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FACTORY AUTOMATION

Mitsubishi Servo System Controllers
Quick Start Guide

Let's Start!

Quick Start Guide

MELSEC iQ-R Series Simple Motion Module

MELSEC iQ-R series

Applicable Model

- RD77MS2
- RD77MS4
- RD77MS8
- RD77MS16

SAFETY PRECAUTIONS (Read these precautions before using this product.)

Before using this product, please read this manual and the relevant manuals carefully and pay full attention to safety to handle the product correctly.
The precautions given in this manual are concerned with this product only. Refer to the user's manual of the CPU module to use for a description of the PLC system safety precautions.
In this manual, the safety precautions are classified into two levels: "⚠WARNING" and "⚠CAUTION".

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

Under some circumstances, failure to observe the precautions given under "⚠CAUTION" may lead to serious consequences.
Observe the precautions of both levels because they are important for personal and system safety.
Make sure that the end users read this manual and then keep the manual in a safe place for future reference.

[Design Precautions]

⚠ WARNING

- Configure safety circuits external to the programmable controller to ensure that the entire system operates safely even when a fault occurs in the external power supply or the programmable controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  (1) Configure external safety circuits, such as an emergency stop circuit, protection circuit, and protective interlock circuit for forward/reverse operation or upper/lower limit positioning.
  (2) The programmable controller stops its operation upon detection of the following status, and the output status of the system will be as shown below.
  • 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) Also, 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 the user's manual of the CPU module to use.
  (4) Outputs may remain on or off due to a failure of a component such as a relay and transistor in an output circuit. Configure an external circuit for monitoring output signals that could cause a serious accident.
- In an output circuit, when a load current exceeding the rated current or an overcurrent caused by a load short-circuit flows for a long time, it may cause smoke and fire. To prevent this, configure an external safety circuit, such as a fuse.
- Configure a circuit so that the programmable controller is turned on first and then the external power supply. If the external power supply is turned on first, an accident may occur due to an incorrect output or malfunction.
- For the operating status of each station after a communication failure, refer to manuals relevant to the network. Incorrect output or malfunction due to a communication failure may result in an accident.

⚠ WARNING

- When connecting an external device with a CPU module or intelligent function module to modify data of a running programmable controller, configure an interlock circuit in the program to ensure that the entire system will always operate safely. For other forms of control (such as program modification, parameter change, forced output, or operating status change) of a running programmable controller, read the relevant manuals carefully and ensure that the operation is safe before proceeding. Improper operation may damage machines or cause accidents.
- Especially, when a remote programmable controller is controlled by an external device, immediate action cannot be taken if a problem occurs in the programmable controller due to a communication failure. To prevent this, configure an interlock circuit in the program, and determine corrective actions to be taken between the external device and CPU module in case of a communication failure.
- Do not write any data to the "system area" and "write-protect area" of the buffer memory in the module. Also, do not use any "use prohibited" signals as an output signal from the CPU module to each module. Doing so may cause malfunction of the programmable controller system. For the "system area", "write-protect area", and the "use prohibited" signals, refer to the user's manual for the module used.
- If a communication cable is disconnected, the network may be unstable, resulting in a communication failure of multiple stations. Configure an interlock circuit in the program to ensure that the entire system will always operate safely even if communications fail. Failure to do so may result in an accident due to an incorrect output or malfunction.
- To maintain the safety of the programmable controller system against unauthorized access from external devices via the network, take appropriate measures. To maintain the safety against unauthorized access via the Internet, take measures such as installing a firewall.
- Configure safety circuits external to the programmable controller to ensure that the entire system operates safely even when a fault occurs in the external power supply or the programmable controller. Failure to do so may result in an accident due to an incorrect output or malfunction.
  (1) Machine home position return is controlled by two kinds of data: a home position return direction and a home position return speed. Deceleration starts when the near-point dog signal turns on. If an incorrect home position return 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 suddenly 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 home position return 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, servo amplifier and servomotor, make sure that the safety standards are satisfied.
- Construct a safety circuit externally of the module or servo amplifier if the abnormal operation of the module or servo amplifier differs from the safety directive operation in the system.
- Do not remove the SSCNETIII cable while turning on the control circuit power supply of Multiple CPU system and servo amplifier. Do not see directly the light generated from SSCNETIII connector of the module or servo amplifier and the end of SSCNETIII cable. When the light gets into eyes, you may feel something wrong with eyes. (The light source of SSCNETIII complies with class1 defined in JISC6802 or IEC60825-1.).

[Design Precautions]

⚠ CAUTION

- Do not install the control lines or communication cables together with the main circuit lines or power cables. Keep a distance of 100 mm or more between them. Failure to do so may result in malfunction due to noise.
- During control of an inductive load such as a lamp, heater, or solenoid valve, a large current (approximately ten times greater than normal) may flow when the output is turned from off to on. Therefore, use a module that has a sufficient current rating.
- After the CPU module is powered on or is reset, the time taken to enter the RUN status varies depending on the system configuration, parameter settings, and/or program size. Design circuits so that the entire system will always operate safely, regardless of the time.
- Do not power off the programmable controller or do not reset the CPU module during the setting registration. Doing so will make the data in the flash ROM undefined. The data need to be set in the buffer memory and to be written to the flash ROM again. Doing so may cause malfunction or failure of the module.
- Reset the CPU module after changing the parameters. Failure to do so may cause malfunction because the previous parameter settings remain in the module.
- When changing the operating status of the CPU module from external devices (such as remote RUN/STOP), select "Do Not Open by Program" for "Opening Method" in the module parameters. If "Open by Program" is selected, an execution of remote STOP causes the communication line to close. Consequently, the CPU module cannot reopen the communication line, and external devices cannot execute the remote RUN.

[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 manual "Safety Guidelines" included in 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, and push in the module until the hook(s) located at the top snaps into place. Incorrect mounting may cause malfunction, failure, or drop of the module.
- When using the programmable controller in an environment of frequent vibrations, fix the module with a screw.
- Tighten the screws within the specified torque range. Undertightening can cause drop of the screw, short circuit, or malfunction. Overtightening can damage the screw and/or module, resulting in drop, short circuit, or malfunction.
- When using an extension cable, connect it to the extension cable connector of the base unit securely. Check the connection for looseness. Poor contact may cause incorrect input or output.
- When using an SD memory card, fully insert it into the memory card slot. Check that it is inserted completely. Poor contact may cause malfunction.
- Securely insert an extended SRAM cassette into the cassette connector of a CPU module. After insertion, close the cassette cover and check that the cassette is inserted completely. Poor contact may cause malfunction.
- Do not directly touch any conductive parts and electronic components of the module, SD memory card, extended SRAM cassette, or connector. Doing so may 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 damage to the product.
- After installation and wiring, attach the included terminal cover to the module before turning it on 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 ohm 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 or coaxial cables must be crimped or pressed with the tool specified by the manufacturer, or must be correctly soldered. Incomplete connections may cause short circuit, fire, or malfunction.
- Securely connect the connector to the module. Poor contact may cause malfunction.
- Do not install the control lines or communication cables together with the main circuit lines or power cables. Keep a distance of 100 mm or more between them. Failure to do so may result in malfunction due to noise.
- Place the cables in a duct or clamp them. If not, dangling cable may swing or inadvertently be pulled, resulting in damage to the module or cables or malfunction due to poor contact. Do not clamp the extension cables with the jacket stripped.
- 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.
- 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.
- Mitsubishi 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 MELSEC iQ-R Ethernet/CC-Link IE User's Manual (Startup). 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 may cause the battery to generate heat, explode, ignite, or leak, resulting in injury or 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 or cause the module to fail or malfunction.

[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 Handyphone 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 mount/remove the module to/from the base unit, and the terminal block to/from the module, and do not insert/remove the extended SRAM cassette to/from the CPU module more than 50 times (IEC 61131-2 compliant) respectively. Exceeding the limit of 50 times may cause malfunction.
- 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.
- Do not touch the integrated circuits on the circuit board of an extended SRAM cassette. Doing so may cause malfunction or failure.
- Do not drop or apply shock to the battery to be installed in the module. Doing so may damage the battery, causing the battery fluid to leak inside the battery. If the battery is dropped or any shock is applied to it, dispose of it without using.

- Startup and maintenance of a control panel must be performed by qualified maintenance personnel with knowledge of protection against electric shock. Lock the control panel so that only qualified maintenance personnel can operate it.
- Before handling the module, touch a conducting object such as a grounded metal to discharge the static electricity from the human body. Failure to do so may cause the module to fail or malfunction.
- 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 value motor has been replaced, always perform a home position return.
- 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 undefined. The values need to be set in the buffer memory and written to the flash ROM again. Doing so also can 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.

[Operating 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.

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MEMO

1. OVERVIEW

This document describes necessary items and operation for first-time users of the Simple Motion module to make wiring, perform JOG operation, program operation, and synchronous control with Programmable Controller Engineering Software, MELSOFT GX Works3.
Refer to related manuals, where necessary, to fully utilize capability of each module.

1.1 Simple Motion Module Features

1. A wide range of controls, such as positioning, advanced synchronous, cam, speed-torque controls, are available.
2. Advanced, extensive controls can be achieved just with function blocks (FB) and sequence programs.
3. Programming, Servo adjustment, operation and maintenance can be all covered by MELSOFT GX Works3 only.
4. The Simple Motion module can be connected to SSCNET III/H compatible, high-performance servo amplifiers.

1.2 Relevant Manuals

(1) Simple Motion module

Name	Number
MELSEC iQ-R Simple Motion Module User's Manual (Startup) This manual explains specifications, procedures before operation, system configuration, wiring, and operation examples of the Simple Motion module.	IB-0300245
MELSEC iQ-R Simple Motion Module User's Manual (Application) This manual explains functions, input/output signals, buffer memories, parameter settings, programming, and troubleshooting of the Simple Motion module.	IB-0300247
MELSEC iQ-R Simple Motion Module User's Manual (Advanced Synchronous Control) This manual explains functions and programming for the synchronous control of the Simple Motion module.	IB-0300249

(2) MELSEC iQ-R series PLC

Name	Number
MELSEC iQ-R CPU Module User's Manual (Startup) This manual explains the specifications of the CPU module, procedures before operation, and procedures for troubleshooting.	SH-081263
MELSEC iQ-R CPU Module User's Manual (Application) This manual explains the basic knowledge required for program design, CPU module functions, devices/labels, parameters etc.	SH-081264
MELSEC iQ-R Module Configuration Manual This manual explains the specifications of the power supply modules, base units, SD memory cards etc., and the mounting environment and mounting position.	SH-081262

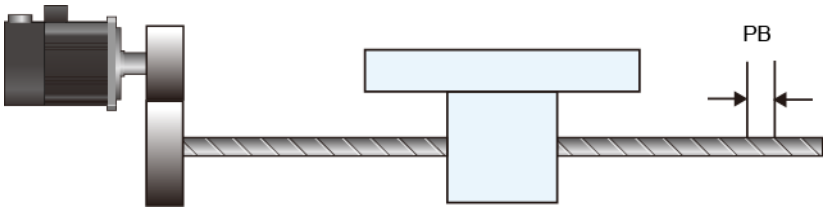
(3) Servo amplifier

Name	Number
MR-J4-_B_(-RJ) Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others for MR-J4-_B(-RJ)/MR-J4-_B4(-RJ)/MR-J4-_B1(-RJ) Servo amplifier.	SH-030106
MR-J4W2-_B/MR-J4W3-_B/MR-J4W2-0303B6 Servo amplifier Instruction Manual This manual explains the I/O signals, parts names, parameters, start-up procedure and others for Multi-axis AC Servo MR-J4W2-_B/MR-J4W3_B/MR-J4W2-0303B6 Servo amplifier.	SH-030105

2. MODULE STARTUP

A 1-axis system with ball screw is used as an example in Chapter 2 to 3.

<Machine>



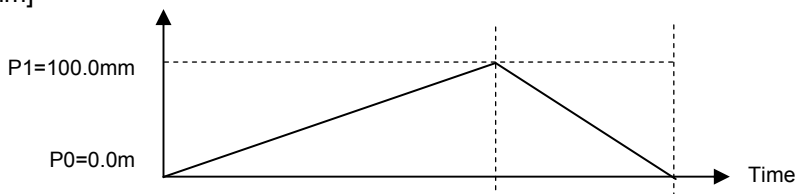
<Specifications>

Ball screw lead (PB) : 10000.0μm (=10mm)
Reduction ratio (NL/NM) : 1/2 (Load side [NL]/Motor side [NM])
The load-side ball screw is made to rotate once by rotating the motor twice.
Encoder resolution : 4194304 [pulse/rev]
Servo amplifier : MR-J4-10B
Servo motor : HG-KR series

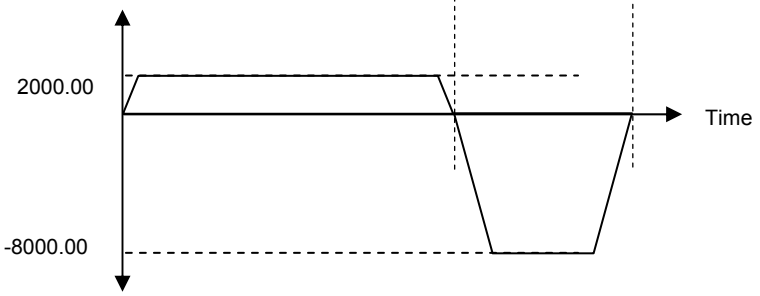
<Operation pattern>

(1) The workpiece travels from home position to P1 back and forth.
1. It moves at 2000.00mm/min from home position (0 mm) to P1.
2. It moves at 8000.00mm/min from P1 to the home position.
(2) Continuous positioning of 1. through 2. is performed.

<Position [mm]>

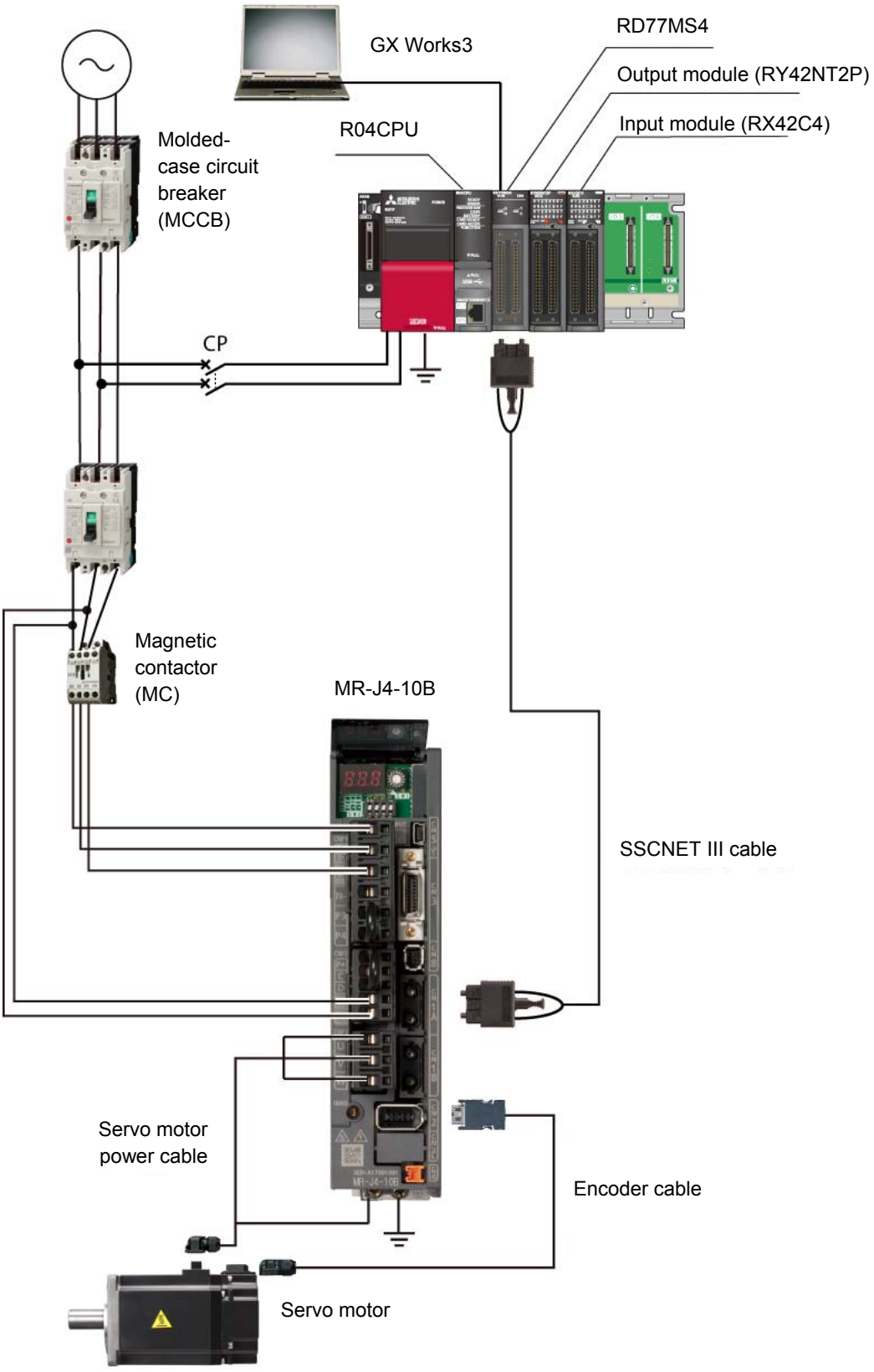


<Speed [mm/min]>



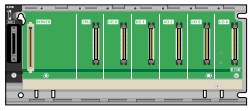
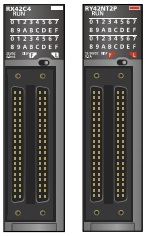
2.1 System Configuration

The following shows a system example using the Simple Motion module, MR-J4-10B, and a servo motor.



2.2 Device Preparation

Prepare the following devices, cables, and software.

Simple Motion module RD77MS4 	Engineering Software MELSOFT GX Works3 		
Servo amplifier MR-J4-10B 	Servo motor HG-KR13 		
Main base unit R35B 	Power supply module R61P 	PLC CPU module R04CPU 	Input/output module RX42C4 (Input) RY42NT2P (Output) 
Encoder cable 	Servo motor power cable 	SSCNET III cable MR-J3BUS_M 	USB cable 
Molded-case circuit breaker (MCCB) 	Magnetic contactor (MC) 	Circuit protector (CP) 	

2.3 Startup Procedure

The following sections explain operation details and procedures required for system startup.

2. MODULE STARTUP
2.1 System configuration
2.2 Device preparation
2.3 Startup procedure
2.4 Installation of modules
(1) Installing a battery
(2) Inserting an extended SRAM cassette and a SD memory card
(3) Installing a module
2.5 Wiring and cable connection
(1) Wiring for power supply module
(2) Wiring for servo amplifier power supply and servo motor power cables
(3) Axis selection rotary switch of servo amplifier
(4) Connection of each cable
(5) Power-on of the system
(6) Power-on of servo amplifier

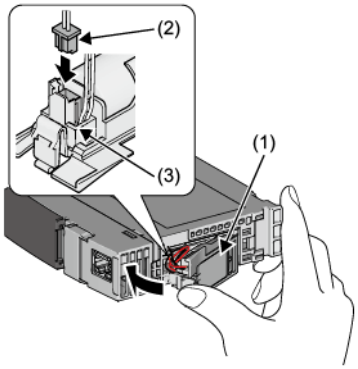
3. POSITIONING CONTROL STARTUP
3.1 Creating a new project
(1) Installing engineering software
(2) Creating a new project
(3) Connecting the PLC CPU to a personal computer
(4) Initializing the PLC CPU module
(5) Settings for sequence program parameters
3.2 Sequence program creation
(1) New sequence programs creation
(2) Multiple comments display setting
(3) Registration of global labels
(4) Element selection window
(5) Sequence program creation with labels
(6) Sequence program creation with module FB
(7) Saving a project
(8) Writing to PLC CPU
3.3 Parameter settings for Simple Motion module
(1) Start of Simple Motion module setting function
(2) System settings
(3) Parameter settings
(4) Servo parameter settings
(5) Positioning data setting
(6) Saving a project
(7) Writing to the Simple Motion module
3.4 Operation check
3.4.1 JOG operation
3.4.2 Home position return (Establishment of the home position)
3.4.3 Positioning control

2.4 Installation of Modules

Install the modules.

(1) Installing a battery

The connector plug of the Q6BAT is disconnected from the jack of the CPU module before shipment. To use the battery, connect the connector, following the procedure below.



1. Open the battery cover located on the bottom of the CPU module.
2. Check that the Q6BAT (1) is correctly installed.
3. Check the direction and securely insert the connector plug of the Q6BAT (2) to the jack (3) of the CPU module.
4. Close the battery cover.

(2) Inserting an extended SRAM cassette and a SD memory card

Since the example system does not use an extended SRAM cassette and a SD memory card, the insertion/removal procedures are omitted in this document.
Refer to MELSEC iQ-R CPU Module User's Manual (Startup) for details.

(3) Installing a module

Install each module to the main base unit.
Refer to MELSEC iQ-R Module Configuration Manual for details.

2.5 Wiring and Cable Connection

The following shows the wiring and cable connection example for the Simple Motion module and servo amplifiers.
The system below uses the cables for MR-J4-10B. If the capacity of the servo amplifier is different, refer to SERVO AMPLIFIER INSTRUCTION MANUAL for each model.

(1) Wiring for power supply module

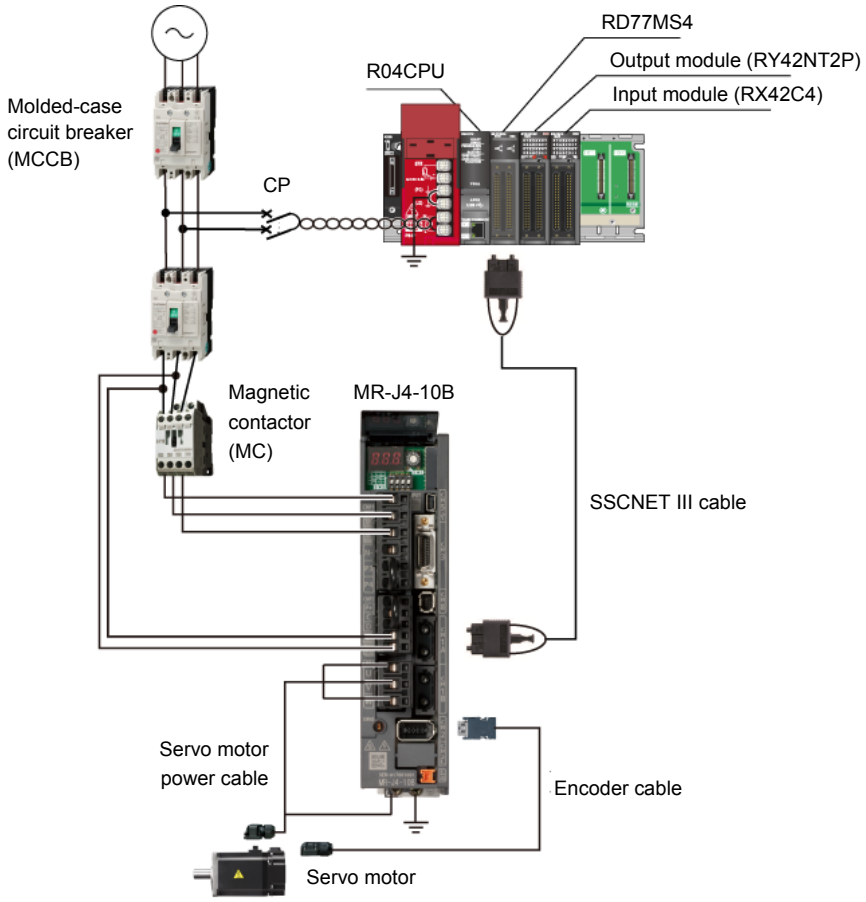
The following shows an example when a power wire and a grounding wire are connected to the power supply module. Connect an isolation transformer when noise often enters in the power supply system.

Item	Applicable wire size	Tightening torque
Power wire	0.75 to 2mm^2 (AWG18 to AWG14)	1.02 to 1.38N•m
Grounding wire	0.75 to 2mm^2 (AWG18 to AWG14)	1.02 to 1.38N•m

(2) Wiring for servo amplifier power supply and servo motor power cables

Wire the control circuit power supply (L11, L21) and the main circuit power supply (L1, L2, L3) of the servo amplifier, and the servo motor power cable.

Item	Applicable wire size	Tightening torque
Control circuit power supply (L11, L21)	1.25mm^2 (AWG16)	-
Main circuit power supply (L1, L2, L3)	2mm^2 (AWG14)	-
Grounding wire	1.25mm^2 (AWG16)	1.2N•m

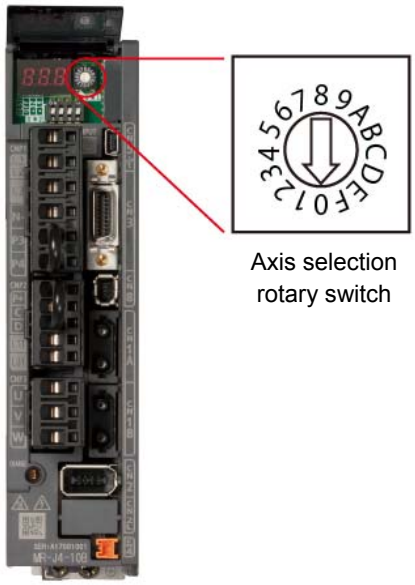


(3) Axis selection rotary switch of servo amplifier

"0" to "F" of the axis selection rotary switch correspond to "d01" to "d16".

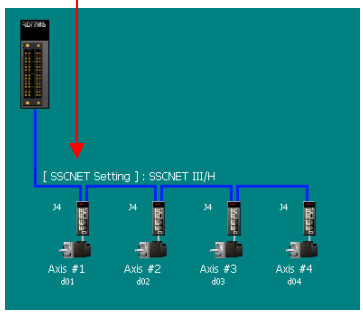
The following table shows the correspondence between SSCNET configuration and the switch No. Set the switch correctly checking the correspondence.

Servo amplifier MR-J4-10B	Description



Axis selection rotary switch

No.	dno.	Axis No.	No.	dno.	Axis No.
“0”	d01	Axis 1	“8”	d08	-
“1”	d02	Axis 2	“9”	d09	-
“2”	d03	Axis 3	“A”	d10	-
“3”	d04	Axis 4	“B”	d11	-
“4”	d05	-	“C”	d12	-
“5”	d06	-	“D”	d13	-
“6”	d07	-	“E”	d14	-
“7”	d08	-	“F”	d15	-



SSCNET configuration

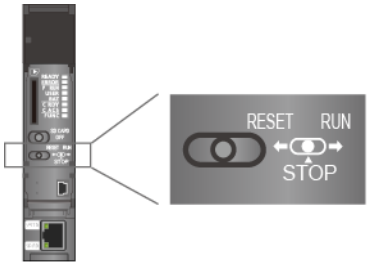
(4) Connection of each cable

Connect the SSCNET III cable, the encoder cable, and the servo motor power cable.

For between the personal computer and PLC CPU, connect a USB cable.

(5) Power-on of the system

1. Check the wiring for the power supply module.
2. Confirm that the PLC CPU is in STOP status.
3. Turn ON the power of PLC CPU.



ERROR LED flickers.

(a) Power supply module: LED (green light) turns ON.

(b) CPU module: READY LED (green light) turns ON.

When parameters and programs are not written to the CPU module, the ERROR LED (red light) of the PLC CPU flickers, but no immediate error is occurring. After writing parameters and programs and turning the power OFF to ON, the ERROR LED will be OFF.

(6) Power-on of servo amplifier

Turn the power ON after checking the following items.

1. Check the wiring for servo amplifier.
2. Turn the servo amplifier ON.

The communication status with the Simple Motion module can be checked on the display.

Servo amplifier	LED display	Status	Description	Wiring result
	AA	Initializing standby	The power supply of servo system controller is turned off while the power supply of servo amplifier is on.	Normal
	Ab	Initializing	During initial setting for communication specifications.	
	AC	Initializing	Initial setting for communication specifications has completed, and then the servo amplifier has been synchronized with the servo system controller.	
	Ad	Initializing	During communication with the servo system controller for initial parameter setting	
	AE	Initializing	During communication with the servo system controller for the servo motor/encoder information	
	AF	Initializing	During communication with servo system controller for initial signal data	
	AH	Initializing completion	The process for initial data communication with the servo system controller is completed.	
	b01	Ready-off	The ready-off command from the servo system controller was received.	
	C01	Servo-off	The servo-off command from the servo system controller was received.	
	d01	Servo-on	The servo-on command from the servo system controller was received.	
	E6.1	Forced stop warning	Forced stop warning	
	E7.1	Controller forced stop warning	Controller forced stop warning	
	OFF	-	Control power is off.	Abnormal

<Actions>

- When parameters are not written to the Simple Motion module, the LED displays "AA" or "Ab", but no immediate error is occurring. In this case, write parameters.
- If the LED turns OFF, check the wiring for control power supply.

3. POSITIONING CONTROL STARTUP

3.1 Creating a New Project

(1) Installing engineering software

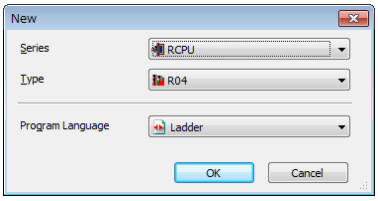
Install MELSOFT iQ Works or MELSOFT GX Works3, following the Installation Instruction provided with the software package.

Product	Model	Description
MELSOFT iQ Works	SW2DND-iQWK-E	FA Engineering Software - System Management Software [MELSOFT Navigator] - Programmable Controller Engineering Software [MELSOFT GX Works3] - Motion Controller Engineering Software [MELSOFT MT Works2] - Screen Design Software [MELSOFT GT Works3] - Robot Total Engineering Support Software [MELSOFT RT ToolBox2 mini] - Inverter Setup Software [MELSOFT FR Configurator2]
MELSOFT GX Works3	SW1DND-GXW3-E	Simple Motion module parameter settings, sequence program creation

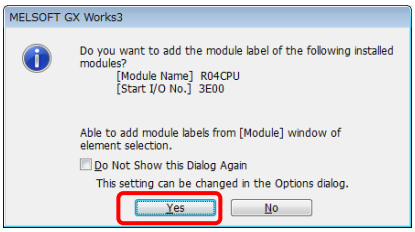
Note) The screen windows in this document may differ from the ones you use.
(The system uses “MELSOFT GX Works3 Version 1.007H”)

(2) Creating a new project

Start MELSOFT GX Works3, and create a new project.



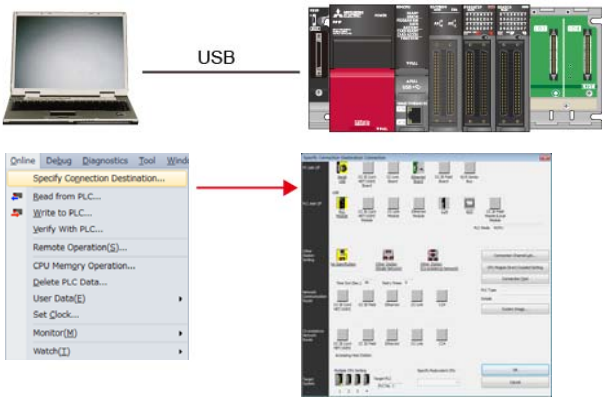
[Project] → [New]
Series : RCPU
Model : R04 (specify the CPU to be used)
Program language : Ladder



The window asking about module label addition appears.
Click [Yes].

(3) Connecting the PLC CPU to a personal computer

Confirm the connection between a personal computer and the PLC CPU.

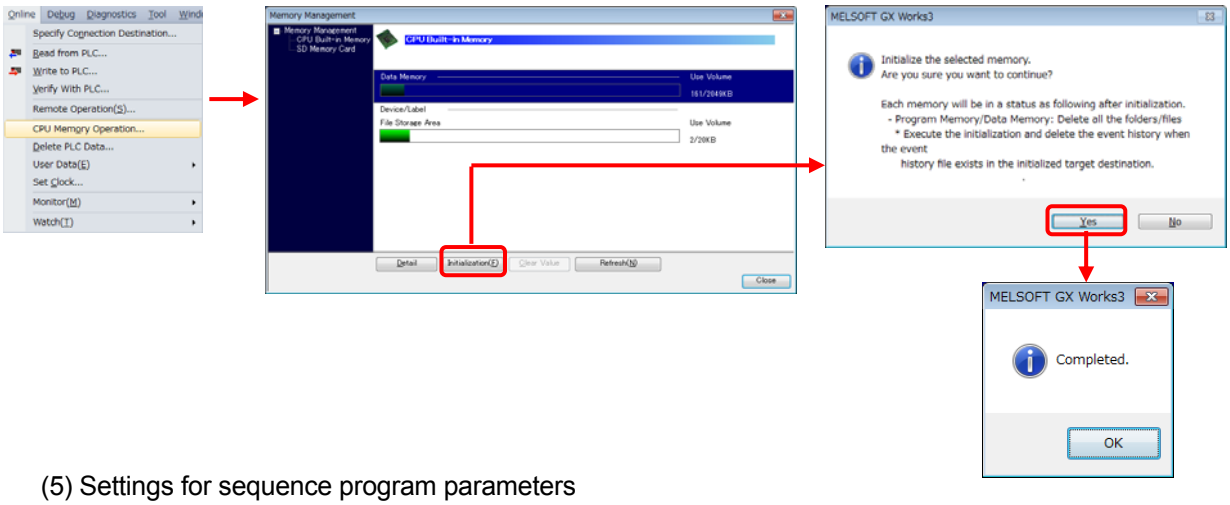


1. Connect the CPU module to a personal computer.
2. Select [Online] → [Specify Connection Destination] to open the [Specify Connection Destination Connection] window.
3. Select “CPU Module Direct Coupled Setting”.
4. Select the connection method with CPU module.

(4) Initializing the PLC CPU module

Initialize a memory of the PLC CPU.

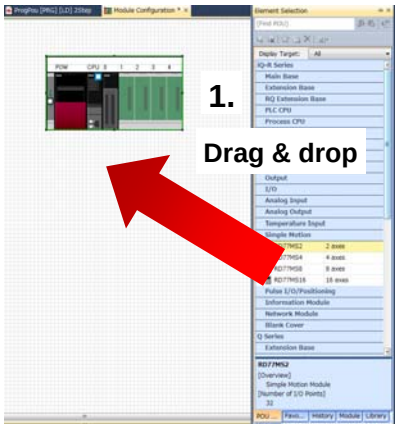
Click [Initialization] on the Memory Management window.



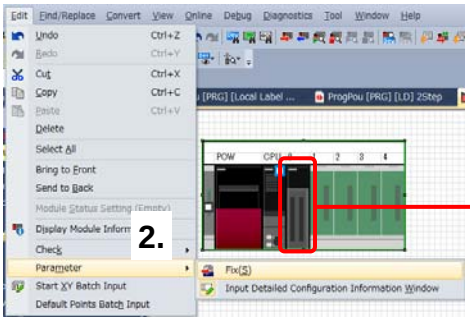
(5) Settings for sequence program parameters

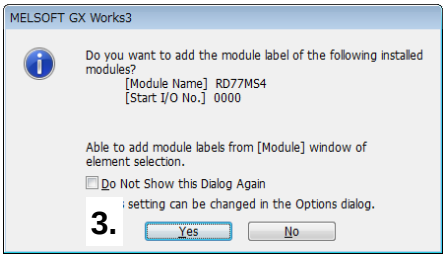
Set the system parameter and each module parameter.

<Creating a module configuration>

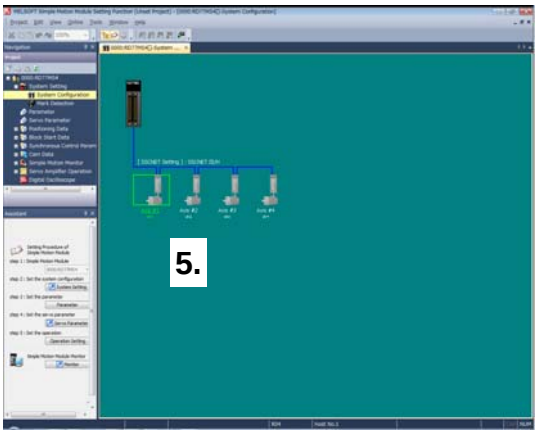


1. Select the main base unit, CPU, I/O, and Simple Motion module to be used from the POU list, and drag & drop them to the configuration screen.
2. Select [Edit] - [Parameter] - [Fix] in the menu.
3. The window asking about module label addition appears for the selected modules. Click "Yes".
4. Double click on the Simple Motion module to open the Simple Motion Module Setting Function screen.
5. Set the parameters, and close it when finished.





4.



3.2 Sequence Program Creation

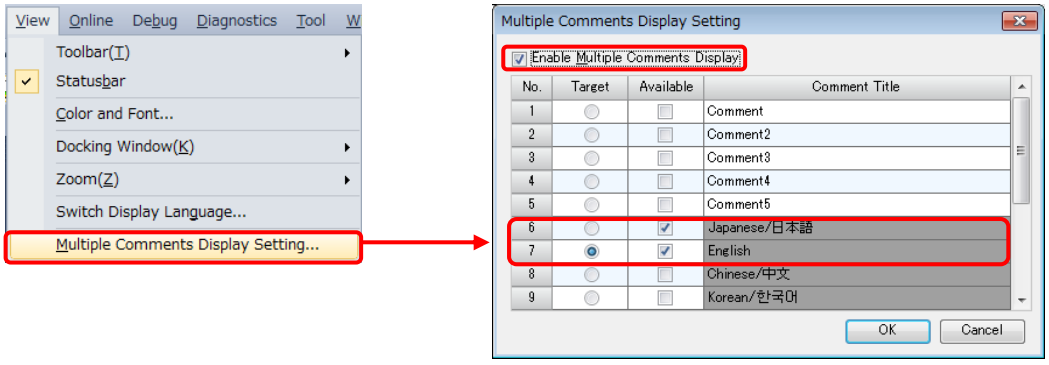
The use of label and function block (FB) removes the need to remember devices when programming.

(1) New sequence programs creation

Appendix 3 provides the sequence program example.

(2) Multiple comments display setting

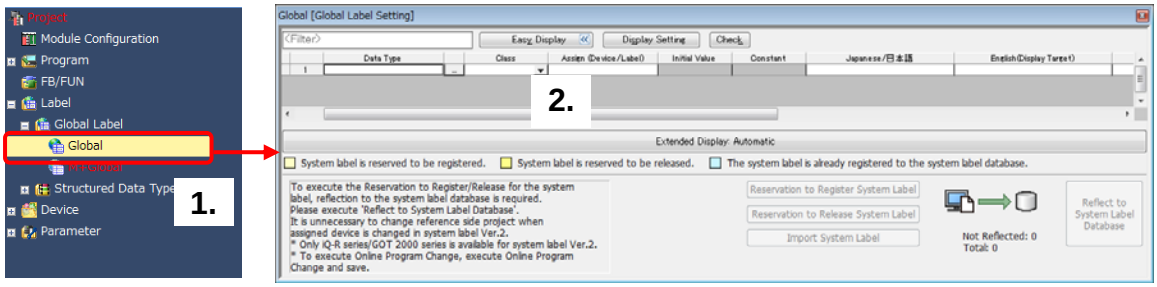
Check the "Enable Multiple Comments Display" box and “Target” boxes for each language to switch the language for comments in sequence programs.



(3) Registration of global labels

Labels are variable elements that allow you to put arbitrary names or data types to programs, etc. The use of labels allows you to create a program without worries about devices and buffer memory, enabling a different model/product to be used with the same program.

1. Select [Label] → [Global].The global label registration window appears.
2. Register the global label, referring to the table below.



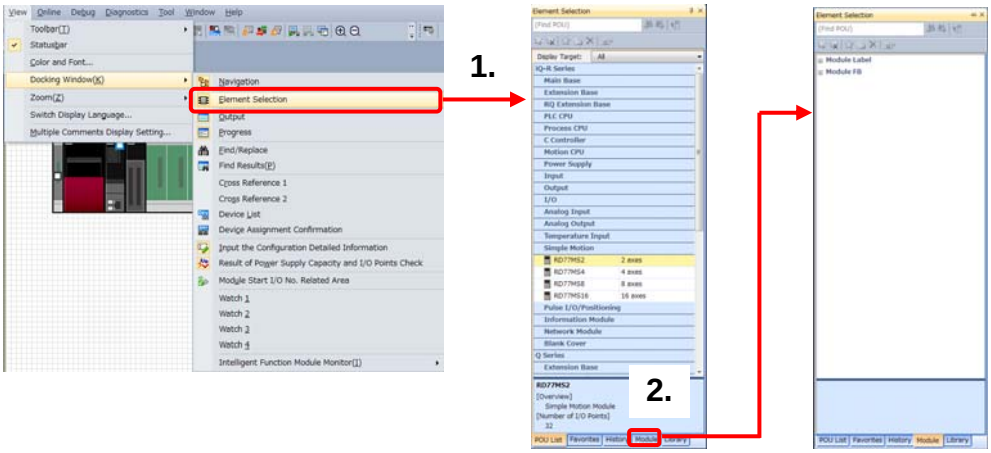
<Global label setting examples>

Label Name	Data type	Class	Device	Description
bDuringJOGInchingOperation	Bit	VAR_GLOBAL	M81	JOG/Inching Operation flag
bJogEND	Bit	VAR_GLOBAL	M82	JOG End Flag
bJogOK	Bit	VAR_GLOBAL	M83	JOG OK flag
bJogERR	Bit	VAR_GLOBAL	M84	JOG Error flag
bStartEND	Bit	VAR_GLOBAL	M85	Positioning Start Operation flag
bStartOK	Bit	VAR_GLOBAL	M86	Positioning Start OK
bStartERR	Bit	VAR_GLOBAL	M87	Positioning Start Error
bPositioningStartReq	Bit	VAR_GLOBAL	M80	Positioning Start Request
iAxisNo	Word [with signs]	VAR_GLOBAL	D14	Axis No
uwPositioningStartNo	Word [with signs]	VAR_GLOBAL	D16	Positioning Start No
i_JogSpeedData	Double word [with signs]	VAR_GLOBAL	D10	Jog Speed data memo
uwErrId	Word [with signs]	VAR_GLOBAL	D12	JOG Error code
bJogSpeedReq	Bit	VAR_GLOBAL	X60	JOG Speed Req
bAxis1	Bit	VAR_GLOBAL	X61	Axis 1
bAxis2	Bit	VAR_GLOBAL	X62	Axis 2 (Note-1)
bHomePositionData	Bit	VAR_GLOBAL	X63	Home Position return Data
bPositioningStartData	Bit	VAR_GLOBAL	X65	Positioning Start Data
bSyncPosiStartData	Bit	VAR_GLOBAL	X66	Synchronous Positioning Start data
bJogForwardReq	Bit	VAR_GLOBAL	X6E	JOG Forward Start req
bJogReverseReq	Bit	VAR_GLOBAL	X6F	JOG Reverse Start Req
bStartpositioning	Bit	VAR_GLOBAL	X71	Start Positioning req
bServoON	Bit	VAR_GLOBAL	X7B	Servo ON req
bErrorReset	Bit	VAR_GLOBAL	X7E	Error reset
bStopSwitch	Bit	VAR_GLOBAL	X7F	Stop
bSynchronous	Bit	VAR_GLOBAL	X7D	Synchronous Axis Set

(Note-1): The labels above are for the synchronous control system in Chapter 4.

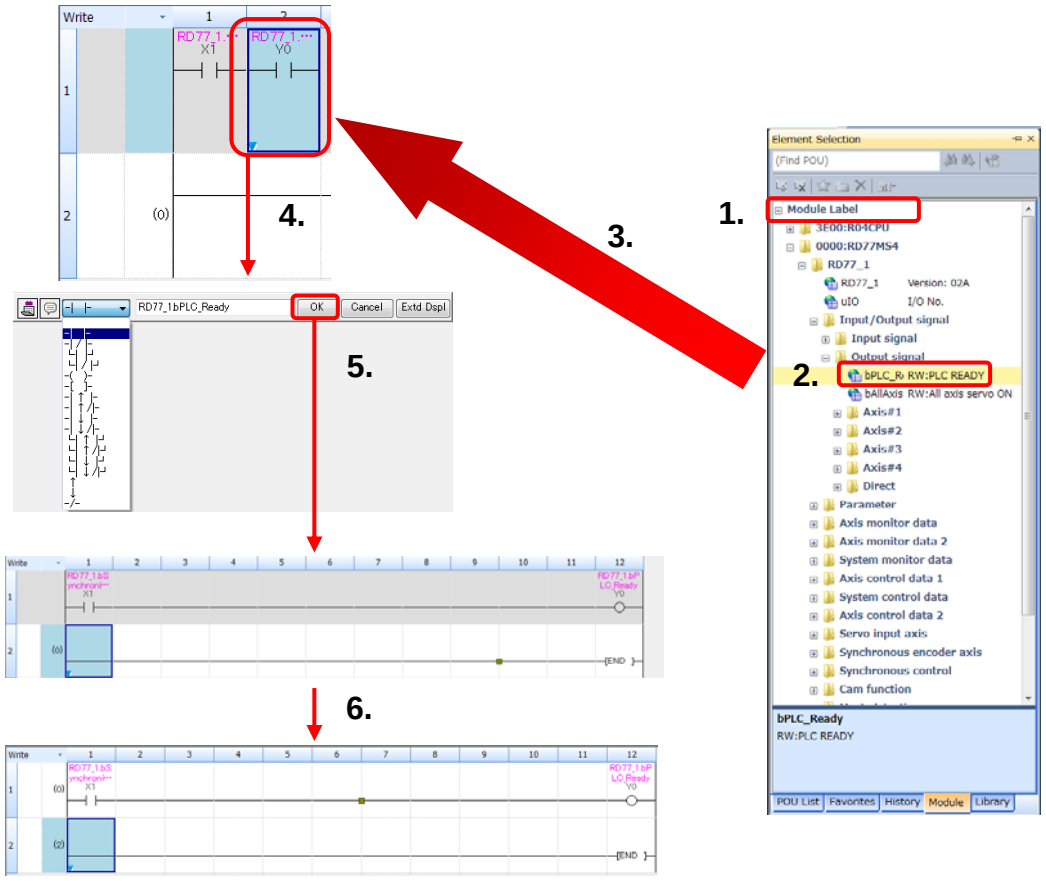
(4) Element selection window

1. Select [View] → [Docking Window] → [Element Selection].
2. Select [Module] tab in the Element Selection window, and Module Label and Module FB are displayed.



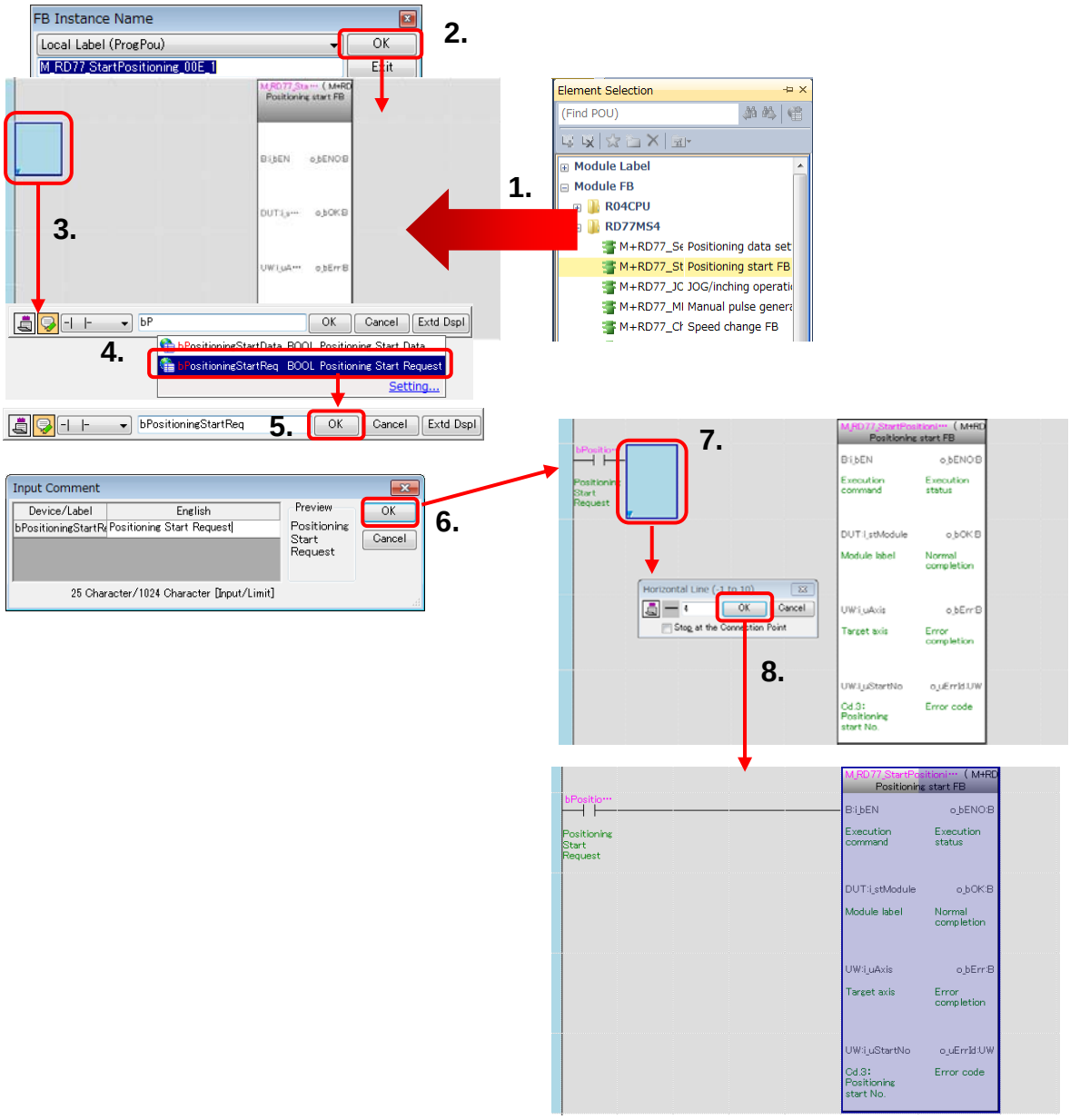
(5) Sequence program creation with module labels

1. Select [Module Label].
2. Select a label from the module label list.
3. Drag & drop the module label.
4. Change the contact to an arbitrary contact or coil by double-clicking it.
5. Click [OK] to create a circuit.
6. Select [Convert] → [Convert] in the menu.

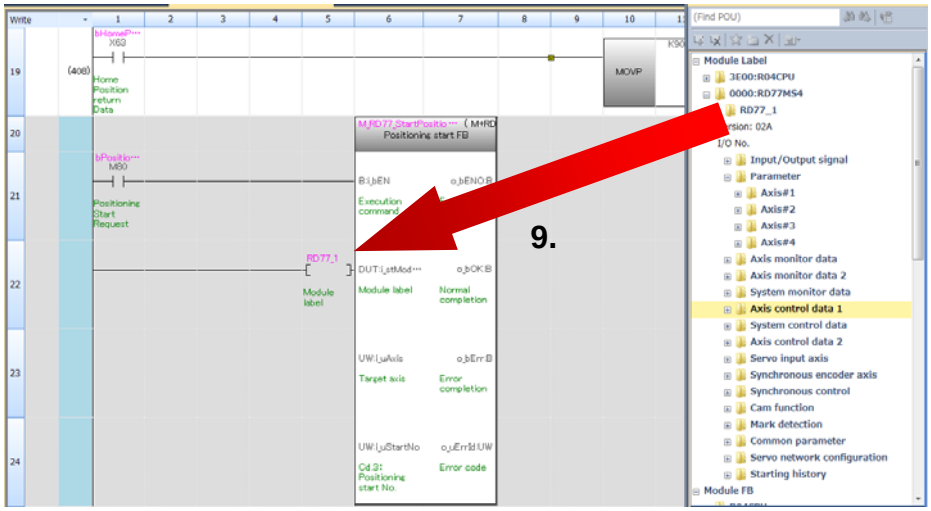


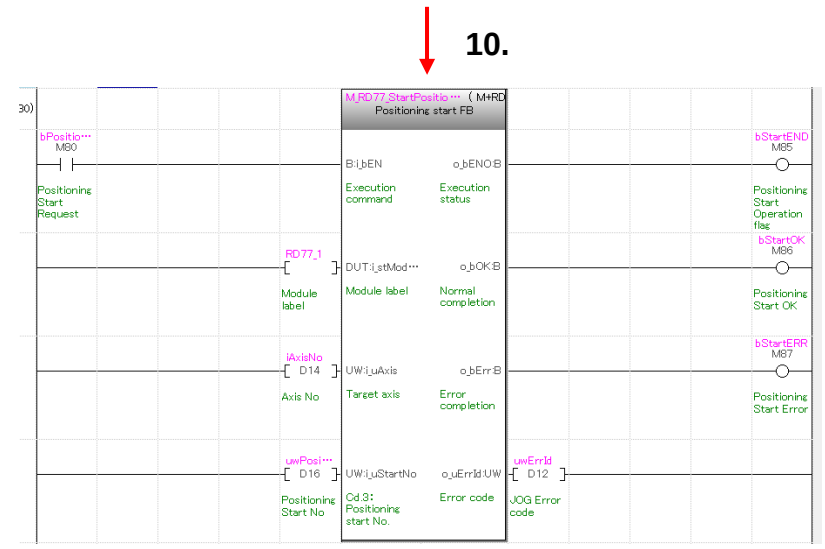
(6) Sequence program creation with module FB

1. Drag & drop a necessary module FB.
2. "FB Instance Name" window appears.
   Select whether the instance is registered as a global label or a local label, and input an instance name.
3. Double click on where a circuit addition is made.
4. Select a circuit symbol, and enter variables.
5. Click [OK], and the “Input Comment” window appears.
6. After inputting comments, click [OK].
7. Move the cursor to where the circuit is added, and double click there.
8. Click [OK], and the circuit is created.



9. Drag & drop "RD77_1" in the [Module Label]. The module label is written.
10. Create another circuit in the same manner and select [F4 (convert)].
    The circuits are converted.

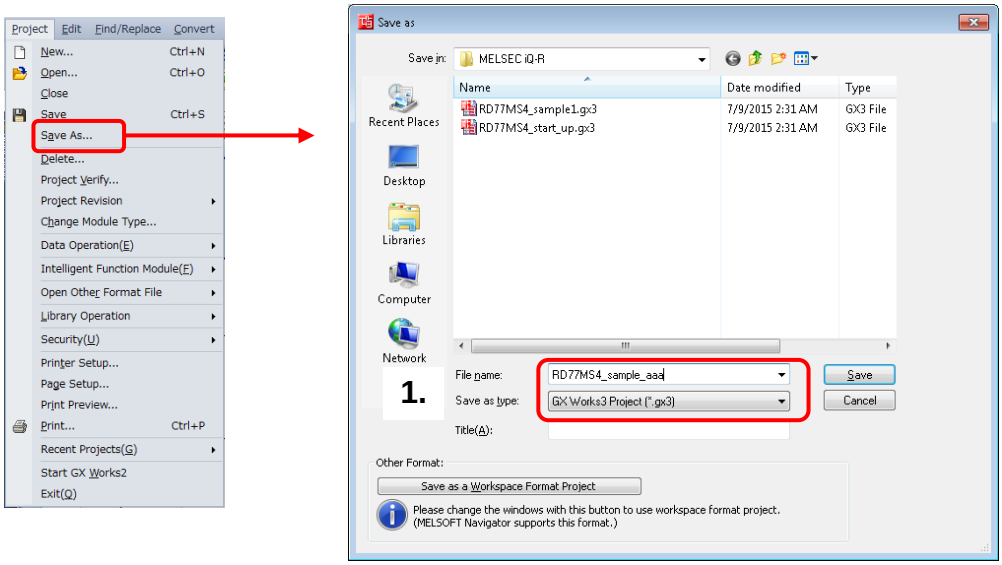




(7) Saving a project

Save a created project.

1. Select [Project] → [Save as], and click [Save] after entering the file name.



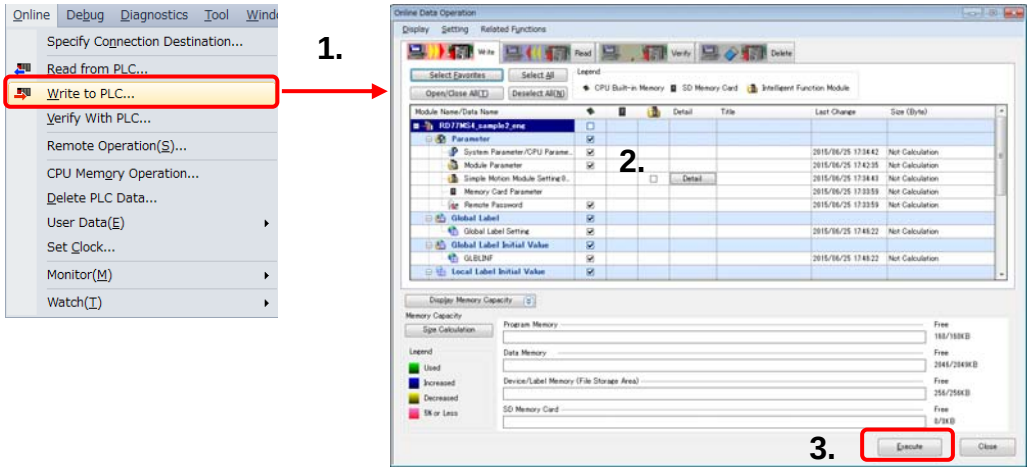
[Saving data]

- Parameters and sequence programs of the PLC CPU
- Positioning data and parameters of the Simple Motion module
- Parameters of servo amplifiers

(8) Writing to PLC CPU

Write set parameters and created programs to the PLC CPU.

1. Select [Online] → [Write to PLC CPU] to open the Online Data Operation window.
2. Check the boxes of System parameter/CPU parameter, Module parameter, and Program.
3. Click [Execute] to start writing the selected items to the PLC CPU.
4. Click [Close] after completion of the writing.

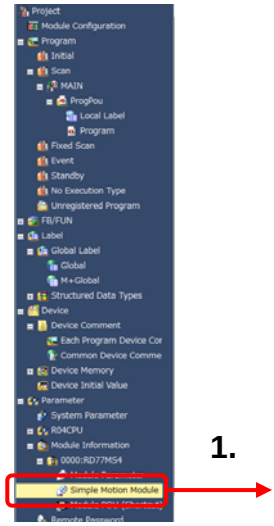


3.3 Parameter Settings for Simple Motion Module

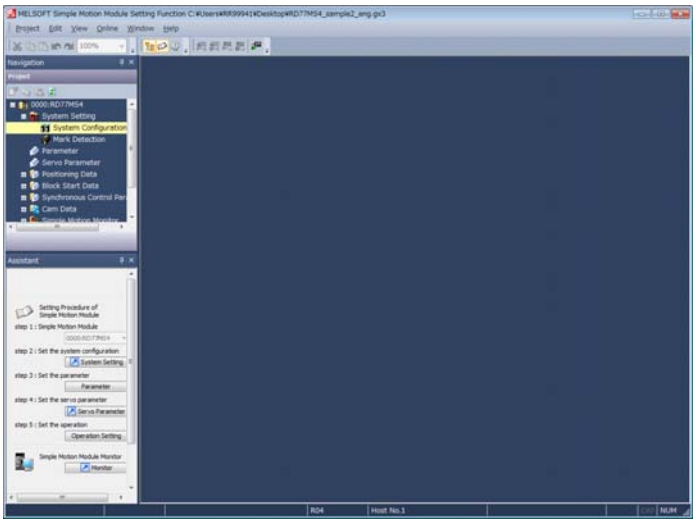
(1) Start of Simple Motion module setting function

1. Double click [Simple Motion Module Setting] in the menu of MELSOFT GX Works3 to open the Simple Motion Module Setting Function window.

GX Works3 Menu

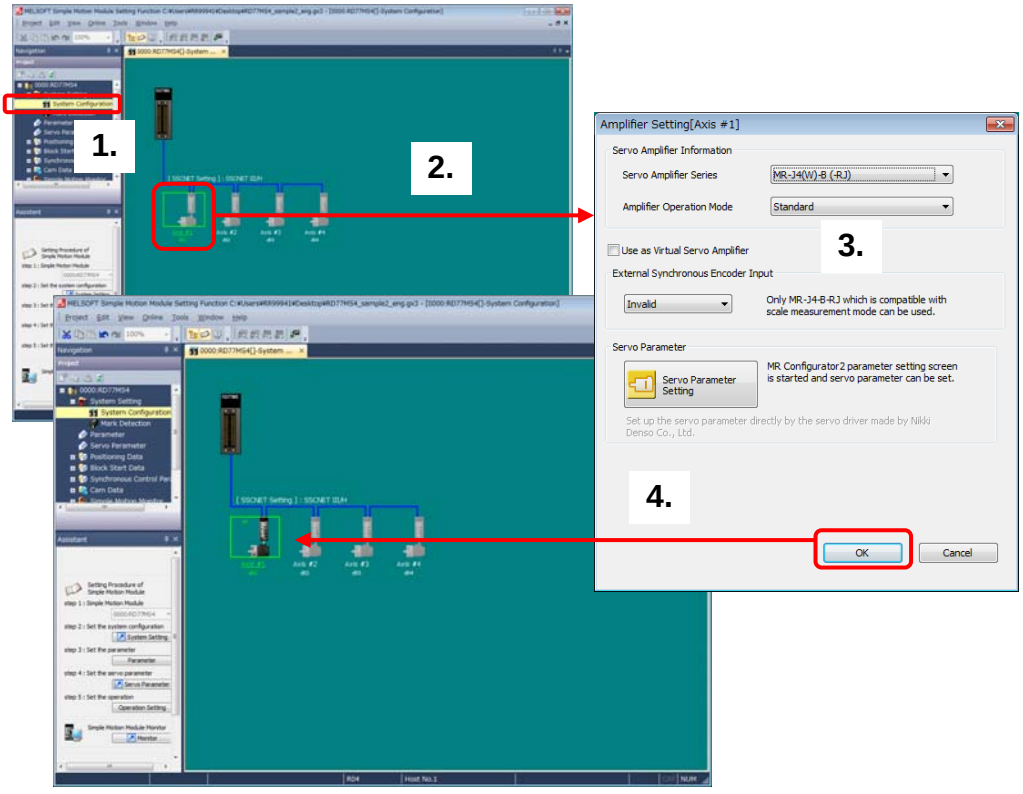


[Simple Motion Module Setting Function]



(2) System settings

1. Select the [System Configuration].
2. Set the servo amplifiers according to the machine.
3. Set the details of servo amplifiers.
4. Click [OK], then the set servo amplifier is colored.



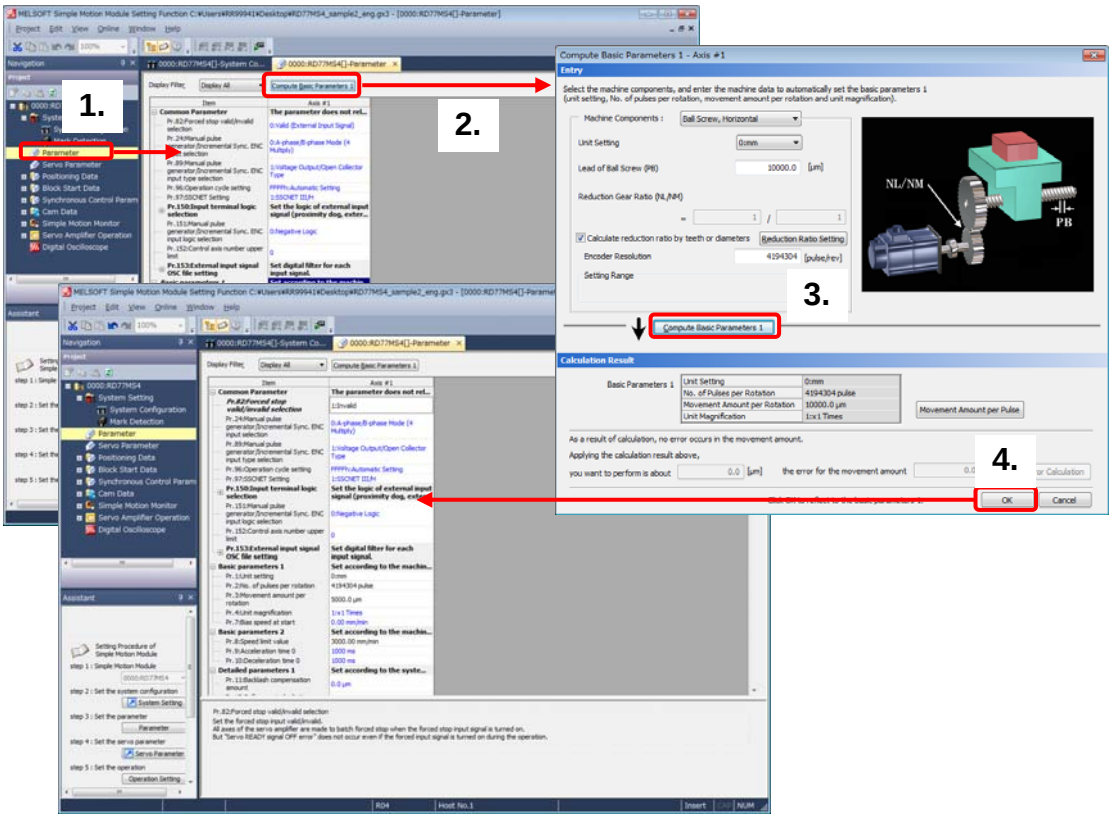
(3) Parameter settings

[Equipment specifications]

Machine configuration	: Horizontal ball screw
Unit setting	: 0: mm
Ball screw pitch	: 10000.0 [μm]
Reduction ratio (NL/NM)	: 1/2 (Load side [NL]/Motor side [NM]) The load-side ball screw is made to rotate once by rotating the motor twice.
Encoder resolution	: 4194304 [pulse/rev]
Servo amplifier	: MR-J4-10B
Servo motor	: HG-KR series

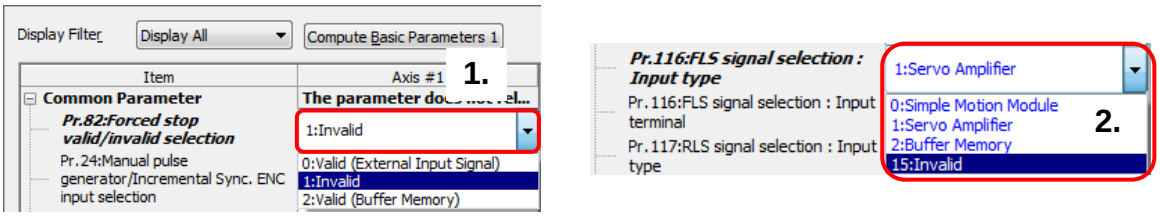
[Operation procedure]

1. Select [Parameter] in the Menu.
2. Click [Compute Basic Parameters 1] to open the electronic gear calculation screen.
3. Set the parameters according to the machine specification. After the setting, click [Compute Basic Parameters 1] to calculate the electronic gear.
4. Click [OK] to write the electronic gear data to the parameters.



POINT

1. Set [Pr.82 Forced stop valid/invalid selection] to "1: Invalid".
   [Pr.82 Forced stop valid/invalid selection] is set to “valid” as default for safety. Since the machine does not use forced stop, change it to "1: Invalid".
2. Set the "Input type" in [Pr.116 FLS signal selection], [Pr.117 RLS signal selection], [Pr.118 DOG signal selection], and [Pr.119 STOP signal selection].
   Select "15: Invalid" since the machine does not use Data set method, FLS, RLS, and STOP for home position return.

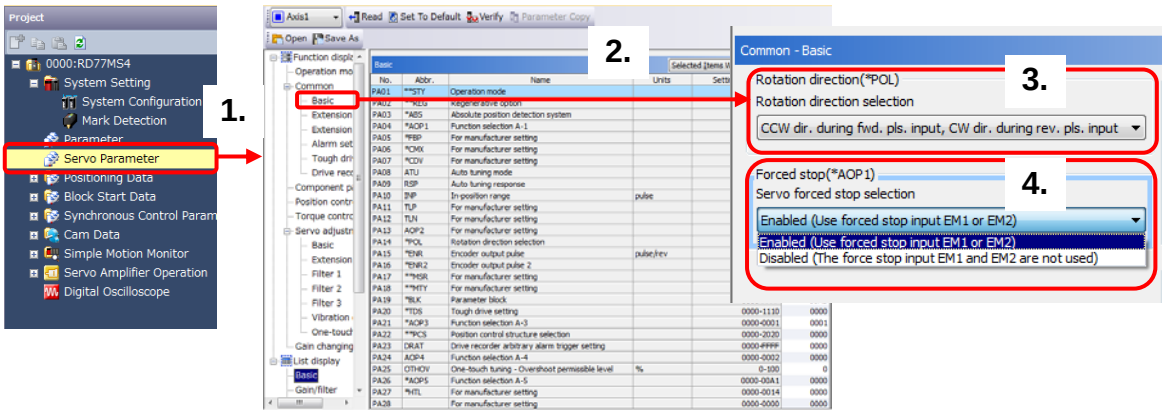


Set common/basic/detailed/home position return/expansion parameters where necessary.
(Refer to Appendix 2 for setting examples.)

(4) Servo parameter settings

[Operation procedure]

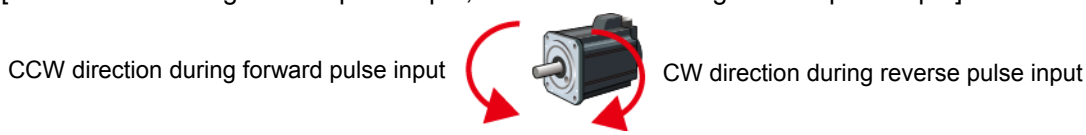
1. Select [Servo parameter] in the menu.
2. Click [Basic] in the menu to open [Common - Basic].



3. Set [Rotation direction].

POINT

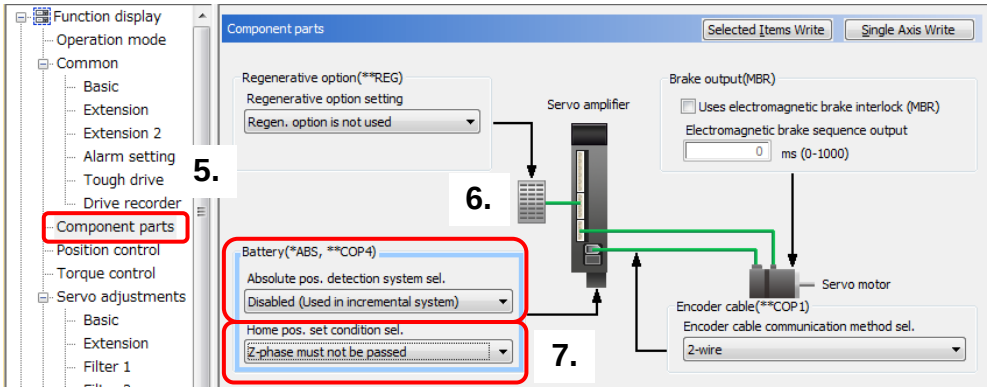
Set rotation direction according to the machine.
Select from [CCW direction during forward pulse input, CW direction during reverse pulse input], or [CW direction during forward pulse input, CCW direction during reverse pulse input].



4. Set the Servo forced stop selection to "Disabled".

POINT

The "Servo forced stop selection" sets whether to read forced stop input signals via servo amplifiers. This parameter is set to "Enabled (Use forced stop input EM2 or EM1.)" as default for safety.
If an error occurs on mechanical system due to crush, etc., establish the absolute position after adjusting the error and ensuring safety. Since the machine in this section does not use forced stop, change it to "1: Disabled".



5. Select "Component parts" to open the Component parts window.
6. [Absolute position detection system/Incremental system selection]
   Select "Disabled (Used in incremental system)" for absolute position detection system selection.
7. For home position setting condition, select "1: Not need to pass servo motor Z-phase after power on".

POINT

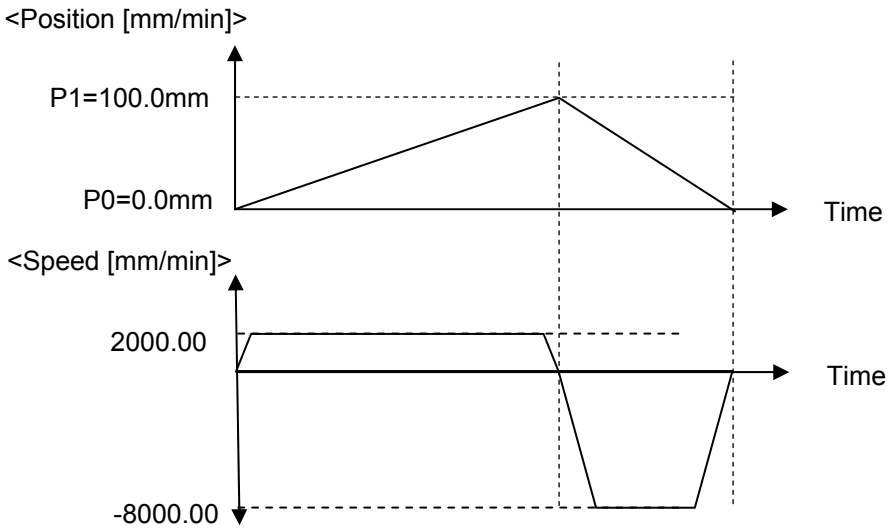
When "1: Not need to pass servo motor Z-phase after power on" is selected, the home position return can be executed without waiting for the motor to rotate one time or more.

Set servo parameters where necessary.

(5) Positioning data setting

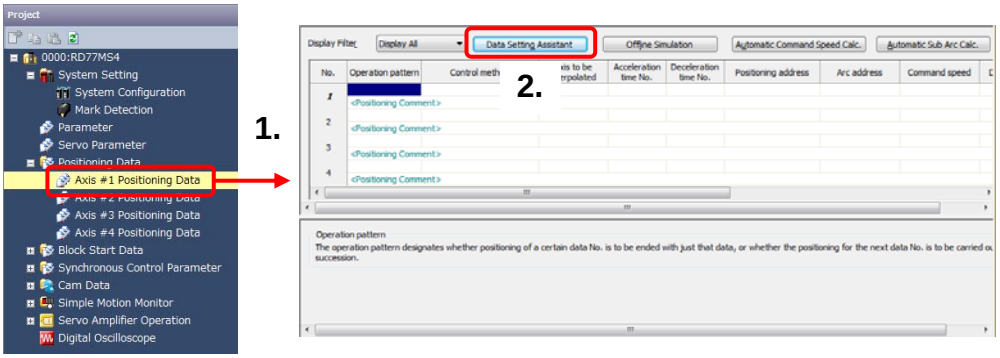
The following explains how to set positioning data through a program example in which the axis travels from the home position (P0) to P1 back and forth.

[Operation example when the axis moves back to the home position (P0) after moving to P1]

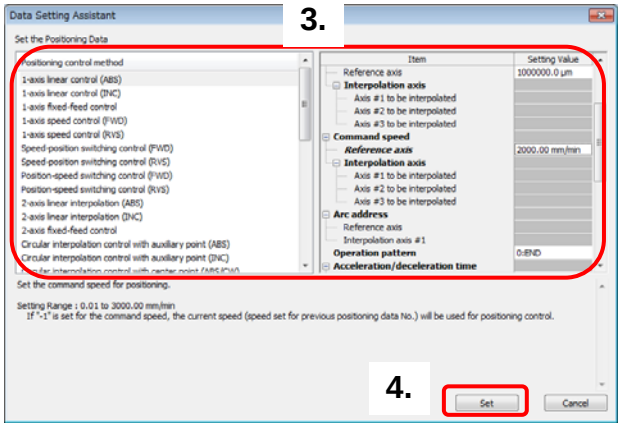


[Operation procedure]

1. Select "Axis #1 Positioning Data" in the menu.

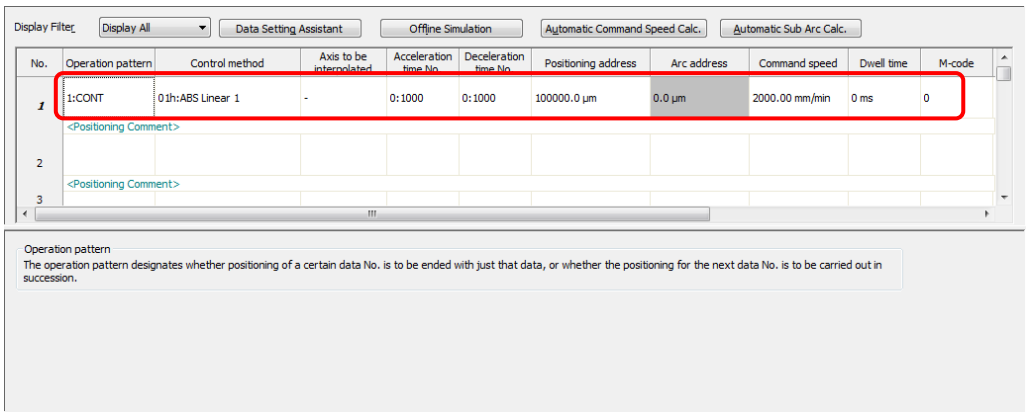


2. Select [Data Setting Assistant].
3. Select the positioning control method, and input each item.



Positioning control method: 1-axis linear control (ABS)
Positioning data No.: 1
Positioning address: 100000.0 μm
Command speed: 2000.00 mm/min
Operation pattern: 1: CONT
Acceleration time No.: 0:1000
Deceleration time No.: 0:1000
Dwell time: 0:0 ms
M-code: 0

4. Click [Set]. The Data Setting Assistant window closes, and the positioning data window appears.



Create the positioning data in the same manner for the axis moving back to the home position from P1.

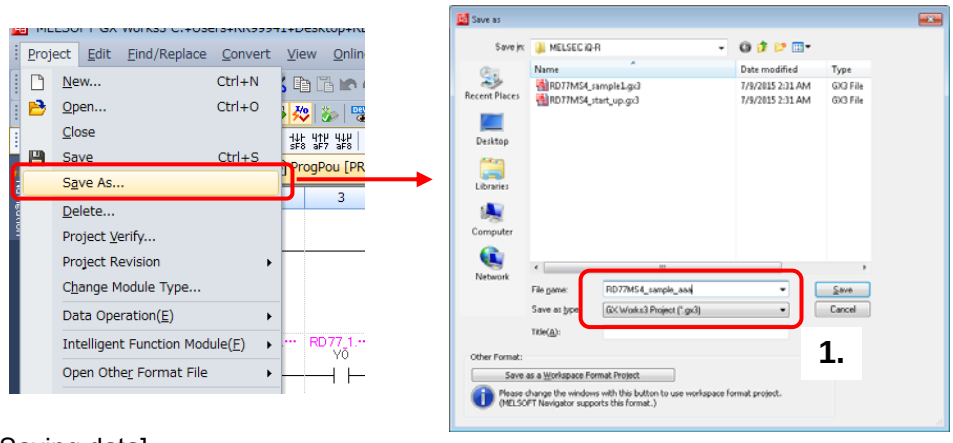
No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed	Dwell time	M-code
1	1: CONT	01h:ABS Linear 1	-	0:1000	0:1000	100000.0 µm	0.0µm	2000.00 mm/min	0ms	0
2	0: END	01h:ABS Linear 1	-	0:1000	0:1000	0.0 µm	0.0µm	8000 mm/min	0ms	0

5. Positioning data creation is completed.

(6) Saving a project

Save a created project.

1. Select [Project] - [Save As]. Input a file name, and click [Save].

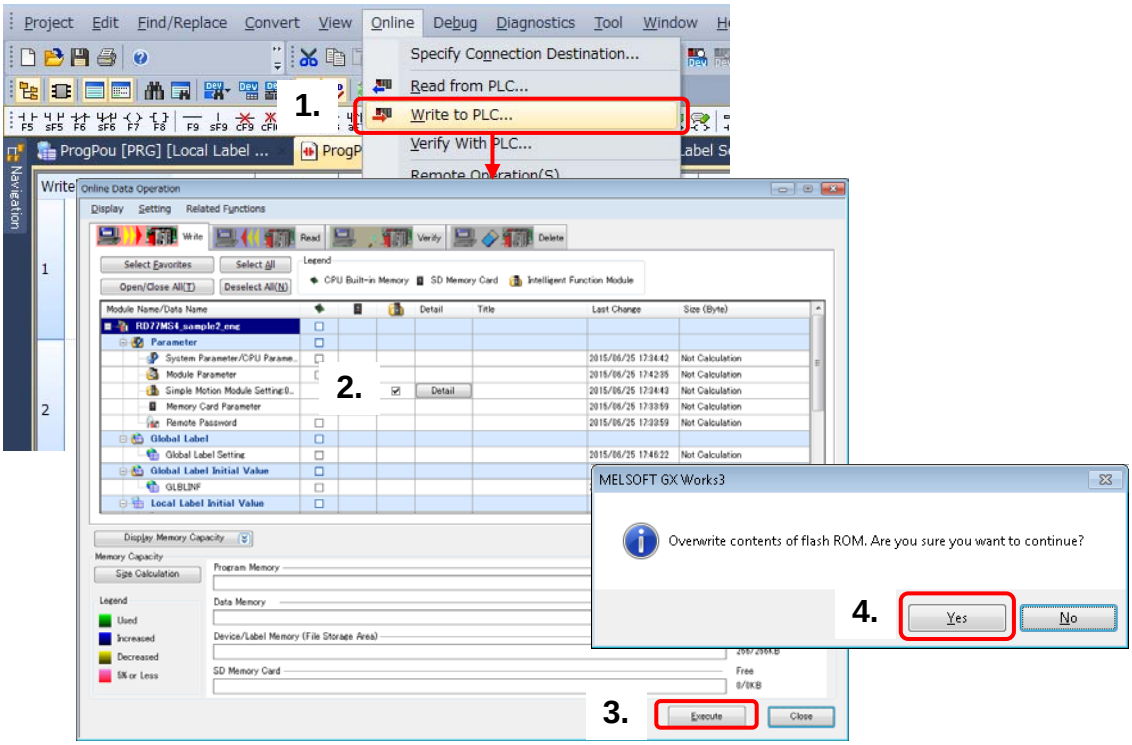


[Saving data]

- Parameters and sequence programs of the PLC CPU
- Positioning data and parameters of the Simple Motion module
- Parameters of servo amplifiers

(7) Writing to the Simple Motion module

1. Select [Online] → [Write to PLC…] to open the Online Data Operation window on MELSOFT GX Works3.
2. Select the Simple module setting.
3. Click [Execute]. Then, the parameters and data are written to the Simple Motion module via the PLC CPU.
4. The confirmation message window for flash ROM overwriting appears. Click [Yes].
5. Click [Close] to complete the writing to the Simple Motion module.



[Writing data to the Simple Motion module]

- Parameters and servo parameters
- Positioning data and block start data
- Synchronous control parameters and cam data

3.4 Operation Check

The sequence program used in this section is an example using R04CPU and RD77MS4. When another different module is used, the signal assignment differs. Refer to MELSEC iQ-R Simple Motion Module User's Manual (Application) for details of each signal.

3.4.1 JOG operation

(1) Servo ON

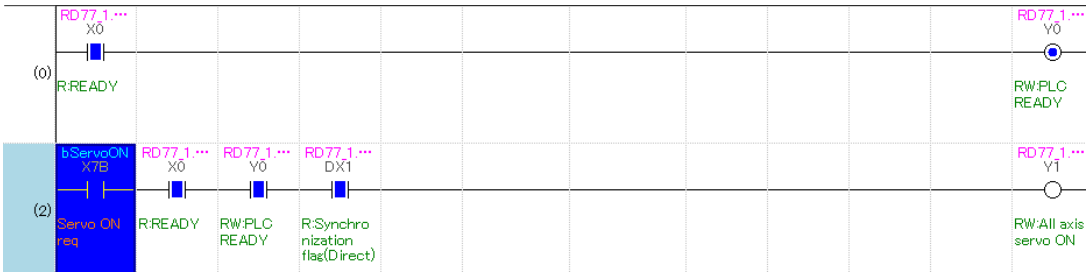
Servo amplifiers become servo ON status by turning ON [All axis servo ON (Y1)].

1. Move the PLC CPU switch (RESET/RUN/STOP) to RUN side.
2. Servo ON by a sequence program

   Select [Online] → [Monitor] → [Start Monitoring] to switch to the monitoring status.

   Move the cursor to the Servo ON req (X7B).

   Servo ON req (X7B) is turned ON by double clicking it while pressing SHIFT key.



POINT

Double-clicking a device while pressing SHIFT key changes the status of the device from OFF to ON, and vice versa.

(2) JOG speed settings

Turn ON the JOG Forward Start req and the JOG Reverse start req after setting JOG speed.

1. Double click the "JOG Speed Req" (X60) while pressing SHIFT key.

(3) JOG start

Confirm that the workpiece moves in “+” direction by forward command, and in “-“ direction by reverse command.

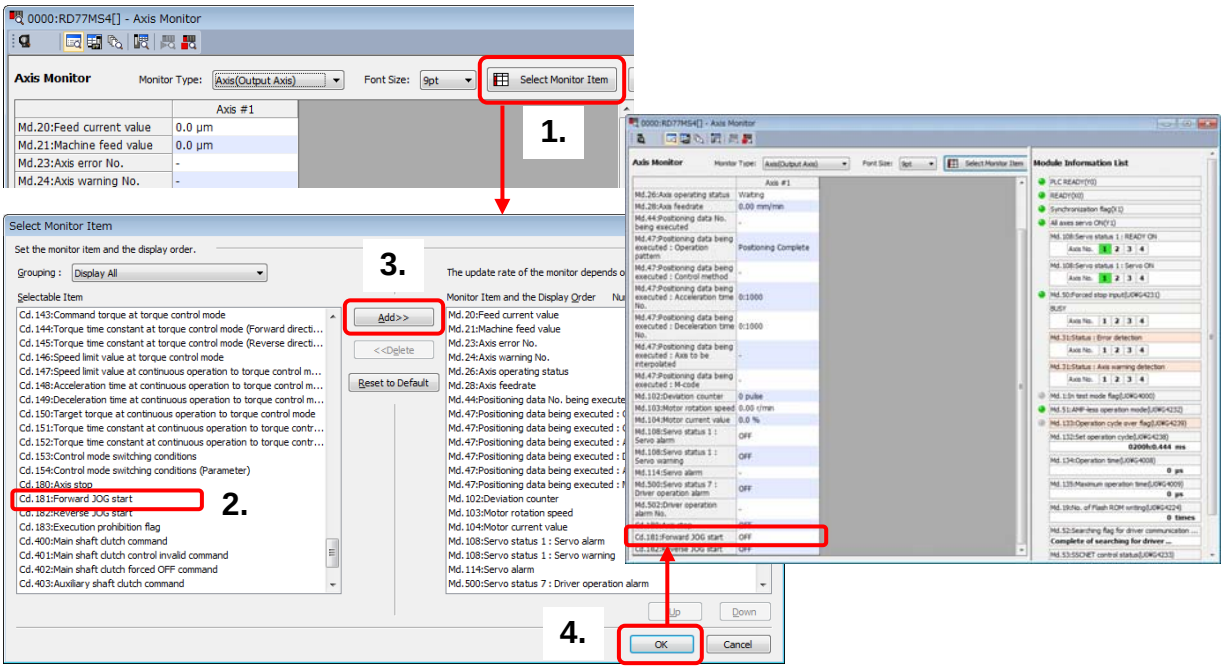
1. Select axis 1 (X61).
2. Select either the JOG Forward Start req (X6E) or the JOG Reverse Start req (X6F).
   Move the cursor to "JOG Forward Start req" or "JOG Reverse Start req", and double click it while pressing SHIFT key.

(4) Confirming JOG operation

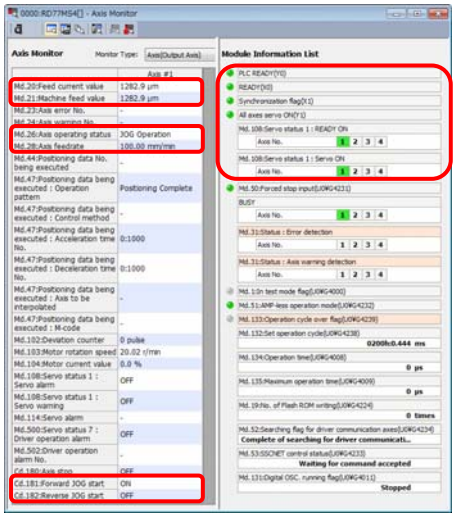
Check the JOG operation on the Axis Monitor window.

Signals, such as Forward JOG start and Reverse JOG start, can be added from the Selectable Items on the Axis Monitor window.

1. Click [Select Monitor Item] on the Axis Monitor window.
2. Select items to be added from the Selectable Item list.
3. Select "Cd.181 Forward JOG start", and click [Add].
4. Click [OK] to go back to the Monitor window.



Check each status on the Axis Monitor window during JOG operation.

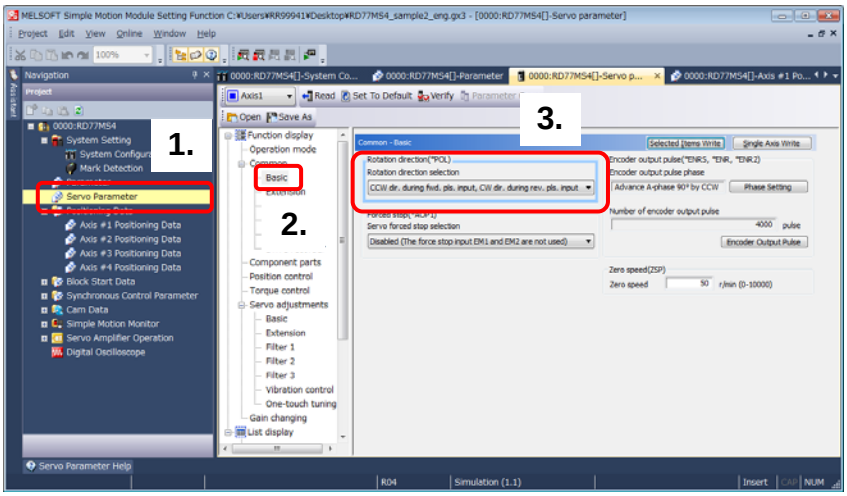


Axis monitor	Checking details
PLC READY (Y0) READY (X0) Synchronization flag (X1) All axes servo ON (Y1)	ON?
Md.20: Feed current value Md.21: Machine feed value	-
Md.26: Axis operating status	JOG operation
Md.28: Axis federate	100.00 mm/min
Md.108: Servo status 1: READY ON Md.108: Servo status 1: Servo ON	ON?
BUSY	Is Axis1 ON?
Cd.181: Forward JOG start Cd.182: Reverse JOG start	Is the starting axis ON?

(5) Confirming the motor rotation direction

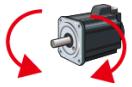
Switch the motor rotation direction to forward/reverse.

1. Select [Servo Parameter].
2. Select [Basic].
3. Select the servo motor rotation direction according to your machine.



POINT

Set the rotation direction according to the machine.
Select from [CCW direction during forward pulse input, CW direction during reverse pulse input], or [CW direction during forward pulse input, CCW direction during reverse pulse input].
After writing servo parameters to the Simple Motion module, cycle the power of both the servo amplifier and the Simple Motion module.

CCW direction during forward pulse input  CW direction during forward pulse input

(6) JOG operation check is completed.

3.4.2 Home position return (Establishment of the home position)

There are two types of home position return control:
- Machine home position return which does not use address information to establish the home position.
- Fast home position return which performs positioning by using the coordinate defined by machine home position.

This document explains the method of performing the machine home position return using Data set method.

After setting "9001" as the positioning start No., the home position return is started by turning ON the Positioning start signal.

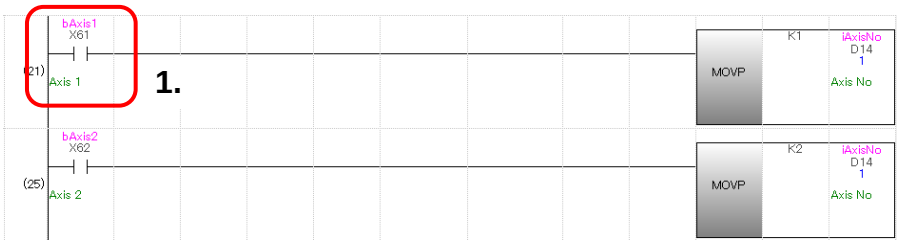
Item	Buffer memory	Signal	Description
Axis 1 positioning start No.	4300	-	Set the positioning start No. Set “9001” for machine home position return.
Axis 1 positioning start	-	Y10	Execute the home position return and positioning start.

POINT

After setting "9001" as the positioning start No., the machine home position return is started by turning ON the Positioning start.

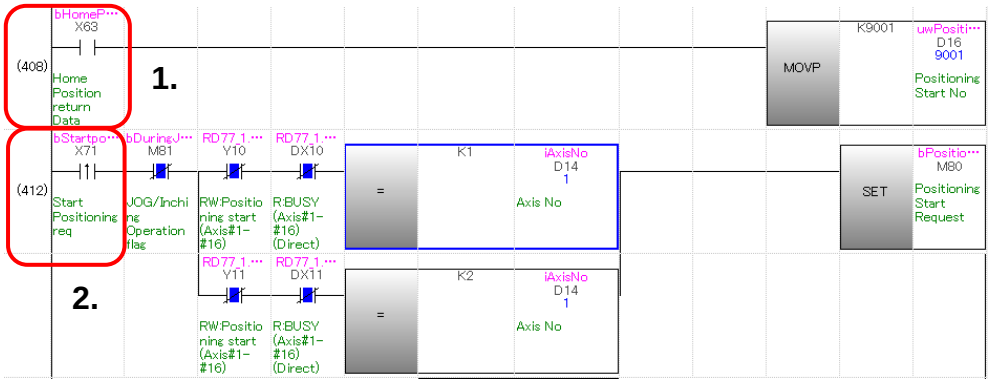
(1) Setting the home position return No.

1. Select the Axis 1. Double click it while pressing SHIFT.



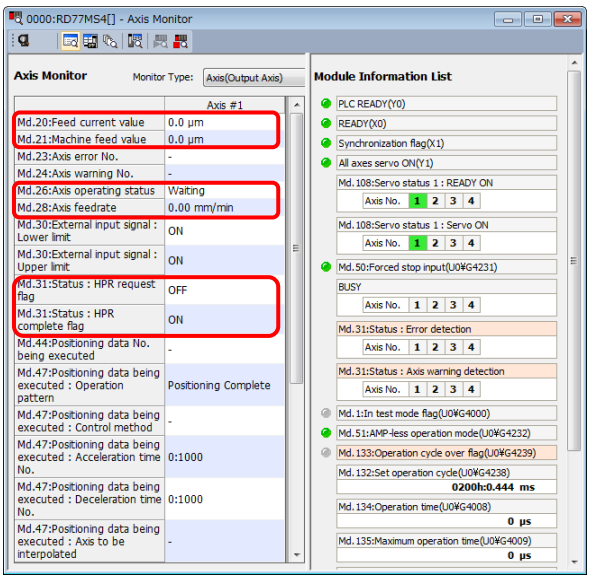
(2) Starting the home position return

1. Set the Positioning start No. (9001) to the buffer memory by double clicking X63 while pressing SHIFT.
2. To start the positioning, double click ”Start Positioning req”.



(3) Confirming the home position return

1. Check the following monitor values and status on the Axis Monitor window.



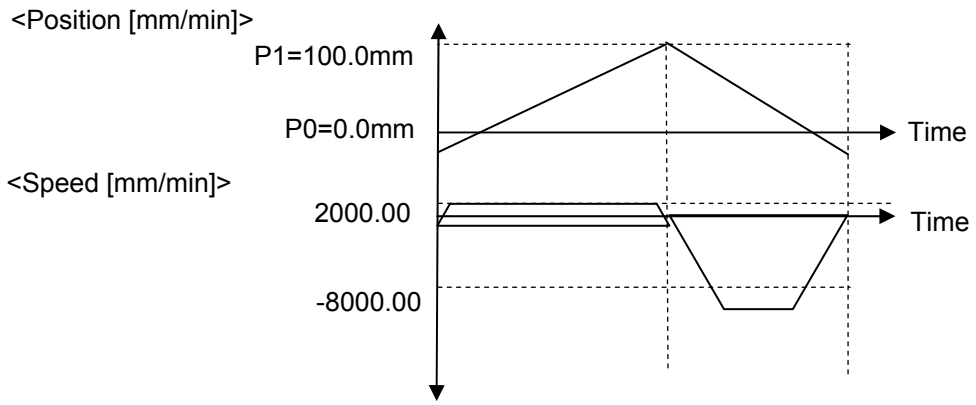
Axis monitor	Checking value
Md.20: Feed current value	0.0 [μm]
Md.21: Machine feed value	0.0 [μm]
Md.26: Axis operating status	Waiting
Md.28: Axis feedrate	0.00 [mm/min]
Md.31: Status: HPR request flag	OFF
Md.31: Status: HPR complete flag	ON

(4) Home position return check is completed.

3.4.3 Positioning control

This section explains the operation check method for positioning control which performs positioning to a specified position using address information.
Positioning is started by a sequence program or a function block.
In this example, positioning control is started by a function block, and synchronous control by a sequence program.

[Operation example when the axis moves back to the home position (P0) after moving to P1]

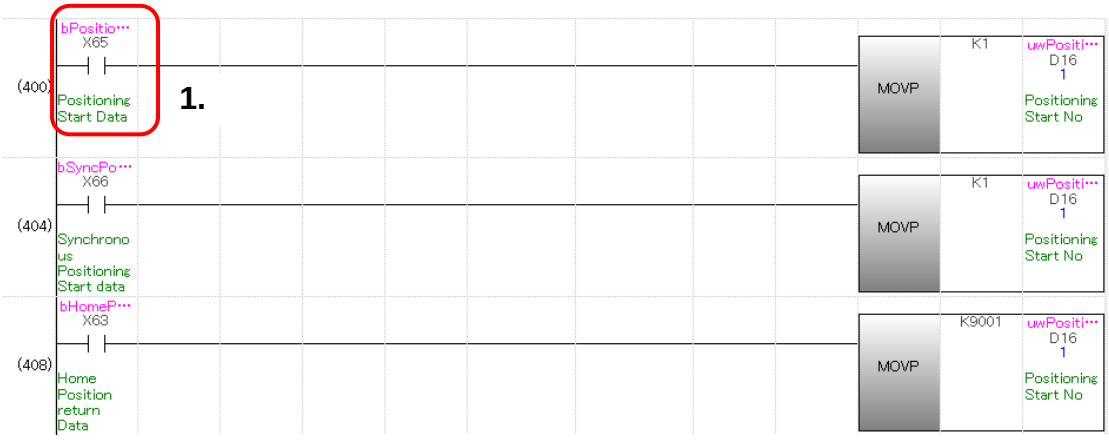


Positioning is started by setting the positioning start No. and turning ON the Positioning start signal.

Item	Buffer memory	Signal	Description
Axis 1 positioning start No.	4300	-	Set the positioning start No.
Axis 1 positioning start	-	Y10	Start the positioning.

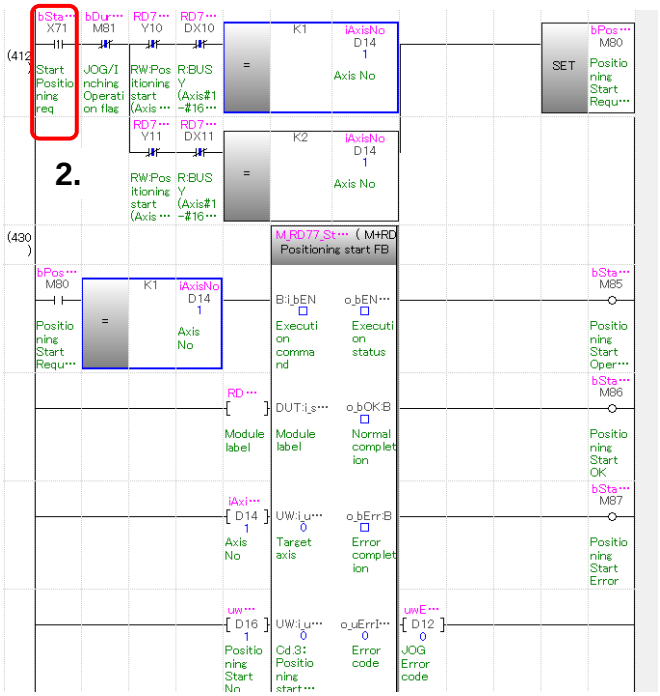
(1) Setting the positioning control start No.

1. Set the positioning start No. Double click the Positioning Start Data (X65) while pressing SHIFT.



(2) Positioning start

2. To start the positioning, double click X71 while pressing SHIFT.

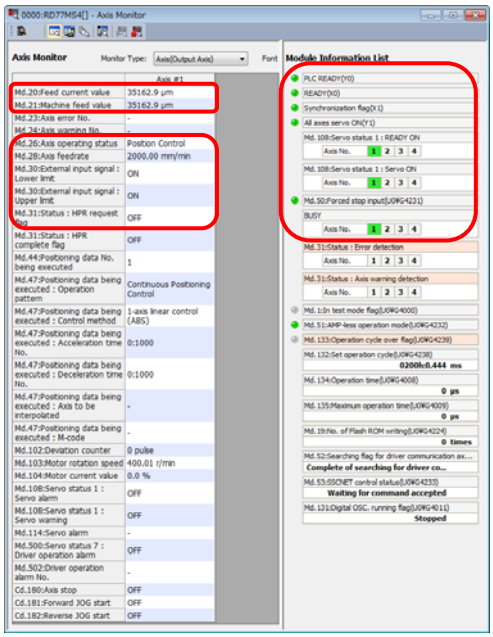


(3) Confirmation of axis 1 positioning control

Check that the axis 1 moves for 100.0 mm and goes back to 0.0 mm through the Feed current value for axis 1 on the Axis Monitor window.

Check that the Axis feedrate for axis 1 is equal to the command speed.

Check each monitor value and status through the Axis monitor.



Axis monitor	Checking details
Md.20: Feed current value	-
Md.21: Machine feed value	-
Md.26: Axis operating status	Position control
Md.28: Axis feedrate	2000.00 [mm/min]
Md.30: External input signal: Lower limit	ON?
Md.30: External input signal: Upper limit	ON?
Md.31: Status: HPR request flag	OFF?

Module information	Checking details
PLC READY (Y0) READY (X0) Synchronization flag (X1) All axes servo ON (Y1)	ON?
BUSY	Is the starting axis ON?

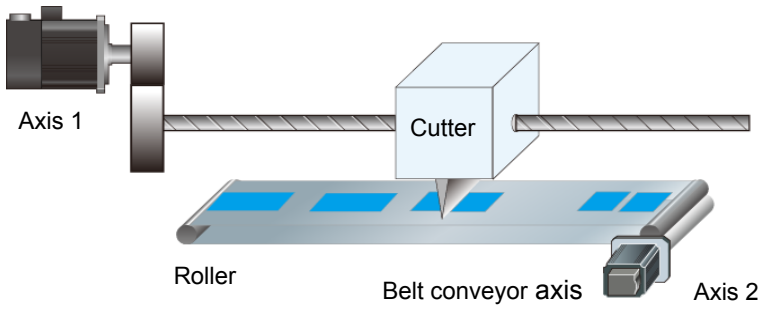
(4) Positioning operation check is completed.

4. SYNCHRONOUS CONTROL STARTUP

This chapter describes synchronous control, mainly about the synchronous control parameter, positioning data for synchronous control, and operation check for synchronous control.
Axis 1 operation is the same as that described in Chapter 2.
Refer to Chapter 2 to 3 for details of the parameters and servo parameters.

<Flying Cutter>

Without stopping the conveyor axis (axis 2), cutter axis (axis 1) synchronizes to the movement of the conveyor belt and cuts the work piece evenly in half. After the cut, the cutter axis returns to the wait position. Synchronous control with electronic cam operation is used for the cutter axis.



<Specification>

A one-time belt conveyor rotation generates the conveyor movement for one work piece.

(1) Cutter axis (cam control axis) specification

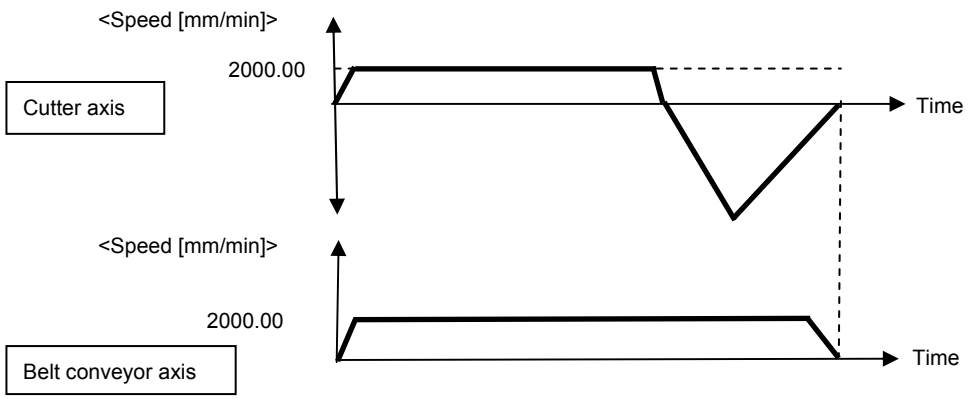
Ball screw lead (PB): 10 mm
Gear ratio of the external reducer: 1/2
Cam stroke amount: 100.0000 mm

(2) Belt conveyor axis specification

Roller diameter: 50 mm (Roller circumference 50mm × π = 157079.6μm)
Gear ratio of the external reducer: 1/1 (Directly connect the servo motor to the roller)

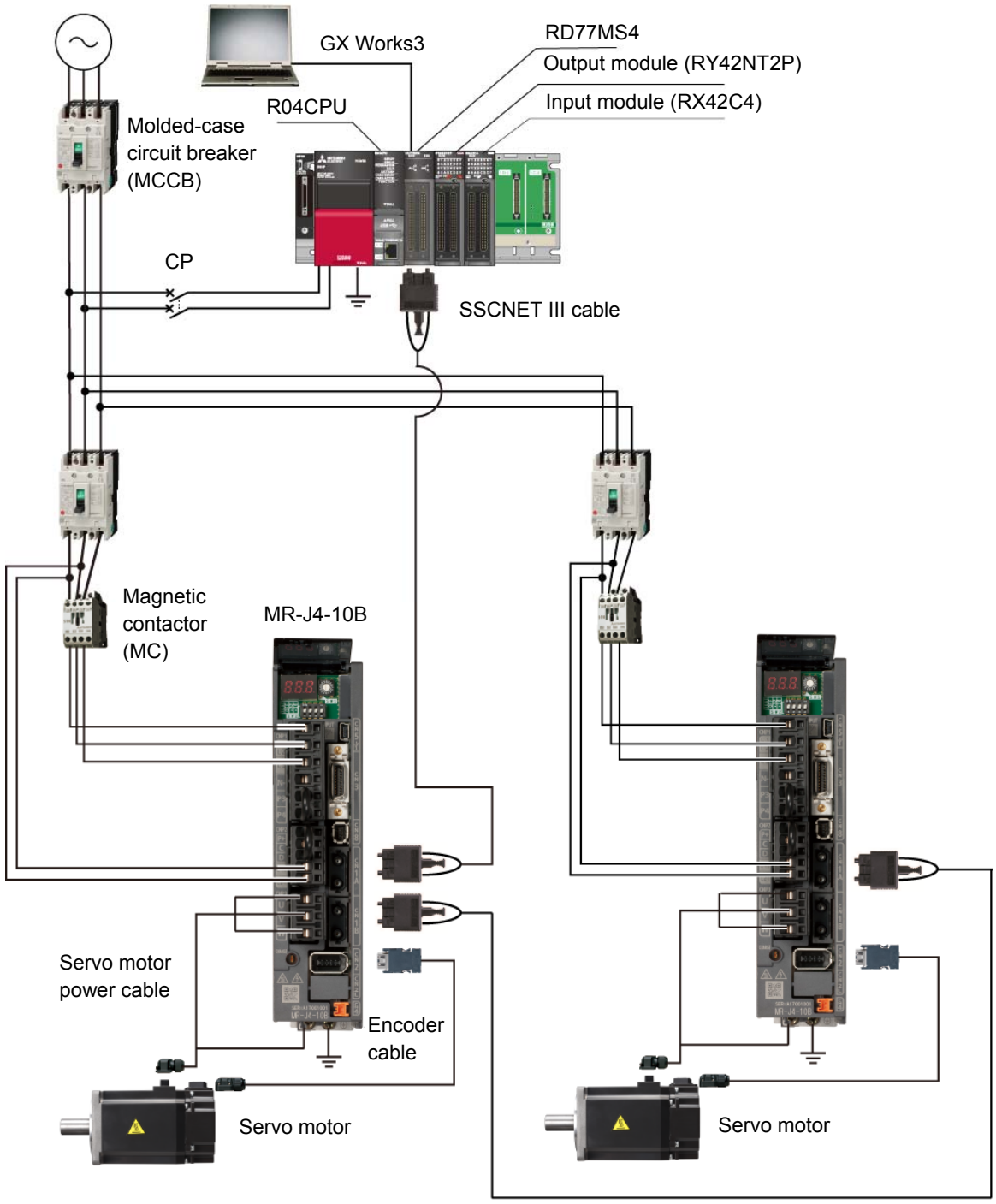
<Machine operation pattern>

The cutter axis (axis 1) moves for certain distance while synchronizing to the belt conveyor movement.
The cutter goes down in synchronization with the conveyor by sequence control, and the cutter returns to the original position after the synchronization.
The belt conveyor moves at a constant speed.



4.1 System Configuration

The following shows a system example consisting of the RD77MS, MR-J4-10B, and servo motors.



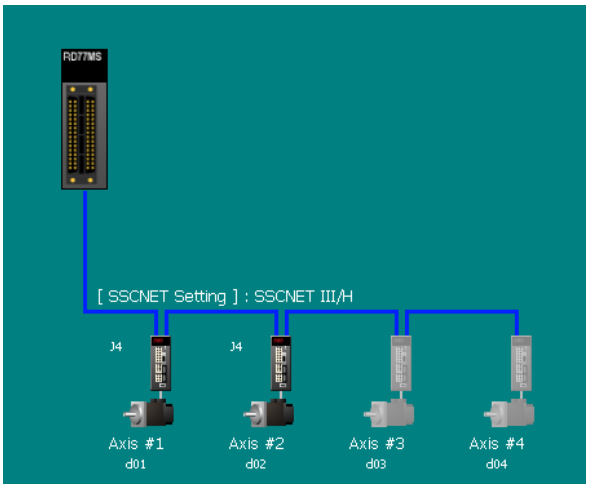
4.2 Startup Procedure for Synchronous Control

4. SYNCHRONOUS CONTROL STARTUP
4.1 System configuration
4.2 Startup procedure for synchronous control
4.3 Parameter creation for synchronous control
4.3.1 System configuration settings
4.3.2 Parameters and servo parameters settings
4.3.3 Positioning data settings
(1) Positioning data selection
4.3.4 Synchronous control parameter settings
(1) Synchronous parameter settings
(2) Input axis parameter settings
(3) Transition of synchronous control parameter window
(4) Settings for synchronous control parameters and input axis parameters are completed.
4.3.5 Cam data creation
(1) Creating a new cam data
(2) Cam curve creation
4.3.6 Saving a project
4.3.7 Writing to the Simple Motion module
4.4 Operation check for synchronous control
4.4.1 Home position return
4.4.2 Synchronous control start
(1) Start and confirmation of output axis to be synchronized
(2) Start and confirmation of the main shaft (input axis)
(3) Operation check for main shaft (input axis)
4.4.3 Operation check with digital oscilloscope
(1) Start of digital oscilloscope
(2) Selecting probe
(3) Sampling condition settings (No need to change)
(4) Trigger condition settings (No need to change)
(5) Start sampling
(6) Checking cam data

4.3 Parameter Creation for Synchronous Control

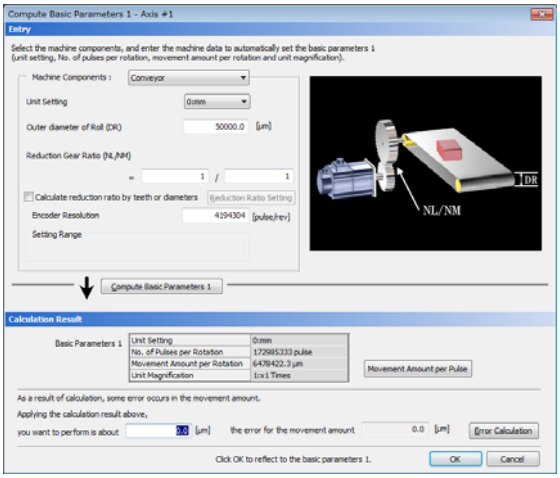
4.3.1 System configuration settings

Configure a 2-axis system.



4.3.2 Parameters and servo parameters settings

Set parameters and servo parameters for axis 1 and axis 2.
The following shows the setting details of the electronic gear setting for the belt conveyor.



[Input]
Machine Components: Conveyor
Unit Setting: 0:mm
Outer diameter of Roll: 50000.0 [µm]
Reduction Gear Ratio (NL/NM)
Load side [NL]: 1
Motor side [NM]: 1
Encoder resolution: 4194304

[Calculation Result]
Unit Setting: 0 mm
Number of Pulses per Rotation: 172985333 pulse
Movement Amount per Rotation: 6478422.3 µm
Unit Magnification: 1: ×1 times

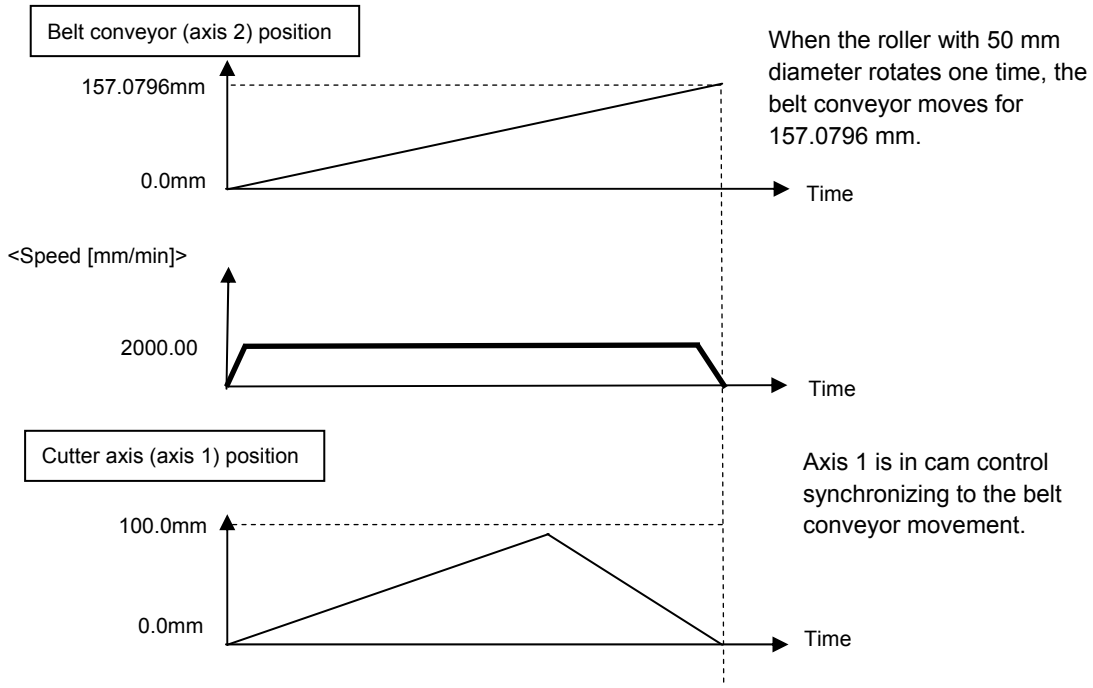
POINT

When the electronic gear value cannot be divided due to circumference ratio π, it will be automatically calculated to the value with less difference.

4.3.3 Positioning data settings

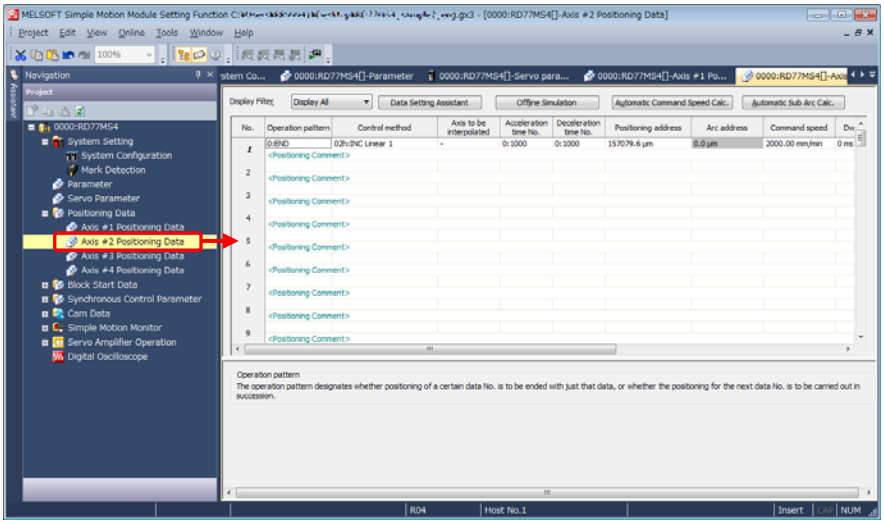
Create a program in which the belt conveyor (axis 2) moves from the home position to P1.
For axis 1 operated with cam control, create cam data in which the axis 1 synchronizes to the belt conveyor.

[Data example in which the axis moves from the home position to P1]



(1) Positioning data selection

Select the Axis # 2 positioning data in the menu.



<Axis 2 positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed	Dwell time	M-code
1	**0: END**	**INC linear 1**	-	1:1000	1:1000	**157079.6 μm**	0.0 μm	**2000.00 mm/min**	0ms	0

4.3.4 Synchronous control parameter settings

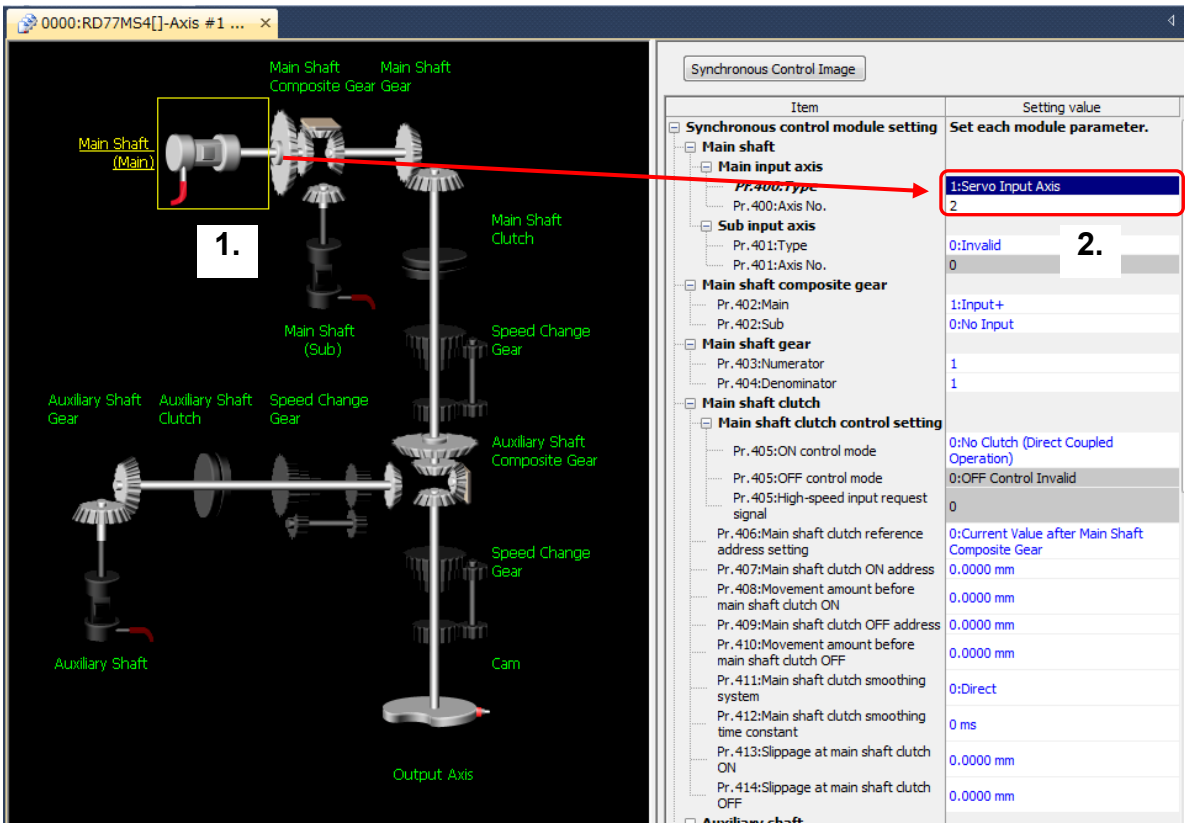
Set parameters for axis 1 which synchronizes to the input axis (axis 2) feed current value in cam operation.

Item	Description
Input axis parameter	Set the servo input axis type for the main shaft. (Set “1: Feed current value ” for axis 2)
Axis 1 synchronous control parameter	Set the axis 1 synchronous control parameter.
Synchronous control image	The configuration of output axes connected to the main shaft is displayed. The configuration of input/output axes can be checked at a glance.

(1) Synchronous parameter settings

The following explains the settings that synchronize the axis 1 to the axis 2 feed current value.

1. Select [Main shaft (Main)], and then the [Type] for the Main input axis is selected.
2. Set [Pr.400 Type] to "1: Servo Input Axis", and [Pr.400: Axis No.] to "2".



3. Change the items with red frames as follows.

<Synchronous parameter axis 1>

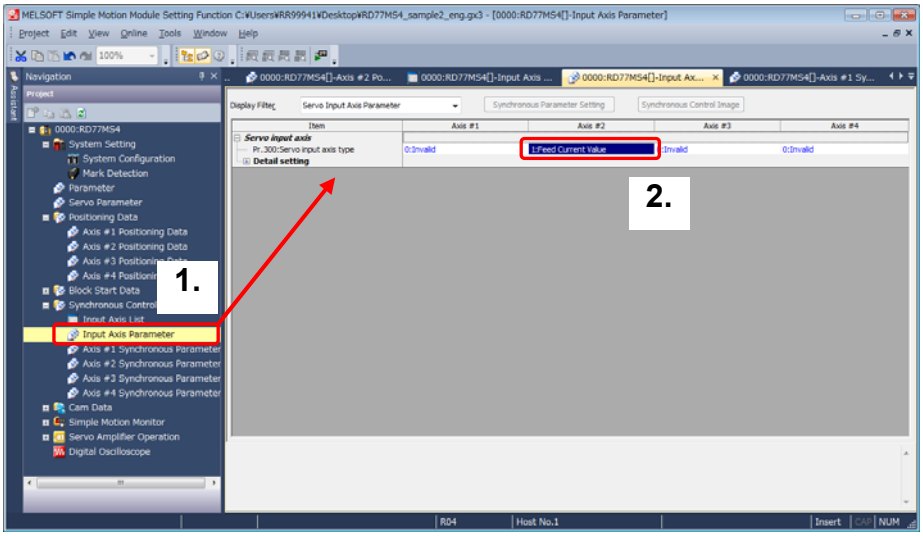
Item			Details
Main shaft	Main input axis No.	Pr.400: Type	**1: Servo input axis**
		Pr.400: Axis No.	**2**
	Sub input axis No.	Pr.401:Type	0: Invalid
		Pr.401: Axis No.	0
Composite main shaft gear	Pr.402: Main		1: Input +
	Pr.402: Sub		0: No input
Main shaft gear	Pr.403: Numerator		1
	Pr.404: Denominator		1
Main shaft clutch	Main shaft clutch control setting	Pr.405: ON control mode	0: No clutch (Direct coupled operation)
		Pr.405: OFF control mode	0: OFF control invalid
		Pr.405: High speed input request signal	0
Output axis	Cam axis cycle unit setting	Pr.438: Unit setting selection	0: Use units of main input axis
		Pr.438: Unit	**0mm**
		Pr.438: Number of decimal places	**0**
	Pr.442: Cam axis length per cycle change setting		0: Invalid
	Pr.439: Can axis length per cycle		**157.0796mm**
	Pr.441: Cam stroke amount		**100000.0μm**
	Pr.440: Cam No.		**1**
	Pr.444: Cam axis phase compensation advance time		0 μs
	Pr.445: Cam axis phase compensation time constant		10 ms
	Pr.446: Synchronous control deceleration time		0 ms
	Pr.447: Output axis smoothing time constant		0 ms

(Note): Items without red frames remain as default values.

(2) Input axis parameter settings

The following explains the settings that synchronize the axis 1 to the axis-2 feed current value.

1. Select [Input Axis Parameter].
2. Select [1: Feed Current Value] for [Pr.300 servo input axis type] for axis 2.



<Input axis parameter (axis 2)>

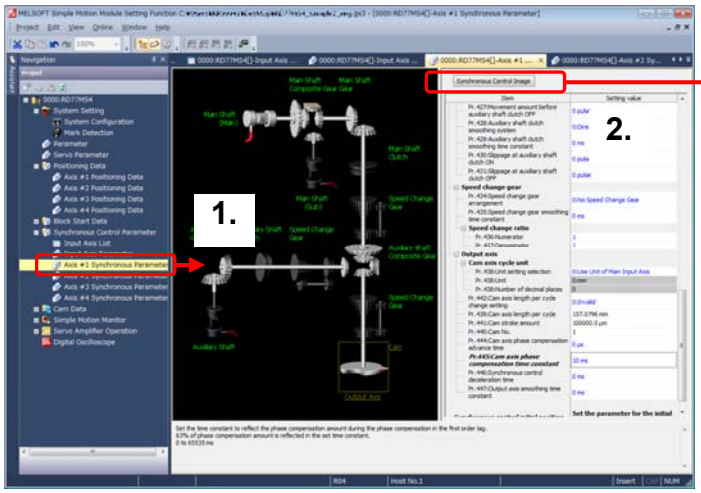
Item			Description
Servo input axis	Servo input axis type		**1: Feed current value**
	Detail setting	Smoothing time constant	0ms
		Phase compensation advance time	0μs
		Phase compensation time constant	10ms
		Rotation direction restriction	0: Without rotation direction restriction

(Note): Items without red frames remain as default values.

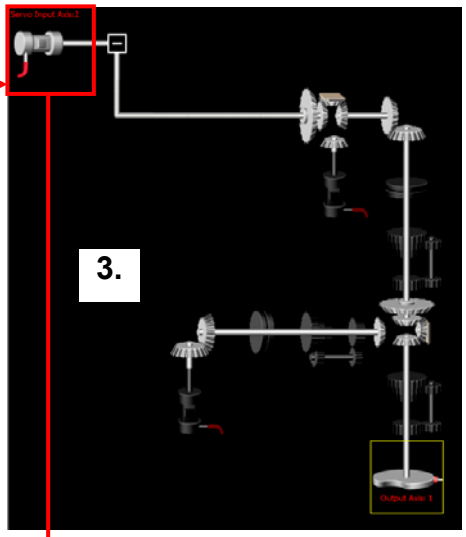
(3) Transition of synchronous control parameter window

1. Select [Axis # 1 Synchronous Parameter] in the menu.
   Then, the axis 1 synchronous parameter can be changed.
2. Click [Synchronous Control Image] to open the image screen.

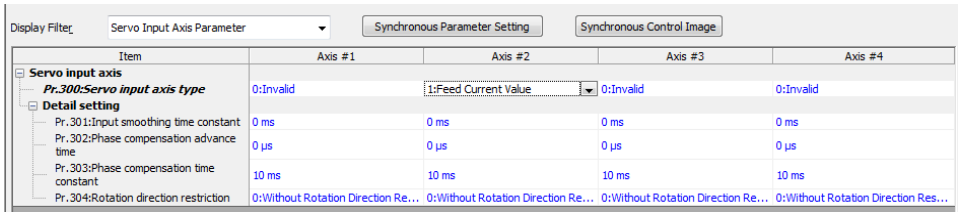
[Synchronous parameter]



[Synchronous control image]



[Input axis parameter]



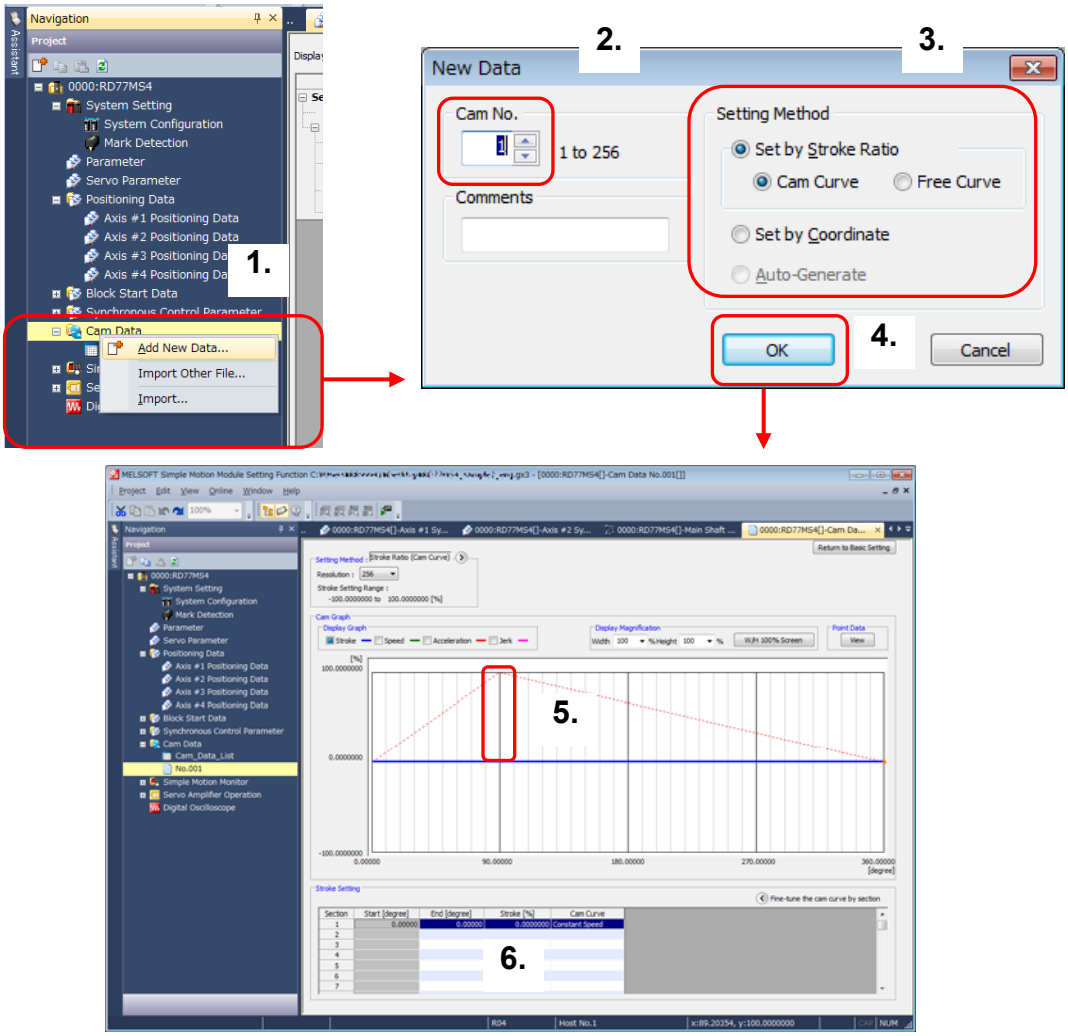
3. Select the main shaft to open the input axis parameter.
   Parameters related to the input axis (axis 2) can be set.

(4) Settings for synchronous control parameters and input axis parameters are completed.

4.3.5 Cam data creation

(1) Creating a new cam data

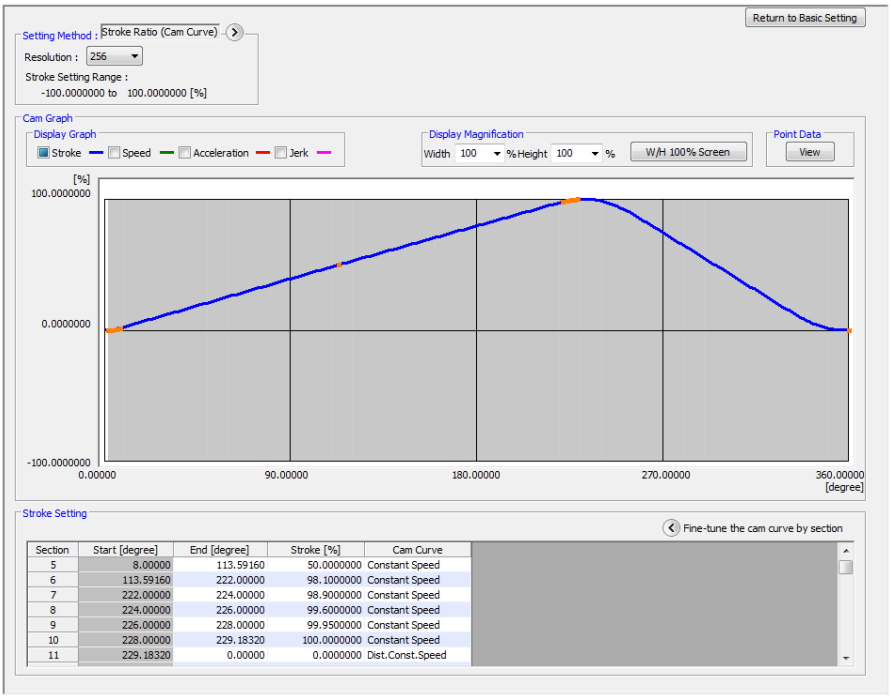
1. Right click on [Cam Data], and select [Add New Data…] to open the New Data window.
2. Set the cam No.
3. Select "Set by Stroke Ratio" and "Cam Curve" in the Setting Method.
4. Click [OK]. The cam data creation screen appears.



5. Make a rough cam graph by dragging an end of the cam waveform.
6. Based on the rough cam data, modify the end point and stroke, and finish the cam data.

(2) Cam curve creation

A cam data graph can be generated by inputting the end point and the stroke.



<Cam data>

Section No.	Start point [degree]	End point [degree]	Stroke [%]	Cam curve
1	0.00000	2.00000	0.0500000	Constant speed
2	2.00000	4.00000	0.5000000	Constant speed
3	4.00000	6.00000	1.1000000	Constant speed
4	6.00000	8.00000	1.9000000	Constant speed
5	8.00000	113.59160	50.0000000	Constant speed
6	113.59160	222.00000	98.1000000	Constant speed
7	222.00000	224.00000	98.9000000	Constant speed
8	224.00000	226.00000	99.6000000	Constant speed
9	226.00000	228.00000	99.9500000	Constant speed
10	228.00000	229.18320	100.0000000	Constant speed
11	229.18320	0.00000	0.0000000	Dist. Constant speed

(3) Cam data creation is completed.

4.3.6 Saving a project

Refer to Section 3.3 "(6) Saving a project".

4.3.7 Writing to the Simple Motion module

Refer to Section 3.3 "(7) Writing to the Simple Motion module".

4.4 Operation Check for Synchronous Control

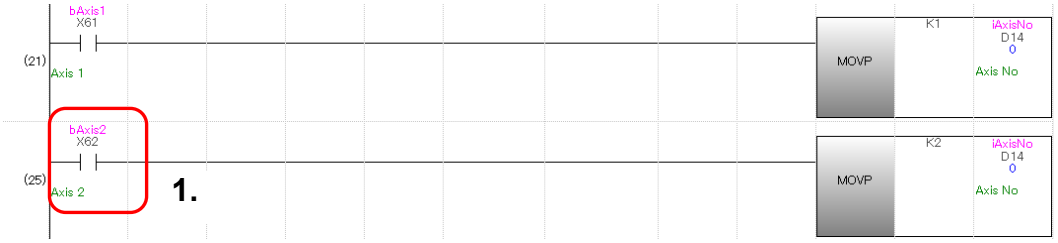
Refer to Chapter 3 for details of JOG operation, home position return, and positioning control.
This section explains operation check for synchronous control.
Follow the procedure below so that the axis 1 synchronizes to the feed current value of axis 2 with cam operation.

4.4.1 Home position return

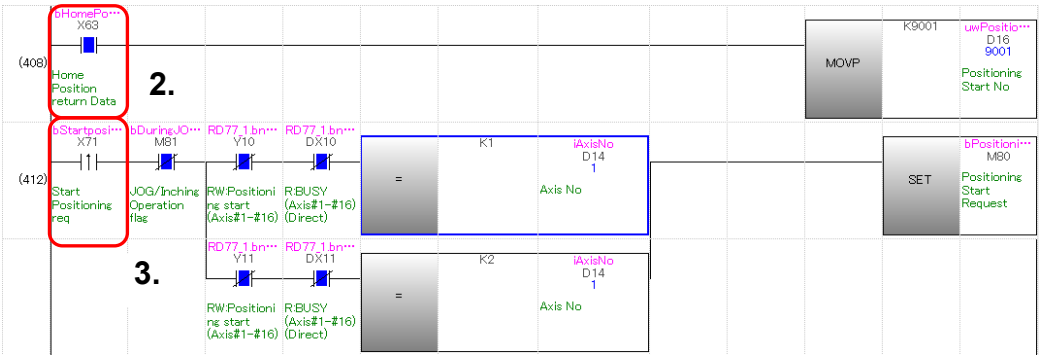
Perform home position return for axis 1 and 2.
This section explains operation check method for axis 2 home position return.
Refer to Chapter 3 for details of the axis-1 home position return operation check.

1. Select axis 2. Double click X62 while pressing SHIFT.
2. Set the Positioning start No. (9001). Double click X63 while pressing SHIFT.
3. Start the positioning. Double click X71 while pressing SHIFT.

[Axis 2 is selected]



[Axis-2 home position return start]



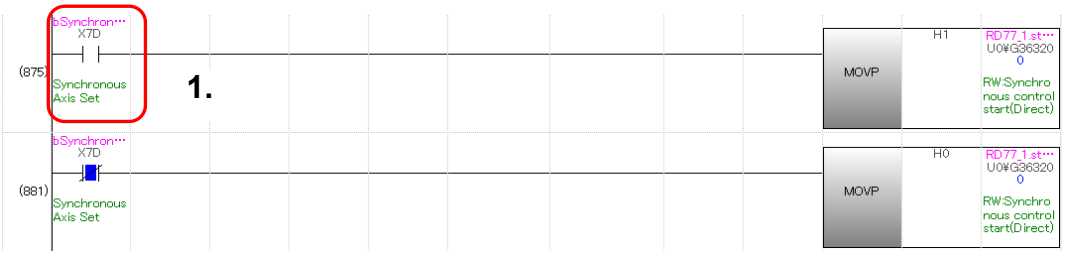
4. Home position return is completed.

4.4.2 Synchronous control start

Set [Cd.380 synchronous control parameter] for each output axis, and start synchronous control. Once the synchronous control starts, output axes operate in synchronization with the input axis operation.

(1) Start and confirmation of output axis to be synchronized

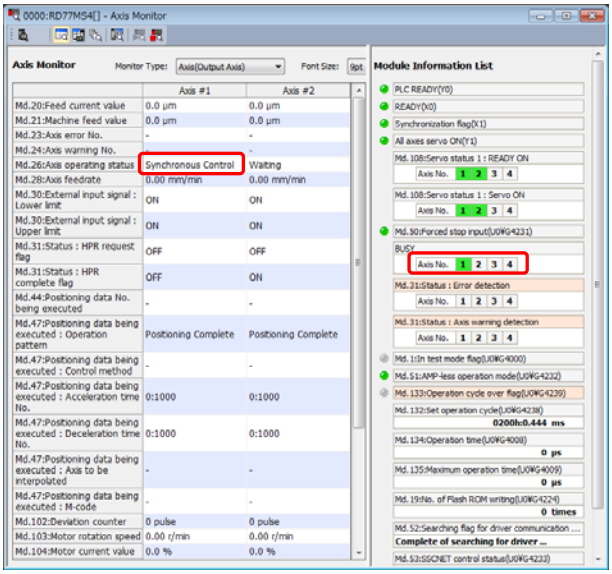
1. Start synchronous control of axis 1. Double click X7D while pressing SHIFT.



2. Check axis-1 BUSY signal

Check the axis operating status and BUSY flag.

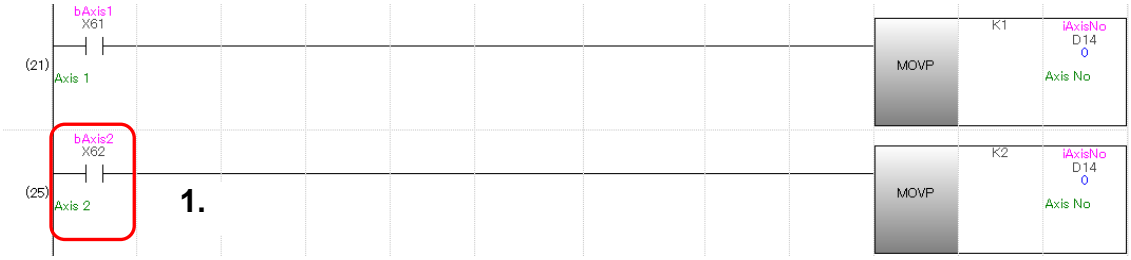
When setting H1 to the buffer memory for synchronous control start (U0\G36320), confirm that axis-1 BUSY signal is turned ON.



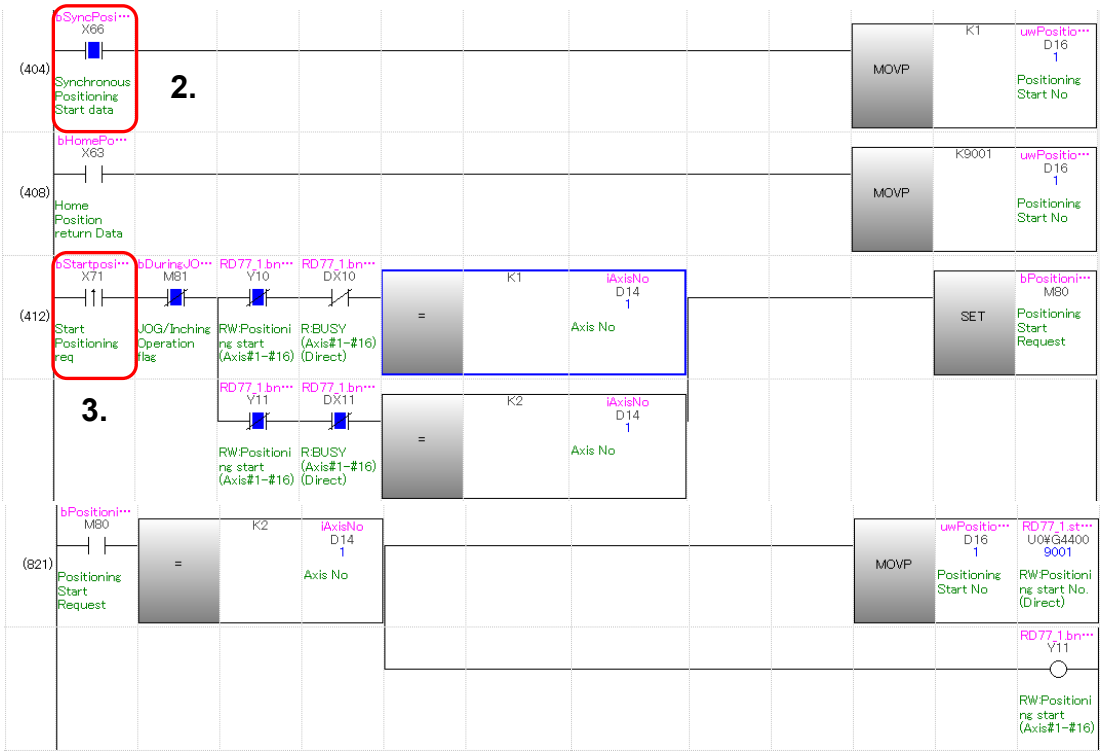
Item	Axis 1
Md.26: Axis operating status	Synchronous control
BUSY	Axis 1: ON

(2) Start and confirmation of the main shaft (input axis)

1. Set the axis No. for the main shaft (input axis). Double click X62 while pressing SHIFT.

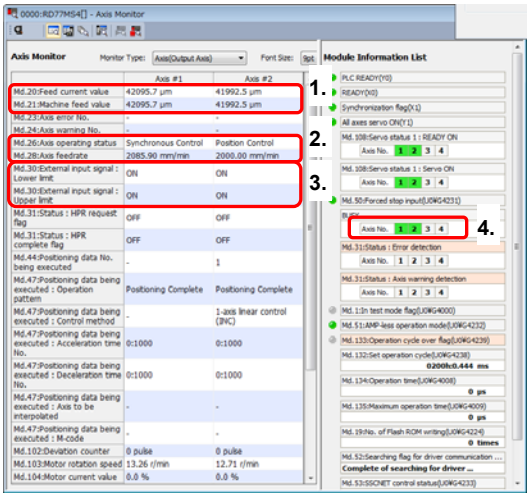


2. Set the program No. for axis 2. Double click X66 while pressing SHIFT.
3. Start the main shaft (input axis). Double click X71 while pressing SHIFT.
   Output axes move synchronizing to the main shaft movement.



(3) Operation check for main shaft (input axis)

Check that the servo motors for axis 1 and 2 start operation.



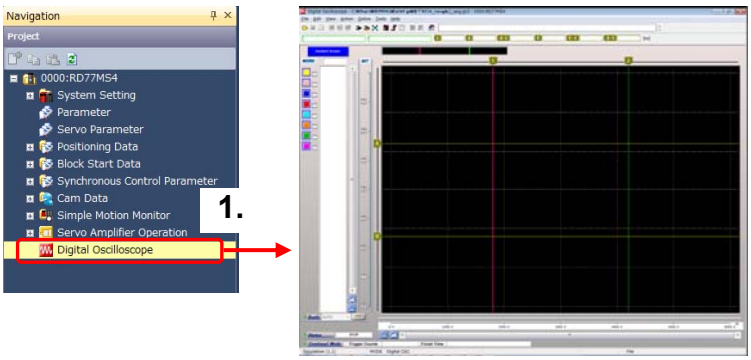
	Item	Axis 1	Axis 2
1	Md.20: Feed current value Md.21: Machine feed value	- -	- -
2	Md.26: Axis operating status Md.28: Axis federate	Synchronous control -	Positioning control 2000.00 [mm/min]
3	Md.30: External input signal: Lower limit Md.30: External input signal: Upper limit	ON ON	ON ON
4	BUSY	ON	ON

4.4.3 Operation check with digital oscilloscope

The section explains how to check the cam operation with the assistant function of digital oscilloscope.

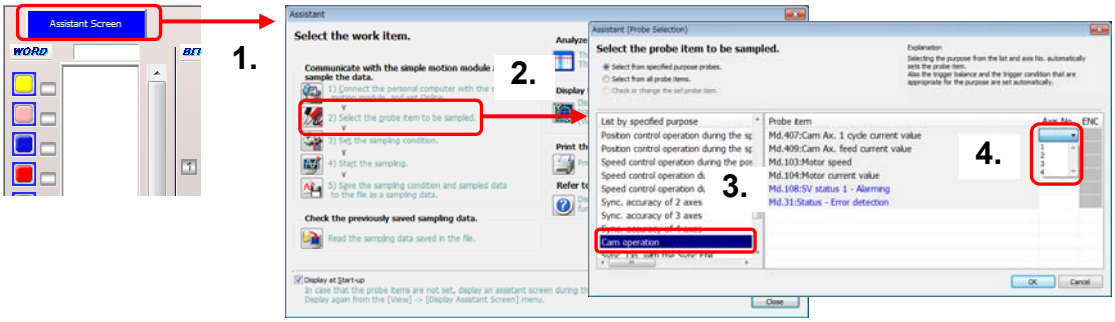
(1) Start of digital oscilloscope

1. Select [Digital Oscilloscope] in the menu.



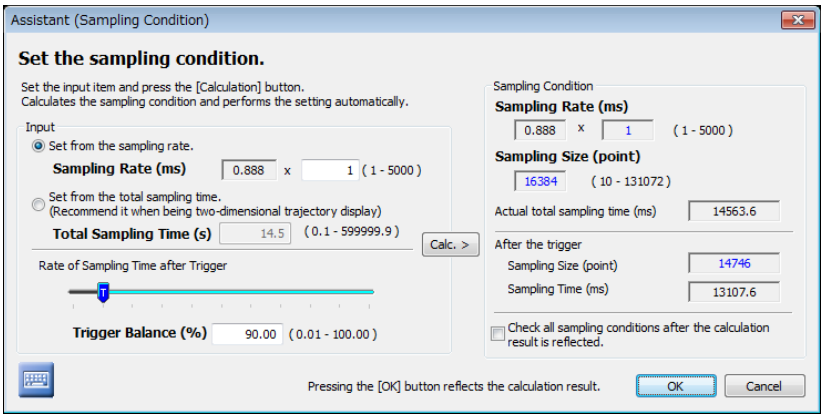
(2) Selecting probe

1. Click [Assistant Screen] to open the Assistant window.
2. Click [Select the probe item to be sampled.] to open the Assistant (Probe Selection).
3. Select [Cam operation] in the List by specified purpose.
4. Select the axis No.



(3) Sampling condition settings (No need to change)

Change the sampling condition where necessary.
In this example, the default values are used.

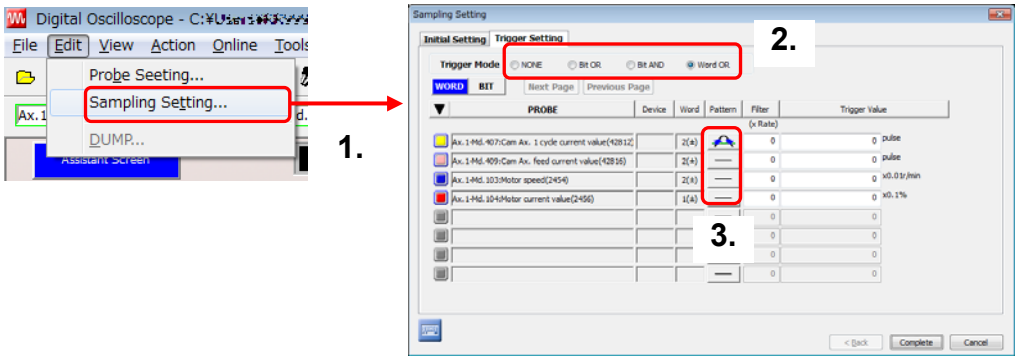


(4) Trigger condition settings (No need to change)

Set the trigger condition where necessary.

The default values are normally used.

1. Select [Edit] → [Sampling settings] to open the Sampling Setting screen.
2. Select the Trigger Mode from Bit OR, Bit AND, Word OR, or NONE.
3. Select pattern. (Leading edge, trailing edge, change)

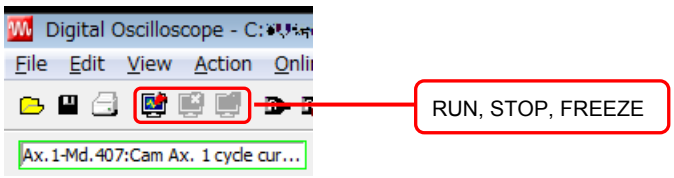


(5) Start sampling

RUN: Start sampling.

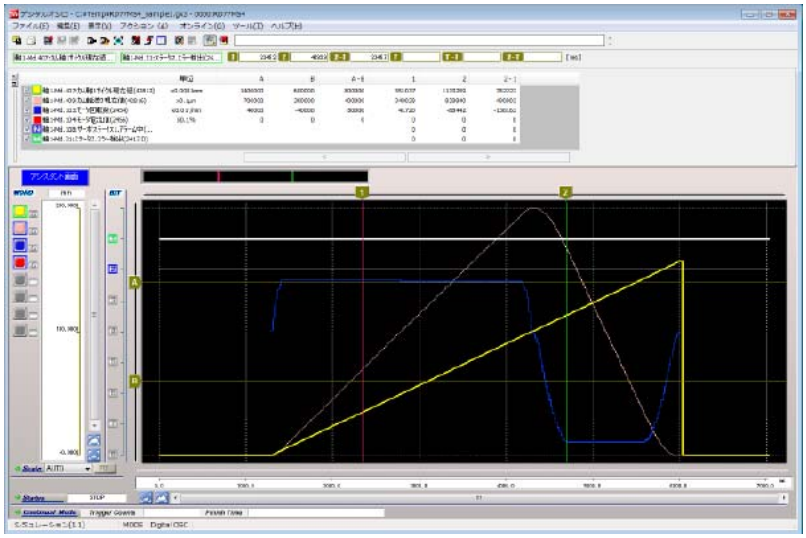
STOP: Stop sampling.

FREEZE: Sampling pauses.



(6) Checking cam data

Check that the waveform of the created cam data matches that of axis 1 feed current value in digital oscilloscope.



(7) Operation check is completed.

MEMO

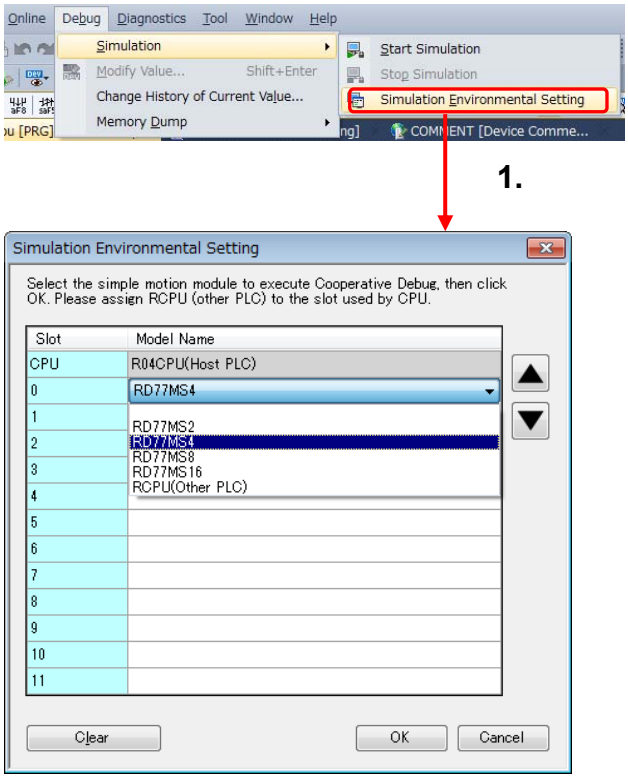
APPENDICES

Appendix 1 Simulation

The MELSOFT GX Works3 can simulate the program on a personal computer without an actual machine during the debugging process, shortening the startup time.

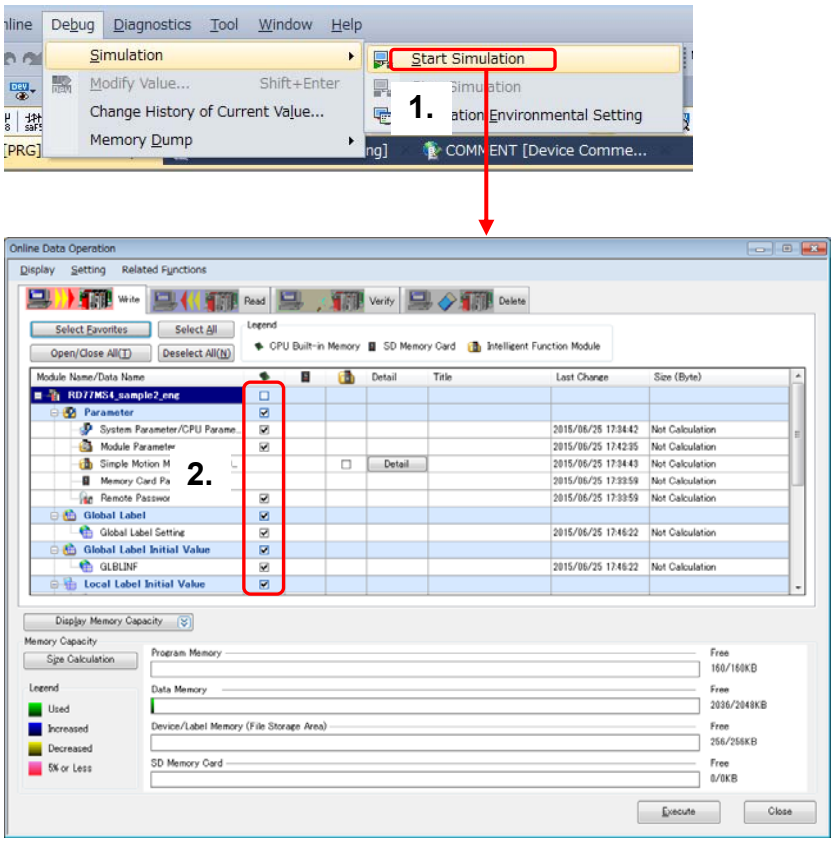
(1) Simulation environment settings

1. Select [Debug] → [Simulation] → [Simulation Environment Setting] to open the Simulation Environment Setting window.
   Add the Simple Motion module registered in the Module configuration screen.



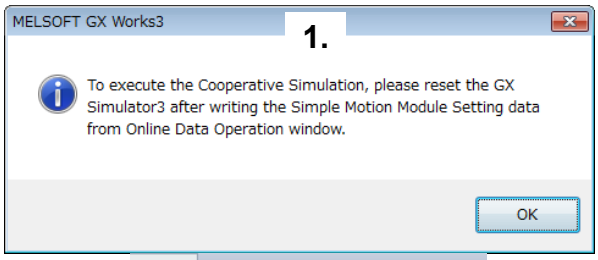
(2) Starting MELSOFT GX Works3 simulator

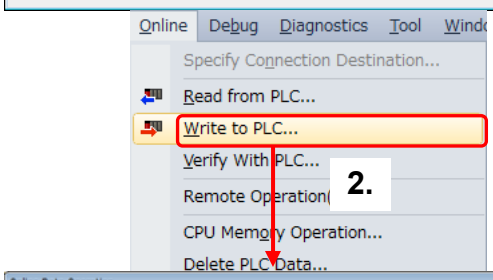
1. Click [Debug] → [Simulation] → [Star Simulation] to open the Online Data Operation screen.
2. Check the boxes for data to be written. Click [Execute].

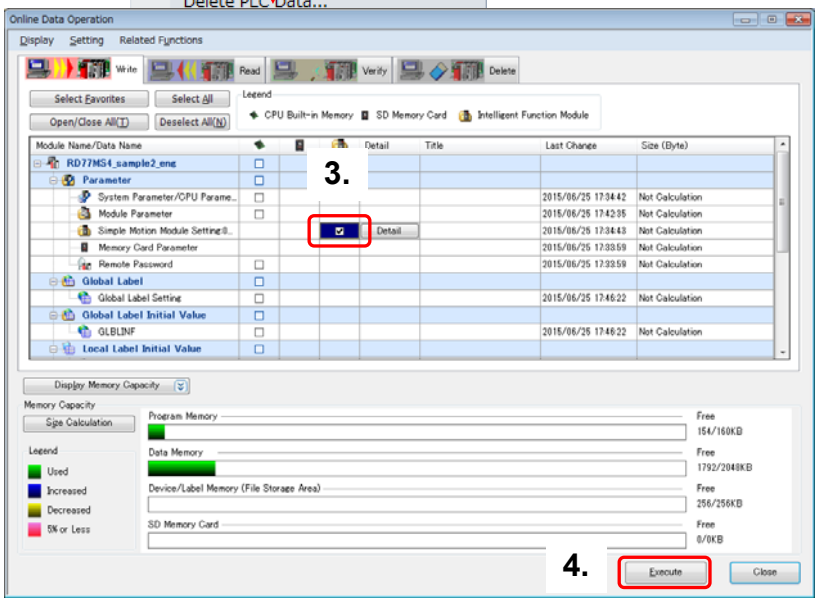


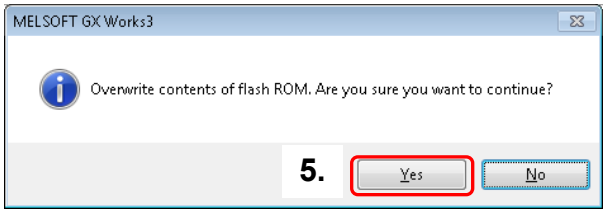
(3) Starting Simple Motion module simulator

1. After closing the [Online Data Operation] window on the previous page, the message window about the Simple Motion module appears.
2. Click [Online] → [Write to PLC…] to open the Online Data Operation screen.
3. Select [Simple Motion Module Settings].
4. Click [Execute].
5. Click [Yes].



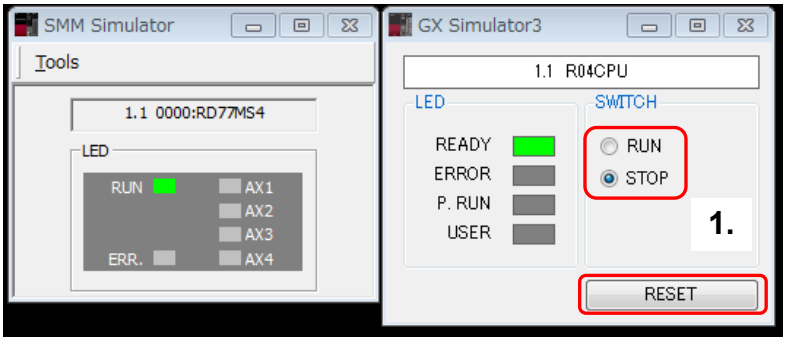




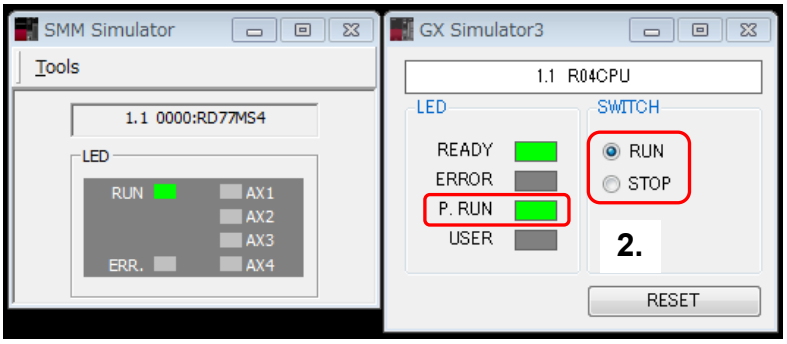


(4) Reset of Simple Motion module simulation

1. Click [Reset]. STOP is selected from RUN.

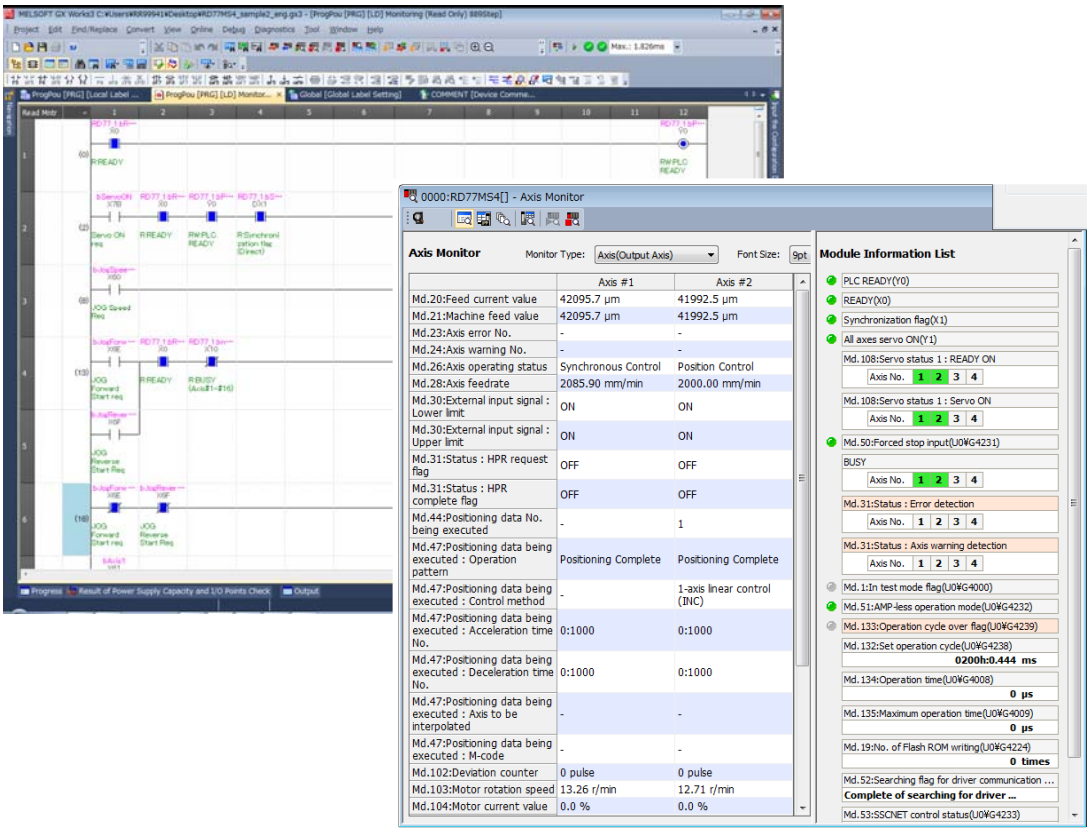


2. Select RUN again, and the P.RUN is turned ON.



(5) Debug by simulation

Debug for the Simple Motion module can be executed with GX Simulator3.



Appendix 2 Parameter and Positioning Data

(1) Parameters

Item	Axis #1	Axis #2
Common Parameter	**The parameter does not rely on axis and relate to the...**	
Pr.82:Forced stop valid/invalid selection	1:Invalid	
Pr.24:Manual pulse generator/Incremental Sync. ENC input selection	0:A-phase/B-phase Mode (4 Multiply)	
Pr.89:Manual pulse generator/Incremental Sync. ENC input type selection	1:Voltage Output/Open Collector Type	
Pr.96:Operation cycle setting	FFFFh:Automatic Setting	
Pr.97:SSCNET Setting	1:SSCNET III/H	
Pr.150:Input terminal logic selection	**Set the logic of external input signal (proximity dog, external command/switching) from the external devi...**	
Pr.151:Manual pulse generator/Incremental Sync. ENC input logic selection	0:Negative Logic	
Pr.152:Control axis number upper limit	0	
Pr.153:External input signal OSC file setting	**Set digital filter for each input signal.**	
Basic parameters 1	**Set according to the machine and applicable motor w...**	
Pr.1:Unit setting	0:mm	0:mm
Pr.2:No. of pulses per rotation	172985333 pulse	172985333 pulse
Pr.3:Movement amount per rotation	6478422.3 µm	6478422.3 µm
Pr.4:Unit magnification	1:x1 Times	1:x1 Times
Pr.7:Bias speed at start	0.00 mm/min	0.00 mm/min
Basic parameters 2	**Set according to the machine and applicable motor w...**	
Pr.8:Speed limit value	8000.00 mm/min	2000.00 mm/min
Pr.9:Acceleration time 0	1000 ms	1000 ms
Pr.10:Deceleration time 0	1000 ms	1000 ms
Detailed parameters 1	**Set according to the system configuration when the s...**	
Pr.11:Backlash compensation amount	0.0 µm	0.0 µm
Pr.12:Software stroke limit upper limit value	214748364.7 µm	214748364.7 µm
Pr.13:Software stroke limit lower limit value	-214748364.8 µm	-214748364.8 µm
Pr.14:Software stroke limit selection	0:Set Software Stroke Limit to Feed Current Value	0:Set Software Stroke Limit to Feed Current Value
Pr.15:Software stroke limit valid/invalid setting	0:Valid	0:Valid
Pr.16:Command in-position width	10.0 µm	10.0 µm
Pr.17:Torque limit setting value	300.0 %	300.0 %
Pr.18:M-code ON signal output timing	0:WITH Mode	0:WITH Mode
Pr.19:Speed switching mode	0:Standard Speed Switching Mode	0:Standard Speed Switching Mode
Pr.20:Interpolation speed designation method	0:Vector Speed	0:Vector Speed
Pr.21:Feed current value during speed control	0:Not Update of Feed Current Value	0:Not Update of Feed Current Value
Pr.22:Input signal logic selection : Lower limit	0:Negative Logic	0:Negative Logic
Pr.22:Input signal logic selection : Upper limit	0:Negative Logic	0:Negative Logic
Pr.22:Input signal logic selection : Stop signal	0:Negative Logic	0:Negative Logic
Pr.22:Input signal logic selection : Proximity dog signal	0:Negative Logic	0:Negative Logic
Pr.81:Speed-position function selection	0:Speed-position Switching Control (INC Mode)	0:Speed-position Switching Control (INC Mode)
Pr.116:FLS signal selection : Input type	15:Invalid	15:Invalid
Pr.116:FLS signal selection : Input terminal	00h:No Setting	00h:No Setting
Pr.117:RLS signal selection : Input type	15:Invalid	15:Invalid
Pr.117:RLS signal selection : Input terminal	00h:No Setting	00h:No Setting
Pr.118:DOG signal selection : Input type	15:Invalid	15:Invalid

Item	Axis #1	Axis #2
Pr.118:DOG signal selection : Input terminal	00h:No Setting	00h:No Setting
Pr.119:STOP signal selection : Input type	15:Invalid	15:Invalid
Pr.119:STOP signal selection : Input terminal	00h:No Setting	00h:No Setting
Detailed parameters 2	**Set according to the system configuration when the s...**	
Pr.25:Acceleration time 1	1000 ms	1000 ms
Pr.26:Acceleration time 2	1000 ms	1000 ms
Pr.27:Acceleration time 3	1000 ms	1000 ms
Pr.28:Deceleration time 1	1000 ms	1000 ms
Pr.29:Deceleration time 2	1000 ms	1000 ms
Pr.30:Deceleration time 3	1000 ms	1000 ms
Pr.31:JOG speed limit value	200.00 mm/min	200.00 mm/min
Pr.32:JOG operation acceleration time selection	0:1000	0:1000
Pr.33:JOG operation deceleration time selection	0:1000	0:1000
Pr.34:Acceleration/deceleration process selection	0:Trapezoidal Acceleration/Deceleration Process	0:Trapezoidal Acceleration/Deceleration Process
Pr.35:S-curve ratio	100 %	100 %
Pr.36:Rapid stop deceleration time	1000 ms	1000 ms
Pr.37:Stop group 1 rapid stop selection	0:Normal Deceleration Stop	0:Normal Deceleration Stop
Pr.38:Stop group 2 rapid stop selection	0:Normal Deceleration Stop	0:Normal Deceleration Stop
Pr.39:Stop group 3 rapid stop selection	0:Normal Deceleration Stop	0:Normal Deceleration Stop
Pr.40:Positioning complete signal output time	300 ms	300 ms
Pr.41:Allowable circular interpolation error width	10.0 µm	10.0 µm
Pr.42:External command function selection	0:External Positioning Start	0:External Positioning Start
Pr.83:Speed control 10x multiplier setting for degree axis	0:Invalid	0:Invalid
Pr.84:Restart permissible value range when servo OFF to ON	0 pulse	0 pulse
Pr.90:Operation setting for SPD-TRQ Cont. mode : Torque initial value selection	0:Command Torque	0:Command Torque
Pr.90:Operation setting for SPD-TRQ Cont. mode : Speed initial value selection	0:Command Speed	0:Command Speed
Pr.90:Operation setting for SPD-TRQ Cont. mode : Condition selection at mode switching	0:Switching Conditions Valid at Mode Switching	0:Switching Conditions Valid at Mode Switching
Pr.95:External command signal selection	0:Not Used	0:Not Used
Pr.122:Manual pulse generator speed limit mode	0:Do Not Execute Speed Limit	0:Do Not Execute Speed Limit
Pr.123:Manual pulse generator speed limit value	200.00 mm/min	200.00 mm/min
HPR basic parameters	**Set the values required for carrying out HPR control (...**	
Pr.43:HPR method	6:Data Set Method	6:Data Set Method
Pr.44:HPR direction	0:Forward Direction (Address Increase Direction)	0:Forward Direction (Address Increase Direction)
Pr.45:HP address	0.0 µm	0.0 µm
Pr.46:HPR speed	1000.00 mm/min	1000.00 mm/min
Pr.47:Creep speed	0.01 mm/min	0.01 mm/min
Pr.48:HPR retry	0:Do Not Retry HPR with Limit Switch	0:Do Not Retry HPR with Limit Switch
HPR detailed parameters	**Set the values required for carrying out HPR control (...**	
Pr.50:Setting for the movement amount after proximity dog ON	0.0 µm	0.0 µm

Pr.51:HPR acceleration time selection	0:1000	0:1000
Pr.52:HPR deceleration time selection	0:1000	0:1000
Pr.53:HP shift amount	0.0 µm	0.0 µm
Pr.54:HPR torque limit value	300.0 %	300.0 %
Pr.55:Operation setting for incompletion of HPR	0:Positioning Control is Not Executed	0:Positioning Control is Not Executed
Pr.56:Speed designation during HP shift	0:HPR Speed	0:HPR Speed
Pr.57:Dwell time during HPR retry	0 ms	0 ms
Pr.86:Pulse conversion unit : HPR request setting	0:Turn HPR Request ON at Servo OFF	0:Turn HPR Request ON at Servo OFF
Pr.87:Pulse conversion unit : Waiting time after clear signal output	0 ms	0 ms
Expansion parameters	**Set according to the system configuration when the s...**	
Pr.91:Optional data monitor : Data type setting 1	0:No Setting	0:No Setting
Pr.92:Optional data monitor : Data type setting 2	0:No Setting	0:No Setting
Pr.93:Optional data monitor : Data type setting 3	0:No Setting	0:No Setting
Pr.94:Optional data monitor : Data type setting 4	0:No Setting	0:No Setting

(2) Positioning data

<Axis-1 positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed	Dwell time	M-code
1	**1: CONT**	**ABS linear 1**	-	1:1000	1:1000	**100000.0 µm**	0.0 µm	**2000.00 mm/min**	0ms	0
2	**0: END**	**ABS linear 1**	-	1:1000	1:1000	**0.0µm**	0.0 µm	**8000.00 mm/min**	0ms	0

<Axis-2 positioning data>

No.	Operation pattern	Control system	Axis to be interpolated	Acceleration time No.	Deceleration time No.	Positioning address	Arc address	Command speed	Dwell time	M-code
1	**0:END**	**INC linear 1**	-	1:1000	1:1000	**157079.6 µm**	0.0 µm	**2000.00 mm/min**	0ms	0

Appendix 3 Sample Program

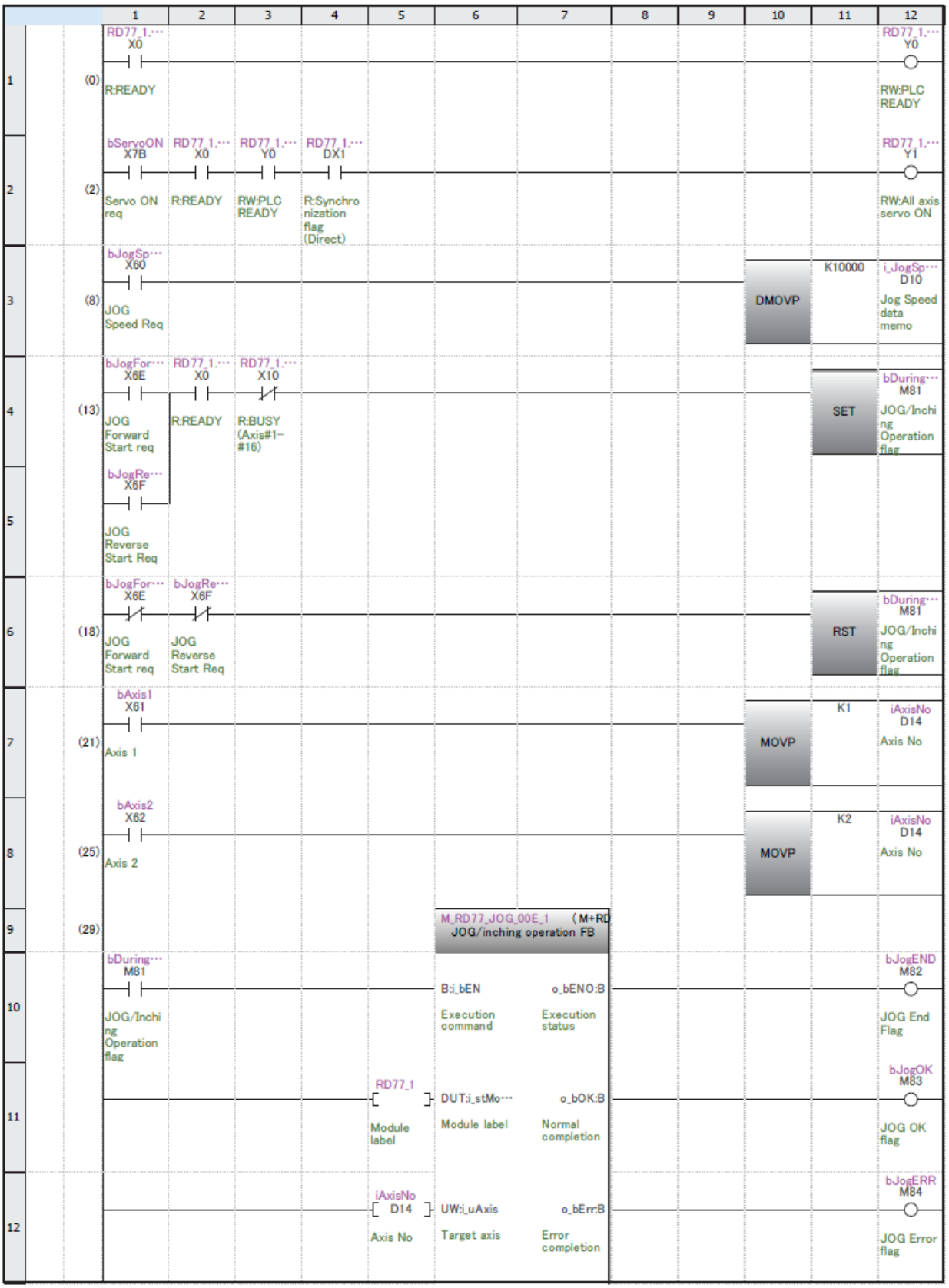
⚠CAUTION

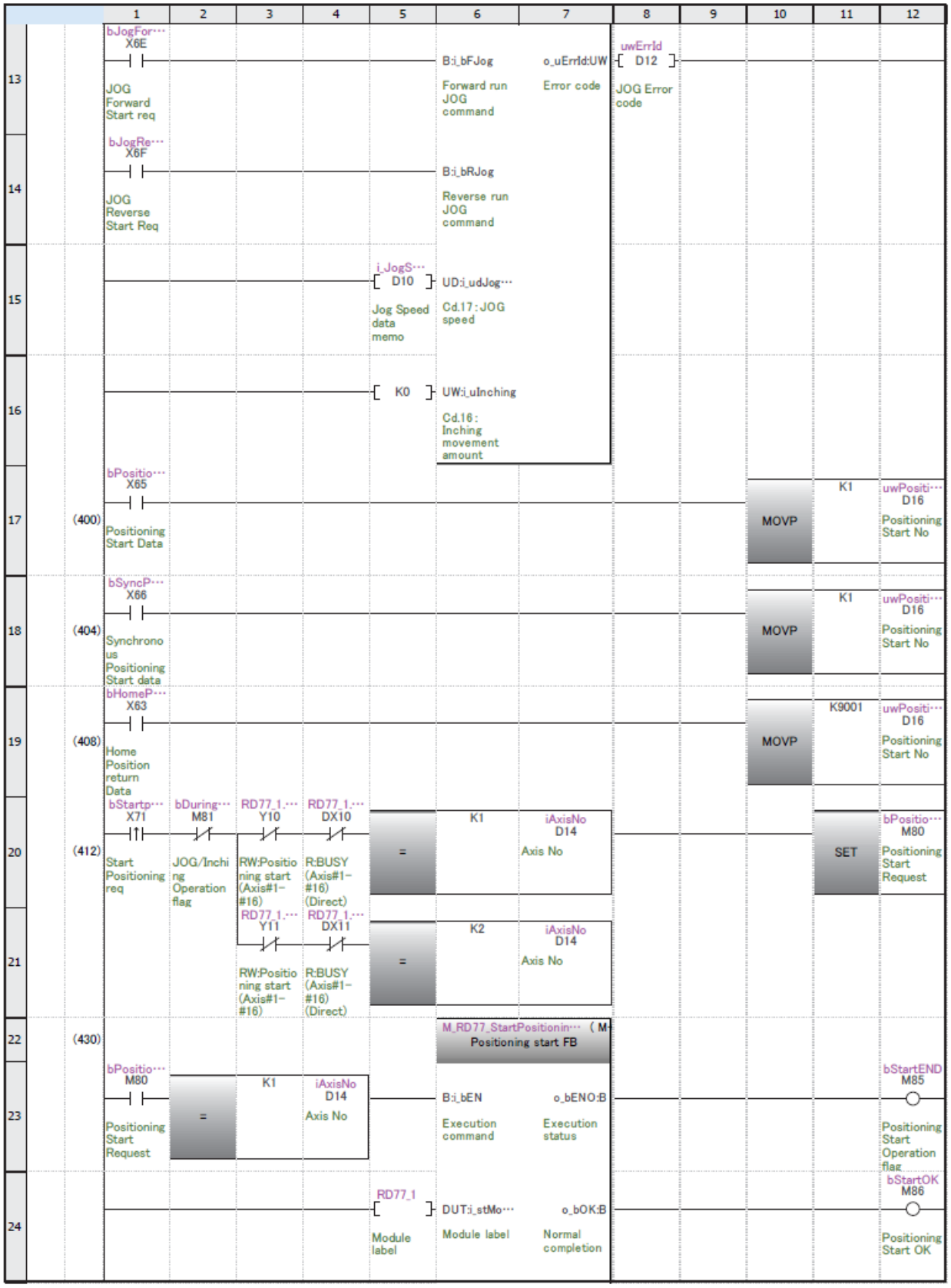
● The sequence program in the appendix is a program example used in this Quick Start Guide. When applying the program examples provided in this document to an actual system, ensure the applicability and confirm that it will not cause system control problems.

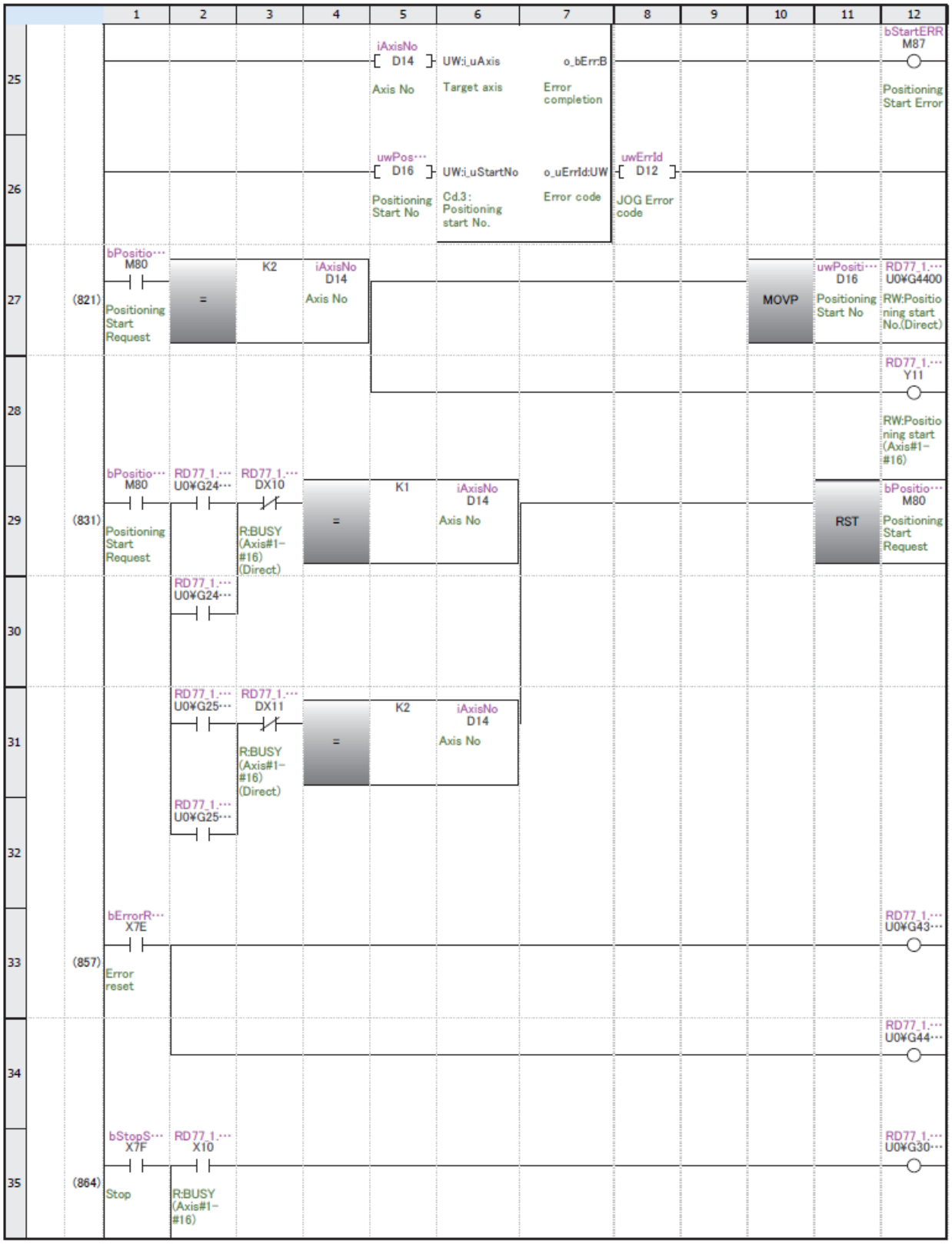
(1) Devices used

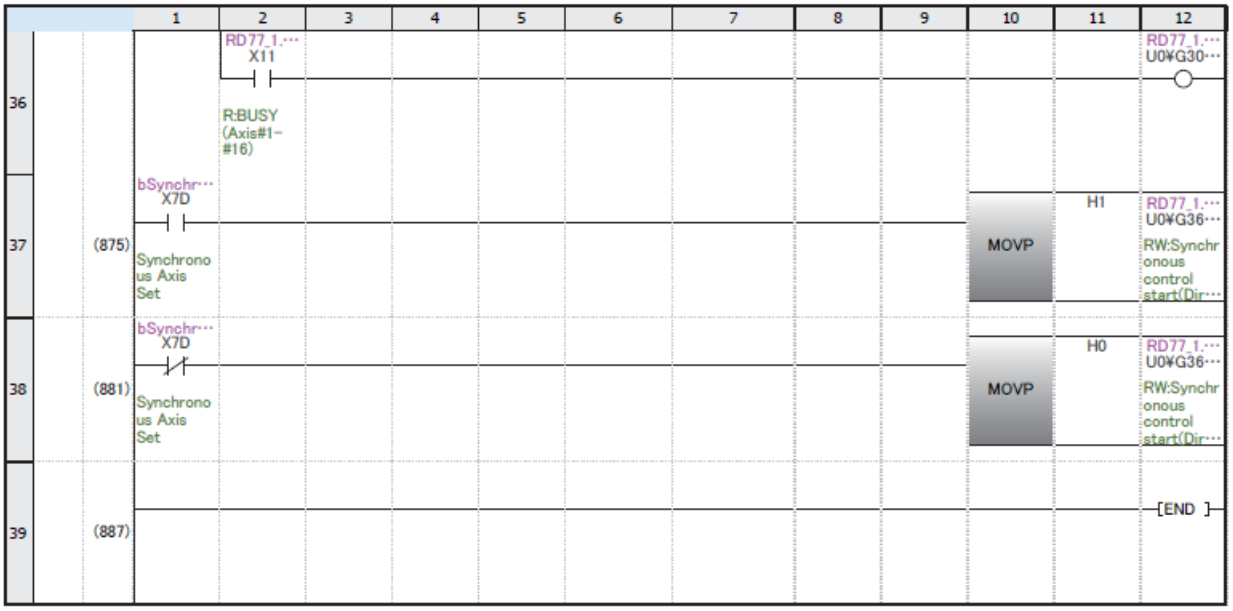
Classification	Device No.	Signal name	Signal
Input	X60	JOG speed Req	Input module ↓ PLC CPU
	X61	Axis 1	
	X62	Axis 2	
	X63	Home Position Return Data	
	X65	Positioning Start Data	
	X66	Synchronous Positioning Start data	
	X6E	JOG Forward Start req	
	X6F	JOG Reverse Start req	
	X71	Start Positioning req	
	X7B	Servo ON req	
	X7D	Synchronous axis set	
	X7E	Error reset	
	X7F	Stop	
Output	Y0	PLC READY	PLC CPU ↓ RD77MS
	Y1	All axis servo ON	
	Y10	Positioning start (Axis#1 - 16)	
	Y11	Positioning start (Axis#1 - 16)	

(2) Sequence program example




bJogFor···
X6E
JOG Forward Start req
B:i_bFJog
Forward run JOG command
o_uErrId:UW
Error code
uwErrId
D12
JOG Error code
bJogRe···
X6F
JOG Reverse Start Req
B:i_bRJog
Reverse run JOG command
i_JogS···
D10
UD:i_udJog···
Jog Speed data memo
Cd.17:JOG speed
K0
UW:i_uInching
Cd.16: Inching movement amount
bPositio···
X65
(400)
Positioning Start Data
MOVP
K1
uwPositi···
D16
Positioning Start No
bSyncP···
X66
(404)
Synchronous Positioning Start data
bHomeP···
X63
(408)
Home Position return Data
K9001
bStartp···
X71
bDuring···
M81
RD77_1.···
Y10
RD77_1.···
DX10
(412)
Start Positioning req
JOG/Inching Operation flag
RW:Positioning start (Axis#1-#16)
R:BUSY (Axis#1-#16) (Direct)
=
K1
iAxisNo
D14
Axis No
SET
bPositio···
M80
Positioning Start Request
RD77_1.···
Y11
RD77_1.···
DX11
K2
M_RD77_StartPositionin···
Positioning start FB
(430)
bPositio···
M80
Positioning Start Request
B:i_bEN
Execution command
o_bENO:B
Execution status
bStartEND
M85
Positioning Start Operation flag
RD77_1
Module label
DUT:i_stMo···
o_bOK:B
Normal completion
bStartOK
M86
Positioning Start OK


iAxisNo
D14
Axis No
UW:i_uAxis
Target axis
o_bErr:B
Error completion
bStartERR
M87
Positioning Start Error
uwPos···
D16
Positioning Start No
UW:i_uStartNo
Cd.3: Positioning start No.
o_uErrId:UW
Error code
uwErrId
D12
JOG Error code
bPositio···
M80
Positioning Start Request
(821)
=
K2
iAxisNo
D14
Axis No
MOVP
uwPositi···
D16
Positioning Start No
RD77_1···
U0¥G4400
RW:Positioning start No.(Direct)
RD77_1···
Y11
RW:Positioning start (Axis#1-#16)
RD77_1···
U0¥G24···
RD77_1···
DX10
R:BUSY (Axis#1-#16) (Direct)
(831)
K1
RST
RD77_1···
U0¥G25···
RD77_1···
DX11
bErrorR···
X7E
Error reset
(857)
bStopS···
X7F
Stop
RD77_1···
X10
(864)
RD77_1···
U0¥G43···
RD77_1···
U0¥G44···
RD77_1···
U0¥G30···


1
2
3
4
5
6
7
8
9
10
11
12
RD77_1.···
X11
U0¥G30···
36
R:BUSY
(Axis#1-
#16)
bSynchr···
X7D
H1
RD77_1.···
U0¥G36···
37
(875)
MOVP
RW:Synchr
onous
control
start(Dir···
Synchrono
us Axis
Set
bSynchr···
X7D
H0
RD77_1.···
U0¥G36···
38
(881)
MOVP
RW:Synchr
onous
control
start(Dir···
Synchrono
us Axis
Set
39
(887)
[END]

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