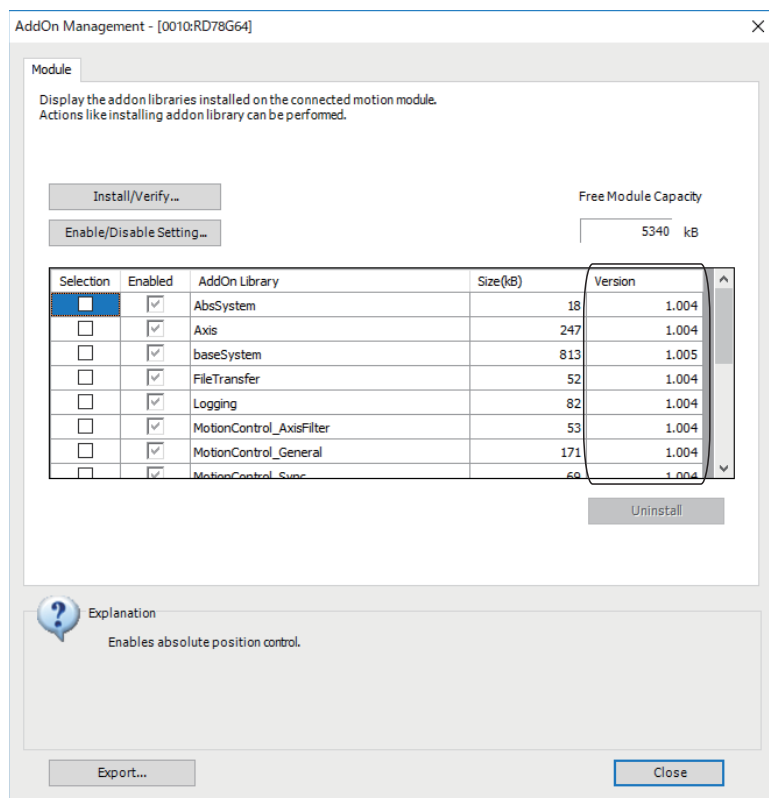
Checking the add-on version

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 Boot Software Version (System.Md.Version_BootSw).

Precautions

Relevant add-ons

This function can be performed without add-ons.

System memory capacity

System memory is not required for the software installation.

21.2 Basic System Software Update Function

Software management

How to install the software

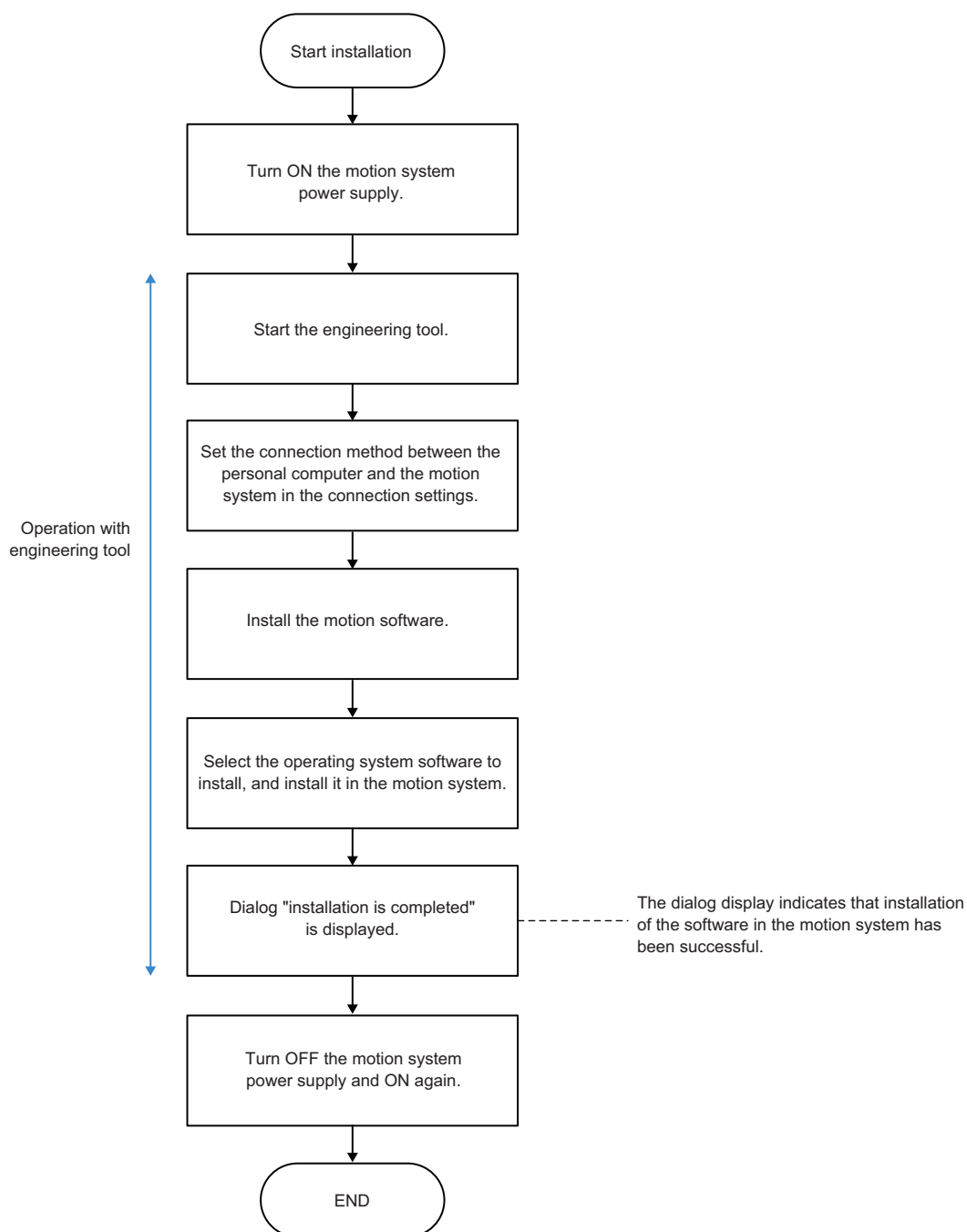
The following explains a procedure for installing the software.

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 669 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.

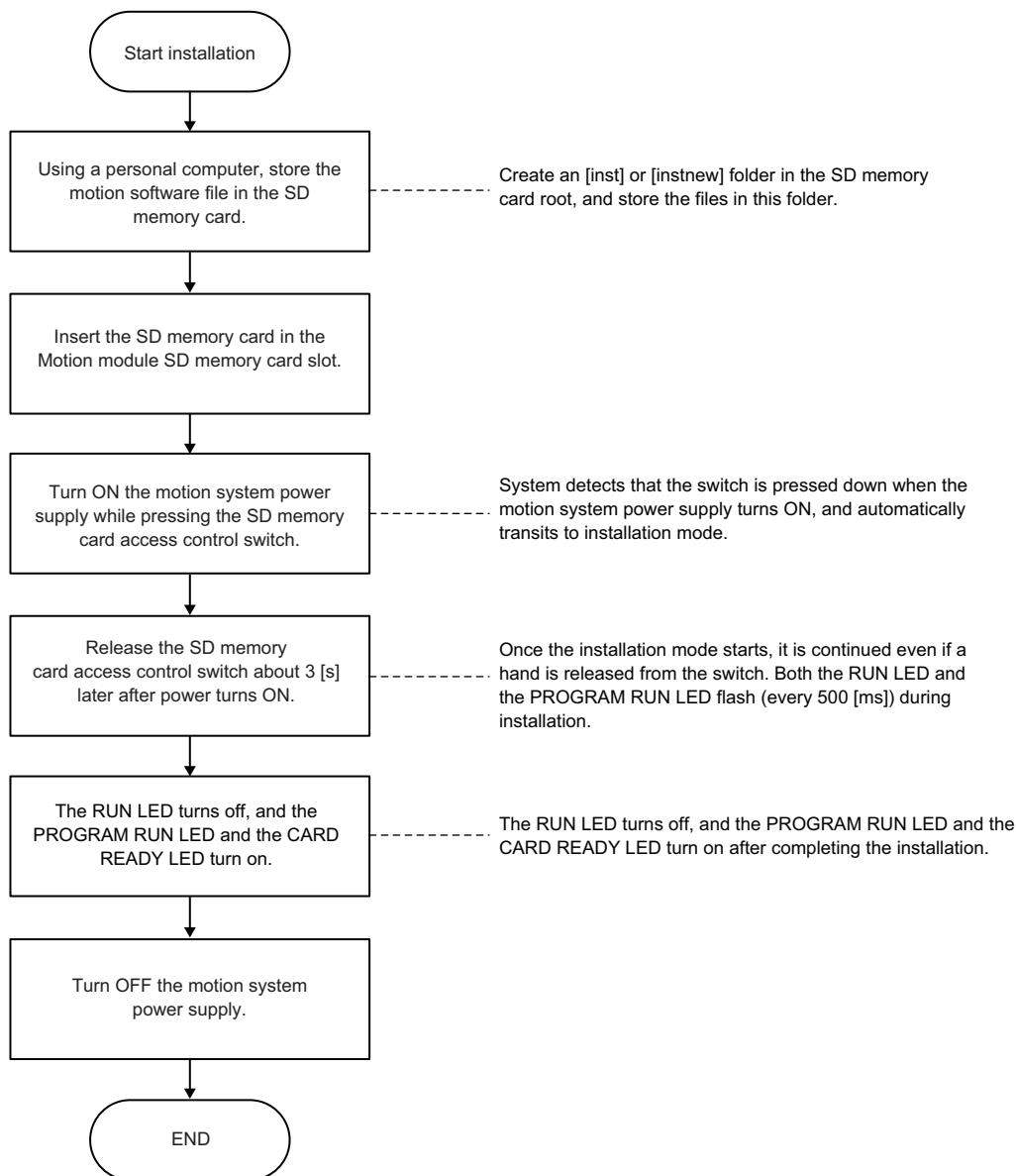
- Each function stored in the motion software package can be selected for the execution of the installation.
- Add-ons which have been installed are not deleted.

■ 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.



- 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 are flashing (every 200 [ms]). 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.
- The ready [X0] and the synchronization flag [X1] do not turn ON during installation execution from the SD memory card.

□: OFF, ■: ON, ●: Flashing

Motion system status	LED display	Description	Action
Normal operation	RUN● P RUN● C RDY□	Flashing (every 500 [ms]): Executing software installation	Wait until software installation is completed.
	RUN□ P RUN■ C RDY■	Turning on: Software installation is normally completed	Turn the power of motion system OFF to ON, and check that the CPU module can be normally turned RUN/STOP.
Operation failure	RUN□ P RUN● C RDY●	Flashing (every 200 [ms]): Software installation is completed with an error.	Turn the power of motion system OFF to ON, or reset the system, then execute software installation 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.

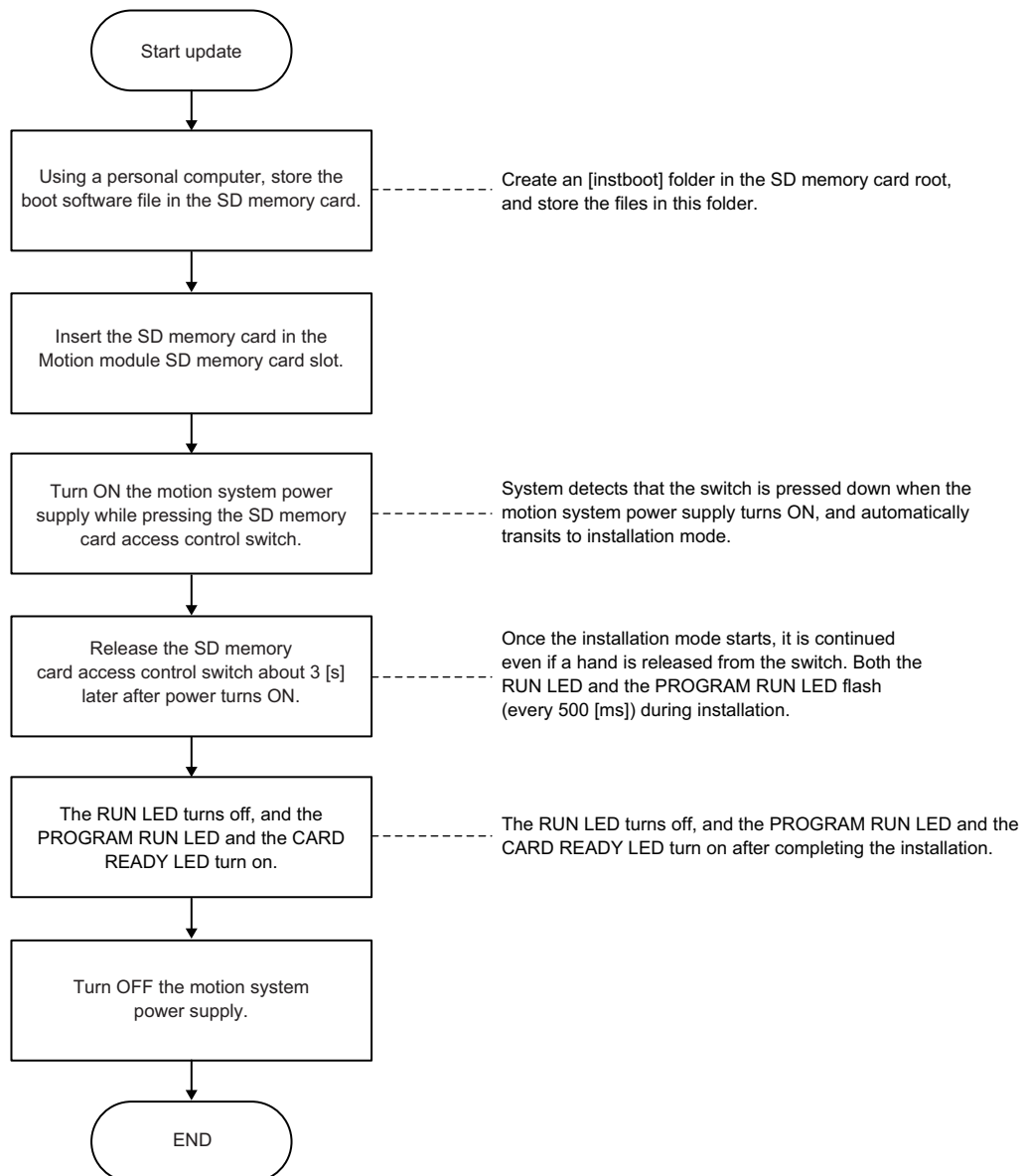
Point

- 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 checked with Boot Software Version (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.



- 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 are flashing (every 200 [ms]). Update the software again after clearing the error.
When reading the SD memory card is abnormal, check the SD memory card.
When the boot software file is abnormal or when it cannot be recognized, check the boot software file.
- If the boot software updating can not be completed successfully, the RUN LED turns OFF or the ERR LED turns OFF or flashing (every 200 [ms]) even if the Motion module is powered ON and the Motion module might not be recognized.
In this case, insert an 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 flashing (every 200 [ms]) 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.
To restore the boot software, follow the procedure above after temporarily changing the rising edge time in the entire system to 15 [s] or less in the system configuration.
- To install the version "07 or earlier" of the motion system software from the SD memory card, boot software update and software installation cannot be executed simultaneously. When there are both folders, only the 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.
- The ready [X0] and the synchronization flag [X1] do not turn ON during installation execution from the SD memory card.

□: OFF, ■: ON, ●: Flashing

Motion system status	LED display	Description	Action
Normal operation	RUN● P RUN● C RDY□	Flashing (every 500 [ms]): Updating the boot software	Wait until boot software update is completed.
	RUN□ P RUN■ C RDY■	Boot software update is normally completed	Turn the power of the motion system OFF to ON, and check that the motion system can be normally turned RUN/STOP.
Operation failure	RUN□ P RUN● C RDY●	Flashing (every 200 [ms]): Boot software update is completed with an error.	Turn the power of the motion system OFF to ON, then execute boot software update again.

The boot software list

For the boot software list, refer to the following.

☞ 28 List of Boot software

22 TROUBLESHOOTING

22.1 LED Control

The status of the motion system can be checked by the following.

The following lists the LED display specifications of the Motion module.

Description differs during software installation. For details, refer to the following.

21 MODULE SOFTWARE INSTALLATION

Name	Description
RUN LED	Displays the operation status. ON: Operating normally Flashing (every 500 [ms]): Clear / Quick clearing OFF: Error occurrence or initializing
ERR LED	Displays the error status. OFF: Operating normally ON: Error occurrence Flashing (every 200 [ms]): Error occurrence 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 ^{*1} OFF: Not communicating data ^{*1}
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} Includes the cyclic transmission data and the transient transmission data of CC-Link IE TSN.

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 control setting function). For details, refer to the following.  Page 610 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.

Operation of this function for each system status

○: Possible

Status	Operation availability
STOP	○
RUN	○
Moderate error	○
Major error	○

Relevant terms

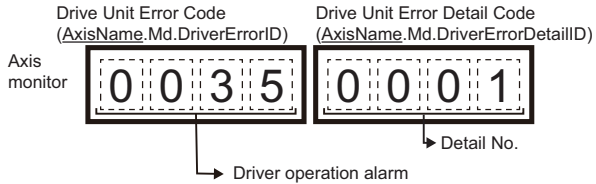
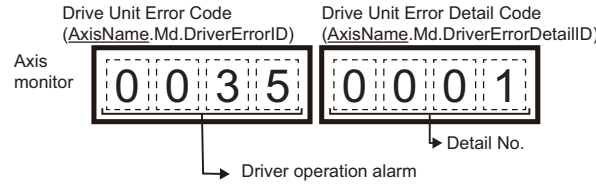
Term	Description
Error reset	Clearing the detection status of errors and warnings
Drive unit error	An error or a warning occurred in the drive unit
Axis error Axis warning Axes group error Axes group warning	An error or a warning related to an axis
System error	An error or a warning not related to an axis When Axis information (Axis) and Axes Group Information (AxesGroup) of the Motion control FBs are not correct, the system error will occur.

Overall block diagram

Refer to the following.

 Page 610 History Data

Relevant variables

Variable/Structure name	Name	Details
System.Md		
Warning	Motion Area System Warning Detection	Becomes TRUE at warning occurrence.
Error	Motion Area System Error Detection	Becomes TRUE at error occurrence.
NetworkError	Network Area Error Detection	Becomes TRUE at network error occurrence.
WarningID	Latest Motion Area System Warning Code	Stores the latest warning code.
ErrorID	Latest Motion Area System Error Code	Stores the latest error code.
NetworkErrorID	Network Area Error Code	Stores the error code at network error occurrence.
AxisName.Md		
Warning	Axis Warning Detection	Becomes TRUE at axis warning occurrence.
Error	Axis Error Detection	Becomes TRUE at axis error occurrence.
DriverError	Drive Unit Error Detection	Becomes TRUE at drive unit error occurrence.
WarningID	Axis Warning Code	Stores the warning code at axis warning occurrence.
ErrorID	Axis Error Code	Stores the error code at axis error occurrence.
DriverErrorID	Drive Unit Error Code	Stores upper 16 bits of "Current alarm (2A41H)" of the slave object at drive unit error occurrence. (Ex.) For MR-J5(W)-G  Stores [0035H] when servo alarm [AL.035. 1_Command frequency error] occurs at drive unit.
DriverErrorDetailID	Drive Unit Error Detail Code	Stores lower 16 bits of "Current alarm (2A41H)" of the slave object at drive unit error occurrence. (Ex.) For MR-J5(W)-G  Stores [0001H] when servo alarm [AL.035. 1_Command frequency error] occurs at drive unit.
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.
Variable/Structure name	Name	Details
System.PrConst		
ExcludeWarning	Excluded Warning	Sets the warning which is not to be detected. (Ex.) "": Not set Not detect the warnings of "0x1000, 0x1001": 0x1000, 0x1001. Not detect the warnings from "0x1000-0x1010": 0x1000 to 0x1010.

Control details

The latest error code occurred in motion is output in Latest Motion Area System Error Code (System.Md.ErrorID).

When multiple errors occur, follow the conditions below whether the error code output to Latest Motion Area System Error Code (System.Md.ErrorID is updated).

Occurring error	Occurred error					
Latest Motion Area System Error Code (System.Md.ErrorID)	Axis Error Code (AxisName.Md.ErrorID)/Axes Group Error Code (AxesGroupName.Md.ErrorID)/Latest Motion Area System Error Code (System.Md.ErrorID)			Network Area Error Code (System.Md.NetworkErrorID)		
	Minor error	Moderate error	Major error	Minor error	Moderate error	Major error
No error	Updating	Updating	Updating	Updating	Updating	Updating
Minor error	Updating	Updating	Updating	Not updating	Updating	Updating
Moderate error	Not updating	Updating	Updating	Not updating	Not updating	Updating
Major error	Not updating	Not updating	Updating	Not updating	Not updating	Not updating

Excluded warning setting

- The specified warning can be ignored by setting Excluded Warning (System.PrConst.ExcludeWarning).
- When the warning set to Excluded Warning (System.PrConst.ExcludeWarning) has occurred, the relevant variables and each histories are not updated.
- If set Excluded Warning (System.PrConst.ExcludeWarning), each checking process to detect warnings is not omitted, so that the processing time is not reduced.
- If set the error code to Excluded Warning (System.PrConst.ExcludeWarning), the error is not excluded.

Precautions

Necessary slave object

■PDO

- CurrentAlarm (monitor of drive unit errors)

■SDO

None

Relevant add-ons

The following add-on is required to use this function.

- MotionControl_General

22.3 Error and Warning Reset

Errors and warnings occurred in the motion system can be reset by the following methods.

Operation of this function for each system status

○: Possible, △: Possible (restricted)

Status	Operation availability
STOP	○
RUN	○
Moderate error	△ (only for the axis and the axes group error reset)
Major error	△ (only for the axis and the axes group error reset)

Data to be reset

■System error reset

- All errors/warnings

Error type	Description	Variable name
System	Motion area system error detection Latest motion area system error code Motion area system warning detection Latest motion area system warning code Network area error detection Network area error code	System.Md.Error System.Md.ErrorID System.Md.Warning System.Md.WarningID System.Md.NetworkError System.Md.NetworkErrorID
Axis	Axis warning detection Axis error code Axis error detection Axis warning code Drive unit error detection Drive unit error code Drive unit error detail code	AxisName.Md.Warning AxisName.Md.ErrorID AxisName.Md.Error AxisName.Md.WarningID AxisName.Md.DriverError AxisName.Md.DriverErrorID AxisName.Md.DriverErrorDetailID
Axes group	Axes group warning detection Axes group warning code Axes group error detection Axes group error code	AxesGroupName.Md.Warning AxesGroupName.Md.WarningID AxesGroupName.Md.Error AxesGroupName.Md.ErrorID

■Axis error reset

- Axis error/warning

Error type	Description	Variable name
Axis	Axis warning detection Axis error code Axis error detection Axis warning code Drive unit error detection Drive unit error code Drive unit error detail code	AxisName.Md.Warning AxisName.Md.ErrorID AxisName.Md.Error AxisName.Md.WarningID AxisName.Md.DriverError AxisName.Md.DriverErrorID AxisName.Md.DriverErrorDetailID

■Axes group error reset

- Axes group error/warning

Error type	Description	Variable name
Axes group	Axes group warning detection Axes group warning code Axes group error detection Axes group error code Axis warning detection* ¹ Axis warning code* ¹ Axis error detection* ¹ Axis error code* ¹ Drive unit error detection* ¹ Drive unit error code* ¹ Drive unit error detail code* ¹	AxesGroupName.Md.Warning AxesGroupName.Md.WarningID AxesGroupName.Md.Error AxesGroupName.Md.ErrorID AxisName.Md.Warning AxisName.Md.WarningID AxisName.Md.Error AxisName.Md.ErrorID AxisName.Md.DriverError AxisName.Md.DriverErrorID AxisName.Md.DriverErrorDetailID

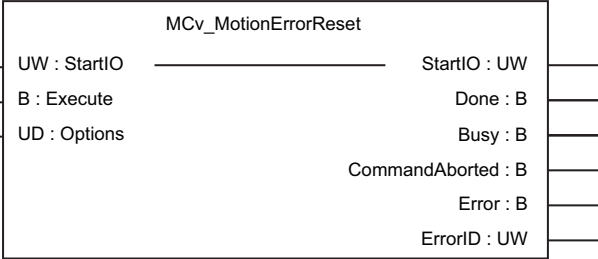
*1 Only axis which belongs to axes group

Relevant variables

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.

Relevant FBs

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 to FF0H	Refer to the right description.	It can be omitted when FB is used at motion system side. Setting values are ignored. It cannot be omitted when FB is used at the CPU module side.

■ Input variables

Import ↑: At start

Name	Variable name	Data type	Import	Setting range	Default value	Description
Execution command	Execute	BOOL	↑	TRUE, FALSE	FALSE	Becomes TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Specify "00000000H". (If other than "00000000H" is specified, the error "Out of Options Range" (error code: 1A4EH) occurs.)

■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. Becomes FALSE because of Execute command (Execute) = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
Error code	ErrorID	WORD(UINT)	0	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]	MC_Reset DUT : Axis B : Execute UD : Options Axis : DUT Done : B Busy : B CommandAborted : B Error : B ErrorID : UW
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 754 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	Becomes TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Specify "00000000H". (If other than "00000000H" is specified, the error "Out of Options Range" (error code: 1A4EH) occurs.)

■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. Becomes FALSE because of Execute command (Execute) = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
ErrorID	ErrorID	WORD(UINT)	0	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	Input import	Setting range	Default value	Description
Axes group information	AxesGroup	AXES_GROUP_REF	↑	—	Omission not possible	📖 Page 758 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	Becomes TRUE, the FB is activated.
Options	Options	DWORD(HEX)	↑	00000000H	00000000H	Specify "00000000H". (If other than "00000000H" is specified, the error "Out of Options Range" (error code: 1A4EH) occurs.)

■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	Indicates that the FB is executing.
Abortion of execution	CommandAborted	BOOL	FALSE	Indicates that the command has been aborted because of timeout. Becomes FALSE because of Execute command (Execute) = FALSE.
Error	Error	BOOL	FALSE	Indicates that an error has occurred in the FB as it is TRUE.
Error code	ErrorID	WORD(UINT)	0	The error code generated in the FB is returned.

System error reset

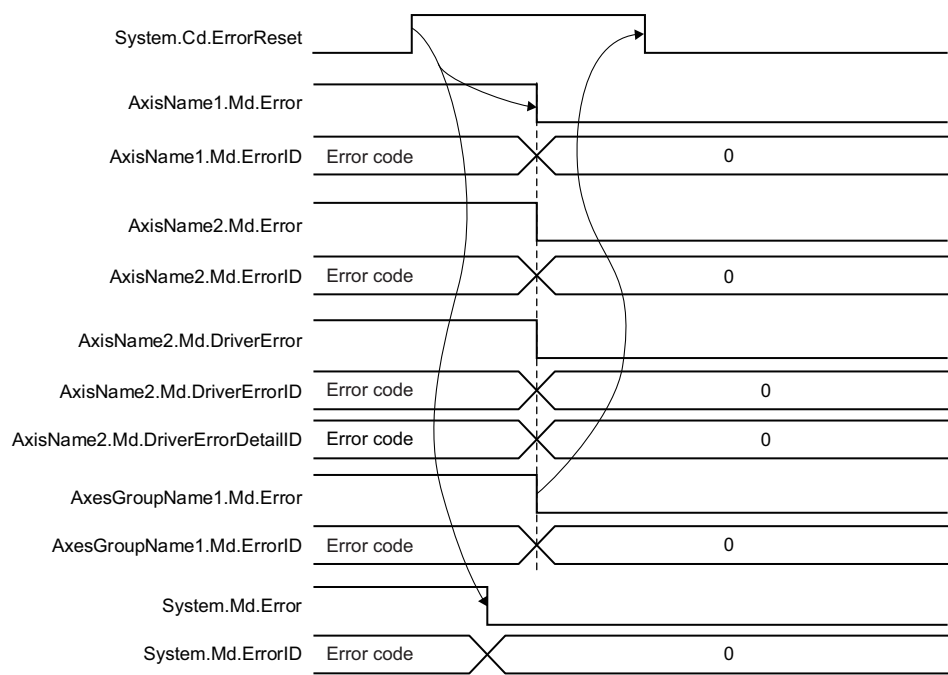
- Reset all errors/warnings of the motion system. There are System Error Reset (System.Cd.ErrorReset), MCv_MotionErrorReset (Motion Error Reset) and clear error button on the module diagnostics window of GX Works3 as a reset method. (System Error Reset (System.Cd.ErrorReset) does not become TRUE as the reset is performed by clear error button.)

Control details

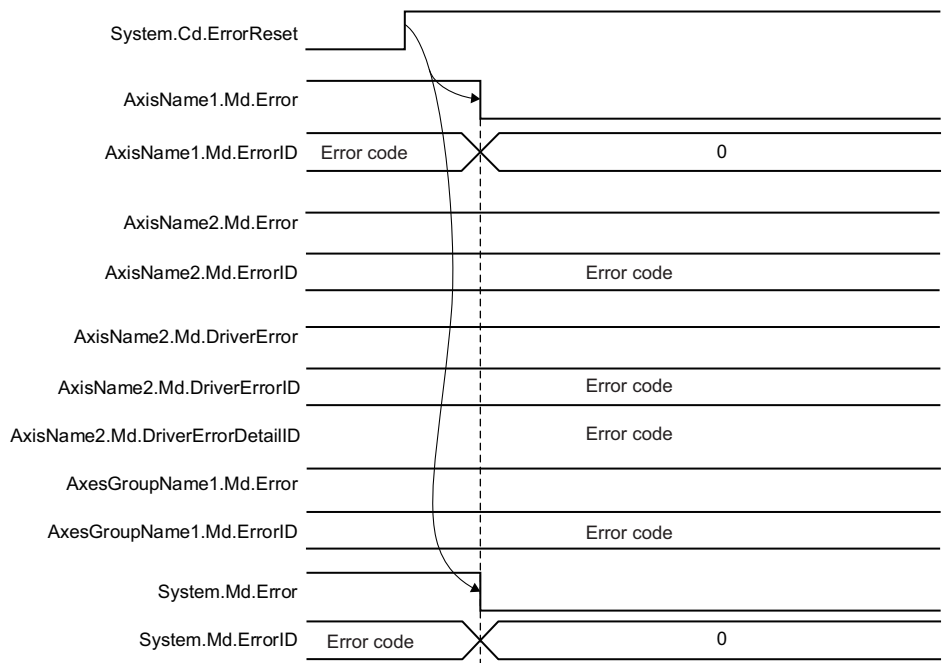
■System Error Reset (System.Cd.ErrorReset)

- Reset is executed at the rising edge detection of System Error Reset (System.Cd.ErrorReset).
- When the reset is completed, System Error Reset (System.Cd.ErrorReset) becomes FALSE.
- If the error reset is not succeeded, System Error Reset (System.Cd.ErrorReset) remains TRUE.

[When the FB is normally completed] (When the error reset is succeeded)



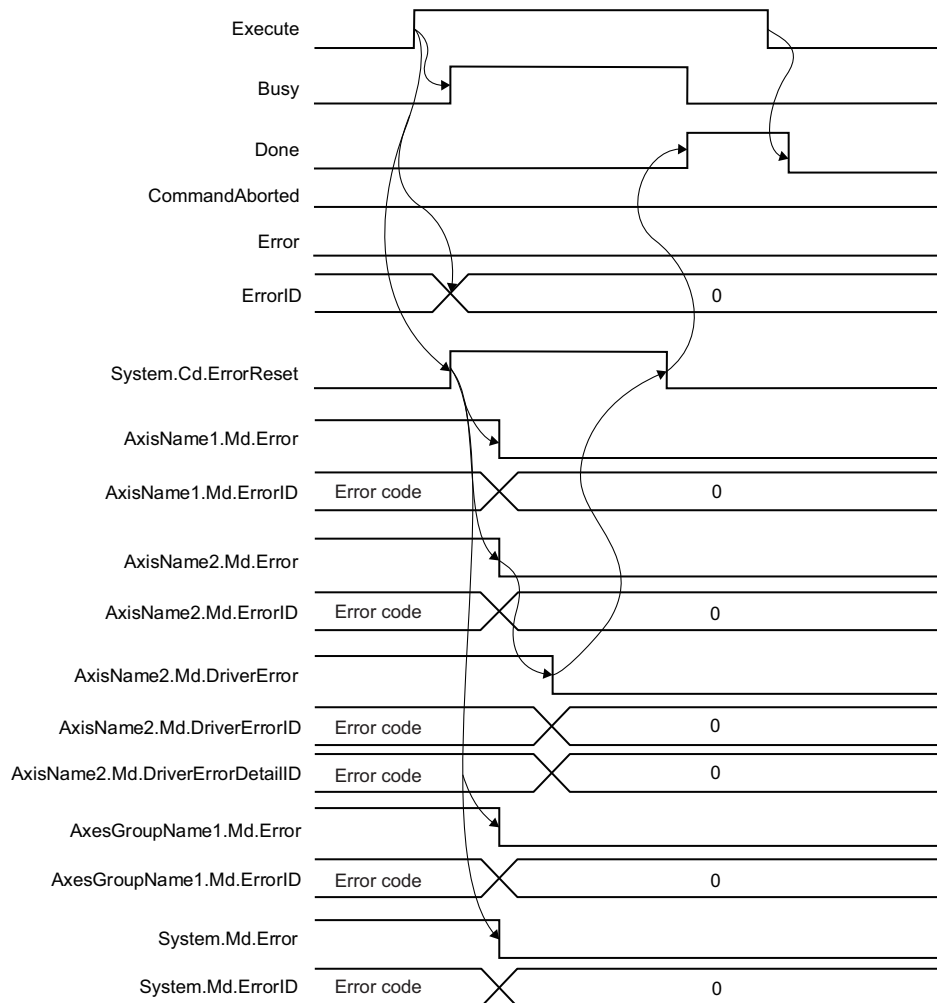
[When an error occurs] (When the error reset is failed)



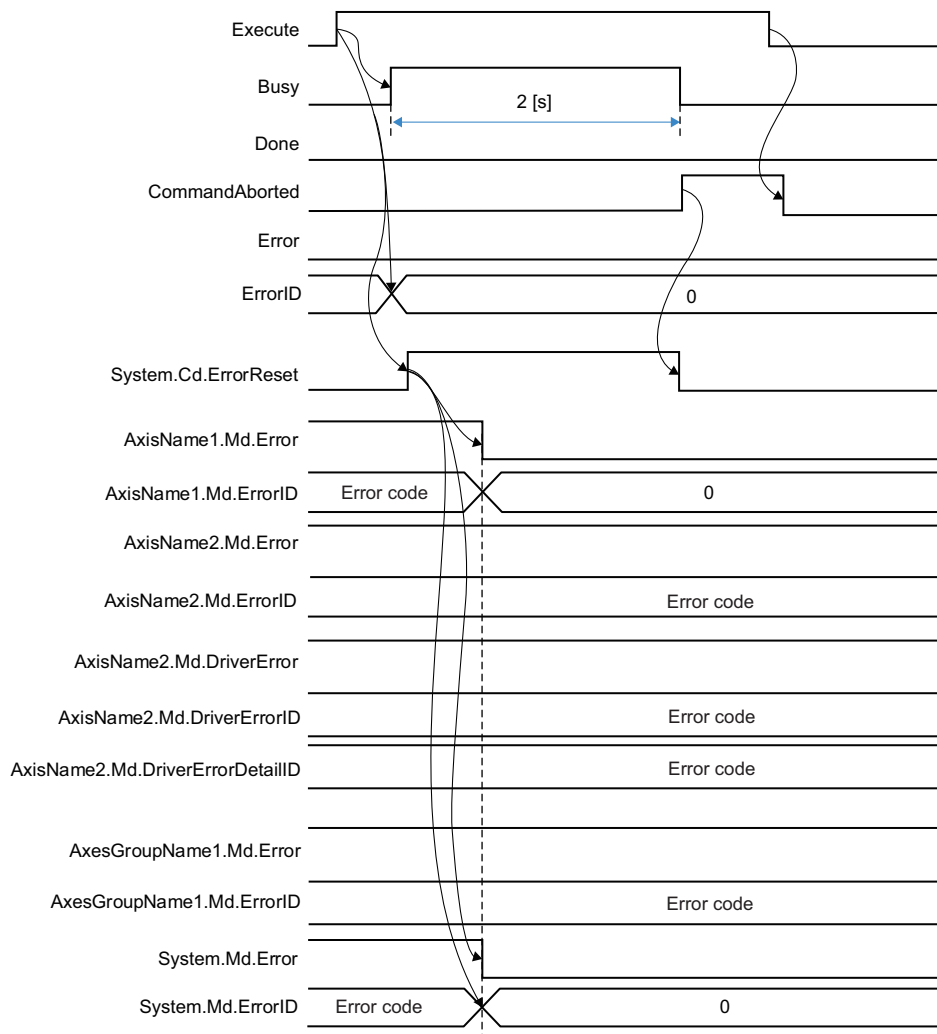
■MCv_MotionErrorReset (Motion Error Reset)

- The FB is executed with Execute command (Execute) = TRUE and Executing (Busy) becomes TRUE as the process starts, and then System Error Reset (System.Cd.ErrorReset) is set to TRUE.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE as clearing the errors/warnings of the motion system is completed.
- The errors/warnings are not cleared if Execute command (Execute) becomes TRUE while the error/warning causes still remain. In this case, Abortion of execution (CommandAborted) becomes TRUE and System Error Reset (System.Cd.ErrorReset) is set to FALSE if the errors are not cleared within two [s] after command executed. Temporarily set Execute command (Execute) to FALSE, remove the causes of the errors/warnings, then set Execute command (Execute) to TRUE again.

[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate System Error Reset (System.Cd.ErrorReset) directly while System Error Reset (SYSTEM.Cd.ErrorReset) is executed.
- Use MCv_MotionErrorReset (Motion Error Reset) without operating System Error Reset (System.Cd.ErrorReset) to perform the error reset from the CPU module.

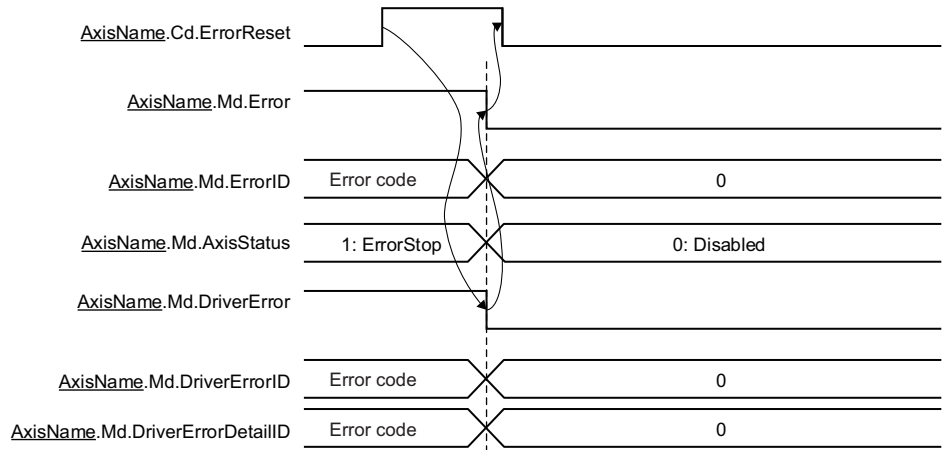
Axis error reset

Reset the error/warning of a single axis and drive unit error by Axis Error Reset (AxisName.Cd.ErrorReset).

Control details

■Axis Error Reset (AxisName.Cd.ErrorReset)

- Reset is executed at the rising edge detection of Axis Error Reset (AxisName.Cd.ErrorReset).
- When the reset is completed, Axis Error Reset (AxisName.Cd.ErrorReset) becomes FALSE.
- The error reset is not executed if it is executed during axis operation. The error monitor is reset when the axis is stopped completely and Axis Error Reset (AxisName.Cd.ErrorReset) is TRUE.

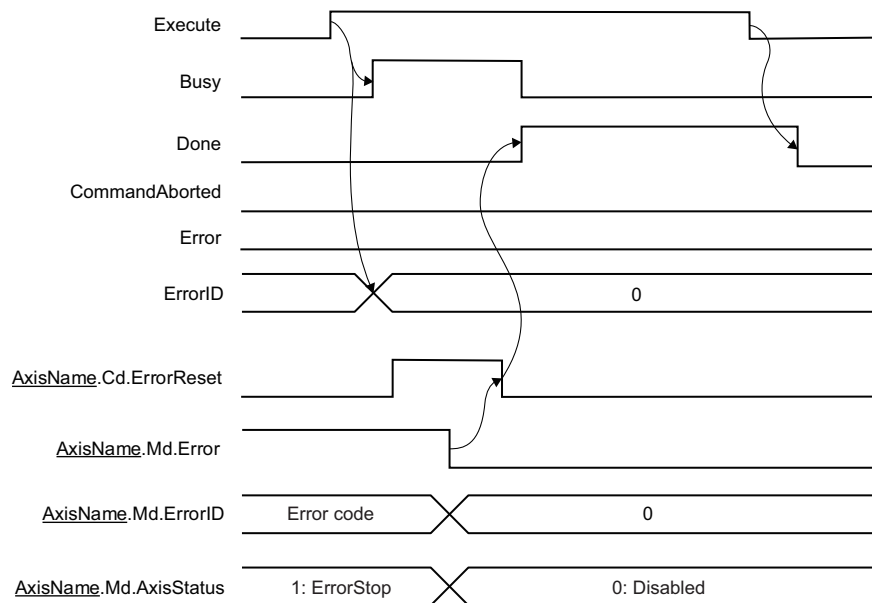


■MC_Reset (Axis Error Reset)

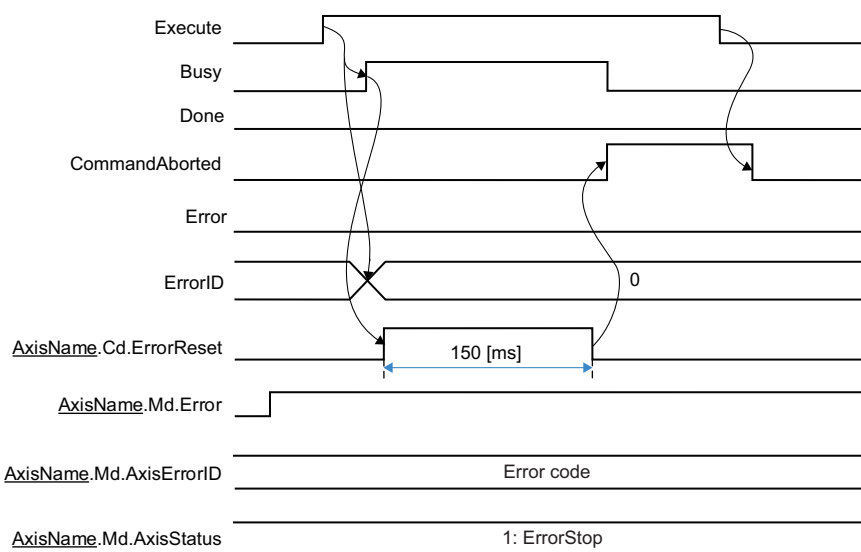
- The FB is executed with Execute command (Execute) = TRUE and Executing (Busy) becomes TRUE as the process starts, and then Axis Error Reset (AxisName.Cd.ErrorReset) of the target axis is set to TRUE.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE as clearing the errors/warnings of the axis is completed.
- Executing (Busy) is set to FALSE and Execution completion (Done) becomes TRUE after the warnings are cleared if execution is carried out as the axis status is not "1: Stopping on error (ErrorStop)".
- The errors/warnings are not cleared if Execute command (Execute) is set to TRUE while the error/warning causes of the axis still remain. In this case, Abortion of execution (CommandAborted) becomes TRUE. Set Execute command (Execute) to FALSE temporarily to clear the error/warning causes and set Execute command (Execute) to TRUE again.
- If the error occurs in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID). For details on error codes, refer to the following.

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[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate Axis Error Reset (AxisName.Cd.ErrorReset) directly while MC_Reset (Axis Error Reset) is executed.
- Use MC_Reset (Axis Error Reset) without operating Axis Error Reset (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 Axes Group Error Reset (AxesGroupName.Cd.ErrorReset).

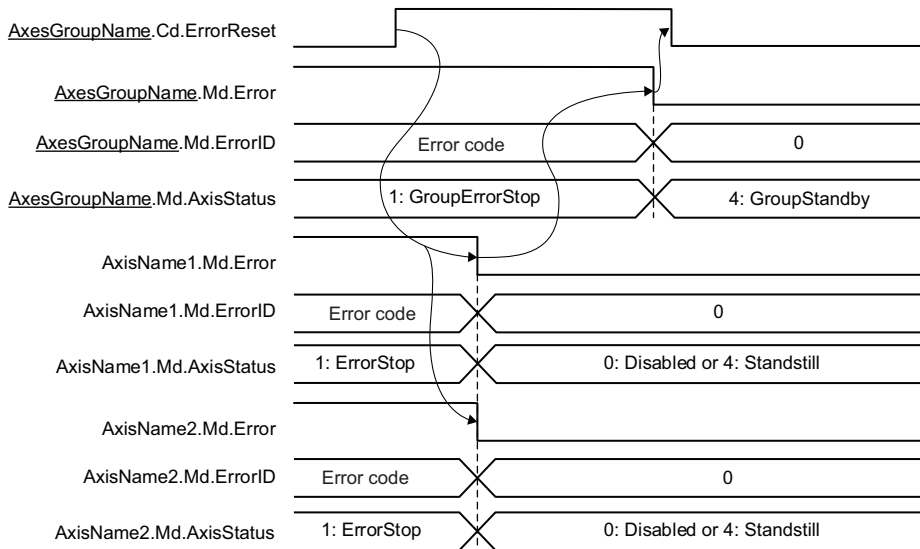
Reset also each axis error which belongs to the axes group in addition to the error/warning of the axes group.

Control details

■ Axes Group Error Reset (AxesGroupName.Cd.ErrorReset)

- Reset is executed at the rising edge detection of Axes Group Error Reset (AxesGroupName.Cd.ErrorReset).
- When the reset is completed, Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) becomes FALSE.
- When the error reset of the configuration axis is not completed, the error reset of the axes group is not completed.
- If the error reset is not succeeded, Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) remains TRUE.
- The error reset is not executed if it is executed during axes group operation. The error monitor is reset when the axes group is stopped completely and Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) is TRUE.
- The error reset can be canceled by changing Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) to FALSE.

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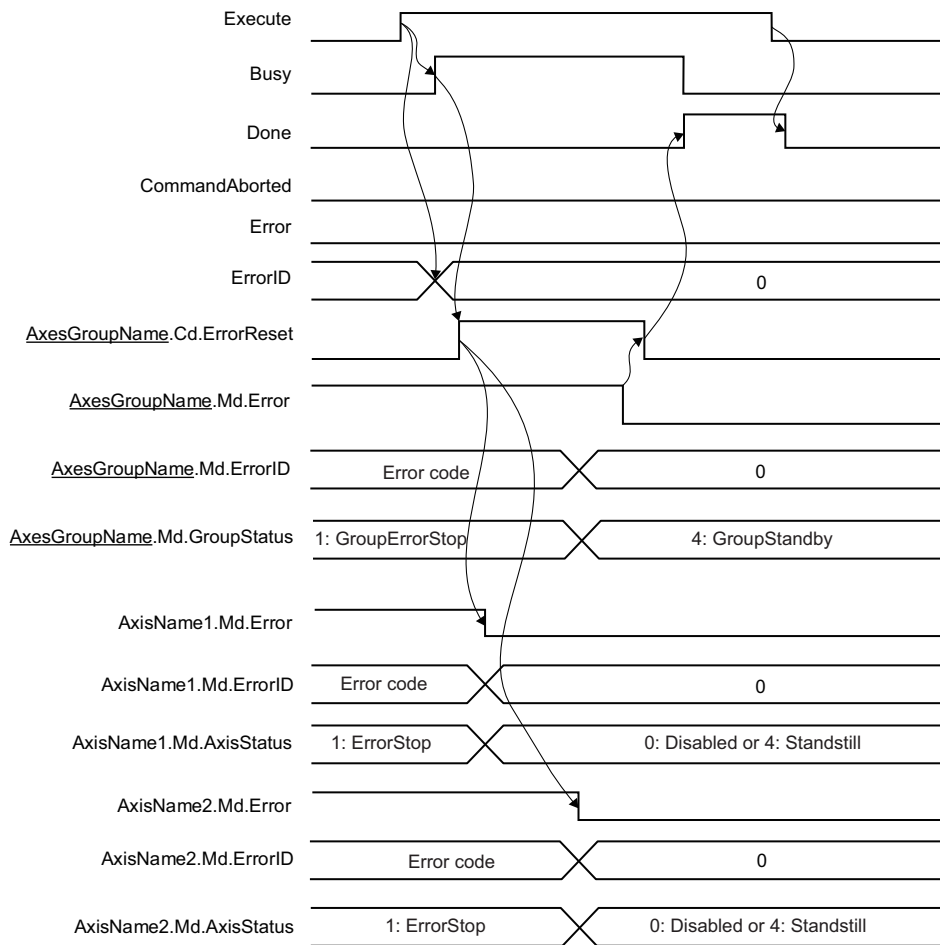


■ MC_GroupReset (Axes Group Error Reset)

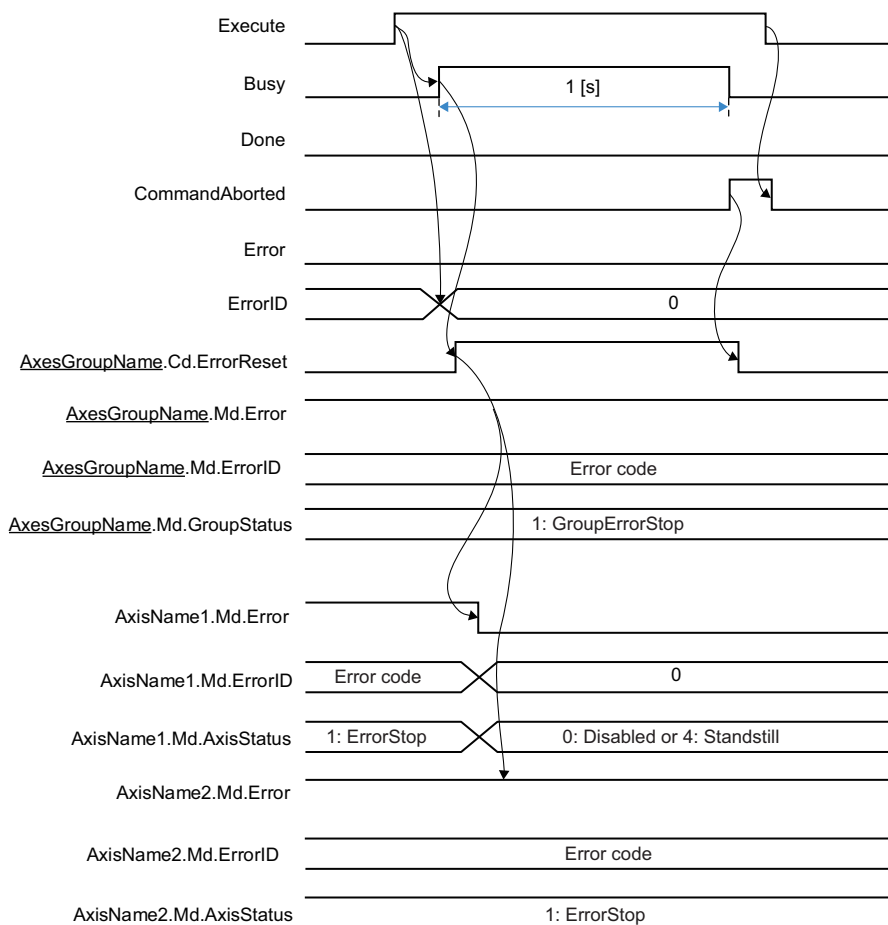
- As the process start by executing this FB at detecting rising edge of Execute command (Execute), Executing (Busy) becomes TRUE, and then Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) of the target axes group is set to TRUE.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE as clearing the errors/warnings of the axis and the axes group is completed.
- Executing (Busy) becomes FALSE and Execution completion (Done) becomes TRUE after the warnings are cleared if execution is carried out as the axes group status is not "1: Stopping on error (GroupErrorStop)".
- The errors/warnings are not cleared if Execute command (Execute) is set to TRUE while the error/warning causes still remain. In this case, Abortion of execution (CommandAborted) becomes TRUE and becomes FALSE Axes Group Error Reset (AxesGroupName.Cd.ErrorReset) of the target axes group if the errors are not cleared within 1 [s] after command executed. Set Execute command (Execute) to FALSE temporarily to clear the error/warning causes and set Execute command (Execute) to TRUE again.
- If the error occurs in the FB, Error (Error) is set to TRUE and the error code is stored in Error code (ErrorID). For details of error codes, refer to the following.

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[When the FB is normally completed]



[At timeout]



Precautions

- Do not operate Axes Group Error Reset (AxisGroupName.Cd.ErrorReset) directly while MC_GroupReset (Axes Group Error Reset) is executed.
- Use MC_GroupReset (Axes Group Error Reset) without operating Axes Group Error Reset (AxisGroupName.Cd.ErrorReset) to perform the error reset from the CPU module.

Precautions

Necessary slave object

■PDO

None

■SDO

Reset alarm (2A46H)

*1 For using the real drive axis, the real encoder axis

Relevant add-ons

The following add-on is required to use this function.

- AXIS
- MotionControl_General^{*1}
- ServoDriver_CANopen^{*2}

*1 For using the FBs in Relevant FBs (📄 Page 689 Relevant FBs)

*2 For using the real drive axis, the real encoder axis

System memory capacity

■Backup RAM Usage

Backup RAM is not used.

22.4 Troubleshooting by Symptom

This section describes troubleshooting for the Motion module.

Servo ON failed

When Servo ON failed, check the following items.

Check item		Action
Are both MC_Power (Operation Available) and MCv_AllPower (All Axes Operation Available) being used?		Check whether both FBs perform Servo ON or not.
MCv_AllPower (All Axes Operation Available) is executed from the PLC CPU	Is I/O No. (StartIO) for the target Motion module set?	Set I/O No. (StartIO) for the target Motion module.
Device label of MR-J5(W)-G or MR-JET-G is set	In network I/O setting, is device label (Controlword of data type RWw) of MR-J5(W)-G or MR-JET-G targeted labeling?	Clear the device label (Controlword of data type RWw) of MR-J5(W)-G or MR-JET-G from labeling target.

A motor does not rotate

When a motor does not rotate, check the following items.

Check item		Action
Servo ON is TRUE	Is Driver unit conversion numerator/Driver unit conversion denominator being set?	Convert machine feed value to the set value of the driver unit by using driver unit conversion function.
Acceleration/Deceleration method is set to Acceleration/Deceleration specification method (default)	Is Acceleration or Deceleration set as Acceleration (Acceleration)/Deceleration (Deceleration), not acceleration/deceleration time?	Correct the setting value of acceleration/deceleration.

22.5 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	Action
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 position erased' at driver side was detected. - Driver object 'Polarity(607EH)' b7:position polarity was changed. - Driver object 'HomeOffset(607CH)' was changed. - The connected driver device was changed. - The encoder resolution of connected driver device was changed. [Real encoder axis (via drive unit) only] 'Absolute position erased' 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 becomes TRUE.	Please execute homing.
0D01H	Axis	Start during Operation Warning	An instruction that cannot start during operation was executed.	During control	Do 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] Do 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.
0D03H	Axis/Axes group	Velocity Limit Value Over Warning	The target velocity exceeded the following when changing velocity/velocity override factor, or velocity exceeded the following during control. <u>AxisName</u>.Pr.VelocityLimit_Positive (Detail Code: 0001H) <u>AxisName</u>.Pr.VelocityLimit_Negative (Detail Code: 0002H) <u>AxesGroupName</u>.Pr.VelocityLimit (Detail Code: 0003H)	At control change During control	[At control change] Continues the operation at the previous speed. [During control] Continues the operation over the speed limit.	Set the velocity within the following. <u>AxisName</u>.Pr.VelocityLimit_Positive <u>AxisName</u>.Pr.VelocityLimit_Negative <u>AxesGroupName</u>.Pr.VelocityLimit

Warning code (Hexadecimal)	Error (System/ axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/ during control)	Operation at warning occurrence	Action
0D04H	Axis/Axes group	Acceleration Time Limit Over Warning	Acceleration time exceeded 8400 [s] when changing velocity/ acceleration (acceleration/ deceleration time)/velocity override factor/acceleration override factor.	During control	Continues the operation at the previous speed/ acceleration (acceleration/ deceleration time).	Set velocity/acceleration (acceleration/ deceleration time)/ velocity override factor/ acceleration override factor so that acceleration time does not exceed 8400 [s].
0D05H	Axis/Axes group	Deceleration Time Limit Over Warning	The following occurred when changing velocity/deceleration (acceleration/deceleration time)/ velocity override factor/ acceleration override factor. - Deceleration time exceeded 8400 [s]. - The deceleration time for automatically decelerating from the target velocity exceeded 8400 [s].	During control	Continues the operation at the previous speed/ deceleration (acceleration/ deceleration time).	Set velocity/deceleration (acceleration/ deceleration time)/ velocity override factor/ acceleration override factor as follows. - Make settings so that deceleration time does not exceed 8400 [s]. - Make settings so that the deceleration time for automatically decelerating from the target velocity does not exceed 8400 [s]. Set velocity/ deceleration (acceleration/ deceleration time)/ velocity override factor/acceleration override factor so that deceleration time does not exceed 8400 [s].
0D06H	Axis/Axes group	Acceleration Limit Value Over Warning	[Acceleration/deceleration commanded method] Target acceleration exceeded <u>AxisName(AxesGroupName).Pr.AccelerationLimit</u> when changing acceleration/ acceleration override factor. [Time-fixed acceleration/ deceleration method] Target acceleration exceeded <u>AxisName(AxesGroupName).Pr.AccelerationLimit</u> when changing velocity/acceleration/ deceleration time/velocity override factor/acceleration override factor.	During control	[Acceleration/ deceleration specifying method] Continues the operation at the previous acceleration. [Time-fixed acceleration/ deceleration method] Continues the operation at the previous speed/ acceleration.	Set target acceleration so that it does not exceed <u>AxisName(AxesGroupName).Pr.AccelerationLimit</u> .
0D07H	Axis/Axes group	Deceleration Limit Value Over Warning	[Acceleration/deceleration commanded method] Target deceleration exceeded <u>AxisName(AxesGroupName).Pr.DecelerationLimit</u> when changing deceleration/ acceleration override factor. [Time-fixed acceleration/ deceleration method] Target deceleration exceeded <u>AxisName(AxesGroupName).Pr.DecelerationLimit</u> when changing velocity/acceleration/ deceleration time/velocity override factor/acceleration override factor.	During control	[Acceleration/ deceleration specifying method] Continues the operation at the previous deceleration. [Time-fixed acceleration/ deceleration method] Continues the operation at the previous speed/ deceleration.	Set target deceleration so that it does not exceed <u>AxisName(AxesGroupName).Pr.DecelerationLimit</u> .

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control)	Operation at warning occurrence	Action
0D08H	Axis/Axes group	Position Command Unit Mismatch Warning	- Different values have been set to <u>AxisName(AxesGroupName).Pr.Unit_Position</u> between axes group and interpolation axes. - Different values have been set to <u>AxisName.Pr.Unit_Position</u> between master axis and slave axis.	At start / At multiple start	—	- Set the same value to <u>AxisName(AxesGroupName).Pr.Unit_Position</u> for axes group and interpolation axes. - Set the same value to <u>AxisName.Pr.Unit_Position</u> for master axis and slave axis. Set the same value to <u>AxisName(AxesGroupName).Pr.Unit_Position</u> for axes group and interpolation axes.
0D09H	Axis	Out of Forward Direction Torque Limit Value Specification Range Warning	The value is out of range for <u>AxisName.Cd.TorqueLimit_Positive</u> .	During control	Continues the operation with the previous torque limit value.	Set <u>AxisName.Cd.TorqueLimit_Positive</u> within the range.
0D0AH	Axis	Out of Reverse Direction Torque Limit Value Specification Range Warning	The value is out of range for <u>AxisName.Cd.TorqueLimit_Negative</u> .	During control	Continues the operation with the previous torque limit value.	Set <u>AxisName.Cd.TorqueLimit_Negative</u> within the range.
0D0BH	Axis/Axes group	Out of Velocity Override Factor Range Warning	The value is out of range for <u>AxisName(AxesGroupName).Cd.VelocityOverride</u> .	During control	Continues the operation with the previous value.	Set <u>AxisName(AxesGroupName).Cd.VelocityOverride</u> within the range.
0D0CH	Axis/Axes group	Out of Acceleration Override Factor Range Warning	The value is out of range for <u>AxisName(AxesGroupName).Cd.AccelerationOverride</u> .	During control	Continues the operation with the previous value.	Set <u>AxisName(AxesGroupName).Cd.AccelerationOverride</u> 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 Velocity Range Warning	The value is out of range for Velocity.	During control	Continues the operation with 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 velocity was not reached according to either of the following settings. - Target position change during control - Acceleration/deceleration, acceleration/deceleration time change during control - Switching based on multiple start	During control / When switching by multiple start	Stops immediately.	Set Velocity, Position/Distance, and Deceleration so that an overrun will not occur.
0D11H	Axis/Axes group	Multiple Start Velocity Mode Specified Mismatch Warning	The VelocityMode of the on-going FB is different from that of the multiply-started FB.	At multiple start	Operates by "VelocityMode" of each FB.	Set the same VelocityMode for the on-going FB and the multiply-started FB.
0D12H	Axis	Torque Limit Value Over Warning	- Torque was changed to a larger value than <u>AxisName.Md.TorqueLimit_Positive</u>. (Detail Code: 0001H) - Torque was changed to a larger value than <u>AxisName.Md.TorqueLimit_Negative</u>. (Detail Code: 0002H)	At control change	Continues the operation with the previous target torque.	Set Torque within the following. <u>AxisName.Md.TorqueLimit_Positive</u> <u>AxisName.Md.TorqueLimit_Negative</u>

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control)	Operation at warning occurrence	Action
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 Master velocity.
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 with 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 with 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 with 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 with the previous acceleration/deceleration time.	Set Acceleration within the range.
0D1BH	Axis	Out of Limit Velocity Range Warning	The value is out of range for LimitVelocity.	At control change	Continues the operation with 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 with 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 with the previous torque reverse direction ramp.	Set TorqueNegativeRamp within the range.
0D1EH	Axes group	Velocity Command Unit Mismatch Warning	The velocity command unit is different from that of the on-going FB.	At multiple start	—	Set the same value to AxisName(AxesGroupName).Pr.Unit_Velocity for axes group and interpolation axes.
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	Speed Limit Value Exceeded during Direction Change Warning	Target velocity exceeded the velocity limit value on that direction when accelerating again from velocity 0 on direction change.	During control	Continues the operation with speed 0.	Make settings so that the target velocity does not exceed velocity limit value after direction change.
0D21H	Axis	Out of End Velocity Range during Operation Warning	The value is out of range for EndVelocity when changing to the end target velocity.	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.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control)	Operation at warning occurrence	Action
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 FilterTime within the range.
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 Factor Range Warning	The value is out of range for <u>AxisName(AxesGroupName).Cd.JerkOverride</u> .	During control	Continues the operation with the previous value.	Set <u>AxisName(AxesGroupName).Cd.JerkOverride</u> within the range.
0D2DH	Axis/Axes group	Out of Position Command Unit Range Warning	The value is out of range for <u>AxisName(AxesGroupName).Pr.Unit_Position</u> .	At power ON At ready ON	Operates as "pulse".	Set <u>AxisName(AxesGroupName).Pr.Unit_Position</u> within the range.
0D2EH	Axis/Axes group	Out of Velocity Command Unit Range Warning	The value is out of range for <u>AxisName(AxesGroupName).Pr.Unit_Velocity</u> .	At power ON At ready ON	Operates as "s".	Set <u>AxisName(AxesGroupName).Pr.Unit_Velocity</u> within the range.
0D2FH	Axis/Axes group	Out of Operation Cycle Converted Velocity Range Warning	The velocity converted from Velocity by operation cycle is out of the range.	During control	Continues the operation with the previous speed.	Set Velocity so that the velocity converted by operation cycle is within the range.
0D30H	Axis/Axes group	Out of Deceleration Range at Stop Warning	The value was out of range for <u>AxisName(AxesGroupName).Pr.StopMode_Deceleration</u> or <u>System.Pr.StopMode_AllDeceleration</u> 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] Stops immediately.	Set <u>AxisName(AxesGroupName).Pr.StopMode_Deceleration</u> or <u>System.Pr.StopMode_AllDeceleration</u> within the range.
0D31H	Axis	Control Mode Switching Disabled Warning	Control mode switching is requested during a switching disabled controlling.	During control	Continues the current control mode.	Please request for switching when control mode is switchable.
0D32H	Axis	Acceleration Time Exceeded during Direction Change Warning	Acceleration time exceeded 8400 [s] when accelerating again from velocity 0 on direction change.	During control	Continues the operation at speed 0.	Make settings so that the acceleration time after direction change does not exceed 8400 [s].
0D33H	Axis/Axes group	Deceleration Time Over Warning on FB Switching	Deceleration time exceeded 8400 [s] on FB switching.	During control	Continues the operation with the velocity and deceleration before the FB switch.	Set velocity, deceleration, and jerk so that deceleration time does not exceed 8400 [s].
0D34H	Axis/Axes group	Out of Velocity Range Clamping Warning	The velocity-overridden velocity was below the velocity lower limit value.	At start At control change	Operates at velocity 0.	Make settings so that the velocity-overridden velocity is 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	Action
0D35H	Axis/Axes group	Out of Acceleration Range Clamping Warning	- The acceleration-overridden acceleration was out of range. - The acceleration calculated from Acceleration was out of range when using the time-fixed acceleration/deceleration method.	At start At control change	Operates at upper limit value of acceleration or 0.	- Make settings so that the acceleration-overridden acceleration is within the range. - Make settings so that the acceleration calculated from Acceleration is within the range when using the time-fixed acceleration/deceleration method.
0D36H	Axis/Axes group	Out of Deceleration Range Clamping Warning	- The acceleration-overridden deceleration was out of range. - The deceleration calculated from Acceleration was out of range when using the time-fixed acceleration/deceleration method.	At start At control change	Operates at upper limit value of deceleration or 0.	- Make settings so that the acceleration-overridden deceleration is within the range. - Make settings so that the deceleration calculated from Acceleration is within the range when using the time-fixed acceleration/deceleration method.
0D37H	Axis/Axes group	Out of Acceleration/Deceleration Time Range Clamping Warning	The acceleration-overridden acceleration/deceleration time was out of range.	At start At control change	Operates at upper limit value of acceleration/deceleration time or 0.	Make settings so that the acceleration-overridden acceleration/deceleration time is within the range.
0D38H	Axis/Axes group	Out of Operation Cycle Converted Acceleration Range Warning	Because the acceleration converted from Acceleration by operation cycle is low, there is a possibility that the error of set velocity is large.	At start At control change	Continues the control.	- Set Acceleration so that the acceleration converted by operation cycle becomes larger. - Increase the operation cycle.
0D39H	Axis/Axes group	Out of Operation Cycle Converted Deceleration Range Warning	Because the deceleration converted from Deceleration by operation cycle is low, there is a possibility that the error of set velocity is large.	At start At control change	Continues the control.	- Set Deceleration so that the deceleration converted by operation cycle becomes larger. - Increase the operation cycle.
0D3AH	Axis/Axes group	Out of Operation Cycle Converted Jerk Range Warning	Because the jerk converted from Jerk by operation cycle is low, there is a possibility that the error of set velocity or set acceleration is large.	At start At control change	Continues the control.	- Set Jerk so that the jerk converted by operation cycle becomes larger. - Increase the operation cycle.
0D3BH	Axis/Axes group	Jerk Acceleration/Deceleration Disabled Warning	Because the jerk converted from Jerk by operation cycle is 0, it does not operate as a jerk acceleration/deceleration.	At start	Operates as trapezoidal acceleration/deceleration.	- Set Jerk so that the jerk converted by operation cycle becomes larger. - Increase the operation cycle.
0F00H	System	Software Reboot Disabled Warning	Software reboot was executed when System.PrConst.SoftReboot_Enable is Disabled.	When executing software reboot	Not execute soft reboot.	Set System.PrConst.SoftRebootEnable as Enabled.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control)	Operation at warning occurrence	Action
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.
0F03H	System	Position Data History Update Disabled Warning	- An error was detected when updating position data history. - The memory capacity of add-on 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 files. - Please check the memory capacity of add-on 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 Setting Failed Warning	- Add-on MotionEventHist is disabled. - The memory capacity of add-on MotionEventHist is insufficient.	When updating filter setting	Continues the operation with the disabled filter setting.	- Enable add-on MotionEventHist. - Please check the memory capacity of add-on 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 with disabled read/write (0x0000) of other access 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.

Warning code (Hexadecimal)	Error (System/axis/axes group)	Warning name	Error detail and cause	Detection timing (At start/during control)	Operation at warning occurrence	Action
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 communication cycle interval setting or buffer memory refresh cycle to a larger value. • When using by a operation cycle of 31.25 μs, please begin with a minimum configuration of add-ons, and then add more add-ons as required according to the load of the system. • When the inter-module synchronization function is enabled, please be sure to execute the EI instruction with the PLC to enable I44 interrupt programs.
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	Axis setting that exceeded the maximum control axis number exists.	At ready ON	The axis which is greater than the maximum 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.
0F0CH	System	Warning Filter Set Failed Warning	• Add-on MotionEventHist is disabled. • The memory capacity of add-on MotionEventHist is insufficient.	At ready ON	Continues the operation with the disabled filter setting.	• Enable add-on MotionEventHist. • Please check the memory capacity of add-on 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 Parameter Storage Location Warning	The project content of the storage location different from module extended parameter storage location setting was changed.	At system start	The written module extended parameter is not enabled.	Please check the module extended parameter storage location 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 with the FilterTime = 0.	Set FilterTime 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	Action
0F10H	System	Servo System Recorder Inconsistency Incorrect Warning	- Add-on with dependencies has not been installed. (Detail Code: 1) - Inconsistency occurred in versions with other add-on. (Detail Code: 1) - Inconsistency occurred in versions with engineering tool. (Detail Code: 2)	At power ON	The servo system recorder does not start.	- Please install the software again. - Please install the add-on with dependencies. - Please install the correct version of the add-on. - Please execute project writing using the engineering tool that supports servo system recorder.
0F11H	System	Switch For Manufacturer Setting [ON] Detected	Switch 3 or 4 for manufacturer setting is ON.	At system start	Continues the operation with manufacturer support mode.	Set switch 3 or 4 to OFF after turning the power OFF, and then start the system again.
0F12H	System	Event History Filter Setting Error Warning	The event history filter is not set correctly.	At system start	Ignores the incorrect filter settings.	Check the filter setting and start the system again.
0F13H	System	Servo System Recorder Setting File Creation Disabled Warning	- There is a user-created logging setting file in save destination. (Detail Code: 1) - Memory capacity in save destination is insufficient. (Detail Code: 2) - Cannot output logging setting file because of system error. (Detail Code: 3)	At power ON	Logging setting data which is created in the servo system recorder is not created.	- Please check if there is a user-created setting file in save destination. - Please check the free capacity in save destination. - Please check if any error occurred to other add-on.
0F14H	System	Servo System Recorder Logging Execution Disabled Warning	- Cannot start servo system recorder because logging setting 10 or 9 is being executed. - Cannot start servo system recorder because an error occurred during the logging.	At power ON	The logging does not start.	- Please stop logging setting 10 or 9 if they are being executed. - Please check the logging error code.
0F15H	System	SD Memory Card Removed Warning	The SD memory card was removed without being disabled.	At removing the SD memory card.	Continues the operation	Remove SD memory card after disabling it.

*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".

22.6 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	Action
1080H	System	Writing to Flash ROM Count Error	The number of writes to the flash ROM has exceeded 100000.	At module start	Does not execute the writes to the flash ROM.	Replace the module.
1800H	System	SDO Communication Error	- An error occurred in the SDO communication. - Issued a large quantity of SLMP requests at a time. - Issued an SLMP request for a slave emulation enabled axis.	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 - Reduce the number of SLMP requests issued, or correct the program to not to issue a new request until a response has been returned. - Correct the program to not to issue an SLMP request when slave emulation is enabled.
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	Does 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	Does not start.	Set ONLY_INSIDE or DISABLE to <u>AxisName.Cd.SwStrokeLimit_Override</u> and move to the valid range.
1A02H	Axis	Start when Software Stroke Limit is Valid	It was started except when <u>AxisName.Pr.SwStrokeLimit_Target</u> get is invalid.	At start	Does not start.	Set invalid for <u>AxisName.Pr.SwStrokeLimit_Target</u> .
1A03H	Axis	Software Stroke Limit Over (Forward Direction)	The value specified for <u>AxisName.Pr.SwStrokeLimit_Target</u> get 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 <u>AxisName.Pr.SwStrokeLimit_Target</u> get 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	Does not start.	Set Position/Distance within the range.
1A06H	Axis	Out of Limit Velocity Range	The value is out of range for LimitVelocity.	At start	Does not start.	Set LimitVelocity within the range.
1A07H	Axis/Axes group	Velocity Limit Value Over	The target velocity exceeded the following. <u>AxisName.Pr.VelocityLimit_Positive</u> (Detail Code: 0001H) <u>AxisName.Pr.VelocityLimit_Negative</u> (Detail Code: 0002H) <u>AxesGroupName.Pr.VelocityLimit</u> (Detail Code: 0003H)	At start At multiple start	[At start] Does not start. [At multiple start] Stops the operation.	Set target velocity so that it does not exceed the following. <u>AxisName.Pr.VelocityLimit_Positive</u> <u>AxisName.Pr.VelocityLimit_Negative</u> <u>AxesGroupName.Pr.VelocityLimit</u>
1A0CH	Axis/Axes group	Acceleration/Deceleration 0 Specified Operation Error at Start	Started after setting <u>AxisName(AxesGroupName).Pr.AccelerationZeroBehavior</u> to -1: ACCError with Acceleration or Deceleration 0.	At start	Does not start.	Make settings so that Acceleration and Deceleration do not become 0.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
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	Does not start.	Set Acceleration within the range.
1A0EH	Axis/Axes group	Acceleration/Deceleration Method Mismatched	The acceleration/deceleration method of the on-going FB is different from that of the multiply-started FB.	At multiple start	Stops the operation.	Set the same acceleration/deceleration method for the on-going FB and the multiply-started FB.
1A0FH	Axis	Acceleration Time Over at Start	Acceleration time exceeded 8400 [s].	At start	Does not start.	Set target velocity/target acceleration/target deceleration/target jerk so that acceleration time does not exceed 8400 [s].
1A10H	Axis	Deceleration Time Over at Start	- Deceleration time exceeded 8400 [s]. - The deceleration time for automatically decelerating from the target velocity exceeded 8400 [s].	At start	Does not start.	- Set target velocity/target acceleration/target deceleration/target jerk as follows. - Make settings so that deceleration time does not exceed 8400 [s]. - Make settings so that the deceleration time for automatically decelerating from the target velocity does not exceed 8400 [s].
1A11H	Axis	Out of Acceleration Range	The value is out of range for Acceleration.	At start	Does not start.	Set Acceleration within the range.
1A12H	Axis	Out of Deceleration Range	The value is out of range for Deceleration.	At start	Does 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	Does 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	Does not start.	Set the velocity of converted driver velocity unit within the setting range.
1A18H	Axis	Out of Velocity Initial Value Selection Range	The value is out of range for velocity initial value selection of Options.	At start	Does not start.	Set velocity 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	Does 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	Does not start.	Execute the instruction in the driver supporting csv.
1A1CH	Axis	cst Unsupported Driver	The driver does not support cst.	At start	Does not start.	Execute the instruction in the driver supporting cst.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
1A1DH	Axis	Control Mode Switching Error	Driver control mode switching did not complete within 1 [s] after control mode switching command had been issued. During communication initialization, driver control mode did not switch to csp.	During control During initial	Stops. Unable to connect to the driver.	- Please check whether an error occurred in the driver or the setting is incorrect, and take necessary actions. - When MR-J5-G series is connected: When you switch the driver control mode while the motor is operating, please set ZSP disabled selection at control switching (PC76.1) to "1: Disabled".
1A1EH	Axis	Out of Target Torque Range	The value is out of range for Torque.	At start	Does not start.	Set Torque within the range.
1A1FH	Axis	Out of Torque Positive Direction Ramp Range	The value is out of range for TorquePositiveRamp.	At start	Does 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	Does not start.	Set TorqueNegativeRamp within the range.
1A22H	Axis	Start at Homing Incomplete	The positioning was started when homing request flag is ON.	At start	Does not start.	Start the operation after executing homing.
1A26H	Axis	Axis Status Incorrect Start	The axis is started in the status except when <u>AxisName.Md.AxisStatus</u> is Standstill.	At start	Does not start.	Start the axis when <u>AxisName.Md.AxisStatus</u> is Standstill.
1A27H	Axes group	Axes Group Status Incorrect Start	The axes group was started when <u>AxesGroupName.Md.AxesGroupStatus</u> was other than GroupStandby.	At start	Does not start.	Start the axes group operation when <u>AxesGroupName.Md.AxesGroupStatus</u> is GroupStandby.
1A28H	Axis	Out of Phase Compensation Advance Time Range	The value is out of range for Time.	At start	Does 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	Does 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	Does not start.	Set ONLY_INSIDE or DISABLE to <u>AxisName.Cd.HwStrokeLimit_Override</u> 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	Does not start.	Set ONLY_INSIDE or DISABLE to <u>AxisName.Cd.HwStrokeLimit_Override</u> and move to the controllable range.
1A2FH	Axis	FLS Signal Detection (Controlling)	The signal input from FLS signal during controlling was detected.	During control	Stops.	Set ONLY_INSIDE or DISABLE to <u>AxisName.Cd.HwStrokeLimit_Override</u> and move to the controllable 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	Action
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 <u>AxisName.Cd.HwStrokeLimit_Override</u> and move to the controllable range.
1A34H	Axis/Axes group	Out of Gear Denominator Range	The value is out of range for <u>RatioDenominator</u> .	At start	Does not start.	Set a value within the range for <u>RatioDenominator</u> .
1A35H	Axis	Out of Time Constant Range	The value is out of range for <u>TimeConstant</u> .	At start	Does not start.	Set a value within the range for <u>TimeConstant</u> .
1A36H	Axis/Axes group	Velocity Limit Value Over during Controlling	The set velocity exceeded the following when <u>AxisName.Pr.VelocityLimit_Over</u> Operation is 3:ImmediateStop. • <u>AxisName.Pr.VelocityLimit_Positive</u> (Detail Code: 0001H) • <u>AxisName.Pr.VelocityLimit_Negative</u> (Detail Code: 0002H)	During control	Operates exceeding " <u>AxisName.Pr.VelocityLimit_Positive</u> " or " <u>AxisName.Pr.VelocityLimit_Negative</u> ".	Set the velocity within the following. • <u>AxisName.Pr.VelocityLimit_Positive</u> • <u>AxisName.Pr.VelocityLimit_Negative</u>
1A37H	Axis	Out of Direction Selection Range	The value is out of range for <u>Direction</u> .	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set Direction within the range.
1A38H	Axis	Acceleration Limit Value Over	Target acceleration exceeded <u>AxisName(AxesGroupName).Pr.AccelerationLimit</u> .	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set target acceleration so that it does not exceed <u>AxisName(AxesGroupName).Pr.AccelerationLimit</u> .
1A39H	Axis	Deceleration Limit Value Over	Target deceleration value exceeded <u>AxisName(AxesGroupName).Pr.DecelerationLimit</u> .	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set target deceleration so that it does not exceed <u>AxisName(AxesGroupName).Pr.DecelerationLimit</u> .
1A3AH	Axis	Jerk Limit Value Over	Target jerk exceeded <u>AxisName(AxesGroupName).Pr.JerkLimit</u> .	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set target jerk so that it does not exceed <u>AxisName(AxesGroupName).Pr.JerkLimit</u> .
1A3BH	Axis	Deceleration Stop by Servo OFF During Operation	[0: Servo OFF after deceleration stop is completed] was selected for <u>AxisName.Pr.StopMode_ServoOff</u> , and FALSE was set to <u>ServoOn</u> in <u>MC_Power(MCv_AllPower)</u> during operation.	During control	Deceleration stops.	Set TRUE to <u>ServoOn</u> in <u>MC_Power(MCv_AllPower)</u> .
1A3CH	Axis	Immediate Stop by Servo OFF During Operation	• [1: Servo OFF after immediate stop] was selected for <u>AxisName.Pr.StopMode_ServoOff</u>, and FALSE was set to <u>ServoOn</u> in <u>MC_Power(MCv_AllPower)</u> during operation. • FALSE was set to <u>Enable</u> in <u>MC_Power(MCv_AllPower)</u> during operation.	During control	Immediately stops.	Set TRUE to <u>Enable</u> and <u>ServoOn</u> in <u>MC_Power(MCv_AllPower)</u> .
1A3DH	Axes group	Stop Cause of Axes Group Configuration Axis	Error occurred in configuration axis.	At start During control	• [At start] Does 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	Does not execute FB.	Set different axis No. to master axis and slave axis.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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	Does not execute FB.	Do not set master axis to the slave axis in the latter part of the 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	Does 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	Does 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	Does 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. - The result of multiplying MasterScaling and the length per cycle is out of the positioning range.	At start When executing FB	Does not execute FB.	- Set a value within the range for MasterScaling. - Set values so that the result of multiplying MasterScaling and the length per cycle is within the positioning range.
1A44H	Axis	Out of Slave Axis Coefficient Range	- The value is out of range for SlaveScaling. - The result of multiplying SlaveScaling and the stroke amount is out of the positioning range.	At start When executing FB	Does not execute FB.	- Set a value within the range for SlaveScaling. - Set values so that the result of multiplying SlaveScaling and the stroke amount is within the positioning range.
1A45H	Axis	Out of Master Axis Follow-up Distance Range	The value is out of range for MasterStartDistance.	At start When executing FB	Does 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	Does 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	Does 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	Does 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	Does not execute FB.	Check axes specified by Master.
1A4AH	Axis	Out of BufferMode Range	The value is out of range for BufferMode.	At start	Does 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	Does not execute FB.	Open cam data to the open area with MC_CamTableSelect or MCv_ProfileSelect.
1A4DH	Axis/Axes group	Out of Velocity Range	The value is out of range for Velocity.	At start	Does not start.	Set Velocity within the range.
1A4EH	Axis	Out of Options Range	The value is out of range for Options.	At start	Does not start.	Set Options within the setting 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	Action
1A4FH	Axis	Same Master Axis 1 Slave Axis Error	The same axis No. was specified to Master1 and Slave.	At start	Does not start.	Set different axis No. to Master1 and Slave.
1A50H	Axis	Same Master Axis 2 Slave Axis Error	The same axis No. was specified to Master2 and Slave.	At start	Does not start.	Set different axis No. to Master2 and Slave.
1A51H	Axis	Out of Master Axis 1 Gear Denominator Range	The value is out of range for GearRatioDenominatorM1.	At start	Does not start.	Set a value within the range for GearRatioDenominator M1.
1A52H	Axis	Out of Master Axis 2 Gear Denominator Range	The value is out of range for GearRatioDenominatorM2.	At start	Does not start.	Set a value within the range for GearRatioDenominator M2.
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 Operation Cycle Incorrect	Operation cycles of configuration axes in axes group are 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 operation cycle in all configuration axes.
1A5AH	Axes group	Axes Group Status Incorrect (During Configuration Axis Write)	MCv_WriteAxesInGroup was executed when <u>AxesGroupName.Md.GroupStatus</u> was other than GroupDisabled.	During Configuration Axis Write	Continues the configuration axis before writing. In operation, the operation is stopped.	Execute MCv_WriteAxesInGroup when <u>AxesGroupName.Md.GroupStatus</u> 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 set in system. • Please delete unnecessary axes 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.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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 was set to station-specific mode when <u>AxisName.PrConst.FastOperationMode</u> was 5FE2H (fast operation mode). - The mapping for fast operation mode was changed when <u>AxisName.PrConst.FastOperationMode</u> was 5FE2H (fast operation 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 Axes Group Over	The memory size of axes group data exceeds the memory capacity set in system.	At power ON At ready ON	Generating axes group fails.	Increase the memory capacity set in system. Or, delete unnecessary axes and keep the memory size of axis data within the memory capacity.
1A61H	Axes group	Out of Velocity Mode Range	The value is out of range for velocity mode.	At start At multiple start	[At start] Does not start. [At multiple start] Stops.	Correct the velocity mode so that it is within the range.
1A62H	Axes group	Circular Interpolation Axes 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] Does not start. [At multiple start] Stops the operation.	- Set the configuration axis in CircAxes with an axis that has been set up. - 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] Does 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] Does not start. [At multiple start] Stops the operation.	Set boundary point (AuxPoint) 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] Does not start. [At multiple start] Stops the operation.	Set center point (AuxPoint) so that start point is not equal to center point.
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] Does 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] Does 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] Does 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] Does not start. [At multiple start] Stops the operation.	Set boundary point (AuxPoint) so that end point is not equal to boundary 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	Action
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] Do 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] Does 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] Does 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] Does 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] Does 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) $\times 2$.
1A6FH	Axes group	Out of Path Selection Range	The value is out of range for PathChoice.	At start At multiple start	• [At start] Does 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] Does not start. • [At multiple start] Stops the operation.	Set CircularErrorTolerance within the range.
1A71H	Axes group	Circular Interpolation Error Allowable Value Over	The difference between radius of start point - center point and radius of end point - center point exceeds CircularErrorTolerance at circular interpolation of center point specification.	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set end point (EndPoint), center point (AuxPoint), and CircularErrorTolerance so that CircularErrorTolerance is not exceeded.
1A72H	Axes group	Software Stroke Limit Invalid at Circular Interpolation	Circular interpolation including an axis where software stroke limit is set to invalid was executed.	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Enable software stroke limit for the axis to execute circular interpolation.
1A73H	Axes group	Out of Pitch Number Range	The value is out of range for Pitch.	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	Set Pitch within the range.
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] Does 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 <u>AxisName.PrConst.TorqueLimit_Max</u> was set to <u>AxisName.PrConst.TorqueLimit_PositiveInitial</u> .	At power ON	Generating axis fails.	Set <u>AxisName.TorqueLimit_PositiveInitial</u> within the range of 0 to <u>AxisName.PrConst.TorqueLimit_Max</u> .

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
1A7AH	Axis	Out of Reverse Direction Torque Limit Initial Value Specification Range	A value larger than <u>AxisName</u> .PrConst.TorqueLimit_Max was set to <u>AxisName</u> .PrConst.TorqueLimit_NegativeInitial.	At power ON	Generating axis fails.	Set <u>AxisName</u> .PrConst.TorqueLimit_NegativeInitial within the range of 0 to <u>AxisName</u> .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 velocity designation.	During control	Stops the operation.	Set target position/movement distance so that movement amount is not insufficient.
1A7CH	Axes group	Motion 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 velocity 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 <u>AxisName</u> .Md.AxisStatus is other than Disable or Standstill.	When executing driver emulate switching	Stops.	Execute driver emulation switch when <u>AxisName</u> .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	Does 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	Does not start.	Set Filter within the range.
1A87H	Axis	Out of Direction Limit Value Specification Range	The value is out of range for PositiveLimit and NegativeLimit.	At start	Does not start.	Set PositiveLimit and NegativeLimit within the range.
1A8AH	Axis	Out of Overrun Operation Setting Range	The value is out of range for <u>AxisName</u> (<u>AxesGroupName</u>).Pr.OverrunOperation.	At start	Does not start.	Set <u>AxisName</u> (<u>AxesGroupName</u>).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	Action
1A90H	Axis	Synchronous Encoder Via Drive Unit Setting Incorrect	- The real drive axis with the same station address as the real encoder axis via drive unit is not set. (Detail Code: 0001H) - The scale measurement function of the connected driver is disabled. (Detail Code: 0002H) - The slave object required to be set for the real encoder axis via drive unit does not exist. (Detail Code: 0003H) - Scale measurement encoder Resolution is 0 (Detail Code: 0004H) - The slave object required to be set for the real encoder axis via drive unit is not mapped to the real drive axis with the same station address. (Detail Code: 0005H) - Absolute position control settings do not match. (Detail Code: 0006H)	At power ON	Generating axis fails.	- Set the real drive axis with the same station address as the real encoder axis via drive unit. - Enable scale measurement function of the connected driver. - Check if the slave object required to be set for the real encoder axis via drive unit exists. - Map the slave object required to be set for the real encoder axis via drive unit 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 control settings of the real encoder axis and the connected device.
1A91H	Axis	Axis No. Setting Duplication Error	The same axis No. has been set.	At power ON	Generating axis fails.	Set a different axis No.
1A94H	Axis	Station Address Duplication Error	The set of IP address and multiple axes ID of a real drive axis overlaps with that of another.	At power ON	Generating axis fails.	Set real drive axes and sets 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 the station address where a device is connected, when slave emulation function is not 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 <u>AxisName.PrConst.FastOperationMode</u> is 5FE2H (fast operation 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 fast operation mode.
1A97H	Axes group	Axes Group Status Incorrect (When Axes Group is Disabled)	MC_GroupDisable was executed when <u>AxesGroupName.Md.GroupStatus</u> is other than GroupStandby or "GroupErrorStop".	Axes Group Disable	Stops the operation.	Execute MC_GroupDisable in the status where <u>AxesGroupName.Md.GroupStatus</u> is GroupStandby or GroupErrorStop.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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	A 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 an existing axis in configuration axis.
1A9AH	Axis	Absolute Position Control 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 control setting of connection device.
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 $0 < \text{Ring counter upper limit value} - \text{Ring counter lower limit value} < 2.0$ • 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: $2.0 < \text{Ring counter upper limit value} - \text{Ring counter lower limit value}$.
1AA4H	Axis	Driver Unit Conversion Magnification Upper Over	The magnification that exceeded upper limit in the driver unit conversion numerator/denominator is set.	At ready ON	• Generating axis fails. • The driver unit conversion numerator/denominator is not changed.	Set values to make sure the calculation result of driver unit conversion numerator/denominator does not exceed 400000000.
1AA5H	Axis	Driver Unit Conversion 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. • <u>AxisName</u>.Md. AxisStatus is Disabled. • <u>AxisName</u>.Md.FollowupDisable is FALSE.
1AA7H	Axis	Add-on Acquisition Failure	Failed to acquire the add-on SignalIO when set the 'Counter Disabling Signal'.	At power ON	Generating axis fails.	Install the add-on SignalIO and enable it.
1AA8H	Axis/Axes group	Necessary Slave Object Unset	Necessary slave object for control command execution is not set to axis (configuration axis in the case of an axes group).	At start At multiple start	• [At start] Does not start. • [At multiple start] Stops the operation.	• Please set necessary object in control command. • Please use single axis synchronization for virtual linked axis.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
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] Does 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 unit normally for homing.	During operation	Homing is not completed normally.	• Execute homing again. • When reading or writing parameters of a slave device while executing homing, reduce the number of executions at a time.
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] Does 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] Does 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) • Hardware stroke limit override incorrect at homing start (Detail Code: 0005H) • Axis/axes group status incorrect (Detail Code: 0100H) • Axes group operating (Detail Code: 0101H) • Configuration axis status incorrect (Detail Code: 0102H)	At start	Does not start.	• Set it so that it will not start when PLC READY [Y0] is OFF. • Set it so that it will not start when READY [X0] is OFF. • Check the sequence program which turns PLC READY [Y0] ON/OFF. • Do not set ONLY_INSIDE for <u>AxisName.Cd.HwStrokeLimit_Override</u> on homing start. • Check the status of the drive unit power supply, the wiring with the drive unit and connector status. • Start it after <u>AxesGroupName.Md.GroupStatus</u> changes into GroupStandby. • Start it after <u>AxisName.Md.AxisStatus</u> changes into Standstill • Disable axes group for axes where <u>AxisName.Md.UseInGroup</u> is TRUE.
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 <u>AxisName.Md.DriverErrorID</u> . (Please refer to the instruction manual of each driver for details of <u>AxisName.Md.DriverErrorID</u> .)

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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.
1AB0H	Axis	PLC READY OFF During Operation	PLC READY [Y0] was turned OFF during operation.	During operation	Stops the operation.	Check the sequence program which turns PLC READY [Y0] 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 position changing. • Position/Distance after change is out of range. • Target position after change is out of range of software stroke limit.	At control change	Stops the operation.	Set Position/Distance at target position changing 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	Does not start.	Enable the <u>AxisName.PrConst.Ring Count_Enable</u> .
1AB6H	Axis	External Signal String Incorrect	• Incorrect string was set in the string of external signal. • An unconnected or non-existent station was set when [OBJ] was specified. • A non-existent object was set for TPDO/RPDO when [OBJ] was specified.	At start	Does not start.	• Set a valid string in the external signal. • Connect the target station when specifying [OBJ]. • Set the target object for TPDO/RPDO when specifying [OBJ].
1AB7H	Axes group	Path Choice Setting Incorrect	Incorrect value was set in PathChoice.	At start At multiple start	• [At start] Does 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] Does 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.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
1AB9H	Axes group	Linear Interpolation Axes Setting Incorrect	- A configuration axis not set up was set in LinearAxes. 0 was set in the first element of LinearAxes. - Same index 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 start	[At start] Does not start. [At multiple start] Stops the operation.	- Set the configuration axis in LinearAxes with an axis that has been set up. - 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.
1ACBH	Axis	Add-on SignalIO Acquisition Failure	Failed to acquire the add-on SignalIO.	At power ON At ready ON	The signal is detected continuously.	Install SignalIO.mpk and enable it.
1AD8H	Axis	Out of Master Axis No. Range	The value is out of range for Master.AxisNo.	At start When executing FB	Does 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	Does 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	Does not execute FB.	Set a value within the range for BufferMode.
1ADBH	System	Command Filter Add-on System Memory Shortage	System memory for the add-on is insufficient.	At start At multiple start	Does not start.	Please check the System.PrConst.Addon_MotionControl_AxisFilter.RamSizeMax.
1ADCH	System	Add-on Memory Shortage	System memory for add-ons related to operation is insufficient.	At start At multiple start	Does not start.	Please check the System.PrConst.Addon_*.RamSizeMax for related add-ons
1ADEH	Axes group	Out of Linear Movement Amount Range	An interpolation axis for which movement amount exceeds "4,294,967,296.0 (= 2 ³²)" exists in the linear interpolation of vector speed specification.	At start At multiple start	[At start] Does 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 software reboot after checking the System.PrConst.Addon_AbsSystem.BackupRamSizeMax.
1AE0H	Axis	Driver Restoration Data Incorrect	The parameter of connected driver device was incorrect when restoring current position.	When restoring current position	Restoring current position is not completed.	- Please change the Electronic Gear to a power of two at connected driver side. - Please change the Electronic Gear to 1:1 at connected driver side, if the connected encoder resolution is not a power of two.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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.
1AE2H	Axis	Out of Addition and Subtraction Selection Range	The value is out of range for CombineMode.	At start	Does 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 to the driver	Please connect a driver that supports csp.
1AE4H	Axis/Axes group	Out of Operation Cycle Converted Velocity Range	The velocity converted from Velocity by operation cycle is out of the range.	At start	Does not start.	Set Velocity so that the velocity converted by operation 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.	Please check the motor and encoder cable.
1AE6H	Axis	Driver Command Discard Detection	The command discard (Statusword bit12 OFF) of the connected 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.	Switch the driver control mode to a control mode that is supported by the motion system
1AE8H	Axis/Axes group	Velocity Range Over during Controlling	Set velocity exceeded the velocity command range.	During operation	Stops the operation.	Make settings so that the set velocity does not exceed the velocity command range.
1AE9H	Axis	Driver Control Mode Unsupported	The driver was switched to an unsupported driver control mode. ct: Continuous operation to torque control (Detail Code: 0001H)	At start	Does not start	Connect a driver that supports the driver control mode to be switched to.
1AEAH	System	Servo Driver Memory Size Over	The memory size of the servo driver exceeds the memory capacity set in system.	When connecting	Unable to connect to the driver	- Please increase the memory capacity set in system. - Please delete unnecessary axes and reduce memory size.
1C40H	System	Network Parameter Error (Total No. of Stations < Station No.)	[Firmware version 06 or before] 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 Settings".	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.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
1C41H	Axis	Watchdog Counter Error	A watchdog counter error of driver was detected.	During communication	Stops immediately.	- When a stop error of CPU module is detected, please check the error details of the CPU module and take actions. - Please check the communication cycle. - Please check surrounding environment errors such as noise etc., and remove the cause. - After taking the above corrective actions, please power on the system again or reset the CPU module.
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 Communication Error	An error occurred in SLMP communication.	During communication	[During initial communication] Unable to connect to the driver	- Please check the slave object setting. - Please check the manual of the driver.
1C44H	System	Network Parameter Error (Station No. Order Error)	[Firmware version 06 or before] 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.
1C45H	System	SLMP Communication 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 set in the network configuration settings only.
1C47H	System	Communication Cycle Unsupported Driver Connection	An MR-J5(W)-G that does not support a communication cycle of 31.25/62.5 μ s was connected.	At start communication	The station can not be connected to the drive unit.	Please check the version of MR-J5-G series amplifier and apply the latest version.
1C48H	System	PDO Mapping Setting Error	Abnormal response for PDO mapping setting was received from a slave station.	At start communication	The station can not be connected to the drive unit.	Please check the details of the error according to the error code (SDO Abort Code) and review the PDO mapping setting.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
1C49H	System	Configuration Mismatch on Reconnection	A model name mismatch was detected on reconnection of slave station.	At start communication	The station can not be connected to the drive unit.	Please connect the slave station with the same model name as the disconnected slave station.
1C80H	System/Axis	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 communication cycle interval setting or buffer memory refresh cycle to a larger value. • When using by a operation cycle of 31.25 μs, please begin with a minimum configuration of add-ons, and then add more add-ons as required according to the load of the system. • When the inter-module synchronization function is enabled, please be sure to execute the EI instruction with the PLC to enable I44 interrupt programs.
1C81H	System	Cycle Assignment Incorrect	The value is out of range for system basic cycle, the first operation 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.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.
1C85H	System	Event History File Incorrect	• An error was detected in the event history file. • The memory capacity of add-on MotionEventHist is insufficient. • The drive specified for System.PrConst.EventHistoryMotion_Path is not mounted.	At updating the event history file.	Updating the event history file stops.	• Delete unnecessary files and secure free capacity. • Format the target drive. • Delete event history files. • Please check the memory capacity of add-on MotionEventHist. • Please check the status of the target drive (System.Md.Storage_*).

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/ during control)	Operation at error occurrence	Action
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 following 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 settings.
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.
1C8EH	System	Variable Manager Acquisition Failure	Failed to acquire variable manager.	At power ON	The add-on which is described in the detailed information is invalid function.	Please re-install the baseSystem.smpk
1C8FH	System	Add-on SignalIO Acquisition Failure	Failed to acquire the add-on SignalIO.	At power ON At ready ON	[At power ON] Generating axis fails.[At ready ON] The READY [X0] does not turn ON.	Install SignalIO.mpk and enable it.
1C91H	System	Insufficient Memory Capacity of Add-on SignalIO	Cannot create a signal, because the memory capacity of the add-on SignalIO is insufficient.	At power ON At ready ON	[At power ON] Generating axis fails.[At ready ON] The READY [X0] does not turn ON.	• Increase the memory capacity of add-on SignalIO. • Increase the memory capacity of add-on ExternalSignal.
1C93H	System	Network Driver Memory Size Over	The memory size of the network driver exceeds the memory capacity set in system.	At power ON	SLMP communication error.	• Please increase the memory capacity set in system. • Please delete unnecessary stations and reduce memory size.
1C94H	System	Backup Data Saving Failure	Failed to save the backup data because of insufficient capacity in the Ich drive.	During operation	Files are not saved.	• Please check the free capacity in the Ich drive and delete unnecessary files. • Please check the capacity of motion event histories if the destination to save motion event histories is the Ich drive.
1C95H	System	Label Instance Error	An error occurred in the corresponding add-on for the label instances.	At power ON At ready ON	Interrupts the process to import the labels.	• Please check the version of the corresponding add-on for the labels. • Please increase the maximum RAM size of the corresponding add-on for the labels.
1C99H	System	Backup Data Saving Failure	Failed to save the backup data because of insufficient capacity in the backup data write area.	During operation	Backup data are not saved.	• Please delete unnecessary cam data. • Please delete unnecessary positioning data.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
1C96H	System	Device Label Import Error	- There are inconsistencies in network configuration settings and the settings at device label creation. - Failed to import device labels.	At power ON	Interrupts the process to import the labels.	Please check the settings of network configuration and then create device labels again.
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 [X0] does not turn ON.	Change the specified value of the parameter in detailed information within the range.
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 [X0] does not turn ON.	Change the specified value of the parameter in detailed information within the 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 [X0] does not turn ON.	Change the specified value of the parameter in detailed information within the 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	- 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 Arithmetic processing or other processing was in abnormal conditions. Processing stopped for more than 1 [s].	During operation	The axis in operation stops immediately or decelerate stops.	Programming - Reduce the number of command execution of initial execution type and normal execution type by program. Execution time monitor - Change the communication cycle interval setting or 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	Action
3205H	System	Add-on Library Load Error	Add-on • The file of add-on is broken. • Add-on with dependencies has not been installed. • Add-on that cannot be combined has been installed. • Inconsistency occurred in versions.	At power ON	Add-on The motion system does not start.	Add-on • Please install the software again. • Please install the add-on with dependencies. • Please delete the add-on that cannot be combined. • Please install the correct version of the add-on.
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_*.RamSizeMax of all add-ons exceeds the total size of system memory (RAM).	At power ON	The motion system does not start.	Please make the total number of System.PrConst.Addon_*.RamSizeMax of all add-ons not exceed the total size of system memory (RAM).
3209H	System	Insufficient Add-on System Memory (RAM)	Memory that exceeded System.PrConst.Addon_*.RamSizeMax has been used.	At power ON During operation	• [At power ON] The motion system does not start. • [During operation] WDT error occurs if the function has an effect on control.	Please increase System.PrConst.Addon_*.RamSizeMax.
320AH	System	Insufficient Total System Memory (Backup RAM)	The total number of System.PrConst.Addon_*.BackupRamSizeMax of all add-ons exceeds the total size of system memory (backup RAM).	At power ON	The motion system does not start.	Please make the total number of System.PrConst.Addon_*.BackupRamSizeMax of all add-ons not exceed the total size of system memory (backup RAM).
320BH	System	Insufficient Add-on System Memory (Backup RAM)	Memory that exceeded System.PrConst.Addon_*.BackupRamSizeMax has been used.	At power ON During operation	• [At power ON] The motion system does not start. • [During operation] WDT error occurs if the function has an effect on control.	Please increase System.PrConst.Addon_*.BackupRamSizeMax.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
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 or decelerate stops.	• Change the fixed scan interval setting of fixed scan execution type program to a larger value. • Change the communication cycle interval setting or buffer memory refresh cycle to a larger value. • When using by a operation cycle of 31.25 μs, please begin with a minimum configuration of add-ons, and then add more add-ons as required according to the load of the system. • When the inter-module synchronization function is enabled, please be sure to execute the EI instruction with the PLC to enable I44 interrupt programs.
320DH	System	Base System Error	• Failed to configure labels. • Failed in initial process.	At power ON	The motion system does not start.	• Please install the software again. • Please write the program again.
320EH	System	Network Driver Error	Failed in communication between motion area and network area.	At power ON During operation	• The motion system does not start. • 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 start. • Creating an instance of driver fails.	Please reinstall the software.
3212H	System	Public Label Address Check Error	Refresh target of public label is incorrect.	At power ON	Interrupts the process to import the labels.	Please install the latest add-on and engineering tool.
3217H	System	Add-on SimpleMotion Acquisition Failure	Failed to acquire the add-on SimpleMotion.	At power ON	The motion system does not start.	Install SimpleMotion.mpk and enable it.
3218H	System	Add-on SimpleMotion Internal Error	Failed in initial process of the add-on SimpleMotion.	At power ON	The motion system does not start.	Please install the software again.
3219H	System	Add-on SimpleMotion Memory Shortage	System memory for the add-on SimpleMotion is insufficient.	At power ON	The motion system does not start.	Please install the software again.
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	Does 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	Does not execute FB.	Set different axis No. to master axis and slave axis.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
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	Does 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	Does 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	Does 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	Does 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	Does 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	Does not execute FB.	Set the value within the range.
3408H	System	Latch Count Incorrect	RecordCount has not been set when RecodeMode = RecordCount, RingBuffer.	When executing FB	Does not execute FB.	Set RecordCount.
3409H	System	Out of Touch Probe ID Range	The value is out of range for TouchProbeID.	When executing FB	Does not execute FB.	Set a valid touch probe ID.
340DH	System	Out of Compensation Time Range	The value is out of range for CompensationTime.	When executing FB	Does not execute FB.	Set the value within the range of -5.0 to 5.0 [s].
340EH	System	Out of Latch Mode Range	The value is out of range for RatchMode.	When executing FB	Does not execute FB.	Set the value within the range for MC_RECORD_MODE.
340FH	System	No Operation Profile Data	The operation profile data does not exist.	During operation	The execution of FB is interrupted.	Set existing operation profile data.
3410H	System	Operation Profile Data Incorrect	- The value is out of range for the data. - Add-on that supports the operation profile data format has not been installed.	During operation	The execution of FB is interrupted.	- Set the data within the range. - Install and enable the add-on that supports the operation profile data format.
3411H	System	Operation Profile Data Being Operated	Operation was executed while the operation profile data was being operated.	During operation	The execution of FB is interrupted.	Operate it when Busy of FB is FALSE.
3412H	System	Operation Profile Data Error	The operation profile data is broken, or the format is incorrect.	During operation	The execution of FB is interrupted.	Set the operation profile data in a correct format.
3413H	System	Out of Offset Range	Offset exceeds the number of elements of operation profile data (file or open area).	During operation	The execution of FB is interrupted.	Set a value which does not exceed the number of elements of operation profile data (file and open area) in Offset.

Error code (Hexadecimal)	Error (System/axis/axes group)	Error name	Error detail and cause	Detection timing (At start/during control)	Operation at error occurrence	Action
3414H	System	Out of Operation Profile Data ID Range	The value is out of range for ProfileData.ID.Number or ProfileID.Number.	At start During operation	• [At start] Does 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 MasterAbsolute Range	The value is out of range for MasterAbsolute.	When executing FB	Does not execute FB.	Set the value within the range.
341EH	System	Out of SlaveAbsolute Range	The value is out of range for SlaveAbsolute.	When executing FB	Does 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	Does not execute FB.	Set the value within the range.
3421H	System	Out of Input Offset Range	The value is out of range for InputsOffset.	When executing FB	Does 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	Does not execute FB.	Set the value within the range.
3423H	System	Out of Input Coefficient Range	The value is out of range for InputsScaling.	When executing FB	Does 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	Does not execute FB.	Set the value within the range.
342FH	System	SD Memory Card Detached	The SD memory card was removed without disabling it.	When removing SD memory card	—	Remove SD memory card after it is disabled.
343FH	System	Out of Backlash Amount Range	The value is out of range for BacklashAmount.	When executing FB	Does 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 range (Detail Code: 0001H) • ExecutionMode is out of the range (Detail Code: 0002H) • The current position after changing is out of range of software stroke limit (Detail Code: 0003H) • Axis status at execution is incorrect (Detail Code: 0004H) • Other MC_SetPosition was executed in the specified axis (Detail Code: 0008H) • Options is out of the range (Detail Code: 0009H)	At start During operation	• Does 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	Action
344FH	System	MCv_SetPositionTriggered Instruction Error	An error occurred during executing MCv_SetPositionTriggered for the following causes. - Position is out of range (Detail Code: 0001H) - ExecutionMode is out of range (Detail Code: 0002H) - The current position after changing is out of range of software stroke limit (Detail Code: 0003H) - Axis status at execution is incorrect (Detail Code: 0004H) - TriggerInput is incorrect (Detail Code: 0005H, 0006H) - Add-on SignalIO is not enabled. (Detail Code: 0007H) - Other MCv_SetPositionTriggered was executed in the specified axis (Detail Code: 0008H) - Options is out of range (Detail Code: 0009H)	At start During operation	- Does 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 the add-on SignalIO. - Set Options within the range.
3450H	System	MCv_SetTorqueLimit Instruction Error	An error occurred during executing MCv_SetTorqueLimit for the following causes. - PositiveValue is out of range (Detail Code: 0001H) - NegativeValue is out of range (Detail Code: 0002H) - ExecutionMode is out of range (Detail Code: 0003H) - Axis type is incorrect (Detail Code: 0004H) - Axis status at execution is incorrect (Detail Code: 0005H) - Other MCv_SetTorqueLimit was executed in the specified axis (Detail Code: 0006H) - Options is out of range (Detail Code: 0007H)	At start During operation	Does 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	Does not execute FB.	Set a value within the range for ExecutionMode.
3452H	System	Insufficient Operation Profile Data 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	Operation Profile Data Control Unsupported	Control FB was executed for the unsupported operation profile data.	At start	Does not execute FB.	Open operation profile data which supports the operation profile data 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] Does 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] Does 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	Action
345CH	System	Out of Output Coefficient Range	The value is out of range for OutputScaling.	At start During operation	• [At start] Does 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] Does not execute FB. • [During operation] Operates with previous setting value.	Set a value within the range for InputsScaling.
345EH	System	Operation Profile Data Read/Write Unsupported	Operation profile data which does not support operation profile data read/write is set.	During operation	The execution of FB is interrupted.	Set operation profile data 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	• An incorrect type is set in Data1 or Data2. • Add-on that supports the operation profile data format has not been installed.	During operation	The execution of FB is interrupted.	• Set a normal type in Data1 and Data2. • Install and enable the add-on that supports the operation profile data format.
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	Does 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	Does not execute FB.	Set an 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	Does not execute FB.	Set the value within the range.
3484H	System	No Digital Cam Switch	The operation profile data specified in Switches does not exist.	When executing FB	Does not execute FB.	Set the existing operation profile data.
348CH	System	Out of Valid Track No. Range	The value is out of range for EnableTrack.	When executing FB	Does 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	Action
3492H	System	Operation Profile Data Add-on System Memory Shortage	System memory for the add-on is insufficient.	At ready ON	The program stops.	• Please check the System.PrConst.Addon_ProfileControl.Ram SizeMax. • Please check the setting to reduce the usage of the open area. • Please reduce the number of FBs to be executed simultaneously.
3493H	System	Operation Profile Data Add-on Internal Error	An error occurred in internal of operation profile data add-on.	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 Enabled)	MC_GroupEnable was executed when <u>AxisName</u> .Md.AxisStatus of configuration axis is other than Standstill or Disabled.	When Axes Group is Valid	The axes group status does not turn to "GroupStandby".	Execute MC_GroupEnable after setting Standstill or Disabled in <u>AxisName</u> .Md.AxisStatus of all configuration axes.
3495H	System	Axes Group Status Incorrect (When Axes Group is Enabled)	MC_GroupEnable was executed when <u>AxesGroupName</u> .Md.GroupStatus is other than GroupStandby or GroupDisabled.	When Axes Group is Valid	Does not execute FB.	Execute MC_GroupEnable when <u>AxesGroupName</u> .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 <u>AxisName</u> .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: 0001H) • ExecutionMode is out of range (Detail Code: 0002H) • Axis status at execution is incorrect (Detail Code: 0004H) • Other MCv_ChangeCycle was executed with the specified instanceID (Detail Code: 0008H) • Options is out of range (Detail Code: 0009H)	At start During operation	• Does not execute FB. • The execution of FB is interrupted.	• Set Cycle within the range. • Set ExecutionMode within the range. • Execute it when the axis status is Standstill. • Execute other MCv_ChangeCycle after the current one is completed. • 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	Action
3498H	System	MCv_ChangeCycleTriggered Instruction Error	An error occurred during executing MCv_ChangeCycleTriggered for the following causes. • Cycle is out of range (Detail Code: 0001H) • ExecutionMode is out of range (Detail Code: 0002H) • Axis status at execution is incorrect (Detail Code: 0004H) • TriggerInput is incorrect (Detail Code: 0005H, 0006H) • Add-on SignalIO is not enabled. (Detail Code: 0007H) • Other MCv_ChangeCycleTriggered was executed with the specified instance ID (Detail Code: 0008H) • Options is out of range (Detail Code: 0009H)	At start During operation	• Does not execute FB. • The execution of FB is interrupted.	• Set Cycle within the range. • Set ExecutionMode within the range. • Execute it when the axis status is Standstill. • Please check the setting of TriggerInput. • Please enable the add-on SignalIO. • Execute other MCv_ChangeCycleTriggered after the current one is completed. • Set Options within the range.
3499H	System	Add-on Memory Shortage	System memory for the related add-ons is insufficient.	At start up	Does not execute FB.	Please increase System.PrConst.Addon_*.RamSizeMax of related add-ons.
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 Factor (VelFactor) Range	The value is out of range for VelFactor.	During control	Continues the operation with the previous value.	Set VelFactor within the range.
349DH	System	Out of Acceleration Override Factor (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 Factor (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 for OutputBuffer is less than RecordCount. • Access to the outside of device or label range was made.	When executing FB During operation	Does not execute FB.	• Set the number of elements specified for OutputBuffer to be more than RecordCount. • Make settings to avoid an access to the outside of the range.
34A0H	System	Out of Backlash Compensation Direction Range	The value is out of range for BacklashDirection.	When executing FB	Does not execute FB.	Set the value within the range.
34A1H	System	Parameter Reading And Writing FB Execution Disabled Error	Unable to execute the parameter reading FB or the parameter writing FB.	When executing FB	Does 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	Does 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	Does 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	Action
34A4H	System	Touch Probe Disabling Unsupported	FB which does not support the touch probe disabling is set.	When executing FB	Does not execute FB.	Set FB which supports the touch probe disabling.
34A5H	System	Signal Target Incorrect	- Incorrect string was set for the Target of the signal. - An unconnected or non-existent station was set when [OBJ] was specified. - A non-existent object was set for TPDO/RPDO when [OBJ] was specified.	When executing FB	Does not execute FB.	- Set a valid string in the Target of the signal. - Connect the target station when specifying [OBJ]. - Set the target object for TPDO/RPDO when specifying [OBJ].
34A6H	System	Out of Detection Setting Range of Signal	The value is out of range for Detection.	When executing FB	Does not execute FB.	Set a value within the range for Detection.
34A7H	System	Out of CompensationTime Setting Range of Signal	The value is out of range for CompensationTime.	When executing FB	Does not execute FB.	Set a value within the range for CompensationTime.
34A8H	System	Out of FilterTime Setting Range of Signal	The value is out of range for FilterTime.	When executing FB	Does not execute FB.	Set FilterTime 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 Called 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 $\pm\infty$).	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	Action
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.
3503H	System	File Incorrect	The program file is incorrect or is not correctly written.	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	Action
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 location.	At ready ON	The program stops.	Please check the memory capacity of ST add-on.
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	Undefined MCFB exists.	At ready ON	The program stops.	- Please write the program again. - Please check if the necessary add-on 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	Action
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 Add-on System Memory Shortage	System memory for the add-on is insufficient.	At ready ON	The program stops.	Please check the System.PrConst.Addon_Program_ST.RamSizeMax.
3518H	System	ST Add-on Internal Error	An error occurred in ST add-on.	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.	• Please take measures to reduce noise. • Please 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.	• Please take measures to reduce noise. • Please 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.	• Please take measures to reduce noise. • Please 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	Action
3C03H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Please take measures to reduce noise. • Please 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.	• Please take measures to reduce noise. • Please 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.	• Please take measures to reduce noise. • Please 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.	• Please take measures to reduce noise. • Please 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	Action
3C14H	System	Hardware Error	An error was detected in the hardware.	During operation	Stops the system.	• Please take measures to reduce noise. • Please 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.
3F40H	System	Hardware Error	An error was detected in the hardware.	At initialization	Stops the system.	• Please take measures to reduce noise. • Please 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.

22.7 List of Logging Error Codes

Error code (Hexadecimal)	Cause	Action
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 it 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 it 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	Unsupported function.	• Check if the related add-on is installed. • Add-on SignalIO is required to use devices or labels. • Add-on MotionEventHist 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 of 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 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.

22.8 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
07ED	Velocity Override "0"	"0" was set to velocity override.
07EE	Servo System Recorder Start	Servo system recorder is started.
07EF	Follow-up Temporarily Invalid Cancellation	Follow-up invalid has been cancelled.
07F0	MCFB Start (Administrative)	MCFB was started.
07F1	MCFB Start (Motion)	MCFB start or continuous start was executed.
07F2	FB Start	FB was started.
07F3	MCFB Stop	MCFB was stopped by stop cause.
07F4	File Transfer Start	File transfer was started by script file/label.
07F5	Start when SW Stroke Limit is Disabled	Started when software stroke limit was disabled by <u>AxisName.Cd.SwStrokeLimit_Override</u> .
07F6	Start when HW Stroke Limit is Disabled	Started when hardware stroke limit was disabled by <u>AxisName.Cd.HwStrokeLimit_Override</u> .
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 Temporarily Invalid	Follow-up was switched to invalid.
07FC	Servo ON when Follow-up is Invalid	Changed it to servo ON in follow-up invalid status during servo OFF.
07FD	Current Position Restoration Completion	Current position restoration was completed.
07FE	Homing Request OFF to ON	Homing request is ON. - Absolute position erased at driver side was detected. [Real drive axis only] (Detail Code: 0000H) - Absolute position data error in Motion module was detected. (Detail Code: 0001H) - Axis type was changed. (Detail Code: 0002H) - Driver object "Polarity(607Eh)" b7:position polarity was changed. (Detail Code: 0003H) - Change of driver or motor encoder was detected (Detail Code: 0004H) - Machine homing was started. (Detail Code: 0005H) - Driver unit conversion (numerator/denominator) of axis was changed. (Detail Code: 0006H) - Machine homing has never been executed after system started. (Detail Code: 0007H) - Current position restoration was executed. (Detail Code: 0007H) - A driver other than the one used at last home position establishment was connected for a virtual axis. (Detail Code: 0008H) - The upper/lower limit value of encoder ring counter (encoder resolution) was changed. (Detail Code: 0009H) - Driver object "Home offset(607Ch)" was changed. (Detail Code: 000AH)

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
27FFE	Software Reboot Execution	The software reboot was executed.
27FFF	Event History Clear	The event history was cleared.

PART 4 LISTS

23 List of Data Type

24 List of Variables

25 List of Supported Axis Type

26 List of FBs

27 List of Add-on Library

28 List of Boot software

23 List of Data Type

This section describes the following data types.

- Type
- ENUM enumerator

Type

Data type label	Description
Bit (BOOL)	• Bit type label • Bit-specified word [unsigned]/bit string [16 bits] type label • Bit-specified word [signed] type label • Timer/retentive timer/long timer/long retentive timer type label contact/coil • Counter/long counter type label contact/coil
Word [unsigned] / Bit column [16 bits] (WORD)	• Word [unsigned] / Bit column [16 bits] type label • Current value of timer/retentive timer type label • Current value of counter type label
Double word [unsigned] / Bit column [32 bits] (DWORD)	• Double word [unsigned]/bitstring [32 bits] type label • Current value of long timer/long retentive timer type label • Current value of long counter type label
Word [signed] (INT)	• Word [signed] type label • Current value of timer/retentive timer type label • Current value of counter type label
Double word [signed] (DINT)	• Double word [signed] type label • Current value of long timer/long retentive timer type label • Current value of long counter type label
Single-precision real number (REAL)	Single-precision real type label
Double-precision real number (LREAL)	Double-precision real type label
Time (TIME)	Time type label
Character string (STRING(?)) ^{*1}	Character string type label
Character string [Unicode] (WSTRING(?)) ^{*1}	Character string [Unicode] type label

*1 (??) is a value excluding Null.

For details, refer to "Data Specification Method" in the following manual.

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

ENUM enumerator

The type of each ENUM enumerator elements are Word [signed].

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 of Previous One
mcNextExecute	2	Execute at Next Start
mcSpeculatively	3	Execute Speculatively
MC_COMBINE_MODE		
mcAddAxes	0	Add Positions of 2 Input Axes

Type name/Enumerator	Setting value	Description
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 Specification
mcCenter	1	Central Point Specification
mcRadius	2	Radius Specification
MC_CIRC_PATHCHOICE		
mcCW	0	CW
mcCCW	1	CCW
mcShortWay	2	Shortcut
mcLongWay	3	Detour
mcCWLongWay	4	CW Detour
mcCCWLongWay	5	CCW Detour
MC_START_MODE		
mcImmediate	0	Immediate
mcAbsolute	1	Absolute
mcRelative	2	Relative
MC_AXIS_STATUS		
Invalid	-1	Axis variable uninitialization/Axis parameter error
Disabled	0	Axis disabled
ErrorStop	1	Stopping on error
Stopping	2	Decelerating to stop
Homing	3	During homing
Standstill	4	Standby
DiscreteMotion	5	During positioning operation
ContinuousMotion	6	During continuous operation
SynchronizedMotion	7	During synchronous operation
MC_AXES_GROUP_STATUS		
Invalid	-1	Axes group variable uninitialization/Axes group parameter error
GroupDisabled	0	Axes group disabled
GroupErrorStop	1	Stopping on error
GroupStopping	2	Decelerating to stop
GroupHoming	3	Reserve
GroupStandby	4	Standby
GroupMoving	5	Operating
MC_DRIVE_MODE		
NoModeChange	0	Do Not Change
pp	1	Reserve
vl	2	Reserve
pV	3	Reserve
tq	4	Reserve
Reserved	5	Reserve
hm	6	hm (Homing)
ip	7	Reserve

Type name/Enumerator	Setting value	Description
csp	8	csp (Position Control)
csv	9	csv (Velocity Control)
cst	10	cst (Torque Control)
cstca	11	Reserve
ct	-104	ct (Continuous operation to torque Control)
MC_VELOCITY_LIMIT_MODE		
Ignore	0	Ignore
ClampWithRamp	1	Clamp
Truncate	2	Truncate
ImmediateStop	3	Immediate Stop
ClampWithoutRamp	4	Clamp (Without Ramp at Deceleration)
MC_INTERPOLATE_SPEED_MODE		
VectorSpeed	0	Vector Velocity
LongAxisSpeed	1	Long Axis Velocity
ReferenceAxisSpeed	2	Reference Axis Velocity
MC_SYNTHESIZING_MODE		
Addition	0	Addition
Substitution	1	Subtraction
Combine	2	Combination
Interpolation	3	Interpolation
MC_PROFILE_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	Frequency Specified 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 Velocity
ConstantAcceleration	1	Constant Acceleration
DistortedTrapezoid	2	Distorted Trapezoid
DistortedSine	3	Distorted Sine
DistortedConstantSpeed	4	Distorted Constant Velocity
Cycloid	5	Cycloid
FifthCurve	6	5th curve
Trapezoid	7	Trapezoid
ReverseTrapezoid	8	Reverse Trapezoid
DoubleHypotenuse	9	Double Hypotenuse
ReverseDoubleHypotenuse	10	Reverse Double Hypotenuse
SingleHypotenuse	11	Single Hypotenuse
FifthCurve_SpeedDesignation	12	5th curve (Adj.)
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

Type name/Enumerator	Setting value	Description
MC_ENCODER_AXIS_TYPE		
IoModule	0	Via I/O Device
Drive	1	Via Drive Unit
MC_ABS_SYSTEM		
ABSDisabled	0	Disable Absolute Position System
Enabled	1	Enable Absolute Position System
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 Switch On
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	Machine Feed Value
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
LowLevel	1	Detection at FALSE
RisingEdge	2	Detection at FALSE → TRUE (Rising Edge)
FallingEdge	3	Detection at TRUE → FALSE (Falling Edge)
BothEdges	4	Detection at Rising Edge/Falling Edge
MC_STATION_REFRESH_MODE		
EmphasisResponse	0	Response Preferred Method
EmphasisOperationCycle	1	Operation Cycle Preferred Method
MC_ERROR_CLASS		
_None	0	None
Warning	1	Warning
MinorError	2	Minor Error
ModerateError	3	Moderate Error
MajorError	4	Major Error

Type name/Enumerator	Setting value	Description
MC_LOGGING_TYPE		
_None	0	None
ContinuousLogging	1	Continuous Logging
TriggerLogging	2	Trigger Logging
MC_LOGGING_SAVE_STATUS		
UnSave	0	Unsaved
Saving	1	Saving
Saved	2	Saved
FullySaved	3	All Files Saved
MC_EXECUTION_STATE		
Ready	0	Waiting for Execution Request
Executing	1	Executing
Done	2	Execution Completed
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		
NoRegistered	0	Not Registered
Authorized	1	Authentication Completed
SuperPasswordValid	10	Supervisor Password Registered
UnAuthorized	12	Activation Key Registered (Waiting for 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	Restricted
TemporaryNoLimitation	10	Released
Lockout	-1	Lockout
MC_SWITCHING_REQUEST		
NoRequest	0	No Request
Enable_	1	Enable
Disable	2	Disable
MC_POS_RESTORATION_STATUS		
NotExecute	0	Not Executed
WaitingRequest	1	Waiting for Restoration Request
RestoredInIncSystem	2	Restoration Completed in Incremental System
RestoredInAbsSystemUnHomed	3	Restoration Completed in Absolute Position System (Homing Uncompleted)
RestoredInAbsSystem	4	Restoration Completed in Absolute Position System
MC_TRANSITION_MODE		
TMNone	0	Standard

24 List of Variables

This section contains the following information.

- Axis variables
- Axes group variables
- System variables
- Other structure variables

For the setting method of variables, refer to Help of the engineering tool.

Guide for reference of the variables list is shown below.

- Import

Item	Description	Details
Operation cycle	The timing for executing each operation cycle.	☞ Page 113 Operation cycle settings
Normal	The timing for executing normal task of the motion system.	Refer to "Execution of programs" in the following manual. 📖 MELSEC iQ-R Programming Manual (Motion Control Function Blocks)
Logging setting cycle	The timing for correcting the logging target data.	☞ Page 583 Logging setting (LOGGING)
Service	The timing for executing the motion service processing control.	☞ Page 632 Motion service processing control
Immediately	—	—
At start	At FB start	—
At stop	At FB stop	—
At system start	At motion system start.	—
When connecting device	At a slave device connection	—
Ready ON	At the PLC READY [Y0] ON	☞ Page 636 I/O signals
System basic cycle	The timing for executing the system basic cycle processing.	☞ Page 112 System basic cycle
Operation cycle(GroupEnable)	The timing for executing each operation cycle (GroupEnable)	☞ Page 113 Operation cycle settings
When axes group is valid	The timing when the axes group becomes valid.	☞ Page 73 Axes group enabled

- Type

For details on types, refer to the following.

☞ Page 748 Type

- 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)

- 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

- The refresh direction describes labels created automatically by engineering tool.
For example, if a user creates AXIS_REAL type labels manually, the direction can be specified in instance units. When specifying Write, the attribute for all members will be Write. When specifying Read, members with the attribute Write maintains Write.
- The labels with blank parameter type follow the parameter type of the parent member.

Axis variables

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
<u>AxisName.AxisRef.</u>					
AxisNo	Axis No.	—	WORD(UINT)	LIST_WRITE_BACK	ID_MDCST
StartIO	I/O No. (the first 3 digits when expressed in 4-digit hexadecimal)	—	WORD(HEX)	LIST_WRITE_BACK	ID_MDCST
<u>AxisName.PrConst.</u>					
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)	LIST_WRITE_BACK	ID_PRCST
Encoder_AxisType	Real Encoder Axis Type Setting	At system start	ENUM(MC_ENCODER_AXIS_TYPE)	LIST_WRITE_BACK	ID_PRCST
Encoder_CounterDisableSignal	Counter Disabling Signal	At system start	STRUCT(SIGNAL_SELECT)	LIST_WRITE_BACK	ID_PRCST
Encoder_RingCount_LowerValue	Encoder Ring Counter Lower Limit Value	At system start	DINT	LIST_WRITE_BACK	ID_PRCST
Encoder_RingCount_UpperValue	Encoder Ring Counter Upper Limit Value	At system start	DINT	LIST_WRITE_BACK	ID_PRCST
FastOperationMode	Fast Operation Mode Setting	At system start	WORD(HEX)	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	ID_PRCST
PositioningRange	Positioning Range	At system start	LREAL	LIST_WRITE_BACK	ID_PRCST
PosRestoration_AbsPosBase	Absolute Position Reference Setting	At system start	ENUM(MC_POS_SOURCE)	LIST_WRITE_BACK	ID_PRCST
PosRestoration_AbsPosEnable	Absolute Position Control Setting	At system start	ENUM(MC_ABS_SYSTEM)	LIST_WRITE_BACK	ID_PRCST
RingCount_Enable	Ring Counter Enabled Selection	At system start	BOOL	LIST_WRITE_BACK	ID_PRCST
RingCount_LowerValue	Ring Counter Lower Limit Value	At system start	LREAL	LIST_WRITE_BACK	ID_PRCST
RingCount_UpperValue	Ring Counter Upper Limit Value	At system start	LREAL	LIST_WRITE_BACK	ID_PRCST
SlaveEmulate_Enable	Slave Emulation Enabled	At system start	BOOL	LIST_WRITE_BACK	ID_PRCST
SlaveObject	Slave Object Data	At system start	STRUCT(SLAVE_OBJECT_REAL)	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	LIST_WRITE_BACK	ID_PRCST
TorqueLimit_NegativeInitial	Negative Direction Torque Limit Initial Value	At system start	LREAL	LIST_WRITE_BACK	ID_PRCST
TorqueLimit_PositiveInitial	Positive Direction Torque Limit Initial Value	At system start	LREAL	LIST_WRITE_BACK	ID_PRCST
<u>AxisName.Pr.</u>					
AccelerationLimit	Acceleration Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	LIST_WRITE_BACK	ID_PR
CmdInPos_Width	Command In-position Width	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
DecelerationLimit	Deceleration Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
Drive_UnitConvRatioNum	Driver Unit Conversion Numerator	Ready ON	DWORD(UDINT)	LIST_WRITE_BACK	ID_PR

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
Drive_UnitConvRatioDen	Driver Unit Conversion Denominator	Ready ON	DWORD(UDINT)	LIST_WRITE_BACK	ID_PR
ForcedStop_Signal	Forced Stop Signal	Ready ON	STRUCT(SIGNAL_SELECT)	LIST_WRITE_BACK	ID_PR
Homing_Required	Homing Required or Not	Ready ON	BOOL	LIST_WRITE_BACK	ID_PR
JerkLimit	Jerk Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
OverrunOperation	Operation Setting at Overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StartableAtUnhomed	Start Permission at Homing Uncompleted	Ready ON	BOOL	LIST_WRITE_BACK	ID_PR
StopMode_Deceleration	Deceleration at Stop	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_General	Stop Selection at Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_SwStrokeLimit	Stop Stop Selection at Software Stroke Limit Error Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	Ready ON	BOOL	LIST_WRITE_BACK	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	LIST_WRITE_BACK	ID_PR
SwStrokeLimit_Target	Software Stroke Limit Target	Ready ON	ENUM(MC_POS_SOURCE)	LIST_WRITE_BACK	ID_PR
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
Unit_Position	Position Command Unit	Ready ON	DWORD(HEX)	LIST_WRITE_BACK	ID_PR
Unit_PositionString	Position Command Unit String	Ready ON	WSTRING(31)	LIST_WRITE_BACK	ID_PR
Unit_Velocity	Velocity Command Unit	Ready ON	DWORD(HEX)	LIST_WRITE_BACK	ID_PR
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Ready ON	ENUM(MC_VELOCITY_LIMIT_MODE)	LIST_WRITE_BACK	ID_PR
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR

AxisName.Md.

AccelerationLimit	Acceleration Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
AccelerationOverride	Acceleration Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	LIST_READ_ONLY	ID_MD
ActualPosition	Actual Position	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
ActualVelocity	Actual Velocity	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)	LIST_READ_ONLY	ID_MD
BufferingFBs	Number of Buffering FBs	At start/At stop	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	LIST_READ_ONLY	ID_MD
CommandedAcceleration	Commanded Acceleration	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
CommandedDeceleration	Commanded Deceleration	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedJerk	Commanded Jerk	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedPosition	Commanded Position	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedVelocity	Commanded Velocity	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
Cst_SetTorque	Set 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
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_UnitConvRatioNum	Driver Unit Conversion Numerator	Ready ON	DWORD(UDINT)	LIST_READ_ONLY	ID_MD
Drive_UnitConvRatioDen	Driver Unit Conversion Denominator	Ready ON	DWORD(UDINT)	LIST_READ_ONLY	ID_MD
Driver_Mode	Driver Control Mode	Operation cycle	ENUM(MC_DRIVE_MODE)	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)	LIST_READ_ONLY	ID_MD
DriverError	Drive Unit Error Detection	Immediately	BOOL	LIST_READ_ONLY	ID_MD
DriverErrorID	Drive Unit Error Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
DriverErrorDetailID	Drive Unit Error Detail Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
Encoder_Connected	Connection Status	Operation cycle	BOOL	LIST_READ_ONLY	ID_MD
Encoder_CounterDisable	Counter Disabled	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	Machine Feed Value	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
Homing_Complete	Homing Completed	Immediately	BOOL	LIST_READ_ONLY	ID_MD
Homing_Request	Homing Request	Immediately	BOOL	LIST_READ_ONLY	ID_MD
Homing_Required	Homing Required or Not	Ready ON	BOOL	LIST_READ_ONLY	ID_MD
Homing_Status	Homing Operation Status	Operation cycle	WORD(HEX)	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 Velocity Reached	Operation cycle	BOOL	LIST_READ_ONLY	ID_MD
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_Statusword	Operation cycle	WORD(HEX)	LIST_READ_ONLY	ID_MD
Io_TargetPos	Object Data_TargetPos	Operation cycle	DINT	LIST_READ_ONLY	ID_MD
Io_TargetVelocity	Object Data_TargetVelocity	Operation cycle	DWORD(UDINT)	LIST_READ_ONLY	ID_MD
Io_VelActualValue	Object Data_VelActualValue	Operation cycle	DWORD(UDINT)	LIST_READ_ONLY	ID_MD
Io_TorqueActualValue	Object Data_TorqueActualValue	Operation cycle	DWORD(UDINT)	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

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
OverrunOperation	Operation Setting at Overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
PosRestoration_Status	Current Position Restoration Status	Service	ENUM(MC_POS_RESTORATION_STATUS)	LIST_READ_ONLY	ID_MD
ProfileID	Execution Profile ID No.	Operation cycle	WORD(UINT)	LIST_READ_ONLY	ID_MD
SetAcceleration	Set Acceleration	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
SetPosition	Set 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 Homing Uncompleted	Ready ON	BOOL	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)	LIST_READ_ONLY	ID_MD
StopMode_General	Stop Selection at Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	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
SwStrokeLimit_Target	Software Stroke Limit Target	Ready ON	ENUM(MC_POS_SOURCE)	LIST_READ_ONLY	ID_MD
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	Ready ON	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 Velocity	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)	LIST_READ_ONLY	ID_MD
Unit_PositionDisplay	Position Command Unit Display	Ready ON	WSTRING(31)	LIST_READ_ONLY	ID_MD
Unit_PositionString	Position Command Unit String	Ready ON	WSTRING(31)	LIST_READ_ONLY	ID_MD
Unit_Velocity	Velocity Command Unit	Ready ON	DWORD(HEX)	LIST_READ_ONLY	ID_MD
Unit_VelocityDisplay	Velocity Command Unit Display	Ready ON	WSTRING(31)	LIST_READ_ONLY	ID_MD
UseInGroup	Using Axes Group	Operation cycle	BOOL	LIST_READ_ONLY	ID_MD
VelocityLimit_Negative	Negative Direction Velocity Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	Ready ON	ENUM(MC_VELOCITY_LIMIT_MODE)	LIST_READ_ONLY	ID_MD
VelocityLimit_Positive	Positive Direction Velocity Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
VelocityOverride	Velocity Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
Warning	Axis Warning Detection	Immediately	BOOL	LIST_READ_ONLY	ID_MD
WarningID	Axis Warning Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
<u>AxisName.Cd.</u>					
AccelerationOverride	Acceleration Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	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	Homing 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)	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	Velocity Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_CD

Axes group variables

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
<u>AxesGroupName.AxesGroupRef.</u>					
GroupNo	Axes Group No.	—	WORD(UINT)	LIST_WRITE_BACK	ID_MDCST
StartIO	I/O No. (the first 3 digits when expressed in 4-digit hexadecimal)	—	WORD(HEX)	LIST_WRITE_BACK	ID_MDCST
<u>AxesGroupName.Pr.</u>					
AccelerationLimit	Acceleration Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	LIST_WRITE_BACK	ID_PR
Axis[1..16]	Configuration Axis	Ready ON	STRUCT(AXIS_REF)	LIST_WRITE_BACK	ID_PR
CmdInPos_Width	Command In-position Width	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
DecelerationLimit	Deceleration Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
JerkLimit	Jerk Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
OverrunOperation	Operation Setting at Overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_Deceleration	Deceleration at Stop	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	Ready ON	ENUM(MC_STOP_CURVE_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_General	Stop Selection at Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_WRITE_BACK	ID_PR
Unit_Position	Position Command Unit	When Axes Group is Valid	DWORD(HEX)	LIST_WRITE_BACK	ID_PR
Unit_PositionString	Position Command Unit String	When Axes Group is Valid	WSTRING(31)	LIST_WRITE_BACK	ID_PR
Unit_Velocity	Velocity Command Unit	When Axes Group is Valid	DWORD(HEX)	LIST_WRITE_BACK	ID_PR
VelocityLimit	Velocity Limit Value	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
<u>AxesGroupName.Md.</u>					
AccelerationLimit	Acceleration Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
AccelerationOverride	Acceleration Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	Ready ON	ENUM(MC_ACC_ZERO_MODE)	LIST_READ_ONLY	ID_MD
ActualVelocity	Actual Velocity	Operation cycle(GroupEnable)	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
Axis[1..16]	Configuration Axis	Immediately	STRUCT(AXIS_REF)	LIST_READ_ONLY	ID_MD
BufferingFBs	Number of Buffering FBs	At start/At stop	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	LIST_READ_ONLY	ID_MD
CommandedAcceleration	Commanded Acceleration	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedDeceleration	Commanded Deceleration	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedJerk	Commanded Jerk	Operation cycle	LREAL	LIST_READ_ONLY	ID_MD
CommandedVelocity	Commanded Velocity	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_STATUSES)	LIST_READ_ONLY	ID_MD
InterpolationAxes	Interpolation Axes	Operation cycle	DWORD(HEX)	LIST_READ_ONLY	ID_MD
InVelocity	Target Velocity Reached	Operation cycle	BOOL	LIST_READ_ONLY	ID_MD
JerkLimit	Jerk Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
NumberOfAxes	Number of Configuration Axes	Immediately	INT	LIST_READ_ONLY	ID_MD
OverrunOperation	Operation Setting at Overrun	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
SetAcceleration	Set 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)	LIST_READ_ONLY	ID_MD
StopMode_ErrorInGroup	Configuration Axes Operation Selection at Axis Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
StopMode_General	Stop Selection at Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	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 Velocity	Operation cycle(GroupEnable)	LREAL	LIST_READ_ONLY	ID_MD
Unit_Position	Position Command Unit	When Axes Group is Valid	DWORD(HEX)	LIST_READ_ONLY	ID_MD
Unit_PositionDisplay	Position Command Unit Display	When Axes Group is Valid	WSTRING(31)	LIST_READ_ONLY	ID_MD
Unit_PositionString	Position Command Unit String	When Axes Group is Valid	WSTRING(31)	LIST_READ_ONLY	ID_MD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
Unit_Velocity	Velocity Command Unit	When Axes Group is Valid	DWORD(HEX)	LIST_READ_ONLY	ID_MD
Unit_VelocityDisplay	Velocity Command Unit Display	When Axes Group is Valid	WSTRING(31)	LIST_READ_ONLY	ID_MD
VelocityLimit	Velocity Limit Value	Ready ON	LREAL	LIST_READ_ONLY	ID_MD
VelocityOverride	Velocity Override Factor	Operation cycle	LREAL	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 Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_CD
ErrorReset	Axes Group Error Reset	Service	BOOL	LIST_READ_ONLY	ID_CD
VelocityOverride	Velocity Override Factor	Operation cycle	LREAL	LIST_READ_ONLY	ID_CD

System variables

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
System.PrConst.					
Addon_AbsSystem	Add-on AbsSystem Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_Axis	Add-on Axis Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_ExternalSignal	Add-on ExternalSignal Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_FileTransfer	Add-on FileTransfer Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_Logging	Add-on Logging Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_MotionControl_AxisFilter	Add-on MotionControl_AxisFilter Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_MotionControl_General	Add-on MotionControl_General Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_MotionControl_Sync	Add-on MotionControl_Sync Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_MotionEngine	Add-on MotionEngine Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_MotionEventHist	Add-on MotionEventHist Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_NetworkDriver_CCIETSN	Add-on NetworkDriver_CCIETSN Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_PackagingApp	Add-on PackagingApp Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_PlcInstruction	Add-on PlcInstruction Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_ProfileControl	Add-on ProfileControl Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_Program_ST	Add-on Program_ST Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_ServoDriver_CANopen	Add-on ServoDriver_CANopen Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_ServoSystemRecorder	Add-on ServoSystemRecorder Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
Addon_SignalIO	Add-on SignalIO Parameter	At system start	STRUCT(ADDON_PARAM)	LIST_WRITE_BACK	ID_PRCST
BuffermemoryRefreshCycle	Buffer Memory Refresh Cycle Setting	At system start	STRUCT(CYCLE_PARAM)	LIST_WRITE_BACK	ID_PRCST

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
EventHistoryCpu_Exclude	Event Excluding CPU Event History	At system start	STRING(255)	LIST_WRITE_BACK	ID_PRCST
EventHistoryMotion_Capacity	Motion Event History Capacity	At system start	INT	LIST_WRITE_BACK	ID_PRCST
EventHistoryMotion_Exclude	Event Excluding Motion Event History	At system start	STRING(255)	LIST_WRITE_BACK	ID_PRCST
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	Fast Operation Mode Setting	At system start	WORD(HEX)	LIST_WRITE_BACK	ID_PRCST
FileTransfer_AcFile_lch	File Transfer Access Control (Files in Latch Drive)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AcFile_ram	File Transfer Access Control (Files in RAM Drive)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AcFile_rom	File Transfer Access Control (Files in User Drive)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AcFile_sdc	File Transfer Access Control (Files in SD Memory Card)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AcFile_sys	File Transfer Access Control (Files in System Drive)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AcLabel	File Transfer Access Control (Label)	At system start	WORD(HEX)	LIST_READ_ONLY	ID_PRCST
FileTransfer_AutorunEnable	File Transfer Auto Execution Enabled	At system start	BOOL	LIST_READ_ONLY	ID_PRCST
FileTransfer_LogCapacity	File Transfer Log Capacity	At system start	INT	LIST_WRITE_BACK	ID_PRCST
LabelMemorySize	Label Memory Size	At system start	INT	LIST_WRITE_BACK	ID_PRCST
Link_MotionStationRefreshType	Motion Synchronization Station Send/Receive Data Refresh Method	At system start	ENUM(MC_STATI ON_REFRESH_M ODE)	LIST_WRITE_BACK	ID_PRCST
Logging_AutoLoggingEnable	Auto Logging Enabled	At system start	BOOL	LIST_READ_ONLY	ID_PRCST
MeasuresPrograms	Measurement Flag for Program Information	At system start	BOOL	LIST_WRITE_BACK	ID_PRCST
OperationCycle[1]	Operation Cycle Setting	At system start	STRUCT(CYCLE_ PARAM)	LIST_WRITE_BACK	ID_PRCST
SoftReboot_Enable	Software Reboot Enabled	At system start	BOOL	LIST_WRITE_BACK	ID_PRCST
MultiThreadMode	For Manufacturer Setting	At system start	WORD(HEX)	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 Cause Occurrence	Ready ON	ENUM(MC_DECE L_STOP_MODE)	LIST_WRITE_BACK	ID_PR
StopMode_AllDeceleration	Deceleration at All Axes Stop	Ready ON	LREAL	LIST_WRITE_BACK	ID_PR
System.Cd.					
AddonLimit_Key	Add-on Library Configuration Restriction Key Setting	Immediately	STRING(31)	LIST_READ_ONLY	ID_CD
AddonLimit_Level	Add-on Library Configuration Restriction Level	Immediately	INT	LIST_READ_ONLY	ID_CD
AddonLimit_Regist	Add-on Library Configuration Restriction Request	Service	ENUM(MC_ADDO N_LIMIT_CMD)	LIST_READ_ONLY	ID_CD
BackupRestore	Backup/Restore Request	Service	WORD(HEX)	LIST_READ_ONLY	ID_CD
ErrorReset	System Error Reset	Service	BOOL	LIST_READ_ONLY	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
SequenceReady	PLC Ready	Service	BOOL	LIST_READ_ONLY	ID_CD
SoftRebootRequest	Software Reboot Request	Service	STRING(15)	LIST_READ_ONLY	ID_CD
Storage_sdcForcedDisable	SD Memory Card Force Disabled Command	Service	BOOL	LIST_READ_ONLY	ID_CD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
Storage_sdcardRemovalProhibit	SD Memory Card Removal Prohibition	Service	BOOL	LIST_READ_ONLY	ID_CD
System.Md.					
Addon_AbsSystem	Add-on AbsSystem Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_Axis	Add-on Axis Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_ExternalSignal	Add-on ExternalSignal Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_FileTransfer	Add-on FileTransfer Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_Logging	Add-on Logging Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_MotionControl_AxisFilter	Add-on MotionControl_AxisFilter Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_MotionControl_General	Add-on MotionControl_General Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_MotionControl_Sync	Add-on MotionControl_Sync Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_MotionEngine	Add-on MotionEngine Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_MotionEventHist	Add-on MotionEventHist Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_NetworkDriver_CCIETSN	Add-on NetworkDriver_CCIETSN Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_PackagingApp	Add-on PackagingApp Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_PlcInstruction	Add-on PlcInstruction Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_ProfileControl	Add-on ProfileControl Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_Program_ST	Add-on Program_ST Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_ServoDriver_CANopen	Add-on ServoDriver_CANopen Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_ServoSystemRecorder	Add-on ServoSystemRecorder Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
Addon_SignalIO	Add-on SignalIO Monitor	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
AddonLimit_Level	Add-on Library Configuration Restriction Level	Immediately	INT	LIST_READ_ONLY	ID_MD
AddonLimit_State	Add-on Library Configuration Restriction State	Immediately	ENUM(MC_ADDON_LIMIT_STATE)	LIST_READ_ONLY	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)	LIST_READ_ONLY	ID_MD
Error	Motion Area System Error Detection	Immediately	BOOL	LIST_READ_ONLY	ID_MD
ErrorID	Latest Motion Area System Error Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
EventHistoryMotion_ClearStatus	Motion Event History Clear Execution Status	Service	ENUM(MC_EXECUTION_STATE)	LIST_READ_ONLY	ID_MD
EventHistoryMotion_Path	Motion Event History Path	At system start	STRING(127)	LIST_READ_ONLY	ID_MD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
FileTransfer_State	File Transfer Executing State	Service	ENUM(MC_EXECUTION_STATE)	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)	LIST_READ_ONLY	ID_MD
HwStatus_RomWriteCycle	Flash ROM Write Count Index Value	Service	DWORD(UDINT)	LIST_READ_ONLY	ID_MD
LabelMemoryFreeSize	Label Memory Free Size	Immediately	INT	LIST_READ_ONLY	ID_MD
MemorySize	System Memory Size	Service	STRUCT(ADDON_PARAM)	LIST_READ_ONLY	ID_MD
MemoryUsage	System Memory Usage	Service	STRUCT(ADDON_MONI)	LIST_READ_ONLY	ID_MD
NetworkError	Network Area Error Detection	Immediately	BOOL	LIST_READ_ONLY	ID_MD
NetworkErrorID	Network Area Error Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
OperationCycle[1]	Operation Cycle Monitor	Immediately	STRUCT(CYCLE_MONI)	LIST_READ_ONLY	ID_MD
Program_Ei	EI Flag	Immediately	BOOL	LIST_READ_ONLY	ID_MD
Program_NormalTaskCycle	Normal Task Processing Time Monitor	Normal	STRUCT(CYCLE_MONI)	LIST_READ_ONLY	ID_MD
Ready	Ready	Service	BOOL	LIST_READ_ONLY	ID_MD
ServoSystemRecorder_Enable	Servo System Recorder Enabled	At system start	BOOL	LIST_READ_ONLY	ID_MD
StopMode_All	Stop Selection at All Axes Stop Cause Occurrence	Ready ON	ENUM(MC_DECEL_STOP_MODE)	LIST_READ_ONLY	ID_MD
StopMode_AllDeceleration	Deceleration All Axes Stop	At startReady ON	LREAL	LIST_READ_ONLY	ID_MD
Storage_Ich	Latch Drive Information	Service	STRUCT(STORAGE_INFORMATION)	LIST_READ_ONLY	ID_MD
Storage_ram	RAM Drive Information	Service	STRUCT(STORAGE_INFORMATION)	LIST_READ_ONLY	ID_MD
Storage_rom	User Drive Information	Service	STRUCT(STORAGE_INFORMATION)	LIST_READ_ONLY	ID_MD
Storage_sdc	SD Memory Card Information	Service	STRUCT(STORAGE_INFORMATION)	LIST_READ_ONLY	ID_MD
Storage_sdcForcedDisabled	SD Memory Card Force Disabled	Service	BOOL	LIST_READ_ONLY	ID_MD
Storage_sdcInserted	SD Memory Card Inserted	Service	BOOL	LIST_READ_ONLY	ID_MD
Storage_sdcProtected	SD Memory Card Protected	Service	BOOL	LIST_READ_ONLY	ID_MD
Storage_sys	System Drive Information	Service	STRUCT(STORAGE_INFORMATION)	LIST_READ_ONLY	ID_MD
Sync	Synchronization flag	Service	BOOL	LIST_READ_ONLY	ID_MD
SystemBaseCycle	System Basic Cycle Monitor	Immediately	STRUCT(CYCLE_MONI)	LIST_READ_ONLY	ID_MD
SystemBaseCycle_Counter	System Basic Cycle Counter	System basic cycle	WORD(UINT)	LIST_READ_ONLY	ID_MD
Version_BaseSystemSw	Basic System Software Version	At system start	WORD(UINT)	LIST_READ_ONLY	ID_MD
Version_BootSw	Boot Software Version	At system start	WORD(UINT)	LIST_READ_ONLY	ID_MD
Version_NetworkBootSw	Network Boot Software Version	At system start	WORD(UINT)	LIST_READ_ONLY	ID_MD
Warning	Motion Area System Warning Detection	Immediately	BOOL	LIST_READ_ONLY	ID_MD
WarningID	Latest Motion Area System Warning Code	Immediately	WORD(HEX)	LIST_READ_ONLY	ID_MD
WDTerror	WDT Error	Immediately	BOOL	LIST_READ_ONLY	ID_MD

Variable/Structure name	Name	Import	Type	Attribute	Parameter type
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)	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
TriggerCountIgnored	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
TriggerStatusWord	Trigger Status Word	Logging setting cycle	DWORD(HEX)	LIST_READ_ONLY	ID_MD

Other structure variables

Variable/Structure name	Name	Type
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)
TARGET_REF		
StartIO	IO No.	WORD(HEX)
Target	Target	WSTRING(63)
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	Operation 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		

Variable/Structure name	Name	Type
Number	Profile ID No.	WORD(UINT)
CYCLE_PARAM		
Cycle	Cycle Setting	DINT
NumOfCycleOverWngDetectTimes	Number of Cycle Over Warning Detections	WORD(UINT)
NumOfCycleOverErrDetectTimes	Number of Cycle Over Error Detections	WORD(UINT)
CycleOverErrorType	Cycle Over Error Selection	ENUM(MC_ERROR_CLASS)
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)
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 No.	WORD(UINT)
PROFILE_CAM_DATA		
Interpolate	Interpolation Method Specification	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 Velocity	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 Velocity	LREAL
EndAcceLeration	End Point Acceleration	LREAL

Variable/Structure name	Name	Type
PROFILE_ROTARY_CUTTER		
Resolution	Resolution	DWORD(UDINT)
InputUnitString	Input Unit String	WSTRING(31)
Options	Options	DWORD(HEX)
AutoGenerationOptions	Auto-generation Options	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 Adjustment	LREAL
AccDecWidth	Acceleration/Deceleration Width	LREAL
AsyncSpd	Asynchronous Velocity 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]
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)
EncoderIncrements	EncoderIncrements	WSTRING(63)
FollowingErrActualValue	FollowingErrActualValue	WSTRING(63)
GearRatioMotorRevolutions	GearRatioMotorRevolutions	WSTRING(63)
HomeOffset	HomeOffset	WSTRING(63)
MaxMotorSpeed	MaxMotorSpeed	WSTRING(63)
MaxTorque	MaxTorque	WSTRING(63)
ModesOfOp	ModesOfOp	WSTRING(63)
ModesOfOpDisp	ModesOfOpDisp	WSTRING(63)
NegativeTorqueLimitValue	NegativeTorqueLimitValue	WSTRING(63)
Polarity	Polarity	WSTRING(63)
PosActualValue	PosActualValue	WSTRING(63)
PosEncoderResolution	PosEncoderResolution	WSTRING(63)
PosEncoderResolutionMotorRevolutions	PosEncoderResolutionMotorRevolutions	WSTRING(63)
PositiveTorqueLimitValue	PositiveTorqueLimitValue	WSTRING(63)
ShaftRevolutions	ShaftRevolutions	WSTRING(63)
SiUnitPos	SiUnitPos	WSTRING(63)
SiUnitVel	SiUnitVel	WSTRING(63)
StatusWord	StatusWord	WSTRING(63)
SupportedDriveModes	SupportedDriveModes	WSTRING(63)
TargetPos	TargetPos	WSTRING(63)
TargetTorque	TargetTorque	WSTRING(63)

Variable/Structure name	Name	Type
TargetVelocity	TargetVelocity	WSTRING(63)
TargetActualValue	TorqueActualValue	WSTRING(63)
VelActualValue	VelActualValue	WSTRING(63)
vControlDi1	ControlDi1	WSTRING(63)
vControlDi2	ControlDi2	WSTRING(63)
vControlDi3	ControlDi3	WSTRING(63)
vControlDi4	ControlDi4	WSTRING(63)
vControlDi5	ControlDi5	WSTRING(63)
vControlDi6	ControlDi6	WSTRING(63)
vControlDi7	ControlDi7	WSTRING(63)
vCurrentAlarm	CurrentAlarm	WSTRING(63)
vEncoderStatus1	EncoderStatus1	WSTRING(63)
vHomeAbsCounter	HomeAbsCounter	WSTRING(63)
vHomeCycleCounter	HomeCycleCounter	WSTRING(63)
vInitialAbsCounter	InitialAbsCounter	WSTRING(63)
vInitialCycleCounter	InitialCycleCounter	WSTRING(63)
vInitialPos	InitialPos	WSTRING(63)
vMaxAbsCounter	MaxAbsCounter	WSTRING(63)
vStatusDo1	StatusDo1	WSTRING(63)
vStatusDo2	StatusDo2	WSTRING(63)
vStatusDo3	StatusDo3	WSTRING(63)
vStatusDo4	StatusDo4	WSTRING(63)
vStatusDo5	StatusDo5	WSTRING(63)
vStatusDo6	StatusDo6	WSTRING(63)
vStatusDo7	StatusDo7	WSTRING(63)
vSupportedControlDi1	SupportedControlDi1	WSTRING(63)
vSupportedControlDi2	SupportedControlDi2	WSTRING(63)
vSupportedControlDi3	SupportedControlDi3	WSTRING(63)
vSupportedControlDi4	SupportedControlDi4	WSTRING(63)
vSupportedControlDi5	SupportedControlDi5	WSTRING(63)
vSupportedControlDi6	SupportedControlDi6	WSTRING(63)
vSupportedControlDi7	SupportedControlDi7	WSTRING(63)
vSupportedStatusDo1	SupportedStatusDo1	WSTRING(63)
vSupportedStatusDo2	SupportedStatusDo2	WSTRING(63)
vSupportedStatusDo3	SupportedStatusDo3	WSTRING(63)
vSupportedStatusDo4	SupportedStatusDo4	WSTRING(63)
vSupportedStatusDo5	SupportedStatusDo5	WSTRING(63)
vSupportedStatusDo6	SupportedStatusDo6	WSTRING(63)
vSupportedStatusDo7	SupportedStatusDo7	WSTRING(63)
vSyncAbsCounter	SyncAbsCounter	WSTRING(63)
vSyncCycleCounter	SyncCycleCounter	WSTRING(63)
vVelLimitValue	VelLimitValue	WSTRING(63)
vWatchDogCounterDI	WatchDogCounterDI	WSTRING(63)
vWatchDogCounterUI	WatchDogCounterUI	WSTRING(63)
vEncoderStatus2	EncoderStatus2	WSTRING(63)
vScaleCycleCounte	ScaleCycleCounter	WSTRING(63)
vScaleAbsCounter	ScaleAbsCounter	WSTRING(63)
vScaleMeasurementEncoderResolution	ScaleMeasurementEncoderResolution	WSTRING(63)
vScaleMeasurementEncoderReceptionStatus	ScaleMeasurementEncoderReceptionStatus	WSTRING(63)
SLAVE_OBJECT_ENCODER		
PosActualValue	PosActualValue	WSTRING(63)
SLAVE_OBJECT_VIRTUAL_ENCODER		
PosActualValue	PosActualValue	WSTRING(63)

25 List of Supported Axis Type

Variables supported by each axis type are shown below.

○: Supported, ×: Not supported

Axis variables

Variable/Structure name		Name	Axis type (data type)				
			Real drive axis (AXIS_REAL)	Real encoderaxis (AXIS_ENCODER)	Virtual drive axis (AXIS_VIRTUAL)	Virtual encoderaxis (AXIS_VIRTUAL_ENCODER)	Virtual linked axis(AXIS_VIRTUAL_LINK)
AxisName.PrConst.							
	AddressOfStation	Station Address Setting	○	○	×	×	×
	AxisType	Axis Type Setting	○	○	○	○	○
	Encoder_AxisType	Real Encoder Axis Type Setting	×	○	×	×	×
	Encoder_CounterDisableSignal	Counter Disabling Signal	×	○	×	○	×
	Encoder_RingCout_LowerValue	Encoder Ring Counter Lower Limit Value	×	×	×	○	×
	Encoder_RingCout_UpperValue	Encoder Ring Counter Upper Limit Value	×	×	×	○	×
	FastOperationMode	Fast Operation Mode Setting	○	○	○	○	○
	HwStrokeLimit_FlsSignal	Upper Limit Signal	○	×	○	×	×
	HwStrokeLimit_RlsSignal	Lower Limit Signal	○	×	○	×	×
	OperationCycle	Control Cycle Setting	○	○	○	○	○
	PositioningRange	Positioning Range	○	○	○	○	○
	PosRestoration_AbsPosBase	Absolute Position Reference Setting	○	×	×	×	×
	PosRestoration_AbsPosEnable	Absolute Position Control Setting	○	○	○	○	○
	RingCount_Enable	Ring Counter Enabled Selection	○	○	○	○	○
	RingCount_LowerValue	Ring Counter Lower Limit Value	○	○	○	○	○
	RingCount_UpperValue	Ring Counter Upper Limit Value	○	○	○	○	○
	SlaveEmulate_Enable	Slave Emulation Enabled	○	×	×	×	×
	SlaveObject	Slave Object Data	○	×	×	×	×
	SlaveObject	Slave Object Data	×	×	×	○	×
	TorqueLimit_Max	Torque Limit Maximum Value	○	×	×	×	×
	TorqueLimit_NegativeInitial	Negative Direction Torque Limit Initial Value	○	×	×	×	×
	TorqueLimit_PositiveInitial	Positive Direction Torque Limit Initial Value	○	×	×	×	×
AxisName.Pr.							
	AccelerationLimit	Acceleration Limit Value	○	×	○	×	×
	AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	○	×	○	×	×
	CmdInPos_Width	Command In-position Width	○	×	○	×	×
	DecelerationLimit	Deceleration Limit Value	○	×	○	×	×
	Drive_UnitConvRatioNum	Driver Unit Conversion Numerator	○	○	×	○	×

Variable/Structure name	Name	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)
Drive_UnitConvRatioDen	Driver Unit Conversion Denominator	○	○	×	○	×
ForcedStop_Signal	Forced Stop Signal	○	×	○	×	×
Homing_Required	Homing Required or Not	○	○	○	○	○
JerkLimit	Jerk Limit Value	○	×	○	×	×
OverrunOperation	Operation Setting at Overrun	○	×	○	×	×
StartableAtUnhomed	Start Permission at Homing Uncompleted	○	○	○	○	○
StopMode_Deceleration	Deceleration at Stop	○	×	○	×	×
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	○	×	○	×	×
StopMode_General	Stop Selection at Stop Cause Occurrence	○	×	○	×	×
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	○	×	○	×	×
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	○	×	○	×	×
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	○	×	○	×	×
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	○	×	×	×	×
StopSignal	Stop Signal	○	×	○	×	×
SwStrokeLimit_Lower	Software Stroke Limit Lower Value	○	×	○	×	×
SwStrokeLimit_Target	Software Stroke Limit Target	○	×	○	×	×
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	○	×	○	×	×
Unit_Position	Position Command Unit	○	○	○	○	○
Unit_PositionString	Position Command Unit String	○	○	○	○	○
Unit_Velocity	Velocity Command Unit	○	○	○	○	○
VelocityLimit_Negative	Negative Direction Velocity Limit Value	○	×	○	×	×
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	○	×	○	×	×
VelocityLimit_Positive	Positive Direction Velocity Limit Value	○	×	○	×	×
AxisName.Md.						
AccelerationLimit	Acceleration Limit Value	○	×	○	×	×
AccelerationOverride	Acceleration Override Factor	○	×	○	×	×
AccelerationZeroBehavior	Operation Selection at Start Acceleration/Deceleration 0	○	×	○	×	×
ActualPosition	Actual Position	○	○	×	×	×
ActualVelocity	Actual Velocity	○	○	×	×	×
Analyzing	Analyzing	○	○	○	○	○
AutoDeceleration	Automatically Decelerating	○	×	○	×	×
AxisName	Axis Name	○	○	○	○	○
AxisStatus	Axis Status	○	○	○	○	○
BufferingFBs	Number of Buffering FBs	○	×	○	×	×

Variable/Structure name	Name	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)
CmdInPos	Command In-position	○	×	○	×	×
CmdInPos_Width	Command In-position Width	○	×	○	×	×
CommandedAcceleration	Commanded Acceleration	○	×	○	×	×
CommandedDeceleration	Commanded Deceleration	○	×	○	×	×
CommandedJerk	Commanded Jerk	○	×	○	×	×
CommandedPosition	Commanded Position	○	×	○	×	×
CommandedVelocity	Commanded Velocity	○	×	○	×	×
Cst_SetTorque	Set Torque at Torque Control	○	×	×	×	×
Cst_TargetTorque	Target Torque at Torque Control	○	×	×	×	×
CumulativePosition	Cumulative Current Position	○	○	○	○	○
DecelerationLimit	Deceleration Limit Value	○	×	○	×	×
Drive_RPDO[1..64]	RPDO (Slave Device -> Motion System) Mapping	○	×	×	×	×
Drive_TPDO[1..64]	TPDO (Motion System -> Slave Device) Mapping	○	×	×	×	×
Drive_UnitConvRatioNum	Driver Unit Conversion Numerator	○	○	×	○	×
Drive_UnitConvRatioDen	Driver Unit Conversion Denominator	○	○	×	○	×
Driver_Mode	Driver Control Mode	○	×	×	×	×
Driver_ReadyOn	Driver Ready On Status	○	×	×	×	×
Driver_ServoOn	Driver Servo On Status	○	×	×	×	×
Driver_State	Driver Status	○	×	×	×	×
DriverError	Drive Unit Error Detection	○	×	×	×	×
DriverErrorID	Drive Unit Error Code	○	×	×	×	×
DriverErrorDetailID	Drive Unit Error Detail Code	○	×	×	×	×
Encoder_Connected	Connection Status	×	×	×	○	×
Encoder_CounterDisable	Counter Disabled	×	○	×	○	×
Error	Axis Error Detection	○	○	○	○	○
ErrorID	Axis Error Code	○	○	○	○	○
FeedMachinePosition	Machine Feed Value	○	×	×	×	×
FollowupDisable	Follow-up Disabled	○	×	×	×	×
ForcedStop_Released	Forced Stop Cancelling	○	×	○	×	×
ForcedStop_Signal	Forced Stop Signal	○	×	○	×	×
Homing_Complete	Homing Completed	○	○	○	○	○
Homing_Request	Homing Request	○	○	○	○	○
Homing_Required	Homing Required or Not	○	○	○	○	○
Homing_Status	Homing Operation Status	○	×	×	×	×
HwStrokeLimit_FlsStatus	Upper Limit Signal Status	○	×	○	×	×
HwStrokeLimit_Override	Hardware Stroke Limit Override	○	×	○	×	×
HwStrokeLimit_RlsStatus	Lower Limit Signal Status	○	×	○	×	×
InVelocity	Target Velocity Reached	○	×	○	×	×
Io_PosActualValue	Object Data_PosActualValue	○	○	×	○	×
Io_PosEncoderResolution	Object Data_PosEncoderResolution	×	○	×	○	×
Io_Statusword	Object Data_Statusword	○	○	×	×	×

Variable/Structure name	Name	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)
Io_TargetPos	Object Data_TargetPos	○	×	○	×	×
Io_TargetVelocity	Object Data_TargetVelocity	○	×	×	×	×
Io_TorqueActualValue	Object Data_TorqueActualValue	○	×	×	×	×
Io_VelActualValue	Object Data_VelActualValue	○	×	×	×	×
JerkLimit	Jerk Limit Value	○	×	○	×	×
OperationCycle	Control Cycle	○	○	○	○	○
OverrunOperation	Operation Setting at Overrun	○	×	○	×	×
PosRestoration_Status	Current Position Restoration Status	○	○	○	○	○
ProfileID	Execution Profile ID No.	○	×	○	×	○
SetAcceleration	Set Acceleration	○	×	○	×	×
SetPosition	Set Position	○	○	○	○	○
SetVelocity	Set Velocity	○	×	○	○	×
SlaveEmulate_Enable	Slave Emulating	○	×	×	×	×
StartableAtUnhomed	Start Permission at Homing Uncompleted	○	○	○	○	○
StopMode_Deceleration	Deceleration at Stop	○	×	○	×	×
StopMode_DecelerationCurve	Stop Selection at Deceleration to Stop	○	×	○	×	×
StopMode_General	Stop Selection at Stop Cause Occurrence	○	×	○	×	×
StopMode_HwStrokeLimit	Stop Selection at Hardware Stroke Limit Error Occurrence	○	×	○	×	×
StopMode_ServoOff	Process Selection at Servo OFF Command During Operation	○	×	○	×	×
StopMode_SwStrokeLimit	Stop Selection at Software Stroke Limit Error Occurrence	○	×	○	×	×
StopOption_DriverTargetIgnored	Driver Command Discard Detection Setting	○	×	×	×	×
StopSignal	Stop Signal	○	×	○	×	×
StopStatus	Stop Status	○	×	○	×	×
SwStrokeLimit_Lower	Software Stroke Limit Lower Value	○	×	○	×	×
SwStrokeLimit_Override	Software Stroke Limit Override	○	×	○	×	×
SwStrokeLimit_Target	Software Stroke Limit Target	○	×	○	×	×
SwStrokeLimit_Upper	Software Stroke Limit Upper Value	○	×	○	×	×
TargetAcceleration	Target Acceleration	○	×	○	×	×
TargetDeceleration	Target Deceleration	○	×	○	×	×
TargetVelocity	Target Velocity	○	×	○	×	×
TorqueLimit_Negative	Negative Direction Torque Limit Value	○	×	×	×	×
TorqueLimit_Positive	Positive Direction Torque Limit Value	○	×	×	×	×
Unit_Position	Position Command Unit	○	○	○	○	○
Unit_PositionDisplay	Position Command Unit Display	○	○	○	○	○

Variable/Structure name	Name	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)
Unit_PositionString	Position Command Unit String	○	○	○	○	○
Unit_Velocity	Velocity Command Unit	○	○	○	○	○
Unit_VelocityDisplay	Velocity Command Unit Display	○	○	○	○	○
UseInGroup	Using Axes Group	○	○	○	○	○
VelocityLimit_Negative	Negative Direction Velocity Limit Value	○	×	○	×	×
VelocityLimit_OverOperation	Operation Setting at Velocity Limit Value Exceeded	○	×	○	×	×
VelocityLimit_Positive	Positive Direction Velocity Limit Value	○	×	○	×	×
VelocityOverride	Velocity Override Factor	○	×	○	×	×
Warning	Axis Warning Detection	○	○	○	○	○
WarningID	Axis Warning Code	○	○	○	○	○
AxisName.Cd.						
AccelerationOverride	Acceleration Override Factor	○	×	○	×	×
Encoder_Connect	Connection Command	×	×	×	○	×
Encoder_CounterDisable	Counter Disabled	×	○	×	×	×
Encoder_InputValue	Encoder Input Value	×	×	×	○	×
ErrorReset	Axis Error Reset	○	○	○	○	○
FollowupDisable	Follow-up Disabled	○	×	×	×	×
Homing_ClearRequest	Homing Request Clear	○	○	○	○	○
HwStrokeLimit_Override	Hardware Stroke Limit Override	○	×	○	×	×
SlaveEmulate_Param	Slave Emulation Parameter	○	○	×	×	×
SlaveEmulate_Request	Slave Emulation Request	○	○	×	×	×
SwStrokeLimit_Override	Software Stroke Limit Override	○	×	○	×	×
TorqueLimit_Negative	Negative Direction Torque Limit Value	○	×	×	×	×
TorqueLimit_Positive	Positive Direction Torque Limit Value	○	×	×	×	×
VelocityOverride	Velocity Override Factor	○	×	○	×	×

26 List of FBs

Name	Description	Type	Reference
MC_CamIn	Starts cam operation.	MCFB (motion/single)	Page 478 MC_CamIn
MC_CombineAxes	Combines the motion of 2 axes.	MCFB (motion/single)	Page 510 MC_CombineAxes
MC_GearIn	Starts gear operation.	MCFB (motion/single)	Page 503 MC_GearIn
MC_GroupStop	Executes a forced stop for an axes group.	MCFB (motion/single)	Page 171 MC_GroupStop
MC_Home	Executes homing.	MCFB (motion/single)	Page 208 MC_Home
MC_MoveAbsolute	Executes positioning (absolute).	MCFB (motion/single)	Page 216 MC_MoveAbsolute
MC_MoveRelative	Executes positioning (relative).	MCFB (motion/single)	Page 219 MC_MoveRelative
MC_MoveVelocity	Executes speed control.	MCFB (motion/single)	Page 291 MC_MoveVelocity
MCv_SpeedControl	Executes speed control (including position loop).	MCFB (motion/single)	Page 231 MCv_SpeedControl
MC_Stop	Executes a forced stop.	MCFB (motion/single)	Page 169 MC_Stop
MC_TorqueControl	Executes torque control.	MCFB (motion/single)	Page 302 MC_TorqueControl
MCv_BacklashCompensationFilter	Backlash compensation filter	MCFB (motion/single)	Page 412 MCv_BacklashCompensationFilter
MCv_DirectionFilter	Travel direction control filter	MCFB (motion/single)	Page 408 MCv_DirectionFilter
MCv_Jog	Executes JOG operation.	MCFB (motion/single)	Page 235 MCv_Jog (JOG Operation)
MCv_MoveCircularInterpolateAbsolute	Executes circular interpolation control (absolute).	MCFB (motion/single)	Page 248 MCv_MoveCircularInterpolateAbsolute
MCv_MoveCircularInterpolateRelative	Executes circular interpolation control (relative).	MCFB (motion/single)	Page 251 MCv_MoveCircularInterpolateRelative
MCv_MoveLinearInterpolateAbsolute	Executes linear interpolation control (absolute).	MCFB (motion/single)	Page 243 MCv_MoveLinearInterpolateAbsolute
MCv_MoveLinearInterpolateRelative	Executes linear interpolation control (relative).	MCFB (motion/single)	Page 246 MCv_MoveLinearInterpolateRelative
MCv_SmoothingFilter	Enables smoothing filter.	MCFB (motion/single)	Page 406 MCv_SmoothingFilter
MCv_SpeedLimitFilter	Velocity control filter	MCFB (motion/single)	Page 410 MCv_SpeedLimitFilter
MC_AbortTrigger	Disables the touch probe.	MCFB (motion/single)	Page 448 MC_AbortTrigger
MC_CamTableSelect	Selects cam tables.	MCFB (administrative)	Page 518 MC_CamTableSelect
MC_GroupDisable	Disables an axes group.	MCFB (administrative)	Page 68 MC_GroupDisable
MC_GroupEnable	Enables an axes group.	MCFB (administrative)	Page 66 MC_GroupEnable
MC_GroupReset	Axes group error reset	MCFB (administrative)	Page 691 MC_GroupReset
MC_GroupSetOverride	Sets the values of override for an axes group.	MCFB (administrative)	Page 383 MC_GroupSetOverride
MC_Power	Controls the power stage (ON or OFF) for a single axis.	MCFB (administrative)	Page 90 MC_Power
MC_ReadParameter	Parameter read	MCFB (administrative)	Page 652 MC_ReadParameter
MC_Reset	Axes error reset	MCFB (administrative)	Page 690 MC_Reset
MC_SetOverride	Sets the values of override.	MCFB (administrative)	Page 381 MC_SetOverride
MC_SetPosition	Changes the current position.	MCFB (administrative)	Page 321 MC_SetPosition
MC_TouchProbe	Enables the touch probe.	MCFB (administrative)	Page 446 MC_TouchProbe
MC_WriteParameter	Parameter write	MCFB (administrative)	Page 654 MC_WriteParameter
MCv_AllPower	Controls the power stage (ON or OFF) for all axes.	MCFB (administrative)	Page 92 MCv_AllPower
MCv_ChangeCycle	Changes the current value per cycle.	MCFB (administrative)	Page 529 MCv_ChangeCycle
MCv_ChangeCycleTriggered ^{*1}	Changes the current value per cycle.	MCFB (administrative)	Page 531 MCv_ChangeCycleTriggered (Future support planned)
MCv_MotionErrorReset	Motion error reset	MCFB (administrative)	Page 689 MCv_MotionErrorReset
MCv_SetPositionTriggered ^{*1}	Compensates the current position at a trigger event.	MCFB (administrative)	Page 324 MCv_SetPositionTriggered (Future support planned)
MCv_SetTorqueLimit	Sets torque limits.	MCFB (administrative)	Page 394 MCv_SetTorqueLimit
MCv_ProfileCalc ^{*1}	Calculates profile data.	General FB	Page 523 MCv_ProfileCalc (Future support planned)

Name	Description	Type	Reference
MCv_ProfileSelect ^{*1}	Selects profile data.	General FB	Page 521 MCv_ProfileSelect (Future support planned)
MCv_ReadProfileData	Reads profile data.	General FB	Page 525 MCv_ReadProfileData
MCv_WriteProfileData	Writes profile data.	General FB	Page 527 MCv_WriteProfileData

^{*1} These FBs are planned for a future support.

27 List of Add-on Library

Each add-on version which is compatible with the software version of the Motion module is as follows.

Software version of the Motion module	Add-on library name					
	baseSystem	MotionEngine	Axis	MotionControl_General	MotionControl_Sync	AbsSystem
01	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0
02	1.2.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0
03	1.3.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0
04	1.4.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0
05	1.5.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0
06	1.6.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0
07	1.7.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0
08	1.8.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0
09	1.9.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0
10	1.10.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0
12	1.12.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0
13	1.13.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0
14	1.14.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0
16	1.16.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0
17	1.17.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0

Software version of the Motion module	Add-on library name						
	ServoDriver_CANopen	NetworkDriver_CCIETSN	PicInstruction	SignalIO	ExternalSignal	Program_ST	Logging
01	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0
02	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0
03	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0
04	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0
05	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0
06	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0
07	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0
08	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0
09	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0
10	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0
12	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0
13	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0
14	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0
16	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0
17	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0

Software version of the Motion module	Add-on library name						
	MotionEventH ist	FileTransfer	MotionControl _AxisFilter	ProfileControl	PackagingApp	ServoSystem Recorder	SimpleMotio n
01	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	1.0.1.0	—	—
02	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	1.1.1.0	—	—
03	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	1.2.1.0	—	—
04	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	1.3.1.0	—	—
05	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	1.4.1.0	—	—
06	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	1.5.1.0	—	—
07	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	1.6.1.0	—	—
08	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	1.7.1.0	—
09	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	1.8.1.0	—
10	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	1.9.1.0	—
12	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	1.11.1.0	—
13	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	1.12.1.0	—
14	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	1.13.1.0	—
16	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0	1.15.1.0
17	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0	1.16.1.0

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	[baseSystem] [Axis]	—
Axis	Axis control	Add-on for axis control	[baseSystem] [MotionEngine]	[AbsSystem] [ServoDriver] [SignalIO] [MotionEventHist]
MotionControl_General	PLCopen motion control single-axis/multi-axis control FB	Enables PLCopen® motion control single-axis/multi-axis control FB.	[baseSystem] [MotionEngine] [Axis]	[SignalIO]
MotionControl_Sync	PLCopen motion control synchronous control	Enables PLCopen® motion control synchronous control FB.	[baseSystem] [MotionEngine] [Axis] [MotionControl_General]	—
AbsSystem	Absolute position control	Enables absolute position control.	[baseSystem] [Axis]	—
ServoDriver_CANopen	Servo driver (CANopen)	CANopen servo driver	[baseSystem] [Axis] [NetworkDriver_CCIETSN] [SignalIO]	—
NetworkDriver_CCIETSN	Network driver (CC-Link IE TSN)	Network driver of CC-Link IE TSN	[baseSystem]	—
PlcInstruction	External sequence dedicated instructions	Enables external sequence dedicated instructions.	[baseSystem]	[PLCopenMC_General] [ST] [SignalIO]
SignalIO	I/O signal	Provides the signal input/output function.	[baseSystem]	[Axis]
ExternalSignal	External signal	Enables external signals.	[baseSystem] [SignalIO] [Axis]	—
Program_ST	ST language execution	Add-on that executes ST language	[baseSystem]	[PLCopenMC_General]
Logging	Logging	Provides the logging function.	[baseSystem] [SignalIO]	—
MotionEventHist	Motion event history	Add-on for motion event history.	[baseSystem]	—
FileTransfer	File transfer	Provides the file transfer function.	[baseSystem]	—
MotionControl_AxisFilter	Command filter	Enables PLCopen® motion control command filter FB.	[baseSystem] [MotionEngine] [Axis] [MotionControl_General] [MotionControl_Sync]	—
ProfileControl	Operation profile control	Enables operation profile control.	[baseSystem] [MotionEngine] [Axis] [MotionControl_General] [MotionControl_Sync]	[SignalIO]
PackagingApp	Packaging	Provides functions for packaging machines.	[baseSystem] [ProfileControl]	—
ServoSystemRecorder	Servo System Recorder	Provides the servo system recorder function.	[baseSystem] [Logging] [Axis]	[ServoDriver_CANOpen]
SimpleMotion	SimpleMotion	Add-on for simple motion.	[baseSystem] [Axis] [ServoDriver_CANOpen] [NetworkDriver_CCIETSN] [SignalIO]	—



baseSystem is necessary.

28 List of Boot software

The versions of each boot which is compatible with the software version of the Motion module are shown below.

Software version of the Motion module	Boot name	
	Network boot software	Boot software
01	1	1
02	2	1
03	2	1
04	2	2
05	3	3
06	3	3
07	3	3
08	4	4
09	4	4
10	5	5
12	5	5
13	5	5
14	6	6
16	7	7
17	8	8

MEMO

APPENDICES

Appendix 1 Connectable device to CC-Link IE TSN

This section describes how to set and use the motion system when a connectable device to CC-Link IE TSN is connected with the Motion module.

For details on the wiring and the parameters, refer to the manual of each device.

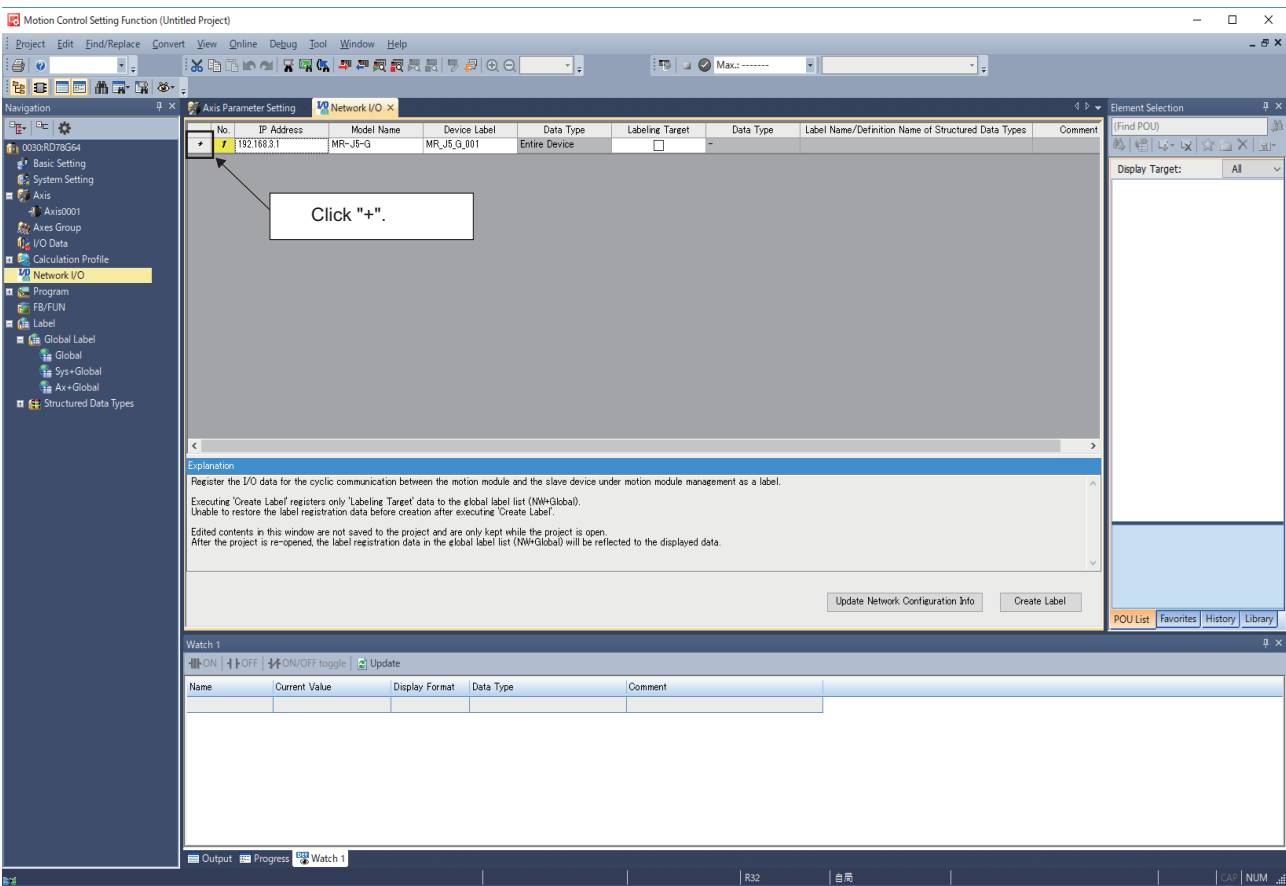
Common Items for all devices

- How to use the slave label

Labels assigned to the cyclic data of the slave devices in the motion control station are called "Slave labels". The slave labels are generated by setting unique device name (device label) for each slave device in the engineering tool.

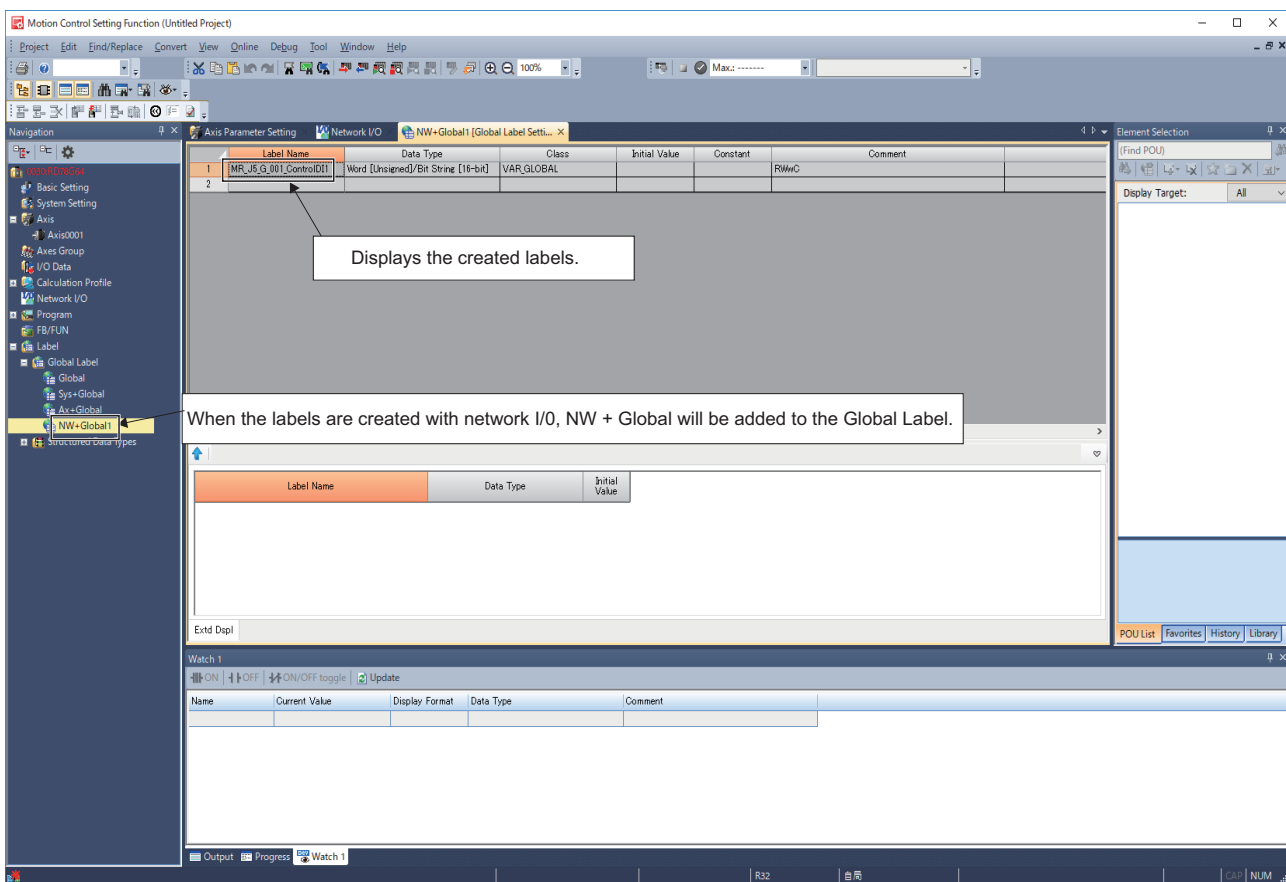
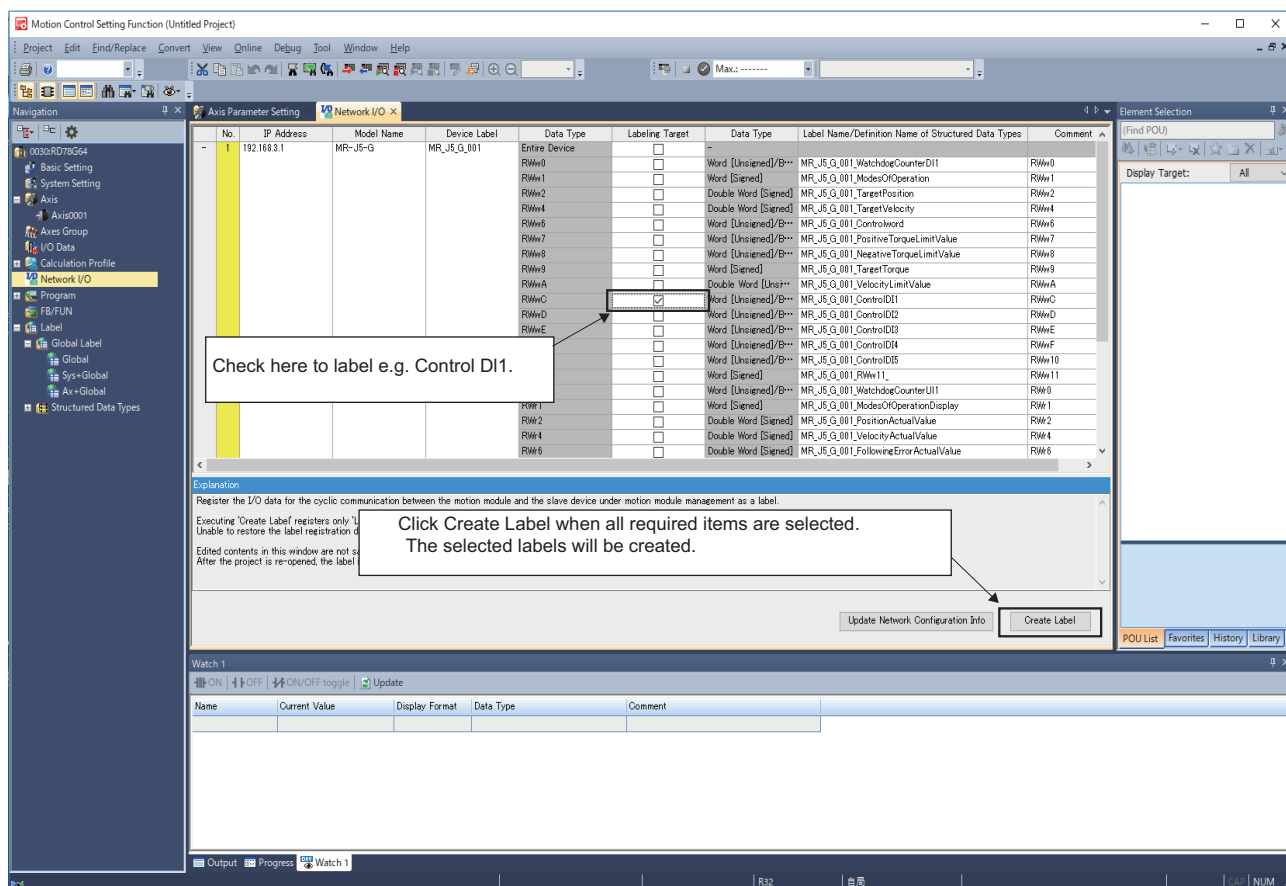
The method of using the slave label is shown below. The following shows the MR-J5-G usage example and other device can also use it with the same method.

1. Click the left end "+" of the device, its label is generated, from the devices displayed on Network I/O screen.

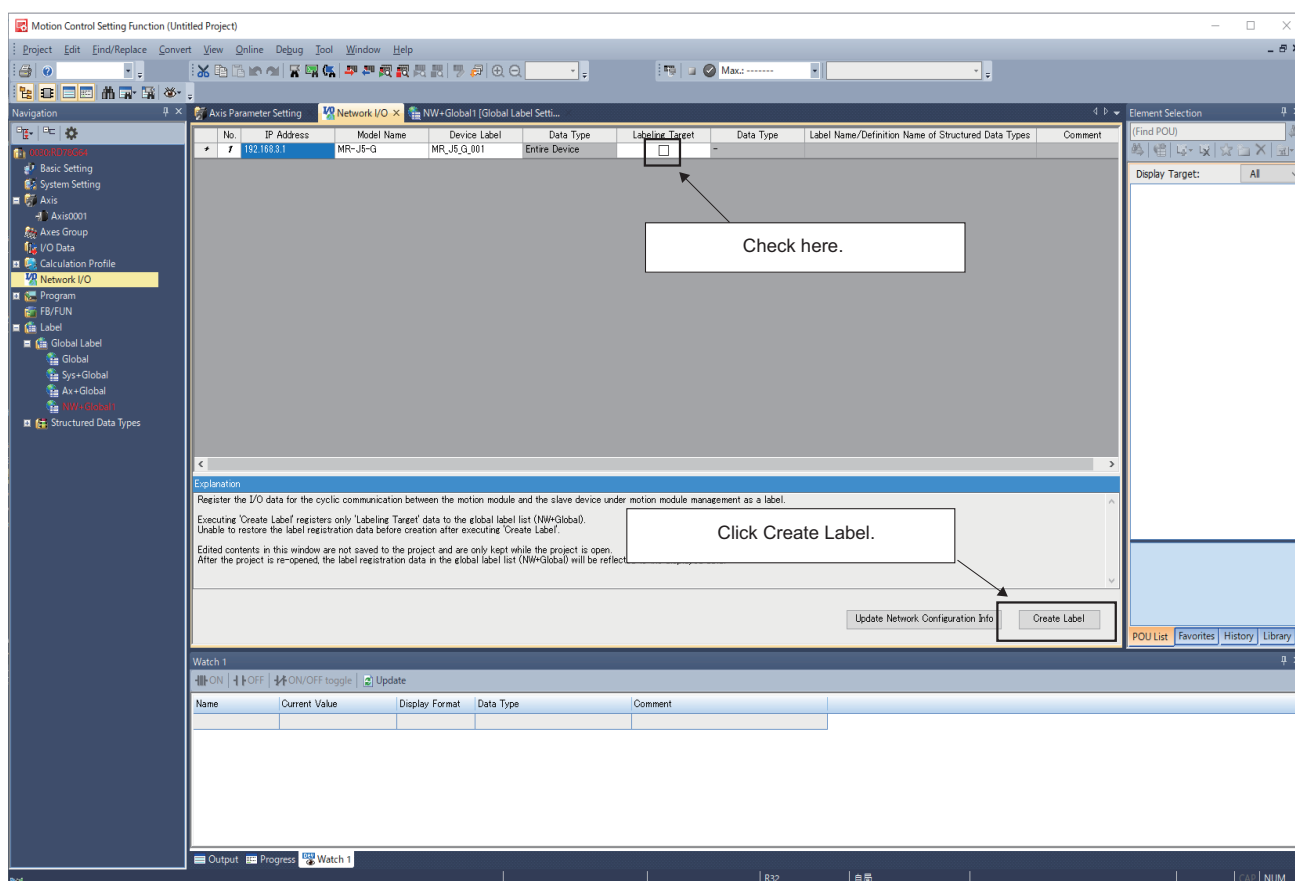


A

2. Set as the following to label each object.



3. Set as follows to label the whole device.



Precautions

- The slave labels cannot be used properly when there are mismatches in the settings of network configuration in the settings of network configuration and network I/O in the engineering tool. Perform the procedure above again when the network configuration setting is changed.
- When the slave labels are assigned to 1 byte cyclic data (such as Modes of operation display object), the lower byte of Word [signed] type label is used, and The upper byte will always be 0. Therefore, even when the cyclic data is a negative value, it is displayed as a positive value.
(Ex.) The slave label is 255(00FFH) when the cyclic data is -1(FFH).

A

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 "Speed/acceleration/deceleration unit selection (PT01.1)" is set to "0h", the setting value is 1 and if PT01.1 is "1h", it is 1 or 2 ⁿ .
PA07	Electronic gear - Denominator	1	[MR-J5(W)-G version (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 "Speed/acceleration/deceleration unit selection (PT01.1)" is set to "0h", the setting value is 1 and if PT01.1 is "1h", it is 1 or 2 ⁿ .
PC29.5	[AL. 0E3 Absolute position counter warning] selection	1h	0h (Available for infinite feed function.) (When using the absolute position system)
PT01.1*1	Velocity / acceleration/ deceleration unit selection	0h	Any setting value can be used for positioning control. For using other than positioning control, set 1h when [Pr. PA06 Electronic gear - Numerator] and [Pr. PA07 Electronic gear - Denominator] are other than 1 : 1 (velocity command unit: command unit/s, acceleration/deceleration unit: command unit/s ²) and it is arbitrary when they are 1 : 1. *2
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 slave object "Velocity actual value (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 system. Therefore, use the function of motion system side to restrict the command position.

*4 Set 1 when the resolution of the encoder connected with MR-J5(W)-G 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	000000001h	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 "Sensor input method selection (PD41.3)" is set to "1: input from controller (FLS/RLS/DOG)")

^{*1} When "0h" is set, the command of motion system is ignored and the motor stops as the limit switch signal is detected in 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:

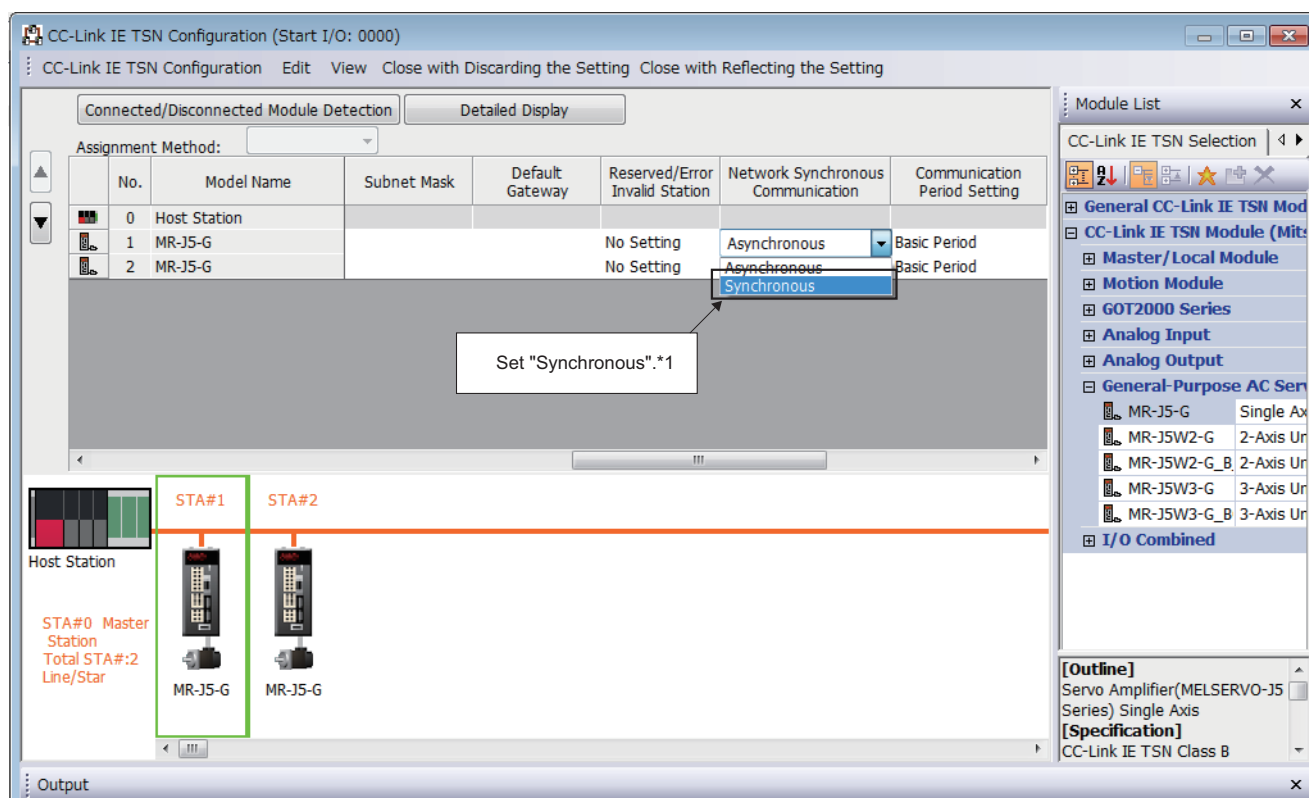
Sets Driver Command Discard Detection Setting (AxisName.Pr.StopOption_DriverTargetIgnored) to valid to stop the command of the motion side when the motor is stopped due to the signal detection of the MR-J5(W)-G side.

^{*2} When "1h" is set, wire the limit switch to the controller 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 slave 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 later of 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 slave 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 slave label is shown below. (Generate the label previously as Control DI1 and Status DO1 are used for the gain switching.)

[Global label]
bGainChange //Bit type label

[ST program]
//the gain switching request to MR-J5-G
//MR_J5_G_001_ControlDI1.4 := bGainChange;

//check the gain of MR-J5-G is switched or not
IF(MR_J5_G_001_StatusDO1.4 = TRUE) THEN
 //describes the process after the gain switching
END_IF;

The bit4 of ControlDI1 is the gain switching request.
This program switches the gain of MR-J5-G as operating bit4 of ControlDI1 with bGain Change.

The bit4 of StatusDO1 is the gain switching status.
The process which is performed only during the gain switching can be created by checking the bit4 status.

■The connection with MR-J5(W)-G in fast operation mode

For details on the fast operation mode, refer to the following.

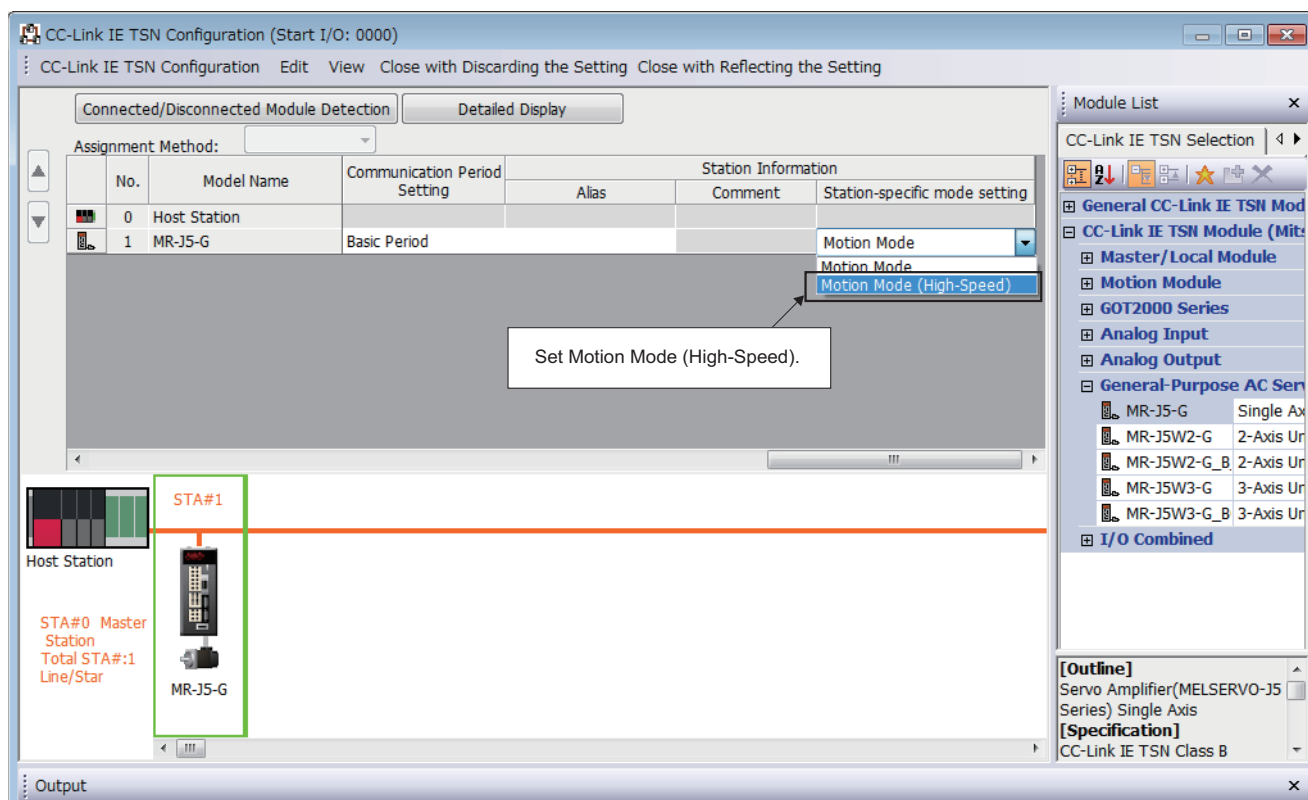
☞ Page 112 Operation Cycle

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 system setting [Engineering tool]]

Set to the fast operation mode. For details, refer to the following.

☞ Page 112 Operation Cycle

[MR-J5(W)-G setting [MR Configurator2]]

When connecting with 31.25 [μs] 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

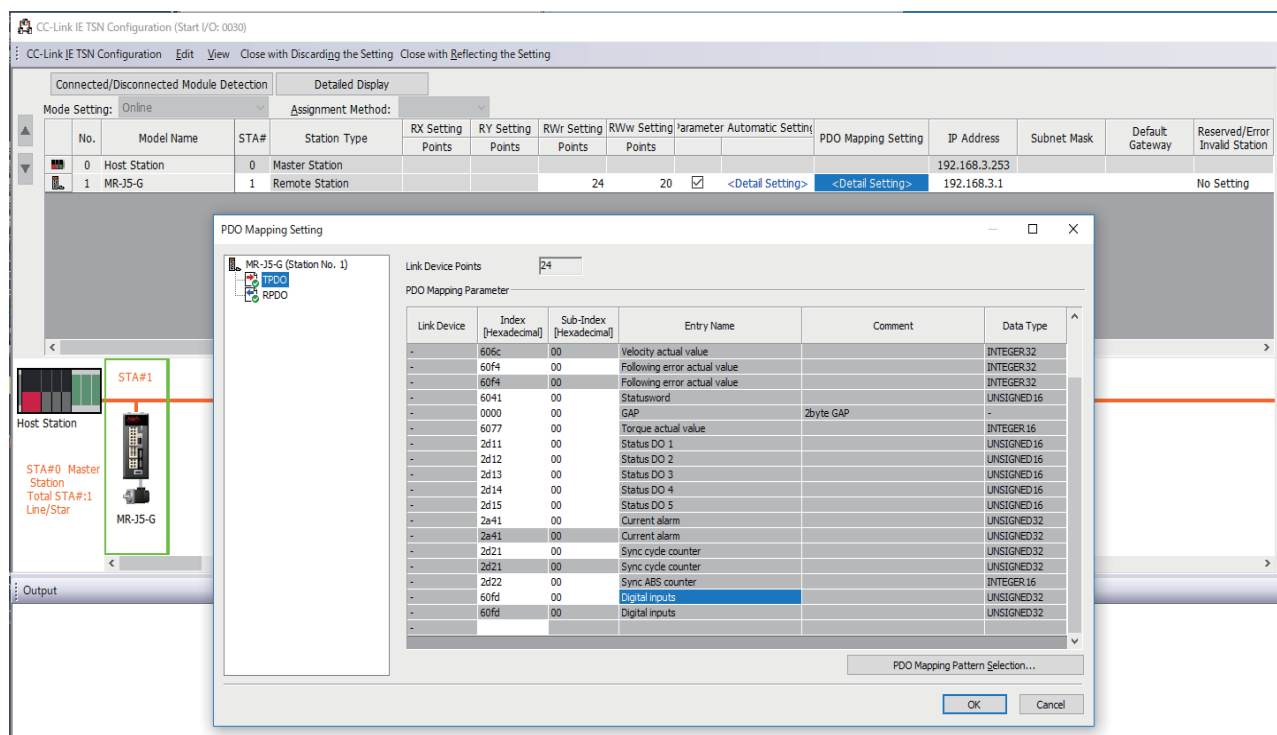
Communication in high speed mode is allowed when MR-J5(W)-G is connected with motion system in the above setting.

■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 system

(LSP/LSN/DOG) input signal of the servo amplifier side can be used as the FLS/RLS, and home position switch signal of the motion system by assigning the object, [Digital inputs(60fdh)] to TPDO mapping of MR-J5(W)-G and creating the slave label.

1. Map [Digital inputs(60fdh)] to TPDO.

Add Digital inputs by specifying index: 60fdh and subindex: 00h to TPDO of the target amplifier in Network Configuration Settings on the engineering tool.

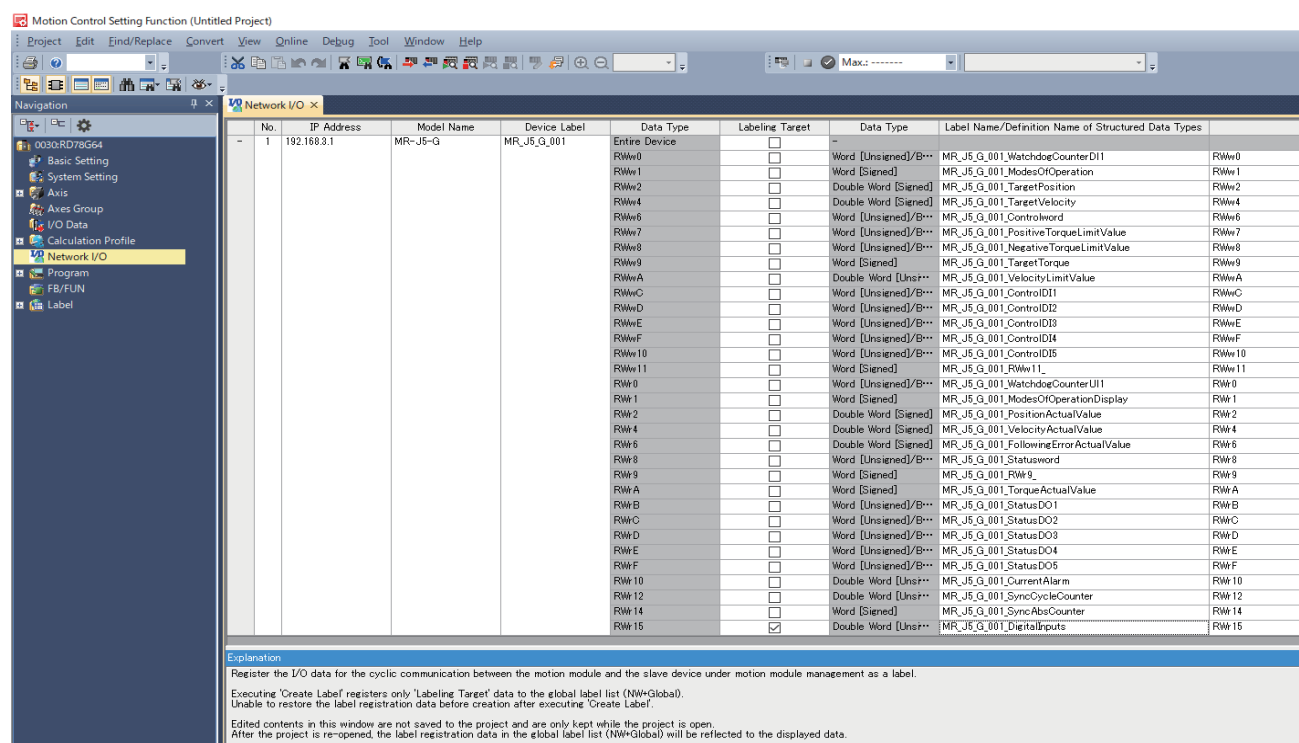


- Make [Digital inputs(60fdh)] the slave label.
For the method of the slave labeling, refer to the following.

Page 781 Common Items for all devices

Ex.

When the labeling is performed with the name of "MR_J5_G_001_DigitalInputs".

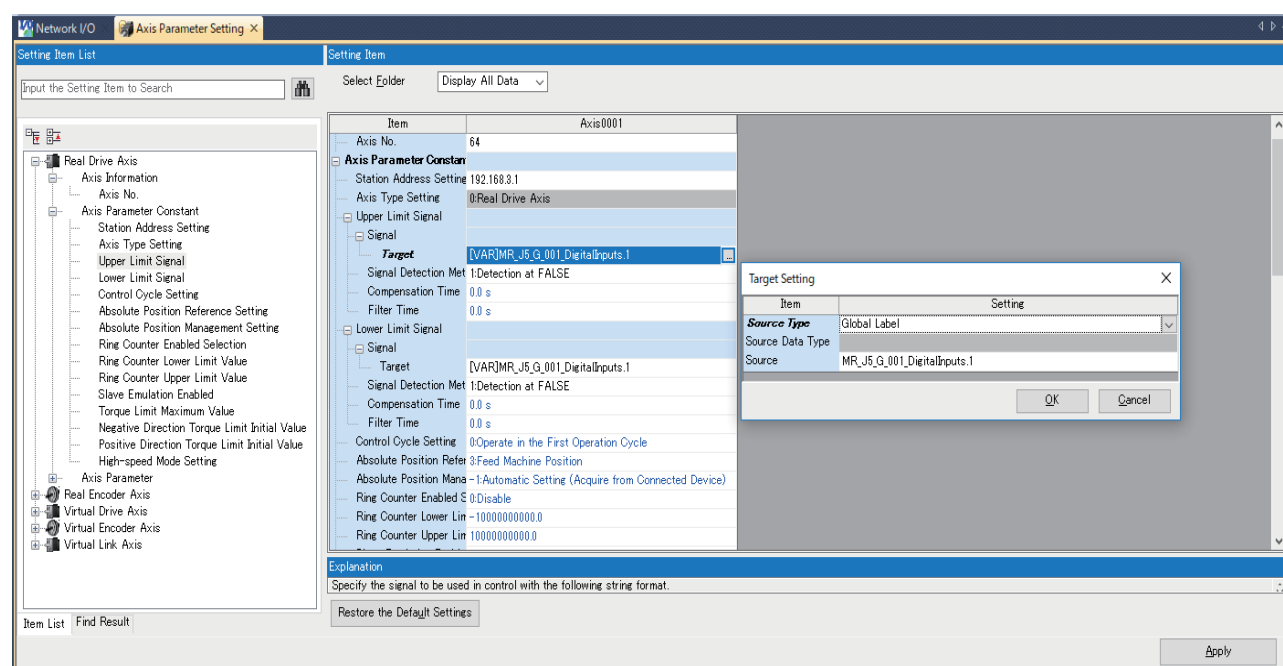


- Specify the slave label to the home position switch of FLS/RLS or MC_Home (Homing).

[The upper limit/lower limit setting]

Set the upper limit signal target/lower limit signal target of the axis parameter.

Variable	Setting value (when "Travel direction selection (PA14)" is 0)
Target (AxisName.PrConst.HwStrokeLimit_FlsSignal.Source.Target)	[VAR]MR_J5_G_001_DigitalInputs.1
Target (AxisName.PrConst.HwStrokeLimit_RlsSignal.Source.Target)	[VAR]MR_J5_G_001_DigitalInputs.0



[Specify the DOG signal at homing]

Specify the following to "home position switch" input into MC_Home (Homing).

Variable	Setting value (when "Travel direction selection (PA14)" is 0)
Target (MC_INPUT_REF.Signal.Source.Target)	[VAR]MR_J5_G_001_DigitalInputs.2

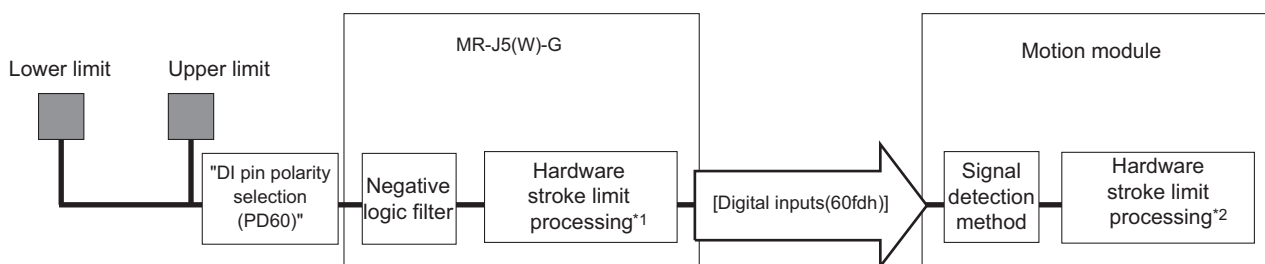
- This setting is not required if "0h: Input from servo amplifier (LSP/LSN/DOG)" is selected in "Sensor input method selection (PD41.3)", input the DOG signal to MRJ5(W)-G directly.
- Set "1: Dog detection with on" to "Device input polarity 1 (PT29.0)" if "1h: Input from controller (FLS/RLS/DOG)" is 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 system.
- 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.
For MR-J5(W)-G: MR-J5-G/MR-J5W-G User's Manual (Parameters)
- Set the following for signal detection method of the motion system side to be the same polarity of Bit0 (Negative limit switch) and Bit1 (Positive limit switch) of object [Digital inputs(60fdh)] of MR-J5(W)-G. If the setting is different, unintended operation may occur.

Variable	Setting value
Signal Detection Method (AxisName.PrConst.HwStrokeLimit_FlsSignal.Detection)	1: Detection at FALSE (LowLevel)
Signal Detection Method (AxisName.PrConst.HwStrokeLimit_RlsSignal.Detection)	

- The data flow of object [Digital inputs(60fdh)] is shown below when "0h: Input from servo amplifier (LSP/LSN/DOG)" is selected in "Sensor input method selection (PD41.3)".



Signal input	MR-J5(W)-G			→	[Digital inputs(60fdh)] Bit0 and Bit1	→	Motion module	
	"DI pin polarity selection (PD60)"	External input signal logic	Hardware stroke limit error detection*1				External input signal logic setting	Hardware stroke limit error detection*2
ON	0	Negative logic	Not detect	→	TRUE	→	Negative logic (1: Detection at FALSE (LowLevel))	Not detect
	1		Detect		FALSE			Detect
OFF	0		Detect		FALSE			Detect
	1		Not detect		TRUE			Not detect
ON	0	Positive logic	Not detect	→	FALSE	→	Positive logic (0: Detection at TRUE (HighLevel))	Not detect
	1		Detect		TRUE			Detect
OFF	0		Detect		TRUE			Detect
	1		Not detect		FALSE			Not detect

*1 When "Limit switch enabled status selection (PD41.2)" is "0: Limit switch always enabled", the error stop is executed in the servo amplifier side not even during homing.

*2 The error stop is executed even in the Motion module during homing. The hardware stroke limit error detection in homing can be temporarily disabled by setting Hardware Stroke Limit Override (AxisName.Cd.HwStrokeLimit_Override).

Precautions

- When labeling of data sent from the motion system 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 system can not be sent to the servo amplifier. For making it the slave 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 alarm [AL. 035_Command frequency error] may be detected in MR-J5(W)-G when an operation cycle over occurs in the motion system during a motor operation and the command differs greatly before the operation cycle over and after a restoration. Check the program and increase the operation cycle setting or decrease the loading if necessary.
- 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 (other than Cyclic synchronous mode) connection method

This section describes how to set when connecting MR-J5(W)-G (other than the cyclic synchronous mode) and use various functions.

For details on 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 the mode other than the cyclic synchronous mode is shown below.

Model name	Mode	Version
MR-J5(W)-G	Profile mode	A4 or later
	Point table mode	B8 or later

Setting method

An example 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 other than the cyclic synchronous mode. For details of the objects used in each mode and using method, refer to the manual of MR-J5(W)-G.

■CPU setting [GX Works3]

[Module Parameter (Network)]⇒[Basic Settings]⇒[Network Configuration Settings]

Set PDO mapping and map required objects in the mode to use on the "CC-Link IE TSN Configuration" screen.

CC-Link IE TSN Configuration (Start I/O: 0010)

Connected/Disconnected Module Detection Detailed Display

Mode Setting: Online Assignment Method:

No.	Model Name	Parameter Automatic Setting	PDO Mapping Setting	IP Address	Subnet Mask	Default Gateway
0	Host Station			192.168.3.253		
1	MR-J5-G	☐ <Detail Setting>	<Detail Setting>	192.168.3.1		
2	MR-J5-G	☐ <Detail Setting>	<Detail Setting>	192.168.3.2		

Set PDO mapping for the second station to use it in other than the cyclic synchronous mode.

Module List

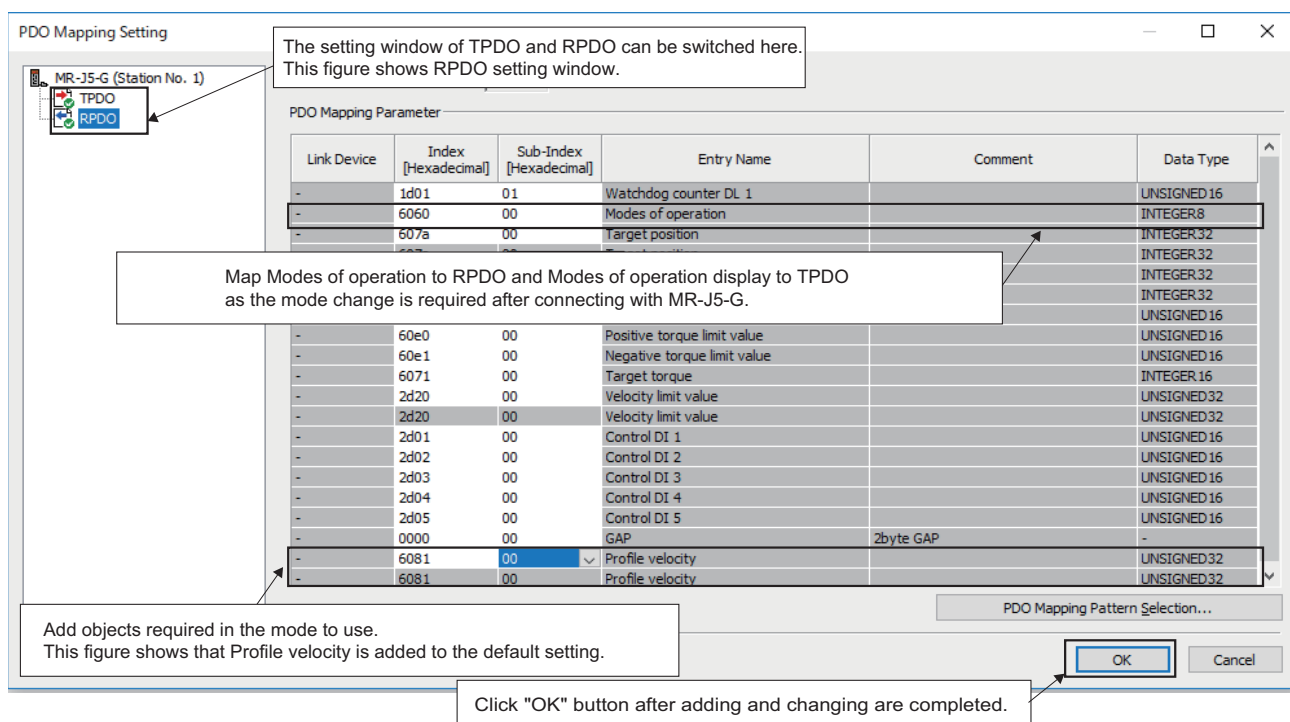
CC-Link IE TSN Selection Find Module My Favorites

- General CC-Link IE TSN Module
- CC-Link IE TSN Module (Mitsubishi Electric Corporation)
 - Master/Local Module
 - Motion Module
 - GOT2000 Series
 - DC Input
 - Transistor Output
 - Analog Input
 - Analog Output
 - General purpose Inverter
 - General-Purpose AC Servo
 - MR-J5-G Single Axis 0.1 to 3
 - MR-J5-G-RJ Single Axis 0.1 to 3
 - MR-J5W2-G 2-Axis Unification 0
 - MR-J5W2-G_B_Axis 2-Axis Unification 0
 - MR-J5W3-G 3-Axis Unification 0
 - MR-J5W3-G_BC_Axis 3-Axis Unification 0
 - I/O Combined

[Outline]
Servo Amplifier(MELSERVO-J5 Series) Single Axis

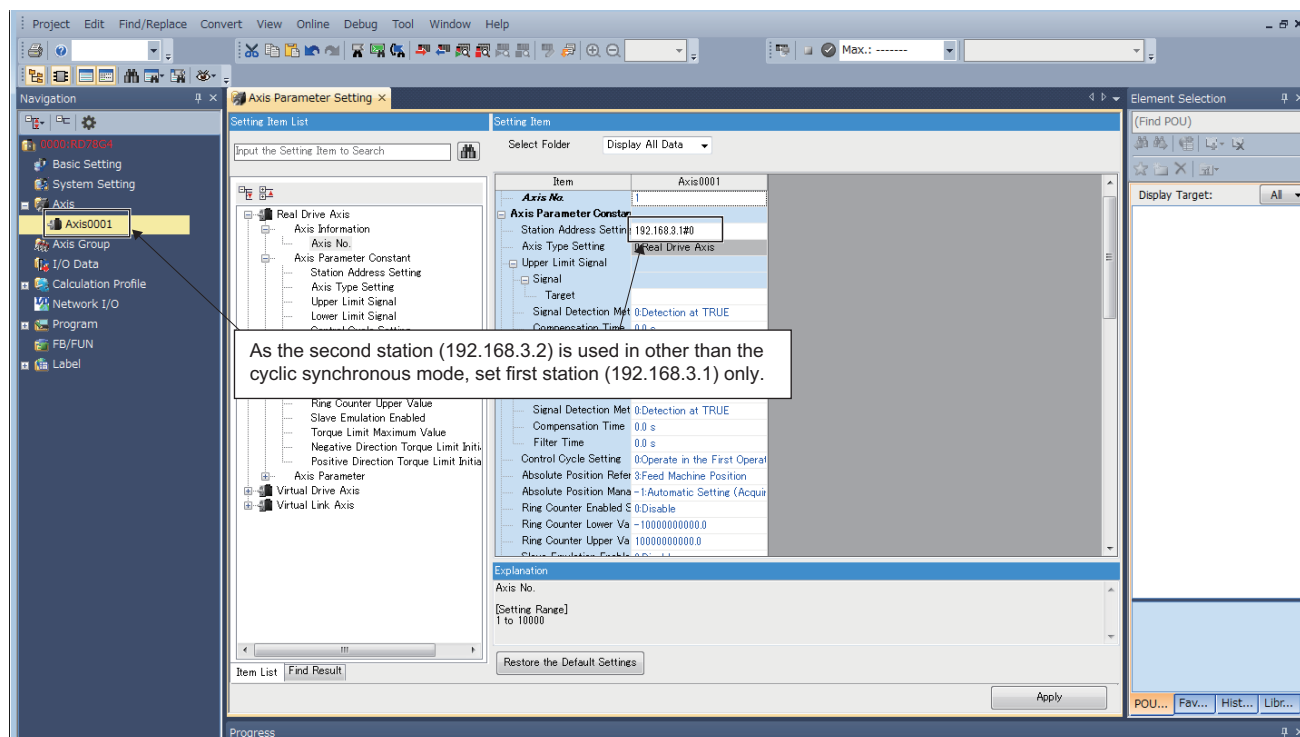
[Specification]
CC-Link IE TSN Class B
Output voltage: 3-Phase 0 to 240VAC
Output rated current: 1.3 to 17.0A

Output

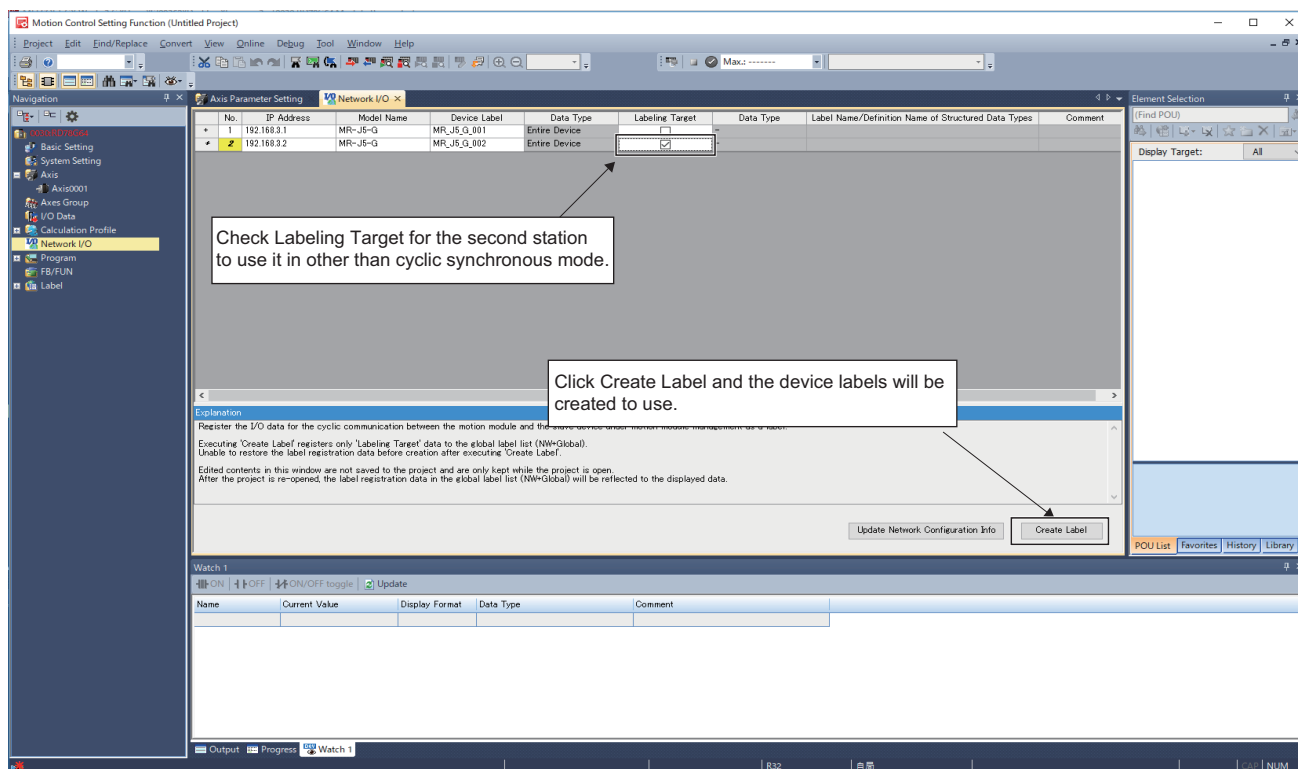


■The motion system setting [Motion control setting function]

The axis to be used in other than the cyclic synchronous mode must not be set.



Generate the slave label of MR-J5-G using for other than the cyclic synchronous mode according to the procedure described in "Common Items for all devices". For using with other than the cyclic synchronous mode, generate labels of the entire device as the labeling target.

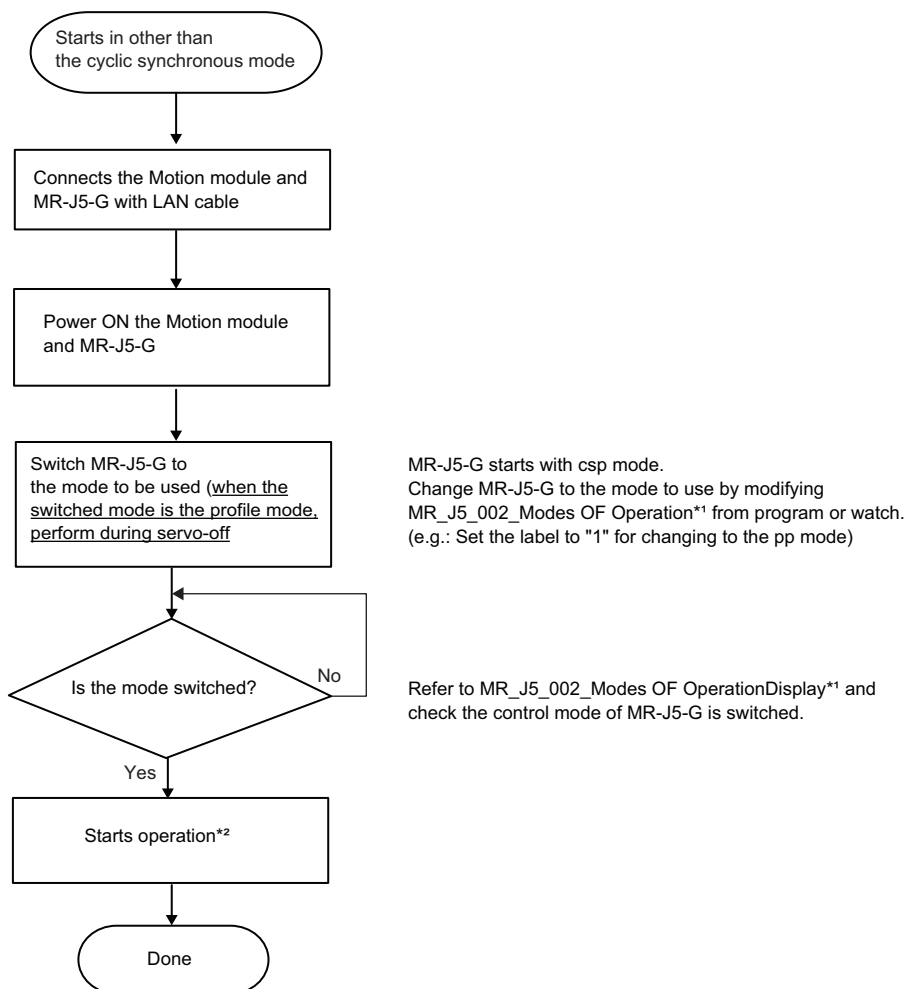


■MR-J5-G setting [MR Configurator2]

Refer to the manual of MR-J5(W)-G because the required settings are different depending on the mode to use.

Setting method

The following figure describes the process for driving motors with other than the cyclic synchronous mode.



*1 A label name differs depending on a labeled device. The name described in this 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:

Set bit15 to TRUE.

Method 2:

Add 1 for each communication cycle. (Be sure not to be turned FALSE bit15 by adding 1 as bit15 has to be TRUE constantly.)

[When the version of baseSystem is Ver. 1.16 or later]

When Watch dog counter DL is mapped to PDO, Creating of an update program by users is not required because the WDC process is performed in the module.

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 in other than the cyclic synchronous mode, the motion system does not perform the limit check of the command, or issuing the forced stop 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 [μ s]/62.5 [μ s], 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 on 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 alarm [AL. 035_Command frequency error] may be detected in MR-JET-G when an operation cycle over occurs in the motion system during a motor operation and the command differs greatly before the operation cycle over and after a restoration. Check the program and increase the operation cycle setting or decrease the loading if necessary.

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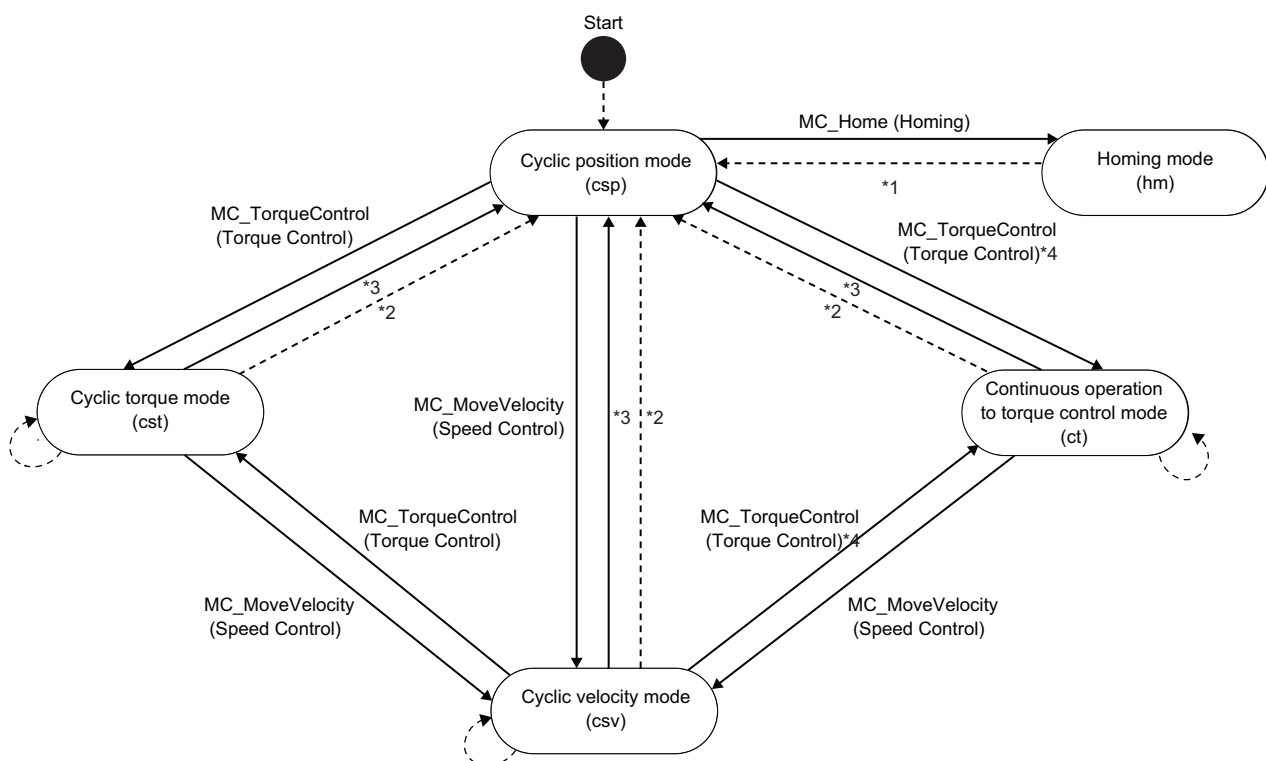
Relevant functions

Driver control mode

The motion system supports the following control modes.

Supported control mode		Description	Parameter name
Homing mode (hm)	6: hm	Executes homing operation by a driver.	Page 210 Driver homing method
Cyclic position mode (csp)	8: csp	Executes control following the sequential positioning command from the controller in each communication cycle.	7 DIRECT CONTROL
Cyclic velocity mode (csv)	9: csv	Executes control following the velocity command from the controller in each communication cycle.	
Cyclic torque mode (cst)	10: cst	Executes control following the torque command from the controller in each communication cycle.	
Continuous operation to torque control mode (ct)	-104: ct	A mode to switch to the continuous operation to torque operation smoothly without stopping from the cyclic position mode or the cyclic velocity mode.	
			Page 799 Continuous operation to torque control mode

Control mode switching of the driver is executed at the same time when the Motion control FB 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 positioning control FB other than MC_MoveVelocity (Speed Control)/MC_TorqueControl (Torque Control) is being Aborting/Buffered.

*4 For continuous operation to torque control mode (ct) switch, refer to the following.

☞ Page 799 Continuous operation to torque control mode

Precautions

When the control mode does not switch within 1 [s] after requesting the control mode switching to the driver, the error "Control Mode Switching Error" (error code: 1A1DH) occurs and the axis stops.

Continuous operation to torque control mode

■Overview

For the drive unit which supports the continuous operation to torque control mode, when MC_TorqueControl (Torque Control) is started with selecting "1: ct (continuous operation to torque control mode)" by Control mode switching selection (Options (Options) bit19), the driver control mode can be switched to the continuous operation to torque control mode (ct) and the driver can be controlled.

The continuous operation to torque control mode is a mode to switch to the continuous operation to torque operation smoothly without stopping from the cyclic position mode in positioning or the cyclic velocity mode in velocity command.

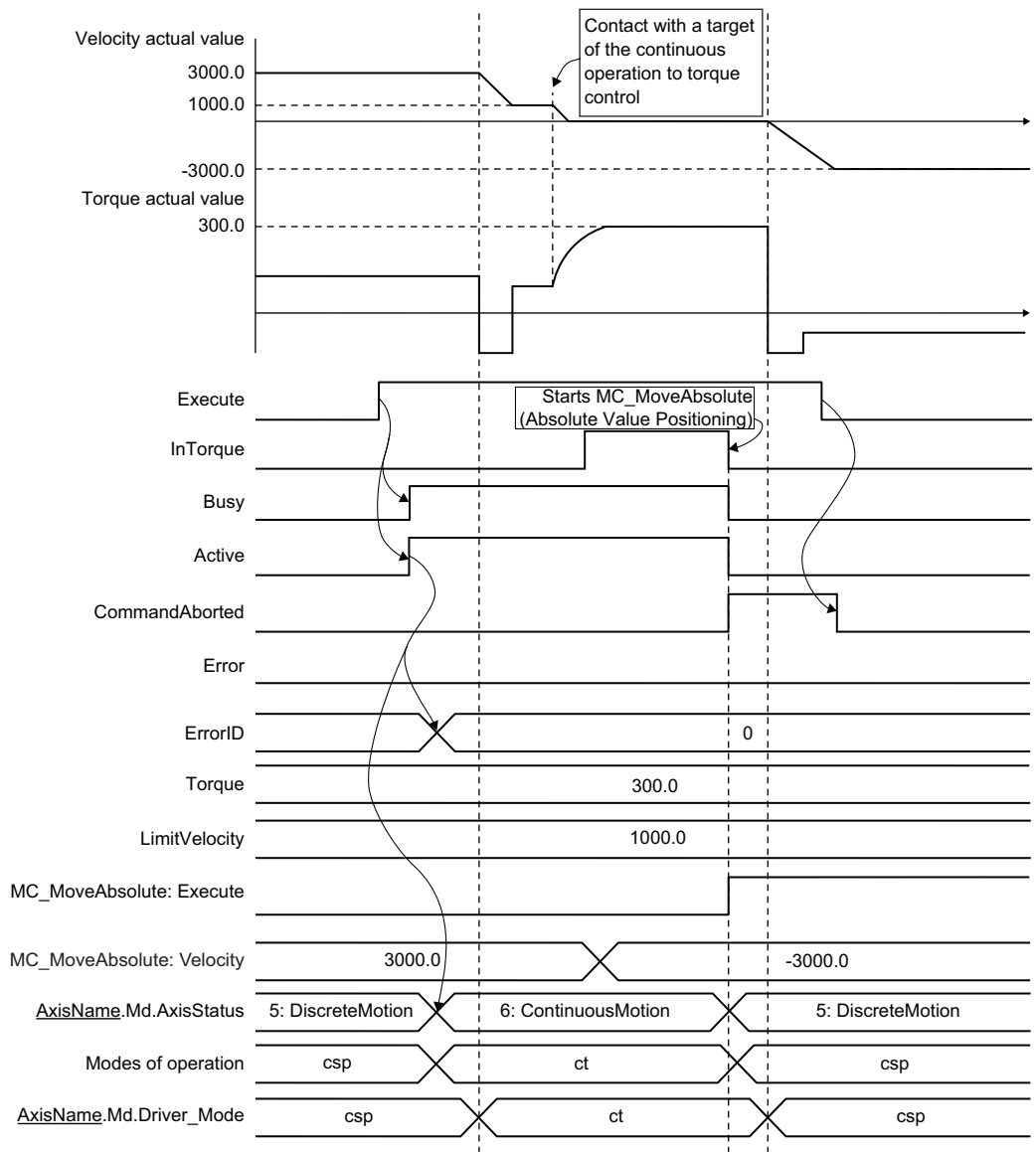
In the continuous operation to torque control mode, the driver executes the torque control with commanded torque set to Target torque (Torque) as accelerating or decelerating to the velocity set to Limit velocity (LimitVelocity).

To finish this FB, start MC_Stop (Forced Stop).

■Timing chart

[When the FB is normally completed]

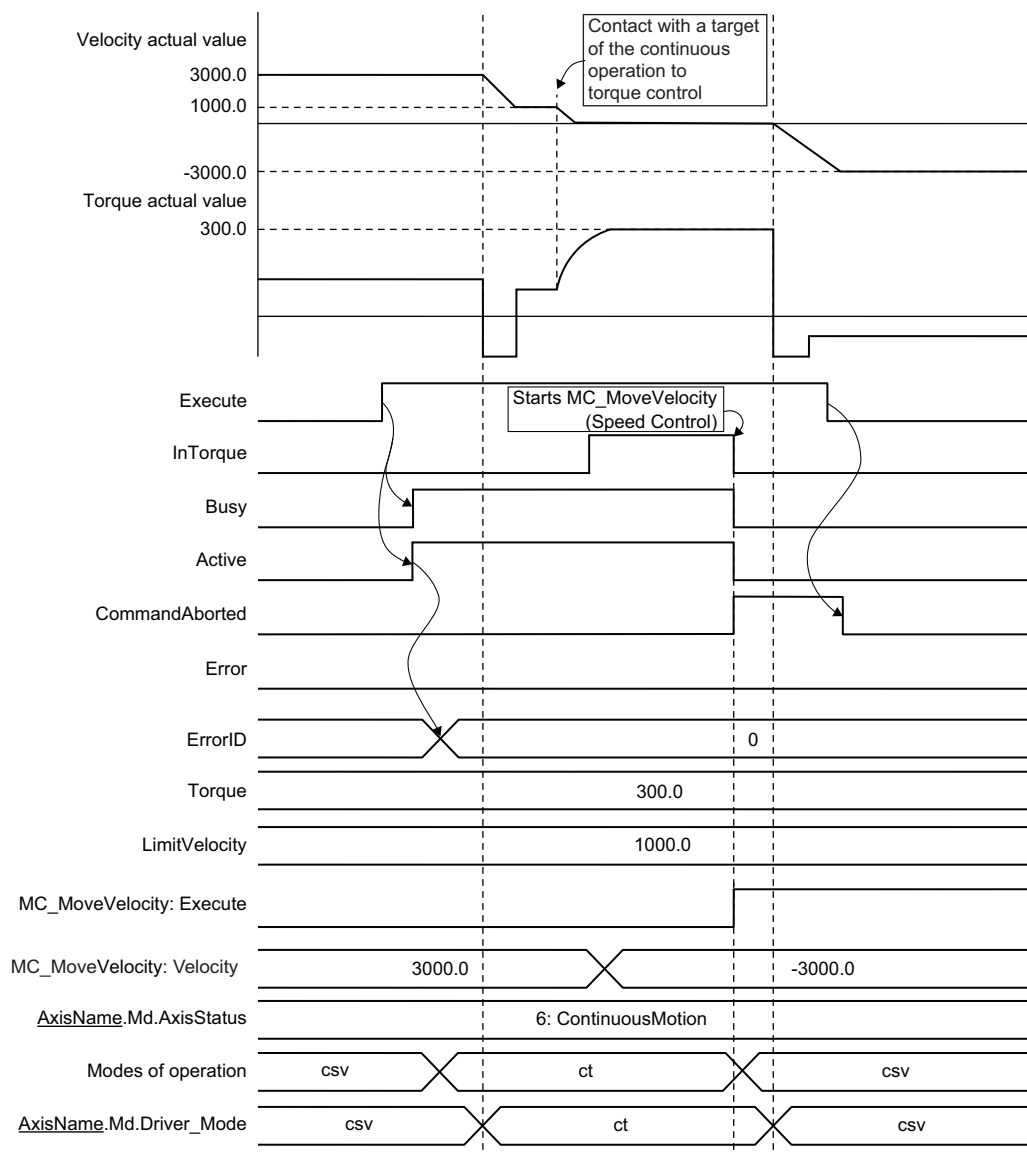
- Operation for "cyclic position mode ⇔ continuous operation to torque control mode switching"



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Set "1: Actual velocity" to Velocity initial value selection at continuous operation to torque control mode switching (Options (Options) bit20 and bit21) to switch to the continuous operation to torque control mode when there is a difference between set velocity and actual velocity such as accelerating and decelerating or the velocity does not reach to the set velocity due to the limited torque.

- Operation for "cyclic velocity mode ⇔ continuous operation to torque control mode switching"



A torque command value in the continue operation to torque control mode will be disabled when it is switched from the continuous operation to torque control mode to the cyclic velocity mode.

As shown above, when the drive unit is continuously operates to torque to the continuous operation to torque direction, the torque will be output to the torque limit value when it is switched to the cyclic velocity mode.

In this case, execute any of the following before switching to the cyclic velocity mode.

- Start MC_MoveVelocity (Speed Control) in the reverse direction setting to the continuous operation to torque direction and switch to the cyclic velocity mode. (At this time, it is recommended to specify "0: Acceleration/deceleration specification method (mcAccDec)" for Acceleration/deceleration method setting (Options (Options) bit0 to 2).)
- Change the torque limit value to the lower value.

[When an error occurs]

For details, refer to the following.

☞ Page 27 Execute command (Execute) type/Enable (Enable)

■Relevant variables/FB

For details, refer to the following.

☞ Page 302 Relevant variables

■Control details

For details, refer to the following.

☞ Page 302 Torque Control

■Precautions

The firmware for connected devices which can use the continuous operation to torque control mode is shown below.

Model name	Version
MR-J5(W)-G	B0 or later
MR-JET-G	

- "The cyclic torque mode ⇔ the continuous operation to torque control mode switching" cannot be executed when multiple start MC_TorqueControl (Torque Control) is executed during MC_TorqueControl (Torque Control) start-up. If it is executed, the warning "Control Mode Switching Disabled Warning" (warning code: 0D31H) occurs and operates in the current control mode.
- An actual motor velocity may not reach the limit velocity depending on the machine load during the continuous operation to torque control mode.
- It is recommended to match the direction of the torque command and the velocity command. If they differ, the velocity may decelerate once to 0.
- When switching from the continuous operation to torque control mode to the cyclic position mode, it is recommended to switch after changing the motor to stop status (zero speed status). The zero speed status can be monitored by labeling Status DO2(2D12h) to the slave label.
- When switching from the continuous operation to torque control mode to the cyclic position mode without waiting for stop of the motor, set "ZSP disabled selection at control switching (PC76.1)" of the servo parameter to "1: Disabled" and disable monitoring of zero speed status. However, note that it may cause vibration or impact at control mode switching.
- For unavailable functions of the servo amplifier during the continuous operation to torque control mode, refer to the specification of connected driver device.

A

Point

Set the system configuration with an unlimited operation range during the continuous operation to torque control mode as a stroke limit signal of the servo amplifier cannot be used during the continuous operation to torque control mode.

Use the software stroke limit function of Motion module side to restrict the set position.

Safety communication

A safety CPU and the firmware for connectable devices which can combine with RD78G(H) and perform the safety communication are shown below.

Model name	Version
RnSFCPU	☞ Restrictions by the version
MR-J5-G-RJ	B2 or later For details, refer to the following manual. ☞ MR-J5-G/MR-J5W-G User's Manual (Introduction)
MR-J5D-G	C0 or later For details, refer to the following manual. ☞ MR-J5D-G User's Manual (Introduction)

■Precautions for the safety communication with MR-J5-G-RJ

When executing safety communication with MR-J5-G-RJ, the servo warning [AL. 5E2.1_Safety communication no connection warning A (safety sub-function)] or [AL. 5E2.9_Safety communication no connection warning B (safety sub-function)] occurs in the driver until the safety communication is established. Therefore the warning "Driver Warning" (warning code: 0D1FH) is detected in the motion system at connecting.

When referring the warning as execution conditions of the program, execute an error reset after connecting.

External signal high-accuracy input

When the following signals that support external signal high-accuracy input are used for the function that has Trigger input signal (TriggerInput), high-accuracy control with a slave station signal detection time is enabled.

For the accuracy of signal detection time, refer to the manual of the slave device to be used.

When the following signals are specified for the function that does not support high-accuracy input, the signals operate with the same accuracy as normal signals.

- Signals that can be used to external signal high-accuracy input

Signals that can be used to external signal high-accuracy input differs depending on the slave device to be used.

Slave device	Signal name	Description
MR-J5(W)-G series	[OBJ]60B90010.6	Toggle status for latch completion at the rising edge of touch probe 1
	[OBJ]60B90010.7	Toggle status for latch completion at the falling edge of touch probe 1
	[OBJ]60B90010.E	Toggle status for latch completion at the rising edge of touch probe 2
	[OBJ]60B90010.F	Toggle status for latch completion at the falling edge of touch probe 2
	[OBJ]2DE90010.6	Toggle status for latch completion at the rising edge of touch probe 3
	[OBJ]2DE90010.7	Toggle status for latch completion at the falling edge of touch probe 3

■Relevant variables

I/O signals are expressed by the TARGET_REF structure. For details, refer to the following.

📖 Page 439 External Signal Selection

■Control details

For the control details of each function when using external signal high-accuracy input, refer to the specification of each function.

For the list of functions that support external signal high-accuracy input, refer to the following.

📖 Page 439 External Signal Selection

Precautions

- When MR-J5(W)-G series is used as external signal high-accuracy input, the touch probe function of MR-J5(W)-G series is required. The touch probe function of MR-J5(W)-G series has restrictions of the device and the version that can be used. For details, refer to the manual of MR-J5(W)-G series.

MR-J5-G/MR-J5W-G: 📖MR-J5-G/MR-J5W-G User's Manual (Introduction)

MR-J5D-G: 📖MR-J5D-G User's Manual (Introduction)

[Connected devices and versions that support the touch probe function]

Device name	Supported version
MR-J5-G-RJ	B6 or later
MR-J5(W)-G	B6 or later
MR-J5D-G	C0 or later

■Required settings for external signal high-accuracy input

External signal high-accuracy input uses a slave station signal detection time, so that the setting to obtain the signal detection time is required.

If the required setting is not executed to external signal high-accuracy input, the signals operate with the same accuracy as normal signals.

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

When using MR-J5(W)-G series, the touch probe function of MR-J5(W)-G series is used.

For the details of parameters and objects of MR-J5(W)-G series, refer to the manual of MR-J5(W)-G.

The touch probe function of MR-J5(W)-G series has restrictions of the device and the version that can be used. For details, refer to the manual of MR-J5(W)-G series.

<Setting of MR-J5(W)-G series>

1. Set connector pins to assign TPR1, TPR2, and TPR3 of the input device to be used.

Setting example) When using TPR1, TPR2, and TPR3 with MR-J5-G-RJ

- Set "2Ch" to Pr.PD38.0-1. (Assign TPR1 to connector the pin CN3-10.)
- Set "2Dh" to Pr.PD39.0-1. (Assign TPR2 to connector the pin CN3-1.)
- Set "63h" to Pr.PD05.0-1. (Assign TPR3 to connector the pin CN3-19.)

<Setting of the motion system>

1. Set the following slave objects to TPDO of PDO mapping.

For how to mapping, refer to "'CC-Link IE TSN Configuration" Window" of Part 1 of the following manual.

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

When using TPR1

Index	Sub Index	Object name	Description
60B9h	00h	Touch probe status 1	Set to use TPR1 and 2.
60D1h	00h	Touch probe time stamp 1 positive value	Set to detect the rising edge of TPR1. (The setting is not required for detecting the falling edge only.)
60D2h	00h	Touch probe time stamp 1 negative value	Set to detect the falling of TPR1. (The setting is not required for detecting the rising only.)

When using TPR2

Index	Sub Index	Object name	Description
60B9h	00h	Touch probe status 1	Set to use TPR1 and 2.
60D3h	00h	Touch probe time stamp 2 positive value	Set to detect the rising edge of TPR2. (The setting is not required for detecting the falling edge only.)
60D4h	00h	Touch probe time stamp 2 negative value	Set to detect the falling of TPR2. (The setting is not required for detecting the rising only.)

When using TPR3

Index	Sub Index	Object name	Description
2DE9h	00h	Touch probe status 2	Set to use TPR3.
2DF8h	00h	Touch probe time stamp 3 positive value	Set to detect the rising edge of TPR3. (The setting is not required for detecting the falling edge only.)
2DF9h	00h	Touch probe time stamp 3 negative value	Set to detect the falling edge of TPR3. (The setting is not required for detecting the rising edge only.)

2. Set high-accuracy input to data of MC_TRIGGER_REF type.

Detection signal	Detection direction	Setting of MC_TRIGGER_REF type data			
		Target (Target)	Signal Detection Method (Detection)* ¹	Compensation time (CompensationTime)* ²	Filter Time (FilterTime)* ³
TPR1	Rising edge	[OBJ]0x60B90010.6@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x60B90010.7@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0
TPR2	Rising edge	[OBJ]0x60B90010.E@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x60B90010.F@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0
TPR3	Rising edge	[OBJ]0x2DE90010.6@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0
	Falling edge	[OBJ]0x2DE90010.7@station address	4: Detection at Rising Edge/Falling Edge (BothEdges)	Arbitrary value	0.0

*1 Toggle status for latch completion at the rising edge/the falling edge which is set to Target (Target) differs the status (0 and 1) every detection at rising/falling edge. Therefore, set "4: Detection at Rising Edge/Falling Edge (BothEdges)".

*2 For the setting range., refer to the specification of each function.

*3 To use as the external signal high-accuracy input, set 0.0.

3. Set to the input of function that uses the external signal with MC_TRIGGER_REF type data which has been set. (Example) Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled)

4. Enable the touch probe function of MR-J5(W)-G series.

Enable the touch probe function of MR-J5(W)-G series using the following objects.

When using TPR1 and TPR2

Index	Sub Index	Size (number of bits)	Object name
60B8h	00h	10h	Touch probe function 1

When using TPR3

Index	Sub Index	Size (number of bits)	Object name
2DE8h	00h	10h	Touch probe function 2

Set the following value to the objects above. There are two methods to set the value to the object, one is using the transient transmission and the other one is using the cyclic transmission.

Detection signal	Detection direction	Object name	Value to be set	Description
TPR1	Rising edge	Touch probe function 1	Set "1" to Bit0, 1, 4.	Bit0: Touch probe 1 enabled Bit1: Continuous trigger mode
	Falling edge	Touch probe function 1	Set "1" to Bit0, 1, 5.	Bit4: Start sampling the rising edge of touch probe 1 Bit5: Start sampling the falling edge of touch probe 1
TPR2	Rising edge	Touch probe function 1	Set "1" to Bit8, 9, 12.	Bit8: Touch probe 2 enabled Bit9: Continuous trigger mode
	Falling edge	Touch probe function 1	Set "1" to Bit8, 9, 13.	Bit12: Start sampling the rising edge of touch probe 2 Bit13: Start sampling the falling edge of touch probe 2
TPR3	Rising edge	Touch probe function 2	Set "1" to Bit0, 1, 4.	Bit0: Touch probe 3 enabled Bit1: Continuous trigger mode
	Falling edge	Touch probe function 2	Set "1" to Bit0, 1, 5.	Bit4: Start sampling the rising edge of touch probe 1 Bit5: Start sampling the falling edge of touch probe 1

If the slave device that is used is disconnected from the network, reconnect the slave device and execute the procedure from 4. again.

●How to use the transient transmission

Write to the following object using MC_WriteParameter (Parameter Write).

For details of MC_WriteParameter (Parameter Write), refer to the following.

📖 Page 652 Parameter Read/Write Function

Object writing by MC_WriteParameter (Parameter Write) can be executed in the slave station in which axis is assigned only.
(Program example) When using TPR1 of MR-J5-G-RJ (When using both of rising edge and falling edge)

ST program

```
// Enable the touch probe function of MR-J5-G-RJ.
// writeValue is a label of DINT
// writeParameterExecute and writeParameterDone are labels of BOOL type.
writeValue := DINT#16#00000033; //Set Bit0, 1, 4, and 5.
MC_WriteParameter_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= writeParameterExecute ,
  ParameterNumber:= UDINT#16#60B80010 , //Touch probe function 1
  Value:= DINT_TO_LREAL( writeValue ) ,
  ExecutionMode:= 0 ,
  Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
  Done => writeParameterDone);
```

●How to use the cyclic transmission

(a) Set the following object to RPDO of PDO mapping.

For how to mapping, refer to "CC-Link IE TSN Configuration" Window" of Part 1 of the following manual.

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

When using TPR1 and TPR2

Index	Sub Index	Object name
60B8h	00h	Touch probe function 1

When using TPR3

Index	Sub Index	Object name
2DE8h	00h	Touch probe function 2

(b) Generate a device label of the above object.

For how to generate a device label, refer to the following.

📖 Page 781 Common Items for all devices

(c) Execute the following operation to the generated device label.

(Program example) When using TPR1 of MR-J5-G-RJ (When using both of rising edge and falling edge)

ST program

```
// Enable the touch probe function of MR-J5-G-RJ.
MR_J5_G_RJ_001_TouchProbeFunction:= UDINT#16#0033; //(Set 1 to BIT0, 1, 4, and 5.)
```

5. Check whether the touch probe function of MR-J5(W)-G series is enabled.

Check whether the touch probe function of MR-J5(W)-G series is enabled using the following object.

When using TPR1 and TPR2

Index	Sub Index	Size (number of bits)	Object name
60B9h	00h	10h	Touch probe status 1

When using TPR3

Index	Sub Index	Size (number of bits)	Object name
2DE9h	00h	10h	Touch probe status 1

Check the following value is stored to the above object. There are two methods to check the object, one is using the transient transmission and the other one is using the cyclic transmission.

Detection signal	Detection direction	Object name	Value at touch probe enabled	Description
TPR1	Rising edge	Touch probe Status1	Bit0 is set to 1.	Bit0: Touch probe 1 enabled
	Falling edge	Touch probe Status1	Bit0 is set to 1.	
TPR2	Rising edge	Touch probe Status1	Bit8 is set to 1.	Bit8: Touch probe 2 enabled
	Falling edge	Touch probe Status1	Bit8 is set to 1.	
TPR3	Rising edge	Touch probe Status2	Bit0 is set to 1.	Bit0: Touch probe 3 enabled
	Falling edge	Touch probe Status2	Bit0 is set to 1.	

●How to use the transient transmission

Read the following object using MC_ReadParameter (Parameter Read).

For details of MC_ReadParameter (Parameter Read), refer to the following.

☞ Page 652 Parameter Read/Write Function

(Program example) When using TPR1 of MR-J5-G-RJ

ST program
<pre>// Obtain the status of touch probe of MR-J5-G-RJ. // readValue is a label of LREAL. // tempValue is a label of INT. // readParameterEnable and readParameterValid are labels of BOOL type. MC_ReadParameter_1(Axis:= Axis0001.AxisRef , Enable:= readParameterEnable , ParameterNumber:= UDINT#16#60B90010 , //Touch probe status 1 Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign. Valid => readParameterValid, Value => readValue); // Check whether touch probe of MR-J5-G-RJ is enabled. tempValue := LREAL_TO_INT(readValue); IF tempValue.0 THEN //Start the function that uses external signal high-accuracy input. END_IF;</pre>

●How to use the cyclic transmission

(a) Generate a device label of the following object.

For how to generate a device label, refer to the following.

☞ Page 781 Common Items for all devices

When using TPR1 and TPR2

Index	Sub Index	Object name
60B9h	00h	Touch probe status 1

When using TPR3

Index	Sub Index	Object name
2DE9h	00h	Touch probe status 2

(b) Execute the following operation to the generated device label.

(Program example) When using TPR1 of MR-J5-G-RJ (When using both of rising edge and falling edge)

ST program
<pre>// Check whether touch probe of MR-J5-G-RJ is enabled. IF MR_J5_G_RJ_001_TouchProbeStaus.0 THEN //Start the function that uses external signal high-accuracy input. END_IF;</pre>

■How to check whether high-accuracy input is enabled

Check whether a signal detection time is stored to the object or link device those stores a slave station signal detection time at the signal detection using the device label, etc.

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

When using TPR1

- To detect the rising edge of signal: Touch probe time stamp 1 positive value(60D1h)
- To detect the falling edge of signal: Touch probe time stamp 1 negative value(60D2h)

When using TPR2

- To detect the rising edge of signal: Touch probe time stamp 2 positive value(60D3h)
- To detect the falling edge of signal: Touch probe time stamp 2 negative value(60D4h)

When using TPR3

- To detect the rising edge of signal: Touch probe time stamp 3 positive value(2DF8h)
- To detect the falling edge of signal: Touch probe time stamp 3 negative value(2DF9h)

■Program example

[When using MR-J5-G-RJ series]

When TPR1 of the station address 192.168.3.1 is used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled) at the rising edge detection

<Setting of MR-J5-G-RJ>

1. Set a connector pin to assign TPR1 of the input device to be used.

- Set "2Ch" to Pr.PD38.0-1. (Assign TPR1 to the connector pin CN3-10.)

<Setting of the motion system>

1. Set the following slave objects to TPDO of PDO mapping.

For how to mapping, refer to ""CC-Link IE TSN Configuration" Window" of Part 1 of the following manual.

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

Index	Sub Index	Object name
60B9h	00h	Touch probe status 1
60D1h	00h	Touch probe time stamp 1 positive value

2. Generate a label to be used as Trigger input signal (TriggerInput) of MC_TouchProbe (Touch Probe Enabled).

Create a new data of MC_TRIGGER_REF type and set Toggle status for latch completion of TPR1 to Target (Target).

Data name	Setting of MC_TRIGGER_REF type data			
	Target (Target)	Signal Detection Method (Detection)	Compensation Time (CompensationTime)	Filter Time (FilterTime)
SignalData0001	[OBJ]0x60B90010.6@192.168.3.1	4: Detection at Rising Edge/Falling Edge (BothEdges)	0.0	0.0

3. Generate a label to be used as Probe data (ProbeData) of MC_TouchProbe (Touch Probe Enabled).

Create a new data of TARGET_REF type and set Probe data (ProbeData). As an example, the case to set axis data is shown below.

Data name	Setting of TARGET_REF type data	
	Taeget (Target)	
SignalData0002	[AXIS]mcSetValue@Position	

4. Enable the touch probe function of MR-J5-G-RJ by ST program and start MC_TouchProbe (Touch Probe Enabled).

ST program

```
// Enable the touch probe function of MR-J5-G-RJ.
// writeValue is a label of DINT.
// writeParameterExecute, writeParameterDone, and touchProbeExecute are labels of BOOL type.
writeValue := DINT#16#00000013; //Set Bit0, 1, 4.
MC_WriteParameter_1(
  Axis:= Axis0001.AxisRef ,
  Execute:= writeParameterExecute ,
  ParameterNumber:= UDINT#16#60B80010 , //Touch probe function 1
  Value:= DINT_TO_LREAL( writeValue ) ,
  ExecutionMode:= 0 ,
  Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
  Done => writeParameterDone);

// Obtain the status of touch probe of MR-J5-G-RJ.
// readValue is a label of LREAL. tempValue is a label of INT.
// readParameterEnable and readParameterValid are labels of BOOL type.
MC_ReadParameter_1(
  Axis:= Axis0001.AxisRef ,
  Enable:= readParameterEnable ,
  ParameterNumber:= UDINT#16#60B90010 , //Touch probe status 1
  Options:= UDINT#16#000000010000, //Set the setting value of integer data to the integer value without a sign.
  Valid => readParameterValid,
  Value => readValue );

tempValue := LREAL_TO_INT(readValue); // When touch probe of MR-J5-G-RJ is enabled
IF tempValue.0 THEN
  touchProbeExecute := TRUE; //Set TRUE to Execute of MC_TouchProbe.
  readParameterEnable := FALSE; //Stop readParameter.
END_IF;

// Set external signal high-accuracy input to TriggerInput of MC_TouchProbe.
// Latch the data set to ProbeData at the rising edge of TPR1 of MR-J5-G-RJ.
// touchProbeRecordedPos is a label of LREAL type.
MC_TouchProbe_1(
  Axis:= Axis0001.AxisRef ,
  Execute := touchProbeExecute,
  TriggerInput := SignalData0001 ,
  ProbeData := SignalData0002 ,
  RecordedPosition => touchProbeRecordedPos);
```

■Precautions

- When using external signal high-accuracy input, set 0 to Filter Time (FilterTime) of the external signal selection.
If the slave device has the input filter, use the filter of the slave device.
When using external signal high-accuracy input and setting other than 0 to Filter Time (FilterTime) of the external signal selection, a signal detection time cannot be detected correctly.
- Note that the signal to be input to the slave station as high-accuracy input should not be turned ON/OFF several times within a communication cycle. If the signal turns ON/OFF several times within a communication cycle, the signal cannot be detected correctly.

Precautions

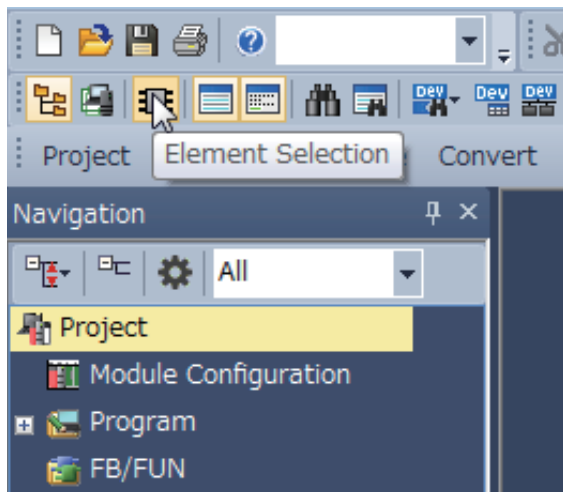
When using MR-J5(W)-G with old firmware, the error "Watchdog Counter Error" (error code: 1C41H) may occur at connecting.

When this symptom occurs, update the firmware of MR-J5(W)-G.

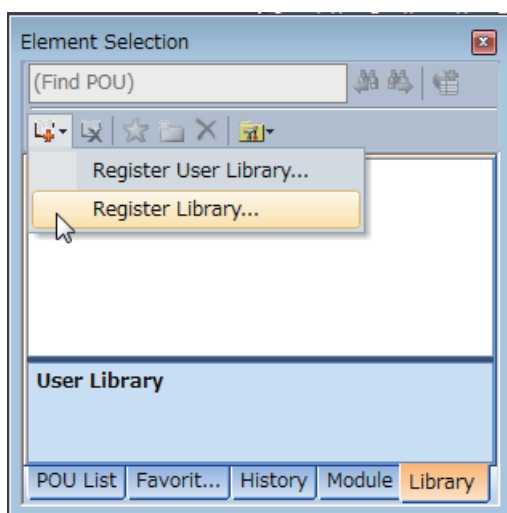
Appendix 2 Project Setting Example

Library Registration Procedure

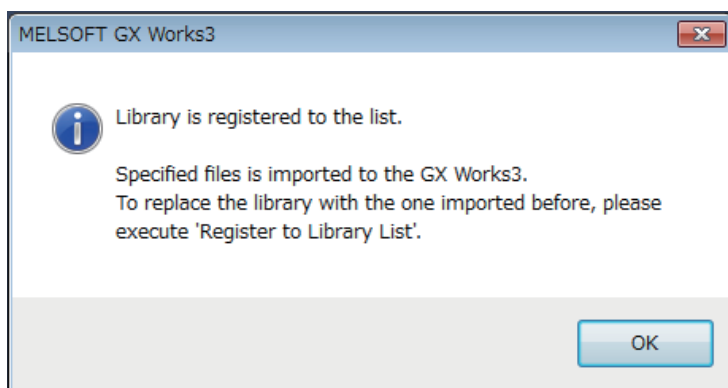
1. For the Motion control FB library, please consult your local Mitsubishi representative.
2. Start GX Works3, select [Project] ⇒ [New], and select a type. Display the Element Selection window.



3. Select the Library tag, and select "Register Library..." of the "Register to Library List" icon.

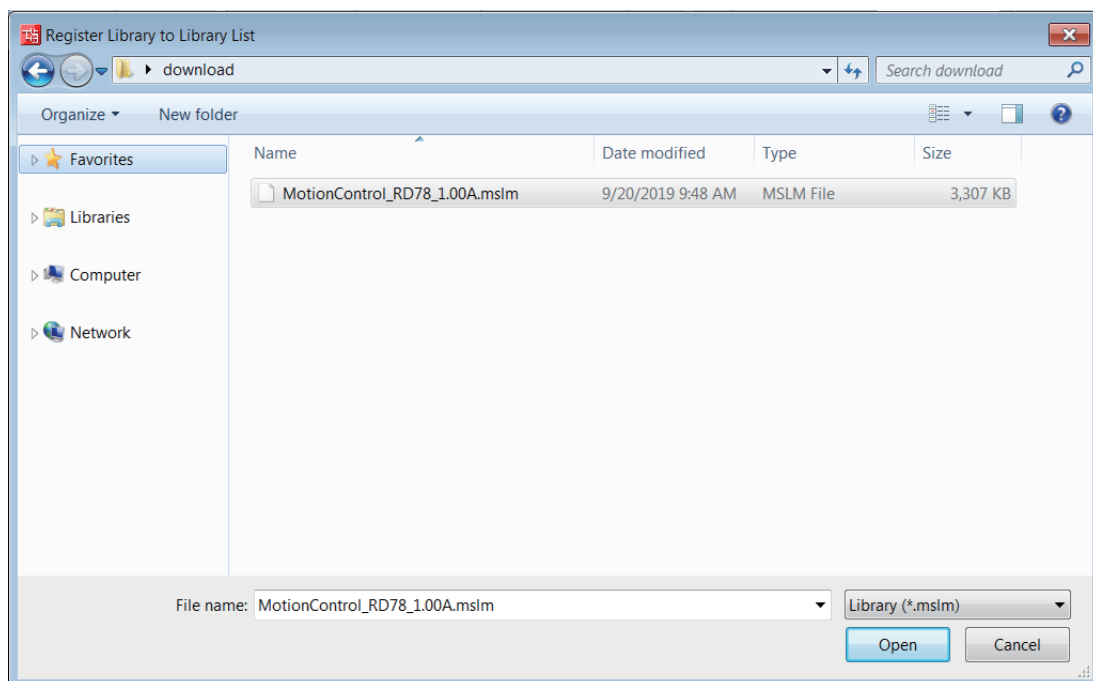


4. The following dialog box appears. Click the [OK] button.

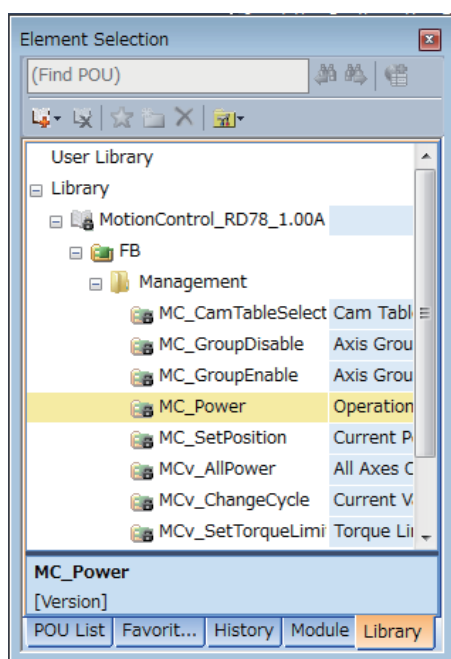


A

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.

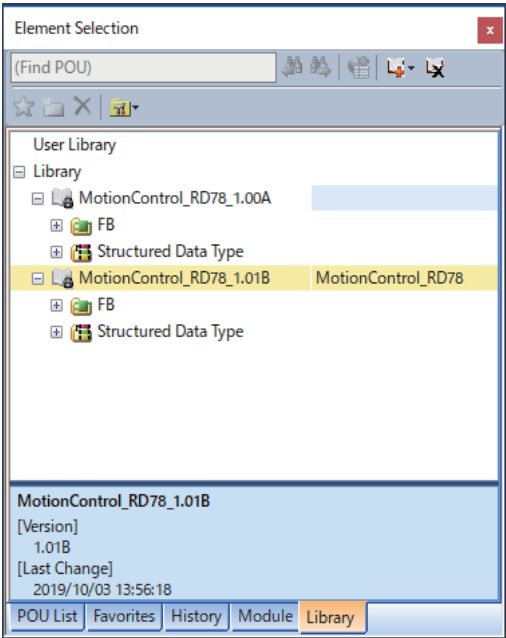
Library Update Procedure

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".

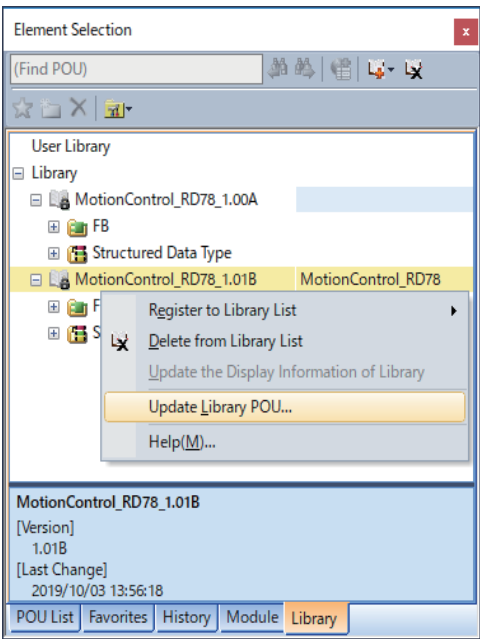
Ex.

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...".



A

3. The FB list used for the project is displayed in "Update library element" window.

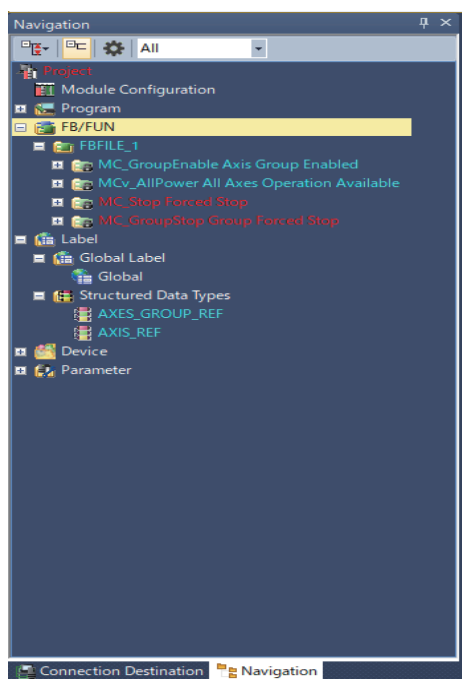
As the FBs required updating of the version are automatically selected their checkboxes, click the [Update] button.

Update Library POU

Please select the library POU's to be updated.
It may take several minutes to complete if multiple POU's are selected or the data size of project or library is large.
Setting contents (execution order of program block, initial value of label, assigned device, and other settings) might be changed. Please check the settings after updating.

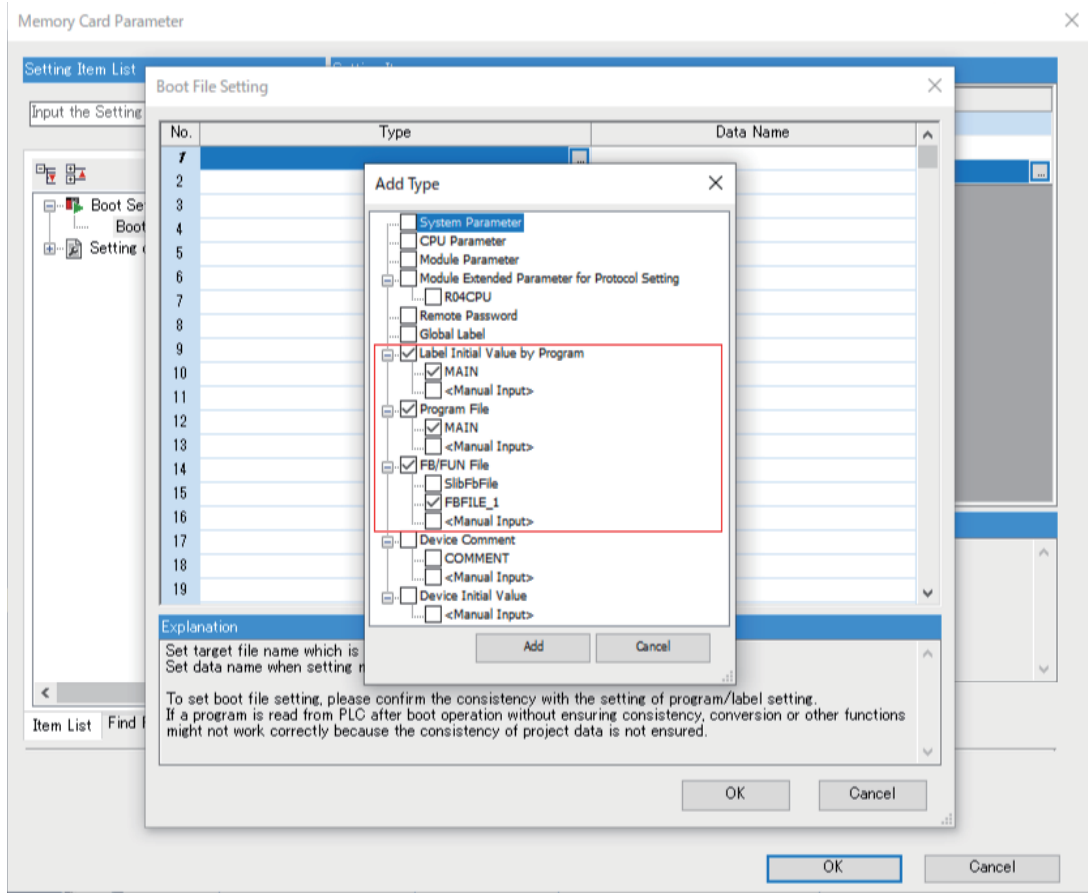
	Data Type	Data Name	Version in Project	Version in Library	Language in Library	Library Name
☐	Function Block	MC_GroupEnable	00A	01B	Ladder	MotionControl_RD78_1.01B
☐	Function Block	MCv_AllPower	00A	01B	Ladder	MotionControl_RD78_1.01B
☒	Function Block	MC_GroupStop	00A	01B	Ladder	MotionControl_RD78_1.01B
☒	Function Block	MC_Stop	00A	01B	Ladder	MotionControl_RD78_1.01B
☐	Structured Data Types	AXES_GROUP_REF	00A	00A		MotionControl_RD78_1.01B
☐	Structured Data Types	AXIS_REF	00A	00A		MotionControl_RD78_1.01B

Select All Deselect All ☐ Update with Elements in Callee **Update** Cancel



Precautions

[When setting program files using FB library in CPU module boot operation]
Each FB in "MotionControl_RD78_****.mslm" uses default value of labels classified by programs.
In CPU module boot operation, when specifying program files using this library FB by boot setting, also specify default value file of labels classified by programs by boot setting.



A

Appendix 3 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	Motion control FB Library
RD78G	Ver. 04 or earlier	1.056J or later	R00CPU/R01CPU/R02CPU: 12 or later R04CPU/R08CPU/R16CPU/R32CPU/ R120CPU: 44 or later	1.00A
	Ver. 05 or later	1.060N or later (The motion control setting function 1.005F or later)	R04ENCPU/R08ENCPU/R16ENCPU/ R32ENCPU R120ENCPU: 44 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 the Motion control FB Library are shown below.

Version	
Motion control FB Library	GX Works3
1.00A	1.056J or later (motion control setting function 1.000A or later)
1.01B or later	1.060N or later (motion control 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 776 List of Add-on Library

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
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports safety communication function.
Add-on library		
	baseSystem	1.8
	NetworkDriver_CCIETSN	1.7
CPU module firmware		R08SFCPU/R16SFCPU/R32SFCPU/R120SFCPU: 20
GX Works3		1.065T
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports communication speed 100 Mbps.
Add-on library		
	baseSystem	1.8
CPU module firmware		—
GX Works3		1.065T
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports Inter-module Synchronization Function.
Add-on library		
	baseSystem	1.16
CPU module firmware		R00CPU/R01CPU/R02CPU: 24 R04CPU/R08CPU/R16CPU/R32CPU/R120CPU: 57 R04ENCPU/R08ENCPU/R16ENCPU/R32ENCPU/R120ENCPU: 57
GX Works3		1.075D
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—

Item		Detail
Function		Supports the Simple motion mode.
Add-on library		
	baseSystem	1.16
	Axis	1.15
	ServoDriver_CANOpen	1.15
	NetworkDriver_CCIETSN	1.15
	SignalIO	1.15
	SimpleMotion	1.15
CPU module firmware		—
GX Works3		1.075D
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports station information list.
Add-on library		
	baseSystem	1.16
CPU module firmware		—
GX Works3		1.075D
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		Supports Continuous operation to torque control mode.
Add-on library		
	MotionEngine	1.7
	ServoDriver_CANOpen	1.7
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports watchdog counter.
Add-on library		
	baseSystem	1.16
	NetworkDriver_CCiETSN	1.15
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		—
Item		Detail
Function		Supports MR-J5D-G.
Add-on library		
	baseSystem	1.17
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		Adds logging realtime monitor.
Add-on library		
	Logging	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		
	ProfileControl	1.4
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.005F
Motion software setting tool		—
Item		Detail
Function		Adds Servo System Recorder.
Add-on library		
	Axis	1.7
	Logging	1.7
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
Motion control setting function		1.010L
Motion software setting tool		—
Item		Detail
Function		Supports Position data history.
Add-on library		
	Axis	1.7
	MotionEventHist	1.7
CPU module firmware		—
GX Works3		—
GX Works3 Motion Control FB library		
	—	—
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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
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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.

(3) Mitsubishi shall have no responsibility or liability for any problems involving programmable controller trouble and system trouble caused by DoS attacks, unauthorized access, computer viruses, and other cyberattacks.

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