MITSUBISHI ELECTRIC

Mitsubishi Electric Industrial Robot

MELFA

Robot Seminar Textbook <FR/F Series Basics>

MELFA

BFP-A3592

MELFA Robot Seminar Curriculum <Basics>

Day 1		Day 2	
Item	Time	Item	Time
Opening Greetings Orientation (1) Safety related laws ◆ Industrial robot safety (video) ◆ Safety Manual	90 min.	(7) Review of previous day's lessons (Inputting the program) (8) Practice (Actual machine operation) ◆ Individual command functions ◆ Exercise 2	75 min.
Break	15 min.	Break	15 min.
(2) Introduction to MELFA ◆ Device configuration, control power ◆ Operation panel, T/B ◆ Jog operation, hand operation (3) Moving the robot with jog operation (Actual machine operation) ◆ Joint, Cartesian, Tool jog operation ◆ Opening/closing the hand, etc.	60 min.	(9) Input/output signal specifications and methods of use (10) Practice (Actual machine operation) ◆ Individual command functions ◆ Exercise 3	75 min.
Lunch		Lunch	
(4) Moving the robot with automatic operation ◆ Inputting a program with RT ToolBox3 ◆ Position teaching with T/B ◆ Operation check with T/B ◆ Automatic operation (5) Robot language ◆ MELFA-BASIC specifications ◆ Constants, variables, common variables, etc. ◆ Program instructions ◆ Each command functions	110 min.	(11) Practice (Actual machine operation) ◆ Individual command functions ◆ Exercise 4 and 5	90 min.
Break	20 min.	Break	20 min.
(6) Programming and teaching ◆ Exercise 1 ◆ Programming and inputting ◆ Position teaching with T/B ◆ Confirming the registered position data operation ◆ Automatic operation End	110 min.	(12) T/B menus (Actual machine operation) (13) Industrial robot mechanisms, functions and control technology (video) (14) Maintenance ◆ List of error codes ◆ After-sales servicing End (Presentation of Certification of Completion)	90 min.

⚠ Safety Precautions

Always read the following precautions and the separate "Safety Manual" before starting use of the robot to learn the required measures to be taken.

⚠ CAUTION	All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.) Enforcement of safety training
⚠ CAUTION	For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.) Preparation of work plan
⚠ WARNING	Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.) Setting of emergency stop switch
⚠ CAUTION	During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.) Indication of teaching work in progress
⚠ DANGER	Provide a fence or enclosure during operation to prevent contact of the operator and robot. Installation of safety fence
⚠ CAUTION	Establish a set signaling method to the related operators for starting work, and follow this method. Signaling of operation start
⚠ CAUTION	As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc. Indication of maintenance work in progress
⚠ CAUTION	Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors. Inspection before starting work

The points of the precautions given in the separate "Safety Manual" are given below.
Refer to the actual "Safety Manual" for details.

⚠ DANGER

When automatic operation of the robot is performed using multiple control devices (GOT, programmable controller, push-button switch), the interlocking of operation rights of the devices, etc. must be designed by the customer.

⚠ CAUTION

Use the robot within the environment given in the specifications. Failure to do so could lead to a drop or reliability or faults. (Temperature, humidity, atmosphere, noise environment, etc.)

⚠ CAUTION

Transport the robot with the designated transportation posture. Transporting the robot in a non-designated posture could lead to personal injuries or faults from dropping.

⚠ CAUTION

Always use the robot installed on a secure table. Use in an instable posture could lead to positional deviation and vibration.

⚠ CAUTION

Wire the cable as far away from noise sources as possible. If placed near a noise source, positional deviation or malfunction could occur.

⚠ CAUTION

Do not apply excessive force on the connector or excessively bend the cable. Failure to observe this could lead to contact defects or wire breakage.

⚠ CAUTION

Make sure that the workpiece weight, including the hand, does not exceed the rated load or tolerable torque. Exceeding these values could lead to alarms or faults.

⚠ WARNING

Securely install the hand and tool, and securely grasp the workpiece. Failure to observe this could lead to personal injuries or damage if the object comes off or flies off during operation.

⚠ WARNING

Securely ground the robot and controller. Failure to observe this could lead to malfunctioning by noise or to electric shock accidents.

⚠ CAUTION

Indicate the operation state during robot operation. Failure to indicate the state could lead to operators approaching the robot or to incorrect operation.

⚠ WARNING

When carrying out teaching work in the robot's movement range, always secure the priority right for the robot control. Failure to observe this could lead to personal injuries or damage if the robot is started with external commands.

⚠ CAUTION

Keep the jog speed as low as possible, and always watch the robot. Failure to do so could lead to interference with the workpiece or peripheral devices.

⚠ CAUTION

After editing the program, always confirm the operation with step operation before starting automatic operation. Failure to do so could lead to interference with peripheral devices because of programming mistakes, etc.

⚠ CAUTION

Make sure that if the safety fence entrance door is opened during automatic operation, the door is locked or that the robot will automatically stop. Failure to do so could lead to personal injuries.

⚠ CAUTION

Never carry out modifications based on personal judgments, or use non-designated maintenance parts.
Failure to observe this could lead to faults or failures.

⚠ WARNING

When the robot arm has to be moved by hand from an external area, do not place hands or fingers in the openings. Failure to observe this could lead to hands or fingers catching depending on the posture.

⚠ CAUTION

Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF. If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

⚠ CAUTION

Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.

⚠ DANGER

Do not connect the Handy GOT when using the GOT direct connection function of this product. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

⚠ DANGER

Do not connect the Handy GOT to a programmable controller when using an iQ Platform compatible product with the CR800-R controller. Failure to observe this may result in property damage or bodily injury because the Handy GOT can automatically operate the robot regardless of whether the operation rights are enabled or not.

⚠ DANGER

Do not remove the SSCNET III cable while power is supplied to the multiple CPU system or the servo amplifier. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables of the Motion CPU or the servo amplifier. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

⚠ DANGER

Do not remove the SSCNET III cable while power is supplied to the controller. Do not look directly at light emitted from the tip of SSCNET III connectors or SSCNET III cables. Eye discomfort may be felt if exposed to the light. (Reference: SSCNET III employs a Class 1 or equivalent light source as specified in JIS C 6802 and IEC60825-1 (domestic standards in Japan).)

⚠ DANGER

Attach the cap to the SSCNET III connector after disconnecting the SSCNET III cable. If the cap is not attached, dirt or dust may adhere to the connector pins, resulting in deterioration connector properties, and leading to malfunction.

⚠ CAUTION

Make sure there are no mistakes in the wiring. Connecting differently to the way specified in the manual can result in errors, such as the emergency stop not being released. In order to prevent errors occurring, please be sure to check that all functions (such as the teaching box emergency stop, customer emergency stop, and door switch) are working properly after the wiring setup is completed.

⚠ CAUTION

Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

⚠ CAUTION

To maintain the safety of the robot 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.

■ Revision history

Date	Manual number	Revisions
2018-03-01	BFP-A3592	· First edition

Safety

A. Related Laws

Work using a robot is designated as "Dangerous and Injurious Works".

B. Laws and Standards for Ensuring Safety

1. Manufacturer side: (Ministry of Economy, Trade and Industry) JIS "B8433" Manipulating Industrial Robots - Safety
2. User side: (Ministry of Health, Labor and Welfare) Industrial Safety and Health Laws, Labor Safety and Health Regulations

C. Special Safety and Health Training Curriculum (Ministry of Health, Labor and Welfare Ministerial Notification No. 49)

The following two articles have been added to Article 17.

<Special training related to teaching of industrial robots, etc.>
Article 18

(1) Special training related to operations listed in the Safety and Health Provisions Article 36-31 shall be carried out with classroom training and practical training.
(2) The above mentioned classroom training shall follow the courses listed below. The scope listed below shall be covered for the specified time.
(3) For the practical training in Section 1, the following courses shall be conducted for the specified time or longer.

Course	Scope	Time
Basics of Industrial Robots	Types of industrial robots, and functions and handling methods of each part	2 hours
Basics of Industrial Robot Operations such as Teaching	Operation methods, such as teaching, risks of operations such as teaching, coupling with related machines, etc.	4 hours
Related Laws	Laws, ordinances and related articles in Safety and Health Provisions	1 hour

1. How to operate an industrial robot 1 hour
2. How to teach an industrial robot, etc. 2 hours

<Special training related to inspection of the industrial robot, etc.>
Article 19

(1) Special training related to the operations listed in Safety and Health Provisions Article 36-32 shall be carried out with classroom training and practical training.
(2) The above mentioned classroom training shall follow the courses listed below. The scope listed below shall be covered for the specified time.
(3) For the practical training in Section 1, the following courses shall be conducted for the specified time or longer.

Course	Scope	Time
Basics of Industrial Robots	Types of industrial robots, control methods, drive methods, structure, function and handling of each part, types and characteristics of control parts	4 hours
Basics of Industrial Robot Inspections, etc.	Inspection, etc., methods, risks in inspection work, etc., coupling with related machines, etc.	4 hours
Related Laws	Laws, ordinances and related articles in Safety and Health Provisions	1 hour

1. How to operate an industrial robot 1 hour
2. How to inspect an industrial robot, etc. 3 hours

D. Matters excluded from industrial robot

1. Machine having a drive motor with a rated output of 80 watts or less (if machine has two or more drive motor, the motor with the larger rated output)
2. Machine that repeats a simple operation of manipulator extension, vertical movement, left/right movement or turning based on information from a fixed sequence control unit.
3. In addition to the machine listed in item 2 above, machine approved by the manager of the Ministry of Health, Labor and Welfare's Labor Standards Bureau as a machine having a structure and performance that will not pose a risk to the operator even if the said machine is touched.

E. Qualifications for Dangerous and Injurious Work

Degree of risk: High ↑ ↓ Low

Qualification	Duty	Jurisdiction	Work Type
License	Acquired	National, Prefectural	Crane, gas equipment, X-ray, boiler
Skill training course	Completed	Bureau-designated training agency	Slinging, fork lift, high-pressure gas
Special training	Completed	Place of business	Electric, arc, grinding, robot

F. Industrial Accidents Caused by Industrial Robots

All of the following fatal accidents were caused by people being crushed after entering the enclosure while an industrial robot was operating.

	Overview of fatal accidents caused by industrial robots
1	At a plant where one industrial robot and four metal processing machines were surrounded by a safety fence, the industrial robot started moving while the victim was measuring the product inside the safety fence after it had been manufactured. The victim was crushed from behind onto the product by the robot, which resulted in death by asphyxiation due to pressure on their abdomen.
2	The victim was found in an automated line with their face in a coolant tank from where their head had been pushed down from above by the tip of a manipulator. They died a month later in hospital.
3	While the victim was dealing with machine trouble, the tray hand of an industrial robot which had been on stand by above them fell. The victim died after being crushed between the tray hand and tray.
4	An industrial robot stopped with an error, and the victim cleared the error by removing the workpiece that the robot was grabbing. At that time, the robot started moving and the victim died after their chest was crushed between the end of the robot manipulator and transfer table.
5	The victim entered the operating area without stopping an industrial robot that transfers pallets, and died after their chest was crushed between the robot support column and the transfer manipulator.
6	When the victim entered a robot operating area surrounded by a safety fence, they died after a product holding guide at the tip of a manipulator holding a container swung round and crushed the victim between the robot stand.
7	When the victim went under a 30cm gap in the fence of an industrial robot while the industrial robot was automatically loading cargo onto a pallet, the manipulator that was holding the cargo fell onto them and they died after their neck was crushed between the cargo and the floor.

8	A welding robot stopped due to an error. When the victim was fixing it, the manipulator unexpectedly started to work and their chest was crushed. They died of asphyxiation.
9	The victim went under the manipulator of an industrial robot that transports workpieces automatically which has an integrated NC lathe. They died after their neck was crushed by the manipulator.

(Excerpts from item 1-1 by Safety Division, Industrial Safety and Health Department, Labor Standards Bureau, Ministry of Health, Labor, and Welfare)

■ Introduction

The FR Series and F Series robots are available in the following two types:

- **First edition iQ Platform compatible type**
- **First edition Standalone type**

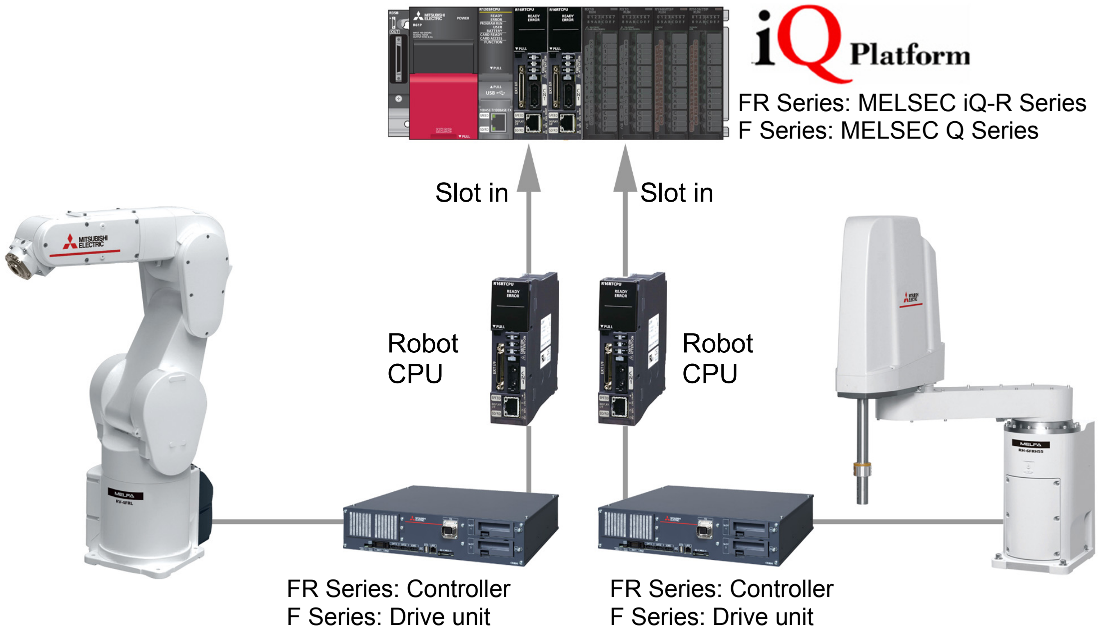
This textbook explains the FR Series and F Series with iQ Platform compatible type and stand alone type.

In the following pages, refer to the following logo marks, and read the page for the robot you are using.

Logo	FR Series		F Series	
	iQ Platform compatible (R type)	Standalone (D type)	iQ Platform compatible (Q type)	Standalone (D type)
COMMON	○	○	○	○
FR series	○	○		
F series			○	○
iQ Platform (FR/F series)	○		○	
iQ Platform (FR series)	○			
iQ Platform (F series)			○	
Standalone (FR/F series)		○		○
Standalone (F series)				○

iQ Platform compatible type (FR Series R type/F Series Q type)

This controller is compatible with "iQ Platform" that integrates each type of controller and HMI, engineering environment, and network seamlessly. With the multi-CPU configuration, compatibility with FA devices is enhanced, and elaborate control and information manage ment can be performed quickly and easily.



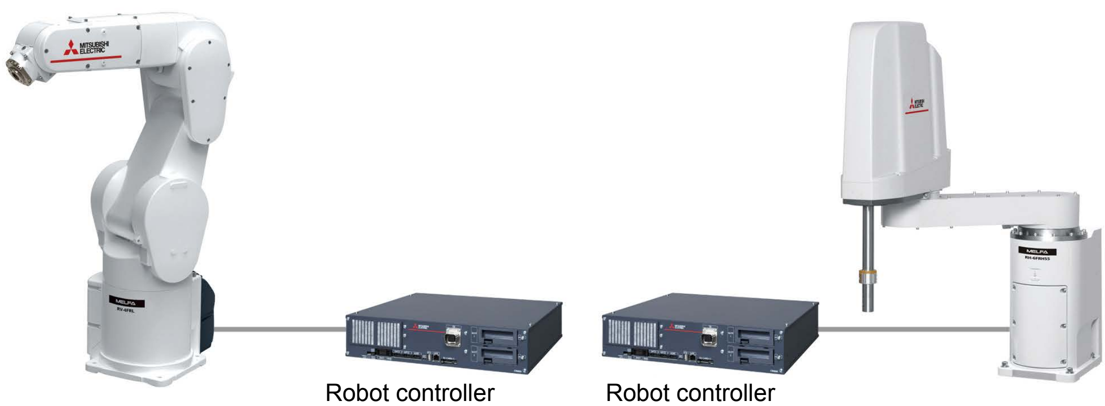
※When using an iQ Platform compatible type robot for the first time, a multi-CPU setup is ne cessary.
The following are examples of how to set up multiple CPUs.

FR Series: Chapter 5 Input/Output Function 5.2 (4) PLC multi-CPU (GX-Works3) settings

F Series: Appendix 5 iQ Platform Compatible (MELSEC Q Series Compatible) Appendix 5.2 Setting Multi-CPU (Using GX Works2)

Standalone type (FR Series D type/F Series D type)

Cells can be built by using the robot controller as the main controller.
This type of robot is equipped with various types of interface as standard, and enables users to build the best system for their application.



Chapter 1 Introduction to MELFA

(1) Types of robot arms

The robot arms include:

1) Vertical articulated type, RV type
2) Horizontal articulated type, RH type

Vertical articulated type
RV type

Horizontal articulated type
RH type

(2) Types of controllers and drive units

1) F Series controller

(O/P: Operation Panel)

Standalone	iQ Platform compatible
CR750-D  With O/P	CR750-Q  (Drive unit)  (CPU) With O/P
CR751-D  No O/P	CR751-Q  (Drive unit)  (CPU) No O/P
CR760-D  With O/P for RV-35/50/70F	CR760-Q  (Drive unit)  (CPU) With O/P for RV-35/50/70F

2) FR Series controller

(O/P: Operation Panel)

Standalone	iQ Platform compatible
CR800-D  No O/P	CR800-R   No O/P

(3) Types of device connection cables

1) F Series connection cables

◆ CR750/CR751 controller/drive unit connection cables

1) For motor power

2) For encoder signals

These two types of cables are available, and they connect robot arms with controller/drive unit.

<For CR750 controller/drive unit>

For motor power

For encoder signal

<For CR751 controller/drive unit>

For motor power

For encoder signal

◆ CR760 controller connection cable

This manual omits explanations for the CR760 controller/drive unit.
For details, confirm with their individual manuals.

2) FR Series connection cables

◆ CR800 controller connection cable

A single type of the CR800 controller connection cable is available.

<For CR800 controller>

1.1 Standalone type device configuration

(1) F Series

Robot arm

Device connection cable

·For CR750 controller

·For CR751 controller

Controller

·CR750-D

·CR751-D

·CR760-D

(2) FR Series

Robot arm

Device connection cable

·For CR800 controller

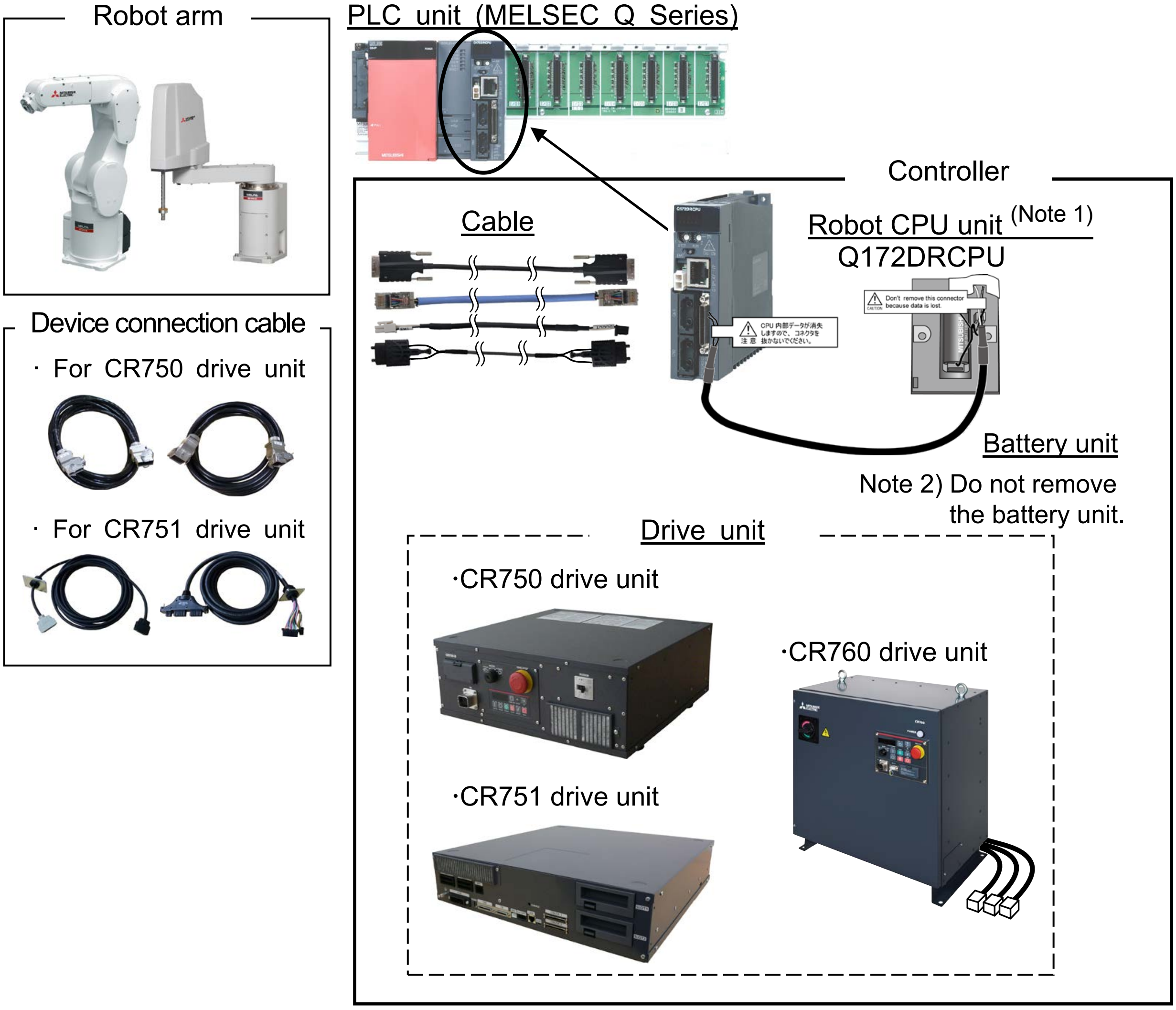
Controller

·CR800-D

1.2 iQ Platform compatible type device configuration

(1) CR750/CR751 drive unit (F Series)

a) Standard device configuration



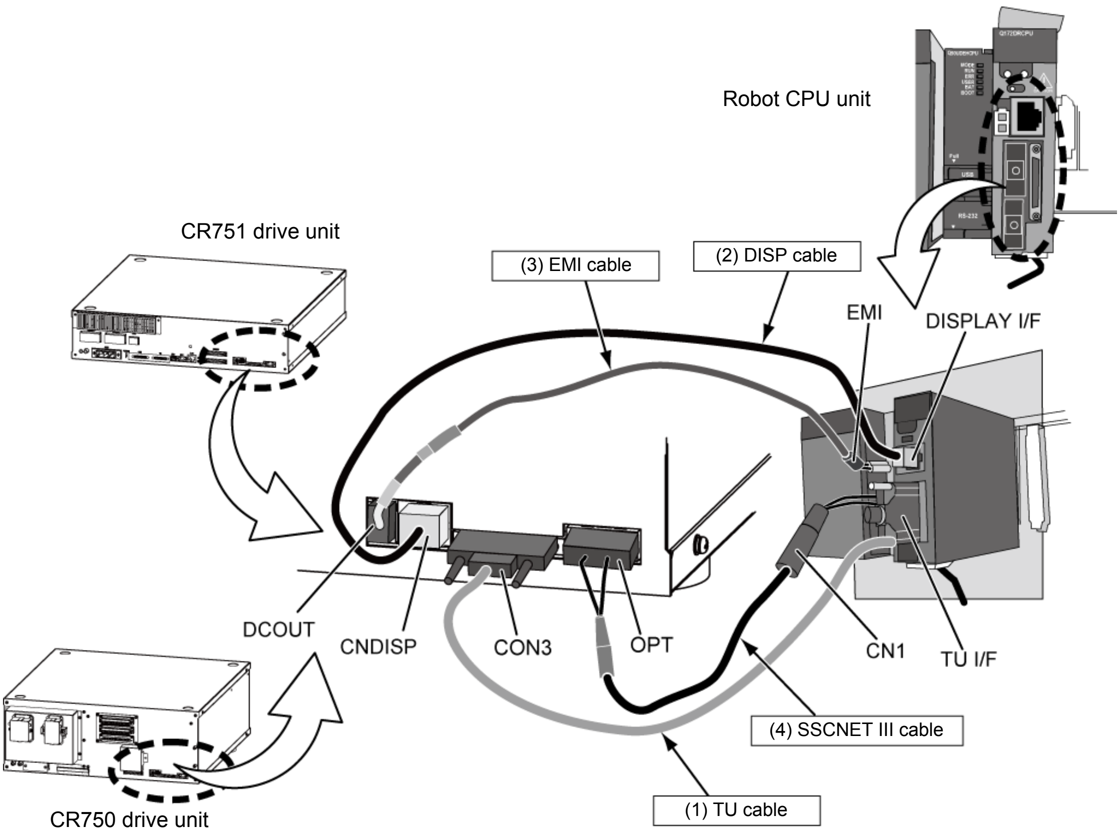
Note 1) The same type of robot CPU module is used for both robot arm types.
The CPU is mounted on the PLC unit (base board, power module, PLC CPU required) prepared by the user.

b) CPU unit connection cable types

The following types of connection cables are used. (These are dedicated for the robot.)
Use this cable to connect the robot CPU unit and drive unit.

(1)	TU cable	For T/B and operation panel signals 
(2)	DISP cable	For T/B data transmission 
(3)	EMI cable	For emergency stop signal CPU side D/U side 
(4)	SSCNET III cable	For servo amplifier control 

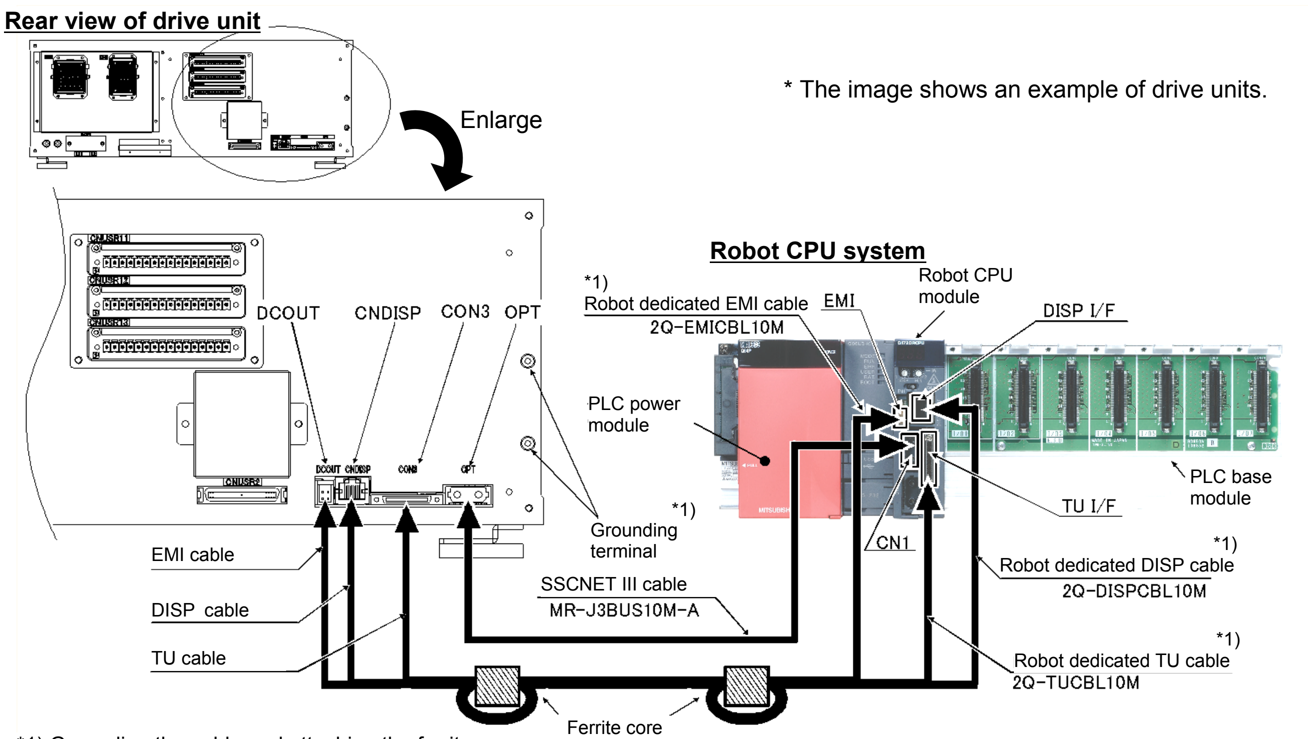
c) Connection with CR750/CR751 drive units



Cable connection between the robot CPU unit and the CR750/751 drive units

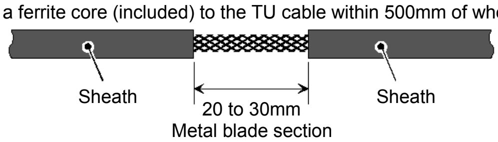
For details, refer to d) Example connection with CR750 drive unit and e) Example of connection with CR751 drive unit.

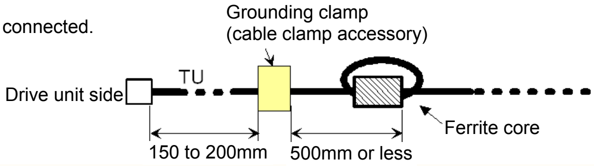
d) Example of connection with CR750 drive unit



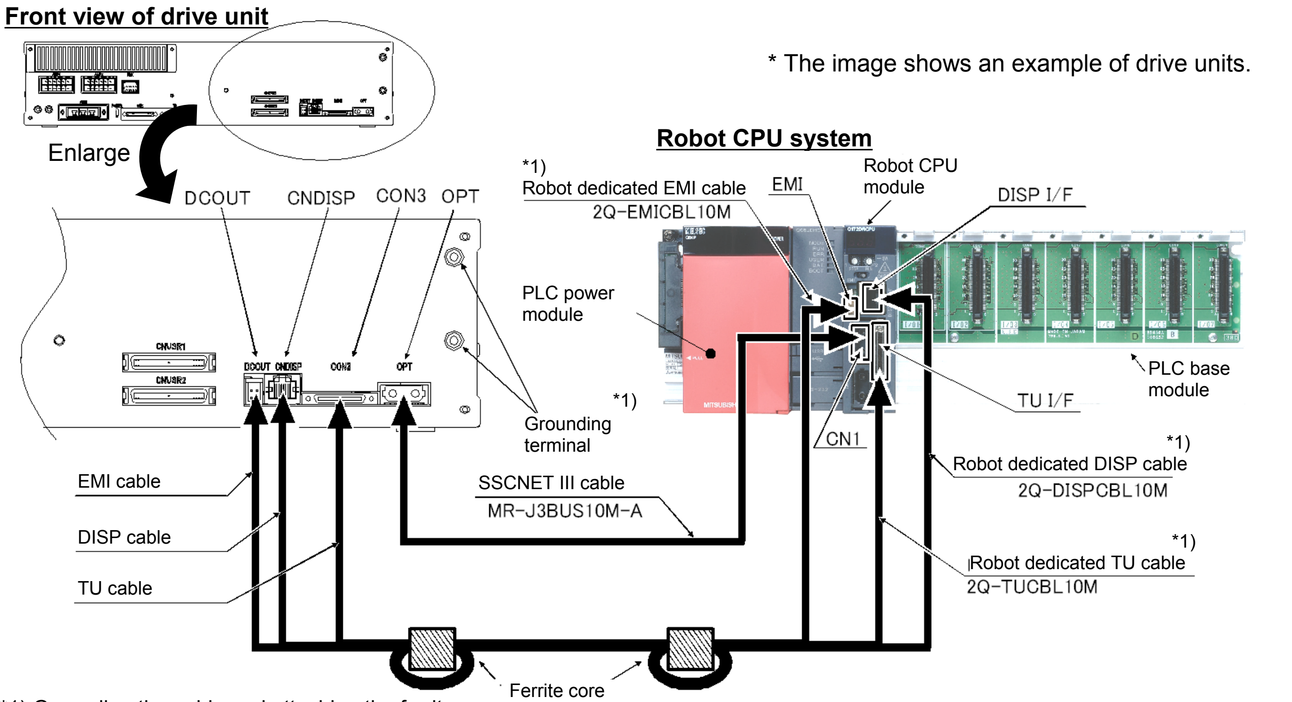
*1) Grounding the cable and attaching the ferrite core

For TU cables, DISP cables, and EMI cables, strip off the sheath of the cable, and connect the exposed metal blade section to the earth terminal on the rear of the drive unit.
Attach a ferrite core (included) to the TU cable within 500mm of where it is connected.





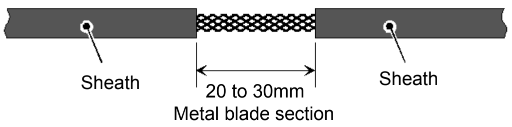
e) Example of connection with CR751 drive unit

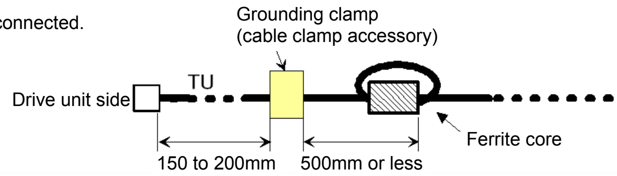


*1) Grounding the cable and attaching the ferrite core

With the TU cable, DISP cable and EMI cable, the metal blade section exposed by peeling the sheath is grounded to the grounding terminal on the front of the drive unit.

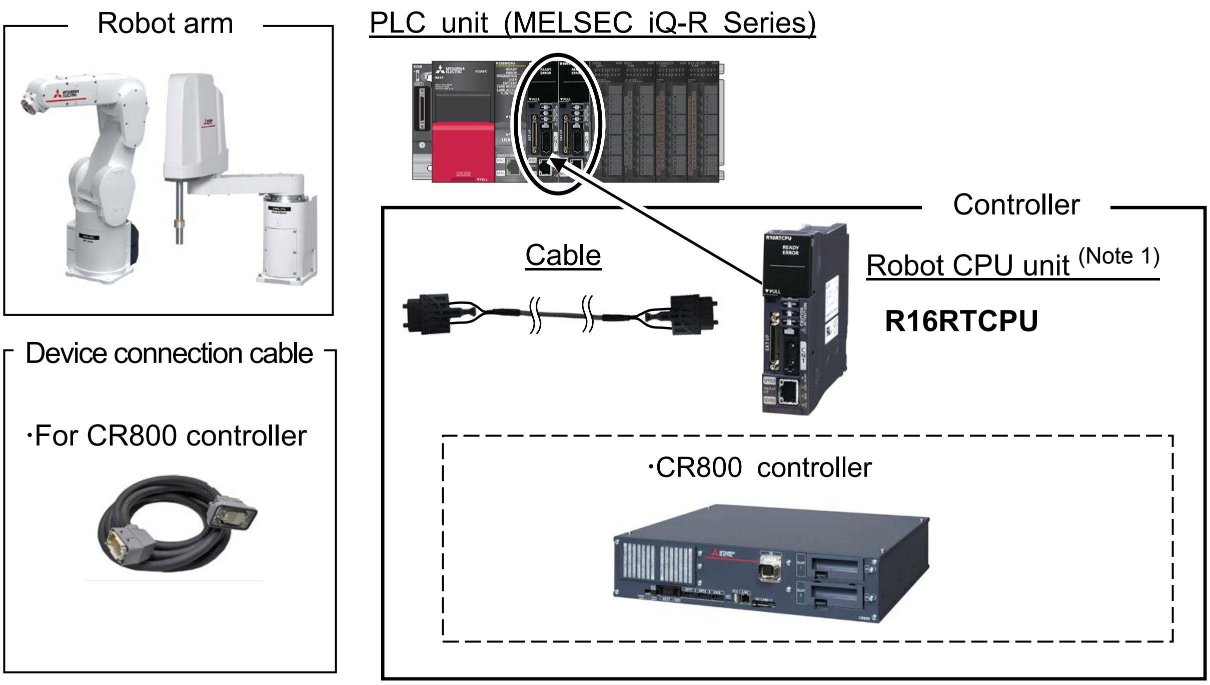
Attach a ferrite core (included) to the TU cable within 500mm of where it is connected.





(2) CR800 controller (FR Series)

a) Standard configuration



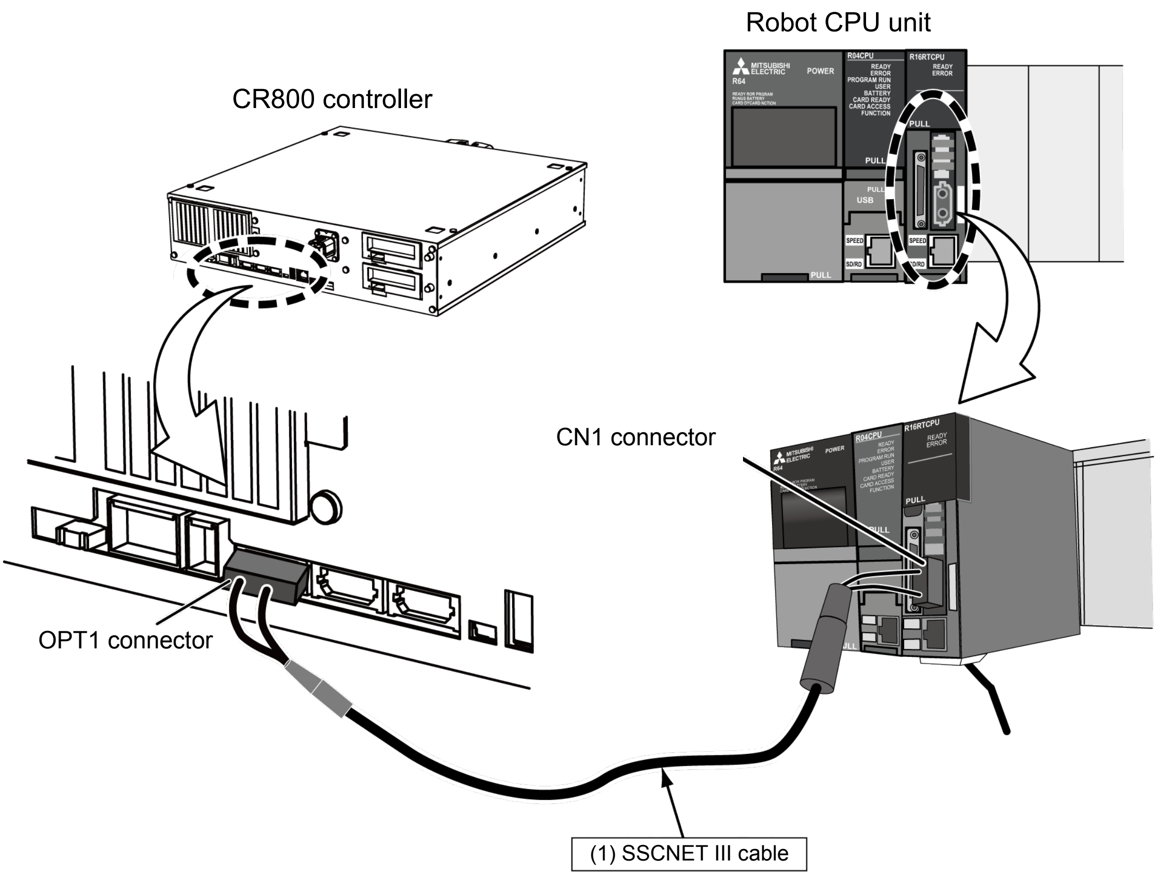
Note 1) The same type of robot CPU module is used for both robot arm types.
The CPU is mounted on the PLC unit (base board, power module, PLC CPU required) prepared by the user.

b) CPU unit connection cable types

Only one type of connection cable is available (robot dedicated).
Connects the robot CPU unit and robot controller.

(1)	SSCNET III cable	For servo amplifier control 

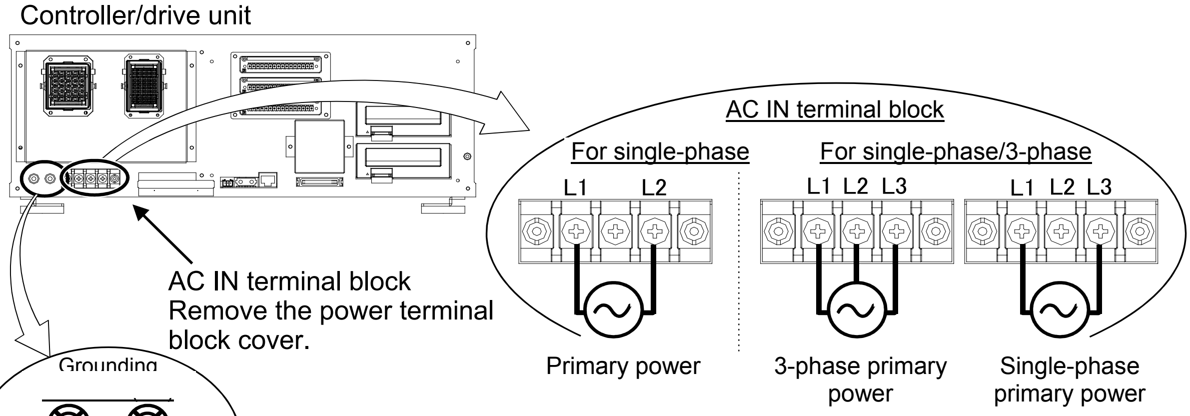
c) Connection with CR800 controller

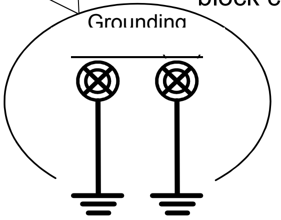


Cable connection between robot CPU unit and CR800 controller

1.3 Power cable connection terminals

(1) CR750 controller/drive unit (F Series)





Attach the primary power cable to the terminal block with the fixing screw.

Screw size: M4

Solderless terminal: ϕ8 or less

Recommended product: 2-M4

(J.S.T. Mfg. Co., Ltd.)

Wire size: AWG #14(2mm^2)/M4 screw

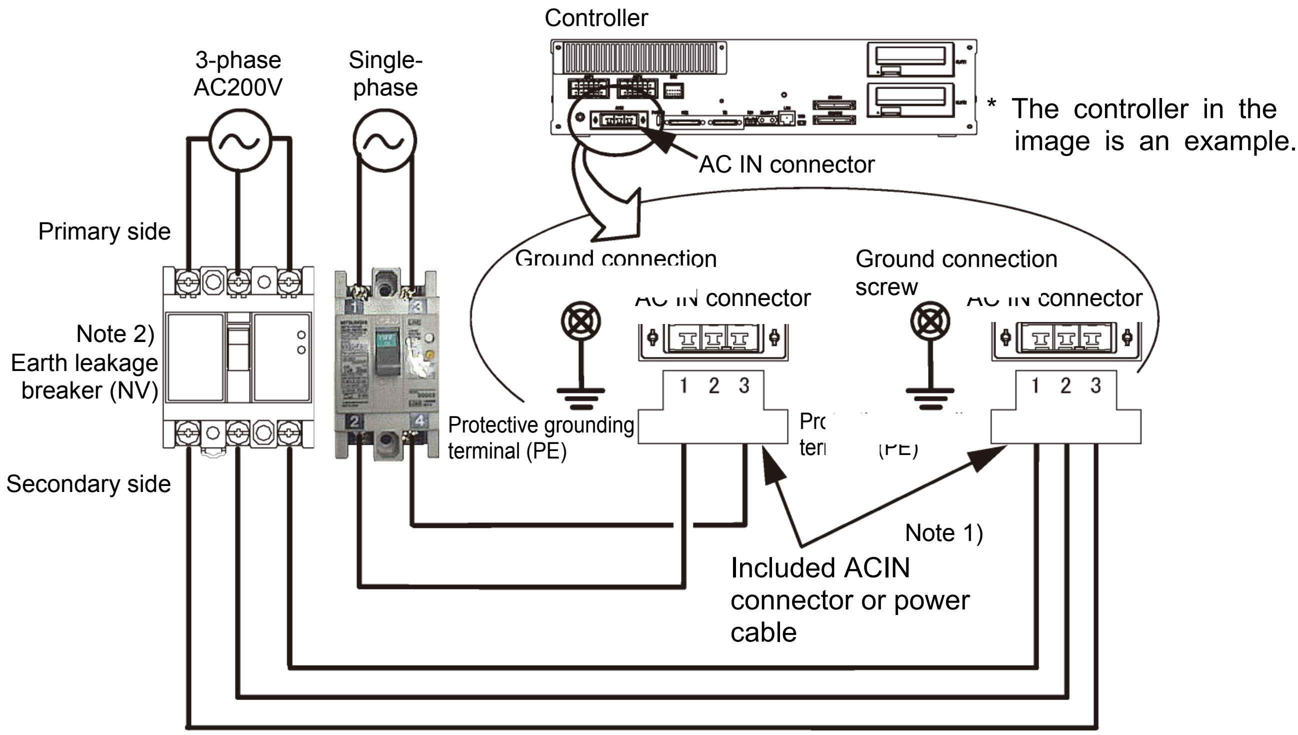
Note) When screwing the power cable onto the AC IN terminal block, hold down the solderless terminal so it does not turn. The partition between the AC IN terminal block terminals could break if force is applied.

Primary voltage specifications

- ·RH-3FHR Series: Single-phase 180 to 253VAC
- ·RH-6FH Series: Single-phase 180 to 253VAC
- ·RH-12FH/20FH Series: 3-phase 180 to 253VAC, or single-phase 207 to 253VAC
- ·RV-2F Series: Single-phase 180 to 253VAC
- ·RV-4F Series: Single-phase 180 to 253VAC
- ·RV-7F/13F/20F Series: 3-phase 180 to 253VAC, or single-phase 207 to 253VAC

(2) CR751 controller/drive unit (F Series)

⚠Caution Provide an earth leakage breaker (prepared by user) on the primary power of the controller/drive unit as protection against leakage currents.



Note 1) A crimping tool is recommended to connect included ACIN connectors. (Soldering is acceptable)
Recommended crimping tool: 234171-1 (Tyco Electronics)

Note 2) The earth leakage breaker is prepared by the user. Make sure to use terminal covers.

Primary voltage specifications

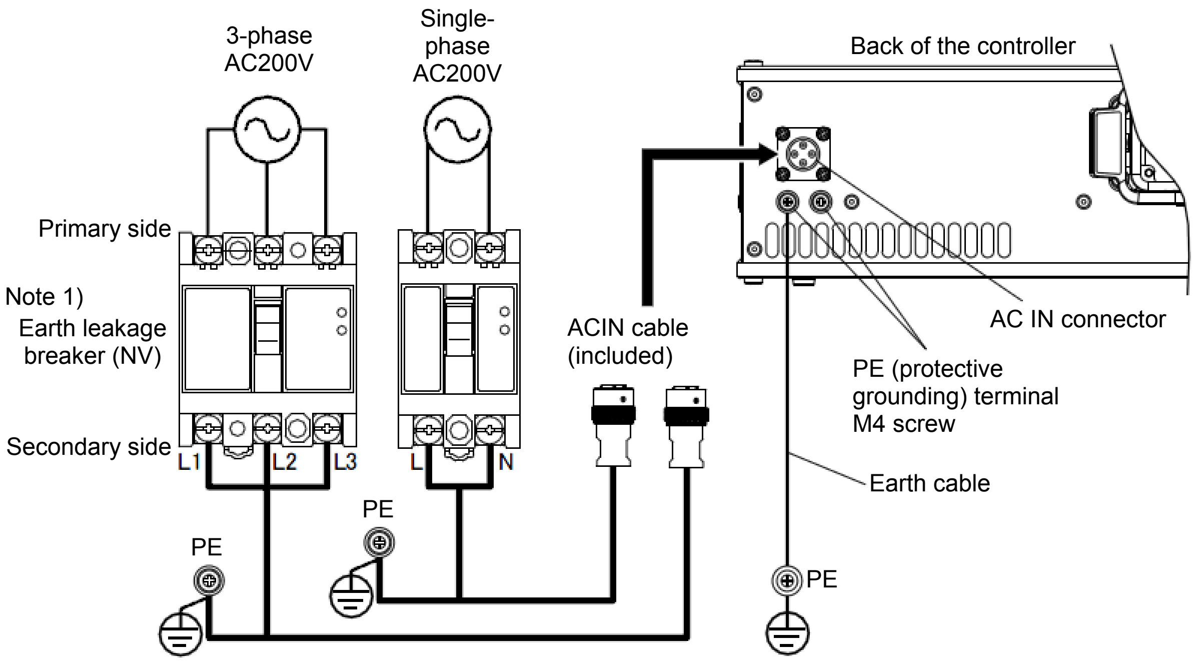
- ·RH-3FH/3FHR Series: Single-phase 180 to 253VAC
- ·RH-6FH Series: Single-phase 180 to 253VAC
- ·RH-12FH/20FH Series: 3-phase 180 to 253VAC, or single-phase 207 to 253VAC
- ·RV-2F Series: Single-phase 180 to 253VAC
- ·RV-4F Series: Single-phase 180 to 253VAC
- ·RV-7F/13F/20F Series: 3-phase 180 to 253VAC, or single-phase 207 to 253VAC

The earth leakage breaker, primary power supply connection cable and earth cable are to be prepared by the customer.

Component name	Specifications
Earth leakage breaker (recommended)	Single-phase: NV30FAU-2P-10A-AC100-240V-30mA (terminal cover: TCS-05FA2) 3-phase: NV30FAU-3P-10A-AC100-240V-30mA (terminal cover: TCS-05FA3)
Primary power supply connection cable	AWG #14 (2 mm^2) or more
Primary power supply earth cable	AWG #12 (3.5mm^2) or more

(3) CR800 controller (FR Series)

⚠Caution Provide an earth leakage breaker (prepared by user) on the primary power of the controller/drive unit as protection against leakage currents.



Note 1) Make sure to install terminal covers to use the earth leakage breakers.

Primary voltage specifications

- ·RV-2FR/4FR/7FR Series: Single-phase 200 to 230VAC
- ·RH-3FRH/3FRHR/6FRH/12FRH/20FRH Series: Single-phase 200 to 230VAC
- ·RV-13FR/20FR/7FRLL Series: Single-phase 230VAC/3-phase 200 to 230VAC

The earth leakage breaker, primary power supply connection cable and earth cable are to be prepared by the customer.

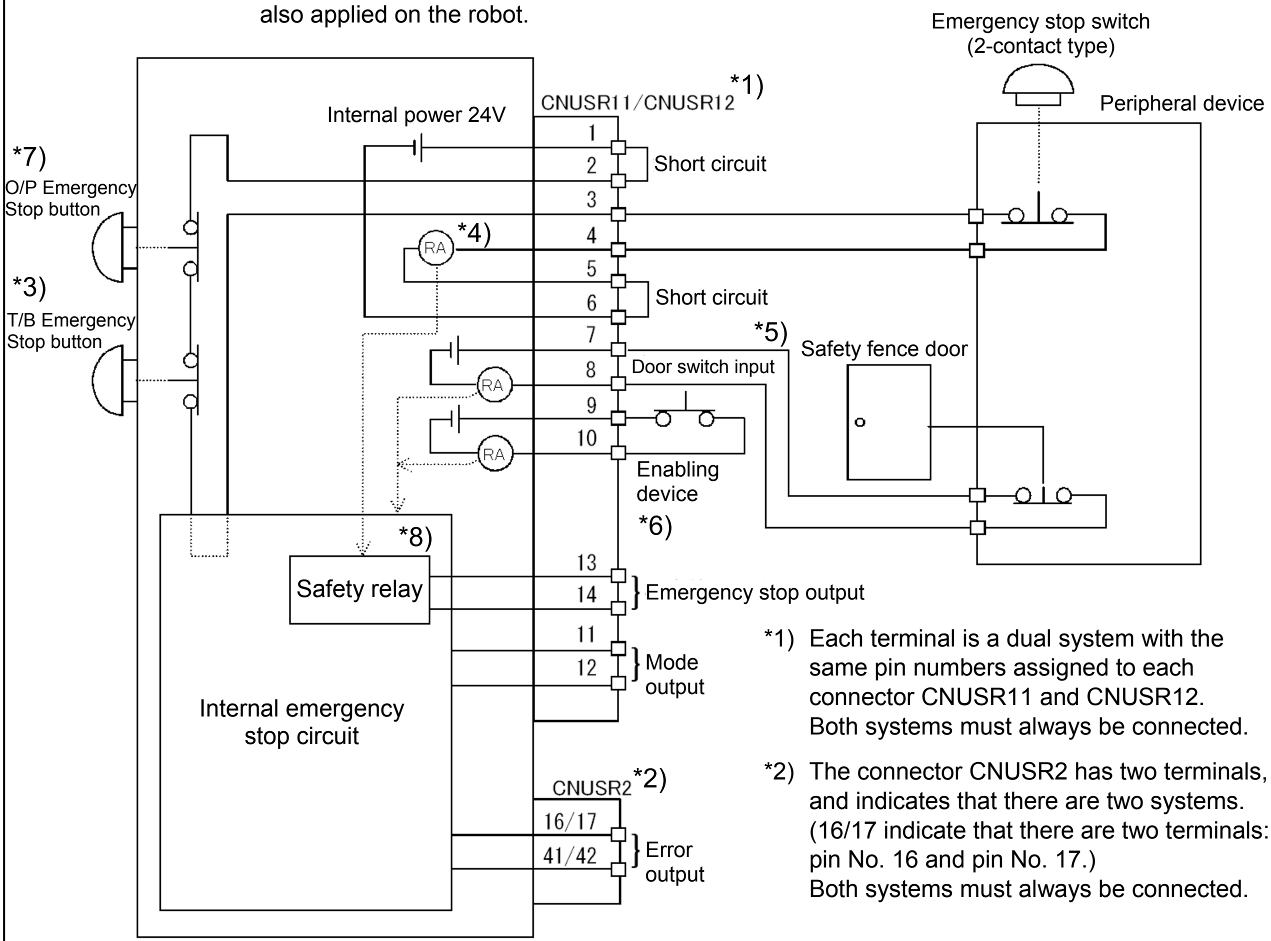
Component name	Specifications
Earth leakage breaker (recommended)	Single-phase: NV30FAU-2P-10A-AC100-240V-30mA (terminal cover: TCS-05FA2) 3-phase: NV30FAU-3P-10A-AC100-240V-30mA (terminal cover: TCS-05FA3)
Primary power supply connection cable	AWG #14 (2 mm^2) or more
Earth cable	AWG #14 (2 mm^2) or more

1.4 Connecting the emergency stop

Two circuits for the emergency stop input are provided on the "dedicated input/output" terminal connector on the controller/drive unit. An example of the safety measures is given below. Refer to these drawings and provide safety measures. The drawings show the normal state with no emergency stop.

(1) CR750 controller/drive unit (F Series)

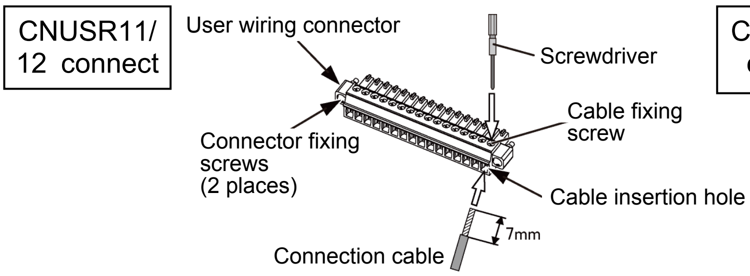
<Wiring example> Connect the peripheral device's emergency stop switch.
The power in the controller/drive unit is used for the emergency stop detection power.
<Emergency stop operation>
When the emergency stop switch on the peripheral device is pressed, emergency stop is also applied on the robot.

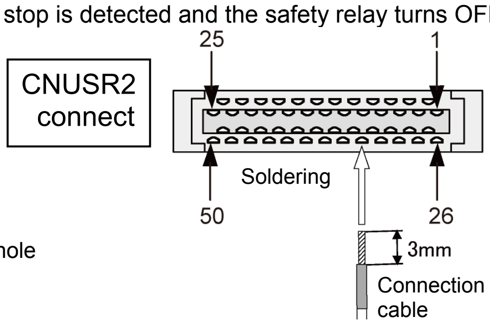


*1) Each terminal is a dual system with the same pin numbers assigned to each connector CNUSR11 and CNUSR12. Both systems must always be connected.

*2) The connector CNUSR2 has two terminals, and indicates that there are two systems. (16/17 indicate that there are two terminals: pin No. 16 and pin No. 17.) Both systems must always be connected.

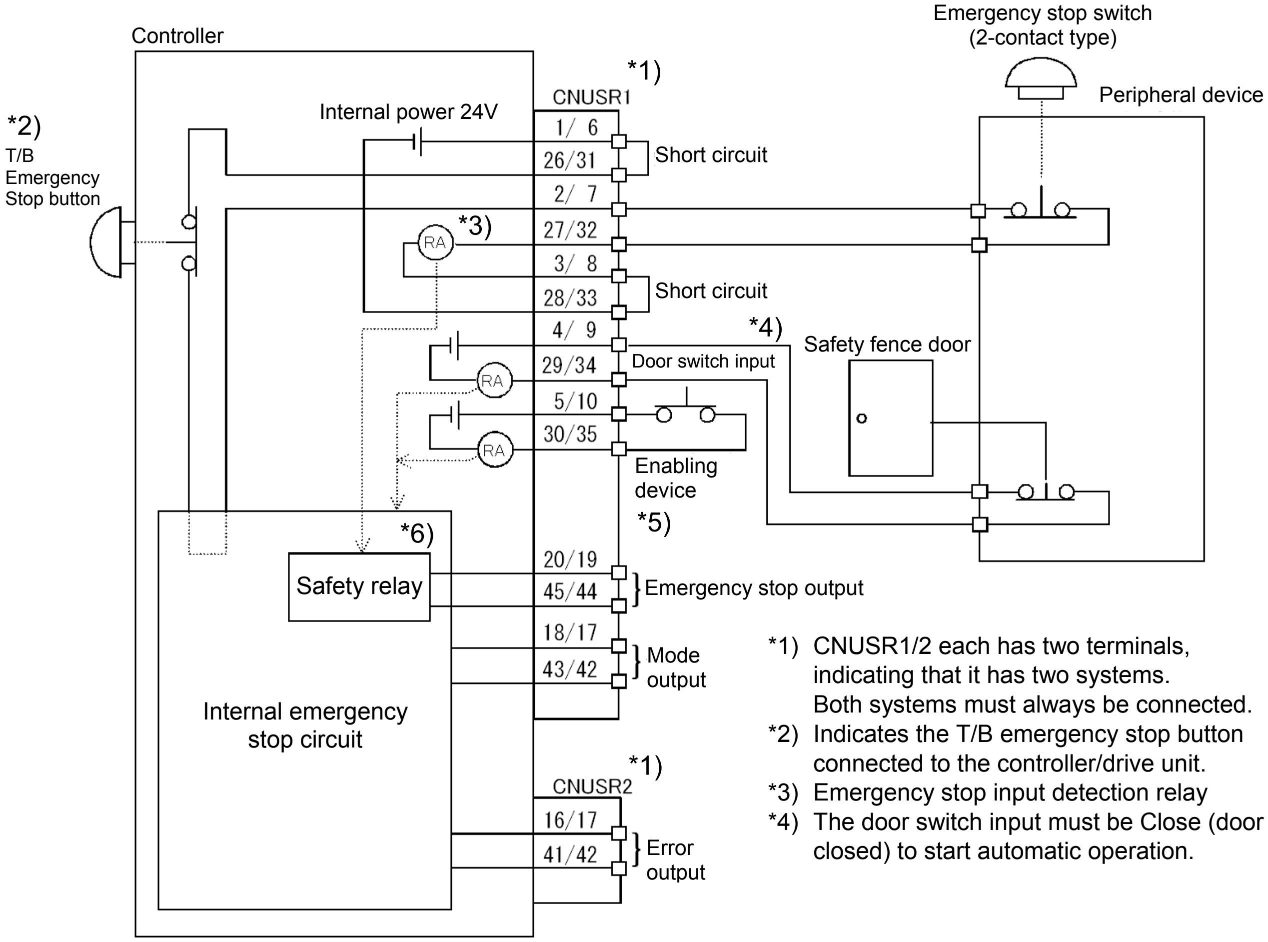
*3) Indicates the T/B emergency stop button connected to the controller/drive unit.
*4) Emergency stop input detection relay
*5) The door switch input must be Close (door closed) to start automatic operation.
*6) Regardless of the door switch input state, the enabling device input must be Close (ON) to release the brakes.
*7) Indicates the emergency stop button on the controller/drive unit's operation panel. (Only on specifications with operation panel.)
*8) The emergency stop input detection relay is used to control the safety relay in the controller/drive unit. When the emergency stop input detection relay turns OFF, an emergency stop is detected and the safety relay turns OFF.





(2) CR751 controller/drive unit (F Series)

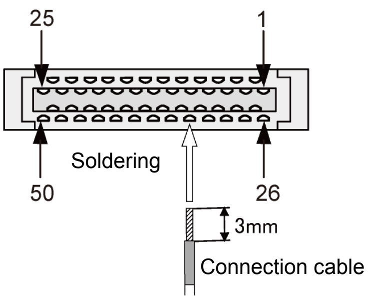
<Wiring example> Connect the peripheral device's emergency stop switch.
The power in the controller/drive unit is used for the emergency stop detection power.
<Emergency stop operation>
When the emergency stop switch on the peripheral device is pressed, emergency stop is also applied on the robot.



*1) CNUSR1/2 each has two terminals, indicating that it has two systems. Both systems must always be connected.
*2) Indicates the T/B emergency stop button connected to the controller/drive unit.
*3) Emergency stop input detection relay
*4) The door switch input must be Close (door closed) to start automatic operation.

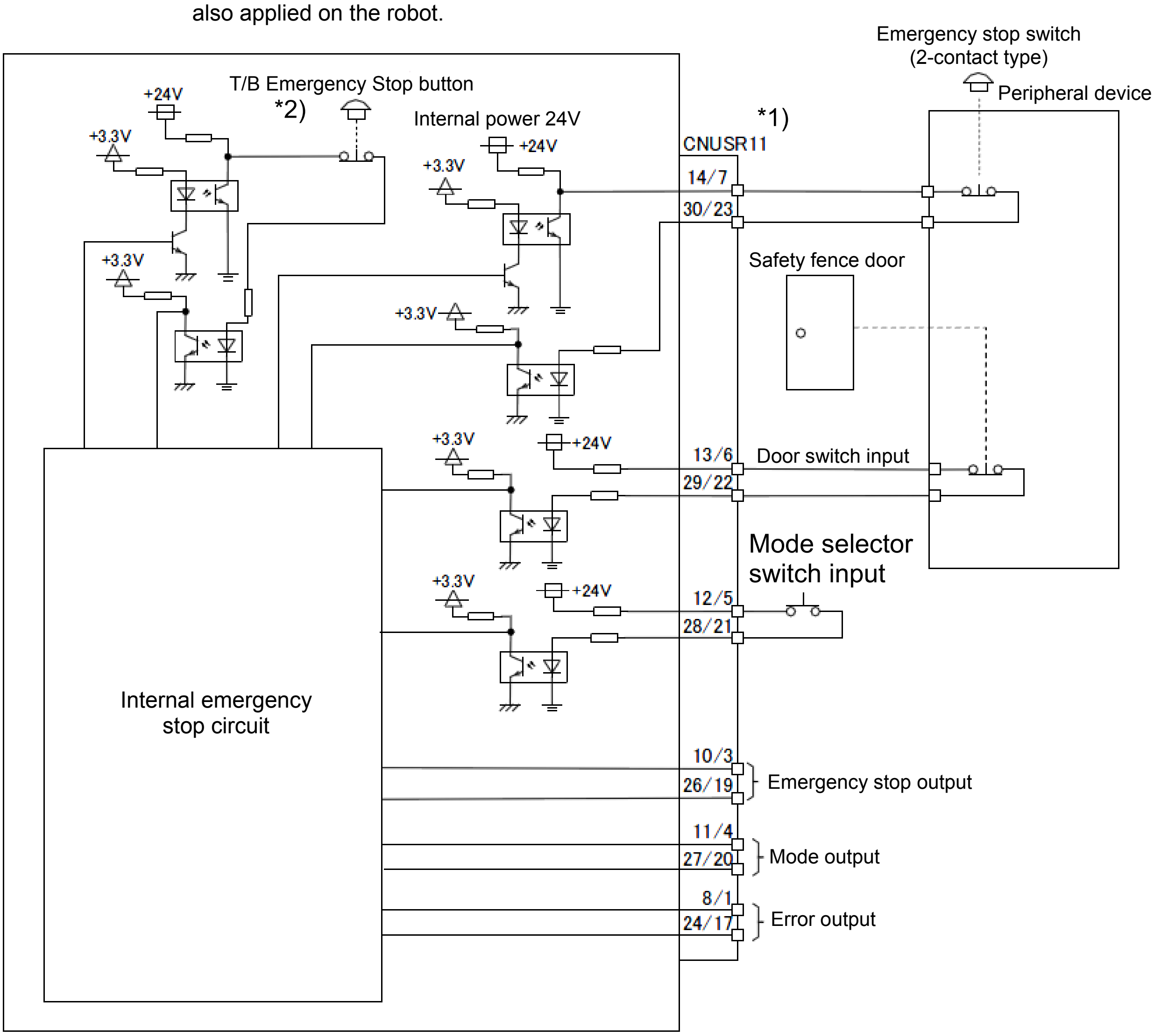
*5) Regardless of the door switch input state, the enabling device input must be Close (ON) to release the brakes.
*6) The emergency stop input detection relay is used to control the safety relay in the controller/drive unit. When the emergency stop input detection relay turns OFF, an emergency stop is detected and the safety relay turns OFF.

CNUSR1/2 connector



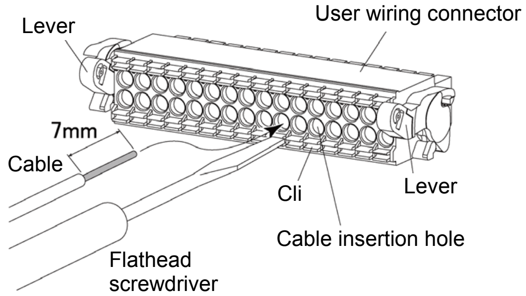
(3) CR800 controller (FR Series)

<Wiring example> Connect the peripheral device's emergency stop switch.
The power in the controller is used for the emergency stop detection power.
<Emergency stop operation>
When the emergency stop switch on the peripheral device is pressed, emergency stop is also applied on the robot.



*1) CNUSR11 each has two terminals, indicating that it has two systems. Both systems must always be connected.
*2) Indicates the T/B emergency stop button connected to the controller.

CNUSR11 connector



1.5 Mode Switching

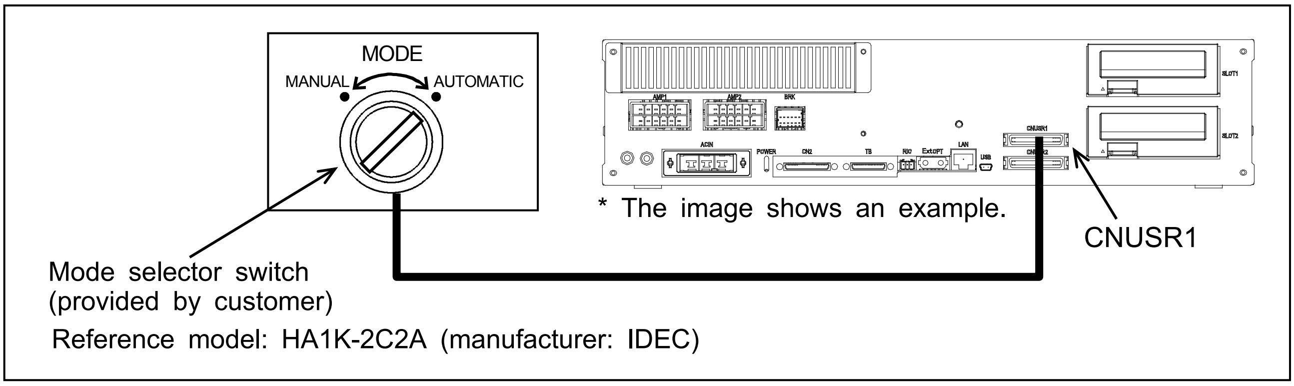
CR751 controller/drive units, and CR800 controllers do not have operation panels.
For mode switching (during teaching/during automatic operation), use the robot when the emergency stop switch, door switch, and mode selector switch prepared by the user is connected.
For details, refer to the separate "INSTRUCTION MANUAL Controller setup, basic operation, and maintenance".

<Operation rights (controller mode)>

AUTOMATIC (during automatic operation) Operation from external devices is available. Operations requiring operation rights from the T/B are not possible. To connect with external devices, set parameters for operation rights. For details of the AUTOMATIC mode, refer to the separate "INSTRUCTION MANUAL Detailed explanations of functions and operations".

MANUAL (during teaching) When the T/B is enabled, only the operation from the T/B is enabled. Operations requiring operation rights from external devices are not possible.

(1) Mode selector switch connection (CR751 controller/drive unit) (F Series)



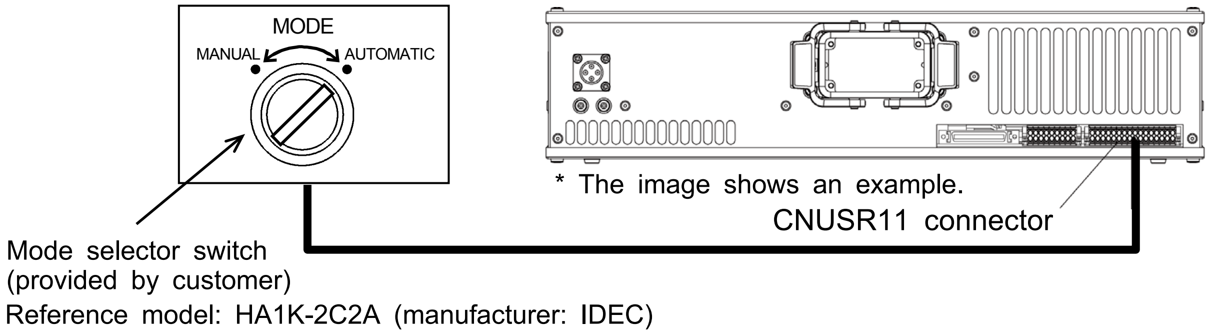
Connect switch contacts to the pins as shown below.

Pin numbers and functions (connector: CNUSR1)		Switch mode Note 1)	
Pin number	Function	MANUAL	AUTOMATIC
49	Key input 1st system	Open	Close
24	Key input 1st system power supply +24V		
50	Key input 2nd system	Open	Close
25	Key input 2nd system power supply +24V		

Note 1) When both pin numbers 49 and 24 or pin numbers 50 and 25 are open or closed at the same time, the mode switches. If the input status between two systems are different, the error H0044 (operation panel mode key line fault) occurs.

[Caution] In the customer's system, do not ground the + side of 24V power supply prepared by the customer for input/output (related with emergency stop and parallel input/output) to connect to the controller/drive unit.
Connecting the devices to the controller/drive unit with the + side grounded will cause a malfunction in the controller/drive unit.

(2) Mode selector switch input connection (CR800 controller) (FR Series)



Connect switch contacts to the pins as shown below.

Pin numbers and functions (connector: CNUSR11)		Switch mode Note 1)	
Pin number	Function	MANUAL	AUTOMATIC
21	Key input 1st system	Open	Close
5	Key input 1st system power supply +24V		
28	Key input 2nd system	Open	Close
12	Key input 2nd system power supply +24V		

Note 1) When both pin numbers 21 and 5 or pin numbers 28 and 12 are open or closed at the same time, the mode switches.
If the input status between two systems are different, the error H0044 (operation panel mode key line fault) occurs.

[Caution] The emergency stop circuit inside the controller is a redundant (duplicated) configuration. Make sure to connect each contact to the connector pins as follows and wire it so that it is duplicated using the two point type switch for the emergency stop switch. If only a single side pin is connected, errors cannot be canceled.

1.6 Turning the control power ON

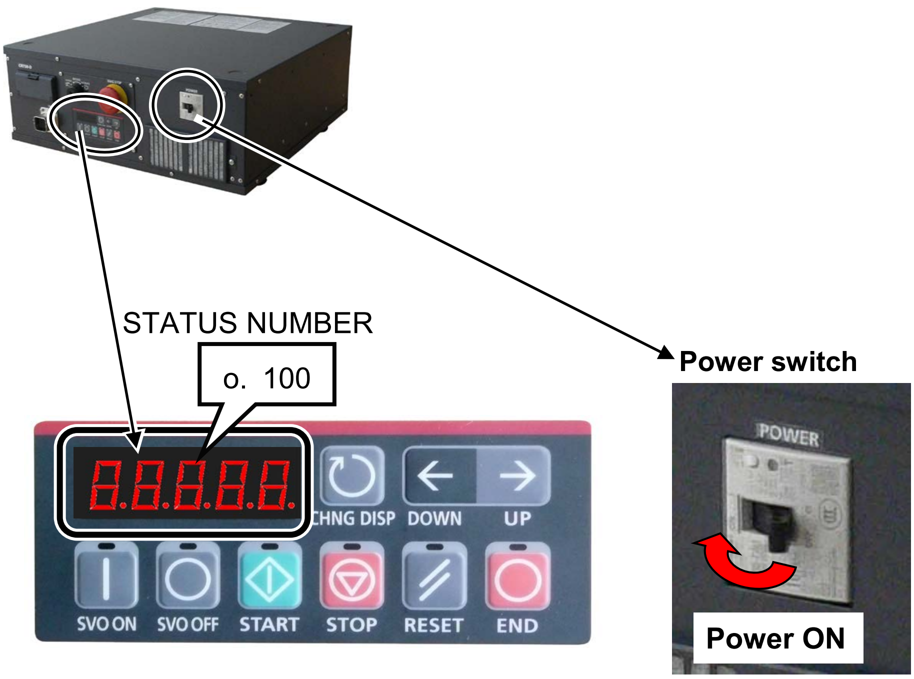
(1) CR750/CR751 controller/drive unit (F Series)

The primary voltage specifications differ according to the type of controller/drive unit.
After wiring the primary power, turn the controller/drive unit's control power ON.
The position of the power switch differs according to the controller/drive unit.

[Caution] For the iQ Platform compatible type, turn ON the drive unit power supply switch, then turn ON the robot CPU system power supply ON. (they can be turned ON simultaneously)
* Turning ON the drive unit power supply only will not turn on LEDs on the operation panel.

a) CR750 controller/drive unit

<Confirmation of status>
The LED on the operation panel will turn ON approximately 15 seconds after the switch is turned ON.
* When the operation starts normally, the speed ("o.100") appears at the STATUS NUMBER field.

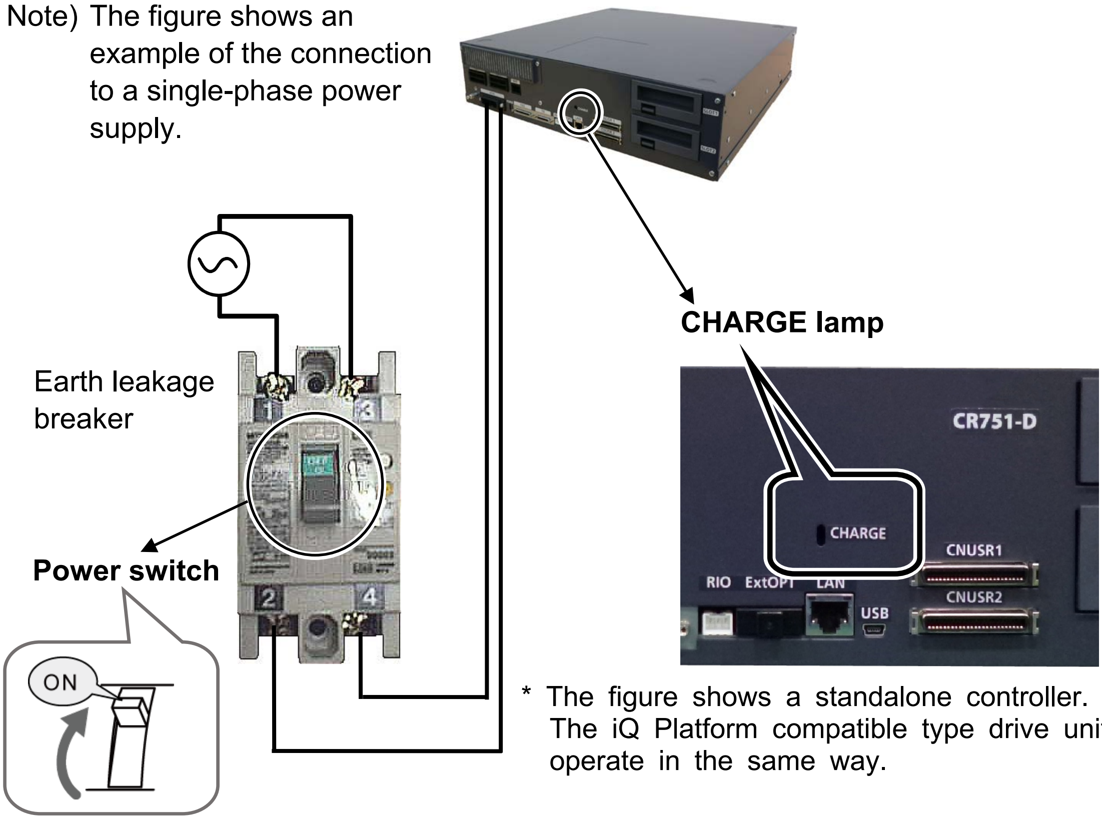


b) CR751 controller/drive unit

<Confirmation of status>

The CHARGE lamp on the front of the controller/drive unit turns ON approximately 15 seconds after the switch is turned ON.

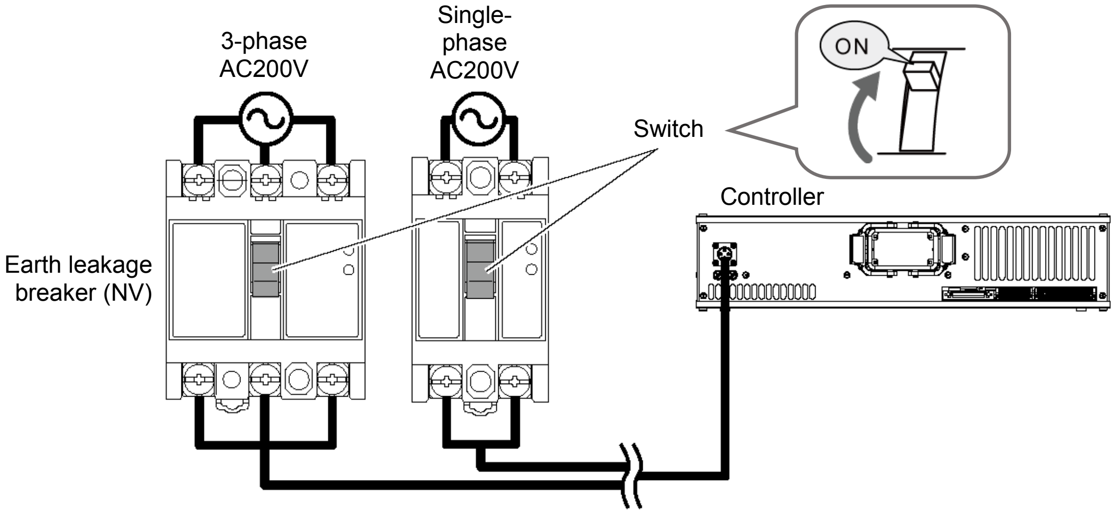
Note) The figure shows an example of the connection to a single-phase power supply.



* The figure shows a standalone controller. The iQ Platform compatible type drive units operate in the same way.

(2) CR800 controller (FR Series)

When the primary power supply wiring is complete, turn ON the control power supply for the controller.
Turn the power supply ON/OFF using the earth leakage breaker switch installed outside the unit.

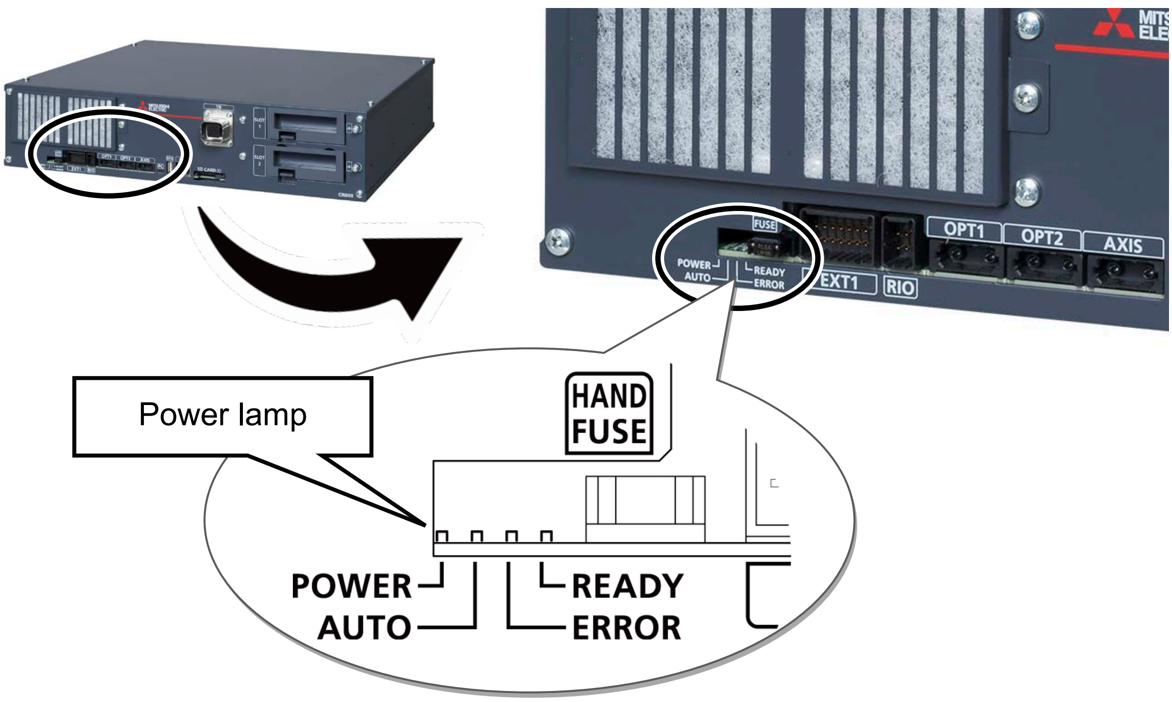


◆ CR800-D controller (standalone type)

1) Turn the earth leakage breaker switch ON to turn ON the power.
2) The POWER lamp turns on, and the control power supply turns on.

◆ CR800-R controller (iQ Platform compatible type)

1) Turn the earth leakage breaker switch ON to turn ON the controller.
2) The POWER lamp turns on, and the control power supply turns on.
3) Turn the robot CPU system power ON.



1.7 Turning the control power OFF

The procedures for turning the power OFF are explained below.

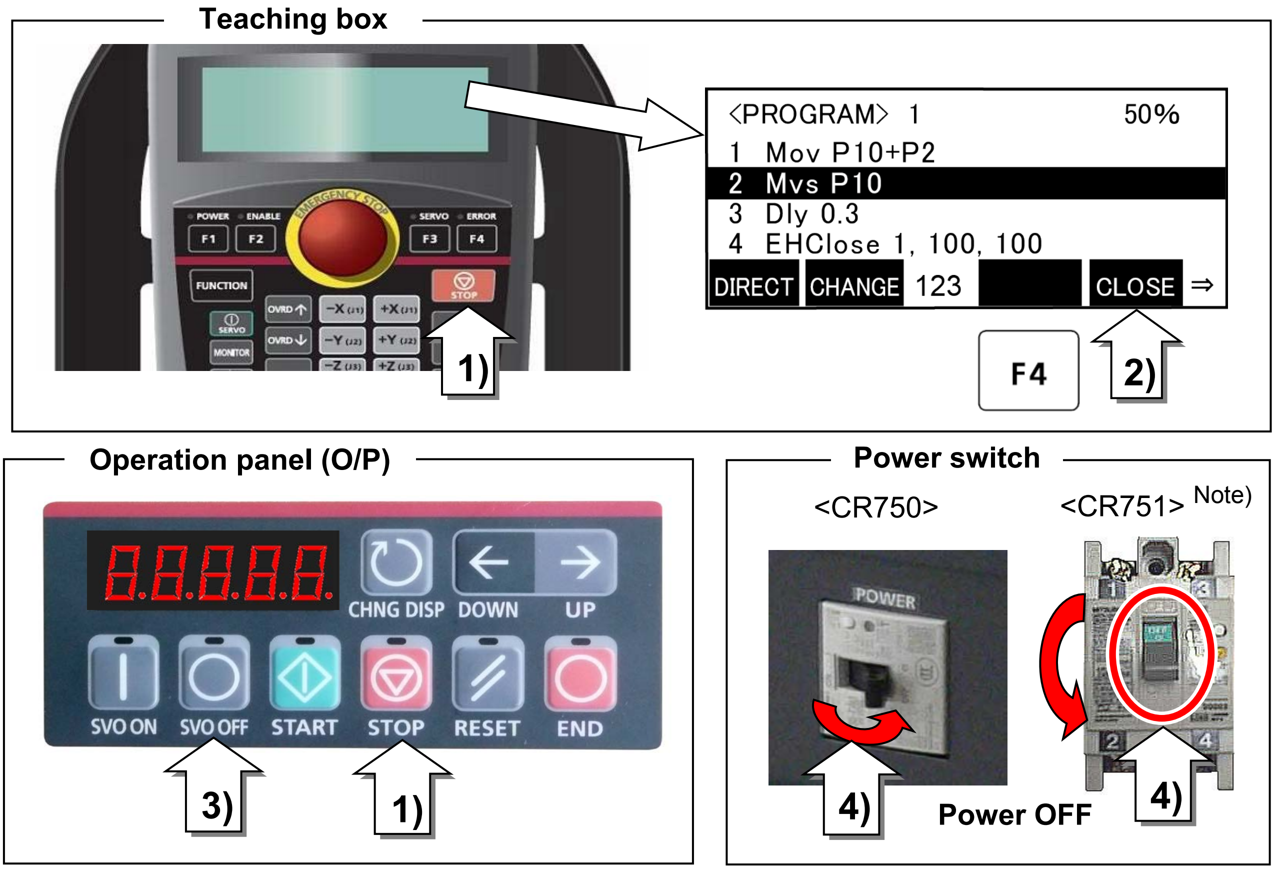
(1) CR750/CR751 controller/drive unit (F Series)

1) Confirm that the robot is stopped
If the robot is operating, press the [STOP] switch on the operation panel or teaching box and stop the robot.
During teaching, the servo can be turned OFF or stopped by releasing the teaching box ENABLE switch.

2) Close the program file (when editing the program or performing teaching)
Press the [F4] key (Close) on the teaching box.
[Caution] If file is not closed the program will not be saved and the edited details will be invalidated.

3) Turn the servo power OFF
Press the [SVO OFF] button on the operation panel.
Servo OFF operations do not require operation rights, therefore the servo can be turned OFF at any time by pressing the [SVO OFF] button.

4) Turn the control power switch OFF
[Caution] For the iQ Platform compatible type, turn the robot CPU system power OFF and turn the drive unit power switch OFF.



Note) This photo is an example of a user-prepared leakage breaker.

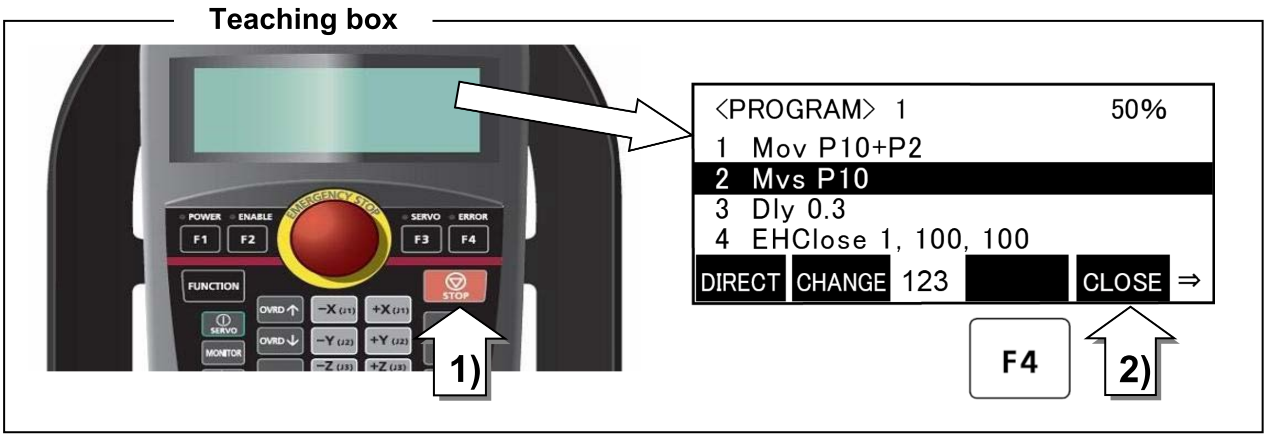
(2) CR800 controller (FR Series)

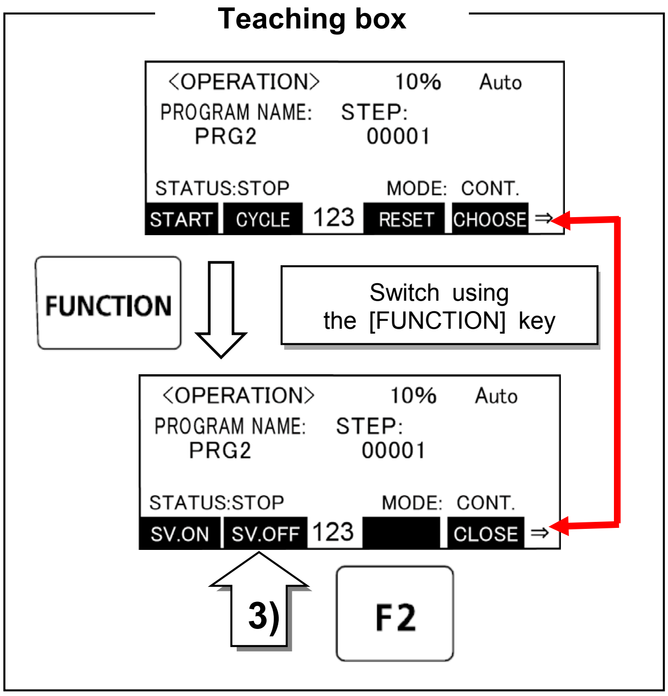
1) Confirm that the robot is stopped
   If the robot is operating, press the [STOP] switch on the teaching box and stop the robot.
   During teaching, the servo can be turned OFF or stopped by releasing the teaching box ENABLE switch.

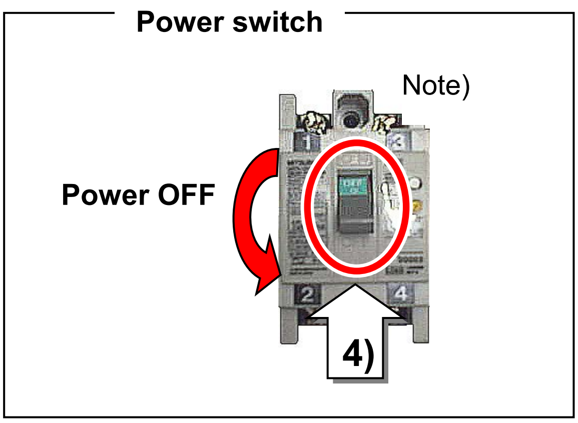
2) Close the program file (when editing the program or performing teaching)
   Press the [F4] key (Close) on the teaching box.
   [Caution] If file is not closed the program will not be saved and the edited details will be invalidated.

3) Turn the servo power OFF
   Press the [F2] key ("SV. OFF") on the teaching box.
   When the function "SV. OFF" is not displayed, press the [FUNCTION] key and switch the function menu display area.

4) Turn the control power switch OFF
   [Caution] For the iQ Platform compatible type, turn the robot CPU system power OFF, turn the earth leakage breaker power switch OFF.

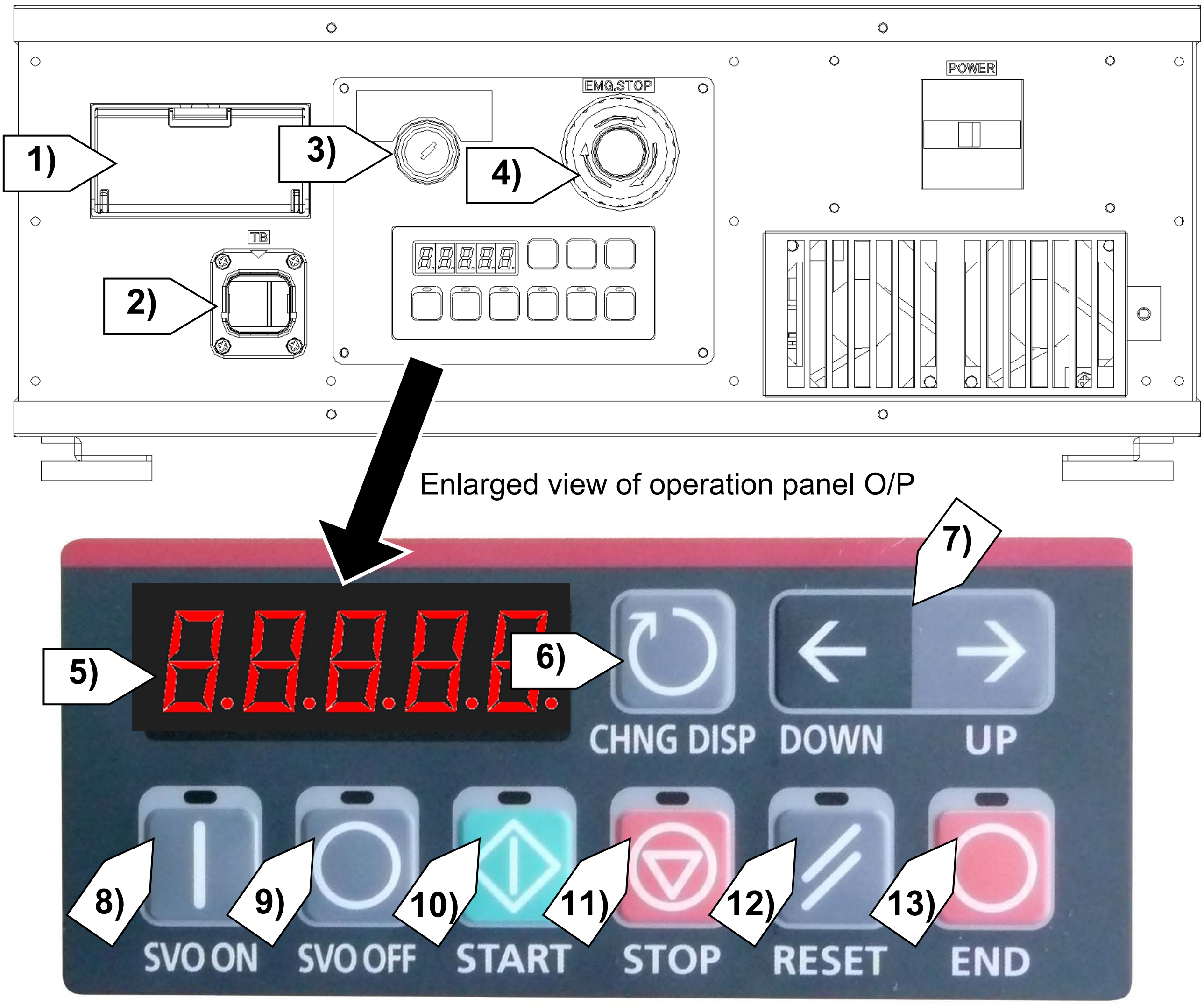






Note) This photo is an example of a user-prepared leakage breaker.

1.8 Names and functions of CR750 controller/drive unit operation panel (O/P) parts



Note) The CR751 controller/drive unit does not have an operation panel.

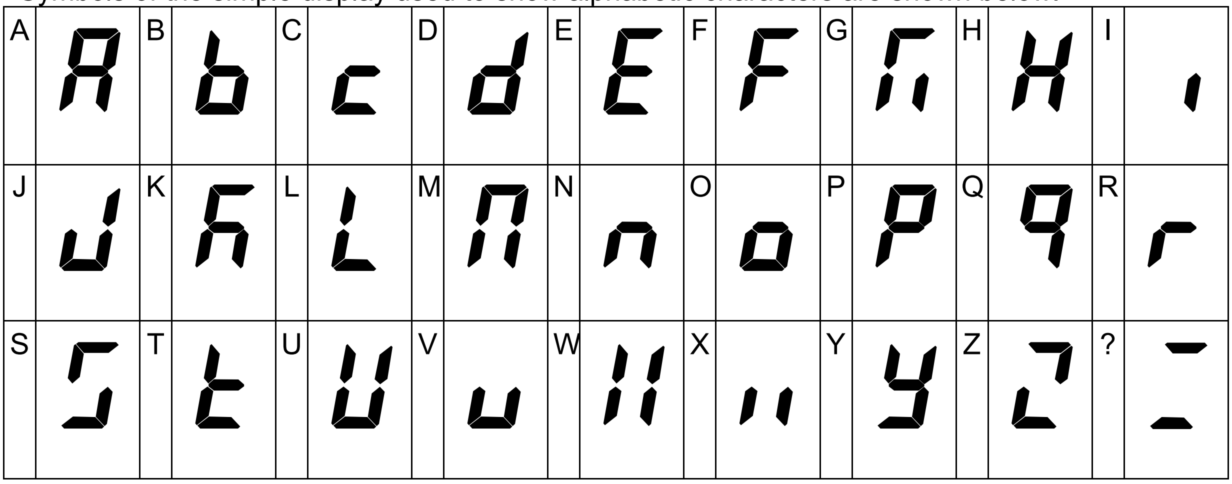
1) Interface cover
   The standalone type (F-D Series) controller is equipped with a USB interface for connection with a personal computer and a backup battery.
   These are not provided on the iQ Platform compatible type (F-Q Series) drive unit.

2) T/B connection connector
   Connect the teaching box with this connector.

3) MODE selection switch
   This selection switch enables the robot operation.
   Operation can be switched from the teaching box, operation panel or external switch.

4) Emergency stop switch (EMG.STOP)
   Press this switch to immediately stop the robot. (The servo power turns OFF.)

5) STATUS NUMBER display
The status such as program No., error No., line No. or speed is displayed.
Symbols of the simple display used to show alphabetic characters are shown below.



6) CHANGING DISPLAY (CHNG DISP)
The display menu (STATUS NUMBER display) is alternated in the order of program No., line No. and speed.

7) UP/DOWN button
Use these buttons to select the program No. and increase/decrease the speed on the display menu (STATUS NUMBER display).

8) SVO ON button
Press to turn the servomotor power ON.

9) SVO OFF button
Press to turn the servomotor power OFF.

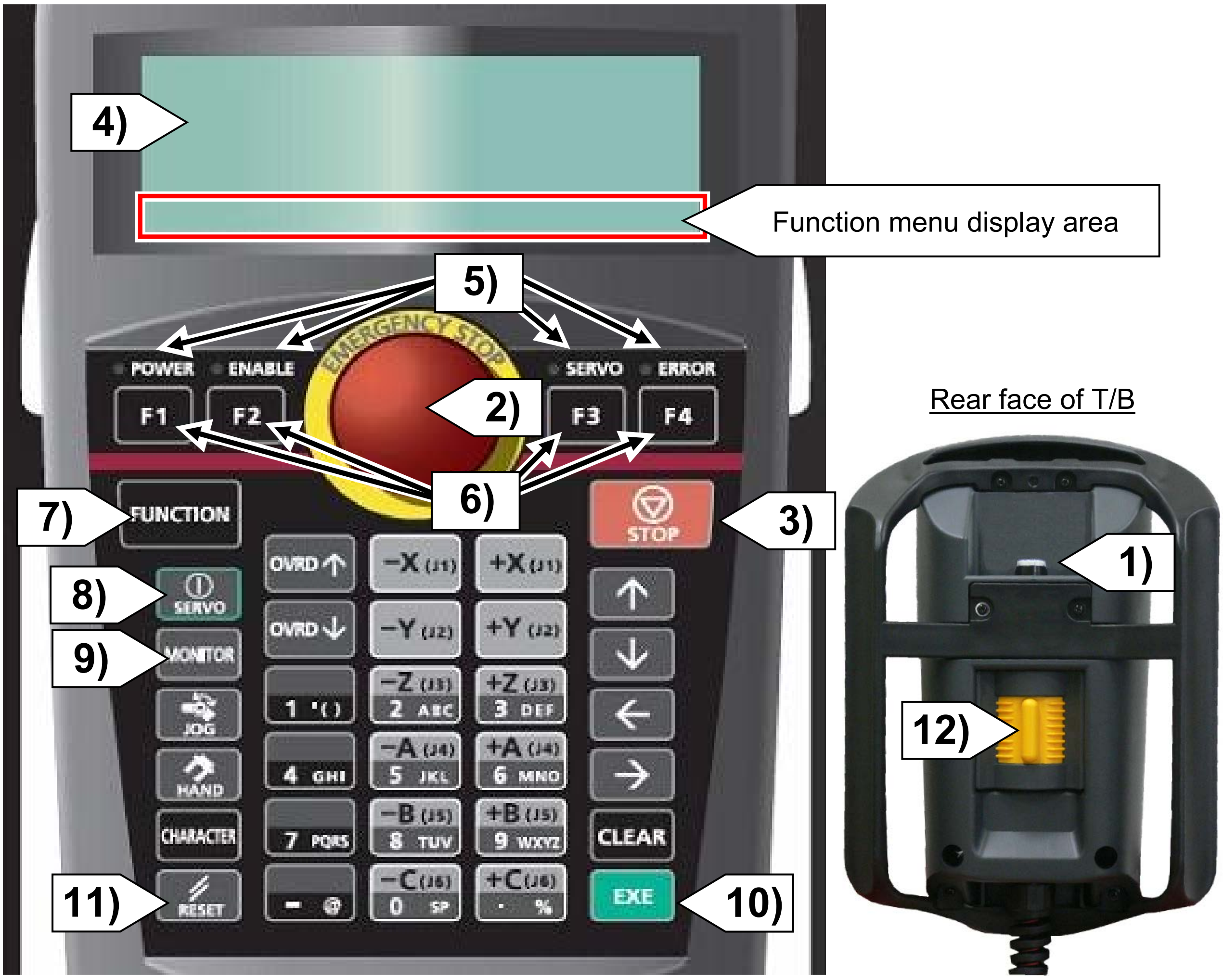
10) START button
Press to start the program. (Repeat operation will start.)

11) STOP button
Press to decelerate the robot to a stop. Press the START button to continue operation.
(The servo power will not turn OFF.)

12) RESET button
Press this to reset the currently occurring error.
The active program (program that was interrupted) will be reset and the program will return to the head.

13) END button
When this button is pressed, the program end (END) instruction is executed and the program stops.
Use this button to stop the robot operation after one cycle. (Repeat operation will not take place.)

1.9 Names and functions of teaching box (T/B) parts



1) T/B ENABLE switch
This switch selects the ENABLE/DISABLE state for operations using the teaching box.

2) EMG.STOP switch (Emergency stop)
This switch instantaneously stops the robot. (Turns the servo power OFF.)

3) STOP key
This switch decelerates the robot to a stop. Press the START button to start operation.
(The servo power does not turn OFF.)

4) Display panel
The teaching box's operation status is displayed on this panel.

5) Status indicator
These indicators show the teaching box and robot status.
(Power, Enable/Disable, servo status, current error)

6) "F1" "F2" "F3" "F4" keys
Press these keys to execute the functions indicated on the function menu display.

7) FUNCTION key
This key switches the function on each menu. The functions that can be executed are displayed at the bottom of the screen.

8) SERVO key
The robot servo power is supplied if this key is pressed while the Enable switch is held down.

9) MONITOR key
When this key is pressed, the monitor mode is enabled and the monitor menu appears.
The previous screen appears when this key is pressed again.

10) EXE key
Press this key to execute the input operation.

11) RESET key
Press this key to reset the current error.

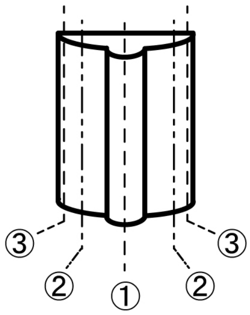
12) Enable switch
This switch is the 3-position switch on the back of the teaching box. To carry out operations such as jog operation and step execution, turn on TB ENABLE and ensure the servo status is set to ON. Holding the switch lightly, perform a servo ON operation.

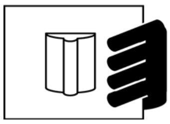
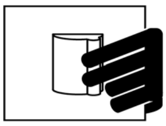
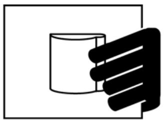
Additionally, during operation (servo ON), releasing this switch or holding it forcefully (pushing) will turn the servo OFF, and the robot in operation will suddenly stop.

When the servo is OFF after an emergency stop or servo OFF operation, holding this switch alone will not turn ON the servo. Try holding this switch lightly again, and carry out a servo ON operation.

<ENABLE switch (3-position switch) operation>

ENABLE switch



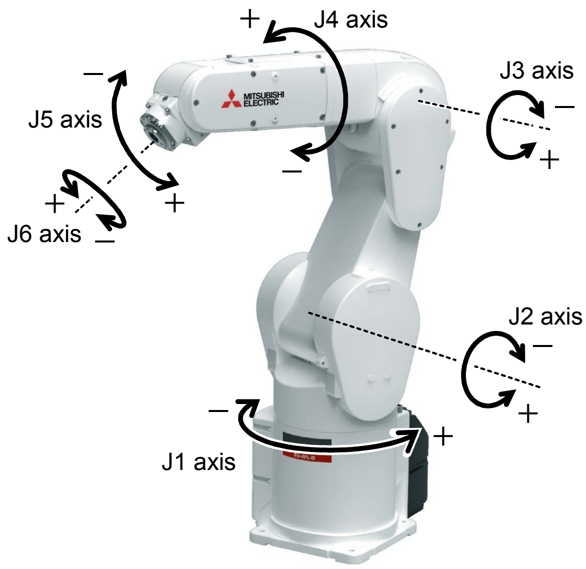
		ENABLE switch	Servo ON operation	Servo status
1)	Position 1 	OFF	Not available	Servo OFF
2)	Position 2 	ON	Available	Servo ON available
3)	Position 3 	OFF	Not available	Servo OFF

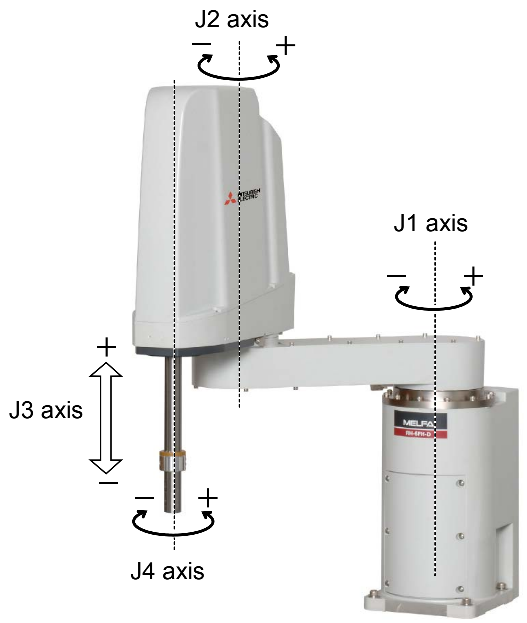
1.10 Jog operation

Jog operation is an operation that uses a teaching box to manually move a robot.
The following describes three commonly used modes.

(1) Joint jog mode

In this method, the robot operates by articulated axes. Each axis moves independently.

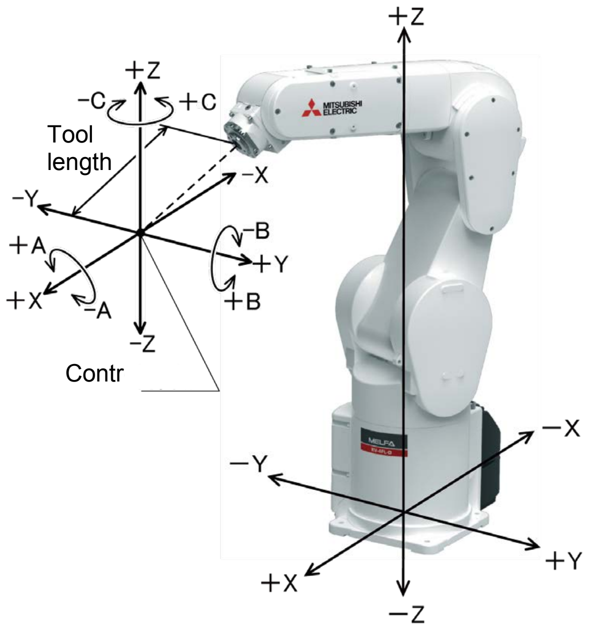


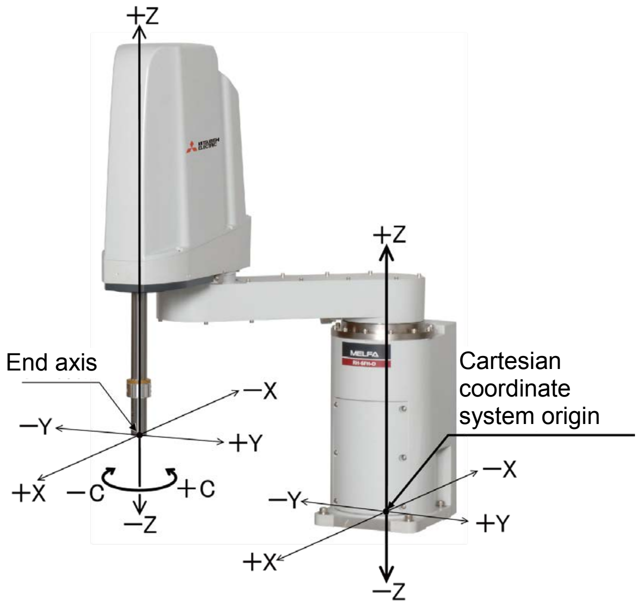


(2) XYZ jog mode

The robot control points move using world coordinates.
XYZ use mm units and operate in straight lines using XYZ coordinates while maintaining the posture of the flange surface.

[Caution] The world coordinate system and the base coordinate system correspond to factory default.



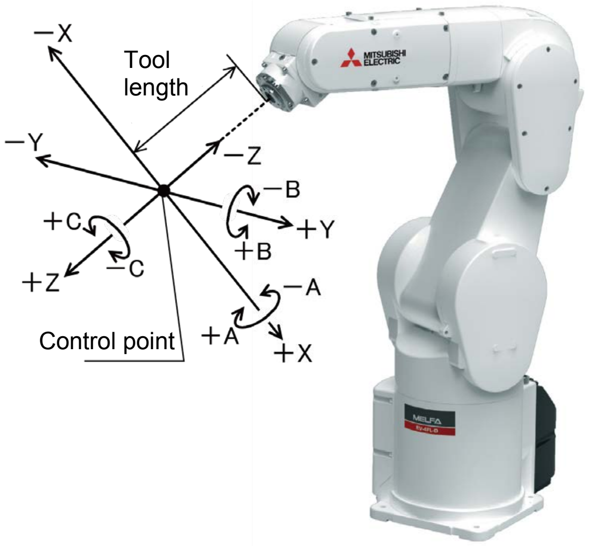


* The A axis, B axis, and C axis are angular units and change the direction of the flange surface while maintaining the control point position.

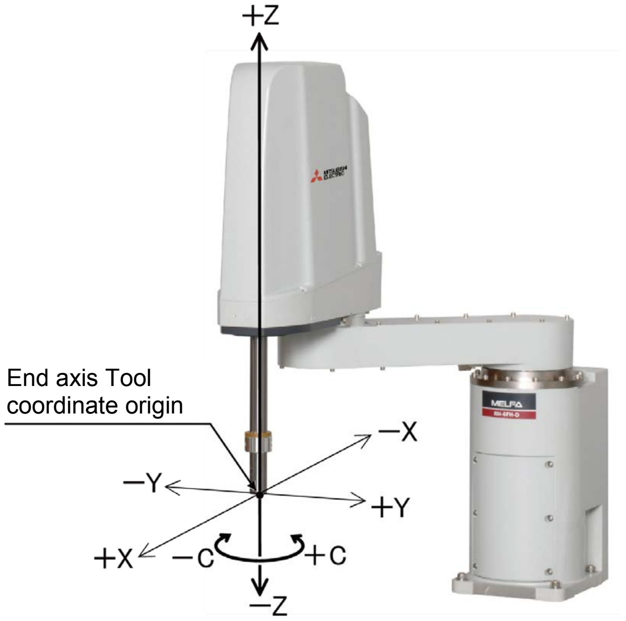
* The C axis is an angular unit and changes its direction by changing the end axis.

(3) Tool jog mode

The robot control points move using TOOL coordinates.
XYZ use mm units and operate in straight lines using TOOL coordinates while maintaining posture of the flange surface.

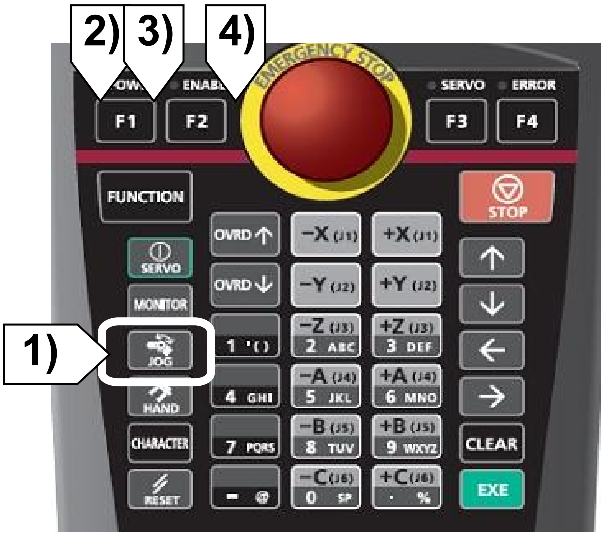


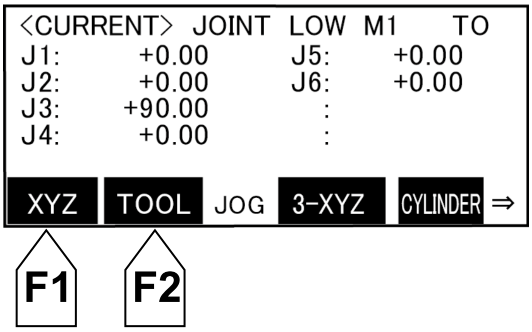
* The A axis, B axis, and C axis are angular units and change the direction of the flange surface while maintaining the control point position.



* The C axis is an angular unit and changes its direction by changing the end axis.

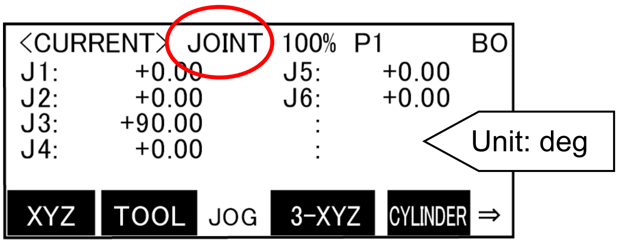
(4) Selecting the jog mode





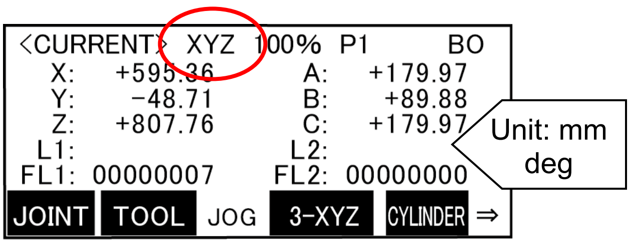
Corresponding function key

1) Displaying the JOG screen
The JOG screen shown on the right appears when the [JOG] key is pressed.
The robot's current position, JOG mode and speed, etc., are displayed.

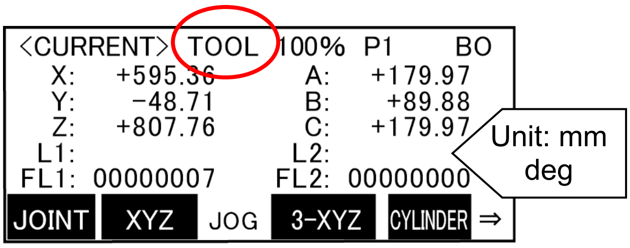


2) Selecting the joint jog mode
When the function key corresponding to the "Joint" is pressed, "Joint" appears at the top of the screen. (Above screen)

3) Selecting the Cartesian jog mode
When the function key corresponding to the "Cartesian" is pressed, "Cartesian" appears at the top of the screen.



4) Selecting the tool jog mode
When the function key corresponding to the "Tool" is pressed, "Tool" appears at the top of the screen.



(5) Speed setting

<Setting the jog operation speed>
When carrying out jog operations, set a slow speed and check the operation before gradually increasing speed.
Keep your eye on the robot.

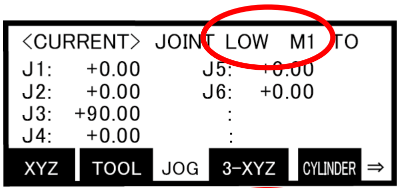
1) Increasing the speed
   The displayed speed value increases when the [OVRD ↑] key is pressed.

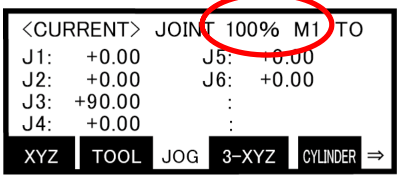
2) Decreasing the speed
   The displayed speed value decreases when the [OVRD ↓] key is pressed.

* The speed can be set in the range of Low to 100%.

Low | **High** | **3%** | **5%** | **10%** | **30%** | **50%** | **70%** | **100%**

← [OVRD ↓] key   [OVRD ↑] key →





Low and High are for inching feed. The robot will move a set amount each time the axis key is pressed.
The amount of movement is set by the following parameters.
The settings values can be changed as required.

Parameter name
JOGJSP: Joint jog
JOGPSP: XYZ jog
(For details of the parameters above, refer to "Appendix 7: Frequently Used Parameters, Jog setting").

(6) Operation method

The joint jog mode operation is explained as an example of the jog operation.
When operating the robot in other jog modes, refer to "(4) Selecting the jog mode" and switch the jog mode.

<Movement with joint jog mode>

2) Hold the ENABLE switch on the rear of the teaching box.
   Carry out the following operations while holding the ENABLE switch.

3) Press the [SERVO] key on the front side and turn the servo power ON.

4) Press the [JOG] key and enter the joint jog mode.
   If other jog modes are displayed, press the [F1] key.

5) Set the robot operation speed.

6) Press the [-X] key and [+X] key for the axes to move.
   (For the J1 axis, [-X(J1)] key and [+X(J1)] key)
   The robot's J1 axis moves in the minus or plus directions only while the keys are pressed.

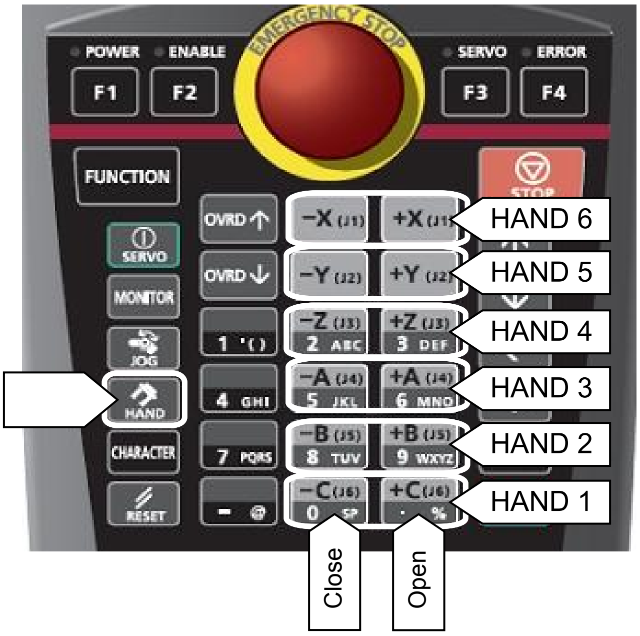
1.11 Operating the hand

(1) Pneumatic hand

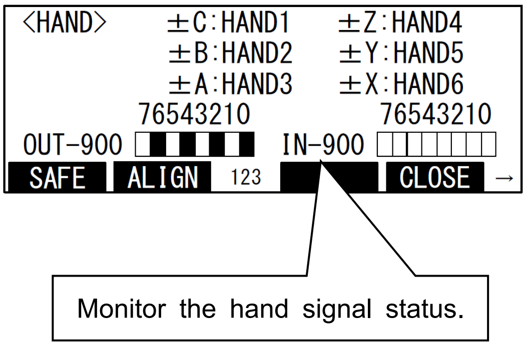
The hand is opened and closed from the teaching box. (Check the relation of the hand and taught position.)

Use the [HAND] key and JOG operation key.

HAND 1 to HAND 6 can be opened and closed.



<Hand> screen



<Hand> screen

OUT-900: Indicates the signal output to the solenoid valve for hand control.
IN-900: Indicates the hand open/close sensor status.
Furthermore, these signals are assigned to signal wires (GR1, GR2 connectors) installed in the robot arm in advance. These signals are enabled by connecting solenoid valves and hand sensors.

1) Hand open/close operation: Press the [HAND] key. The <HAND> screen will appear.
2) With the <Hand> screen displayed, press the JOG operation key to open and close the hand.

· Opening hand 1
Press the [+C(J6)] key.

· Closing hand 1
Press the [–C(J6)] key.

OUT-900 to OUT-907	7	6	5	4	3	2	1	0
Open/Close	Close	Open	Close	Open	Close	Open	Close	Open
Hand No.	4		3		2		1	

IN-900 to IN-907	7	6	5	4	3	2	1	0
Input signal No.	907	906	905	904	903	902	901	900

Opening and closing hands 2 to 6

· Hand 2 opens when the [+B(J5)] key is pressed, and closes when the [–B(J5)] key is pressed.
· Hand 3 opens when the [+A(J4)] key is pressed, and closes when the [–A(J4)] key is pressed.
· Hand 4 opens when the [+Z(J3)] key is pressed, and closes when the [–Z(J3)] key is pressed.
· Hand 5 opens when the [+Y(J2)] key is pressed, and closes when the [–Y(J2)] key is pressed.
· Hand 6 opens when the [+X(J1)] key is pressed, and closes when the [–X(J1)] key is pressed.

[Caution] For double solenoids, hand numbers are 1 to 4; and for single solenoids, 1 to 8.

⚠Caution

If error C0032 occurs at the open/close operations of the pneumatic hand, the sink type/source type of the solenoid valve have not been set. After clearing the error, set the parameter HIOTYPE.
For parameters, refer to "Appendix 7: Frequently Used Parameters, Hand input/output type".

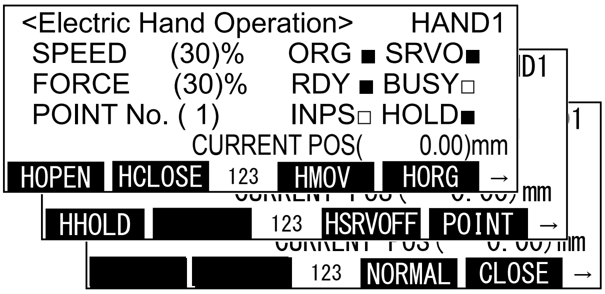
(2) Electric operated hand

The hand is opened and closed from the teaching box. (Check the relation of the hand and taught position.)

Press the [HAND] key to control the hand. The <Electric Operated Hand Operation> screen will appear.

To operate the electrically operated hand, carry out the origin return (refer to next page).

<Electric Operated Hand Operation> screen



* The function menu (screen lower part) is switched by pressing the [FUNCTION] key.

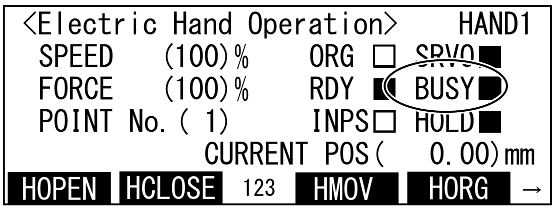
(1) Origin return

<u>Origin return refers to the operation to set the reference position for moving the hand. This step must be completed before moving the hand.</u>

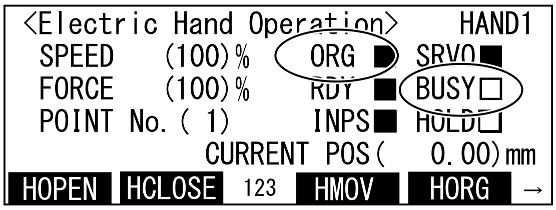
1) Press the ENABLE switch to enable T/B.

2) Press the [HAND] key to display the <Electric Hand Operation> screen.

3) Press the function key ([F4]) corresponding to the "Origin" on the <Electric Operated Hand Operation> screen.
   The electric operated hand will return to the origin while the key is held down. The "BUSY" indication on the T/B screen changes to "■" during the movement.
   When origin return is completed, the "BUSY" display changes to "□", and the "Origin" display changes to "■".



Origin return: "Origin" [F4] key



Origin return complete

* During hand operation, releasing the key stops the operation.

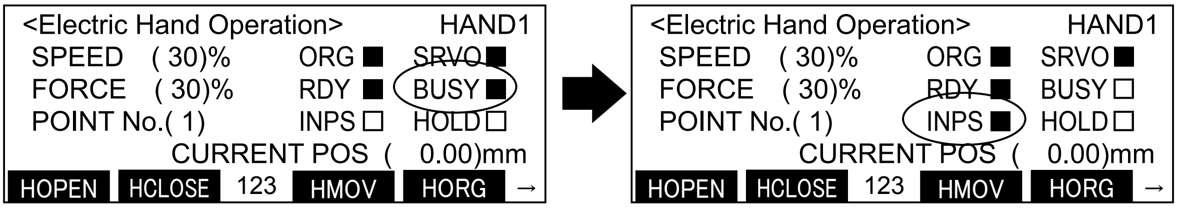
This completes the origin return operation for the electric operated hand.

(2) Opening the electrically operated hand

<Electric Hand Operation>

Press the function key ([F1] key) which corresponds to "HOPEN" on the screen.

While the key is pressed, the hand will operate. (The "BUSY" indication changes to "■" during the movement.)



During hand operation: "HOPEN" = [F1] key Hand operation complete

* During hand operation, releasing the key stops the operation.

When movement to the hand open/close end is finished, the "INSP" indication changes to "■".

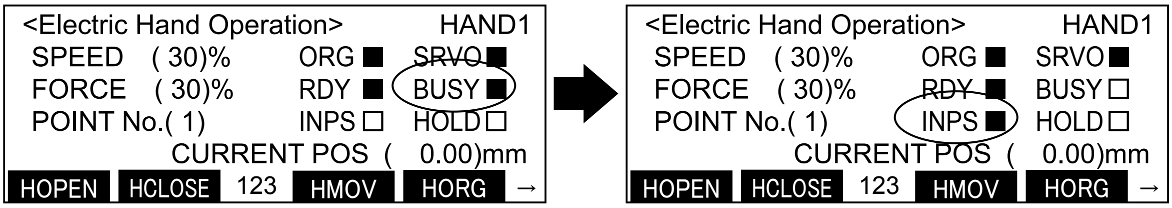
Note) If an object is gripped during the movement, the "HOLD" indication changes to "■".

(3) Closing the electrically operated hand

<Electric Hand Operation>

Press the function key ([F2] key) which corresponds to "HCLOSE" on the screen.

While the key is pressed, the hand will operate. (The "BUSY" indication changes to "■" during the movement.)



During hand operation: "HCLOSE" = [F2] key Hand operation complete

* During hand operation, releasing the key stops th

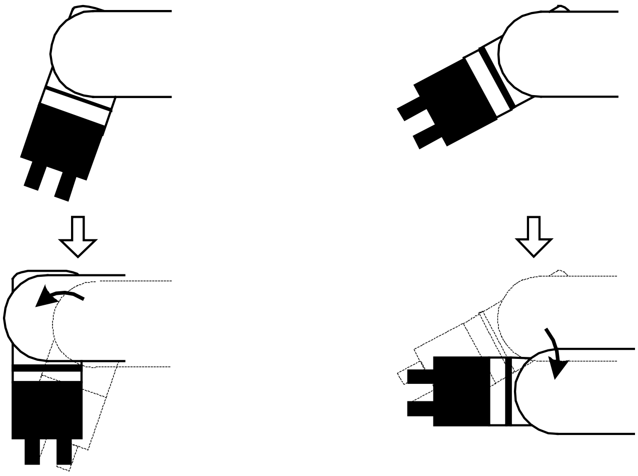
When movement to the hand open/close end is finished, the "INSP" indication changes to "■".

Note) If an object is gripped during the movement, the "HOLD" indication changes to "■".

1.12 Useful functions

(1) Hand alignment

Use this to align the hand posture to straight down, straight up or to the straight side.
When the hand position approaches the straight down position, it is aligned straight down, and when it approaches the straight up position, it is aligned straight up.
* Even though the hand is aligned, the control point position does not change.



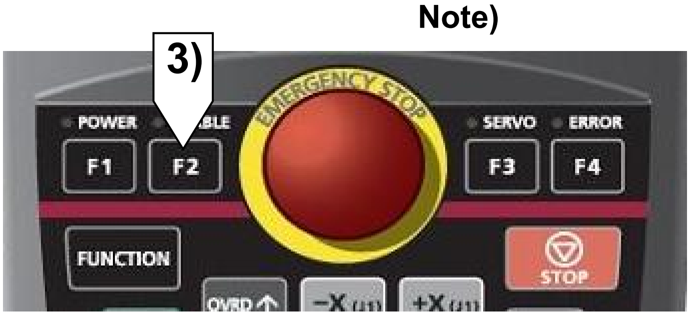
1) While lightly holding the ENABLE switch, press the [SERVO] key and turn the servo ON.

2) While lightly holding the ENABLE switch, press the [HAND] key and open the <Hand> screen.
   * When using the electric operated hand, the <Electric Operated Hand> screen will appear at the above step.
   Press the [FUNCTION] key, and display "Standard" at the bottom of the screen. Press the function key corresponding to "Standard", and open the <Hand> screen.

3) While lightly holding the ENABLE switch, hold down the function key ([F2] key in this case) assigned to "Alignment".
   The robot will move and the hand will be aligned while the key is held down.

```
<HAND>  ±C:HAND1     ±Z:HAND4
        ±B:HAND2     ±Y:HAND5
        ±A:HAND3     ±X:HAND6
       76543210       76543210
OUT-900 □□□□□□□□  IN-900 □□□□□□□□
 SAFE  ALIGN  123  E-HAND  CLOSE  →
```

Note)



Note) "Electric" appears only when using the electric operated hand. If the function key ([F3] key in this case) corresponding to this is pressed, the <Electric Operated Hand Operation> screen will open.

(2) Home Position

It is possible to return the robot to its home position (position set in parameter JSAFE) previously set.

1) While lightly holding the ENABLE switch, press the [SERVO] key and turn the servo ON.

2) While lightly holding the ENABLE switch, press the [HAND] key and open the <Hand> screen.
   * When using the electric operated hand, the <Electric Operated Hand> screen will appear at the above step.
     Press the [FUNCTION] key, and display "Standard" at the bottom of the screen. Press the function key corresponding to "Standard", and open the <Hand> screen.

3) While lightly holding the ENABLE switch, press and hold the function key (in this case the [F1] key) which is assigned to "SAFE".
   While pressing the key, the robot returns to its home position. The controller's [START] LED is on during this operation. During operation, releasing either of keys stops the robot.

```
<HAND>  ±C:HAND1     ±Z:HAND4
        ±B:HAND2     ±Y:HAND5
        ±A:HAND3     ±X:HAND6
       76543210          76543210
OUT-900 □□□□□□□□   IN-900 □□□□□□□□
SAFE  ALIGN  123  E-HAND  CLOSE  →
```

Note)

Note) "Electric" appears only when using the electric operated hand. If the function key ([F3] key in this case) corresponding to this is pressed, the <Electric Operated Hand Operation> screen will open.

Note) The home position needs to be set by using the parameter "JSAFE" in advance.
"JSAFE" is shown by joint angles (units: deg) of each axes 1 to 8.

```
<PARAMETER>     NAME( JSAFE     )
  DATA              ELE(     )
( 0.00,0.00,90.00,0.00,90.00,0.00    )

DATA   Prev  ABC  Next   CLOSE
```

Chapter 2 How to use RT ToolBox3

■ Procedure from program creation to automatic operation

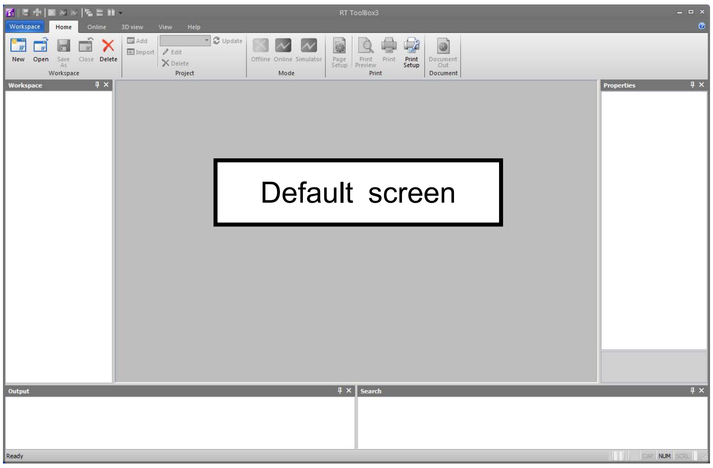
Procedure	Description	Reference (all the following references are included in Chapter 2 Operation Method of RT ToolBox3)	Operating devices
1	Starting RT ToolBox3	2.1 Starting/Ending RT ToolBox3 (1)Start	RT ToolBox3
2	Creating a workspace and project	2.3 Creating a new project (1) Creating a new workspace and adding projects (2) Step 1: Overview (project name and comment)	
3	Selecting the robot controller and robot	2.3 Creating a new project (3) Step 2: Robot model selection	
4	Communication setting	2.3 Creating a new project (4) Step 3: Communication setting (iQ Platform compatible) or (5) Step 3: Communication setting (stand-alone)	
5	Selecting the robot language	2.3 Creating a new project (6) Step 4: Language (setting the robot language)	
6	Preparation for program creation	2.4 Creating a program (1)Preparation for program creation	
7	Creating a program	2.4 Creating a program (2) Creating a program (3) Saving the program	
8	Connecting to the robot controller	2.4 Creating a program (4) Connection with the robot controller	
9	Writing the program to the robot controller	2.4 Creating a program (5) Writing the program to the robot controller	
10	Teaching position	2.5 Teaching position	Teaching box
11	Debug (step operation)	2.6 Debug 2.12 Monitoring function	
12	Automatic operation	2.7 Automatic operation	
13	Saving the program to a personal computer	2.8 Saving the programs (robot → personal computer)	RT ToolBox3

2.1 Starting/Ending RT ToolBox3

(1) Start

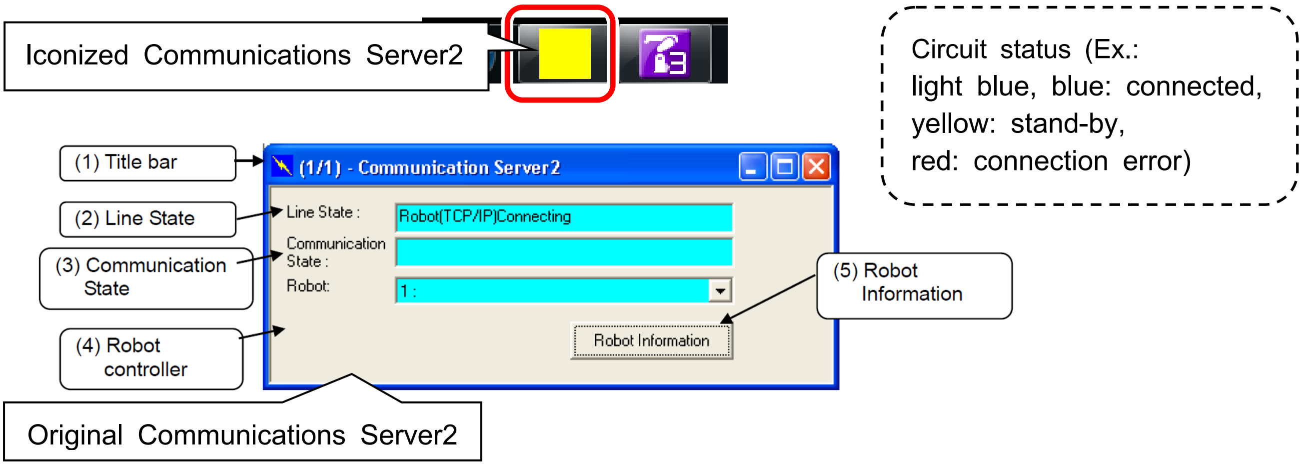
Double-click the shortcut on the desktop.
Or, select the [Start] button → [All Programs] → [MELSOFT], and select [RT ToolBox3].

Shortcut icon



(2) Communications Server2

When RT ToolBox3 starts, "Communications Server2" is minimized to the taskbar.
Do not end Communications Server2 (it ends automatically when RT ToolBox3 ends).
Communications Server2 has functions to connect the robot with robot controllers and virtual controllers during simulation. Restore the minimized Communications Server2 to its original size to check the connection status with the robot.



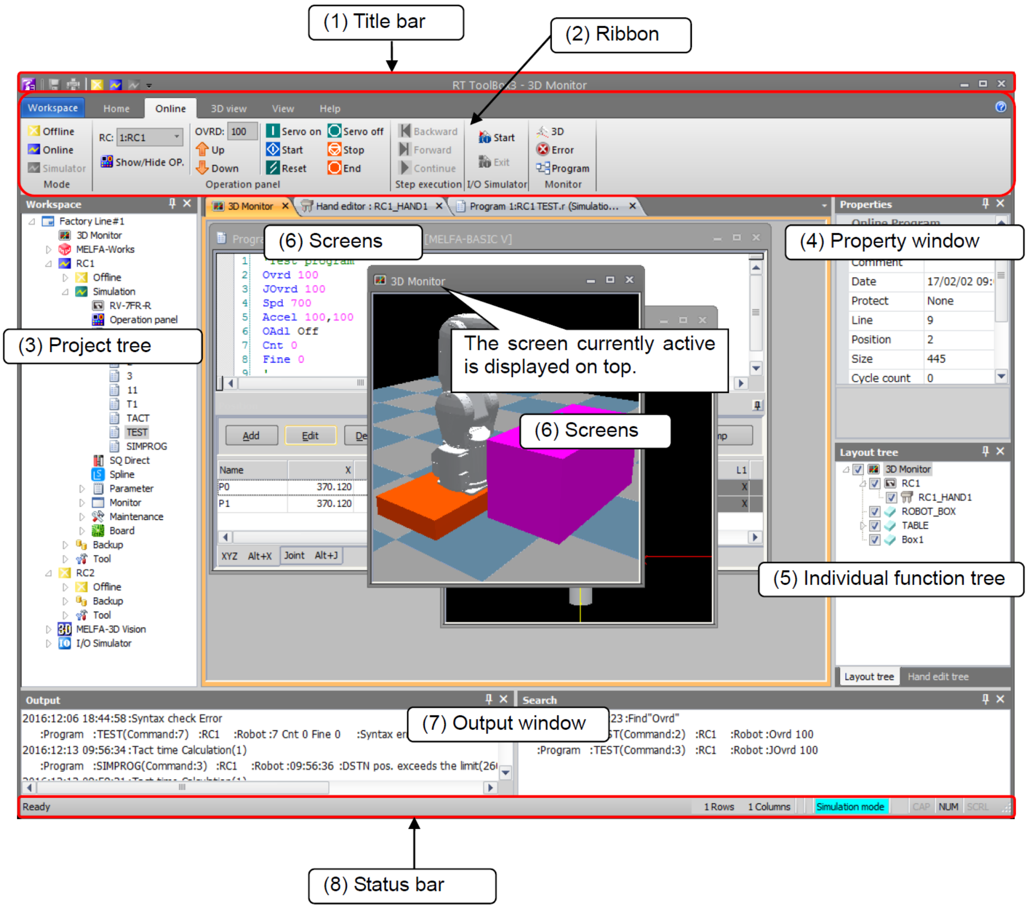
(3) End

Click [END] in the [Workspace] tab on the menu.
Or, click the [X] button at the upper right of the Workspace window.
When RT ToolBox3 ends, Communications Server2 automatically ends too.

2.2 Explanation of the RT ToolBox3 screen

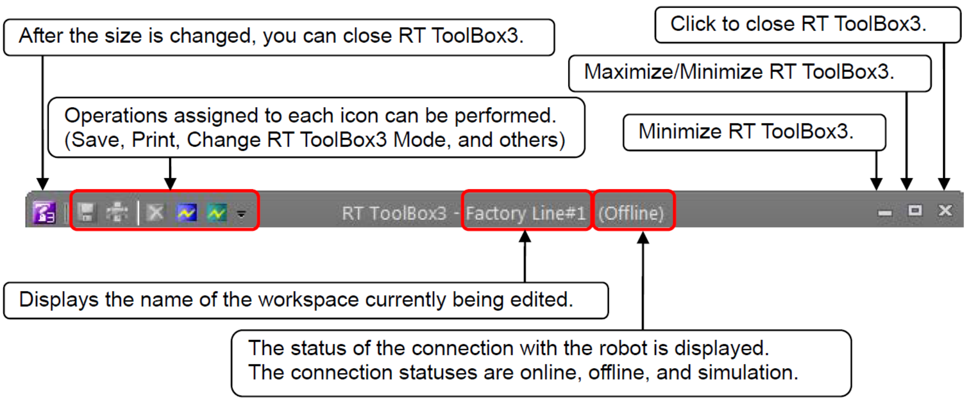
(1) Main screen

The configuration of the RT ToolBox3 main screen is as follows.



1) Title bar

The name of the workspace currently being edited is displayed.



2) Ribbon

Tabs are grouped for each command type.

Clicking a tab displays the list of commands registered in the tab.

3) Project tree

All projects registered in the workspace are displayed by function in a list.

The Program Editing window and Monitor window can be started.

4) Properties window
   Various attributes in the workspace currently being edited can be checked. Clicking an item in the project tree displays the attributes.

5) Individual function tree
   When a specific window such as the 3D Monitor window is displayed, a tree specifically for that window is displayed. If multiple trees are displayed, switching tabs switches the trees displayed.

6) Window
   Windows such as the Program Editing window and Monitor window started from the project tree are displayed.
   The currently active window is displayed to the foreground.

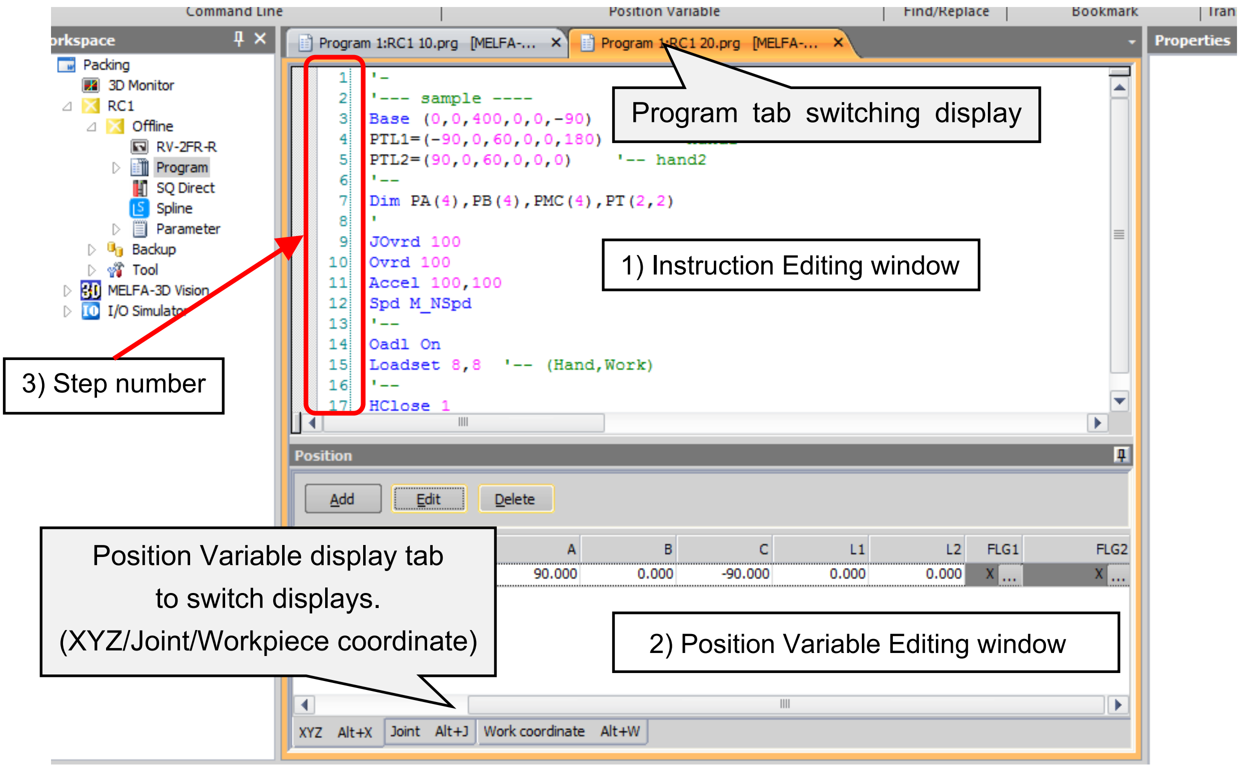
7) Output window
   The event logs and search results of RT ToolBox3 are displayed.
   Event logs such as error details of program syntax checks are displayed in the Output window and search results are output in the Search window, which enables users to copy displayed text strings and save details.

8) Status bar
   Status information such as RT ToolBox3 modes (Offline, Online, Simulation) and cursor position during program edition is displayed.

(2) Program Editing window

The upper section is the Program Instruction Statement Editing window, and the lower section is the Position Variable Editing window.

Drag the boundary of these windows and change the position of the upper and lower window separation.



1) Instruction Statement Editing window

Write the program here. Programs can be input in the same way as a general editor like Notepad.

2) Position Variable Editing window

Edit the position variables. This list shows XYZ, Joint, and Workpiece coordinate variables.

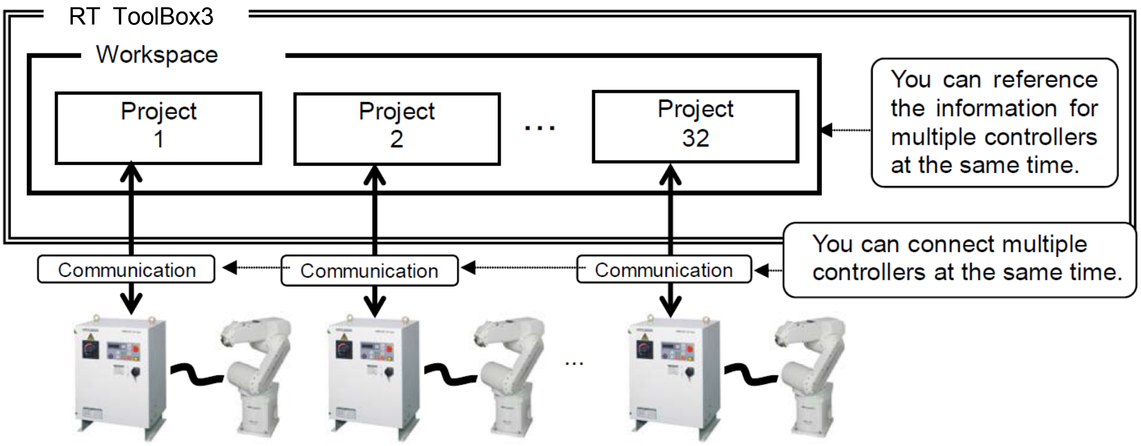
3) Step number

During programming, step numbers are automatically numbered by pressing the [Enter] key on the keyboard.

2.3 Creating a new project

■ Workspace and project

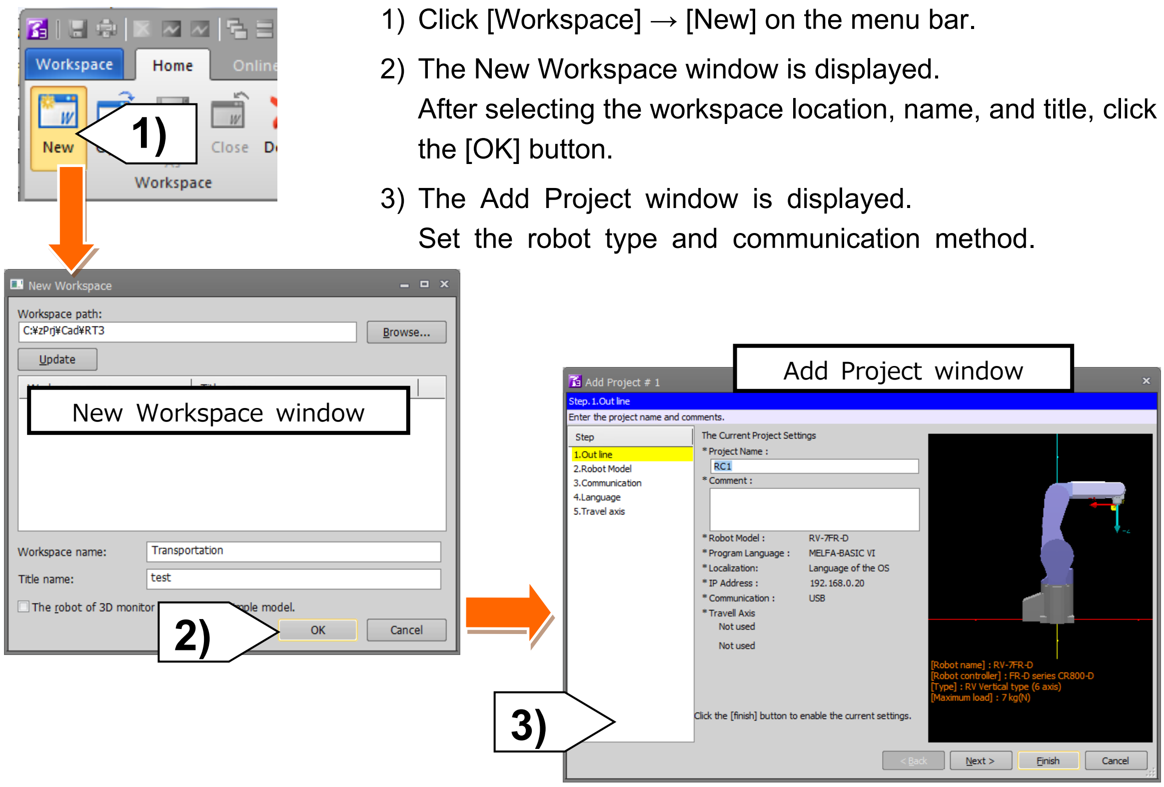
RT ToolBox3 has workspaces and projects.
Information for one controller is managed as a single project.
A workspace can manage 32 projects at maximum.
Multiple workspaces cannot be edited at the same time. Register projects to be referred at the same time in a single workspace.



When using multiple robot controllers

(1) Creating a new workspace and adding projects

(1-1) Creating a new workspace

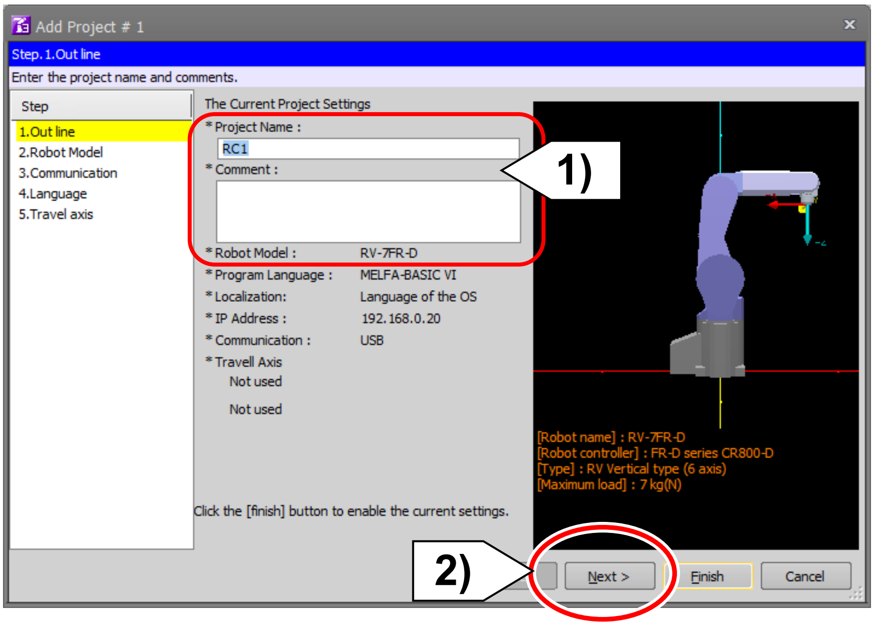


1) Click [Workspace] → [New] on the menu bar.
2) The New Workspace window is displayed.
   After selecting the workspace location, name, and title, click the [OK] button.
3) The Add Project window is displayed.
   Set the robot type and communication method.

(2) Step 1: Overview (project name and comment)

(2-1) Inputting project names and comments

1) Input the project name.
   RC1, RC2, or similar is input as a default value (leaving a default value is acceptable).
   A comment can be set for the project if necessary.
2) Click "Next".

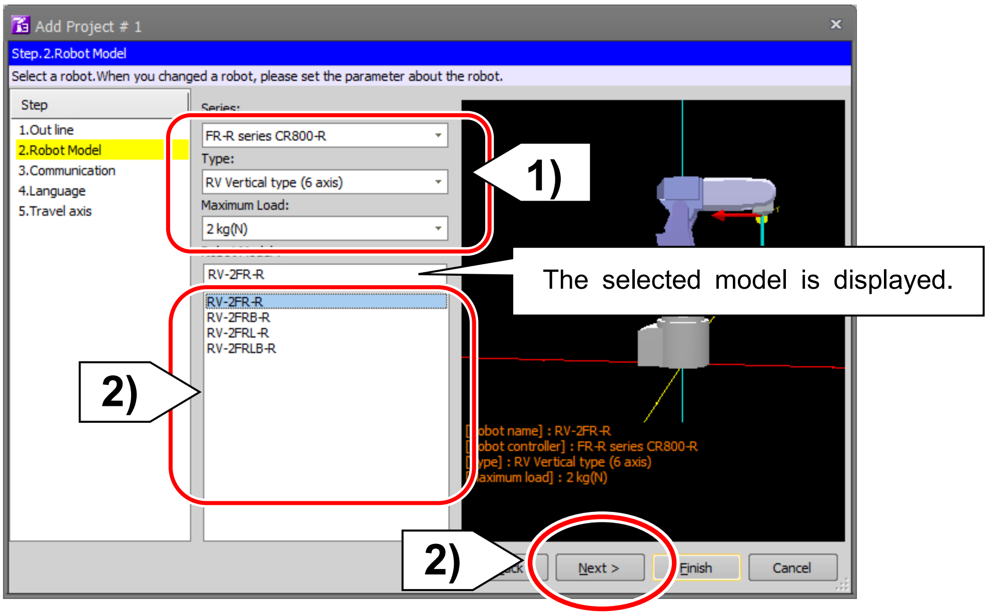


(3) Step 2: Robot model selection

(3-1) Selecting the controller and robot model

Select the series and model of the robot controller used in the project.
By selecting "Type" and "Maximum Load", the target models to be selected are narrowed down.

1) Narrow down the models by using the selection boxes Series, Type, and Maximum Load.
2) From the models at the bottom list. select the desired model. then click "Next".

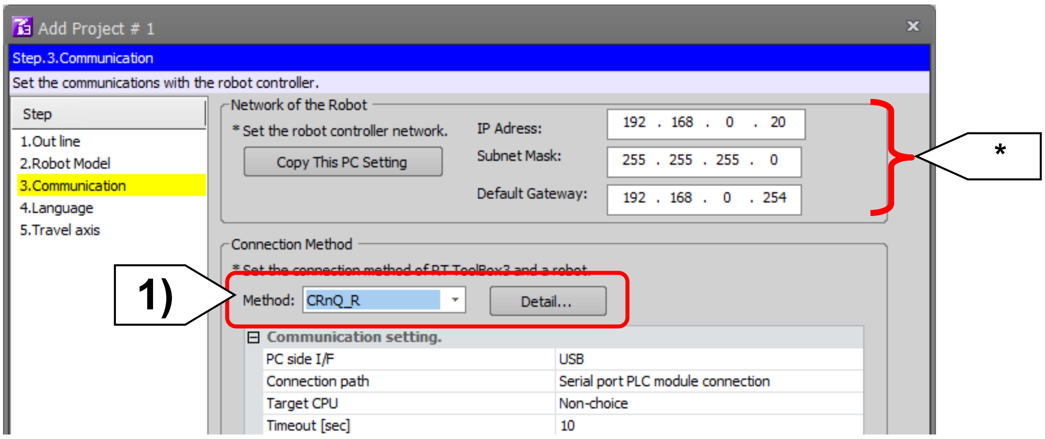


(4) Step 3: Communication setting (iQ Platform compatible)

(4-1) Setting the communication method

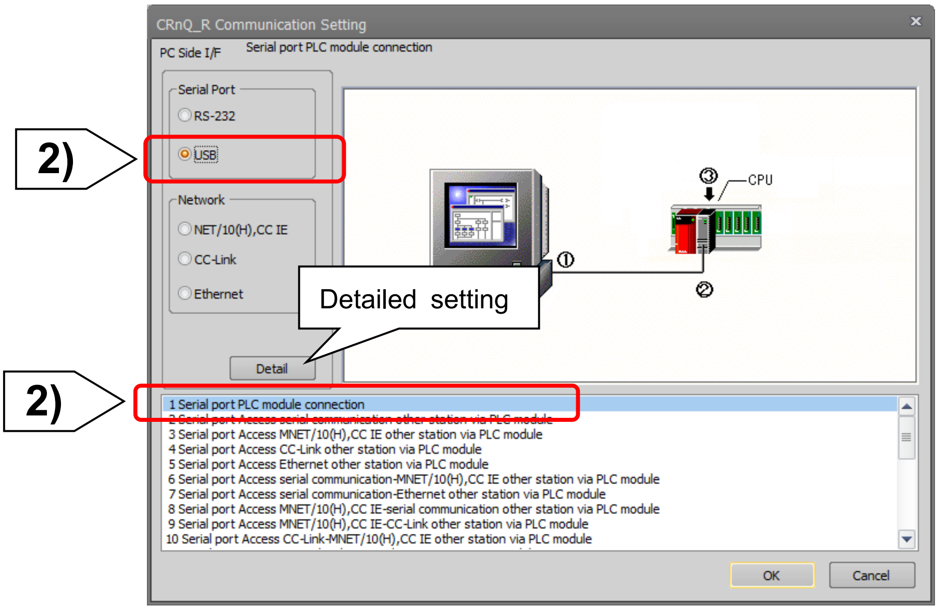
1) Select "CRnQ_R" in "Connection Method", then click the "Detail" button.

The CRnQ_R communication is a communication method using either the PLC RCPU, universal model QCPU, or Ethernet interface module when connecting with CR800-R/CR750-Q/CRnQ-700 series controllers.

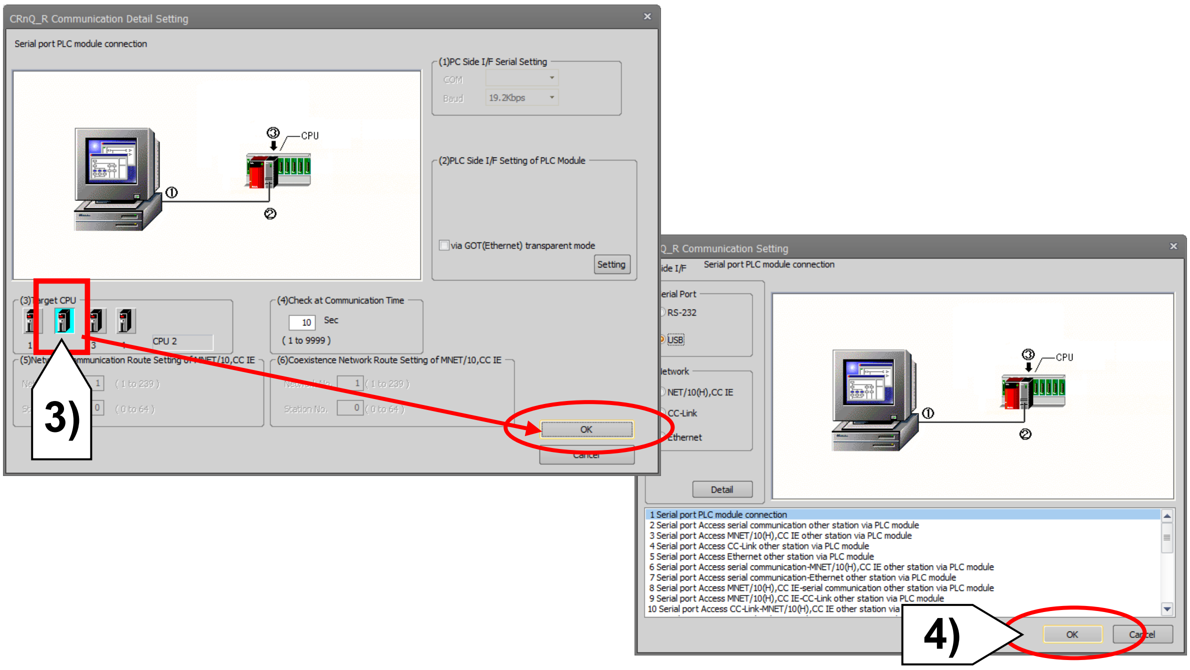


(* Robot network setting: Set these items when using the communication method "TCP/IP(Ethernet)".)

2) The CRnQ-R Communication Setting window opens.
Select "USB" for PC side I/F and "1 Serial port PLC module connection" for the route, then click the "Detail" button.



3) The CRnQ-R Communication Detail Setting window opens.
   Select "2" for "Target CPU" in the CRnQ-R Communication Detail Setting window, then click the "OK" button.
4) The window returns to the CRnQ-R Communication Setting window. Click "OK" and the window returns to the Edit Project window.



[Caution] When using this robot for the first time, in addition to the above settings, it is also necessary to write multi-CPU settings to PLC CPUs using sequence programming software (such as GX Works3) or to robot CPUs using robot engineering software (such as RT ToolBox3).
When using an iQ Platform compatible type robot for the first time, a multi-CPU setup is necessary.
Examples of the setting methods for each series are given in the following.

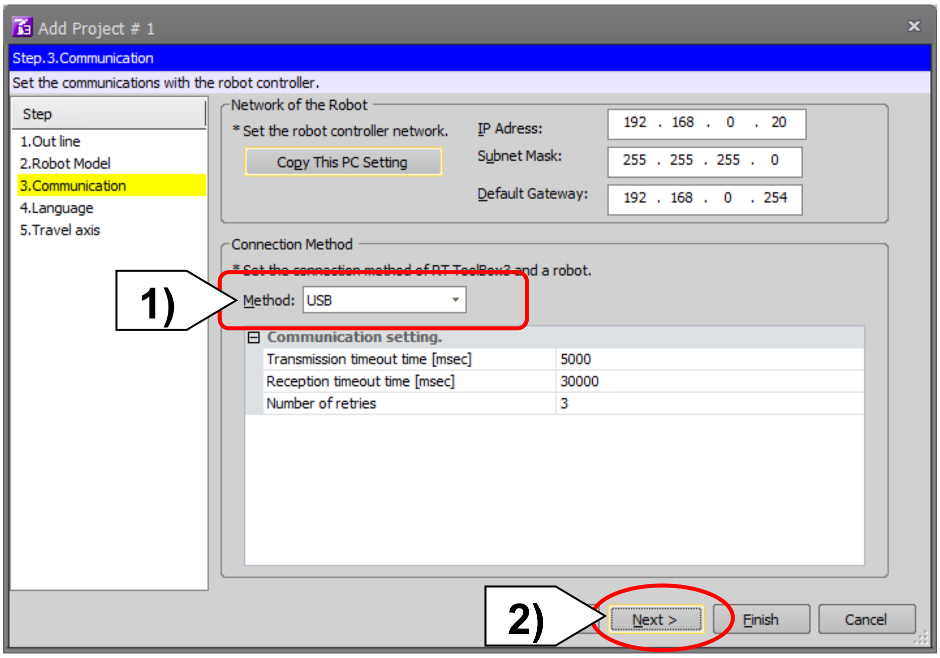
FR Series: Chapter 5 Input/Output Function 5.2 (4) PLC multi-CPU (GX-Works3) settings

F Series: Appendix 5 iQ Platform Compatible (MELSEC Q Series Compatible) Appendix 5.2 Setting Multi-CPU (Using GX Works2)

(5) Step 3: Communication setting (stand-alone)

(5-1) Setting the communication method

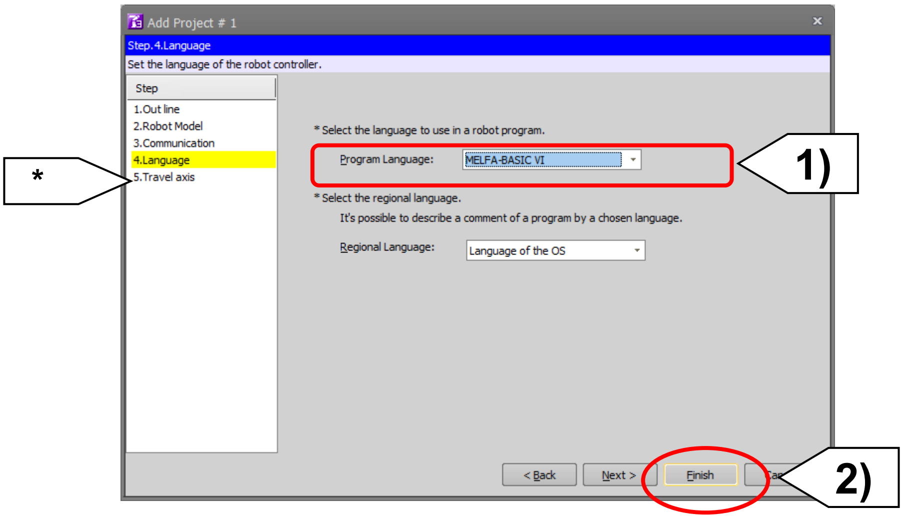
1) Select "USB" in "Connection Method".
2) Click "Next".



(6) Step 4: Language (setting the robot language)

(6-1) Selecting the robot language used in the program

1) Select the robot language used.
2) Click "Finish" to save settings, and close the Edit Project window.

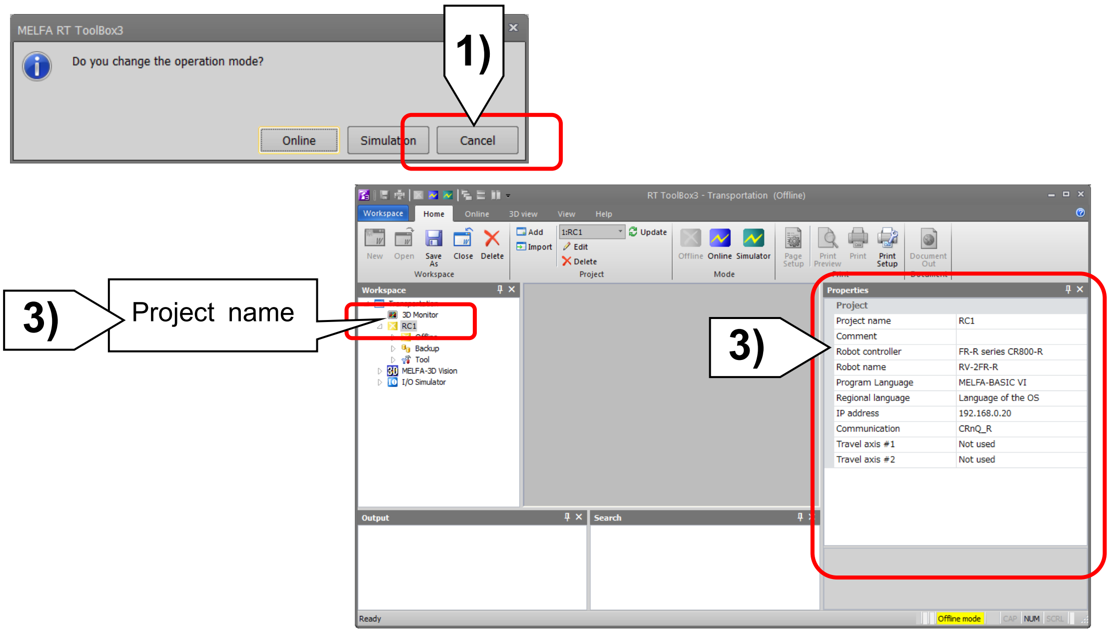


(* Step 5 (Travel axis): Used in simulations.)

(7) Completion of adding projects

(7-1) Completion of adding projects

1) The Operation Mode Change window is displayed. Click "Cancel".
2) The Operation Mode Change window closes, and the project settings are completed.
3) Click the project name in project tree to display the project settings in the Properties window.



* When changing the project settings, refer to "Chapter 2.9 Editing and adding projects".

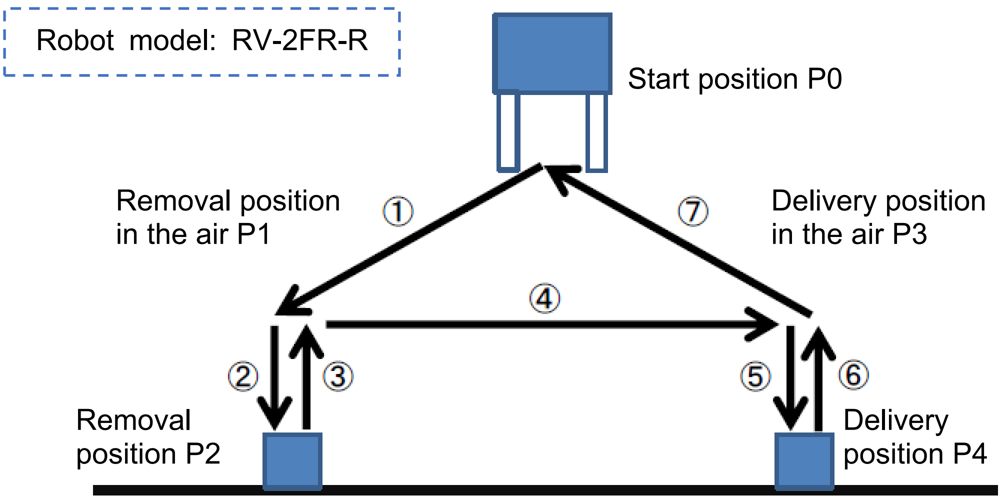
2.4 Creating a program

(1) Preparation for program creation

Decide the following items in preparation for program creation.

- · Robot operation position and operation order
- · Variable name of the robot operation position
- · I/O signal functions and numbers (if necessary)

* As an example, a program that performs the following operation is created.



Pick Up!

Characters that cannot be used as a program file name

The file names shown below cannot be used as program file names.

① Program names that cannot be used on the personal computer

When the program name in the robot controller is the same as Windows "Reserved word", attempting to open the program in the Program Editing window causes an error. In this case, the program name needs to be changed in the controller.

"Reserved word" is a special character string used by Windows on the system, and this cannot be used as a file name on a personal computer. "Reserved word" includes the following.

AUX, COM1 to COM9, CON, LPT1 to 9, NUL, PRN

② Program names that cannot be used on the robot controller

Program names shown below cannot be used on the robot controller.

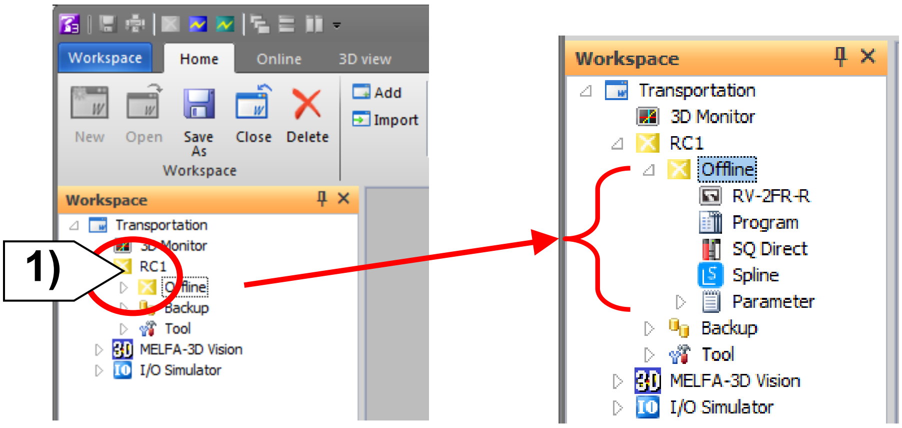
1. Overlong program names (13 characters or longer)
2. Program names that include character strings other than alphabetic characters or numbers (two-byte characters cannot be used)
3. Character strings starting with 0

If program names that include any of these are attempted to be used, a warning occurs at new program creation, program copy, program name change, program conversion, and drag and drop operations.

(2) Creating a program

(2-1) Create a new program file (offline status).

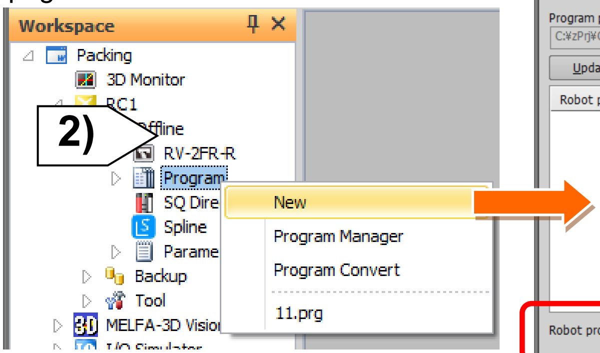
1) Expand the [Online] item in the project tree.

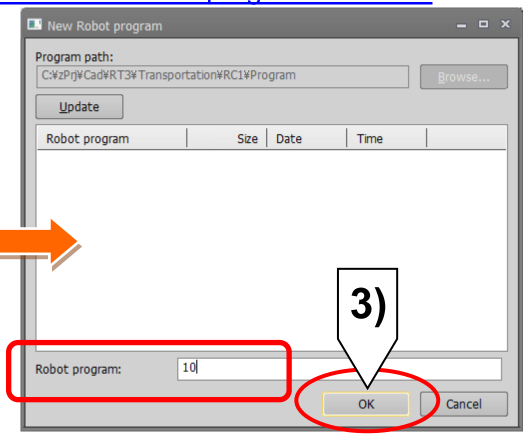


2) Right-click [Program] from [Offline] in the project tree to display a sub menu. Select "New".

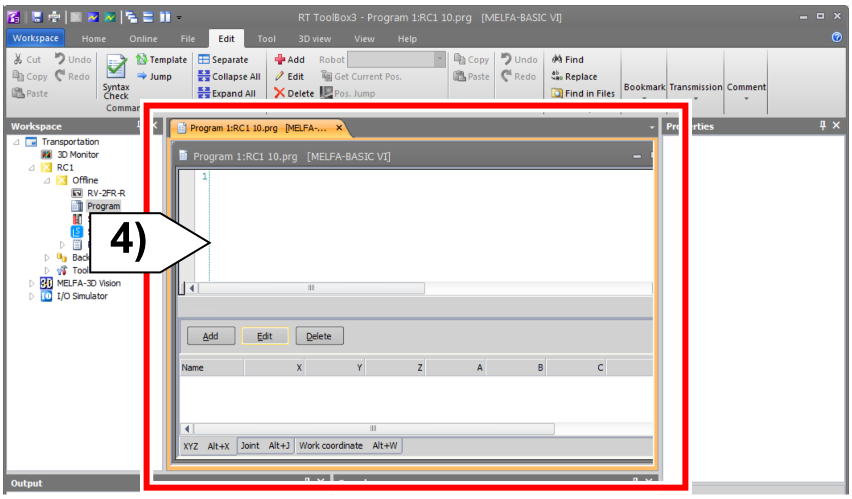
3) In the Robot program field, input the program file name, and click "OK".

* There are restrictions on the characters that can be used for the program file names and the number of characters.
For details, refer to "Characters that cannot be used as a program file name" on the previous page.





4) The Program Editing window opens.



(2-2) Input the program (offline status).

1) Input the program in the Program Editing window.
The following diagram shows the program that is designed to perform the operation shown in "Chapter 2.4 (1) Preparation for programming" as an example.
* For details of robot program instructions, refer to the instruction manual "Detailed explanations of functions and operations".

For pneumatic hands

Program 1:RC1 11.prg [MELFA-...

```
'-- Robot:RV-2FR-R (Air hand)
HOpen 1
'
Mov P0      'Start position
'
Mov P1     'Above a pickup position
Mvs P2      'Pickup position
Dly 0.3
HClose 1    'Grasp a workpiece
Dly 0.5
Mvs P1
'
Mov P3     'Above a placing position
Mvs P4      'Placing position
Dly 0.3
HOpen 1     'Releace a workpiece
Dly 0.5
Mvs P3
'
Mov P0
'
End
```

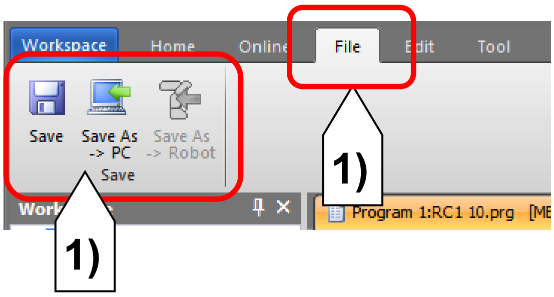
For electrically operated hands

Program 1:RC1 21.prg [MELFA-...

```
'-- Robot:RV-2FR-R (Electric hand)
EHOpen 1,100,100
'
Mov P0      'Start position
'
Mov P1      'Above a pickup position
Mvs P2      'Pickup position
Dly 0.3
EHClose 1,100,100     'Grasp a workpiece
Dly 0.5
Mvs P1
'
Mov P3      'Above a placing position
Mvs P4      'Placing position
Dly 0.3
EHOpen 1,100,100     'Releace a workpiece
Dly 0.5
Mvs P3
'
Mov P0
'
End
```

(3) Saving the program

(3-1) Save the program in the RT ToolBox3 project (personal computer).



1) With the Program Editing window open, select "Save" or "Save As → PC" in the [Save] group in the [File] tab.
When "Save As → PC" is selected, the "Save As" window is displayed.

2) The saved programs are displayed under Program in the project tree.
(The programs saved in the project folder on the personal computer are displayed here.)

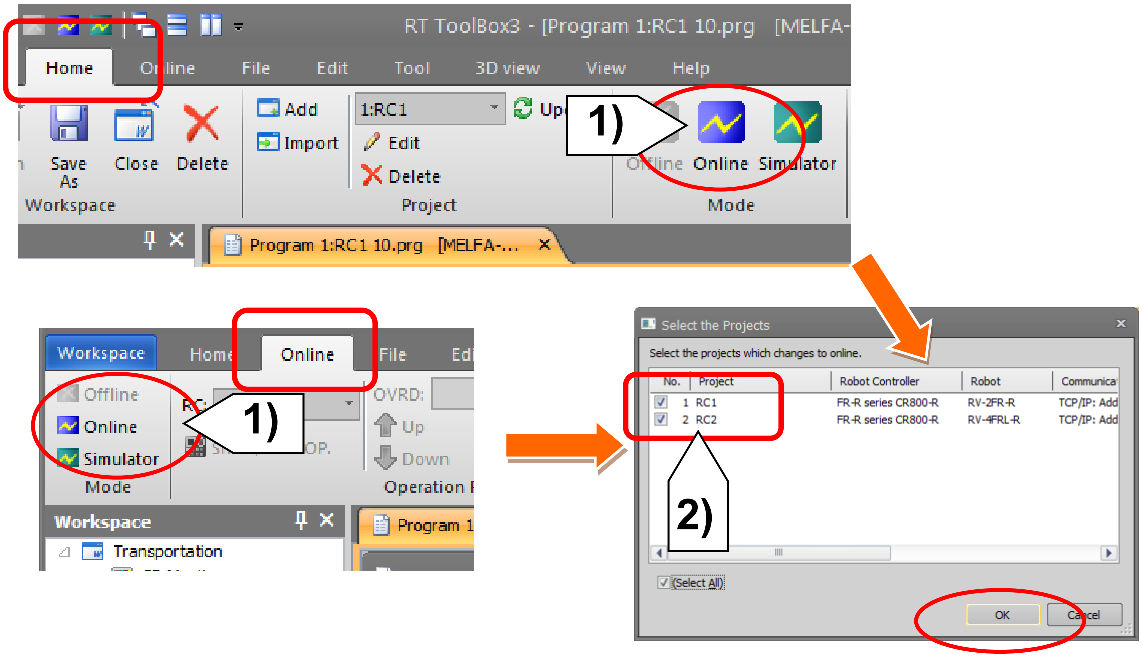
3) After saving the programs, close the Program Editing window.

(4) Connection with the robot controller

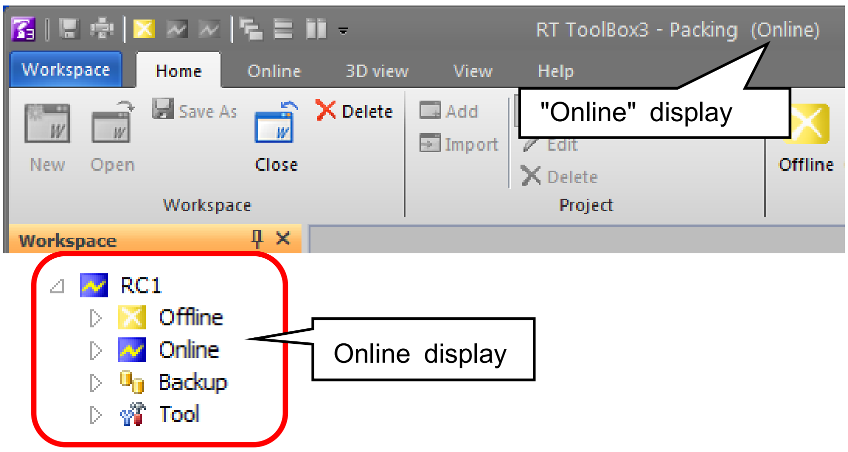
Connect RT ToolBox3 to the robot controller.

(4-1) Activate the online state of RT ToolBox3.

1) Click [Online] in the [Home] tab, or [Online] in the [Mode] group.
2) If there are multiple projects, Select the Projects window is displayed. Select the project in which the mode will be changed, then click "OK".

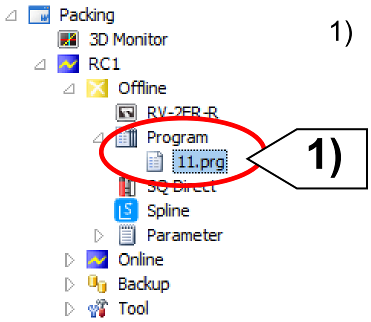


3) "Online" is displayed in the project tree, and RT ToolBox3 is connected to the robot controller.

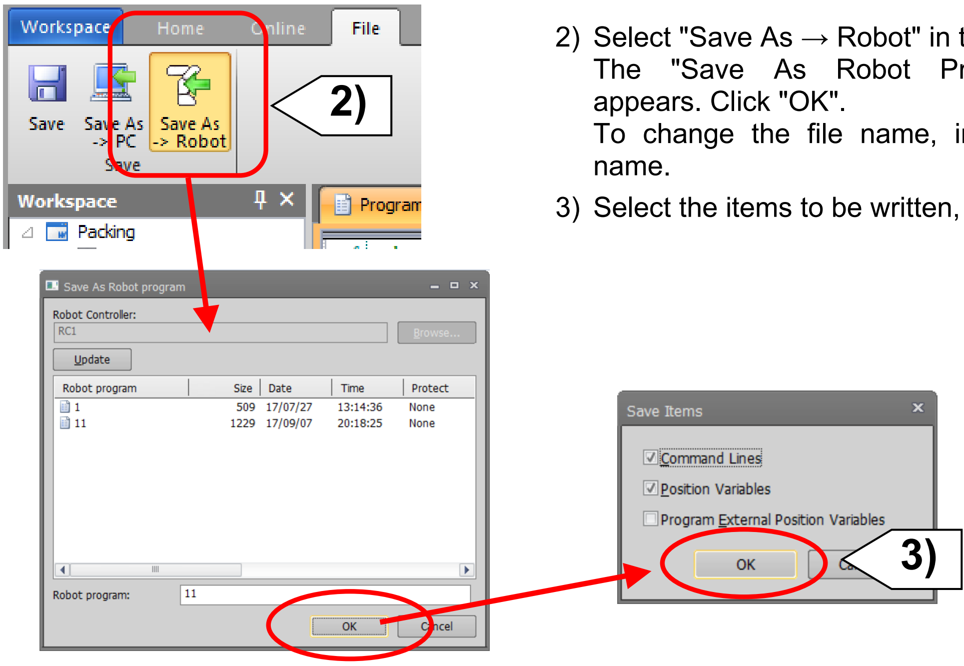


(5) Writing the program to the robot controller

(5-1) Open the program.

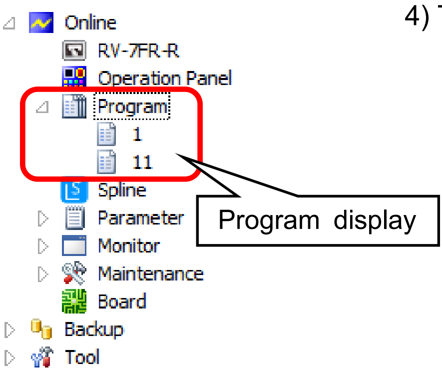


1) Open the program to be saved (double-click or right-click menu) from [Program] under [Offline] in the project tree.



2) Select "Save As → Robot" in the "File" tab. The "Save As Robot Program" window appears. Click "OK". To change the file name, input another file name.

3) Select the items to be written, and click "OK".

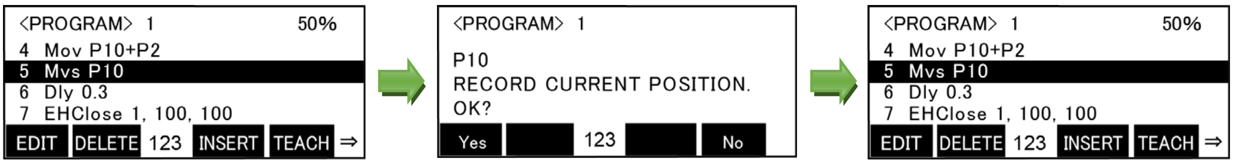


4) The saved file names are displayed in Program under "Online" in the project tree. (The programs saved in the robot controller are displayed.)

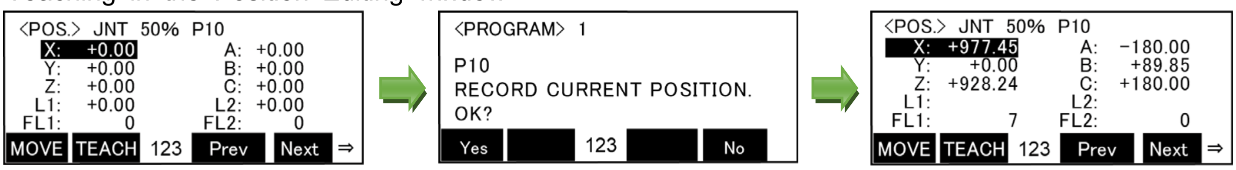
2.5 Teaching position

1) Open the program with the robot controller. For details of the procedure, refer to "Chapter 3 3.1 Displaying the program".
2) Move the robot to the operation position with the JOG operation, and register the position to the position variable used in the program. For details of the procedure for teaching operations using the teaching box, refer to "Chapter 3 3.2 Teaching the current position".
3) To check the registered position data, refer to "Chapter 3 3.3 Checking the registered position data (position jump)" (if necessary).
4) When position teaching is complete, save the program. For details of the procedure for saving programs, refer to "Chapter 3 3.5 Saving programs".

Teaching in the Instruction Editing window



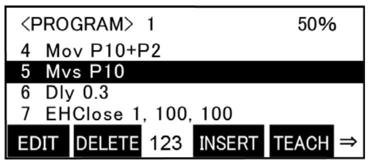
Teaching in the Position Editing window



2.6 Debug

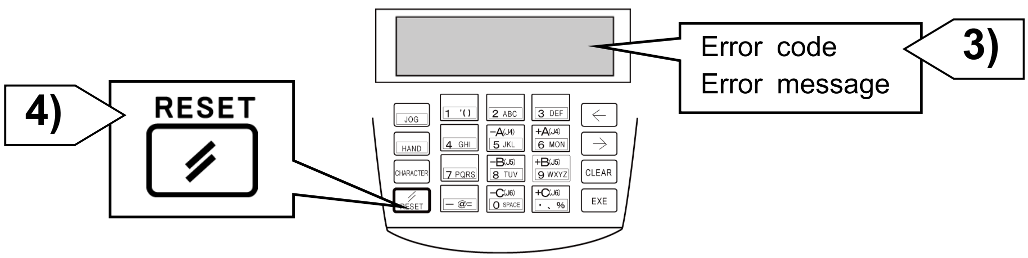
1) Execute the program by one line at a time (step operation) to check if the program operates normally.
2) For details of the procedure for the step operation using the teaching box, refer to "Chapter 3 3.6 Executing step operation".

Execution in the Instruction Editing window



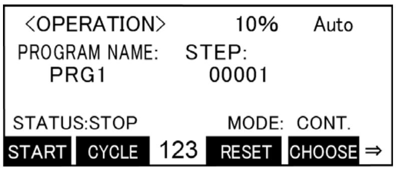
3) If an error occurs, check the error code and error message displayed on the teaching box.
4) Press the [RESET] button on the teaching box to clear the error.
5) Refer to "Appendix 9: List of Error Codes" and take measures for errors.

When errors occur



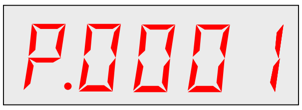
2.7 Automatic operation

1) Perform the automatic operation for the program.
2) Before the automatic operation, check that no person enters the operation range, and that the program operates normally by step operation. Set a slow speed at first.
3) For details of the procedure for automatic operation using the teaching box, refer to "Chapter 3 3.7 Performing automatic operation (T/B)".



4) For details of the procedure for automatic operation using the operation panel, refer to "Chapter 3 3.8 Performing automatic operation (O/P) (F Series)".

STATUS NUMBER
on the controller/drive unit
operation panel (O/P)

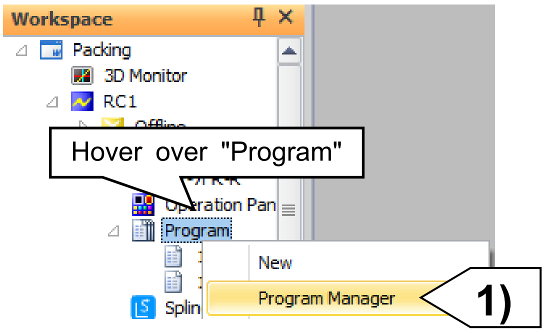


2.8 Saving the programs (robot → personal computer)

Save the programs in the robot controller to a personal computer.

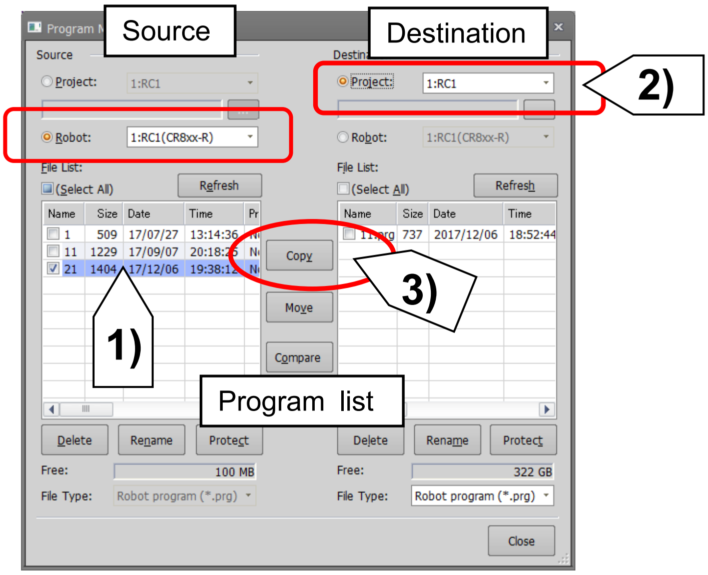
(1) Open the Program Manager window.

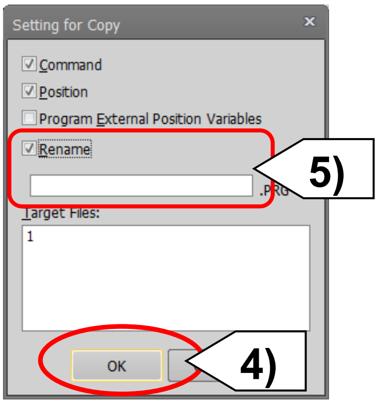
1) Right-click "Program" under "Online" in the RT ToolBox3 project tree and select "Program Manager".



(2) Select the programs to be saved, and save them.

1) Select "Robot" for source, and select the robot controller. The list of programs in the controller is displayed. Select the programs to be saved.
2) Specify the destination.
   Select "Project" for destination (the list of programs in the controller is displayed).
3) Click "Copy" in the lower part of the window.





4) If the file name is not changed in the Setting for copy window, click "OK".

5) To change the file name, select "Rename", input a new name in the field below, then click the "OK" button.

◆◇◆ Preparations for automatic operation of the robot have been completed. ◆◇◆

2.9 Editing and adding projects

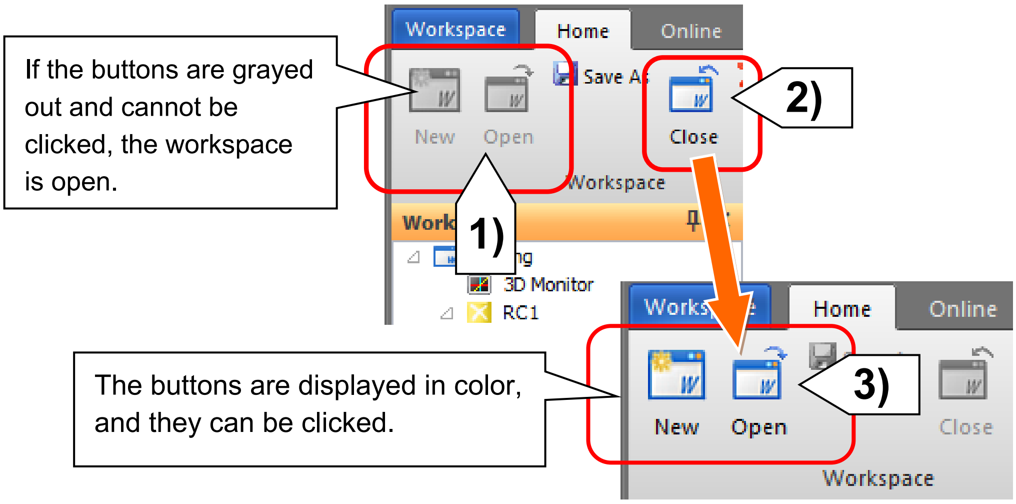
Edit and add projects in the offline state.

(1) Opening a workspace

(1-1) Close the workspace currently in operation.

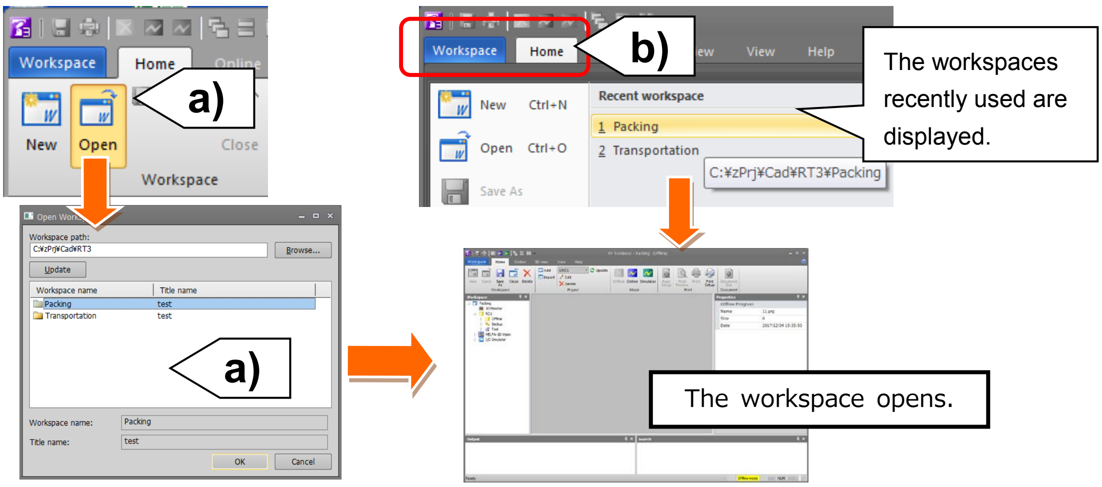
* When opening other workspaces, or creating new workspaces, it is necessary to close the workspace currently in operation.

1) If the [New] and [Open] buttons in the [Home] tab cannot be selected, the workspace is open.
2) Click [Close] in the [Home] tab and close the currently open workspace.
3) The [New] and [Open] buttons are displayed in color.



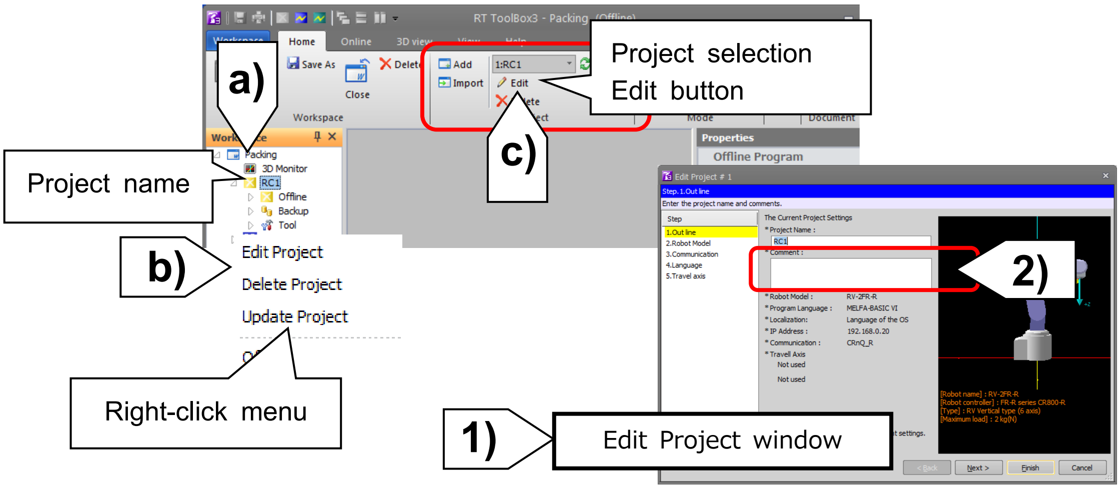
(1-2) Open the workspace.

1) Open the workspace using either of the following methods.
   a) Click [Open] in the [Home] tab. Specify the workspace location with the "Browse" button, select the workspace name, and click "OK".
   b) Click the [Workspace] tab in the ribbon to display the names of the workspaces recently used.
      From these names, select the workspace name to open.



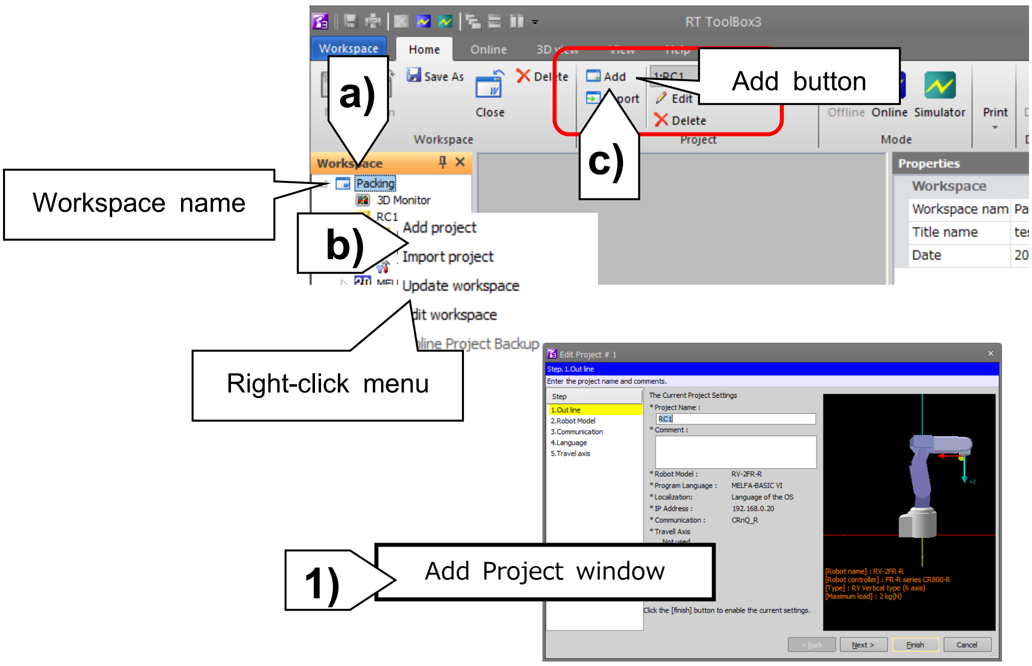
(2) Editing the project

1) Display the Edit Project window using one of the following methods.
   a) Double-click the project in the project tree.
   b) Select the project in the project tree, right-click and select "Edit project".
   c) Select the project from [Project] in the [Home] tab, and click [Edit].
2) Check that <Project name> specified in Step 1: Overview is the project to be edited.
3) For the project editing method, refer to "Chapter 2.3 Creating a new project".



(3) Adding the project

1) Display the Add Project window using one of the following methods.
   a) Double-click the workspace name in the project tree.
   b) Select the workspace in the project tree, right-click and select "Add project".
   c) Click [Add] in the [Project] group in the [Home] tab.
2) For information on how to add a project, refer to "Chapter 2.3 Creating a new project".



2.10 Operation panel

⚠ **DANGER**	The robot may operate at 100% speed during the program operation and debugging. Pay attention to safety around the robot. Before using the operation panel, prepare a T/B in hand and set the robot in a state in which an emergency stop can be made at any time.

For RT ToolBox3, the operation panel that operates a robot can be started at online connection and simulation start.

Robot programs, hand operation, and JOG operation can be performed in the operation panel.

Program debugging can be carried out by step operation.

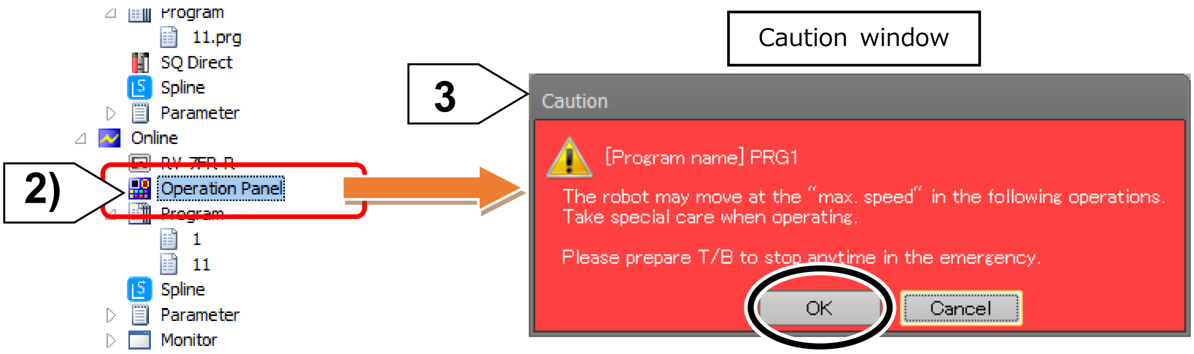
Although Hand operation and JOG operation can be performed on the robot, pay full attention to robot's surroundings.

(1) Starting the operation panel (at online connection)

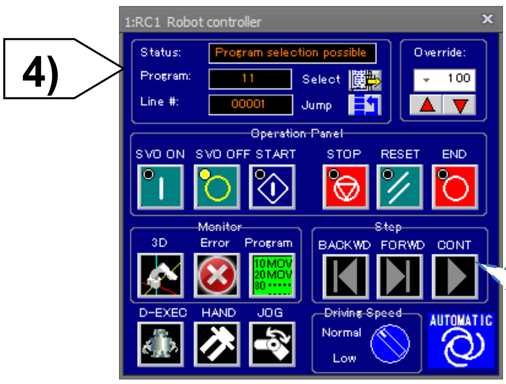
1) Connect RT ToolBox3 to the robot controller.
   For details of connection methods, refer to "Chapter 2.4 Creating a program (4) Connecting to the robot controller".

2) Click [Online] in the project tree, and double-click [Operation Panel].

3) When starting the program or carrying out the direct execution, the Caution window is displayed.
   Clicking the [OK] button starts the robot operation. Make sure it is safe around the robot and prepare a T/B before starting the robot operation.



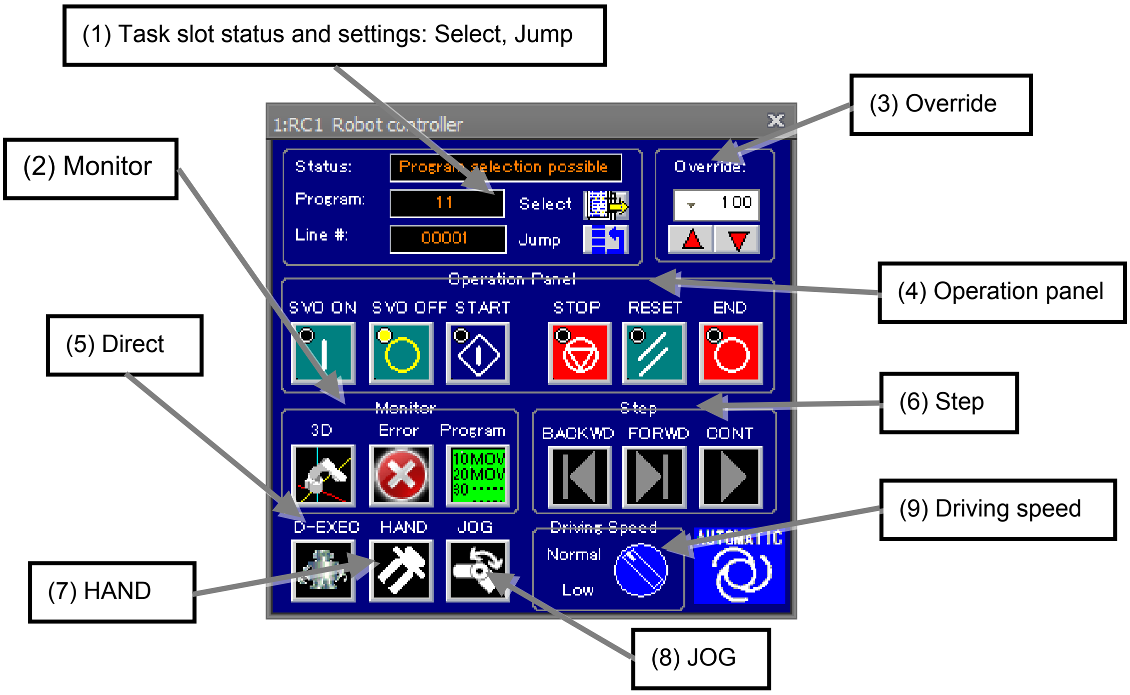
4) Click [OK] in the Caution window, and the operation panel is displayed.



Screen color
During online connection: Blue
At simulation start: Green

(2) Main screen

Programs selected in the operation panel and programs in the debug state can be executed. When the program is opened in the debug state, it can be executed by step operation.



1) Task slot status and specifications
Displays the task slot status, selected program, and line number being executed.
· Click the [Select] button to specify the program to be executed.
· Click the [Jump] button to specify the program execution line.

2) Monitor
Displays the 3D Monitor, Error Monitor window, and Program Monitor window.

3) Override
Displays and sets the robot speed override.

4) Operation panel
Starts, stops, resets, and ends the program operation, and turns the servo ON/OFF.

5) Direct
Performs a direct execution of an instruction (regardless of the robot program).

6) Step
Controls the program in the debug state.
· [FORWD], [BACKWD]: Executes one line of the robot program, and moves the execution line to the previous or next line.
· [CONT]: Executes a program that has stopped by a breakpoint or the stop command continuously from the stopped line.

7) HAND
Operates the robot hand. Click this button to display the Hand Operation window.
In addition to the opening and closing of each hand, hand alignment and home position return can be performed.
(To open and close the electrically operated hand, perform direct execution.)

8) JOG
Performs JOG operation on the robot (For details, refer to "(3) Jog Operation window" on the next page). Click this button to display the JOG Operation window.

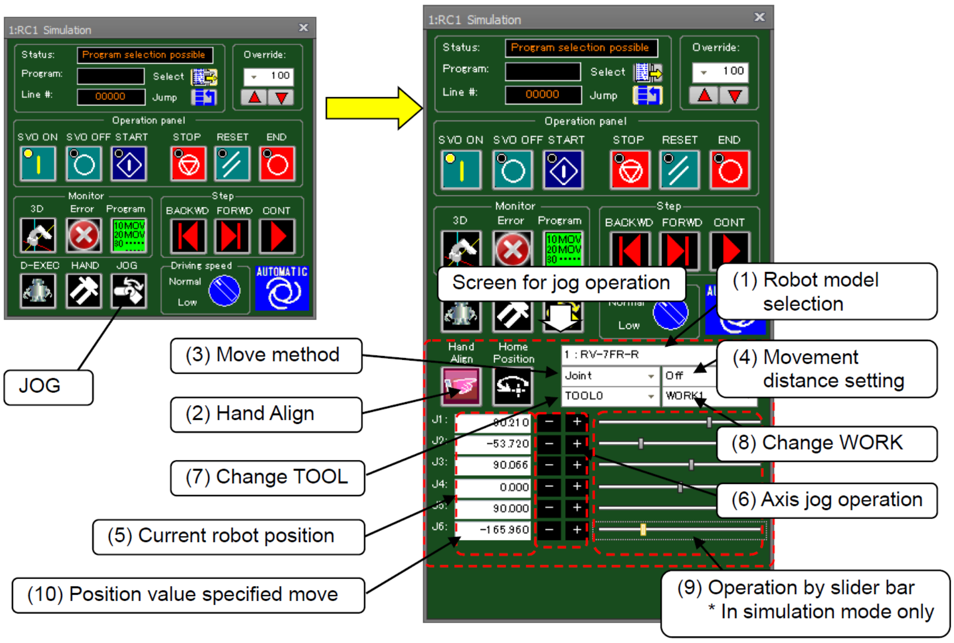
9) Driving speed
Selects the robot driving speed from Normal and Low.
When Low is selected, the robot moves at the maximum JOG operation speed.

(3) Jog Operation window

The robot JOG operations displayed in the robot view can be performed in the online or simulation mode. Click the "JOG" button in the operation panel to display the JOG Operation window.

To perform JOG operation online (when connected to a robot controller), the personal computer needs to be set to acquire operation rights.

When the MODE key of the robot controller is set to "Automatic" and external I/O signals are used, set inputs of operation rights from external I/O to OFF.



1) Robot model selection
   Selects the robot model to be operated when multiple robots are connected.
2) Hand Align
   Aligns the posture of the hand attached to the robot in units of 90 degrees.
   This feature moves the robot to the position where the A, B and C components of the current position are set at the closest values in units of 90 degrees.
3) Move method
   Select the method in which the robot moves. For details on the Move method, refer to "Appendix 2: RT ToolBox3 Simulation Function 2.2 Simulation function (2) Jog operation".
4) Movement distance setting
   Selects the robot movement distance. Selectable move distances are "Off", "High", and "Low".
5) Current robot position
6) Axis JOG operation
   Performs the JOG operation on each robot axis.
   The robot moves while holding down the [+] or [-] button with the mouse.
7) Change TOOL
8) Change Workpiece
9) Adjust settings with the slider bar
   When Joint or XYZ jog is selected, the corresponding coordinate axis can be moved by moving the slider bar to the left and right. The slider bar can be moved only in the simulation mode.
10) Move robot to the specified coordinate
   Specify the Joint or XYZ coordinates directly to move the robot.

2.11 Parameter setting

The parameter information set in the robot controller can be referred to and overwritten.

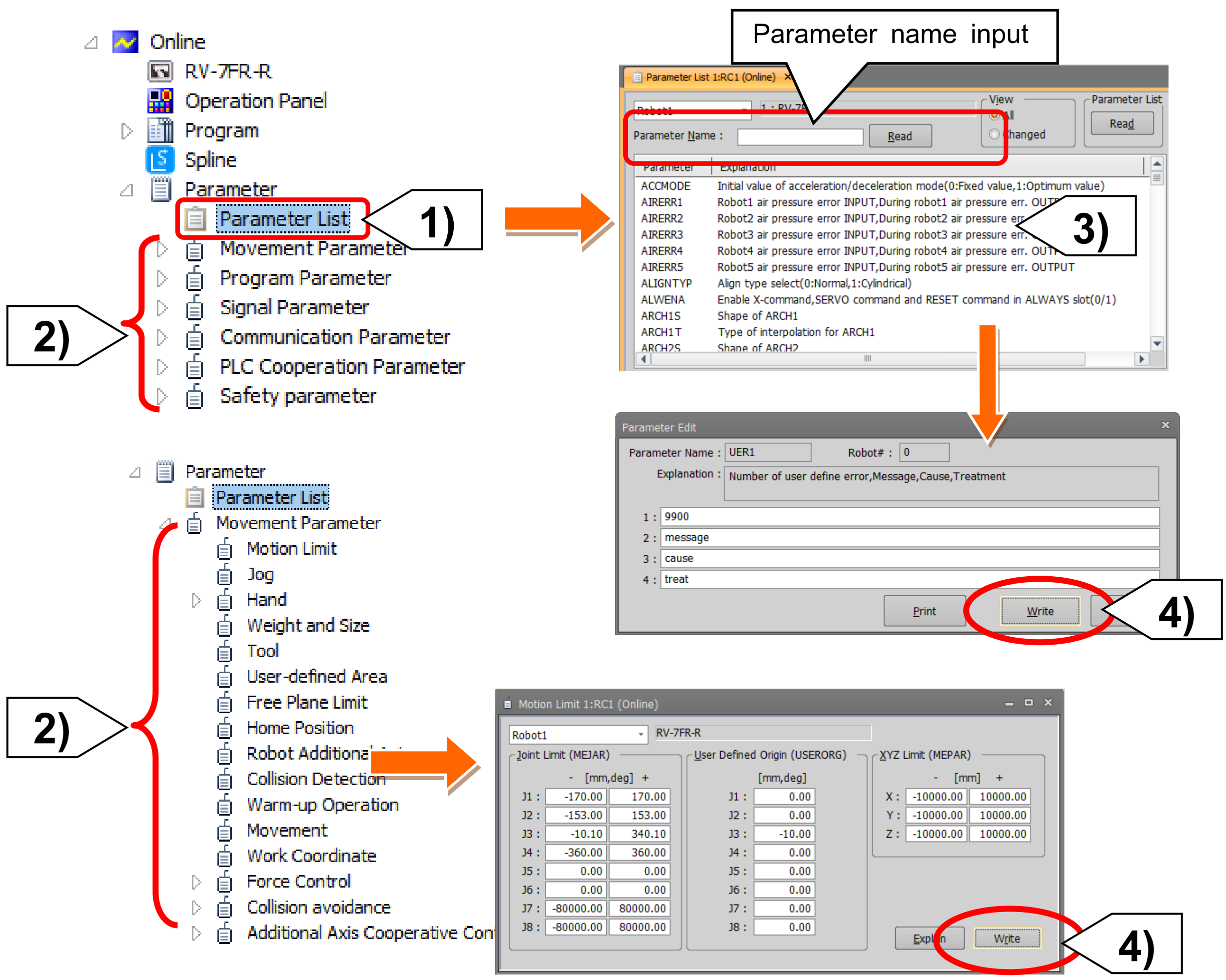
Set the parameters with the robot controller connected to RT ToolBox3.
To set parameters in the robot controller, select [Parameter] under [Online].
Expanding the items in [Parameter] displays items to start each parameter setting window.

Frequently used parameters are described in "Appendix 7: Frequently Used Parameters".
* For details of parameters, refer to the instruction manual "Detailed explanations of functions and operations".

Referring to and overwriting the parameter information

[Reference]
1) Expand [Online] → [Parameter] in the project tree, and double-click [Parameter List].
2) Or, expand each parameter under [Parameter], and double-click the parameter.
3) For [Parameter List], double-click the parameters displayed in the list.
   After inputting a parameter in "Parameter Name", click the "Read" button to search for the parameter.

[Overwrite]
4) To change parameters, change the parameter values and click "Write".
5) To enable the changed parameter values, power on the robot controller again.

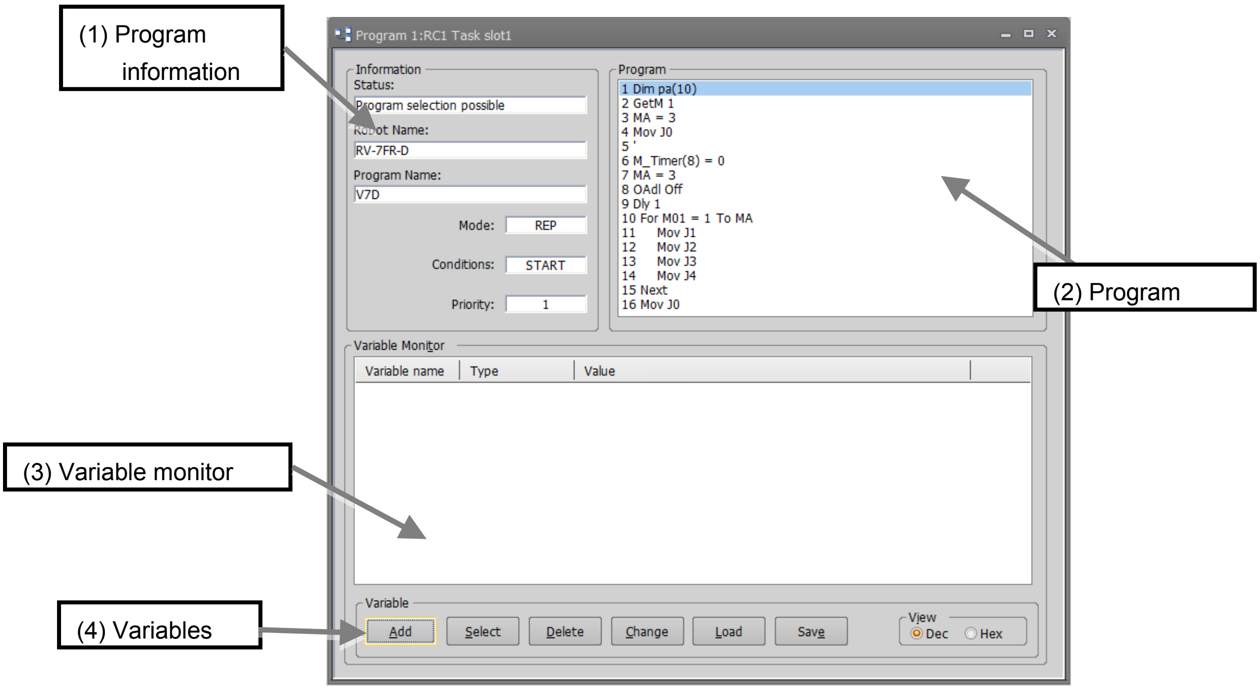


2.12 Monitoring function

Monitor the items related to the operation of the connected robot.

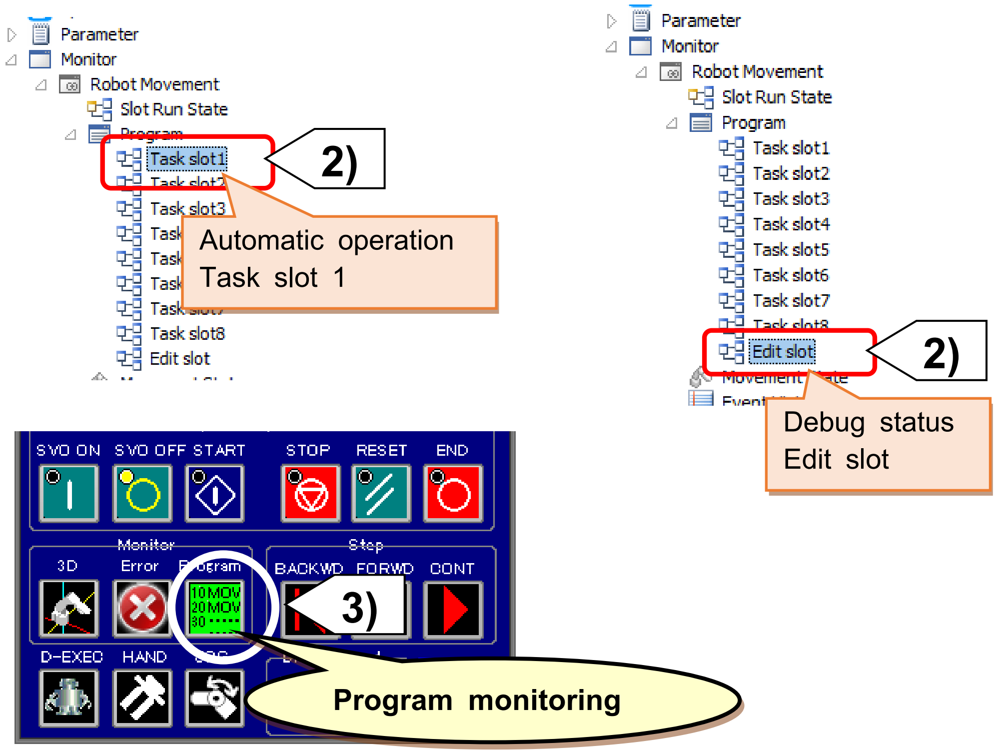
(1) Program monitoring

The program information of current operations can be monitored.
Information such as the line currently being executed, variable values, robot posture, and position information can be checked.



1) Program information
   The program name currently selected, its operation status, and the model name of the connected robot can be checked.
2) Program
   The programs currently selected are displayed. The line currently being executing is highlighted.
3) Variable monitor
   The names of the variables used in the selected programs can be checked.
   The variables to be monitored can be selected with the buttons displayed at the lower part of the window.
4) Variables
   Add or select variables to be monitored.
   Information currently being monitored can be saved to a file.
   The saved variable names and types can be read from the file, and they can be set as variables to be monitored.

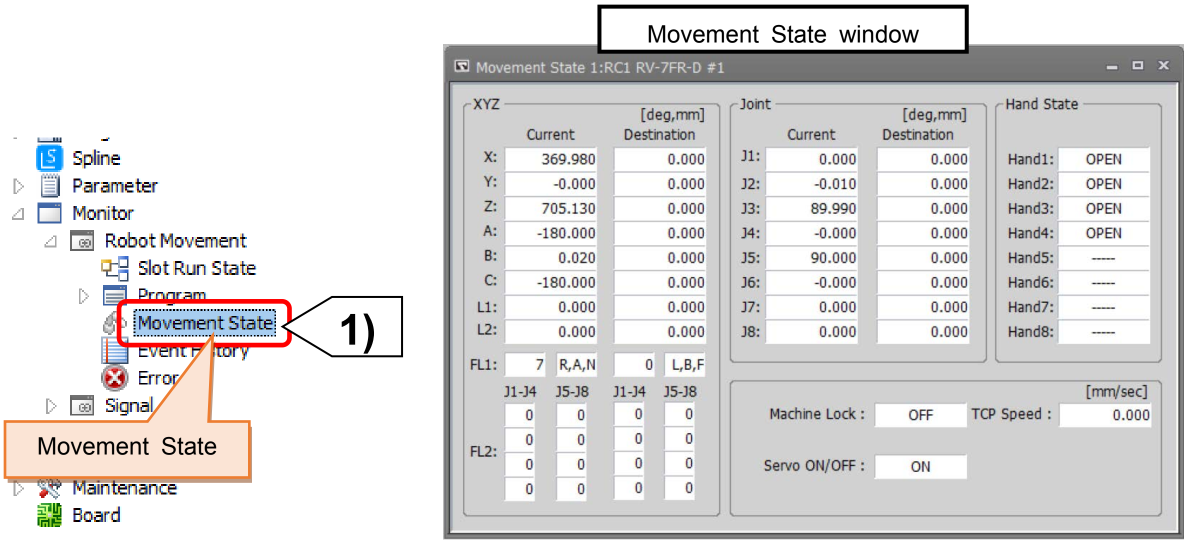
How to display the Program window
1) With the program open or being executed, click [Online] → [Monitor] → [Robot Movement] → [Program] for the target project in the project tree. 2) For automatic operation, double-click "Task slot1". For debug state, double-click "Edit slot". 3) Clicking [Monitor] → [Program] in the operation panel also displays the program monitor (it is not necessary to select a task slot in the project tree).



(2) Movement State

The current position, target position, and hand open/close status of the robot can be checked.

How to display the movement state
1) Double-click [Online] → [Monitor] → [Robot Movement] → [Movement State] for the target project in the project tree.

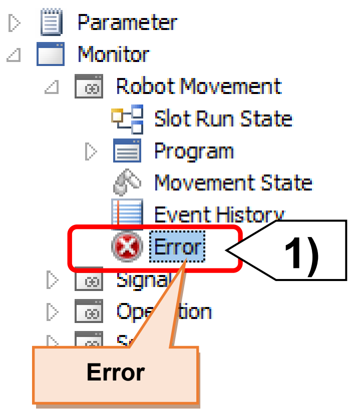


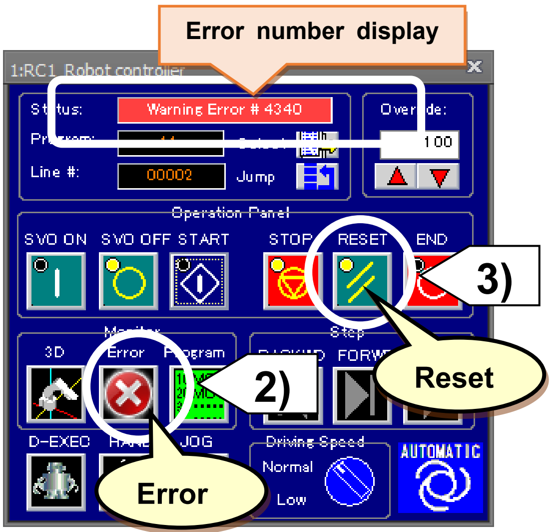
(3) Error monitoring

The errors currently occurring are displayed.
In the Error Detail window, details (causes and recovery methods) of errors that have occurred can be checked.

How to display the Error window

1) Double-click [Online] → [Monitor] → [Robot Movement] → [Error] for the target project in the project tree.
2) Clicking [Monitor] → [Error] in the operation panel also displays the error.
3) To reset the error, click [RESET] in the operation panel.

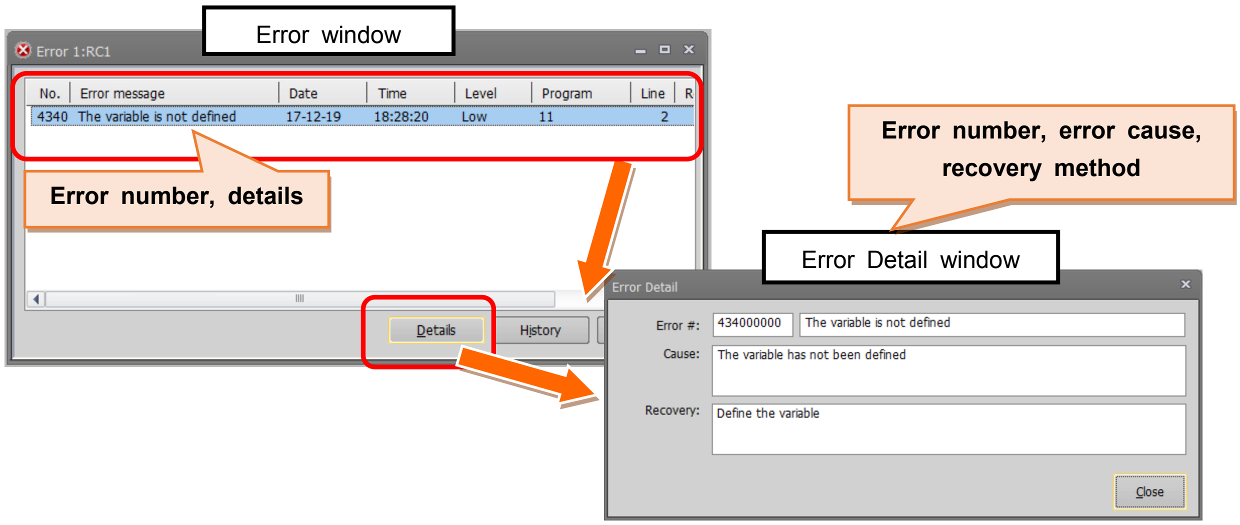




Operation panel at error occurrence

How to display the Error Detail window

1) Select the error and click the [Details] button, or double-click the error message on the Error Monitor window.



(4) Signal monitoring

The statuses of signals input to the robot controller from external equipment and signals output from the robot controller to external equipment can be checked on the General Purpose Signal monitor.

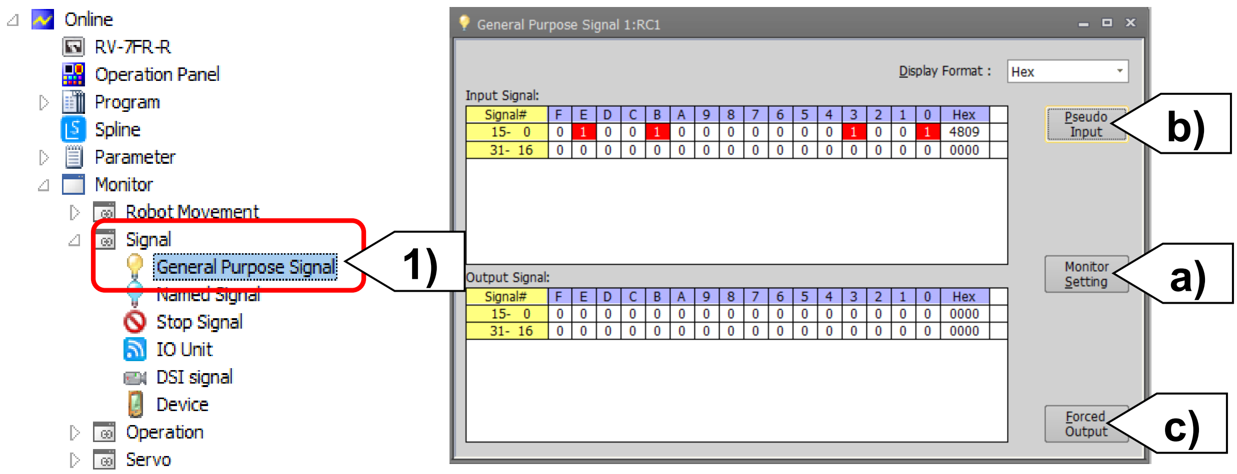
a) Monitor settings: Signals displayed on the monitor can be set in a continuous range.

b) Pseudo-input: Signals are input to the robot controller from a personal computer, not from external equipment.

c) Forced output: Signals can be forcibly output to external equipment from the robot controller.

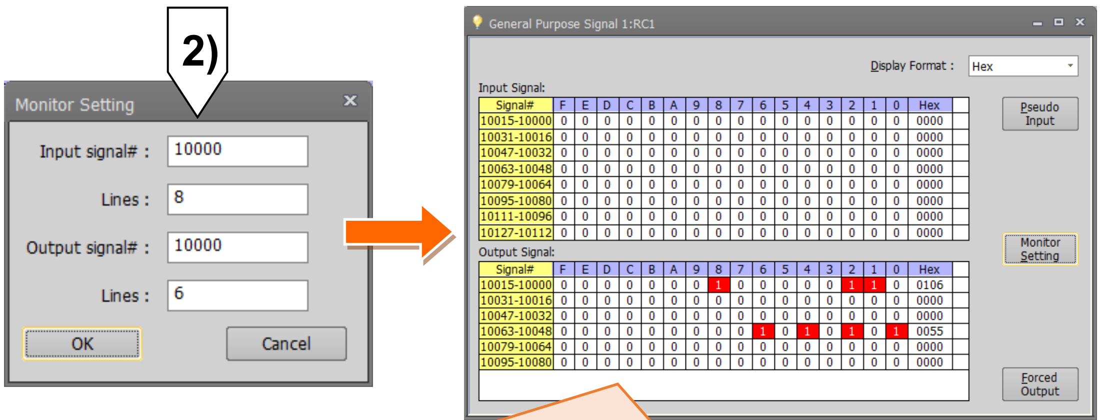
How to display the General Purpose Signal monitor

1) Expand [Online] → [Monitor] → [Signal] for the target project in the project tree, and select "General Purpose Signal".



How to set the signals that are displayed

1) Click the Monitor Setting button (a) to display the Monitor Setting window.
2) Input the start numbers of the signals displayed in [Input signal#] and [Output signal#], set their display ranges in [Lines], and then click the [OK] button.



Example)
Input signal: Signal number 10000 or later, 8 lines displayed
Output signal: Signal number 10000 or later, 6 lines displayed

2.13 Backup and restore

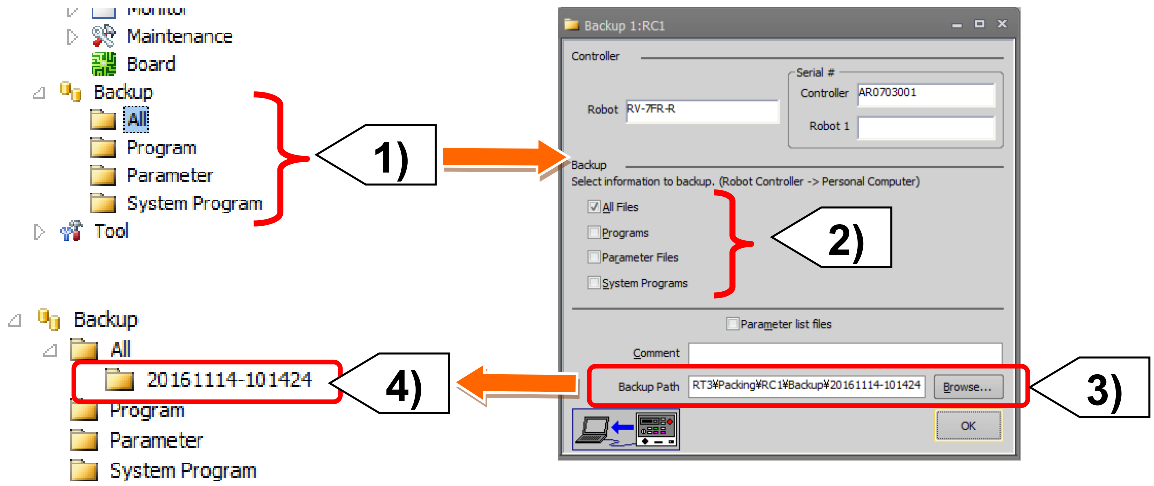
Backup or restore data with the robot controller connected to RT ToolBox3.

(1) Backup (robot → personal computer)

Save the information in the robot controller to a file in a personal computer.

Backup of data in one connected controller

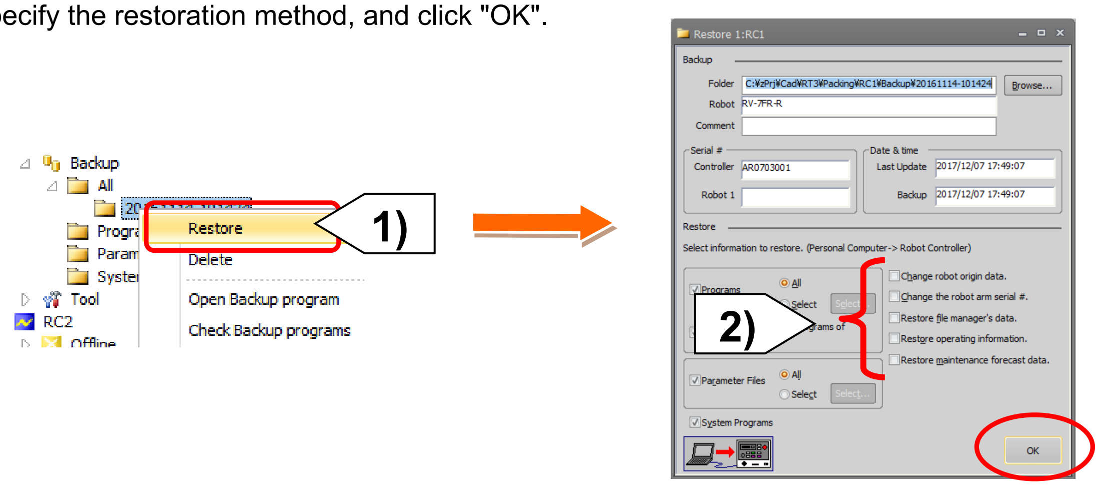
1) Expand [Online] → [Backup] in the project tree. Double-click the item to be backed up from the four types of backup methods displayed in the project tree.
2) The backup method can be changed by selecting a check box in the Backup window.
3) Specify the backup destination, and click "OK".
4) The Confirmation window is displayed, and the backup starts.
5) When the backup has completed, the backup data is displayed under [Backup] in the project tree.



(2) Restore (personal computer → robot)

Transfer information backed up on the personal computer to the robot controller.

1) Expand [Backup] in the project tree. Select the data to be restored, right-click and select "Restore".
2) Specify the restoration method, and click "OK".



2.14 Simulation function

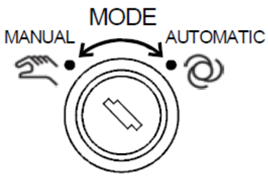
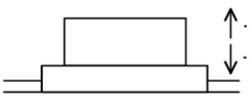
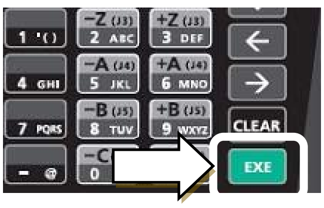
For details of the RT ToolBox3 simulation function, refer to "Appendix 2: RT ToolBox3 Simulation Function".

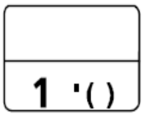
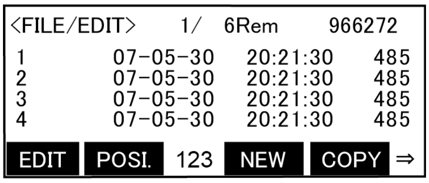
<<MEMO>> * Use this page to write down notes.

Chapter 3 How to operate the Frequently Used T/B

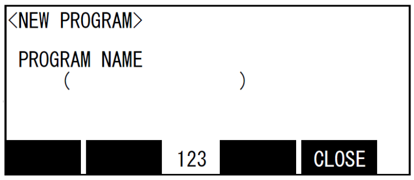
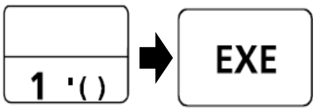
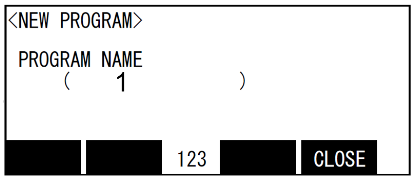
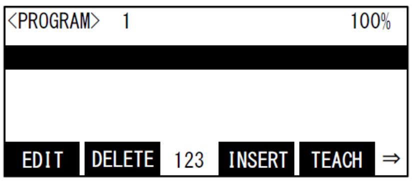
3.1 Displaying the program

(1) Selecting the INSTRUCTION EDIT screen

Step	Operation	T/B screen	Explanation of Operation
1	Controller/ drive unit (O/P) 	<Title screen> MELFA CR800-D Ver. S3 RH-3FRH5515-D COPYRIGHT (C) 2011 MITSUBISHI ELEC TRIC CORPORATION ALL RIGHTS RESE RVED	<F Series (CR750, CR760)> Set the controller/drive unit's MODE selector switch to "MANUAL". <FR Series, F Series (CR751)> Switch the mode selector switch prepared by the user to "MANUAL".
2	Teaching box (T/B) TB ENABLE switch on back side  Out: Disabled Depressed: Enable (lamp ON)  TB on back side	<Title screen> MELFA CR800-D Ver. S3 RH-3FRH5515-D COPYRIGHT (C) 2011 MITSUBISHI ELEC TRIC CORPORATION ALL RIGHTS RESE RVED	Press the TB ENABLE switch on the back of the teaching box (T/B) to enable the T/B operation. (TB ENABLE switch turns ON.) If an alarm occurs, reset it by pressing the [RESET] key at the lower left of the teaching box.
3		<Menu screen> <MENU> 1.FILE/EDIT 2.RUN 3.PARAM. 4.ORIGIN/BRK 5.SET/INIT. 6.ENHANCED CLOSE	The <Menu> screen opens when the [EXE] key is pressed in the title screen. The cursor will flicker at "1. FILE/EDIT" (selected item).

Step	Operation	T/B screen	Explanation of Operation
4		< FILE/EDIT screen> 	Press the number key [1] to open the < FILE/EDIT > screen. A list of registered programs will appear. When opening the saved program, select the program name with the cursor and press the [EXE] key to open the <INSTRUCTION EDIT> screen.

(2) Creating a new program

Step	Operation	T/B screen	Explanation of Operation
1		< FILE/EDIT screen> 	When creating a new program, press the [F3] key ("NEW") to open the new program creation screen. Set the program No. (name).
2		< FILE/EDIT screen> 	To set the program No. (name) to 1, press the number key [1]. Press the [EXE] key to finalize it. The edit screen for program No. 1 opens, and the first line appears.
3		<INSTRUCTION EDIT screen> 	The program name appears at the top line of the <INSTRUCTION EDIT> screen. Nothing is displayed when creating a new program. Input the program in this screen. If the program closes without a program being entered, the program name is deleted.

* To input and correct a program with T/B, refer to "Appendix 1: Teaching Box Appendix 1.3 / Inputting the program with T/B ".

3.2 Teaching the current position

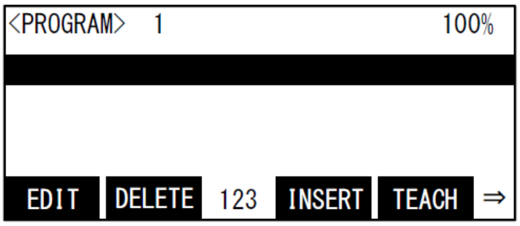
(1) Operation on the POSITION EDIT screen

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	<INSTRUCTION EDIT screen> <PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 DIRECT CHANGE 123 CLOSE ⇒	Open the <INSTRUCTION EDIT> screen. Press the [FUNCTION] key and display "SWITCH" at the function menu at the bottom of the screen.
2	F2	<POSITION EDIT screen> <POS.> JNT 50% P1 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F2] key ("SWITCH") to open the <POSITION EDIT> screen.
3	F3 · F4	<POSITION EDIT screen> <POS.> JNT 50% P10 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F3] key ("Prev") or [F4] key ("Next") displayed at the very bottom of the <POSITION EDIT> screen and display the position variable to be edited. (Display P10 in this case.) * Prev (= Previous): Go to the previous screen Next: Go to the next screen
4	 Servo ON <Jog operation>	<JOG screen> <CURRENT> JOINT 50% M1 T1 B* J1: -23.39 J5: +50.47 J2: +11.94 J6: -24.34 J3: +114.67 : J4: +1.61 : XYZ TOOL JOG 3-XYZ CYLINDER ⇒	Press the [JOG] key to open the JOG screen. Lightly hold down the ENABLE switch on the back of the T/B and press the [SERVO] key to turn the servo ON. Move the robot to the teaching position with jog feed.
5		<POSITION EDIT screen> <POS.> JNT 50% P10 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	After moving the robot to the teaching position, press the [JOG] key (disable JOG mode) again and return to the <POSITION EDIT> screen.
6	F2	<POSITION EDIT screen> <PROGRAM> 1 P10 RECORD CURRENT POSITION. OK? Yes 123 No	Press the [F2] key ("Teach"). The message "Current position will be registered in P_ _. Okay?" will appear.

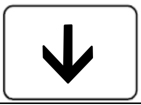
Step	Operation	T/B screen	Explanation of Operation
7	F1	<POSITION EDIT screen> <POS.> JNT 50% P10 X: +282.11 A: −179.99 Y: −116.84 B: +3.16 Z: +329.31 C: +179.95 L1: L2: FL1: 00000000 FL2: 00000000 MOVE TEACH 123 Prev Next ⇒	Press the [F1] key ("YES") to register the current position. To cancel the registration, press the [F4] key ("NO").
8	F4	<POSITION EDIT screen> <POS.> JNT 50% P11 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F4] key ("Next"). The position variable will appear. Perform step 4 to step 7 and register the points in order.
9	FUNCTION ⇩ F3	<POSITION EDIT screen> <POS.> JNT 50% P10 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒ Switch using the [FUNCTION] key DELETE NAME 123 CHANGE CLOSE ⇒ F3 Press F3. <INSTRUCTION EDIT screen> <PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 DIRECT CHANGE 123 CLOSE ⇒	When registering the position data is completed, press the [FUNCTION] key and display "SWITCH" at the function menu at the bottom of the screen. Press the [F3] key ("CHANGE") to return to the <INSTRUCTION EDIT> screen.

(2) Operation of the INSTRUCTION EDIT screen

1) Open the <POSITION EDIT> screen.
2) Press the [FUNCTION] key, and display "SWITCH" at the bottom of the screen.
3) Press the function key ([F3]) for "SWITCH".
4) The <INSTRUCTION EDIT> screen will open.



Teaching (registering) a position (the INSTRUCTION EDIT screen is an example).
The following shows the method for teaching the position from the INSTRUCTION EDIT screen.

Step	Operation	T/B screen	Explanation of Operation
1	 	<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Look at an example to teach P10. Press the [↓] and [↑] keys to move the cursor to the step where P10 is written.
2	 Servo ON <Jog operation>	<CURRENT> XYZ 50% P10 X: +282.11 A: -179.99 Y: -116.84 B: +3.16 Z: +329.31 C: +179.95 L1: L2: FL1: 00000007 FL2: 00000000 JOINT TOOL JOG 3-XYZ CYLINDER ⇒	Press the [JOG] key to open the JOG screen. Lightly hold down the ENABLE switch on the back of the T/B and press the [SERVO] key to turn the servo ON. Move the robot to the teaching position with jog feed.
3		<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	After moving the robot to the teaching position, press the [JOG] key again and disable the JOG mode. The ISNTRUCTION EDIT screen opens.
4	F4	<PROGRAM> 1 P10 RECORD CURRENT POSITION. OK? Yes 123 No	Press the [F4] key ("TEACH"). The confirmation message "Current position will be registered. Okay?"
5	F1	<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	When the [F1] key ("YES") is pressed, the current position data is registered at P10. To cancel the registration, press the [F4] key ("NO").

Pick Up!

When multiple position variables

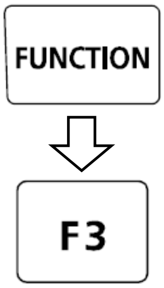
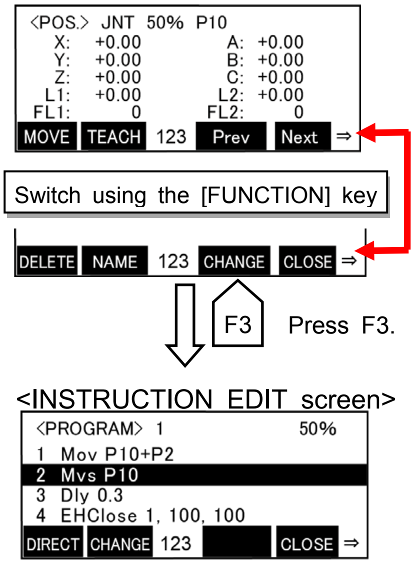
If multiple position variables exists in one line such as "Mov P10+P2", when teaching from the INSTRUCTION EDIT screen, only the first position variable can be taught.

3.3 Checking the registered position data (position jump)

With this procedure, the robot is moved to the registered position data and the position data is confirmed. (Perform this procedure if necessary.)

* Before starting, confirm that the robot will not interfere with peripheral devices even if it moves from the current position.

Step	Operation	T/B screen	Explanation of Operation
1		<INSTRUCTION EDIT screen> <PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Follow "(1) Steps for INSTRUCTION EDIT screen section 3.1 Displaying the program" in this chapter and open the <INSTRUCTION EDIT> screen for the created program.
2	FUNCTION	<PROGRAM> 1 50% 1 Mov P10+P2 2 Mvs P10 3 Dly 0.3 4 EHClose 1, 100, 100 DIRECT CHANGE 123 CLOSE ⇒	Press the [FUNCTION] key and display "SWITCH" at the function menu at the bottom of the screen.
3	F2	<POSITION EDIT screen> <POS.> JNT 50% P1 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F2] key ("SWITCH") to open the POSITION EDIT screen.
4	F3 F4 OVRD↑ OVRD↓	<POS.> JNT 30% P10 X: +977.45 A: −180.00 Y: +0.00 B: +89.85 Z: +928.24 C: +180.00 L1: L2: FL1: 7 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F3] key ("Prev") and [F4] key ("Next") to display the position variable to be confirmed. Press the [OVRD↑] key and [OVRD↓] key and set a safe speed.
5	Servo ON F1	<POS.> JNT 30% P10 X: +977.45 A: −180.00 Y: +0.00 B: +89.85 Z: +928.24 C: +180.00 L1: L2: FL1: 7 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Lightly hold down the ENABLE switch on the back of the T/B and press the [SERVO] key to turn the servo ON. Hold down the function key ([F1]) for "MOVE". The robot will move toward the position of the displayed position variable while the [F1] key is held down. The robot will move to the registered position and then stop. The interpolation method follows the method set for jog operation.

Step	Operation	T/B screen	Explanation of Operation
6		<POSITION EDIT screen> 	When confirming the position data is completed, press the [FUNCTION] key and display "SWITCH" at the function menu at the bottom of the screen. Press the [F3] key ("CHANGE") to return to the <INSTRUCTION EDIT> screen.

There are two interpolation methods:

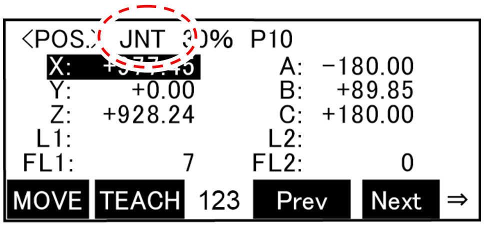
"JOINT" is displayed for joint interpolation

"CARTESIAN" is displayed for linear interpolation

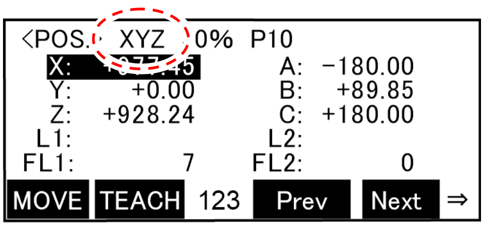
(These depend on the jog mode.)

Note) Before starting, confirm that the robot will not interfere with the peripheral devices even if it moves from the current position.

Joint interpolation



Linear interpolation



3.4 Changing position data

(1) Correcting (MDI compensation)

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 DIRECT CHANGE 123 CLOSE ⇒	Press the [FUNCTION] key and display "SWITCH" at the function menu at the bottom of the screen.
2	F2	<POSITION EDIT screen> <POS.> JNT 50% P1 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F2] key ("SWITCH") to open the <POSITION EDIT> screen.
3	F3 . F4	<POS.> JNT 50% P2 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F3] key ("Prev") and [F4] key ("Next") to display the position variable to be edited.
4	↓ . CLEAR	<POS.> JNT 50% P2 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the arrow keys ([↓], [→]) and move the cursor to the coordinate to be edited. Hold down the [CLEAR] key and delete the displayed "+0.00".
5	Number key EXE	<POS.> JNT 50% P2 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +50.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Input the new value and press the [EXE] key. Ex) Setting the Z axis value to 50mm Press the [5], [0] and [EXE] keys. Only the Z axis value in the position variable P2 is registered as 50mm.

Pick Up!

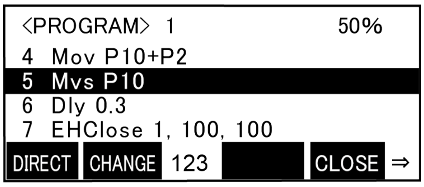
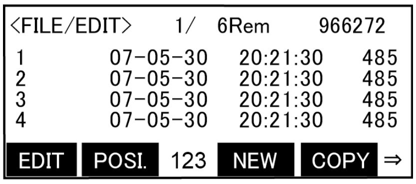
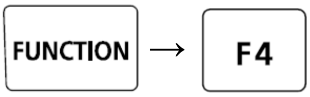
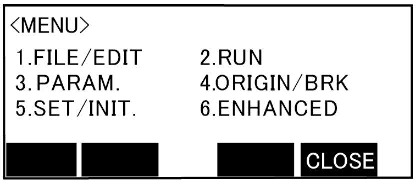
Correcting position

The position data can be corrected in the same manner.
After the position data is finalized, hold down the [F1] key ("MOVE") to move to the compensated data position.
* Note that the current position data is registered again when the [F2] key ("Teach") is pressed on this screen.

(2) Deleting

Step	Operation	T/B screen	Explanation of Operation
1		<POSITION EDIT screen> 〈POS.〉 JNT 50% P1 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Open the <POSITION EDIT> screen.
2	F3 · F4	〈POS.〉 JNT 50% P55 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 MOVE TEACH 123 Prev Next ⇒	Press the [F3] key ("Prev") and [F4] key ("Next"), and display the position variable to be deleted.
3	FUNCTION	〈POS.〉 JNT 50% P55 X: +0.00 A: +0.00 Y: +0.00 B: +0.00 Z: +0.00 C: +0.00 L1: +0.00 L2: +0.00 FL1: 0 FL2: 0 DELETE 123 CHANGE CLOSE ⇒	Press the [FUNCTION] key and display "DELETE" at the function menu.
4	F1	〈POS.EDIT〉 P55 DELETE OK? Yes 123 No	Press the [F1] key ("DELETE"). The confirmation message "xxx will be deleted. Okay?"
5	F1	〈POS.〉 JNT 50% P55 X: A: Y: B: Z: C: L1: L2: FL1: 0 FL2: 0 DELETE 123 CHANGE CLOSE ⇒	When the [F1] key ("YES") is pressed, that position variable data is deleted.

3.5. Saving a program

Step	Operation	T/B screen	Explanation of Operation
1		<INSTRUCTION EDIT screen> 	Press the [FUNCTION] key and display "CLOSE" at the function menu.
2		<MANAGE/EDIT screen> 	When the [F4] key ("CLOSE") is pressed, the program is saved and closed. The list of programs opens.
3		<Menu screen> 	Press the [FUNCTION] key, switch the function menu and press the [F4] key ("CLOSE"). The <Menu> screen opens.

3.6 Executing step operation

With this procedure, the program is executed one line at a time in order of numbers to confirm that the program runs correctly.

Step	Operation	T/B screen	Explanation of Operation
1		<INSTRUCTION EDIT screen> <PROGRAM> 1 50% 1 Ovrd 80 2 Hopen 1 3 Mov P1 4 Mov P10+P2 EDIT DELETE 123 INSERT TEACH ⇒	Follow "(1) Steps for INSTRUCTION EDIT screen section 3.1 Displaying the program" in this chapter and open the <INSTRUCTION EDIT> screen of the program.
2	FUNCTION	<PROGRAM> 1 50% 1 Ovrd 80 2 Hopen 1 3 Mov P1 4 Mov P10+P2 FWD JUMP 123 BWD ⇒	Press the [FUNCTION] key and display "FWD" and "BWD" at the function menu at the bottom of the screen.
3	Servo ON F1 (FWD)	<PROGRAM> 1 50% 1 Ovrd 80 2 Hopen 1 3 Mov P1 4 Mov P10+P2 FWD JUMP 123 BWD ⇒	Lightly hold down the ENABLE switch on the back of the T/B and press the [SERVO] key to turn the servo ON. When the [F1] key ("FWD" is pressed, the step at the cursor location is executed while the key is held down. The program execution stops when the function key is released. During execution, LED above the [START] button on the operation panel turns ON. When execution of one step is completed, the [START] switch's LED turns OFF, and the LED above the [STOP] switch turns ON. When the key is released, the cursor on the T/B automatically moves to the next step. * The override should be set to a delay for safety purposes. Use this operation to execute each line and confirm the operation.
4			To quit, press the "CLOSE" button and save the program.

Pick Up!

Step Return

If the [F4] key ("BWD") is pressed after step feed has been executed several times, program can be executed and the operation confirmed while returning one step at a time. However, this function is limited to the movement command for up to 4 continuous steps.

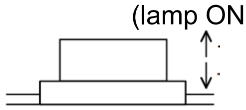
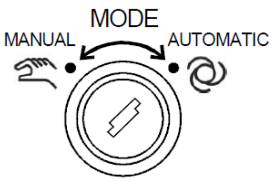
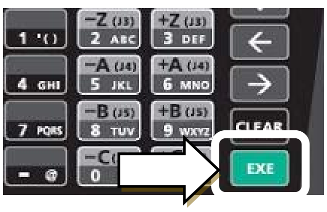
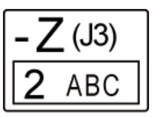
♦◊♦ This completes confirmation of the robot operation (debugging).
Next, try moving the robot with automatic operation!! ♦◊♦

3.7. Performing automatic operation (T/B)

Automatic operation can be executed with the controller/drive unit's operation panel (O/P) or teaching box (T/B).
When operating with the operation panel (O/P), refer to "3.8. Performing automatic operation (O/P) (F Series) ".

♦◊♦ Initially set a low movement speed, and gradually increase it. ♦◊♦

(1) Automatic Operation

Step	Operation	T/B screen	Explanation of Operation
1	Teaching box (T/B) TB ENABLE switch on back side  Out: Disabled Depressed: Enable (lamp ON)  TB on back side 	<Title screen> MELFA CR800-D Ver. S3 RH-3FRH5515-D COPYRIGHT (C) 2011 MITSUBISHI ELECTRIC CORPORATION ALL RIGHTS RESERVED	Press the TB ENABLE switch on the back of the teaching box (T/B) to disable the T/B operation (turn OFF the TB ENABLE switch), and set the mode selector switch of the controller prepared by the user to "AUTOMATIC". When the mode selector switch is switched to AUTO while TB ENABLE of the T/B is enabled, error H5000 "TB Enable key is ON" occurs.
2		<Menu screen> <MENU> 1.FILE/EDIT 2.RUN 3.PARAM. 4.ORIGIN/BRK 5.SET/INIT. 6.ENHANCED CLOSE	The <Menu> screen opens when the [EXE] key is pressed in the title screen.
3		<RUN screen> <RUN> 1.CHECK 2.TEST RUN 3.OPERATION 123 CLOSE ⇒	Press the number key [2] and display the <RUN> menu screen.

Step	Operation	T/B screen	Explanation of Operation
4	+Z (J3) 3 DEF	<OPERATION screen> <OPERATION> 100% Auto PROGRAM NAME: STEP: PRG1 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒	Press the [3] key on the RUN screen to display the <OPERATION> screen.
	ENABLE lamp on front of the teaching box (T/B) 		The status indicator "ENABLE" of the T/B flashes.
5	OVRD↑ OVRD↓	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG1 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒ Set speed to 10%	Press the [OVRD↑] key and [OVRD↓] key and set a safe speed.
6	F4	<PROGRAM selecting screen> <PROGRAM CHOICE> PROGRAM NAME: (PRG1) 123 CLOSE ⇒	When the [F4] key ("CHOOSE") is pressed, the <PROGRAM CHOICE> screen is displayed. (Displays the selected program name.)
7	Program name input EXE	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒ Changed the program name to PRG2	Input the program name to be started in the parentheses of the PROGRAM NAME and press the [EXE] key. A new program is displayed and the display returns to the <OPERATION> screen. * Always confirm that the program to be started is selected. * When the indication of program execution status is "STOP", the program cannot be changed. Press down the [RESET] (F3 key) to set the status indicator to "READY", and then operate again.

Step	Operation	T/B screen	Explanation of Operation
8	FUNCTION	<OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒	When the function of "SV. ON" is not displayed, press the [FUNCTION] key and switch the function menu display area.
9	Servo ON F1	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. SV.ON SV.OFF 123 CLOSE ⇒	Before turning ON the servo, confirm that there are no operators within the operating range of the robot, then press the [F1] key ("SV. ON"). * The servo can be turned ON with the [SERVO] button of the T/B. * You do not have to hold the "ENABLE switch" for this operation.
10	FUNCTION → F1	<STARTING PROGRAM CHECK> <STARTING PROGRAM> PRG2 START THE PROGRAM. OK? Yes 123 No ⇒ screen>	After pressing the [FUNCTION] key and switching the function menu display area, press the [F1] key ("START") to open the CHECK screen.
11	F1	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒ Operation mode	When the [F1] key ("YES") is pressed, the automatic operation starts for the currently selected program. The screen returns to the <OPERATION> screen. The operation mode is based on the mode displayed on the screen.

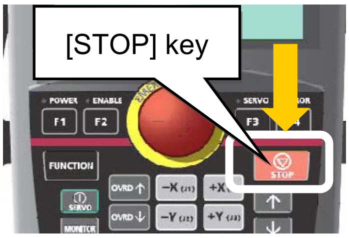
(2) Changing operation mode

Step	Operation	T/B screen	Explanation of Operation
1	F2	<OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS: RUN MODE: CYCLE START CONT. 123 RESET CHOOSE ⇒ When the operation mode has changed to <CYCLE> Cycle ········ Use this button to stop the robot operation after one cycle. Continuous··Repeats the program execution.	Change the operation mode if necessary. When the [F2] key is pressed, the operation mode can be changed. * The operation mode can be changed when "STATUS" is "RUN".

(3) Stopping and resuming

a) Stopping

The running program is immediately stopped, and the moving robot is decelerated to a stop.

Step	Operation	Explanation of Operation
1	Front of the teaching box (T/B) 	Press the [STOP] key on the front of the teaching box (T/B).

b) Resuming automatic operation

When resuming automatic operation, always confirm that the program to be started is selected.

Step	Operation	T/B screen	Explanation of Operation
1	F1	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS: RUN MODE: CYCLE START CONT. 123 RESET CHOOSE ⇒	When the [F1] key ("YES") is pressed, the automatic operation starts for the currently selected program. The screen returns to the <OPERATION> screen. The operation mode is based on the mode displayed on the screen.

(4) Servo OFF

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	<OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒	When the function "SV. OFF" is not displayed, press the [FUNCTION] key and switch to the function menu display area.
2	Servo OFF F2	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. SV.ON SV.OFF 123 CLOSE ⇒	Press the [F2] key ("SV. OFF").

* The brakes will automatically become active when the servo is turned OFF.
(Depending on the type of robot, some axes may not have brakes.)

(5) Resetting the program

The program's stopped state is canceled, and the execution line is returned to the head.

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	<OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. START CYCLE 123 RESET CHOOSE ⇒	When the function "RESET" is not displayed, press the [FUNCTION] key and switch to the function menu display area.
2	F3	<OPERATION screen> <OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS: RUN MODE: CYCLE START CONT. 123 RESET CHOOSE ⇒	When the [F3] key ("RESET") is pressed, STEP will return to its initial position, and the program will be reset. The program cannot be reset while the program is running. Operate while the program is suspended.

(6) Exiting the operation panel

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	<OPERATION> 10% Auto PROGRAM NAME: STEP: PRG2 00001 STATUS:STOP MODE: CONT. SV.ON SV.OFF 123 CLOSE ⇒	When the function "CLOSE" is not displayed, press the [FUNCTION] key and switch to the function menu display area.
2	F4	<RUN screen> <RUN> 1.CHECK 2.TEST RUN 3.OPERATION 123 CLOSE ⇒	Pressing the [F4] key ("CLOSE") closes the operation panel.

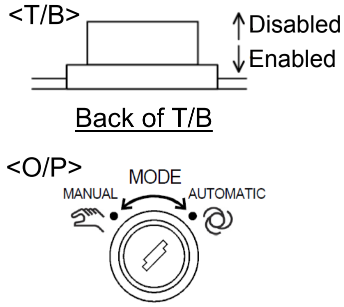
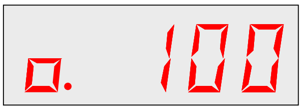
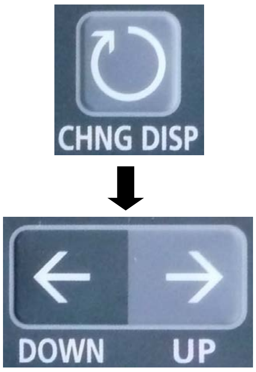
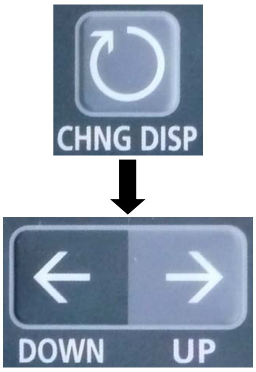
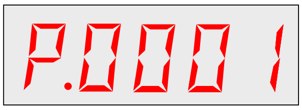
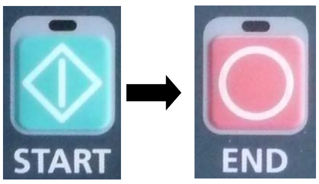
[Caution]

① Even if the operation panel is closed, the status "SV. ON" will continue to be displayed if the servo is not turned OFF as described in item (4). Display the "OPERATION" again and perform item (4), the "Servo OFF" operation.

② If the mode selector switch prepared by the user is switched to "MANUAL" while the OPERATION is displayed, the mode switches to "MANUAL". The servo power turns OFF, but in the "MANUAL" mode, the servo does not turn ON unless the T/B ENABLE is enabled and ENABLE switch is held lightly.

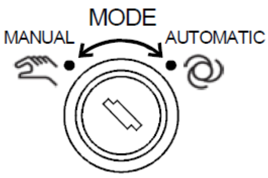
3.8. Performing automatic operation (O/P) (F Series)

(1) Automatic operation

Step	Operation	O/P screen	Explanation of Operation
1		STATUS NUMBER on controller/drive unit's operation panel (O/P) 	Press the TB ENABLE switch on the back of the T/B to disable it, and set the controller/drive unit MODE to AUTOMATIC. While TB ENABLE is enabled, when the "MODE" key is switched to "AUTO", error H5000 "TB Enable key is ON" occurs.
2		<Setting the movement speed> STATUS NUMBER on controller/drive unit's operation panel (O/P) 	Press the [CHNG DISP] button, and display the "Override" at the STATUS NUMBER display. * Press the [DOWN] button and set to approx. 10%.
3		<Selecting the program No.> STATUS NUMBER on controller/drive unit's operation panel (O/P) 	Press the [CHNG DISP] button, and display the "Program No." at the TSATUS NUMBER display. Press the [UP] or [DOWN] button to display the program No. to run with automatic operation. * If the program No. cannot be selected, press the [RESET] button to cancel the robot's stopped state.
4			Before turning ON the servo, confirm that there are no operators within the operating range of the robot, then press the [SVO ON] button. The servo turns ON, and the green lamp on the top of the [SVO ON] button turns ON.
5			Automatic operation (continuous operation) starts when the [START] button is pressed. If the [END] button is pressed during continuous operation, the operation will stop after one cycle.

Step	Operation	O/P screen	Explanation of Operation
6			When the [STOP] button is pressed, the robot will decelerate and stop immediately.
7			When the [START] button is pressed again, the automatic operation will resume (repeated operation).

(2) Servo OFF

Step	Operation	O/P screen	Explanation of Operation
1			Press the [SVO OFF] button. The green LED on the top of the [SVO OFF] button turns ON. * Switch the mode selector switch to "MANUAL" if necessary.
2	<O/P> 		Switch the mode selector switch prepared by the user to "MANUAL" if necessary.

* The brakes will automatically become active when the servo is turned OFF.
  (Depending on the type of robot, some axes may not have brakes.)

(3) Resetting the program

The program's stopped state is canceled, and the execution line is returned to the head.

Step	Operation	O/P screen	Explanation of Operation
1			Press the [RESET] button. The green LED on the top of the [RESET] button turns ON.

Chapter 4 Robot Language

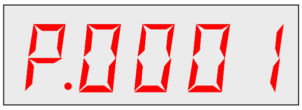
The MELFA-BASIC language is used with the MELFA Series.
Programming using this language is explained in this section.

4.1 MELFA-BASIC specifications

(1) Program name

Uppercase alphanumeric characters are used for the program name. Up to 12 characters can be set.
The number of characters in the program name that can be displayed on the controller/drive unit operation panel is within four characters.
When specifying a program via a GOT or programmable controller, create a name that includes only numbers.

STATUS NUMBER on controller/drive unit operation panel (O/P)

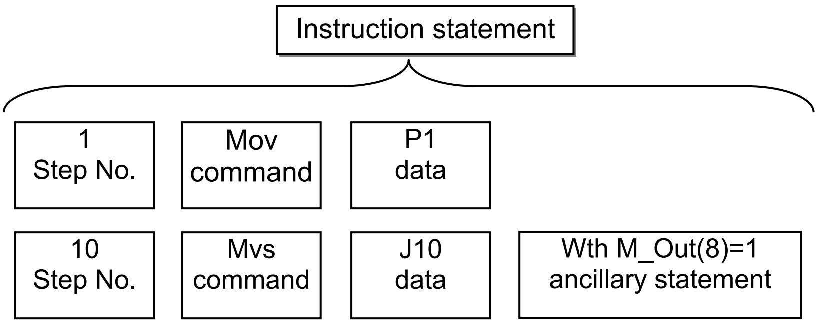


Display of program name

(2) Program instructions

Instructions are configured of the following parts:

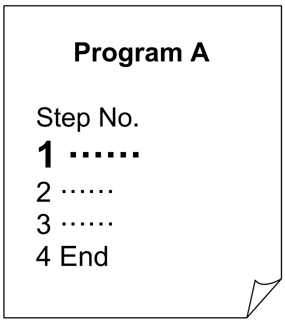
- Step number
- Command
- Data
- Ancillary statement

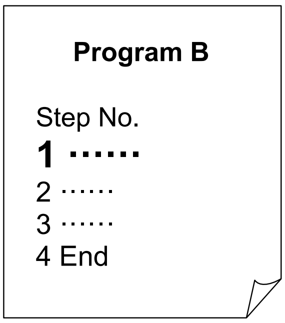


In MELFA BASIC, uppercase and lowercase alphanumeric characters can be used for commands and variable names.

a) Step number

The integers 1 to 32,767 can be used for the step number.
The program is executed from the first step (in ascending order of step numbers).
In MELFA BASIC, inputting step numbers during programming is not necessary.
Step numbers are automatically numbered.





b) Commands

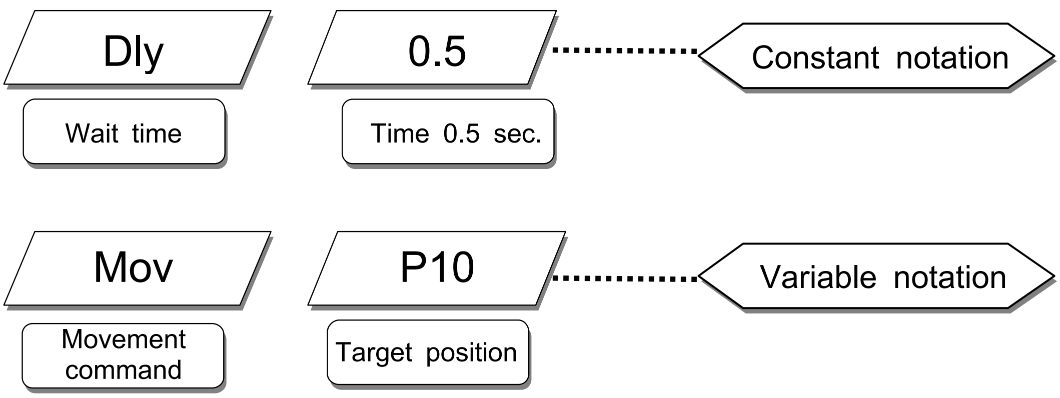
Commands prepared for the MELFA-BASIC can be used.

Typical instruction

No.	Item	Details	Related commands
1	Robot movement control	Joint interpolation movement	Mov
2		Linear interpolation movement	Mvs
3		Circular interpolation movement	Mvr, Mvr2, Mvc
4		Continuous path mode specification	Cnt
5		Optimized acceleration/ deceleration movement	Oadl
6		Positioning range specification	Fine P
7		Hand control (pneumatic hand)	HOpen, HClose
8		Hand control (electric operated hand)	EHOpen, EHClose
9	Pallet operation		Def Plt, Plt
10	Program control	Unconditional branch, Conditional branch	GoTo, If Then Else
11		Waiting for conditions	Wait
12		Limited repetition	For Next
13		Interrupt	Def Act, Act
14		Subroutine	GoSub, CallP
15		Timer	Dly
16		Stop	End, Hlt
17	External signal	Input/output signal	M_In, M_Out
18	Output signal/variable clear	Output signal/variable clear	Clr

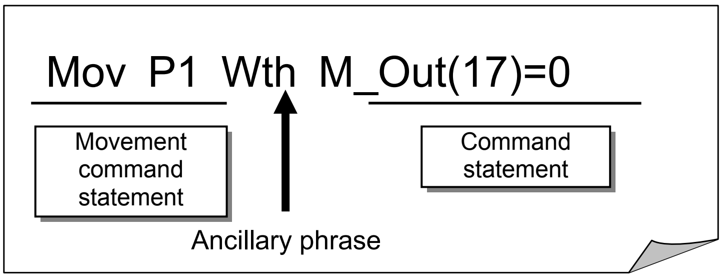
c) Data

Data is described with constants and variables.



d) Ancillary statement

A process command can be added only to movement commands.

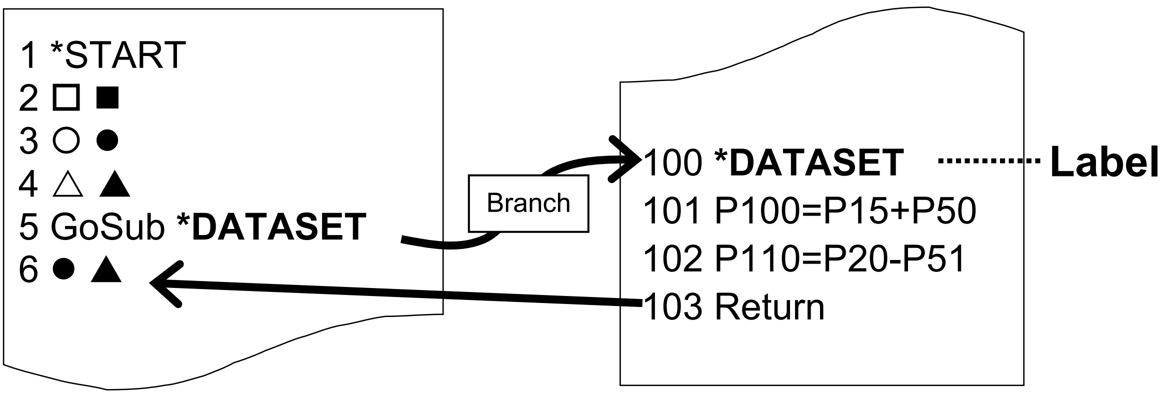


The robot turns off the output number 17 while moving to P1.

An ancillary phrase can be used to connect command statements.
This is limited to movement commands.

e) Label

The label is used to designate a branch destination in the program.



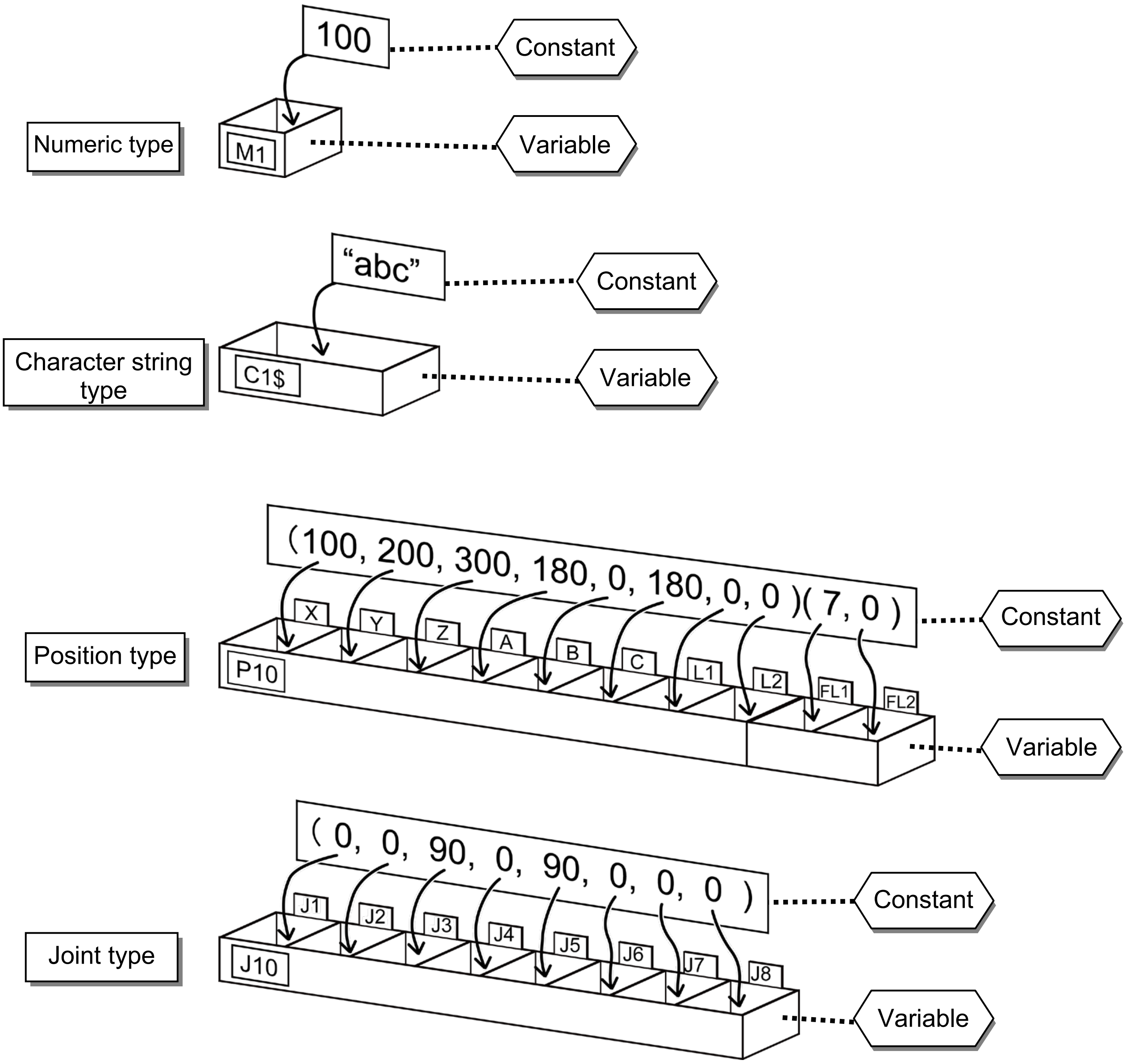
f) Usable characters

Class		Usable characters
Alphabet		ABCDEFGHIJKLMNOPQRSTUVWXYZ abcdefghijklmnopqrstuvwxyz
Numbers		0123456789
Special characters	Symbols	! ” # $ % & ( ) * + - . , / : ; = < > ? @ ’ [\ ] ^ { } ~ |
	Blank	Blank character (space)
	Underline	_ (underscore)

(3) Program constants and variables

(1) Data types

A constant is a fixed value that is set beforehand.
A variable is a container for storing data.
There are various types of constants and variables depending on the data used or stored.

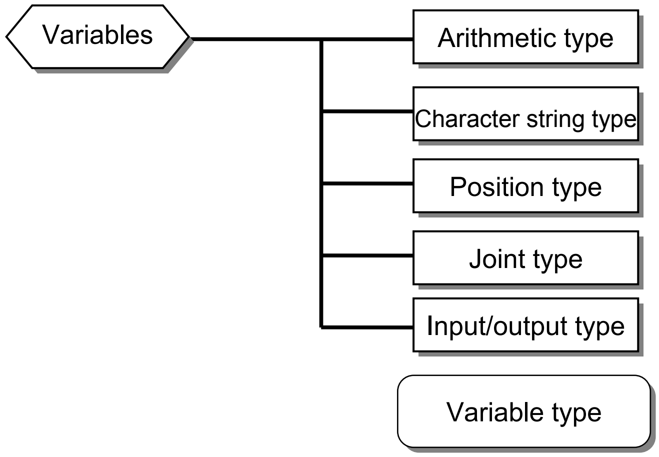


(2) Variables

The following types of variables are used:

- Calculation formula
- Character string
- Position
- Joint
- Input/output

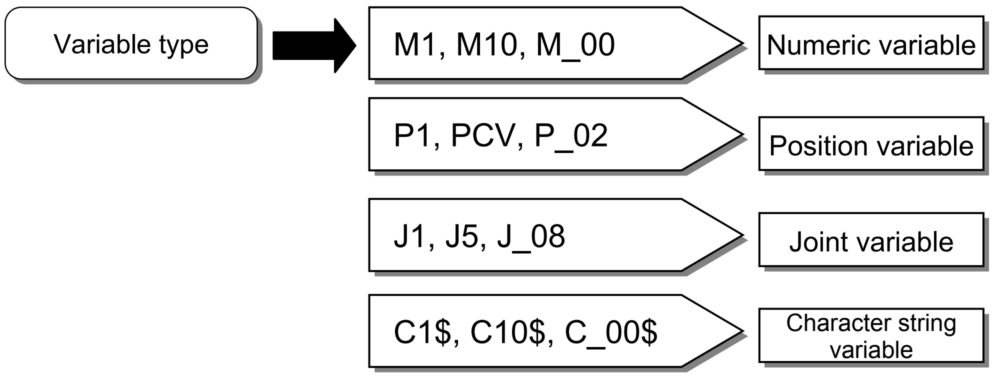
These are called variable types. The variable name is described with 16 or less alphanumeric characters.



(3) Variable types

The following alphabet is added to indicate the variable type.

- Numeric variable M is added to head
- Position variable P is added to head
- Joint variable J is added to head
- Character string variable C is added to head



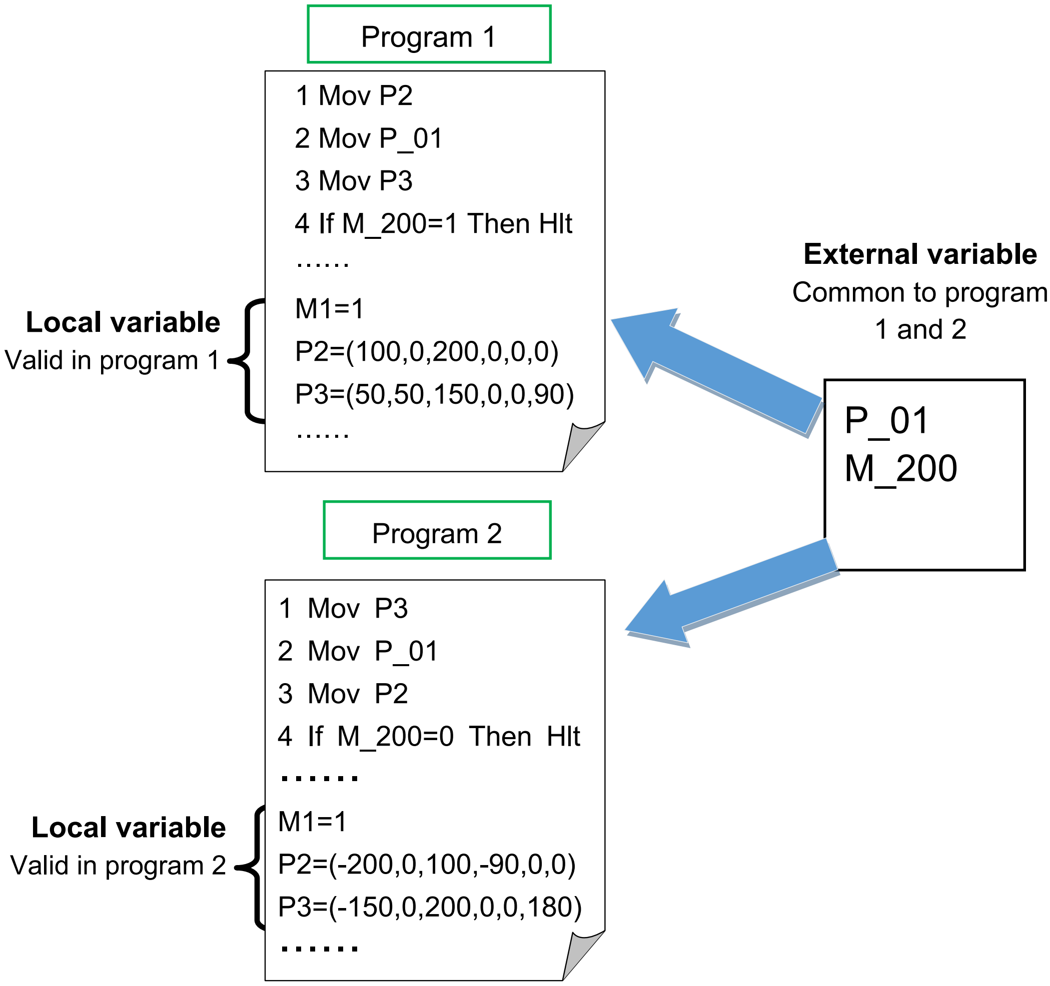
(4) Types of variables

There are two types of variables:

- Local variable valid only in one program
- External variable common in all programs

Variable valid only in one program → Local variable Ex.) M1, P1, etc.

Variable common in all programs → External variable Ex.) M_01,P_01
- ・Program external variable
- ・Status variable
- ・User-defined external variable



(5) Processing numeric variables

Numeric variables are processed with the following types:

- Integer type
- Single-precision real number type
- Double-precision real number type

Integer type
-32768 to 32767

Single-precision real number type
-3.40282347e+38 to 3.40282347e+38
Note: e is the exponential of 10

Double-precision real number type
-1.7976931348623157e+308 to 1.7976931348623157e+308

(6) Configuration of position variable

The position variable starts with the alphabet P, and is configured with a number, alphabet character or element, etc.

P1, P10, P150 (number)

PA, PDV, PWORK (alphabet)

P1.Z, PDV.X (element data)

Element data is used to set or change the specified value (such as "X" and "Z") in the position variable.

Example) P1=(200, 300, 400, 180, 0, 180, 0, 0)
P1.Z=500

P1=(200, 300, 500, 180, 0, 180, 0, 0)

(7) Constants

There are five types of constants.

- Numeric value
- Character string
- Position
- Joint
- Angle

- Constant
  - Numeric constant
  - Character string constant
  - Position constant
  - Joint constant
  - Angle constant

(8) Numeric constants

Numeric constants include:

- Decimal
- Hexadecimal
- Binary

- Numeric constant
  - (1) Decimal: 0 to 9, 1.5
  - (2) Hexadecimal: &H6B
    For a hexadecimal number, add &H at the beginning.
  - (3) Binary: &B00001010
    For a binary number, add &B at the beginning.

Example

```
Wait  M_Inb(10)=10

Wait  M_Inb(10)=&H000A

Wait  M_Inb(10)=&B00001010
```

(9) Character string constant

String constants are characters enclosed by double quotations (").
Ex.) "ABCDEFGHIJKLMN" "123"

Pick Up!

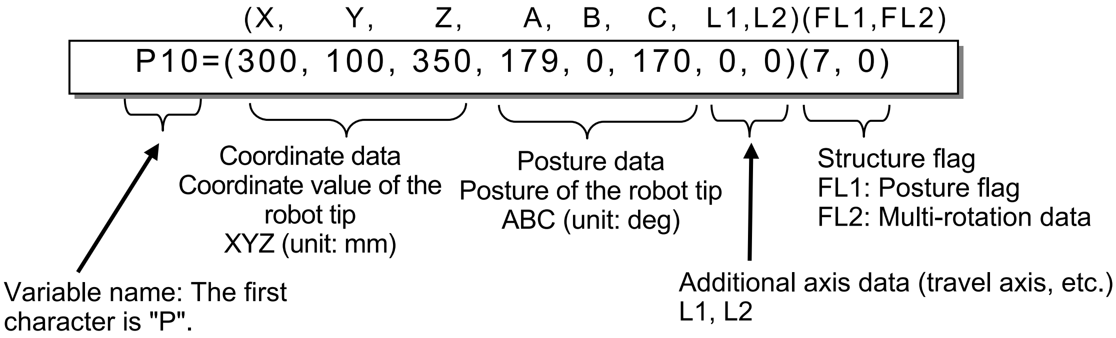
Up to 240 characters per character string

· The character string can have up to 240 characters including the step numbers and double quotations.

· Input two double quotations in succession to include them in a character string. For the character string AB"CD, input "AB" "CD".

(10) Position constant

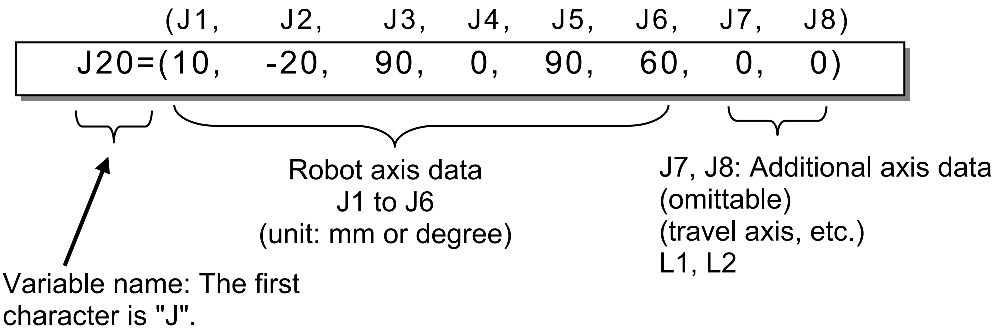
Position constants are configured of position data for eight axes, including the additional axes, and a structure flag that indicates the posture.



Example)
P1=(300, 100, 400, 180, 0, 180, 0, 0)(7,0)
P2=(100, 200, 50, 0, 0, 90, 0, 0)(4,0)········· [4-axis horizontal multi-joint type]
P3=(0, 0, 50, 0, 0, 0)(0,0) ······················· [No additional axis data]

(11) Joint constant

The structure of the joint constant is shown below. Variables cannot be described in the joint constant.



Example)
J21=(0, 10, 90, 10, 90, 90, 0, 200)···········[6-axis robot + additional axis]
J22=(10, 90, 30, 10)·····························[4-axis robot]
J23=(10, 90, 30, 10, , , 0, 200)················[4-axis robot + additional axis]

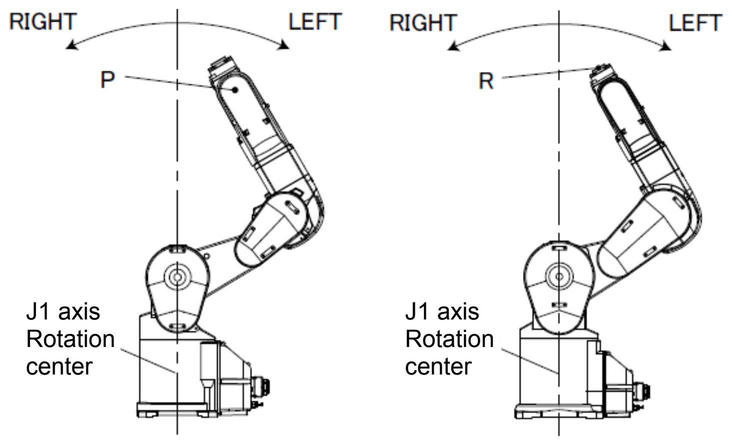
(12) Structure flag (FL1, FL2)

Posture flag (FL1) example

[Vertical multi-joint robot]
<RIGHT/LEFT>

6-axis type: Indicates the position (P) of the J5 axis rotation center in respect to the straight above the J1 axis rotary center.

5-axis type: Indicates the position of the center of the flange (R) in relation to the rotary center of the J1 axis.

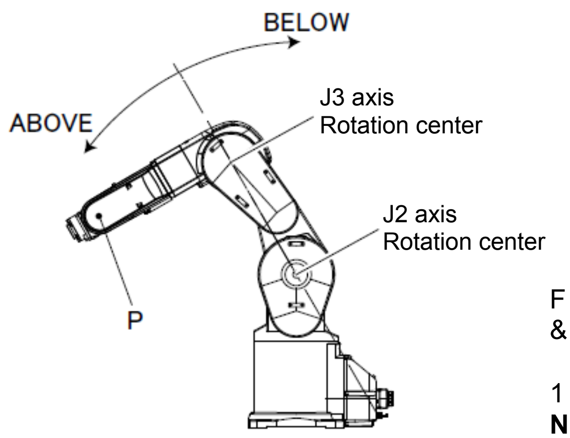


6-axis type　　5-axis type

F L 1 (Flag 1)
& B 0 0 0 0 0 0 0 0
↑
1 / 0 = RIGHT / LEFT
Note) &B indicates a binary.

<ABOVE/BELOW>

Indicates the J5 axis rotation center position (P) from the J2 axis rotation center to the J3 axis rotary center.

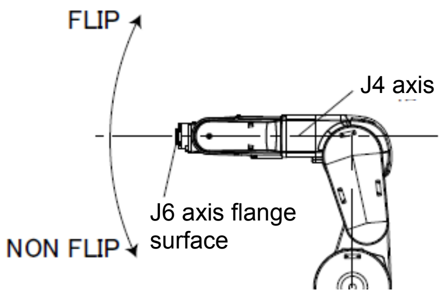


5-axis type/6-axis type

F L 1 (Flag 1)
& B 0 0 0 0 0 0 0 0
↑
1 / 0 = ABOVE / BELOW
Note) &B indicates a binary.

<NONFLIP/FLIP>

Indicates the flange surface direction in respect to the J4 axis rotation center to the J5 axis rotation center.

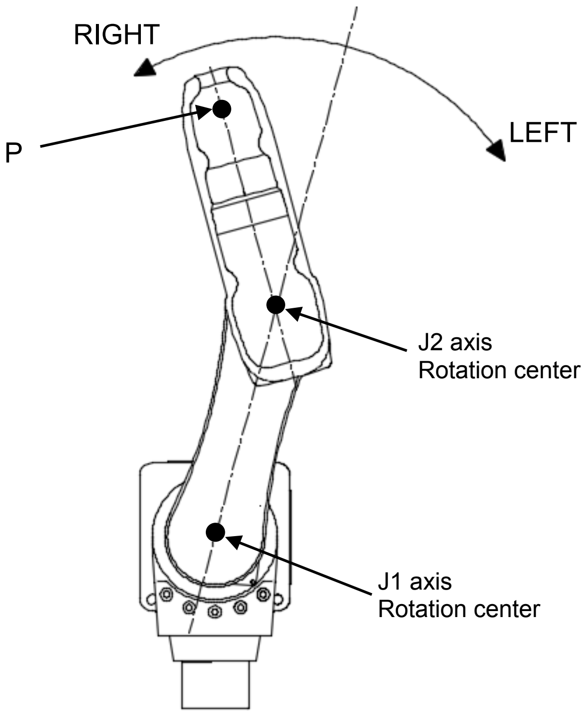


F L 1 (Flag 1)
& B 0 0 0 0 0 0 0 0
↑
1 / 0 = NONFLIP / FLIP
Note) &B indicates a binary.

[Horizontal multi-joint robot]

<RIGHT/LEFT>

Indicates the position (P) of the tip axis to the vertical line that passes from the J1 axis rotary center to the J2 axis rotary center.



F L 1 (Flag 1)
& B 0 0 0 0 0 0 0 0 0
↑
1 / 0 = RIGHT / LEFT
Note) &B indicates a binary.

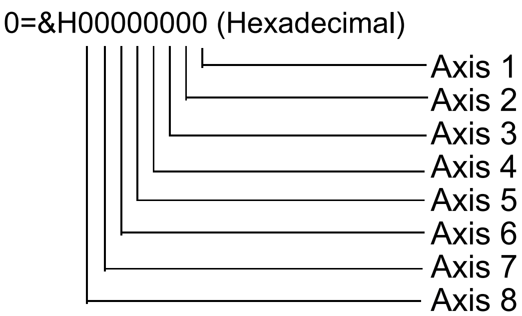
Multi-rotation flag (FL2)

The wrist tip axis value in the XYZ coordinates system (J6 axis in a vertical multi-joint robot) is the same as that after one rotation (360 degrees). For this reason, FL2 is used to count the number of rotations.

Multi-rotation data values

Angle of each axis		−900		−540		−180		0		180		540		900	
Multi-rotation data values	···		−2 (E)		−1 (F)		0				1		2		···

The multi-rotation flag data shows the status of all axes in decimal



Pick Up!

Singularities (- Precautions when teaching a vertical multi-joint robot -)

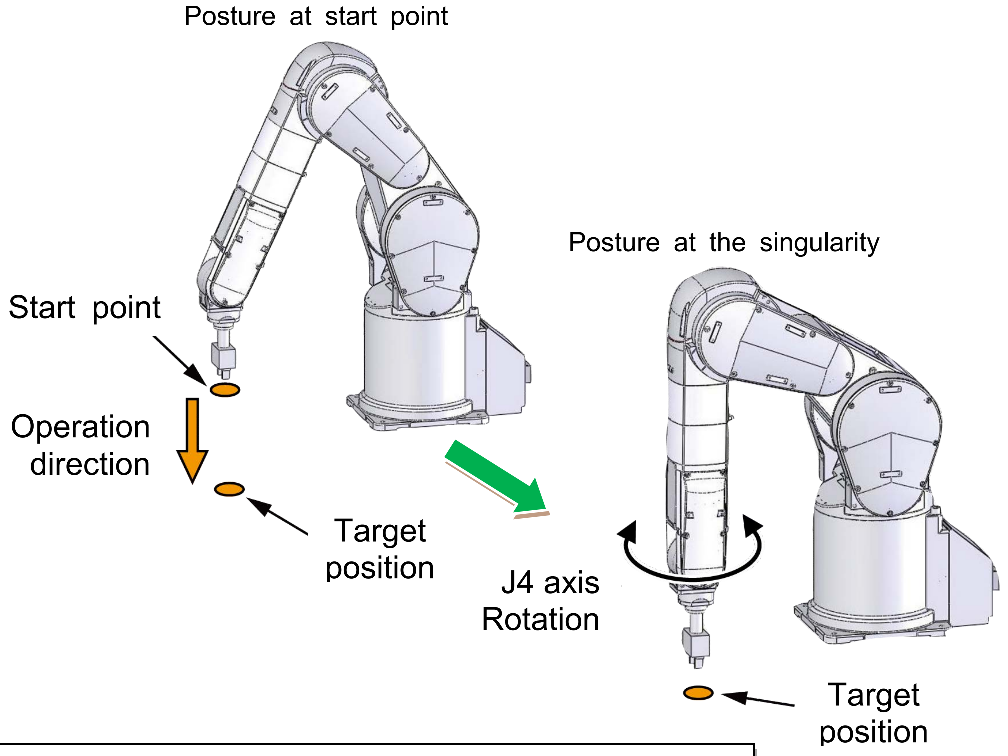
· If the J5 axis angle is 0° when performing linear interpolation movement using the position data of the XYZ coordinates system, infinite combinations of angles formed by the J4 and J6 axes may exist. However, the robot cannot always be made to move to the desired position and posture. This position is called a singularity.

· A singularity occurs when the center of the axis J5 is on the Z axis of the base coordinate system and the wrist is facing upward.

· When the structure flag changes during the linear interpolation movement, a singularity occurs.

· When a robot with a singularity is being operated at the XYZ jog, TOOL jog, CYCLINDER jog, or WORK jog using a T/B, an alarm is generated to warn the operators of the robot if the control point of the robot approaches the singularity.

· For robots with a singularity pass function, enabling the function allows the robot to pass through the singularity by the XYZ jog or linear interpolation. This expands the work area by the linear interpolation and enhances the flexibility of the layout.



Operation at the singularity
When the robot attempts to pass through the singularity (J5 axis = 0˚) or its vicinity with a fixed posture, the J4 axis of the robot rotates rapidly and the robot cannot pass through.

4.2 Program instructions

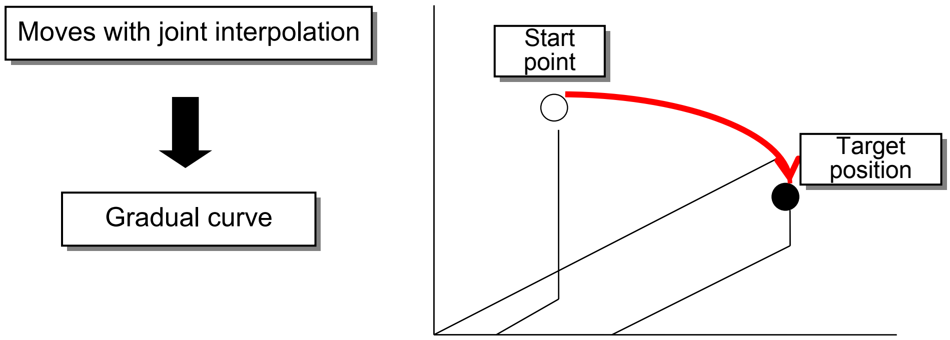
The typical instructions used for programming are explained in this section.

(1) Interpolation instruction

This instruction is used to move the robot.
All axes start simultaneously and stop simultaneously.

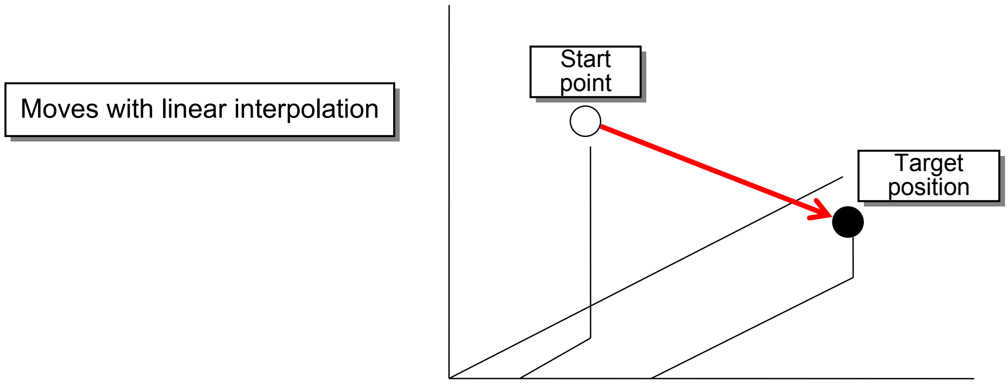
a) Mov (Move)

The robot moves with joint interpolation to the target position.



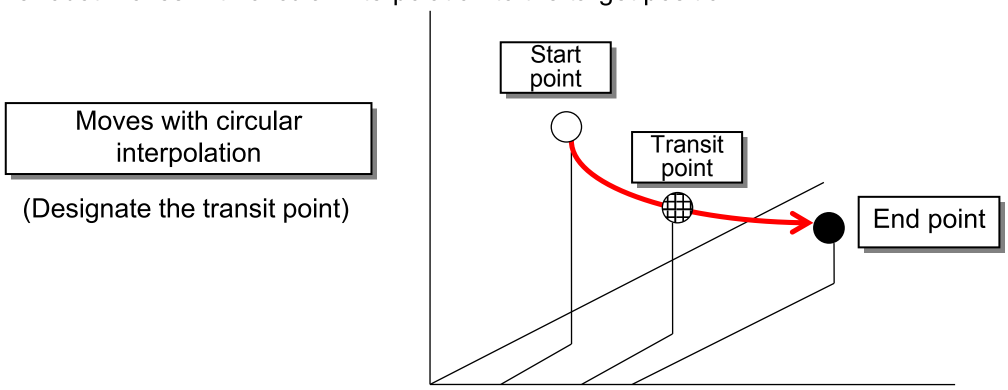
b) Mvs (Move S)

The robot moves with linear interpolation to the target position.



c) Mvr (Move R)

The robot moves with circular interpolation to the target position.



d) Cnt (Continuous)

Select from one of the following actions to be taken when passing through the taught points:

- Decelerate and stop
- Do not accelerate or decelerate, and complete smooth interpolation to the end point

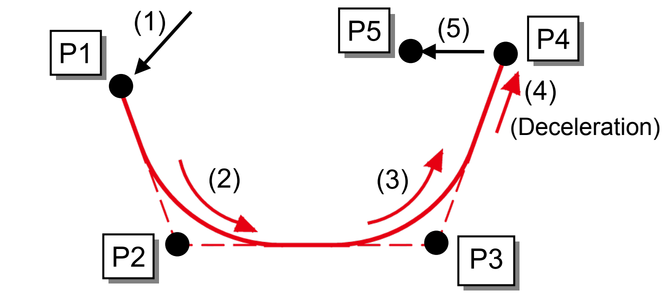
<u>When moving from P1 to P5 via P2, P3, and P4</u>

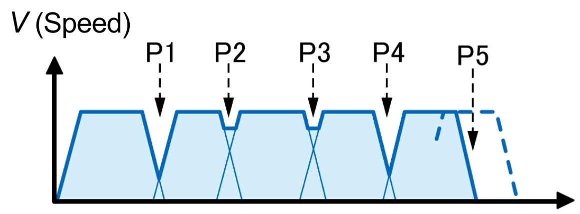
For Cnt1 (continuous operation):

Pass through the vicinity of each point and move with continuous operation.
(Acceleration/deceleration operation at the initial value)

<Program example>

1 Mov P1	'Move with acceleration/deceleration (1) to P1.
2 Cnt 1	'Enable continuous operation.
3 Mvs P2	' } Continuous operation (2), (3)
4 Mvs P3	'
5 Mvs P4	'Move with deceleration (4) to P4.
6 Cnt 0	'Disable continuous operation.
7 Mvs P5	'Move with acceleration/deceleration (5) to P5.





Speed transition graph
(Note 1)

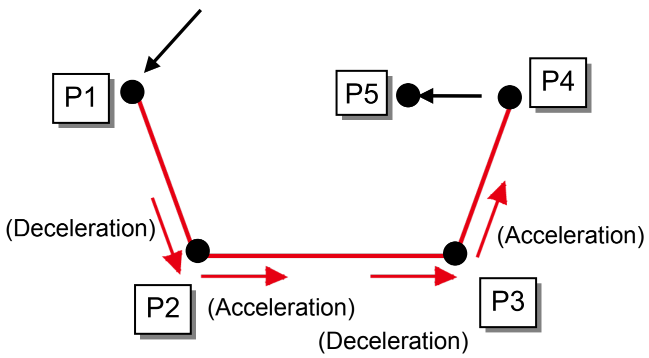
For Cnt0 (acceleration/deceleration operation):

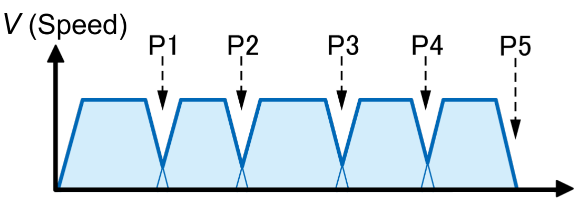
Pass through each point and move with acceleration/deceleration.
(Acceleration/deceleration operation at the initial value)

<Program example>

1 Mov P1
2 Mvs P2
4 Mvs P3
5 Mvs P4
6 Mvs P5

} Acceleration/deceleration operation (Not set = acceleration/deceleration operation)

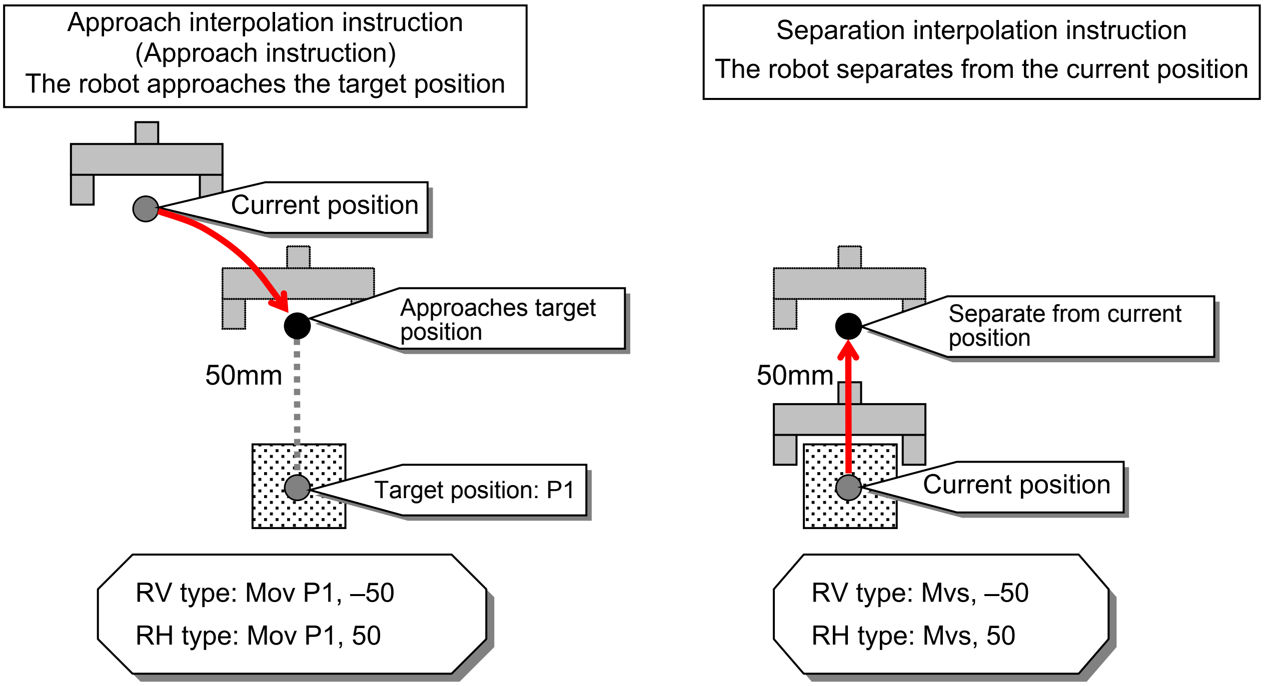




Speed transition graph
(Note 1)

Note 1) "Speed transition graph" shown above is an example. Depending on the movement distance and speed, acceleration/deceleration may occur during interpolation connection.

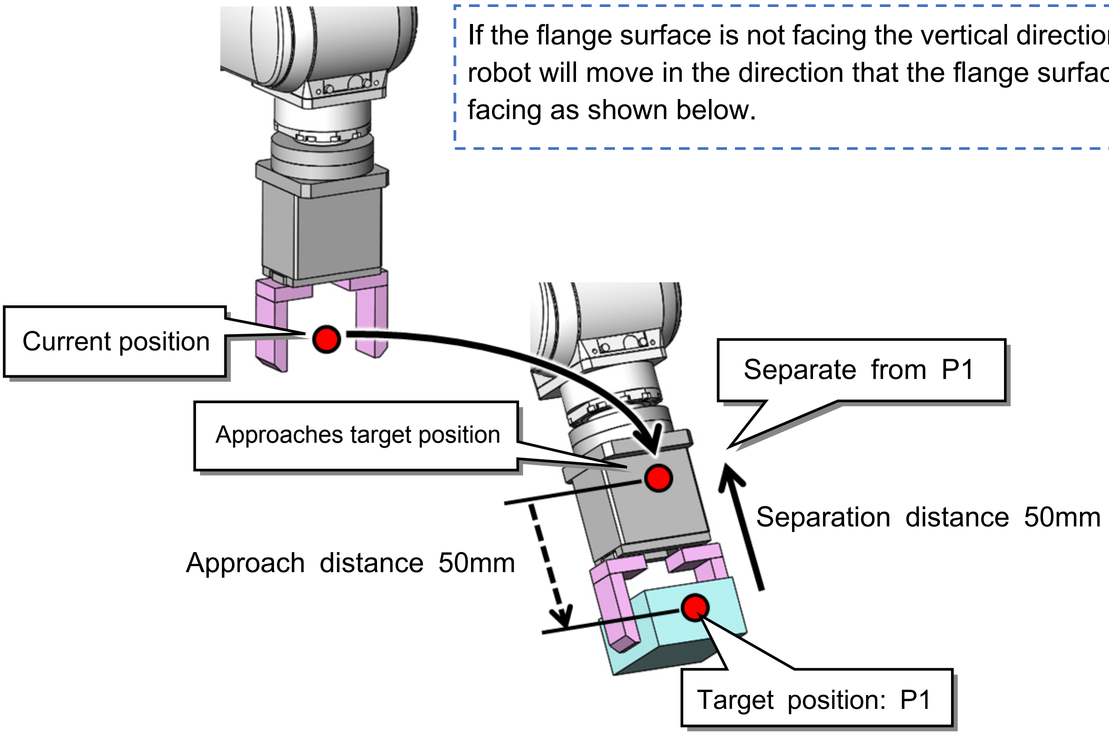
e) Convenient interpolation instructions



Note 1) The approach distance and separation distance are expressed as values in the tool coordinate system's Z axis direction.

If the flange surface is facing the vertical direction, the robot will move in the vertical direction as shown above.

If the flange surface is not facing the vertical direction, the robot will move in the direction that the flange surface is facing as shown below.

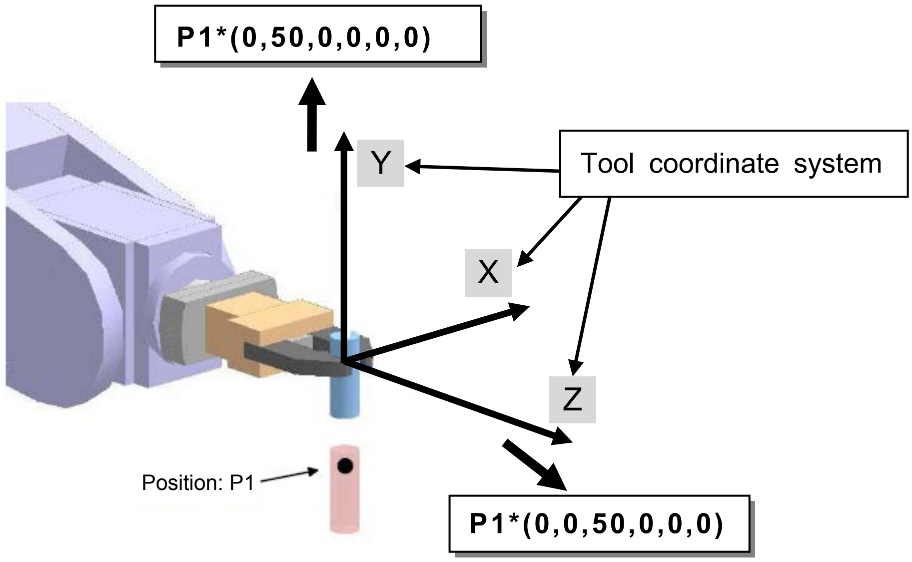


Position data addition/subtraction
The addition/subtraction is made with mutual data elements.

Example) Addition: P1 + P100
Subtraction: P1 - P20

Position calculation in the robot tool coordinate system

Position calculation can be performed in the robot tool coordinate system.
The position calculation uses "*".



Using the robot tool coordinate, you can operate the robot along the hand surface direction. This enables the adjustment of the hand posture for the target workpiece and easy change of the posture of the held workpiece.

(2) Speed instruction

Speed instructions are used to control the movement speed while the robot is operating.

a) Ovrd (Override)

Override is valid for all interpolation instructions.
Set the percentage to the general speed (maximum speed) reached during operation.

Program example

Ovrd <Designated value>
1 Ovrd 80

Value range: 1 to 100%

Override display of the T/B 70% × Program description Ovrd 80% ➡ Robot operation speed 56% (70% × 80% = 56%)

b) Spd (Speed)

Speed is valid for the Mvs and Mvr instructions.
Set the movement distance per second (mm/sec)
* The robot's execution speed is calculated by multiplying the following three elements:
  - Speed set on operation panel
  - Override (Ovrd) instruction speed
  - Speed (Spd) instruction speed

Program example

```
1 Ovrd 80
2 Mov P1
3 Spd 500
4 Mvs P10, 100
```

Operation panel speed setting 100% × Override instruction speed 80% × Spd instruction speed 500mm/sec ➡ Movement distance per second 400mm/sec (100% × 80% × 500mm/sec)

c) Hand processing instructions

These instructions are used to control a tool attached to the robot.

Control tool attached to robot end

1) HOpen/EHOpen (Hand open)
   The hand designated in the program opens.
   (HOpen: Pneumatic hand,
   EHOpen: Electric operated hand)
2) HClose/EHClose (Hand close)
   The hand designated in the program closes.
   (HClose: Pneumatic hand,
   EHClose: Electric operated hand)

Program example

```
1 Ovrd 80
2 Mov P_00
3 Mov P10, 100
4 HOpen 1
5 Dly 0.5
```

Program example

```
1 Ovrd 80
2 Mov P_00
3 Mov P10, 100
4 HClose 1
5 Dly 0.5
```

* The following format is used for the electric operated hand instructions.
- EHOpen <Hand No.>, <Speed(%)>, <Power(%)>
- EHClose <Hand No.>, <Speed(%)>, <Power(%)>

Describe the instructions as follows:
EHOpen 1, 100, 100
EHClose 1, 100, 100

When using the pneumatic hand, the hand numbers 1 to 4 are used for the double solenoid, and numbers 1 to 8 for the signal solenoid. When using the electric operated hand, the hand numbers are 1 to 3.

(3) Dly (Delay)

When this instruction is used, the program waits the designated time before moving to execution of the instruction on the next line.
Use this to complete the hand open/close operation or wait for the operation stabilization of the robot.

For the description of the appropriate wait time, use "Fine P (Fine Pause)".

Wait the time designated in the program → Adjust the robot movement time

Program example

```
9   Mvs P10
10 Dly 0.3
11 HClose 1
12 Dly 0.3
13 Mvs P10+P100
14 Mov P20+P100
15 Mvs P20
16 Dly 0.3
17 HOpen 1
18 Dly 0.3
```

Lines 10–12: The hand closes after the robot finishes movement, and starts the next movement after the hand completely closes

Lines 16–18: The hand opens after the robot finishes movement, and starts the next movement after the hand completely opens

Note) The values (time) shown above are reference values. These must be adjusted for actual operation.

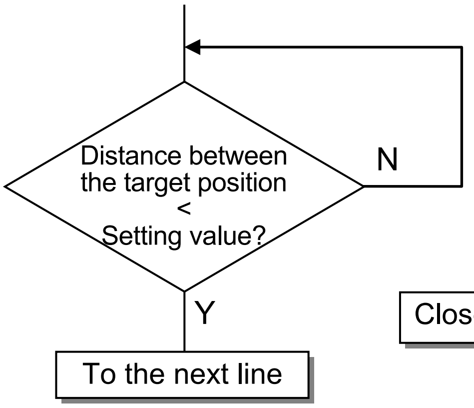
(4) Fine P (Fine Pause)

This instruction specifies the conditions in which the robot will complete its positioning with a linear distance.

Use this to wait for the target position to be reached.

Fine P is disabled for all axes by default. Once Fine P is enabled, the enabled status is applied continuously until disabled.

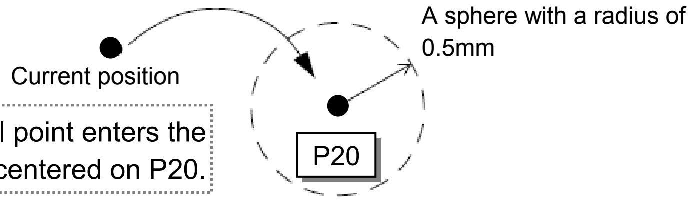
Note) During the continuous path control (Cnt 1), the Fine P instruction is disabled.



Program example

```
Fine <Linear distance> , P
1 Fine 0.5,P
2 Mov P20
3 HClose 1
```

Close the hand when the robot reaches P20 (within 0.5mm).



Positioning is completed when the control point enters the sphere with a radius of 0.5mm centered on P20.

Pick Up!

Differences with the Dly instruction

The Dly instruction specifies the waiting time for the robot positioning completion. If the time specified is not appropriate, time may be wasted in standby. The Fine P instruction reduces the wasted wait time since the operation proceeds to the next step when the positioning is completed.

The following shows when the program example for the Dly instruction description is replaced with the Fine P instruction.

Replace the movement completion of the robot with the Fine P instruction.

Program example

```
8 Fine 0.5,P
9   Mvs P10
10 HClose 1
11 Dly 0.3
12 Fine 0,P
13 Mvs P10+P100
14 Mov P20+P100
15 Fine 0.5,P
16 Mvs P20
17 HOpen 1
18 Dly 0.3
19 Fine 0,P
```

Set the movement completion of the robot within 0.5mm (8 Fine 0.5,P)

Wait until the robot enters within 0.5mm of the target position (9 Mvs P10)

Disable the Fine P setting (12 Fine 0,P)

Operate without waiting for positioning completion (13 Mvs P10+P100, 14 Mov P20+P100)

Set the movement completion of the robot within 0.5mm (15 Fine 0.5,P)

Wait until the robot enters within 0.5mm of the target position (16 Mvs P20)

Disable the Fine P setting (19 Fine 0,P)

(5) Subroutine instructions

a) CallP (call program) and FPrm (F parameter)

The designated program is called and executed.

The variables defined in the program to be called can be handed over.

Format

```
CallP "<program name>" [,<argument> [, <argument>] ]
```

```
FPrm <argument> [, <argument>]
```

Main Program

```
1  M1=0
2  CallP  "10",M10,P1,P5
3  M20=M10
4  Wait  M_In(10)=1
5  Mov  P5
```

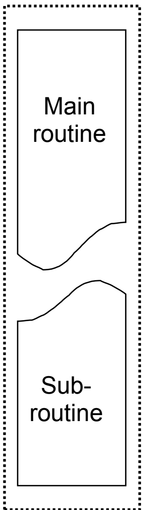
Sub-program "10"

```
1  FPrm  M1,P1,P2
2  If  M1=1  Then  *L
3  Mov  P1
4  *L
5  Mvs  P2
6  End
```

b) GoSub (Go subroutine) and Return (return)

The subroutine for the designated label is executed.
The main routine is returned to with the return command in the subroutine.

Program structure



Main routine

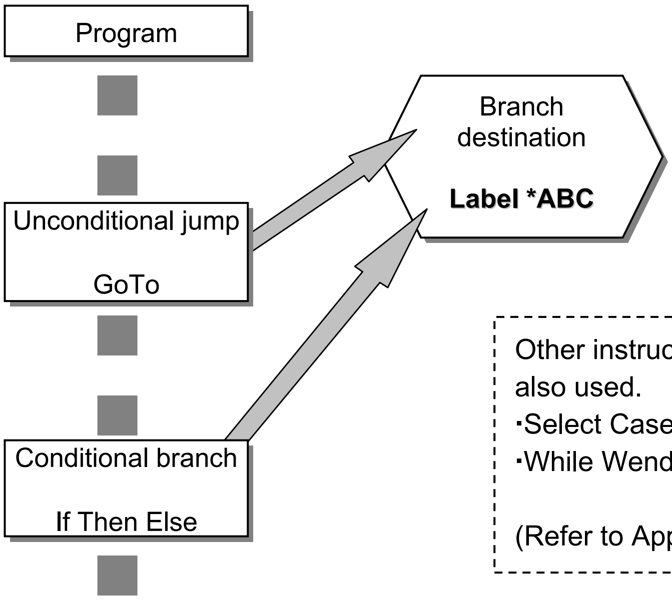
```
1 'MAIN PRO
2 Ovrd 90
3 Mov P_Safe
4 Wait M_In(12)=1
5 GoSub *DATA
6 Mov P10, 100
7 Mvs P10
8 Dly 0.3
9 HClose 1
10 Dly 0.3

49 End
   :
```

Subroutine

```
50 *DATA
51 P100=P1
52 P100.X=P100.X+5
53 P100.Y=P100.Y-2
54 P110=P10
55 P110.X=P110.X-2
56 P110.Y=P110.Y+1
57 Return
```

(6) Branch instruction

Branch instructions are used in the command for unconditional jump or jump based on condition judgment.

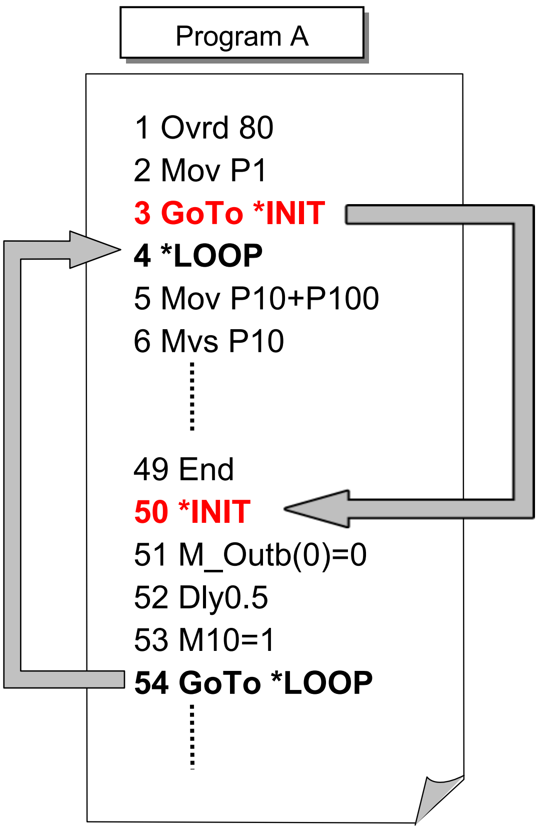


Other instructions including the following are also used.
･Select Case (Select Case)
･While Wend (While End)

(Refer to Appendix 4 MELFA-BASIC.)

a) GoTo (go to)

The program jumps to the designated label.

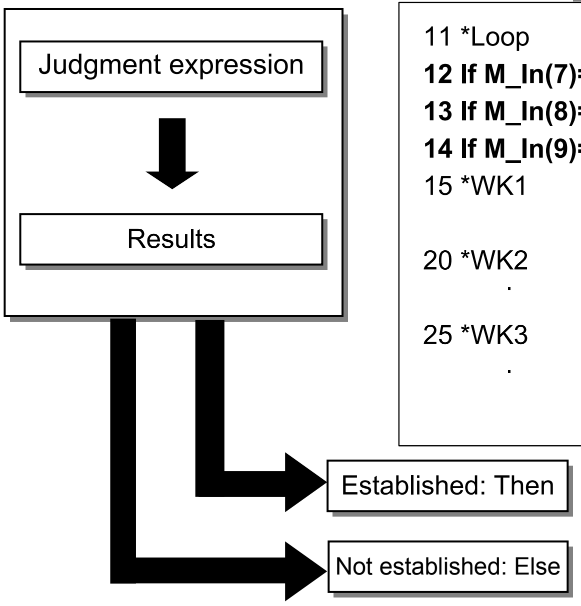


b) If Then Else (If then else)

If the condition expression designated with the If statement is established (true), the instruction after Then is executed.
If not established (false), the next step is executed.
If Else is designated after Then and the condition expression designated with the If statement is established (true), the instruction after Then is executed. If not established (false), the instruction after Else is executed.

Program example

```
11 *Loop
12 If M_In(7)=1 Then GoTo *WK1
13 If M_In(8)=1 Then GoTo *WK2
14 If M_In(9)=1 Then GoTo *WK3 Else GoTo *Loop
15 *WK1

20 *WK2
        .
25 *WK3
        .
```

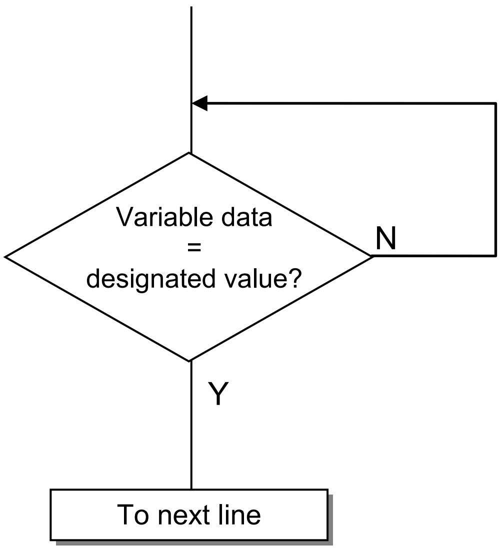


* In this example, the GoTo instruction is set after the Then, Else instructions, so the Goto instruction after the Then, Else instructions can be omitted

If <expression statement> Then <branch destination> Else < branch destination>

c) Wait (wait)

The robot waits here until the variable data reaches the value designated in the program.
Use this for interlock control, etc.



Program example

Wait <Numeric variable> = <Value>

```
1 Wait M_In(10)=1
2 Mov P20,100
```

Use for interlock with external signal

(7) Stop and end instructions

(1) Hlt (halt)

This is the program stop instruction.
The program will stop when this instruction is executed.
The start signal is used to resume the program.

Program example

```
50 Act 1=0
51 M_Out(10)=1 Dly 1
52 M10=1
53 Hlt
54 P100=P_Curr
55 Return 0
```

53 Hlt → Stop automatic operation ↓ To start → Start signal

(2) End (end)

This instruction defines the last line of the program.
When cycle stop turns ON, one cycle operation is executed and then the program ends.

Cycle stop ON ↓ One cycle operation

Program example

```
1 Ovrd 80
2 Mov P10,100
3 Mov P1
4 M_Out(8)=0
5 Dly 0.5
6 End
```

6 End → Defines last line of program

(8) Clear

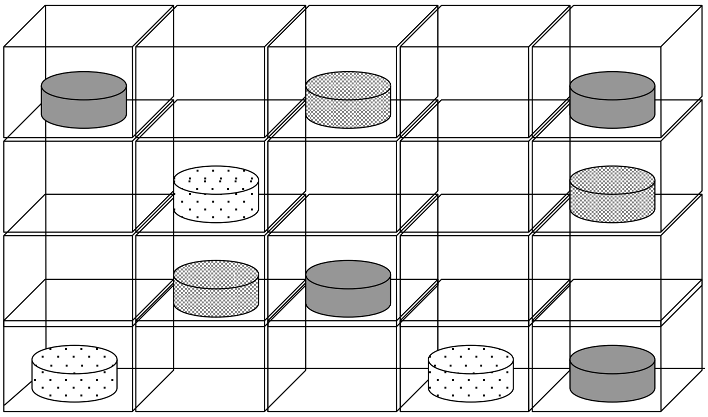
This instruction clears general-purpose output signals, local numeric variables in a program, and external numeric variables.

1 Clr 1 ⋯ ⋯	The general-purpose output signals are returned to the initial values that are set beforehand.⋯(1)
1 Clr 2 ⋯ ⋯	The local numeric variables and numeric array variables in the program are cleared to 0.⋯(2)
1 Clr 3 ⋯ ⋯	All external numeric variables and external numeric array variables are cleared to 0.⋯(3)
1 Clr 0 ⋯ ⋯	The operations (1) to (3) above are performed simultaneously.

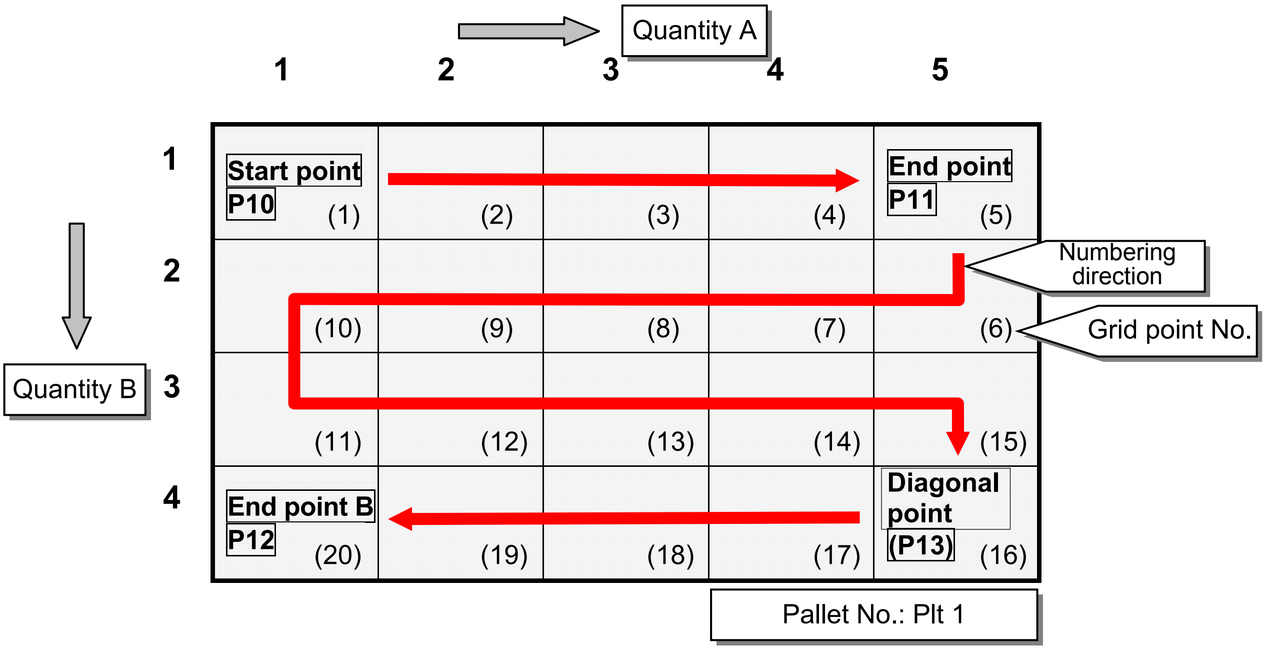
(9) Palletizing control instruction

When carrying out the operation to arrange workpieces with equal distance (palletizing), or removing workpieces arranged with equal distance (depalletizing), the reference workpiece positions on the four corners are taught and other positions can be obtained by calculation.

1) Def (define) and Plt (pallet)
   This instruction sets the conditions for using the pallet.
   The instruction is described in the following order:
   - Definition/pallet
   - Pallet number
   - Start point
   - End points A, B
   - Diagonal point
   - Quantity A, B
   - Numbering direction

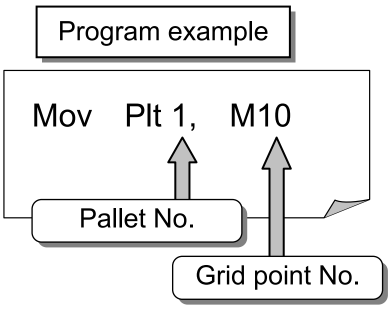


Program example: Def Plt 1, P10, P11, P12, P13, 5, 4, 1



* To move to a grid point into the pallet, describe the instruction in the following order:
- Mov (move)
- Pallet No.
- Grid point No.

Typically, the alphabet M variable is used as a counter for the grid point number.



(10) Interrupt control instructions

Set a specified condition beforehand to stop the instruction that is being currently processed and execute another process (branched to the designated line) when the condition is satisfied. (Returning to the interrupt source line is possible.)

1) Def (define) and Act (act)

These instructions define the processing details for an interrupt during program execution.

The instruction is described in the following order:

- Define/act
- Act No.
- Condition expression for interrupt
- Process at interruption
- Type

Program execution
↓
Interrupt execution
↓
Process definition

Program example: Def Act 1,M_In(15)=1 GoSub *EROR ,S

: **When the type designation is omitted, the robot stops at the position assuming 100%**
: When **S** is designated for the type, **the robot decelerates to a stop with the shortest time**
: When **L** is designated for the type, **the robot stops after finishing the execution**

* Up to eight types of interrupt processes can be defined simultaneously. (Act No. 1 to 8)
The smaller the act No. is, the higher the priority it.

* Designate whether or not to enable the interrupt process with the act statement.

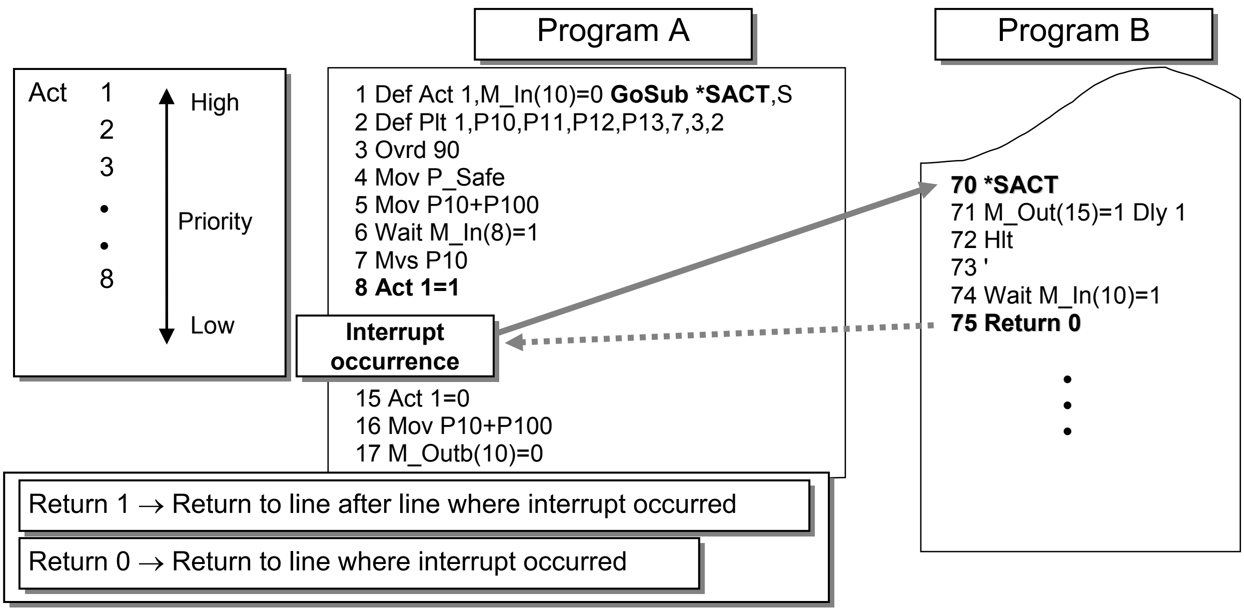
- When 1 is designated, the interrupt process is enabled.
- When 0 is designated, the process is disabled
- When -1 is designated, the interrupt processing state is released and the interruption is disabled.
- When nothing is specified, the interruption is disabled (default).

Act 1=1 : Interrupt enabled

Act 1=0 : Interrupt disabled

Act 1=-1: Interrupt released and monitoring stopped

* The method of returning from the jump destination depends on the 1 or 0 described after the return instruction.



<<MEMO>> * Use this page to write down notes.

Chapter 5 Input/Output Function

5.1 Standalone type

(1) Required device

The 24VDC power must be prepared by the user.

(2) Number of parallel input/output interface points (Option)

Option slot	Input	Output
SLOT1	32 points (bits 0 to 31)	32 points (bits 0 to 31)
SLOT2	32 points (bits 32 to 63)	32 points (bits 32 to 63)

Power line	Pin No.
0V	1C
24V	1D, 2C

(3) How to use the input/output signals

Up to 32 input points and 32 output points can be used with one parallel input/output interface. These 32 points are used for the dedicated input/output signals (used to control the robot), the general input/output signals (for the interlock, part type and sensor signals, etc., in the robot program).

The table on the right shows some examples of the dedicated input/ output signals. The bit numbers for the dedicated input/output signals are set with the parameters.

Dedicated input signal	Dedicated output signal
Stop	Stopped
Servo OFF	In servo OFF
Error reset	Error occurring
Start	Running
Operation rights	Operation rights active
Servo ON	Within user-defined area

(4) Types of extenral inputs and outputs

The following types of external inputs and outputs are available.

a) Dedicated input/output .... These input/output signals are used for remote operation such as executing the robot program or stopping, and to indicate the status such as information on operation being executed and the servo power, etc. A function is assigned to each input/output signal. These assignments can be made by setting the working signal NO. of each dedicated parameter, and the emergency stop input. Signals with a high frequency of use are assigned beforehand. These can be added and changed.

b) General purpose input/output .... These signals are used to communicate with PLC, etc., using the robot program. Use these to retrieve the positioning signals from the peripheral devices, and to confirm the robot position, etc.

c) Hand input/output .... These signals are used to control the hand. They issue the hand open/close instructions and retrieve information from the sensors attached to the hand. (The electric operated hand cannot be controlled with the input/output signals.) The signals are wired beforehand to near the end of the robot hand. (The hand output is an option.)

General map of input/output signals

	Input/output signal No.	Usage method
Hand input/output (for pneumatic hand)	900 to 907	Refer/substitute with M_In, M_Inb, M_Inw, M_Out, M_Outb, M_Outw Also possible with HOpen, HClose instructions Ex) If M_In(900) Then M_Out(900)=1 HOpen 1, HClose 1

5.2 iQ Platform compatible type

(1) Types of extenral inputs and outputs

The following types of external inputs and outputs are available.

a) Dedicated input/output............... These input/output signals are used for remote operation such as executing the robot program or stopping, and to indicate the status such as information on operation being executed and the servo power, etc. A function is assigned to each input/output signal. These assignments can be made by setting the working signal NO. of each dedicated parameter, and the emergency stop input. Signals with a high frequency of use are assigned beforehand. These can be added and changed.

b) General purpose input/output.... These signals are used to communicate with PLC, etc., using the robot program. Use these to retrieve the positioning signals from the peripheral devices, and to confirm the robot position, etc.

c) Hand input/output....................... These signals are used to control the hand. They issue the hand open/close instructions and retrieve information from the sensors attached to the hand. (The electric operated hand cannot be controlled with the input/output signals.) The signals are wired beforehand to near the end of the robot hand. (The hand output is an option.)

d) Device ··········· As with PLCs, devices include bit devices, such as X and Y, used to store information in increments of one bit and word devices, such as D, used to store information in increments of one word.
These devices are used to exchange information with GOTs and SLMP-compatible equipment.
They are used to publish robot information and provide instructions to robots from external equipment.

External input/output correspondence table by series

	Dedicated input/output	General input/output	Hand input/output	Device
MELSEC iQ-R series compatible (FR series)	○	○	○	○
MELSEC Q series compatible (F series)	○	○	○	-

(2) General map of input/output signals

a) MELSEC iQ-R series compatible (FR series)

	Input/output signal No.	Usage method
Hand input/output	900 to 907	Refer/substitute with M_In, M_Inb, M_Inw, M_Out, M_Outb, M_Outw Also possible with HOpen, HClose instructions Ex) If M_In(900) Then M_Out(900)=1 HOpen 1, HClose 1
PLC link input/output	10000 to 18191	Refer/substitute with M_In, M_Inb, M_Inw, M_Out, M_Outb, M_Outw Ex) If M_In(10080)=1 Then M Out(10080)=1 **Note)** If a dedicated output is assigned to the signal, an output cannot be made using the M_Out, M_Outb or M_Outw variables.
SKIP input	800 to 803	800: Exclusively for stop input 801 to 803: Reference with M_In variables

b) MELSEC Q series compatible (F series)

	Input/output signal No.	Usage method
Hand input/output	900 to 907	Refer/substitute with M_In, M_Inb, M_Inw, M_Out, M_Outb, M_Outw Also possible with HOpen, HClose instructions Ex) If M_In(900) Then M_Out(900)=1 HOpen 1, HClose 1
PLC link input/output	10000 to 18191	Refer/substitute with M_In, M_Inb, M_Inw, M_Out, M_Outb, M_Outw Ex) If M_In(10080)=1 Then M Out(10080)=1 **Note)** If a dedicated output is assigned to the signal, an output cannot be made using the M_Out, M_Outb or M_Outw variables.

(3) PLC link input/output function

This function communicates by the sequence ladder program using the memory shared by the PLC CPU and the robot CPU.
During communication, the "CPU buffer memory periodical communication area" in the CPU buffer memory is used for the MELSEC iQ-R series (FR series) and the "multi-CPU high-speed communication area" in the shared memory is used for the MELSEC Q series (F series).

The robot CPU uses the signal numbers 10000 to 18191 for both input signals and output signals.
To use this function, set multi-CPU related parameters for both the PLC CPU and robot CPU.

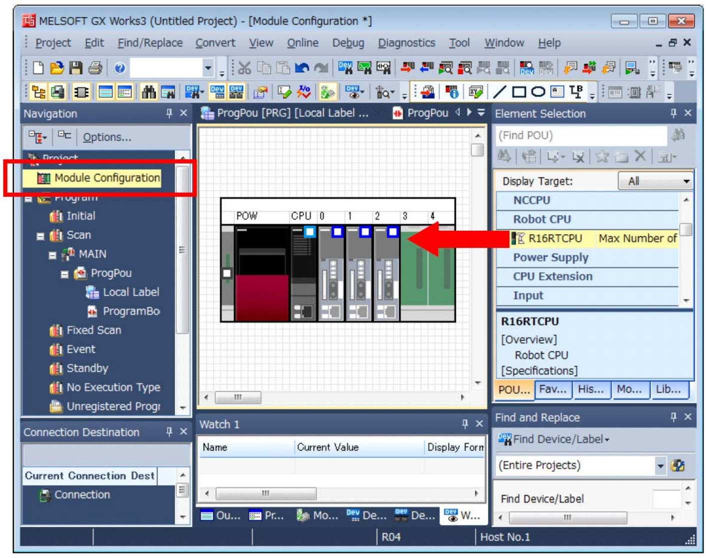
For the setting method of multi-CPU related parameters, refer to the following.
FR Series: Chapter 5 Input/Output Function 5.2 (4) PLC multi-CPU (GX-Works3) settings

F Series: Appendix 5 iQ Platform Compatible (MELSEC Q Series Compatible) (F Series)
Appendix 5.2 Setting Multi-CPU (Using GX Works2)

(4) PLC multi-CPU (GX-Works3) settings

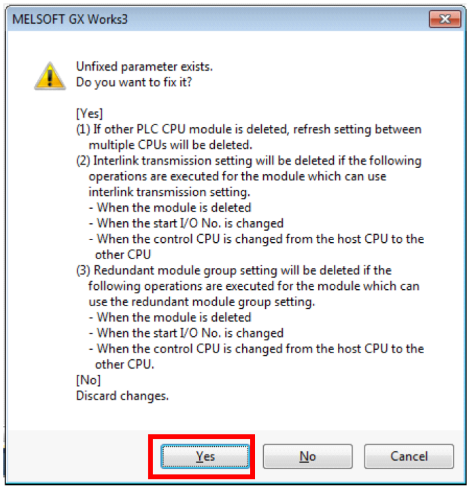
Set the multi-CPU parameters using GX-Works3.

1) Set a module configuration before setting the multi-CPU. Based on the actual module configuration, arrange the modules as shown below. The following shows a setting example for a system having three PLC CPUs and three robot CPUs.



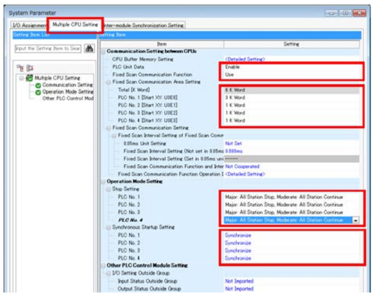
GX Works3 Module Configuration screen example (three robots)

2) When the Module Configuration screen is closed after arranging the modules, the following dialogue box will appear. Click [Yes].



3) Open the System Parameter screen to set the multi-CPU.

Set the number of points in units of K words.
The robot CPU uses less than 1K word, but this should be set to 1K word.



Setting item		Explanation	Setting value
Communication Setting between CPUs	PLC Unit Data	Set this item to avoid data separation of each PLC unit at data communications by refresh among CPU modules.	Enable
	Fixed Scan Communication Function	Set whether to use the fixed scan communication function. Always select "Use" when using together with a robot CPU.	Use
	Fixed Scan Communication Area Setting	Set the transmission area range of each unit in the fixed scan communication area Note1). The necessary areas for robot are as follows. <The CPU buffer memory extended function is valid> · Robot input area···1.0K · Robot output area···1.0K <The CPU buffer memory extended function is invalid> · Robot input area···0.5K · Robot output area···0.5K	<The CPU buffer memory extended function is valid> · CPU No. 1···Sum of the size (1K) of the data to be sent to the robot and the size of the data to be sent to other modules · Robot CPU···Set 1K. · Other CPU modules··· Set the transmission size of the host CPU. <The CPU buffer memory extended function is invalid> · CPU No. 1···Sum of the size (0.5K) of the data to be sent to the robot and the size of the data to be sent to other modules · Robot CPU···Set 1K.Note2) · Other CPU modules··· Set the transmission size of the host CPU.
Operation Mode Setting	Stop Setting	If a major or moderate error occurs at any of the CPUs, set whether to stop or continue operation for all CPUs.	Major: All Station Stop, Moderate: All Station Continue * Set for all CPU modules.
	Synchronous Startup Setting	Set this item to synchronize the startup time of CPU modules in the multi-CPU system. * Always select "Synchronize" since the robot CPU takes approximately 60 seconds to startup.	Synchronize

Note 1) For the multi-CPU and fixed scan communication area, refer to the RCPU manual (MELSEC iQ-R CPU Module User's Manual (Application)).
Note 2) Because the area can be set in 1K units only, allocate 1K in the case of 0.5K.

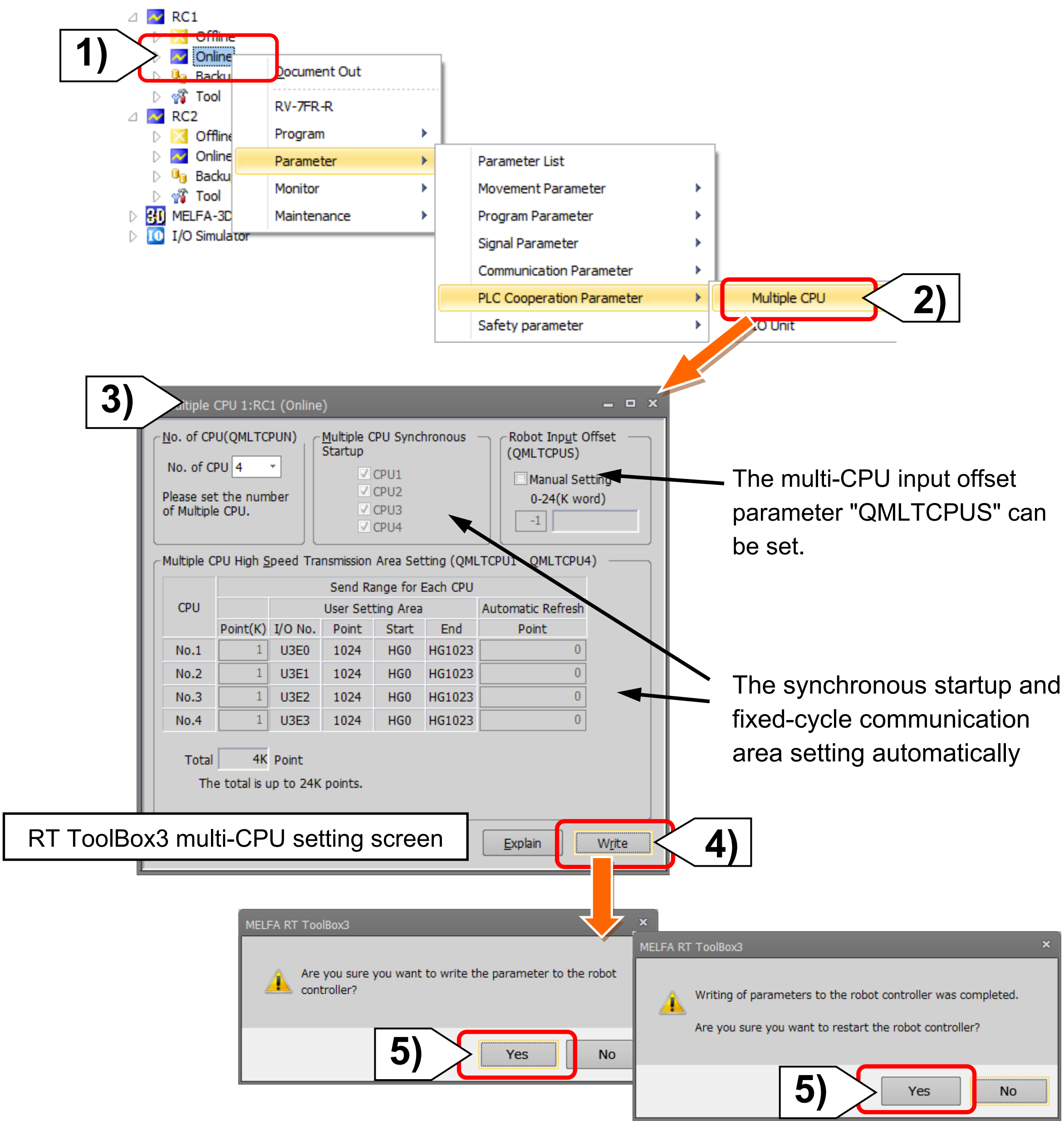
4) Set the parameters for the multi-CPU setting using GX Works3 and write them to the PLC CPU, then reset them.

(5) Setting robot multi-CPU parameters (RT ToolBox3)

Set the multi-CPU parameters of the robot using RT ToolBox3.
(→ Refer to "MELSEC iQ-R series robot CPU parameter")

Procedure for displaying the RT ToolBox3 multi-CPU setting screen

1) After the communication settings, activate the online state between the robot and RT ToolBox3.
2) Right-click [Online] in the project tree and display the menu. Expand [Parameter] → [PLC cooperation parameter], and then click [Multiple CPU].
3) The multi-CPU setting screen is displayed.
4) Enter the multi-CPU parameters and click [Write].
5) Write the parameters in the robot controller and reset the power supply.



[Start address of the robot input offset]

The following table lists the start addresses of the robot input area with the initial robot setting (multi-CPU input offset parameter "QMLTCPUS" is "-1") (the start address differs depending on enable/disable state of the CPU buffer memory extended function).

Start address of the robot input area with the initial robot setting

CPU No.	CPU buffer memory extended function	
	Disable	Enable
CPU No. 2 (robot 1)	0K	0K
CPU No. 3 (robot 2)	0.5K	1.0K
CPU No. 4 (robot 3)	1.0K	2.0K

If the enable/disable state of the CPU buffer memory extended function of other CPUs differs or a unit other than robot is inserted, the start address of the robot input area may differ from the above table.
In such a case, set the multi-CPU input offset parameter "QMLTCPUS".

What is the multi-CPU input offset parameter (QMLTCPUS)?
This parameter is used to set an offset to the input signal of the robot in the multi-CPU in 1K word unit.
For example, when 1 is set to QMLTCPUS, the start address of the robot input area becomes an address (U3E0\HG1024) that is offset by 1K word from the start address of the PLC No. 1 transmission area.
When -1 (initial value) is set to QMLTCPUS, the start addresses of the robot input area are shown in the above table.

Robot CPU parameter

Parameter name	Details	Default setting
QMLTCPUN	Number of multi-CPU modules setting Set the number of multi-CPU modules mounted in the main base unit of the multi-CPU system. Range: 1 to 4	2
QMLTCPUn n=1 to 4	CPU buffer memory fixed scan communication area setting (n = 1 to 4) In the multi-CPU system, read the number of points transmitted and received in the CPU buffer memory fixed scan communication area of the CPU No. 1 to 4 from the CPU No. 1, and set it automatically. The value does not need to be changed. Element 1: Size of the fixed scan communication area (K word) Range: 0 to 12 *The total size of all CPUs is 24K words at maximum. Element 2: Number of automatically refreshed points (word) Range: 0 to 14335 The robot CPU does not support the automatic refresh area, so always set the number of automatic refresh area points to 0. Element 3: System reservation Element 4: Multiple CPU synchronous startup (1: Enabled, 0: Disabled) The robot CPU takes time to start up. Keep the setting 1 (Synchronize) and do not change it. The settings of all CPUs must be the same.	1,0,1,1
IQMEM	Select the CPU buffer memory extended function. A function is assigned for each bit.1/0= Enabled/Disabled 15 0 00000000 00000000 bit2-3, 5-15 are not used bit0: Use the extended function bit1: PLC direct execution fucntion bit4: Interference avoidance function	00000000 00000000
IQSPEC	Set the functions of the CR800-R series controller. A function is assigned for each bit.1/0= Enabled/Disabled 15 0 00000000 00000000 bit1-15 is not used bit0: Writing direction of the CPU buffer memory =0: Execute read/write in order from head to last address =1: Execute read in order from head, and write in order from last address	0000000000000 001

(6) Correspondence of CPU buffer memory and robot input/output signals

In the PLC CPU, the CPU buffer memory is accessed like U3E0\HG511. The CPU buffer memory of the robot CPU No. n accesses like U3En\G511. (n = 1 to 3, up to three robot CPUs can be used.) The robot CPU's input/ output signal numbers are 10000 to 18191 respectively. Note that the PLC side uses word devices, and the robot side uses bit devices.

Note that the correspondence of the CPU buffer memory and robot input/output signals is as shown in the following table and it cannot be changed.

Correspondence of CPU buffer memory and robot input/output signals

PLC (word device)		Robot (bit device)	
Output	U3E0\HG0 to U3E0\HG511	Input	Robot CPU No.1 / 10000 to 18191
	U3E0\HG512 to U3E0\HG1023		Robot CPU No.2 / 10000 to 18191
	U3E0\HG1024 to U3E0\HG1535		Robot CPU No.3 / 10000 to 18191
Input	U3E1\HG0 to U3E1\HG511	Output	Robot CPU No.1 / 10000 to 18191
	U3E2\HG0 to U3E2\HG511		Robot CPU No.2 / 10000 to 18191
	U3E3\HG0 to U3E3\HG511		Robot CPU No.3 / 10000 to 18191

(7) Example of sequence ladder

An example for turning the operation panel's "Robot operation right enable button: X0" ON, set the operation panel's "Robot operation rights enabled lamp: Y20" and output the robot's operation right enabled state is shown below.

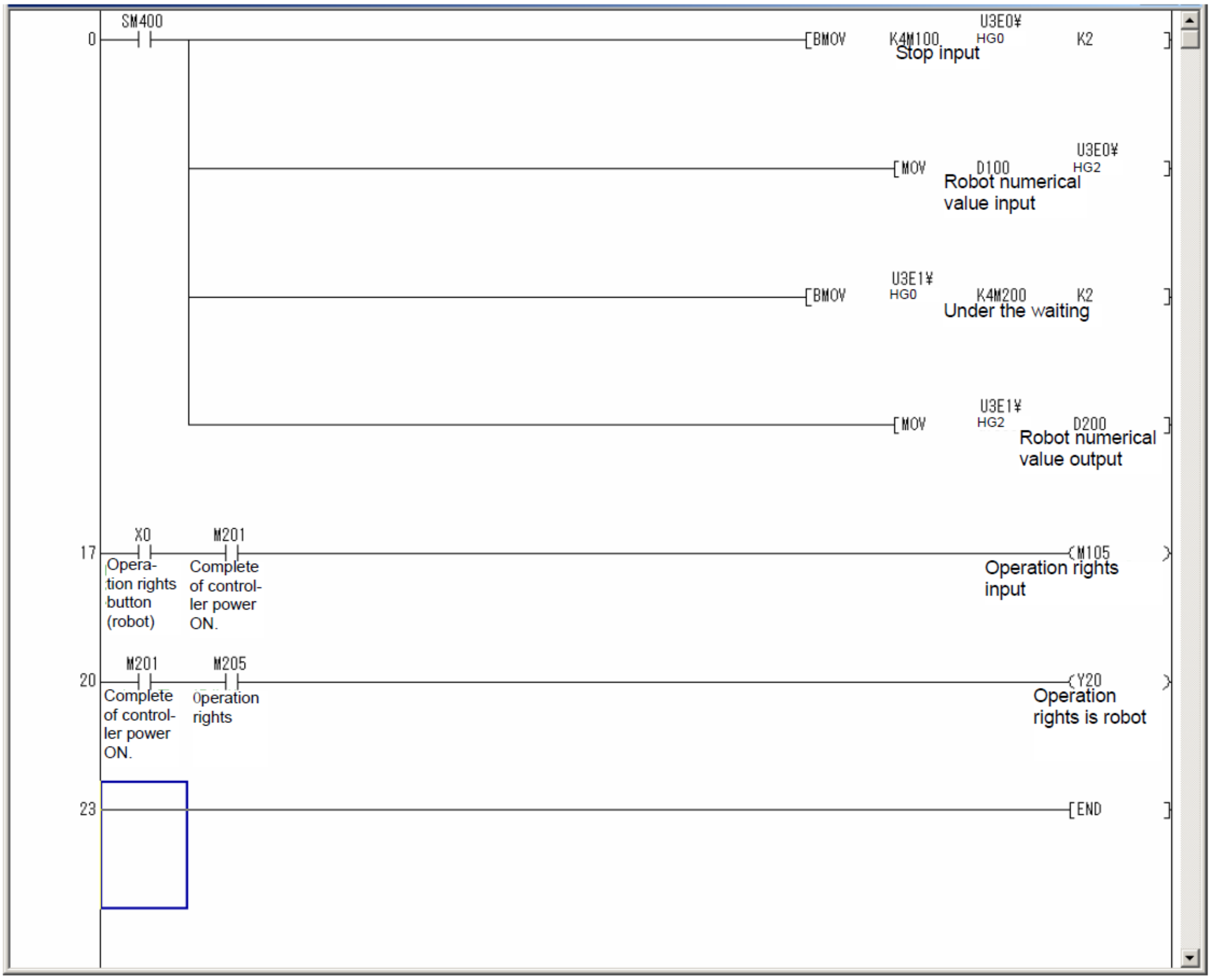
The multi-CPU is configured of the No. 1 unit: PLC RnCPU and No. 2 unit: robot R16RTCPU.

[Explanation]

<Lines 0 to16 > M100 to M131 are written into the U3E0\HG0 and U3E0\HG1shared device memory, and are handled as the input from the PLC to the robot. The U3E1\HG0 and U3E1\HG1 shared device memory is read as the M200 to M231 bit device, and handled as the output from the robot to the PLC.

<Lines 17 to 22 > When X0 turns ON, M105 turns ON and U3E0\HG0 bit 5 of the PLC corresponding to M105 turns ON. Then, the robot input 10005 turns ON, and the operation rights assigned to the dedicated input signal are enabled. When the operation rights are enabled, the robot output 10005 assigned to the dedicated output signal turns ON, and the robot's U3E1\ HG0 bit 5 turns ON. This causes the PLC M205 corresponding to the U3E1\HG0 bit 5 to turn ON, and Y20 to turn ON. In this example, bit device M201 (U3E0\HG0 bit 1, or robot output 10001) indicates the completion of the controller power ON (outputs that external input signal can be received).

Example of sequence ladder



(8) Dedicated input/output signal assignment (Default settings)

The default dedicated input/output signal assignments are shown below.

Dedicated input/output signal assignment (default settings)

Parameter name	Input signal name (* Operation rights required)	Output signal name	Input	Output	G device Note 1)
STOP	Stop input (assignment change is impossible)	Pausing output	10000	10000	HG0
RCREADY	-	Controller power ON ready	-	10001	
ATEXTMD	-	Remote mode output	-	10002	
TEACHMD	-	Teaching mode output	-	10003	
ATTOPMD	-	Teaching mode output	-	10004	
IOENA	Operation rights input signal	Operation rights output signal	10005	10005	
START	Start input (*)	Operating output	10006	10006	
STOPSTS	-	Stop signal input	-	10007	
SLOTINIT	Program reset (*)	Program selection enabled output	10008	10008	
ERRRESET	Error reset input signal	Error occurring output signal	10009	10009	
SRVON	Servo ON input signal (*)	In servo ON output signal	10010	10010	
SRVOFF	Servo OFF input signal	Servo ON disable output signal	10011	10011	
CYCLE	Cycle stop input signal	In cycle stop operation output signal	10012	10012	
SAFEPOS	Safe point return input signal (*)	In safe point return output signal	10013	10013	
BATERR	-	Battery voltage low	-	10014	
OUTRESET	General-purpose output signal reset (*)	-	10015	-	
HLVLERR	-	High level error output signal	-	10016	HG1
LLVLERR	-	Low level error output signal	-	10017	
CLVLERR	-	Warning level error output signal	-	10018	
EMGERR	-	Emergency stop output signal	-	10019	
PRGSEL	Program selection input signal	-	10020	-	
OVRDSEL	Override selection input signal	-	10021	-	
PRGOUT	Program No. output request	Program No. output signal	10022	10022	
LINEOUT	Line No. output request	Line No. output request	10023	10023	
OVRDOUT	Override value request	Override value output signal	10024	10024	
ERROUT	Error No. output request	Error No. output signal	10025	10025	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
IODATA	Numeric value input 0	Numeric value output 0	10032	10032	HG2
	Numeric value input 1	Numeric value output 1	10033	10033	
	Numeric value input 2	Numeric value output 2	10034	10034	

Parameter name	Input signal name (* Operation rights required)	Output signal name	Input	Output	G device Note 1)
IODATA	Numeric value input 3	Numeric value output 3	10035	10035	HG2
	Numeric value input 4	Numeric value output 4	10036		
	Numeric value input 5	Numeric value output 5	10037		
	Numeric value input 6	Numeric value output 6	10038		
	Numeric value input 7	Numeric value output 7	10039		
	Numeric value input 8	Numeric value output 8	10040		
	Numeric value input 9	Numeric value output 9	10041		
	Numeric value input 10	Numeric value output 10	10042		
	Numeric value input 11	Numeric value output 11	10043		
	Numeric value input 12	Numeric value output 12	10044		
	Numeric value input 13	Numeric value output 13	10045		
	Numeric value input 14	Numeric value output 14	10046		
	Numeric value input 15	Numeric value output 15	10047		
HNDCNTL1	-	Hand output signal state 900	-	10048	HG3
	-	Hand output signal state 901	-	10049	
	-	Hand output signal state 902	-	10050	
	-	Hand output signal state 903	-	10051	
	-	Hand output signal state 904	-	10052	
	-	Hand output signal state 905	-	10053	
	-	Hand output signal state 906	-	10054	
	-	Hand output signal state 907	-	10055	
HNDSTS1	-	Hand input signal state 900	-	10056	
	-	Hand input signal state 901	-	10057	
	-	Hand input signal state 902	-	10058	
	-	Hand input signal state 903	-	10059	
	-	Hand input signal state 904	-	10060	
	-	Hand input signal state 905	-	10061	
	-	Hand input signal state 906	-	10062	
	-	Hand input signal state 907	-	10063	
USRAREA	-	User-designated area 1	-	10064	HG4
	-	User-designated area 2	-	10065	
	-	User-designated area 3	-	10066	
	-	User-designated area 4	-	10067	
	-	User-designated area 5	-	10068	
	-	User-designated area 6	-	10069	
	-	User-designated area 7	-	10070	
	-	User-designated area 8	-	10071	

Note 1) The address of the multi-CPU share device. (Address seen from the sequencer CPU side)

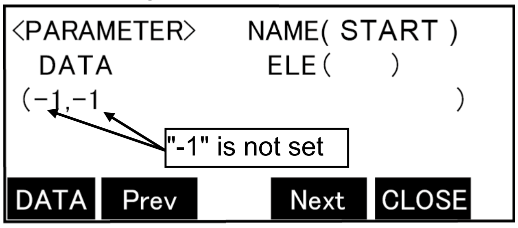
5.3 Assigning dedicated signals

(1) When using the T/B

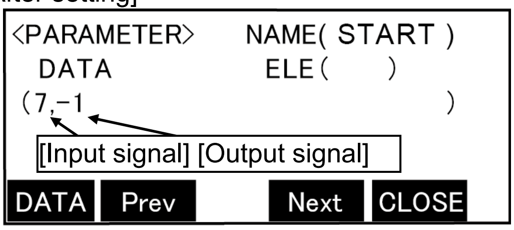
Specify the parameter name in [3.PARAM.] on the MENU screen.
(For the operation method, refer to "Appendix 1: Teaching Box 1.1 Basic menu (3) Parameter menu".)

<Example 1> Parameter name: START
Function: This screen sets the robot program start into the open input signal number 7.

[Before setting]

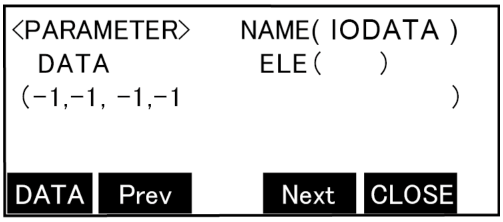


[After setting]

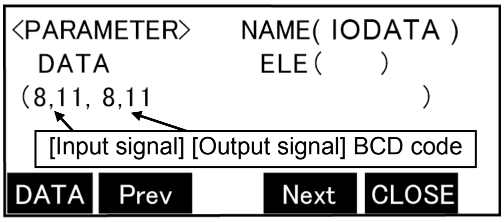


<Example 2> Parameter name: IODATA
Function: This screen sets the numeric data into the open input signal numbers 8 to 11 and open output signal numbers 8 to 11.

[Before setting]

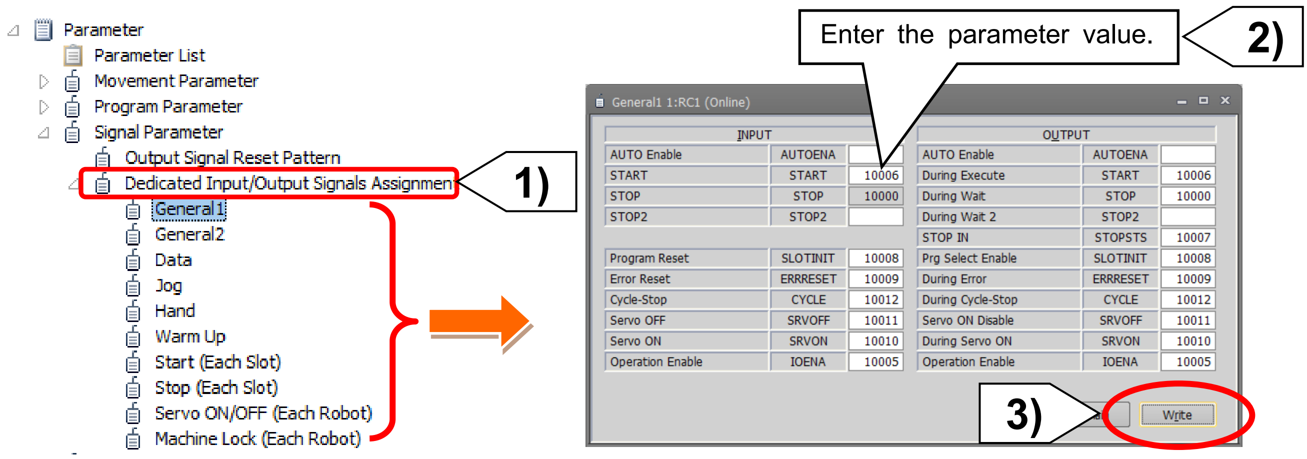


[After setting]



(2) When using RT ToolBox3

1) Expand [Online] → [Parameter] → [Signal Parameter] → [Dedicated Input/Output Signals Assignment] in the project tree.
2) Select each item under [Dedicated Input/Output Signals Assignment] and change the parameter values.
3) After changing the parameter values, click the [Write] button to write them to the robot controller.



* After changing the parameters, always turn the controller/drive unit control power OFF and ON. Turning off and on the control power supply of the controller/drive unit enables the changed parameters.

5.4 General-purpose input/output signals

The remaining open <signals> can be used by the user for general-purpose input/output signals.

[Reference] For details on the input/output signal pin numbers, refer to the section "External input/output functions" in the separate "Instruction Manual / Detailed explanation of functions and operation".

5.5 Controlling the general-purpose input/output signals

- Example to read the general-purpose input/output signal conditions, judge whether the conditions are true or false, and execute branching

  [Caution] In the following example, the general-purpose input/output signal numbers are based on the standalone type (F-D Series). When using the iQ Platform compatible type (F-Q Series), the general- purpose input/ output signal numbers are in the 1000s addresses.

<Example 1> Read whether the designated general-purpose input signal (8) is ON, and branch depending on true or false
If M_In(8)=1 Then *OK Else *NG

<Example 2> Read whether the designated general-purpose input signal (9) is OFF and branch depending on true or false
If M_In(9)=0 Then *GET1 Else *GET2

<Example 3> Wait for designated general-purpose input signal (10) to turn ON (wait for hand input signal (900) to turn ON)
Wait M_In(10)=1
Wait M_In(900)=1

<Example 4> Read whether the four bits of designated general-purpose input signals ((8) to (11)) are ON, and branch depending on true or false
If M_Inb(8)=&B00001111 Then *GETWK Else *WT
If M_Inb(8)=15 Then *GETWK Else *WT
If M_Inb(8)=&H0F Then *GETWK Else *WT

Designated number of bits

Designated bit No.

Data method	No. of bits = 8 bits (1 byte)							
	(15)	(14)	(13)	(12)	(11)	(10)	(9)	(8)
Binary (&B)	0	0	0	0	1	1	1	1
Decimal (Dec)	128	64	32	16	8	4	2	1
Hexadecimal (&H)	0	0	0	0	8	4	2	1

<Example 5> Substitute the 8 bits of input signal data (BCD) from bit No. (8) in numeric variable "M1"
M1=M_Inb(8)

■ Example of program for processing genera-purpose input/output signals

<Example 1> Turn ON designated general-purpose output signal (8)

```
M_Out(8)=1
M_Out(8)=1 Dly 0.5 (pulse output) (parallel process)
```

<Example 2> Turn OFF designated general-purpose output signal (9)

```
M_Out(9)=0
```

<Example 3> Turn ON only the designated general-purpose output signals (8) to (11)

```
M_Outb(8)=&B00001111        ' Binary
M_Outb(8)=15                ' Decimal
M_Outb(8)=&H0F              ' Hexadecimal
M1=15                       ' Variable
M_Outb(8)=M1
```

<Example 4> Turn OFF all 8 bits from the designated general-purpose output signal (8)

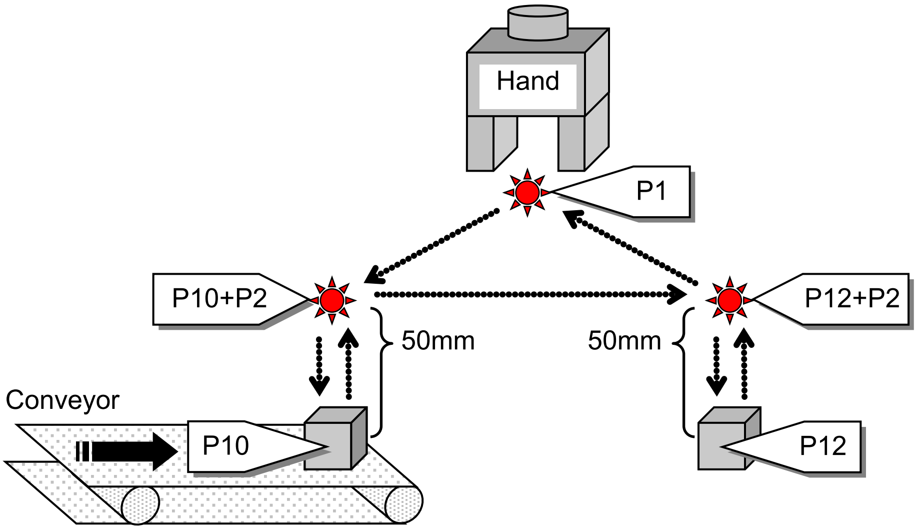
```
M_Outb(8)=0
```

<<MEMO>> * Use this page to write down notes.

Chapter 6 Practice Exercises

6.1 Exercise 1: Material handling work (basic operation)

(1) Start at P1, move the workpiece from P10 to P12, and then return to P1.
(Input the Z data with the MDI for P2.)



(2) Change the P10+P2 operation to 10, -50 (proximity interpolation instruction (approach instruction), and observe the differences.

[Caution] For the RV type robot, decrease the Z data by 50mm and for the RH type increase by 50mm. Set the approach instruction to "P10, -50" for the RV type, and "P10, 50" for the RH type.

6.2 Exercise 2: Material handling work using input/output signals (I/O) (Basic I/O process)

Try adding conditions (1) and (2) to the Exercise 1 program

(1) After input signal (11008) turns ON, pickup the workpiece at P10. Set it at P12, and then turn the output signal (11008) ON for 0.5 seconds.

(2) After input signals (11008), (11009) and (11010) turn ON, pickup the workpiece at P10. Set it at P12, and then turn output signals (11008), (11009) and (11010) ON. Return to P1 and turn all signals OFF.

[Caution] To create a program using the standalone type robot, read the I/O signals (11008 to 11010) to (8 to 10).

Example exercise responses

Example response for Exercise 1: Material handling work (basic operation)

* The example response assumes that an electric operated hand is being used. When using a pneumatic hand, change EHOpen 1,100,100 to HOpen 1, EHClose 1,1000,1000 to HClose 1.

<Example for (1)'s response>	<Example for (2)'s response>	<Details of operation>
1 Ovrd 80	1 Ovrd 80	; Set movement speed to 80%
2 EHOpen 1,100,100	2 EHOpen 1,100,100	; Open hand 1
3 Mov P1	3 Mov P1	; Move to retract position
4 Mov P10+P2	**4 Mov P10,-50**[Caution]	; Move to 50mm above workpiece grasp position
5 Mvs P10	5 Mvs P10	; Move to workpiece grasp position
6 Dly 0.3	6 Dly 0.3	; 0.3 sec. timer (wait for robot operation to settle)
7 EHClose 1,100,100	7 EHClose 1,100,100	; Grasp workpiece
8 Dly 0.5	8 Dly 0.5	; 0.5 sec. timer (wait for hand to completely close)
9 Mvs P10+P2	**9 Mvs ,-50**[Caution]	; Move 50mm up from current position
10 Mov P12+P2	10 **Mov P12,-50**[Caution]	; Move to 50mm above workpiece setting position
11 Mvs P12	11 Mvs P12	; Move to workpiece setting position
12 Dly 0.3	12 Dly 0.3	; 0.3 sec. timer (wait for robot operation to settle)
13 EHOpen 1,100,100	13 EHOpen 1,100,100	; Release workpiece
14 Dly 0.5	14 Dly 0.5	; 0.5 sec. timer (wait for hand to completely open)
15 Mvs P12+P2	15 **Mvs ,-50**[Caution]	; Move 50mm up from current position
16 Mov P1	16 Mov P1	; Return to retract position
17 Hlt	17 Hlt	; Stop
18 End	18 End	; End of program

[P2 is input with MDI]

```
<POS.>  JNT  50%  P2
   X:   +0.00      A:    +0.00
   Y:   +0.00      B:    +0.00
   Z:  +50.00      C:    +0.00
  L1:   +0.00     L2:    +0.00
 FL1:       0    FL2:        0
MOVE  TEACH  123  Prev  Next  ⇒
```

[Caution]
The values for steps 4, 9, 10 and 15 are input as "-50" for the RV type and "+50" for the RH type.
(Tool coordinate system's Z axis direction and distance)

Example response for Exercise 2: Material handling work using input/output signals (Basic I/O process)

(1) Insert between Steps 4 and 5:
***IOCK**
If M_In(11008)=0 Then *IOCK[Supplement] ; After input signal 11008 turns OFF, branch to *IOCK (wait for it to turn ON). Go to next line after input signal turns ON.

Insert between Steps 15 and 16:
M_Out(11008)=1 Dly 0.5 ; Turn output signal ON for only 0.5 sec. (pulse)

[Supplement] Describe as follows when using the Wait instruction:
Wait M_in(11008)=1

(2) Insert the following Steps 4 and 5:
***IOCK**
If M_Inb(11008)<>&B111 Then *IOCK ; If input signals 11008, 11009 and 11010 are not all turn ON, wait for them to turn ON. Go to next line if all signals are ON.

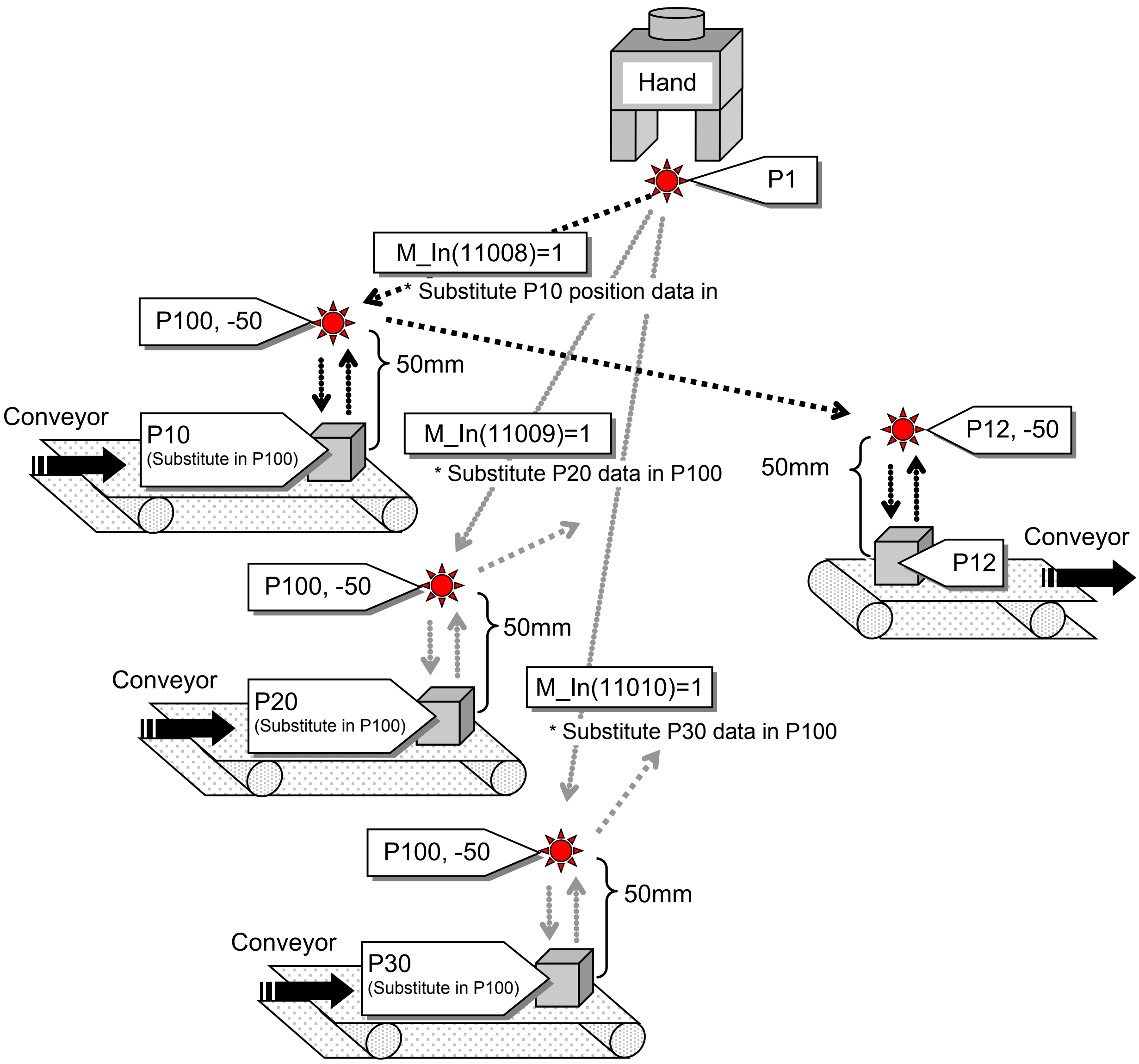
Insert between Steps 15 and 16:
M_Outb(11008)=&B111 ; Turn output signals 11008, 11009 and 11010 all ON
Insert between Steps 16 and 17: Clr 1 ; Set all of the output signals to the parameter-set state beforehand (hold ON, OFF)

6.3 Exercise 3: Take a look at the priority signals and sub-program

In this example, there are three conveyors. The signal input first is read in, and the workpiece is picked up at each position and transferred to P12. Create a sub-program to remove the workpiece.

[Caution] For the RV type robot, decrease the Z data by 50mm and for the RH type increase by 50mm.
[Caution] To create a program using the standalone type robot, read the I/O signals (11008 to 11010) to (8 to 10).

M_In(11010)	M_In(11009)	M_In(11008)	Place of retrieval
0	0	0	Standby
0	0	1	P10
0	1	0	P20
0	1	1	P10, P20
1	0	0	P30
1	0	1	P10, P30
1	1	0	P20, P30
1	1	1	P10, P20, P30



Example exercise responses

Example response for Exercise 3: Create the priority signals and sub-program
(Incorporate the main program and sub-program concepts as an efficient structure.)

> [Caution] For the 19th, 26th, 28th and 33rd lines,
> the RV type is input as "-50" and the RH type is input as "+50".

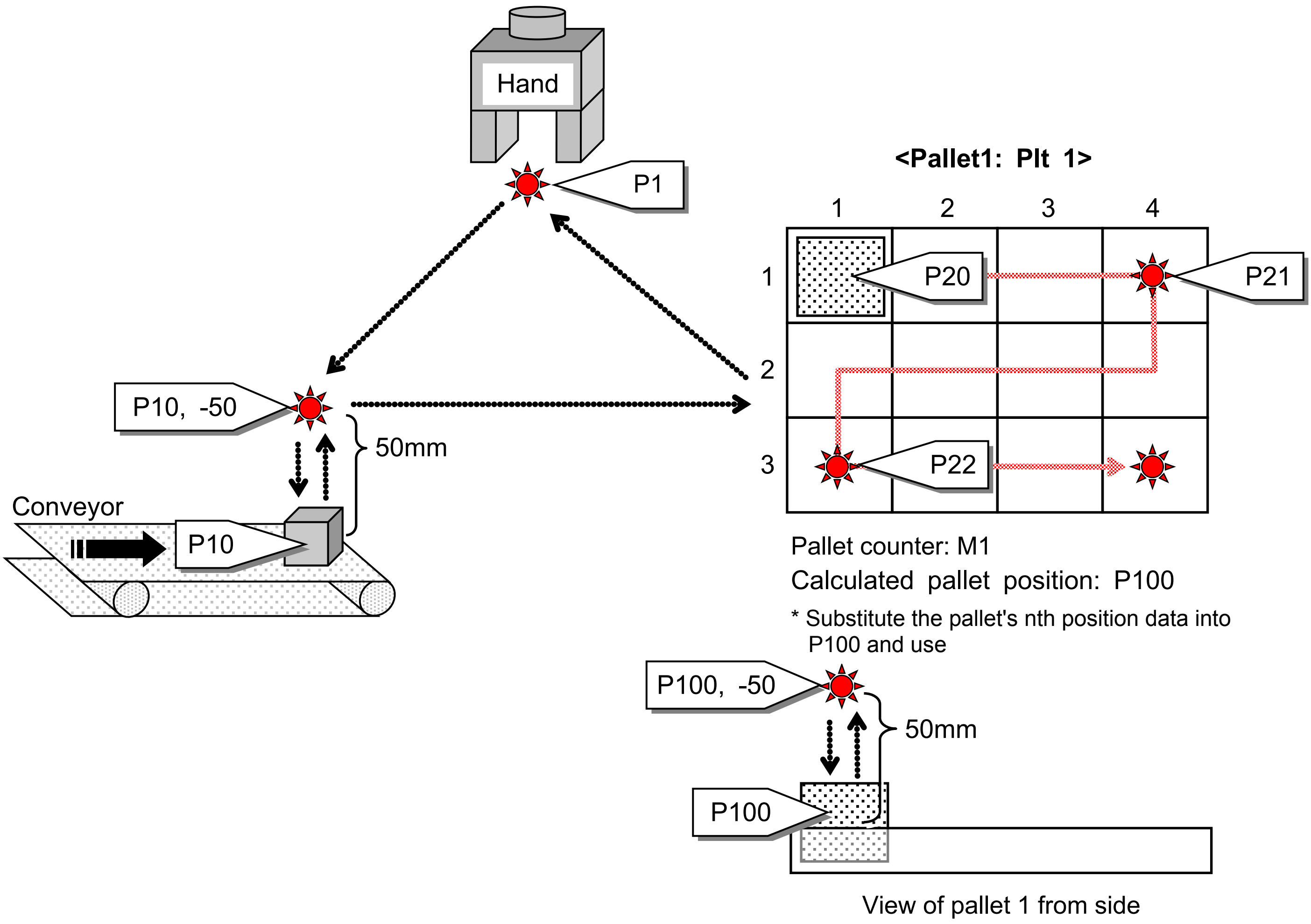
* The example response assumes that an electric operated hand is being used. When using a pneumatic hand, change EHOpen 1,100,100 to HOpen 1, EHClose 1,1000,1000 to HClose 1.

```
1  Ovrd 100                           ; Set operation speed to maximum speed
2  EHOpen 1,100,100                   ; Open hand 1
3  Mov P1                             ; Move to retract position
4  *CHECK8
5  If M_In(11008)=0 Then *CHECK9      ; After input signal No. 11008 turns OFF, branch to *CHECK9
6  P100=P10                           ; Substitute P10 in P100
7  GoSub *GETPUT                      ; Branch to *GETPUT (common program for handling)
8  *CHECK9
9  If M_In(11009)=0 Then *CHECK10     ; After input signal No. 11009 turns OFF, branch to *CHECK10
10 P100=P20                           ; Substitute P20 in P100
11 GoSub *GETPUT                      ; Branch to *GETPUT (common program for handling)
12 *CHECK10
13 If M_In(11010)=0 Then *CHECK8      ; After input signal No. 11010 turns OFF, branch to *CHECK8
14 P100=P30                           ; Substitute P30 in P100
15 GoSub *GETPUT                      ; Branch to *GETPUT (common program for handling)
16 End                                ; End of program
17 '                                  ; Comment line (nothing is executed)
18 *GETPUT
19 Mov P100,-50 [Caution]             ; Move to 50mm above workpiece grasp position
                                        (P10, P20 or P30 is substituted)
20 Ovrd 50                            ; Set movement speed to 50%
21 Mvs P100                           ; Move to workpiece grasp position
22 Dly 0.3                            ; 0.3 sec. timer (wait for robot operation to settle)
23 EHClose 1,100,100                  ; Grasp workpiece
24 Dly 0.5                            ; 0.5 sec. timer (wait for hand to completely close)
25 Ovrd 100                           ; Set movement speed to maximum speed
26 Mvs ,-50 [Caution]                 ; Move to 50mm above current position
27 '                                  ; Comment line (nothing is executed)
28 Mov P5,-50 [Caution]               ; Move to 50mm above workpiece setting position
29 Mvs P5                             ; Move to workpiece setting position
30 Dly 0.3                            ; 0.3 sec. timer (wait for robot operation to settle)
31 EHOpen 1,100,100                   ; Release workpiece
32 Dly 0.5                            ; 0.5 sec. timer (wait for hand to completely open)
33 Mvs ,-50 [Caution]                 ; Move to 50mm above current position
34 Mov P1                             ; Return to retract position
35 Return                             ; Go to step after GoSub
```

6.4 Exercise 4: Palletizing work

(1) Pick up the workpiece with conveyor P10, and palletize it to pallet 4×3 = 12.
(2) Try considering a one-row pallet 4×1.

[Caution] For the RV type robot, decrease the Z data by 50mm and for the RH type increase by 50mm.



6.5 Exercise 5: Adding the interrupt function

<u>Try adding the interrupt function to the movement in Exercise 4</u>

After the input signal (11012) turns ON during the operation, the output signal (11012) turns ON and the robot stops.
After restarting, the output signal (11012) turns OFF, and the operation is executed from the line where the interrupt occurred.

[Caution] To create a program using the standalone type robot, read the I/O signal (11012) to (12).

Example exercise responses

Example response for Exercise 4: Palletizing work

> [Caution] For the 7th, 12th, 15th, 20th and 23rd lines,
> the RV type is input as "-50" and the RH type is input as "+50".

* The example response assumes that an electric operated hand is being used. When using a pneumatic hand, change EHOpen 1,100,100 to HOpen 1, EHClose 1,1000,1000 to HClose 1.

```
1   Def  Plt  1,P20,P21,P22,,4,3,1    ; Define No. 1 pallet (position, size, quantity, order No.)
2   M1=1                              ; Substitute value 1 in variable M1
                                        (M1 is used for pallet grid point No.)
3   Ovrd  100                         ; Set movement speed to maximum speed
4   EHOpen  1,100,100                 ; Open hand 1
5   Mov  P1                           ; Move to home position
6 *LOOP
7   Mov  P10,-50 [Caution]            ; Move to 50mm above workpiece grasp position
8   Mvs  P10                          ; Move to workpiece grasp position
9   Dly  0.3                          ; 0.3 sec. timer (wait for robot operation to settle)
10  EHClose  1,100,100                ; Grasp workpiece
11  Dly  0.5                          ; 0.5 sec. timer (wait for hand to completely close)
12  Mvs  ,-50 [Caution]               ; Move to 50mm above current position
13  '                                 ; Comment line (nothing is executed)
14  P100=Plt  1,M1                    ; Operate the grid point position indicated by the pallet M1 value, and
                                        substitute into P100
15  Mov  P100,-50 [Caution]           ; Move to 50mm above grid point position above pallet
16  Mvs  P100                         ; Move to grid point position above pallet
17  Dly  0.3                          ; 0.3 sec. timer (wait for robot operation to settle)
18  EHOpen  1,100,100                 ; Release workpiece
19  Dly  0.5                          ; 0.5 sec. timer (wait for hand to completely open)
20  Mvs  ,-50 [Caution]               ; Move to 50mm above current position
21  M1=M1+1                           ; Add 1 to the M1 value (number of next grid point on pallet)
22  If  M1<=12  Then *LOOP            ; Repeat until pallet is filled. (* To LOOP)
                                        Go to next step when pallet is full
23  Mov  P10,-50 [Caution]            ; Move to 50mm above workpiece grasp position
24  Hlt                               ; Stop
25  End                               ; End of program
```

Example response for Exercise 5: Adding the interrupt function

Add between steps 2 and 3:

```
Def  Act  1,M_In(11012)=1  GoSub  *STP  ; Define No. 1 interrupt (after input signal No. 11012 turns ON,
                                          execute *STP sub-routine)
Act  1=1                                ; Enable the No. 1 interrupt
```

Add to the end of the program

```
*STP
M_Out(11012)=1                          ; Turn output signal 11012 ON
Hlt                                     ; Stop
M_Out(11012)=0                          ; Turn output signal 11012 OFF
Return  0                               ; Return to line where interrupt occurred
```

Appendix 1: Teaching Box

Appendix 1.1: Basic menu

1) Press the TB Enable switch on the back of the teaching box.
2) Press one of the keys (i.e., [EXE] key.)
3) The <MENU> screen will appear.

There are six types of menus:

1. FILE/EDIT menu
2. RUN menu
3. PARAMETER menu
4. ORIGIN/BRAKE menu
5. SET/INITIALIZE menu
6. ENHANCED menu

```
MELFA CR800-D                    Ver. S3
RH-3FRH5515-D

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TRIC CORPORATION ALL RIGHTS RESE
RVED
```

⇨

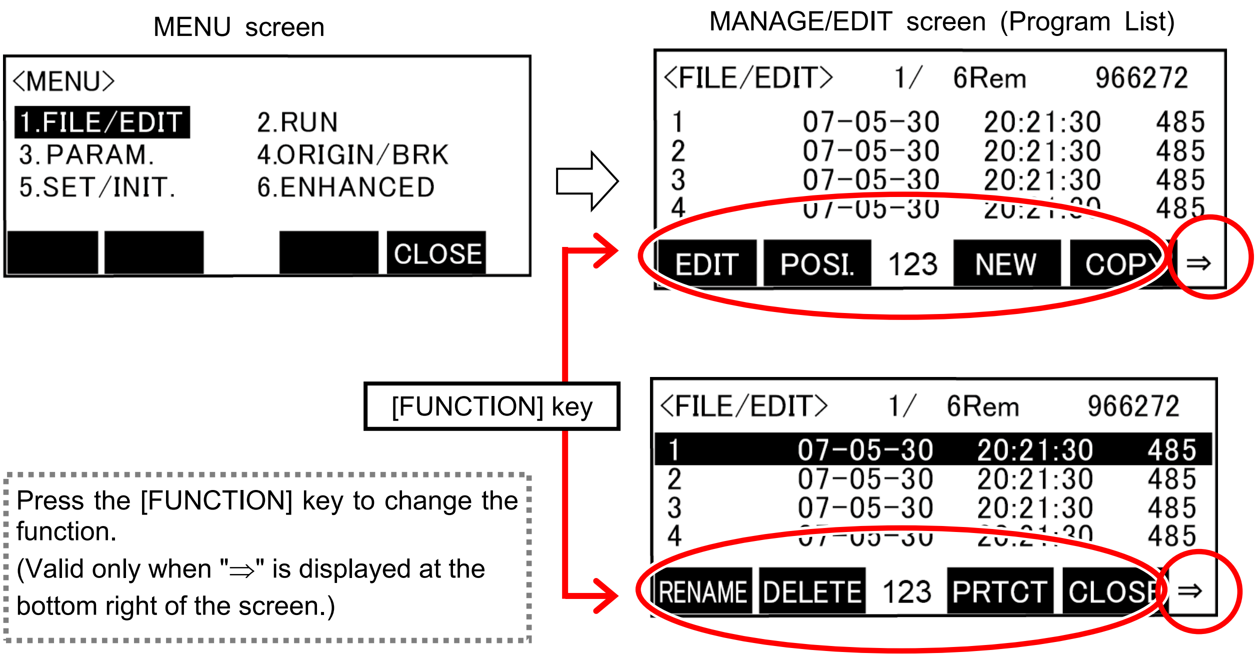
```
<MENU>
1.FILE/EDIT      2.RUN
3.PARAM.         4.ORIGIN/BRK
5.SET/INIT.      6.ENHANCED

                          CLOSE
```

Pressing the number keys, switches the screen to each function screen.

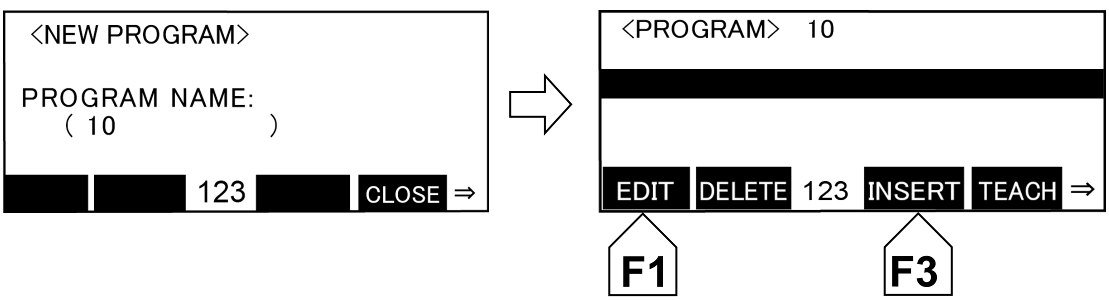
(1) FILE/EDIT menu

The operations related with the program management in the controller can be performed.
Press the number key [1] on the <MENU> screen.
The <MANAGE/EDIT> Screen (Program List) opens.



a) Inputting a program

1) Press the function key ([F3]) corresponding to "NEW".
2) Input a new program name.
   Ex.) When the new program name is "10" ••• Press the number keys [1] and [0], and then press the [EXE] key.
3) The program input screen will open.
4) The program is created by using "Edit" and "Insert".
   Adding command: INSERT ••• Press (F3).
   Correcting command: EDIT ••• Press (F1).



b) Managing the programs

1. COPY
   A registered program can be copied as another program.

2. RENAME
   A registered program can be renamed.

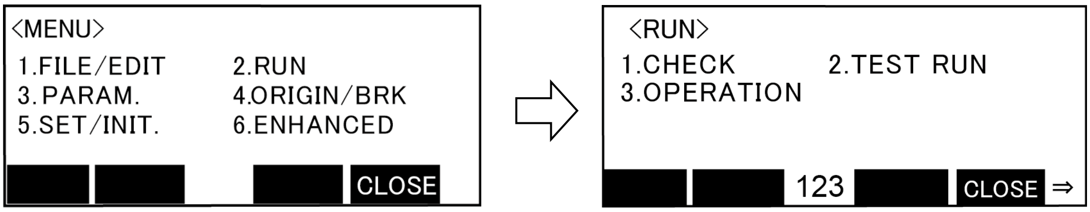
3. DELETE
   Registered programs can be deleted in a batch.

4. PROTECT
   The register and change protection state of the registered programs, instruction statements and data can be set.

(2) RUN menu

The current status of the robot can be checked and the operations equivalent to the operation panel (O/P) can be performed.

1) Press the number key [2] on the <MENU> screen.
2) The <OPERATION> screen opens.



<RUN screen menu>

1. Confirm
   The program being executed is displayed and step operation is performed. The multi-tasking details can also be displayed.

2. Test run
   Switch between continuous operation and cycle operation.

3. Operation panel
   Automatic operation can be started from the teaching box.

(3) PARAMETER menu

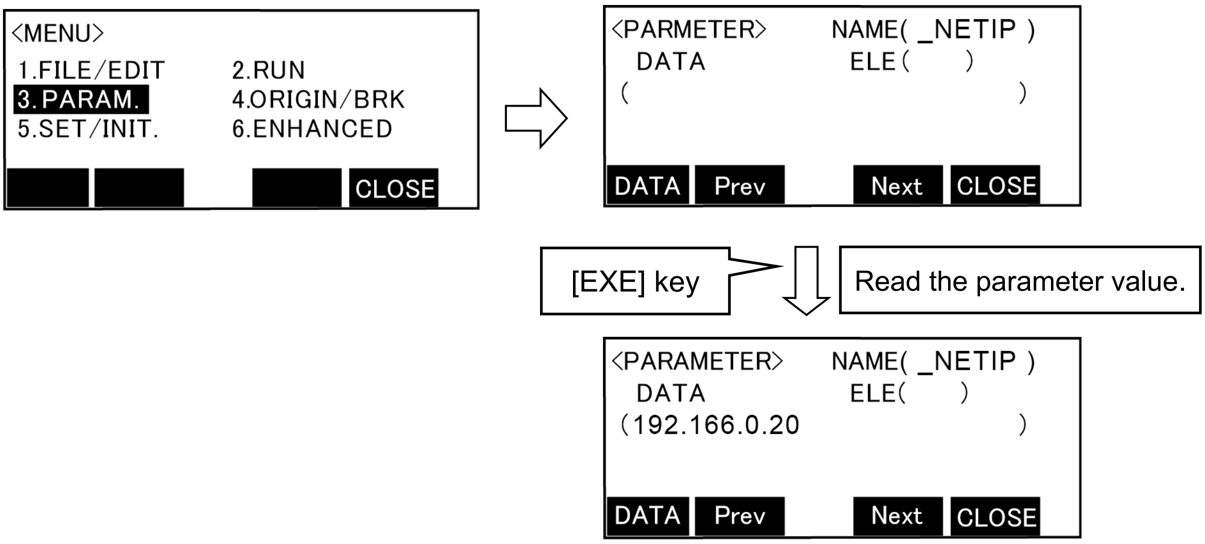
Each parameter setting of the robot can be configured.

1) Press the number key [3] on the <MENU> screen.

2) The <PARAMETERS> screen opens.

3) Input the parameter name in "NAME (   )" to confirm and change the setting values.

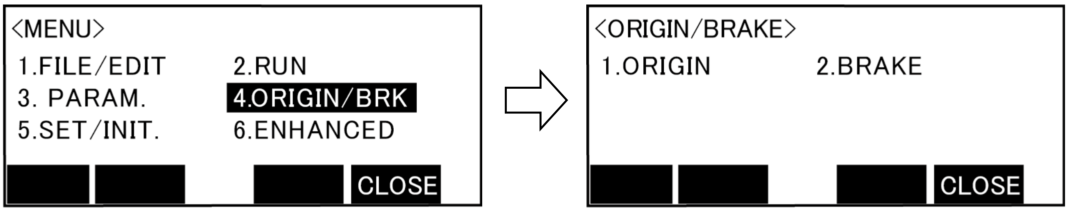
(If the [EXE] key is pressed without inputting the entire parameter name, the parameters closest to the input name will appear. The parameters can be scrolled back and forth with the "Prev" (previous) and "Next" (Next) keys.)



(4) ORIGIN/BRAKE menu

The origin setting of the robot and brakes for each axis are released.

1) Press the number key [4] on the <MENU> screen.
2) The <ORIGIN/BRAKE> screen opens.



<ORIGIN/BRAKE screen menu>

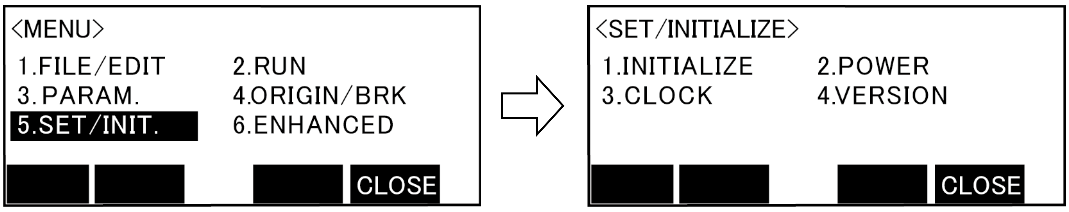
1. ORIGIN
   The origin data unique to the robot's mechanism is registered.

2. BRAKES
   The brakes for each axis are released. The robot arm is moved while supporting it with a hand.

(5) SET/INITIALIZE menu

Initialization of the program and time setting are performed.

1) Press the number key [5] on the <MENU> screen.
2) The <SETTING/INITIALIZATION> screen opens.



<SET/INITIALIZE screen menu>

1. INITIALIZATION
   There are several functions: function to erase all registered programs, function to return parameters to default settings, and function to initialize internal battery's consumption time.
   When the battery's consumption time is initialized, the remaining time is set to 14,600 hours.

2. OPERATION
   The cumulative time that the controller/drive unit power was ON and the battery's remaining time are displayed.

3. TIME SETTING
   The date and time are displayed and set.

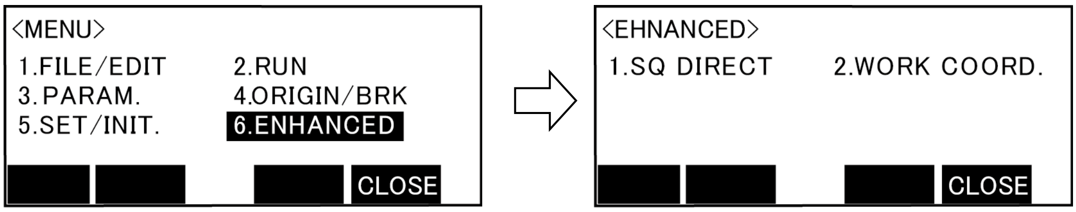
4. VERSION
   The robot CPU and teaching box software versions are displayed.

(6) ENHANCED menu

Enhanced functions can be used.

1) Press the number key [6] on the <MENU> screen.

2) The < ENHANCED > screen opens.



<ENHANCED screen menu>

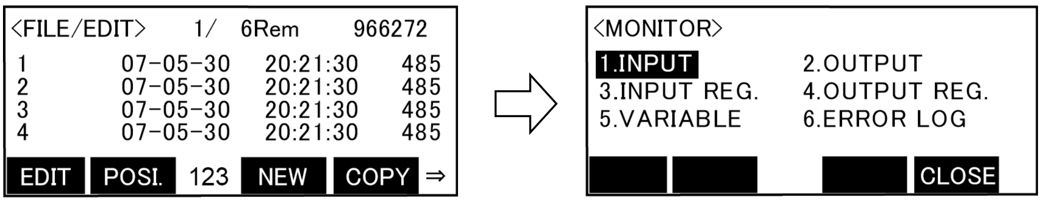
1. PLC DIRECT (only iQ Platform compatible type)
   Settings related to the functions that directly control the robot with the PLC program are made here.

2. WORK COORDINATES
   Define the workpiece coordinate system required for work jog operations.

Appendix 1.2 Monitor function

Press the [MONITOR] key on any screen.

The <MONITOR> screen opens.



<MONITOR screen menu>

1. INPUT
   Signals input from an external source (parallel input signals) can be monitored.

2. OUTPUT
   Signals output to an external source (parallel output signals) can be monitored.

3. INPUT REGISTER
   The input register value can be monitored when using CC-Link.

4. OUTPUT REGISTER
   The output register value can be monitored when using CC-Link.

5. VARIABLES
   The details of variables used in the program can be confirmed.

6. ERROR HSITORY
   The alarm history is displayed.

Appendix 1.3 / Inputting the program with T/B

(1) Inputting a command

Ex.) Inputting "1 Ovrd 80"

Step	Operation	T/B screen	Explanation of Operation
1		<PROGRAM> 1 EDIT DELETE 123 INSERT TEACH ⇒	Open the <INSTRUCTION EDIT> screen.
2	F3	<PROGRAM> 1 123 CLOSE	Press the [F3] key ("INSERT") and enable the Insert Line mode. The Insert Line screen opens.
3	1 '( )	<PROGRAM> 1 1 123 CLOSE	Press the [1] key. "1" is input at the step No.
4	CHARACTER	<PROGRAM> 1 1 ABC CLOSE	Press the [CHARACTER] key and change the display at the center bottom of the screen to "ABC". "ABC" indicates the Character Input mode.
5	−C (J6) 0 SP	<PROGRAM> 1 1 ␣ ABC CLOSE	Insert a space before inputting "Ovrd". Press the [-C/SP] key. A space " " is input.
6	+A (J4) 6 MNO	<PROGRAM> 1 1 O ABC CLOSE	Press the [+A/MNO] key three times. "O" is input.
7	−B (J5) 8 TUV	<PROGRAM> 1 1 OV ABC CLOSE	Press the [-B/TUV] key three times. "V" is input to the right of "O".

Step	Operation	T/B screen	Explanation of Operation
8	[7 PQRS], [+Z (J3) 3 DEF]	〈PROGRAM〉 1 1 OVRD ␣ ABC CLOSE	Next, input R and D. Press the [/PQRS] key three times, and then press [+Z/DEF] key once. The Ovrd instruction is input.
9	[−C (J6) 0 SP]	〈PROGRAM〉 1 1 OVRD ␣ ␣ ABC CLOSE	Insert a space before inputting "80". Press the [-C/SP] key. A space " " is input.
10	[CHARACTER] [−B (J5) 8 TUV] [−C (J6) 0 SP]	〈PROGRAM〉 1 1 OVRD ␣ ␣ 123 CLOSE	Press the [CHARACTER] key and change the display at the center bottom of the screen to "123". "123" indicates the Numeral Input mode. Press the [8] and [0] keys. "80" is input.
11	[EXE]	〈PROGRAM〉 1 1 Ovrd 80 EDIT DELETE 123 INSERT TEACH ⇒	Press the [EXE] key. "1 Ovrd 80" is finalized, and the program proceeds to the next step (Step 2).

Pick Up!

Step number

· Inputting the step number is not necessary (A step number is automatically numbered).

Inputting numbers and characters

· Switch between the number input and character input models by pressing the [CHARACTER] key. The number input mode is active when "123" is displayed at the center bottom of the screen, and the character input mode is active when "ABC" is displayed. The mode alternates with each press of the [CHARACTER] key.

· The number keys are displayed at the lower right of each key. (Number, – (minus), . (decimal point).
The character keys show three or four characters each on the lower right of the key.
Each time the key is pressed, the display will alternate between the several characters shown on the key.
To finalize the character, press another character key or press the "→" key.

· Characters that are not shown on the key can be input. The keys assigned to the hidden characters and the characters that can be input with that key are shown below.

a) [‘ ( )] key .... ' → (→) → " → ^→ : → ; → \ → ?
b) [@ =] key......................... @ → = → + → – → * → / → < → >
c) [, %] key........................... , → % → # → $ → ! → & → _ → .

When an incorrect syntax of the command or characters that cannot be used are used, an error (such as L4220) occurs.

(2) Deleting characters

Step	Operation	T/B screen	Explanation of Operation
1	CLEAR	〈PROGRAM〉 1 3 Mov P 10 ABC CLOSE ⇒	Move the cursor above the character to be deleted. When the [CLEAR] key is pressed, that character is deleted and the characters to the right of the cursor are shifted to the left.

(3) Displaying the previous and next program line

Step	Operation	T/B screen	Explanation of Operation
1	↓	〈PROGRAM〉 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	The highlight moves to the next line when the [↓] is pressed.
2	↑	〈PROGRAM〉 1 50% 1 Ovrd 80 2 Hopen 1 3 Mov P1 4 Mov P10+P2 EDIT DELETE 123 INSERT TEACH ⇒	The highlight moves to the previous line when the [↑] is pressed.

(4) Displaying a specific program line

Step	Operation	T/B screen	Explanation of Operation
1	FUNCTION	〈PROGRAM〉 1 50% 1 Ovrd 80 2 Hopen 1 3 Mov P1 4 Mov P10+P2 FWD JUMP 123 BWD ⇒	Press the [FUNCTION] key and display "JUMP" at the function menu at the bottom of the screen.
2	F2 7 PQRS	〈PROGRAM〉 1 STEP (7) 123 No	Press the [F2] key ("JUMP") to display the Step No. input screen. Input the number of the step to call out (i.e., 7th step).
3	EXE	〈PROGRAM〉 1 50% 6 Dly 0.3 7 EHClose 1, 100, 100 8 Dly 0.5 9 Mov P10+P2 123 CLOSE ⇒	Press the [EXE] key to finalize the input. The 7th step of the program appears at the 2nd line.

(5) Adding a program line

Step	Operation	T/B screen	Explanation of Operation
1	↑ ↓	<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	In this example, one line will be added between Step 4 and Step 5. Press the [↓] and [↑] keys to move the cursor to Step 4.
2	F3	<PROGRAM> 1 50% _ 123 CLOSE	Press the [F3] key ("INSERT") to activate the Insert Line mode. * If "INSERT" does not appear in the function menu at the bottom of the screen, press the [FUNCTION] key and display "INSERT".
3	Number key Character key	<PROGRAM> 1 50% Wait M_In(8)=1 ABC CLOSE	Input the instruction.
4	EXE	<PROGRAM> 1 50% 5 Wait M_In(8)=1 6 Mvs P10 7 Dly 0.3 8 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Press the [EXE] key to finalize the line. The input program line is arranged in step order, and the cursor moves to the next line. The step numbers are also reassigned.

(6) Correcting the program line

Step	Operation	T/B screen	Explanation of Operation
1	↑ ↓	<PROGRAM> 1 50% 5 Wait M_In(8)=1 6 Mvs P10 7 Dly 0.3 8 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Press the [↓] and [↑] keys to move the cursor to the step to be corrected.
2	F1	<PROGRAM> 1 50% Wait M_In(8)=1 ABC CLOSE	Press the [F1] key ("EDIT") to activate the Edit Line mode. * If "EDIT" does not appear in the function menu at the bottom of the screen, press the [FUNCTION] key and display "EDIT".
3	Arrow key CLEAR key	<PROGRAM> 1 50% 5 Wait M_In(10)=1 123 CLOSE	Edit (correct) the instruction.
4	EXE	<PROGRAM> 1 50% 5 Wait M_In(10)=1 6 Mvs P10 7 Dly 0.3 8 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Press the [EXE] key to finalize the changes. The program line is corrected.

(7) Deleting a program line

Step	Operation	T/B screen	Explanation of Operation
1	↑ ↓	<PROGRAM> 1 50% 5 Wait M_In(8)=1 6 Mvs P10 7 Dly 0.3 8 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	Press the [↓] and [↑] keys to move the cursor to step to be deleted.
2	F2	<PROGRAM> 1 5 Wait M_In(10)=1 DELETE OK? Yes 123 No	Press the [F2] key ("DELETE"). The step to be deleted appears with the confirmation message "xxx will be deleted. Okay?"
3	F1	<PROGRAM> 1 50% 4 Mov P10+P2 5 Mvs P10 6 Dly 0.3 7 EHClose 1, 100, 100 EDIT DELETE 123 INSERT TEACH ⇒	When the [F1] key ("YES") is pressed, that step is deleted.

<<MEMO>> * Use this page to write down notes.

Appendix 2: RT ToolBox3 Simulation Function

Appendix 2.1 Creating a workspace and project

Create a workspace and project by referring to "Chapter 2: How to use RT ToolBox3 2.3 Creating a new project".

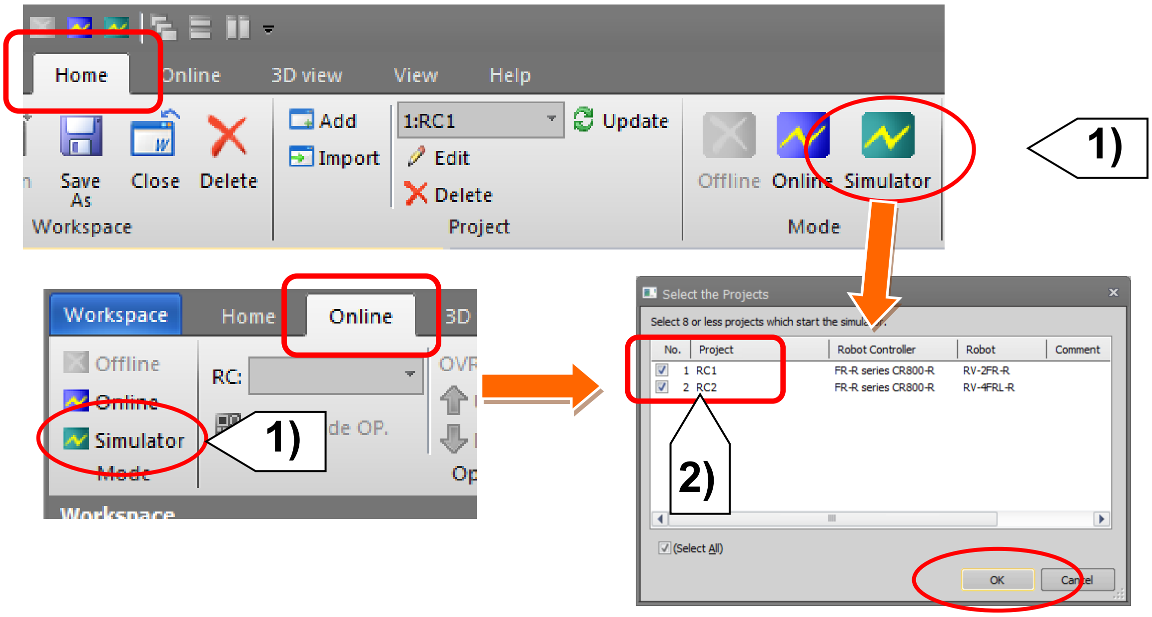
Appendix 2.2 Simulation function

(1) Starting the simulator

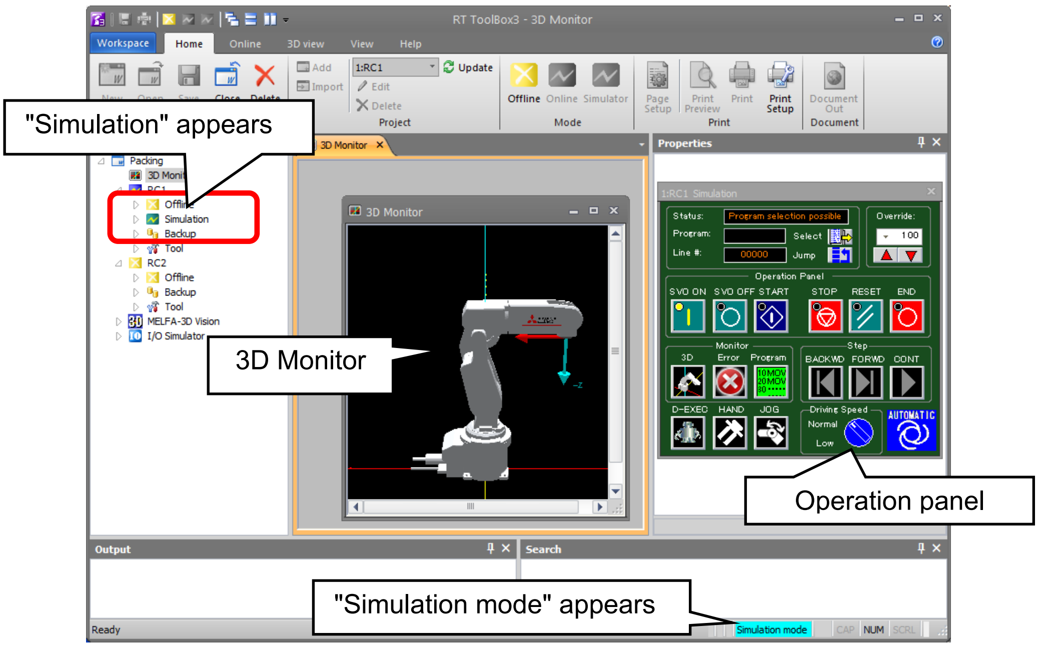
(1-1) Start the simulator.

1) Click [Simulator] on the [Home] tab in the ribbon, or in the [Mode] group in the [Online] tab.

2) If there are multiple projects, then "Select the Projects" window will display. Select the project for which the simulation is to be performed, then click "OK".

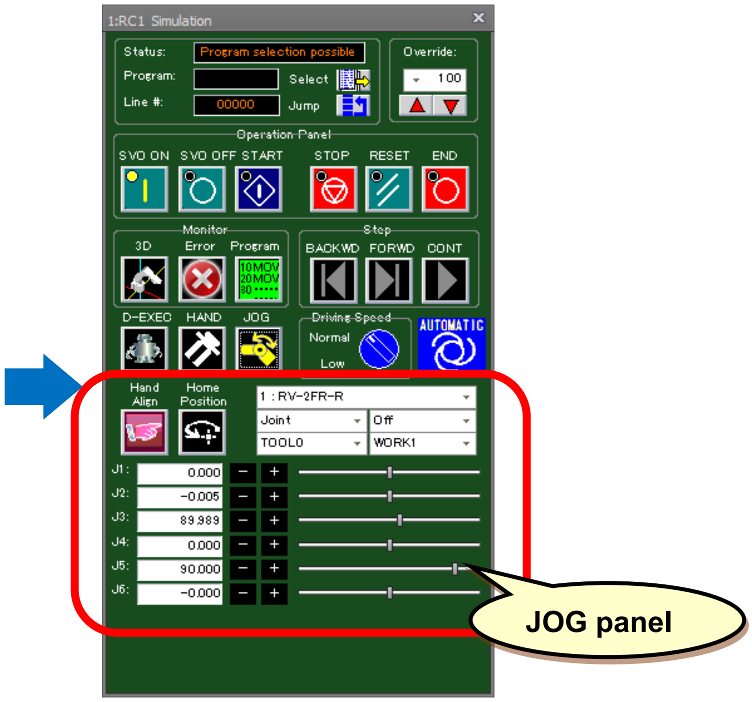


3) "Simulation" is displayed in the project tree, and the simulator starts.

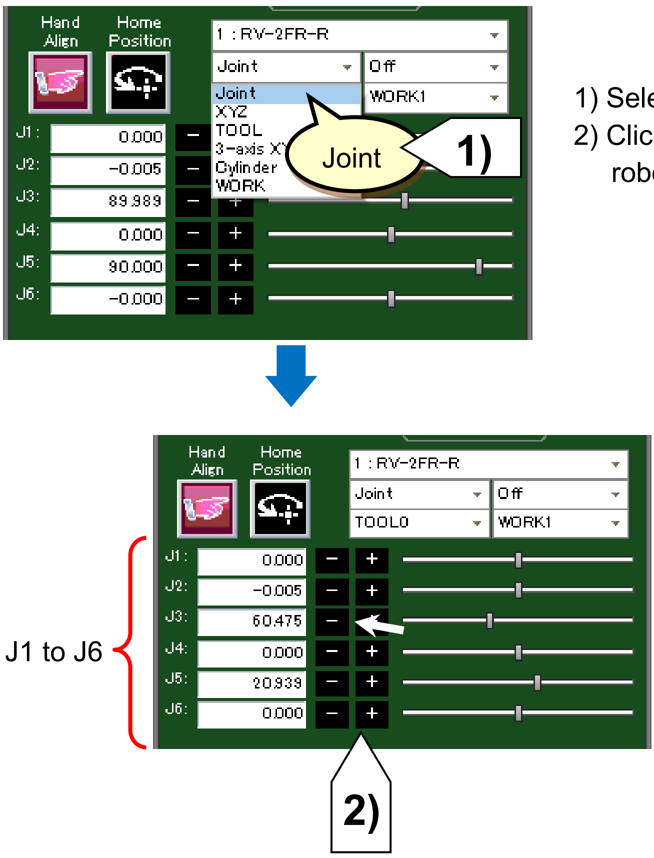


(2) JOG operation

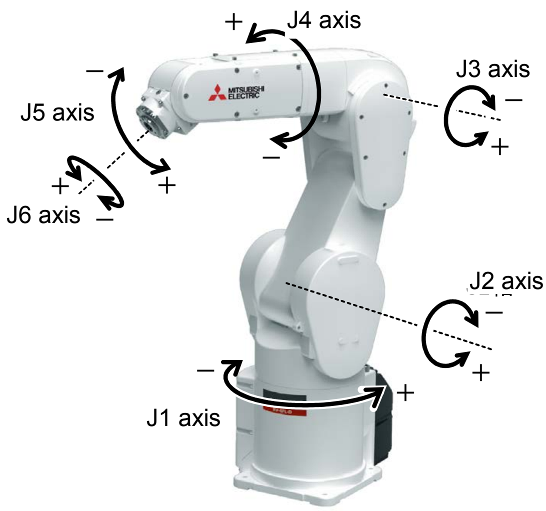
(2-1) Click the "JOG" button to open the JOG panel.



(2-2) Check the operation in the Joint JOG mode.

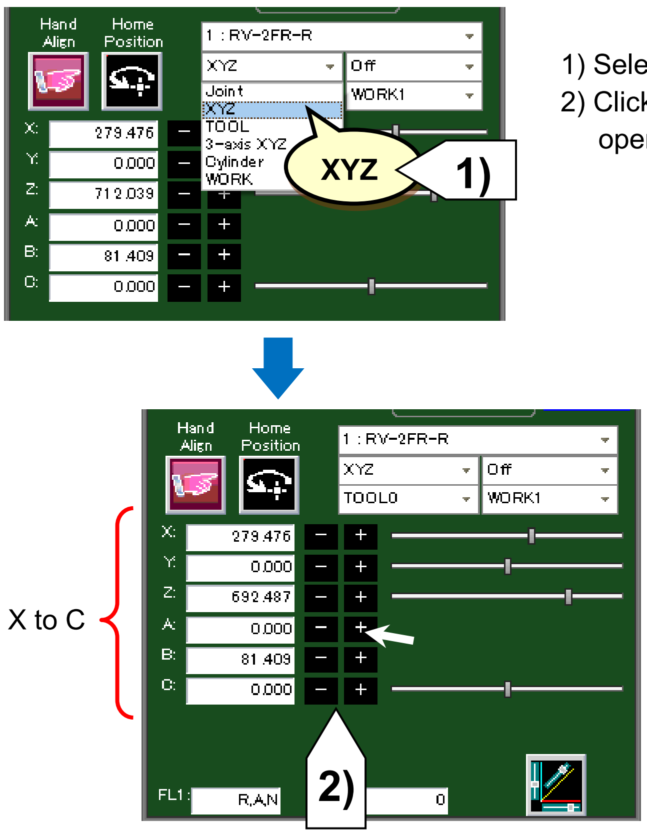


1) Select "Joint" for JOG mode.
2) Click [-] or [+] for J1 to J6, and check that the robot operates.

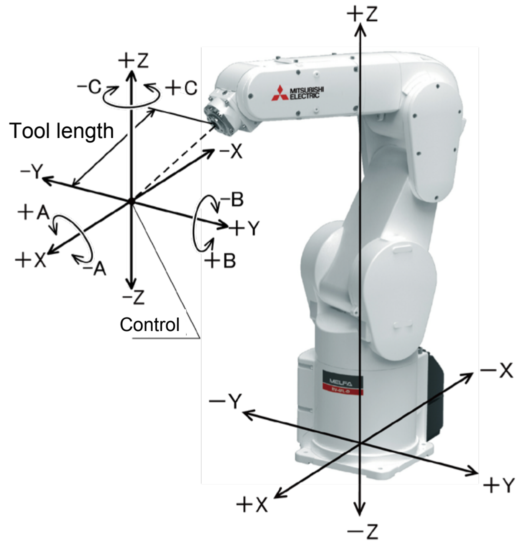


Joint JOG mode
(For the RV type)

(2-3) Check the operation in the XYZ JOG mode.

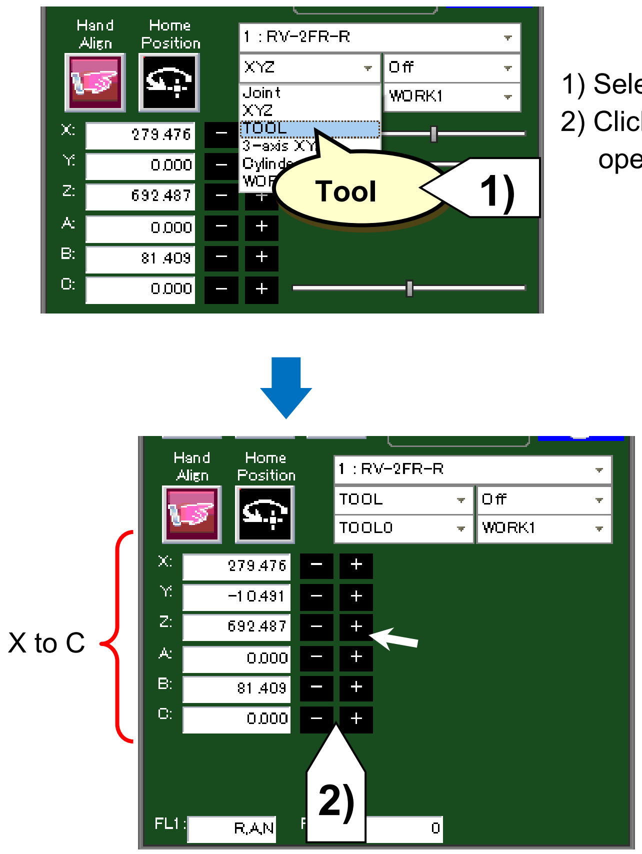


1) Select "XYZ" for JOG mode.
2) Click [-] or [+] for X to C, and check that the robot operates.

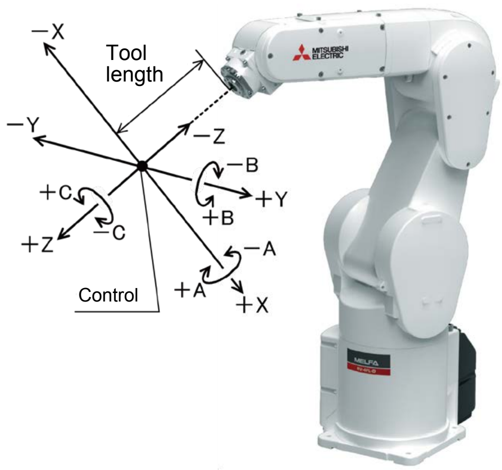


XYZ JOG mode
(For the RV type)

(2-4) Check the operation in the TOOL JOG mode.



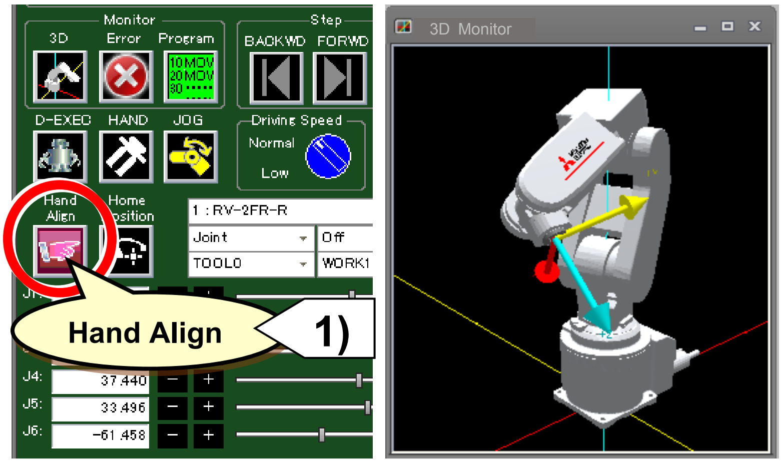
1) Select "TOOL" for JOG mode.
2) Click [-] or [+] for X to C, and check that the robot operates.



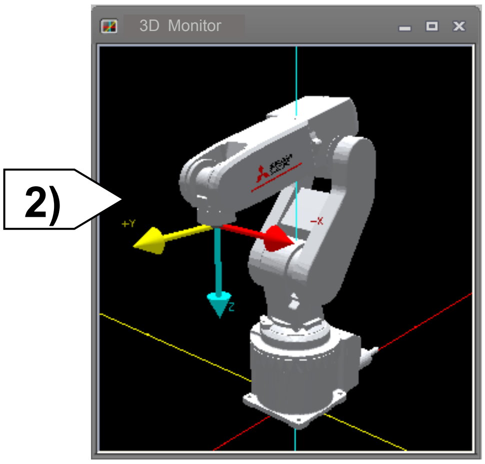
TOOL JOG mode
(For the RV type)

(3) Hand alignment

(3-1) Check the hand alignment operation (correct the robot posture).



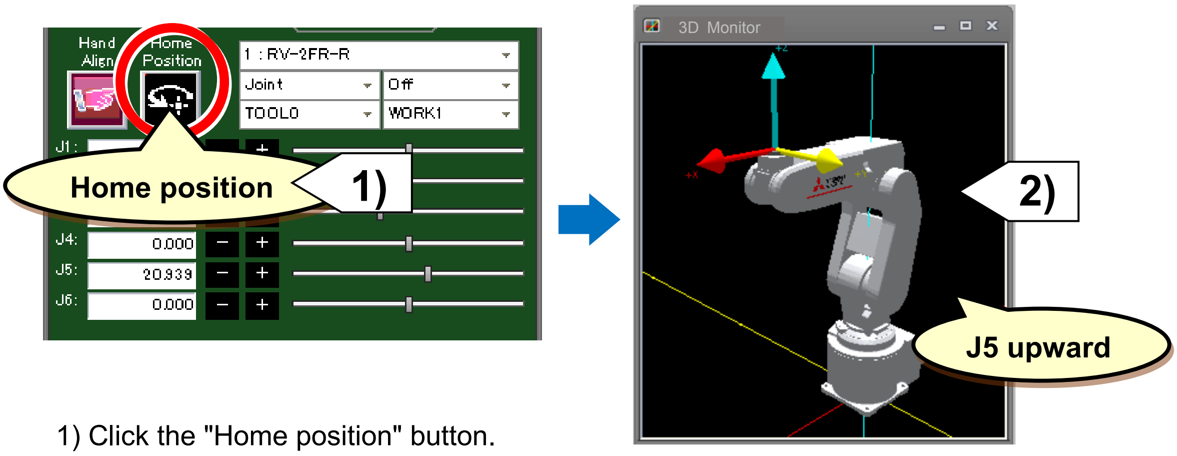
1) Click the "Hand Align" button.



2) The hand moves to the closest posture in increments of 90 degrees.
If the hand almost faces the side, it completely turns to the side. If the hand almost faces upward, it completely turns upward.

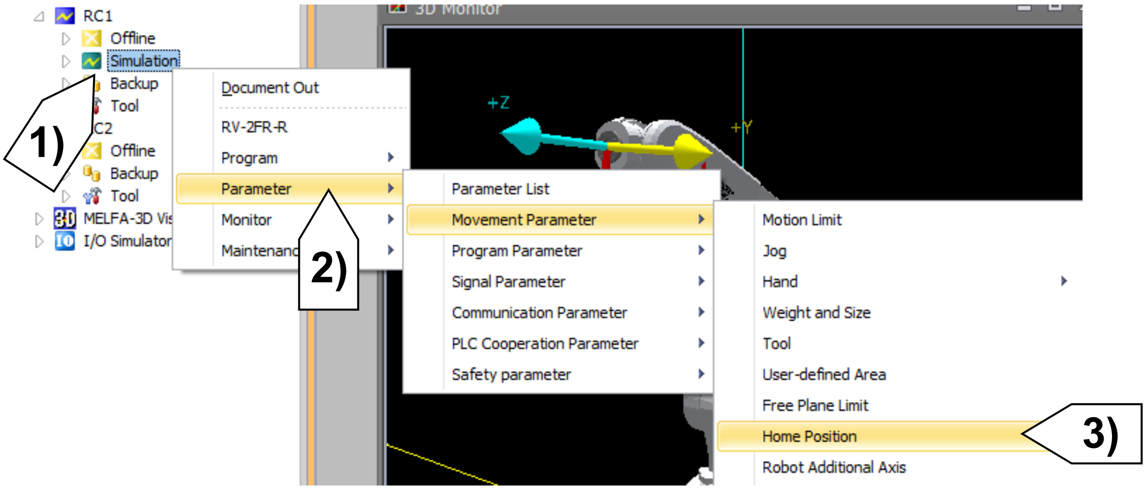
(4) Home position

(4-1) Return to home position.

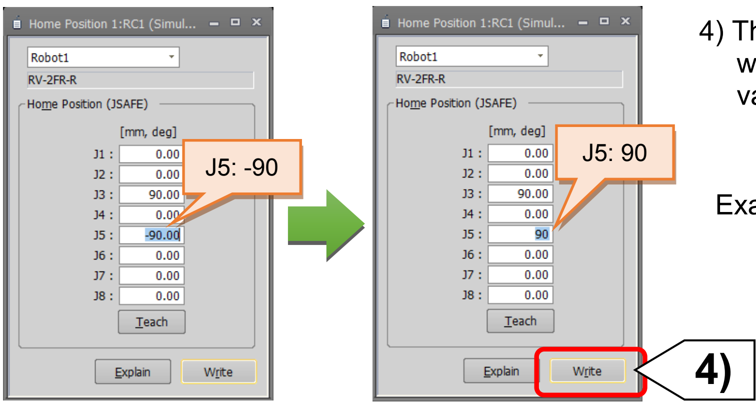


1) Click the "Home position" button.
2) Move to (J1, J2, J3, J4, J5, J6) = (+0.00, +0.00, +90.00, +0.00, -90.00, +0.00) set in the parameter "JSAFE".

(4-2) Changing the home position.

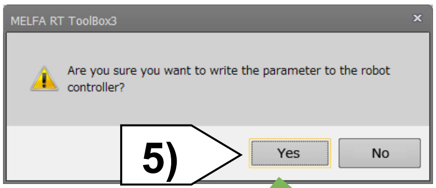


1) Right-click [Simulation] in the project tree to display the sub menu.
2) Move the cursor to [Parameter] to display another sub menu, then move the cursor to [Movement Parameter].
3) In the same way as above select [Home Position] in the displayed menu. click [Home Position]



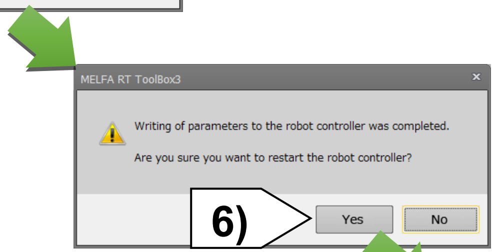
4) The Home Position Parameter window will display. Change the values and click [Write].

Example) Changing the J5 axis value from "-90" to "+90"

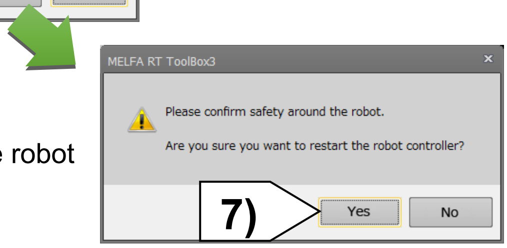


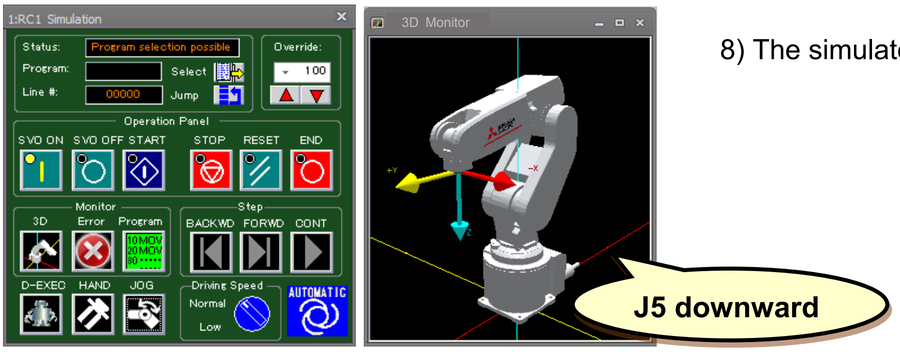
5) Are you sure you want to write the parameter to the robot controller? → "Yes"

6) Are you sure you want to restart the robot controller? → "Yes"



7) Are you sure you want to restart the robot controller? → "Yes"





Posture after restart

8) The simulator restarts.

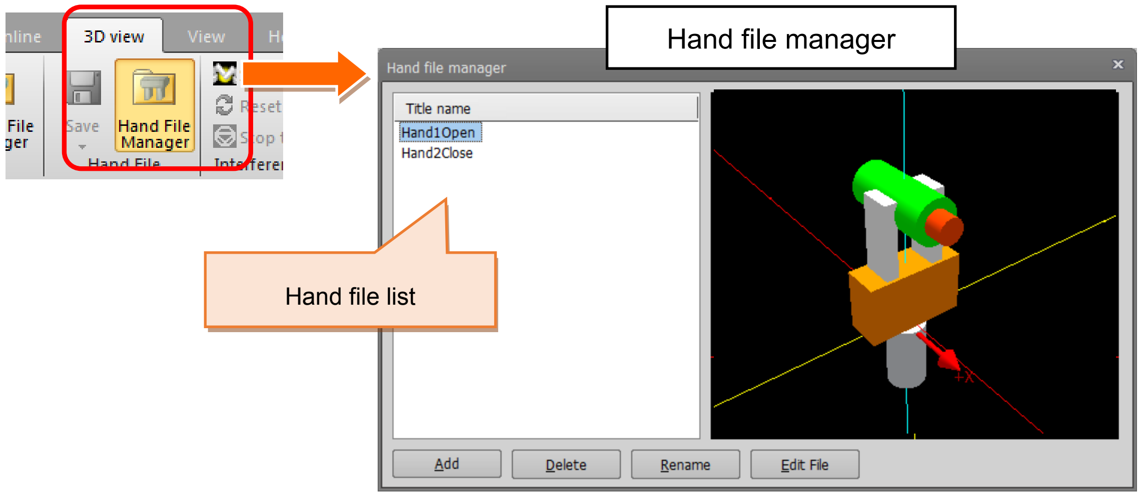
(5) Creating a hand

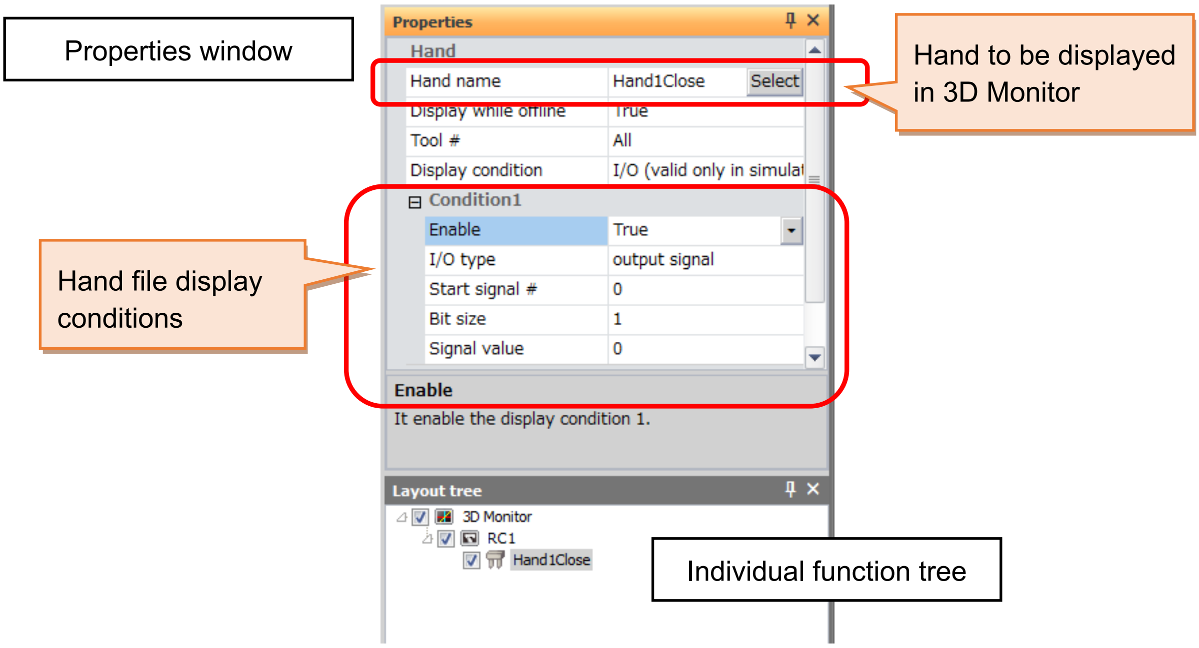
Display the hand in robot tool in the 3D Monitor. The hands to be displayed can be switched depending on the signal status.

<Hand File Manager window>

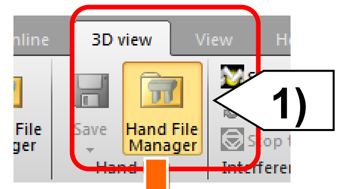
Clicking [Hand File Manager] in the [Hand File] group in the [3D View] tab displays the "Hand file manager" window and a list of hands registered in this workspace.

Set the hand to be displayed in the 3D Monitor and the hand display conditions in the Properties window.



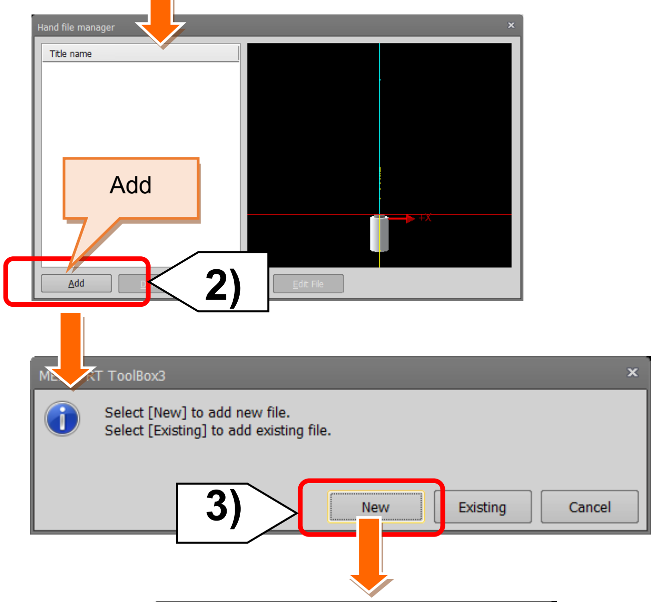


(5-1) Create a hand file.

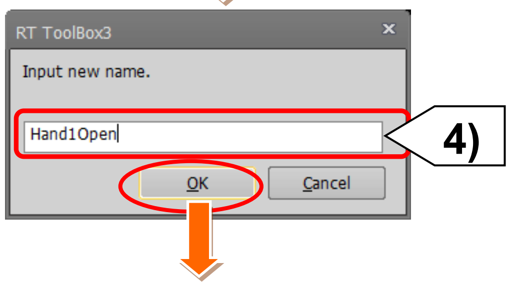


1) Click [Hand file manager] in the [3D view] tab to display the "Hand file manager" window.

2) Click "Add".

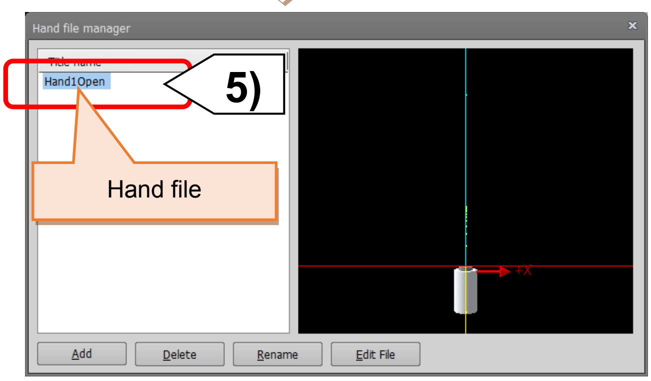


3) To create a new layout file, select [New]. (To correct the existing file, select [Existing].)



4) Input the file name, and click [OK].

5) Hand file created.

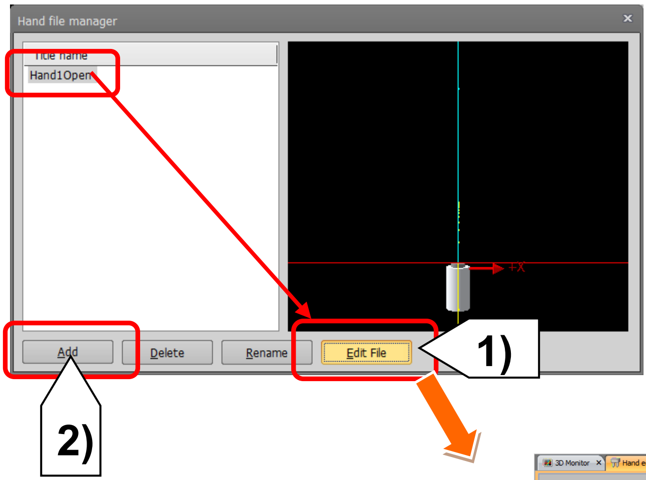


(5-2) Creating hand component parts.

There are four types of 3D parts that can be set as hands: cuboids, cylinders, spheres, and 3D models.

· Cuboids, cylinders, spheres: Specify the size in RT ToolBox3.

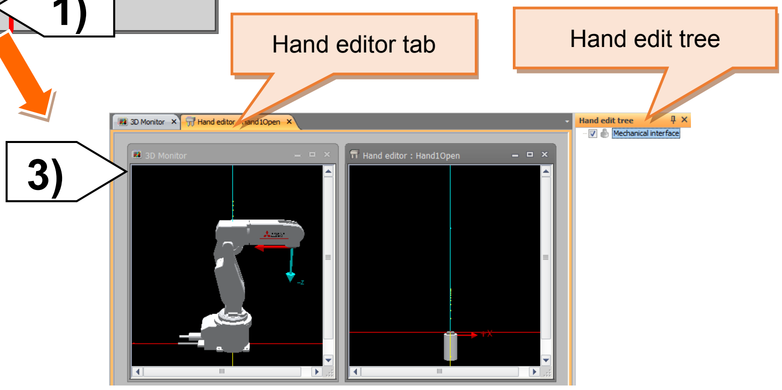
· 3D models: Read data created in CAD beforehand.
Readable formats include STL (Stereolithography), OBJ (Wavefront format), etc.

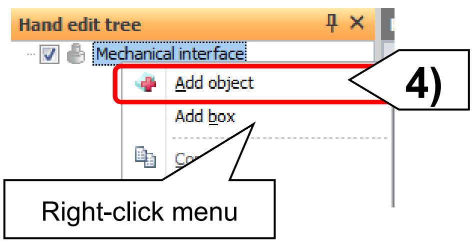


1) Select the hand file to be edited, and click [Edit file] in the Hand file manager window.

2) To create a new file, click [Add].

3) The Hand editor tab and Hand edit tree will display.

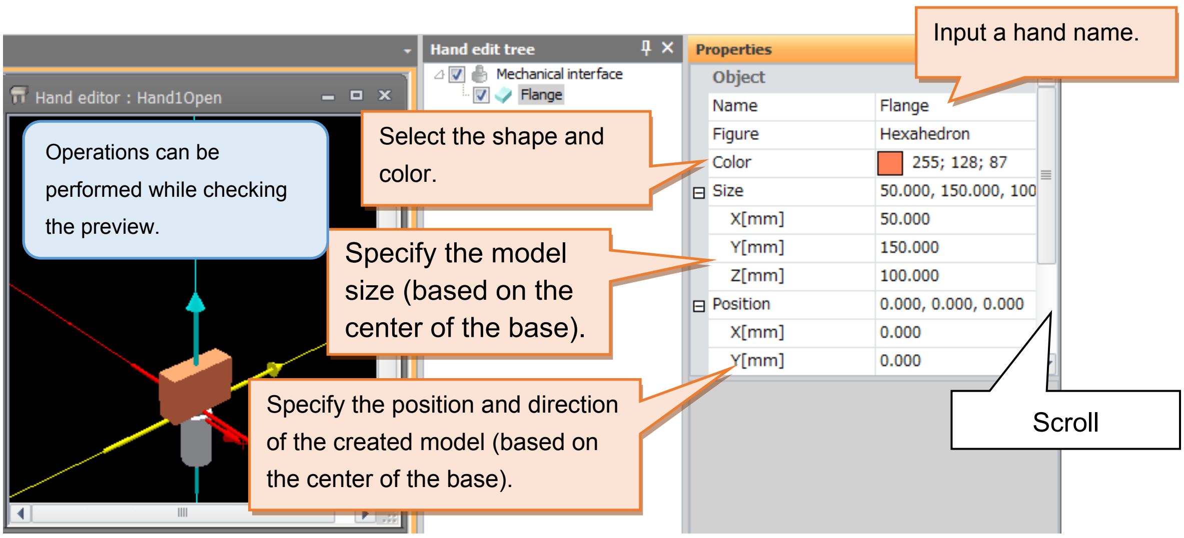




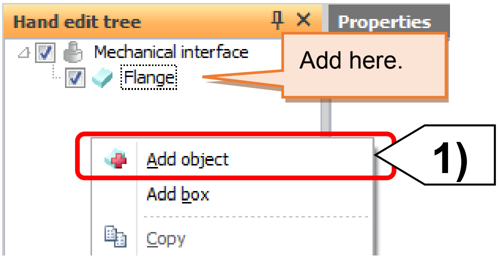
4) Set the shapes of the 3D parts in the Properties window.

5) Right-click [Mechanical interface] in [Hand edit tree] to display the menu and click [Add object].

6) Input shapes and positions of the 3D parts in the Properties window.

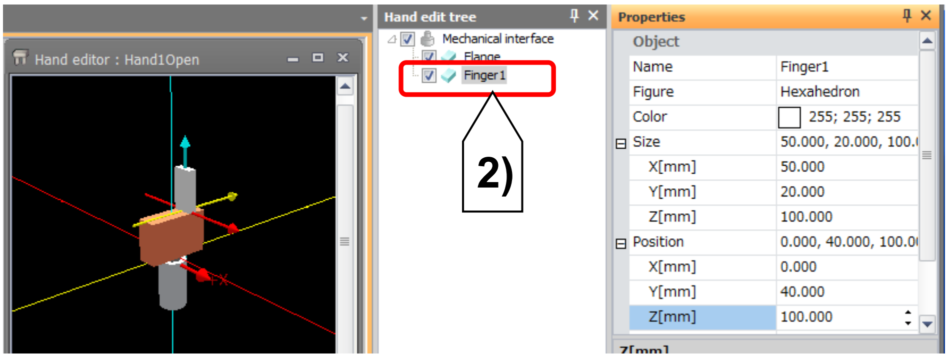


(5-3) Adding parts to the hand.

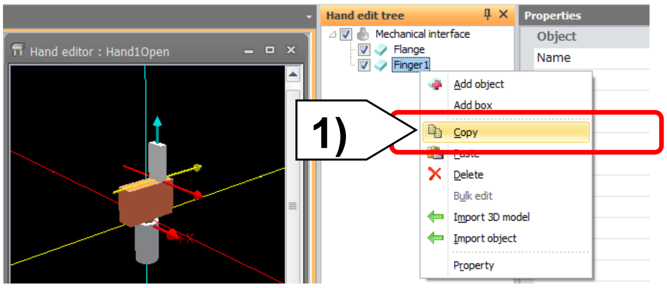


1) Right-click [Mechanical interface] in [Hand edit tree] to display the menu and click [Add object].

2) Select the parts added in [Hand edit tree], and input 3D part information in the Properties window.



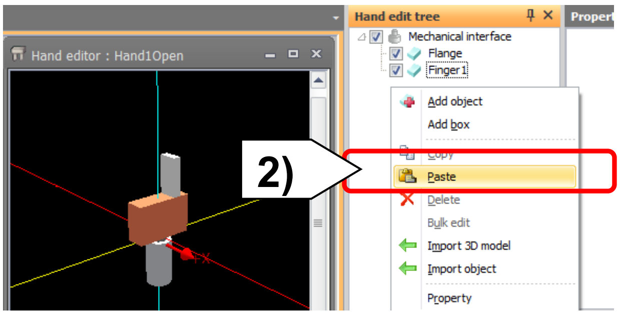
(5-4) Copy an existing hand part to create a new part.

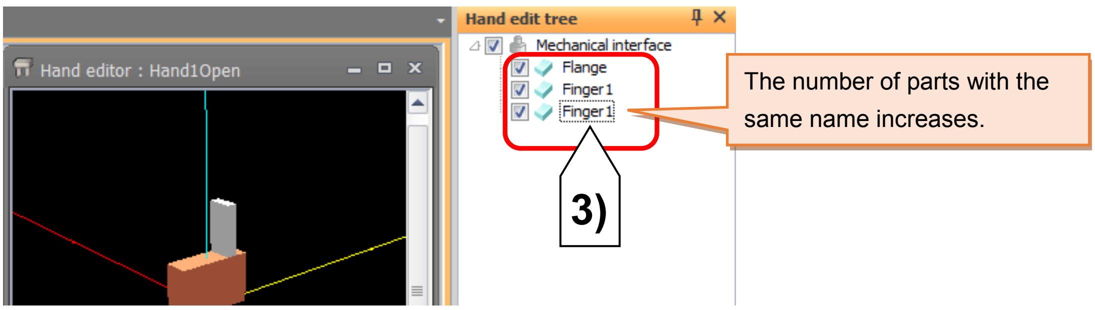


1) Select the parts to be copied in [Hand edit tree] then right-click and select Copy.

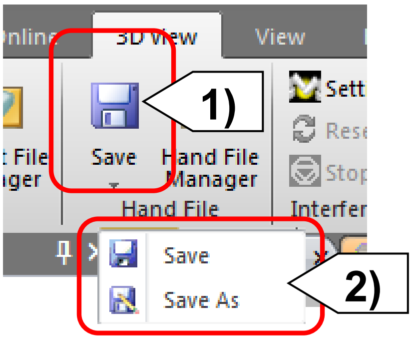
2) Click [Paste].

3) A part with the same name is added. Input the part information in the Properties window.



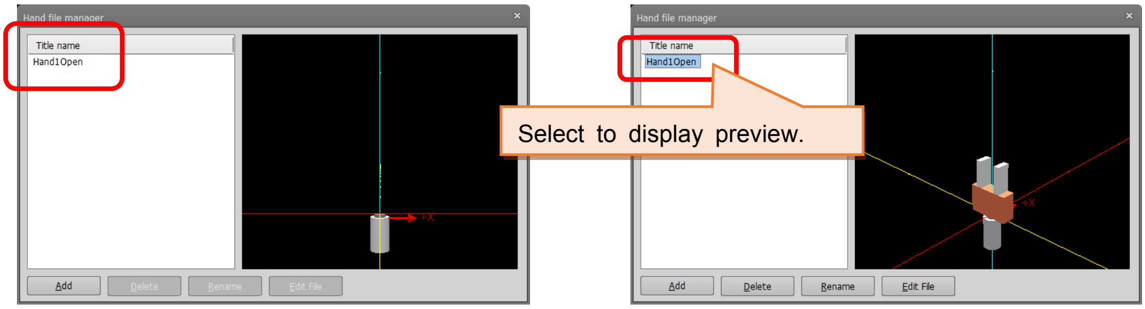


(5-5) Save the hand settings file.



1) Click [Save] in the [Hand File] group in the [3D view] tab.
2) A popup is displayed. Click "Save" or "Save as".

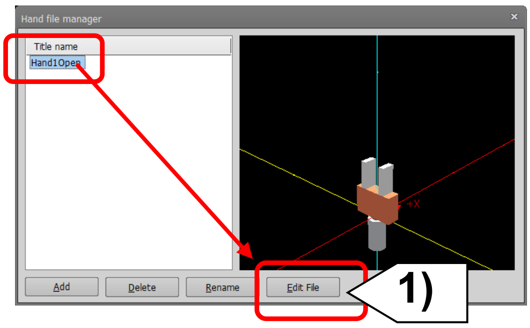
3) The hand file saved in the Hand file manager window will display in the Title name field.
4) Selecting the hand file in the Title name field displays the hand in the preview area.

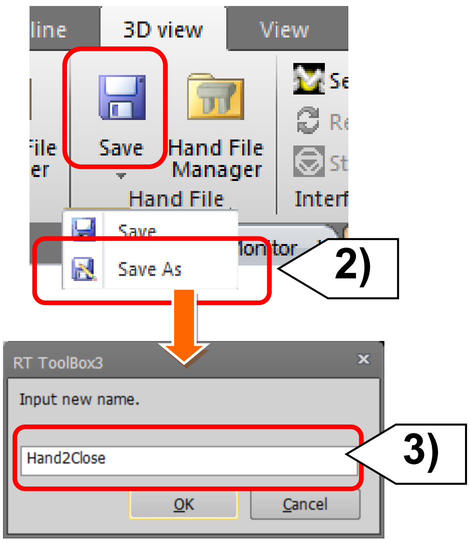


Hand file manager window

(5-6) Copy the hand setting file to create a new hand setting file.

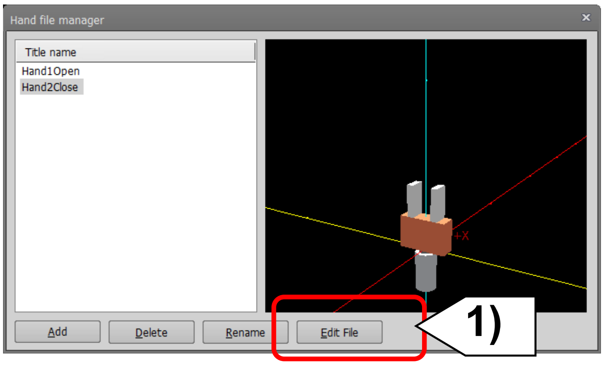
1) Click [Edit file] to open the hand setting file to be copied in the Hand file manager window.
2) Click [Save] in the [Hand File] group in the [3D view] tab.
3) A pop-up is displayed. Click "Save as" and input a file name.



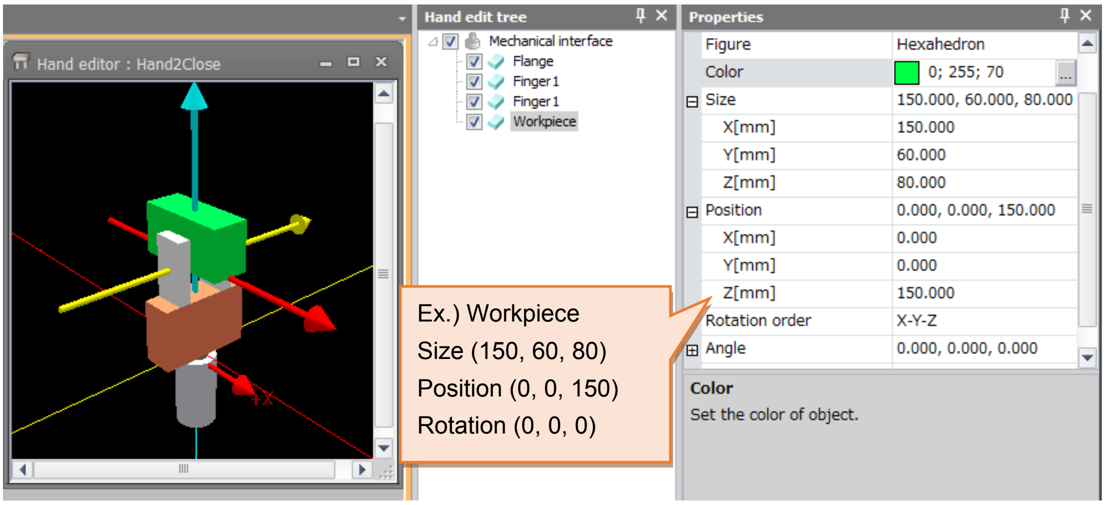


(5-7) Changing the hand to a hand holding a workpiece (hand closed).

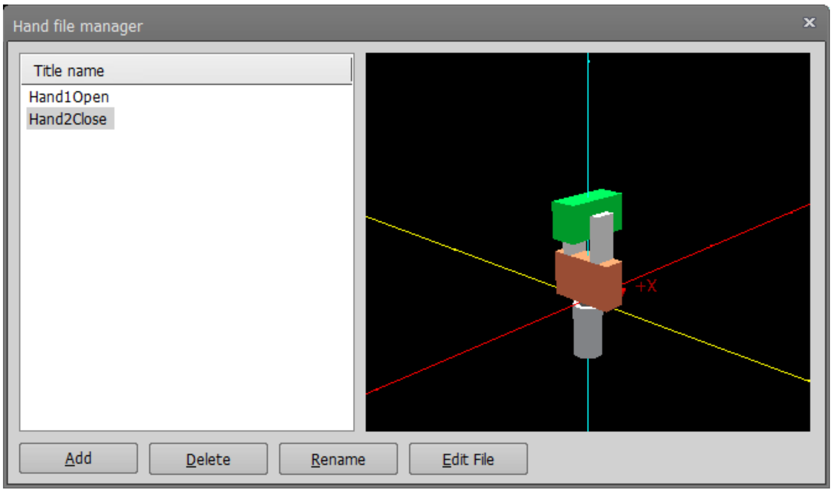
1) Select the hand file, and click [Edit file] in the Hand file manager window.



2) Add a new part (workpiece).



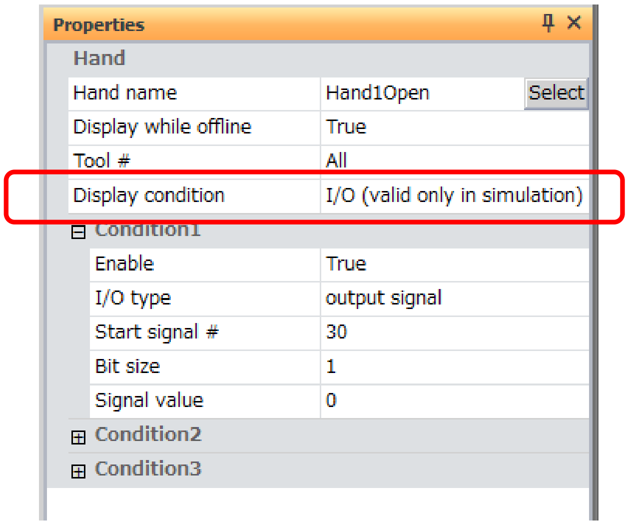
3) Save the settings.



(6) Hand display condition setting

By setting the hand display conditions, the hand can be displayed only when the I/O status or the tool with which the specified target hand file is selected.

When "I/O (Valid Only in Simulation)" is selected for [Display condition] in the "Display condition" field of "Hand" in the Properties window, the condition setting field is displayed.



<Display condition>

Specify the I/O conditions to display the target hand file. These conditions are valid only during simulation.
If no I/O condition is specified, select [Default], and if I/O conditions are specified, select [I/O (Valid Only in Simulation)].

When [I/O (Valid Only in Simulation)] is selected, items of [Condition 1] to [condition 3] are displayed and up to three I/O conditions can be specified. When all the conditions are satisfied, the hand file is displayed.

1) In Enable option select [True] only for the number of I/O conditions to be set. Selecting [True] here enables the settings of the following conditions.

2) I/O type

Specify the I/O type.

3) Start signal #

Specify the I/O Start number.

4) Bit size

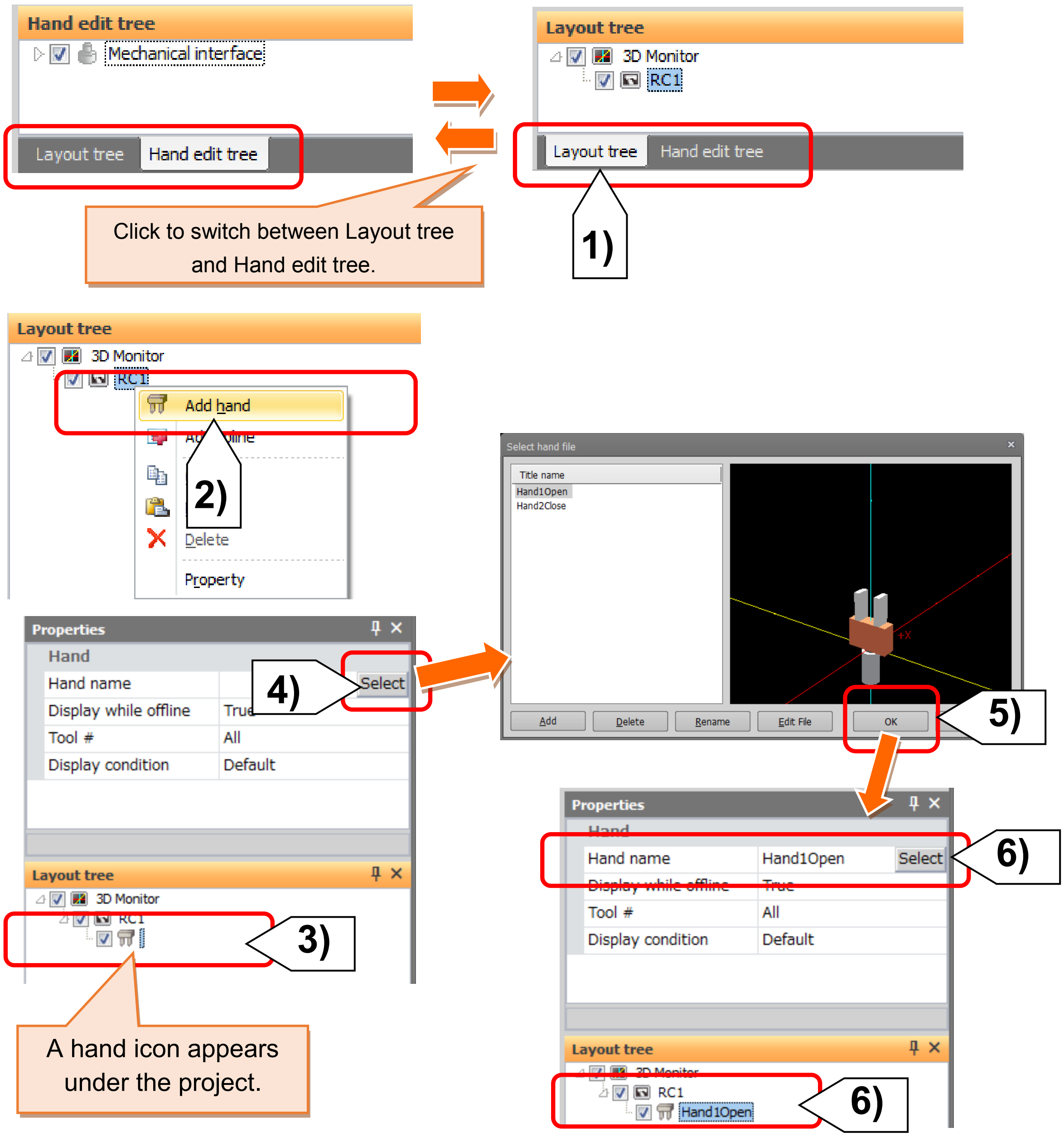
Specify the number of bits (number of registers) from the I/O start signal.

5) Signal value

Specify the numeric values to be compared with the I/O status.

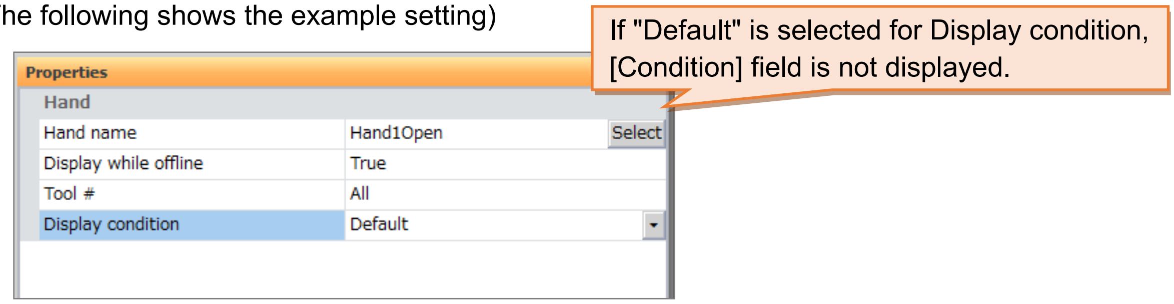
(6-1) Registering the hand in the workspace.

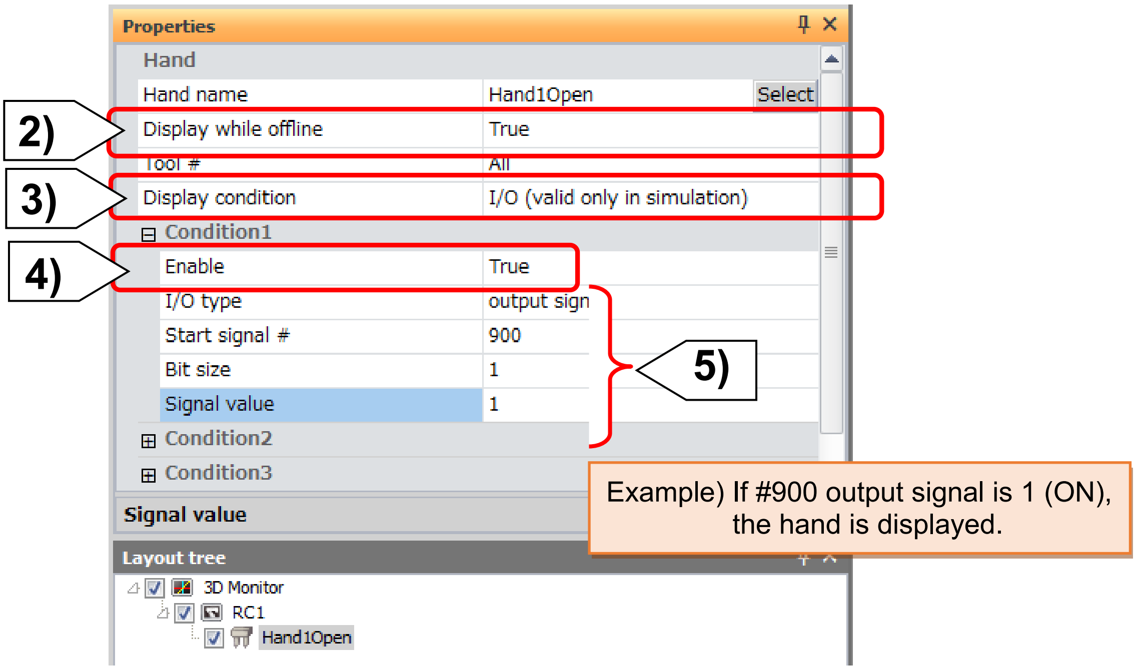
1) Switch [Hand edit tree] to [Layout tree].
2) Select the project in which the hand is registered in [Layout tree], and click "Add hand" in the right-click menu.
3) A hand icon is added under the project in [Layout tree].
4) In the [Properties] window, click "Select" in the field [Hand name].
5) The Select hand file window will display, Select the hand file and click "OK"
6) The selected hand file name is displayed in [Hand name] in the [Properties window] and in [Layout tree].

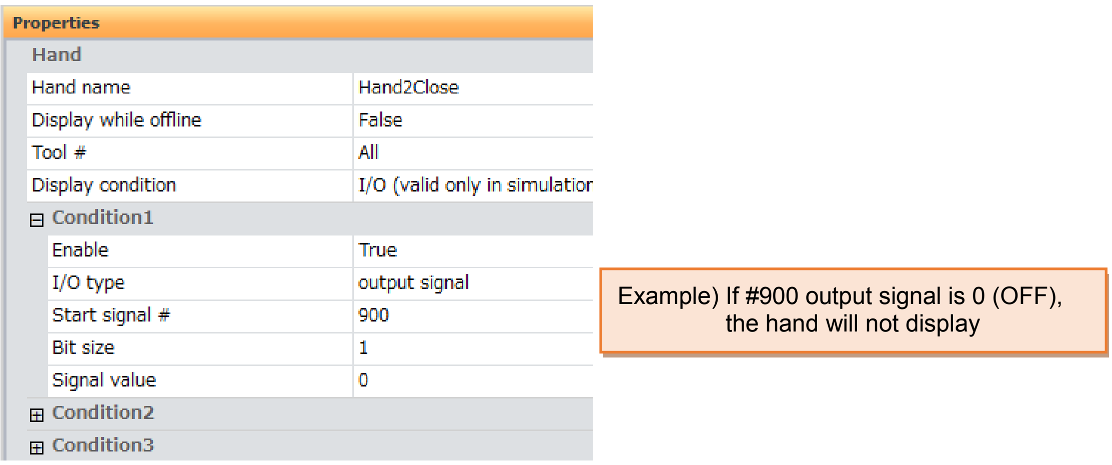


(6-2) Setting the display conditions for the hand.

1) Select the hand in [Layout tree]. Properties of the hand are displayed in the [Properties] window.
2) To display the hand on the 3D Monitor, select "True" in [Display while offline] option
3) Select "I/O (Valid Only in Simulation)" in [Display condition] option
4) Select "True" in [Enable] option(for not required)
5) Signal setting items will display. Input the hand display conditions.
(The following shows the example setting)





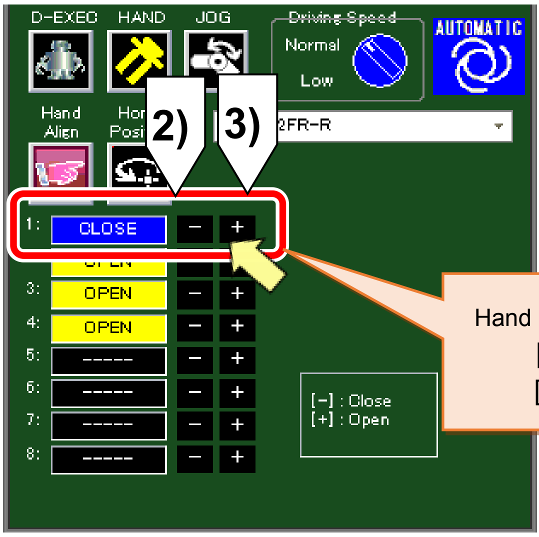


(7) Hand open/close operation

(7-1) The hand open/close operation can be checked in the operation panel

1) Click the "HAND" button in the operation panel to display the Hand Operation panel.

Operation panel

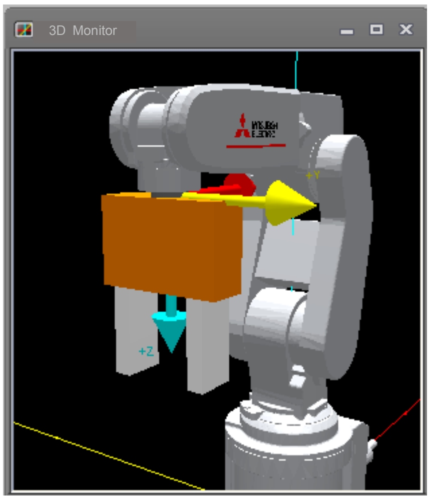


Use [-] and [+] of hand 1 (number on the far left) to switch the hand display on the 3D Monitor.

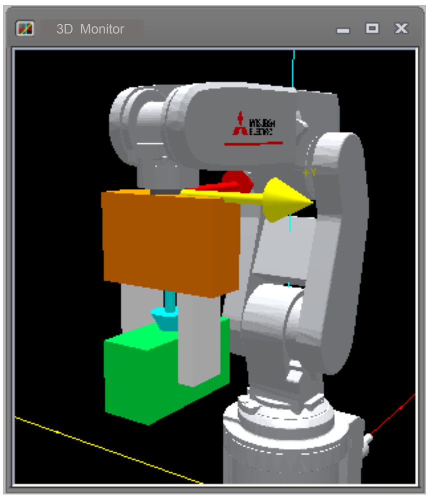
2) Click [-] to display the closed hand (with workpiece).

3) Click [+] to display the open hand (without workpiece).

Hand Operation panel
[-]: Close
[+]: Open



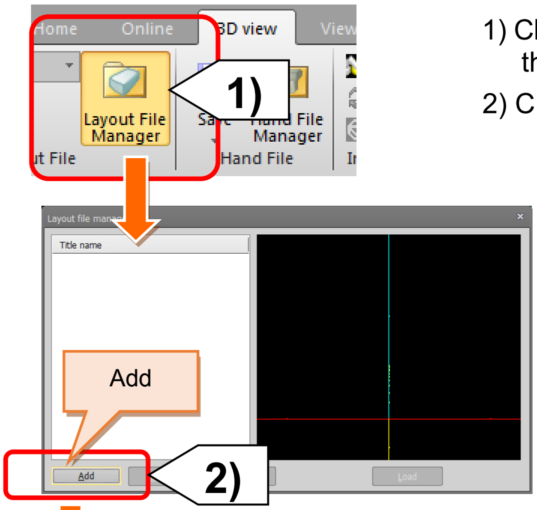
[+]: Open



[-]: Close

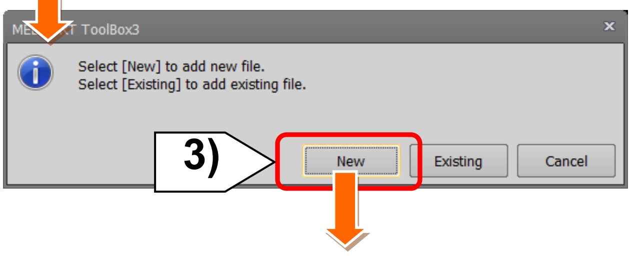
(8) Creating a layout

(8-1) Create a layout file.

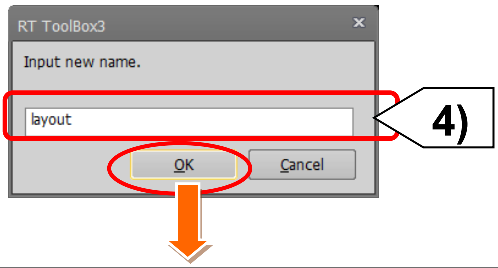


1) Click [Layout File Manager] in the [3D view] tab to display the "Layout file manager" window.

2) Click "Add".

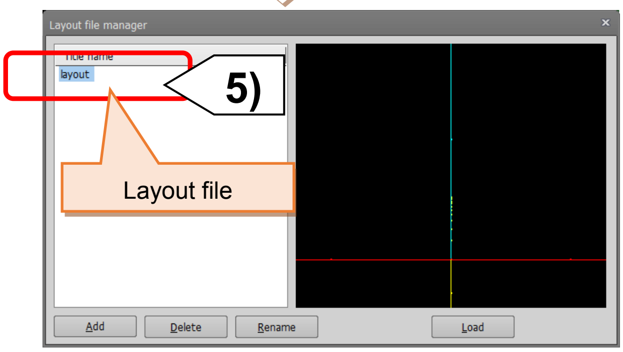


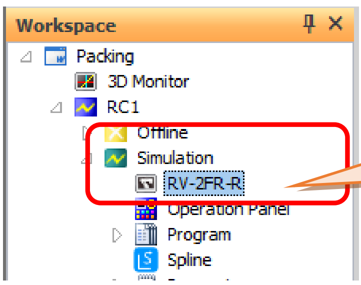
3) To create a new layout file, select [New].
(To correct the existing file, select [Existing].)



4) Input the file name, and click [OK].

5) The layout file is created.

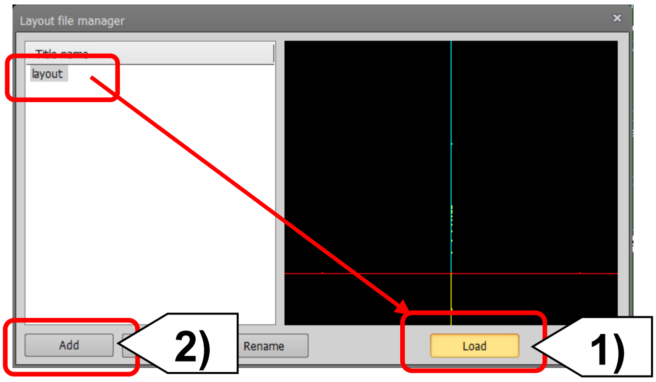




If the 3D Monitor is not displayed, double-click the robot name under "Simulation" in the project tree.

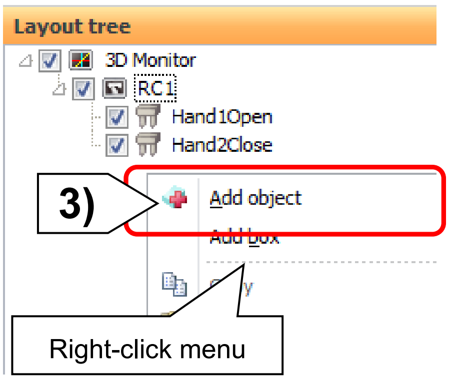
(8-2) Create layout component parts.

There are four types of 3D parts that can be set as layouts: cuboids, cylinders, spheres, and 3D models.
· Cuboids, cylinders, spheres: Specify the size in RT ToolBox3.
· 3D models: Read data created in CAD beforehand.
Readable formats include STL (Stereolithography), OBJ (Wavefront format), etc.



1) Select the layout file to be edited, and click [Load] in the Layout file manager window.

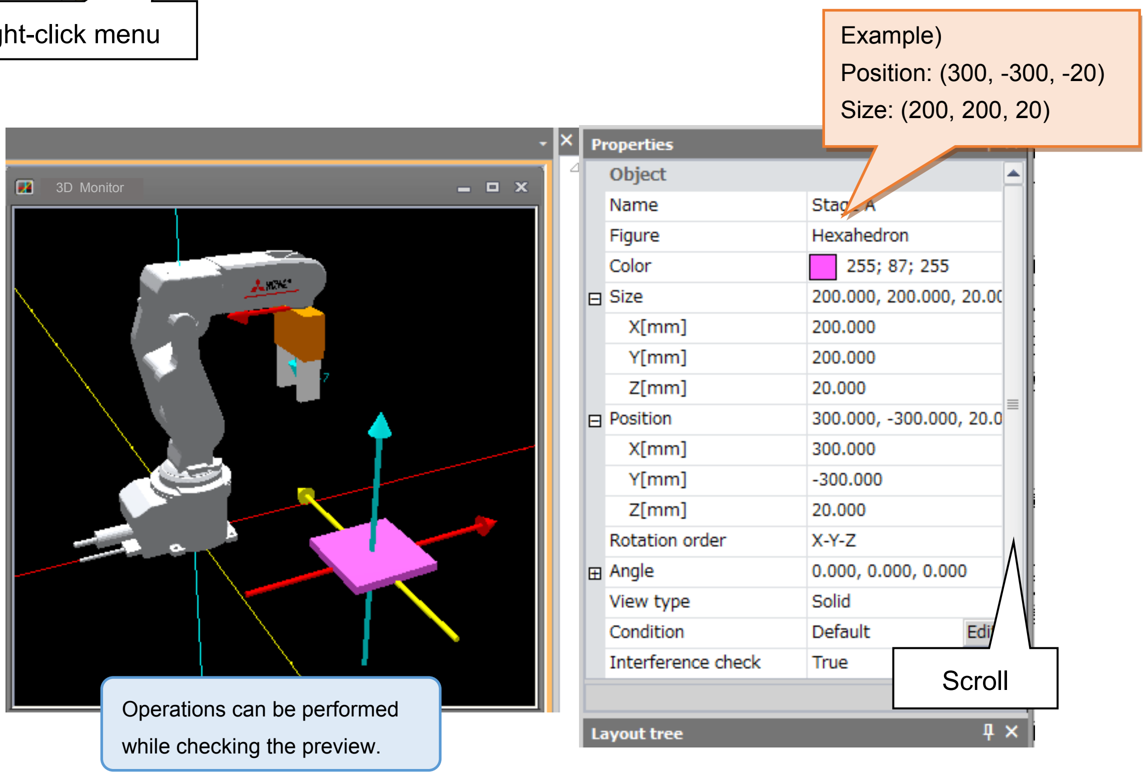
2) To create a new layout, click [add].



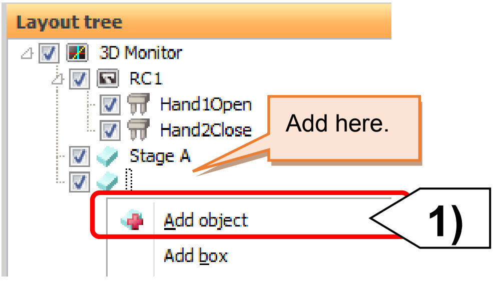
3) Set the shapes of the 3D parts in the Properties window.

4) Right-click in [Layout tree] to display the menu and click [Add object].

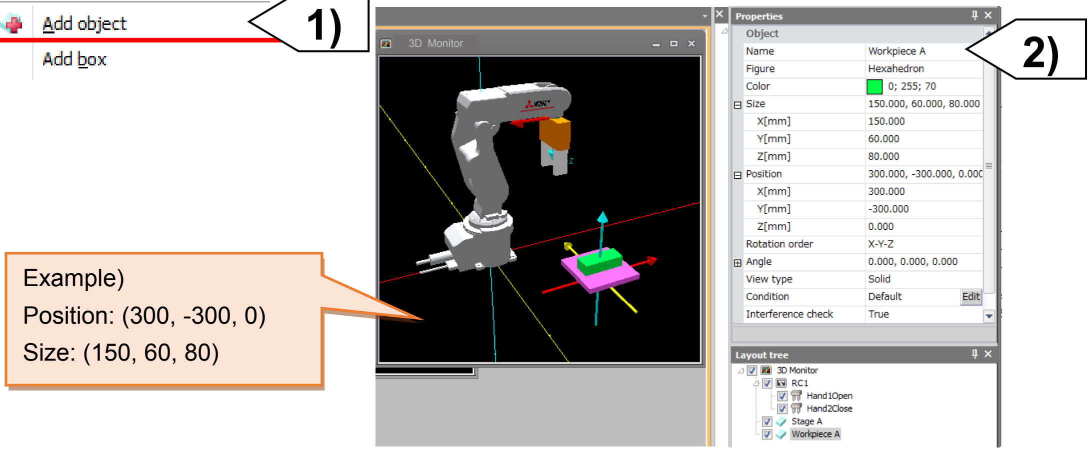
5) Input shapes and positions of the 3D parts in the Properties window. The procedure is the same as when creating a hand.



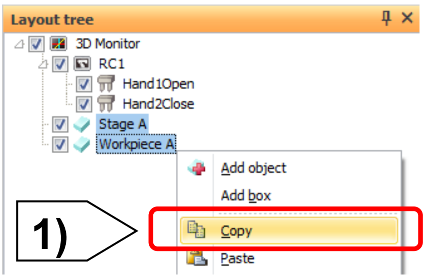
(8-3) Adding parts to the layout.



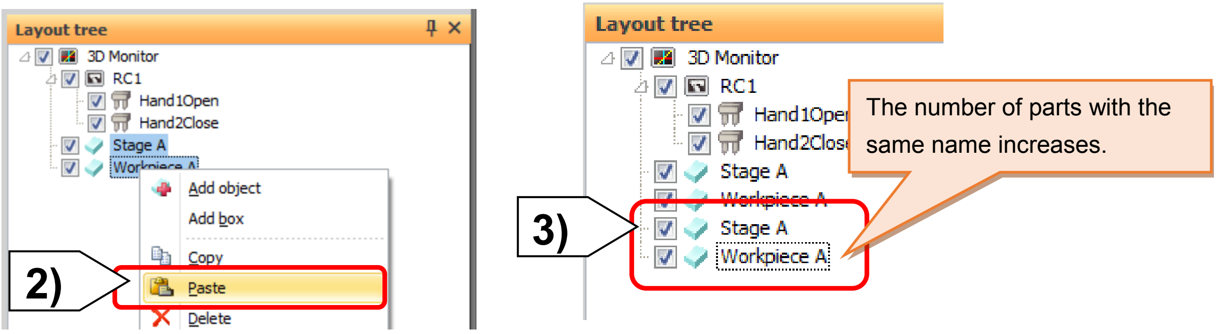
1) Right-click in [Layout tree] to display the menu and click [Add object].
2) Select the parts added in [Layout tree], and input 3D part information in the Properties window.

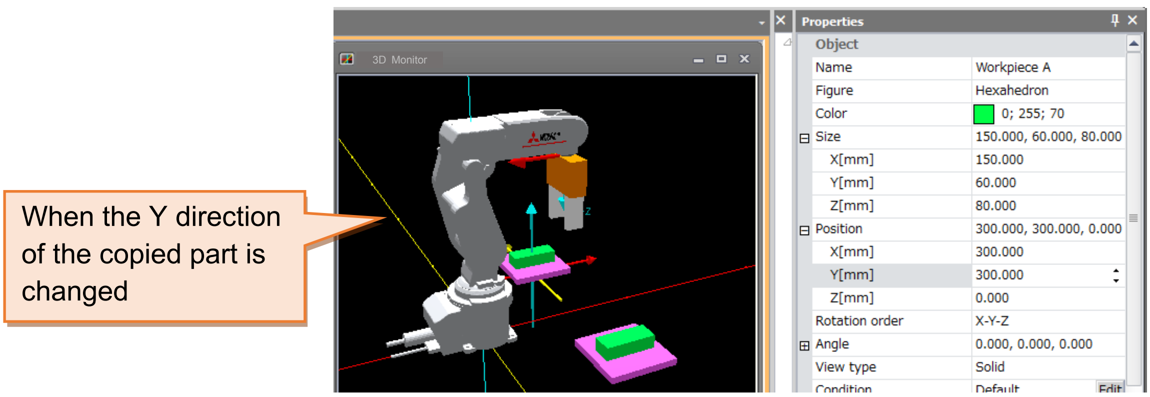


(8-4) Copy an existing layout part to create a new part.



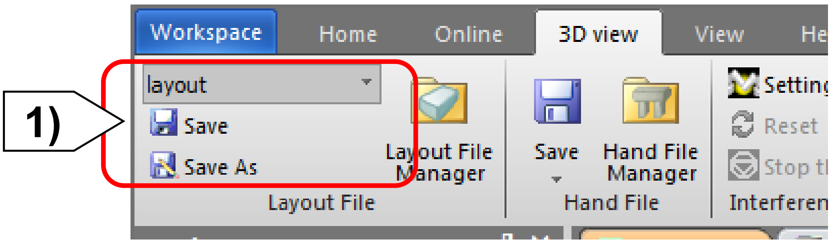
1) Select the parts to be copied in [Layout tree] then right-click and select Copy.
2) Click [Paste].
3) A part with the same name is added. Input the part information in the [Properties] window.





(8-5) Save the layout file.

1) Click "Save" or "Save as" in the [Layout File] group in the [3D view] tab.

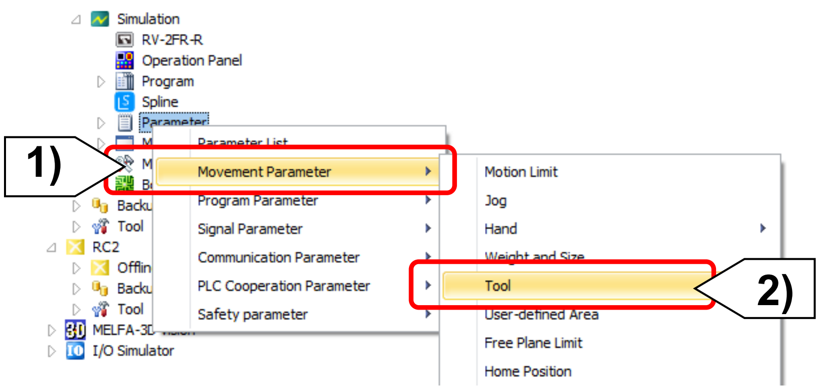


(9) Setting the tool length

By setting the tool length, the robot tool coordinate can be used.
Using the robot tool coordinate can operate the robot along with hand surface direction and make the change of the hand posture and workpiece posture held by the hand easier.
For details of the robot tool coordinate, refer to "Chapter 4 Robot Language 4.2 Program instructions Position operation in the robot tool coordinate system".

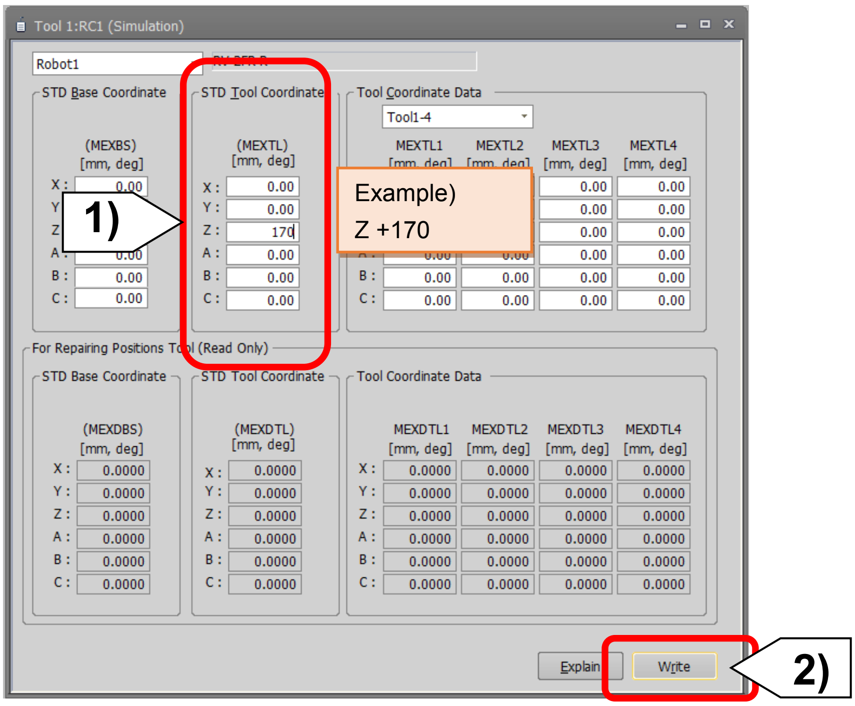
(9-1) Display the Tool parameter window.

1) Right-click [Parameter] under [Simulation] in the project tree to display a sub menu.
2) Move the cursor to [Movement Parameter] to display another sub menu, then move the cursor to [Tool].



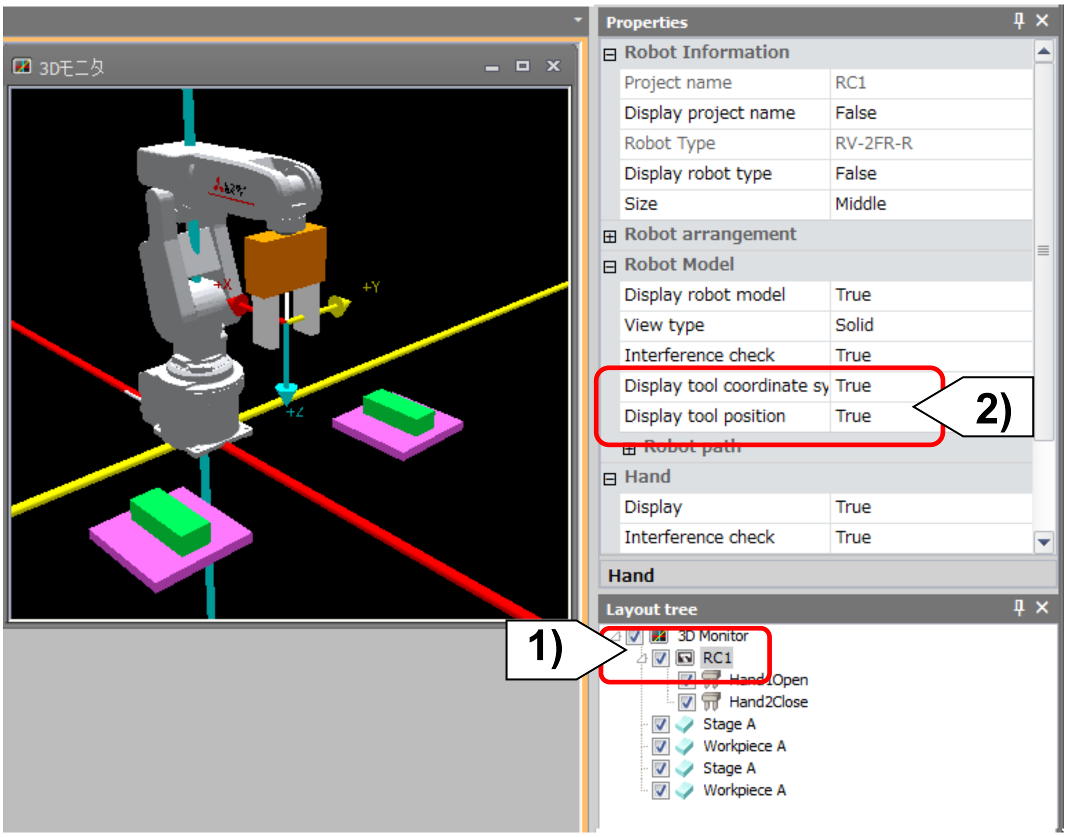
(9-2) Input the tool length in the tool coordinate system.

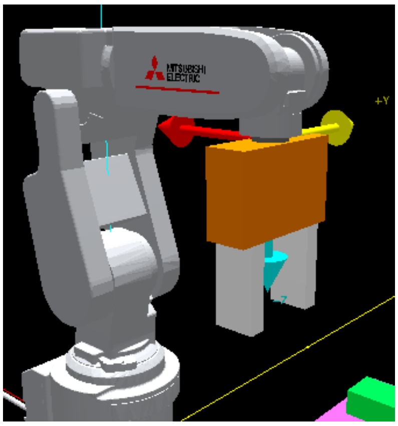
1) Input the tool data in [STD Tool coordinate], Signs are based on the flange coordinates of the robot.
2) Click the [Write] button.
3) In the confirmation window for writing data to the controller → Click "Yes".



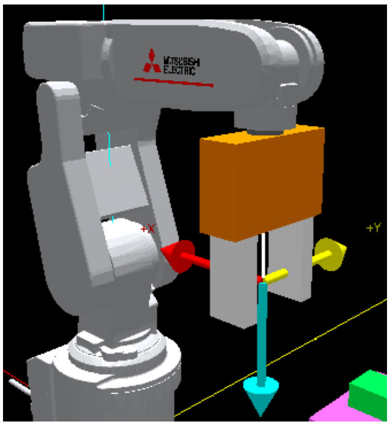
(9-3) Checking the tool in the 3D Monitor.

1) Select the project name in [Layout tree] to display the project properties in the Properties window.
2) Expand [Robot Model] and select "True" for [Display tool coordinate system] and [Display tool position]. The tool coordinate system position is displayed in the 3D Monitor.





Before setting the tool length (flange center)



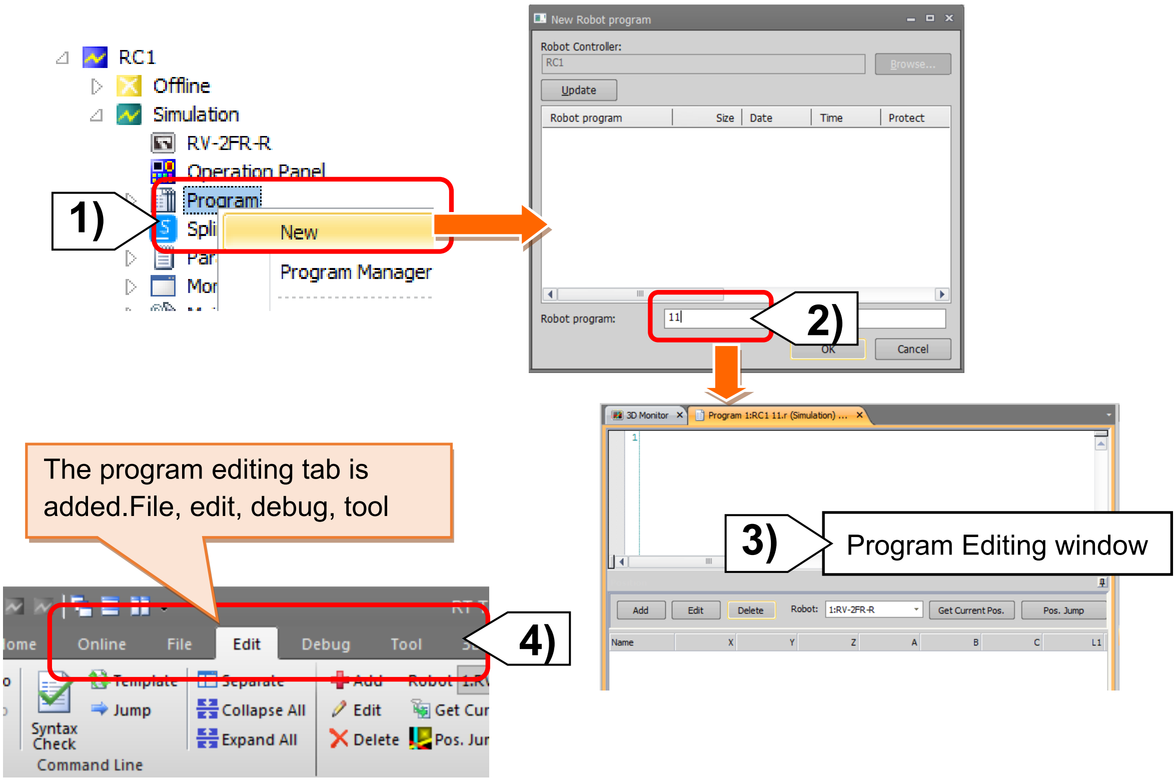
After setting the tool length

[Caution] If the program operated by the simulator has an electric hand instruction, home position return of multi-function electric hand needs to be performed in the program.

(10) Creating a robot program

(10-1) Create a new robot program.

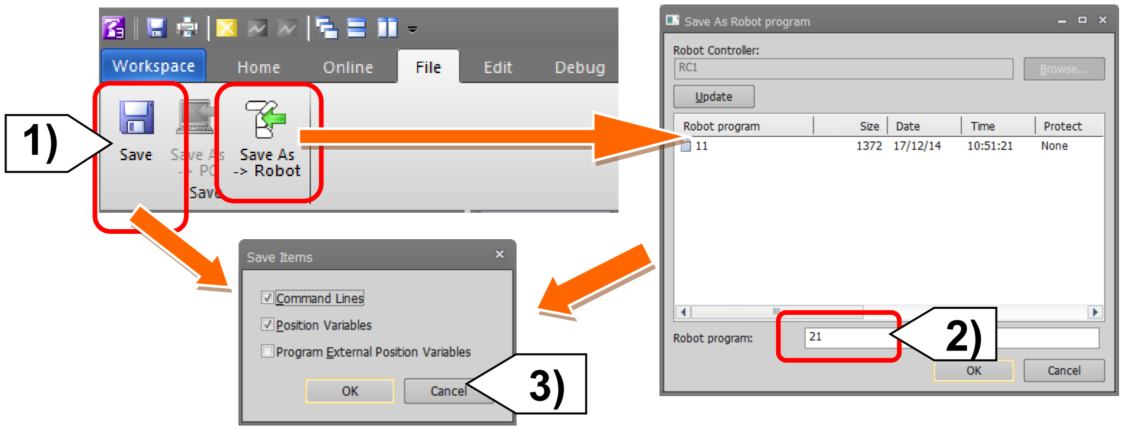
1) Right-click [Program] under [Simulation] in the project tree, then right-click and select "New".
2) Input the robot program file name, and click "OK".
3) The program editing screen opens. Write the program (instruction statement) here.
4) The [File], [Edit], [Debug], and [Tool] tabs are added to the ribbon.
These have functions such as program editing tools, debugging, and file saving.



*If the program operated by the simulator has an electric hand instruction, the home position return of the multi-function electric hand needs to be performed in the program.

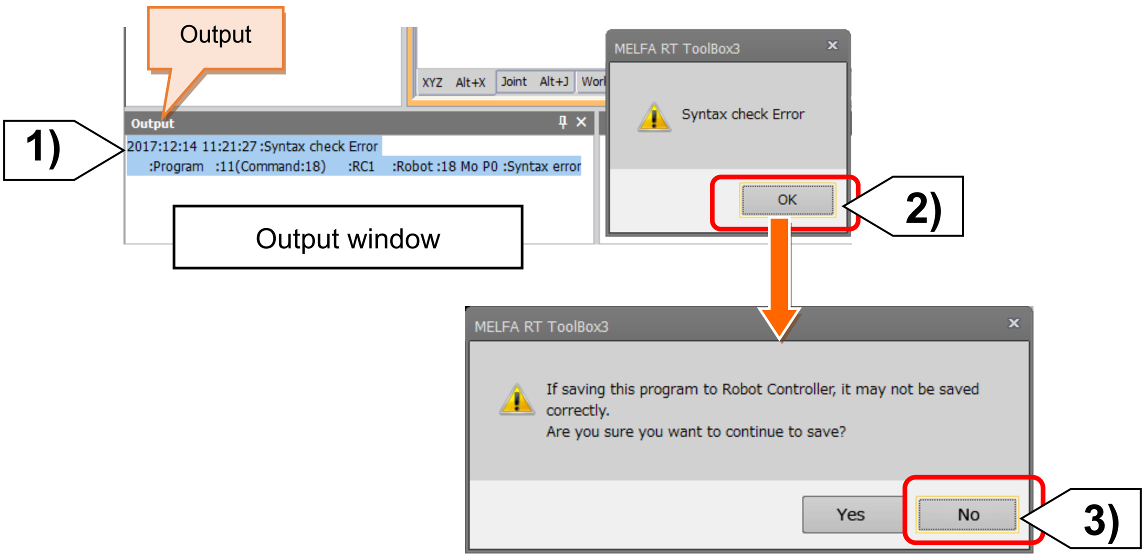
(10-2) Saving the robot program.

1) Click [Save] in the [File] tab.
2) To change the file name, click [Save As Robot] and input a file name.
3) Select the items to be written, and click "OK".



(10-3) When a syntax error occurs.

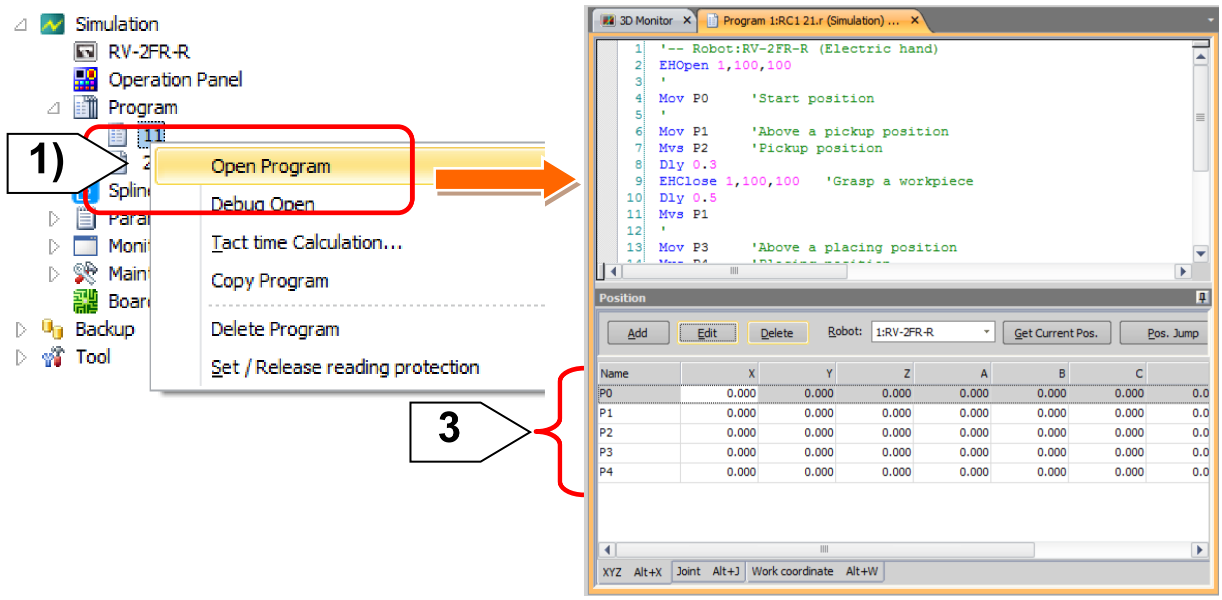
1) When a syntax error occurs, the message "Syntax check Error" and an error message are displayed in the [Output] window.
2) Clicking "OK" in the "Syntax check Error" message displays the save confirmation window. Click "No".
3) Correct the syntax error, and save the program.



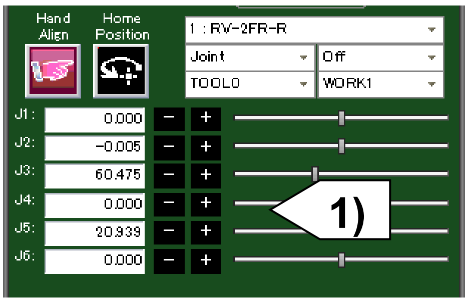
(11) Teaching operation

(11-1) Opening an existing program.

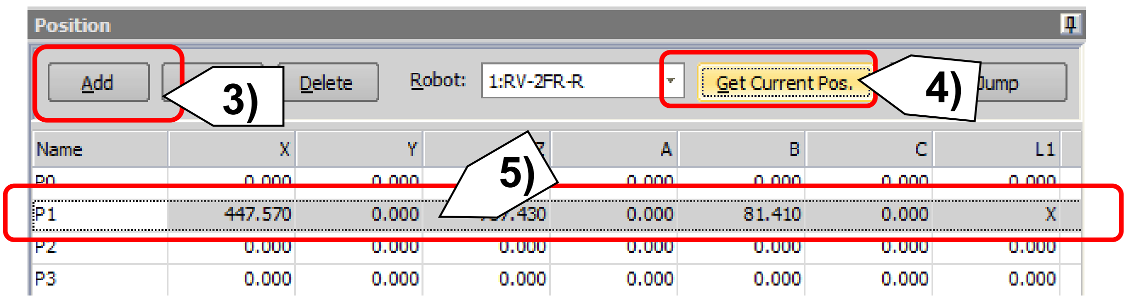
1) Select the program file from Program in the project tree, right-click and select "Open Program".
2) Check the items to be read, and click "OK".
3) Since the position variable used in the program is registered in the position data field, it is clear which position variables are required for teaching.



(11-2) Acquiring position data. (Method 1) (JOG operation → current position reading)



1) To acquire the desired position data, move the robot arm to the desired position by using the JOG operation.
2) Select the position variable in the Position window.
3) To create a new position variable, click "Add" and input a variable name.
(If no variable name is input, registration cannot be made.)
4) Click "Get Current Pos." in the Position window.
5) Current robot position data and posture are input.

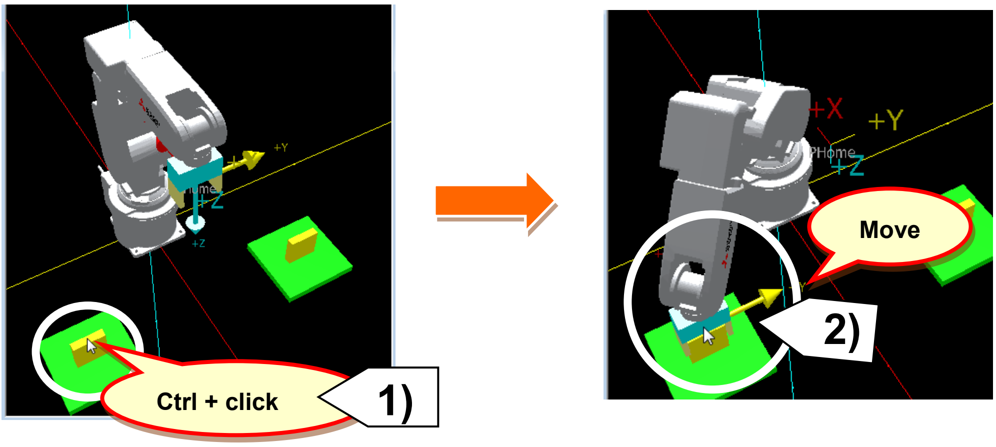


(11-3) Acquiring position data. (Method 2) (Robot click movement → current position reading)

By clicking the object in the 3D Monitor window while pressing the Ctrl key with the simulation started, the robot moves to the position which has been clicked.

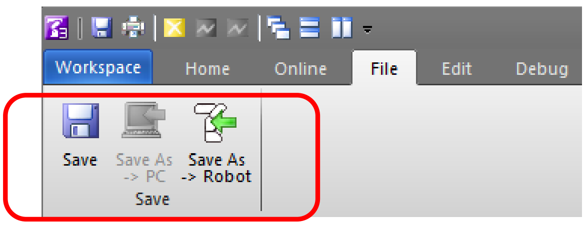
· When no object is set at the position which has been clicked or the position is outside the robot operation range, the robot does not move.
· The robot body does not move based on the posture and status of the multi-rotation joint. This is because the robot body moves independently while maintaining the posture and status of the multi-rotation joint.
· This operation is invalid during the robot operation.

1) Click the top center of the target layout configuration part of the 3D Monitor while pressing the [Ctrl] key.
2) The robot moves to the position which has been clicked.



3) Select the position variable or add a variable, and click "Get Current Pos." in the Position window.

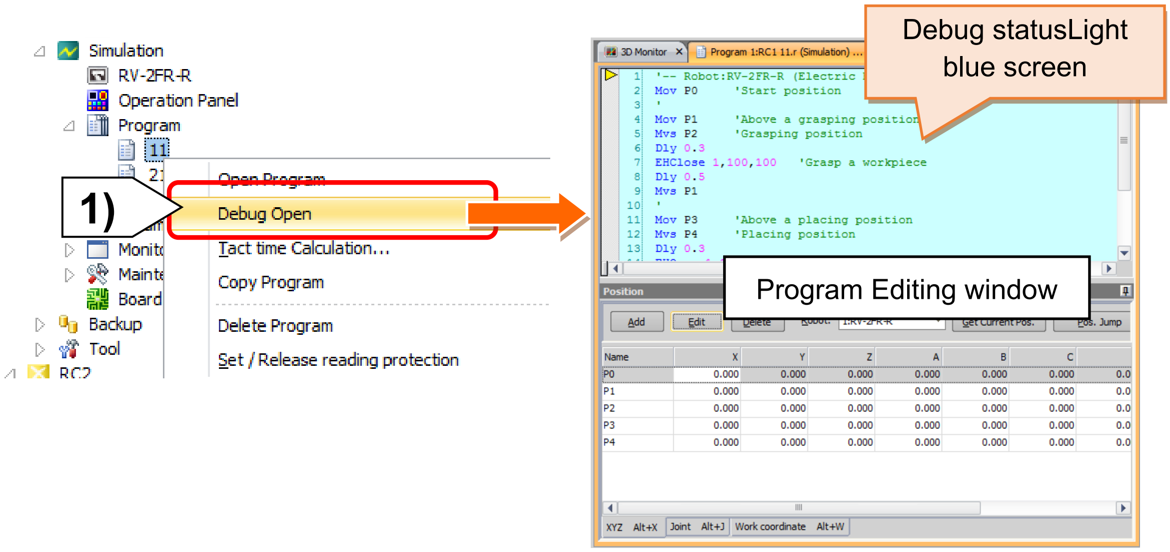
(11-4) Saving the program.



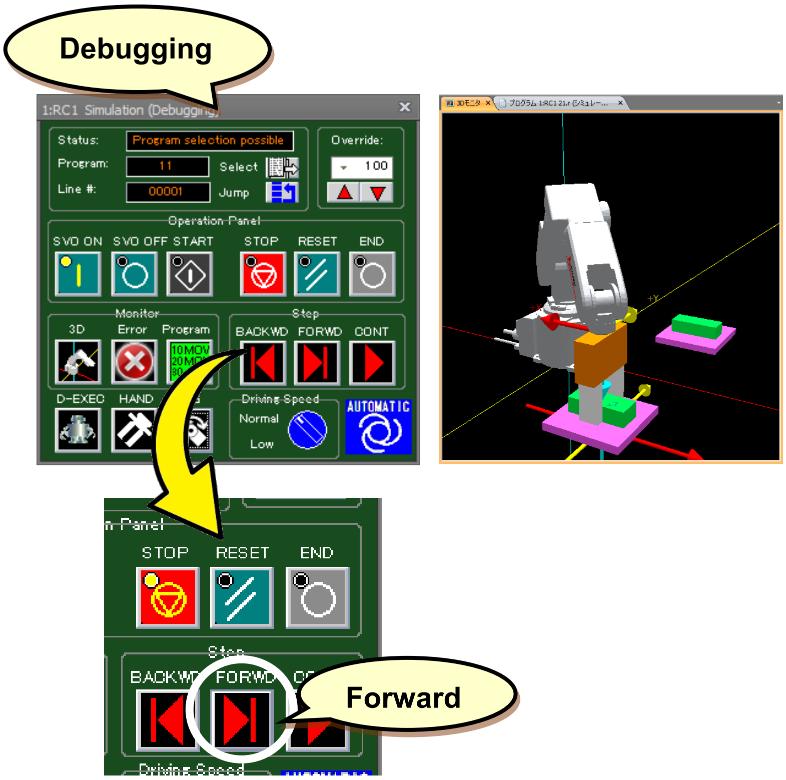
(12) Carrying out debugging

(12-1) Check the program operation with Step operation.

1) Select [Program] under [Online] in the project tree, right-click and select "Debug Open" to open the corresponding program.



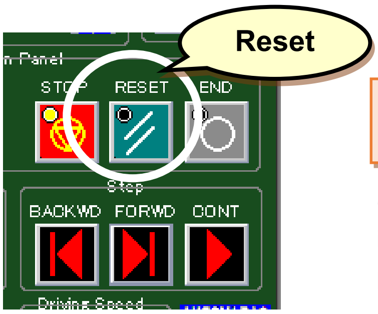
2) Pressing the "FORWD" button in the operation panel executes the program by one step.
Check the posture and operation of the robot by executing the program by one step.



(12-2) Return the program execution line to the first line.

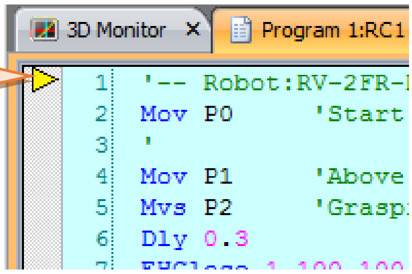
[Reset]

Pressing the "RESET" button in the operation panel returns the program to the first line.



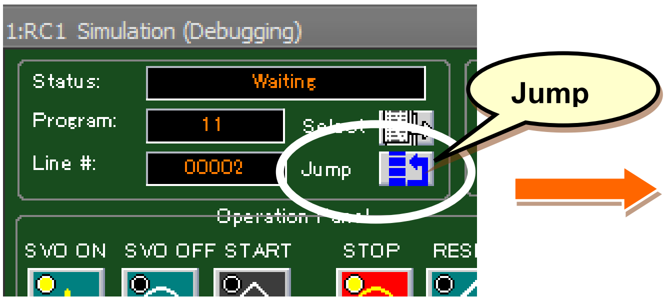
The execution line returns to the first line.

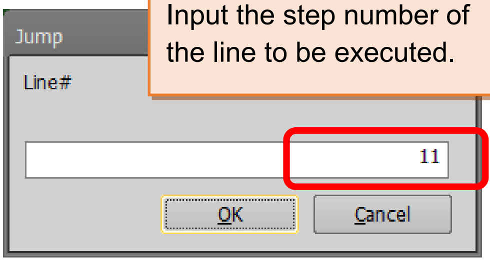
(The RESET button does not initialize signal status, robot posture, variables, or similar.)



[Jump]

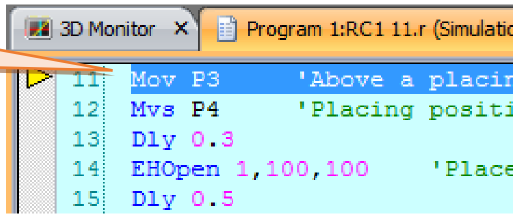
Pressing the "Jump" button in the operation panel and Specify the line to be executed.



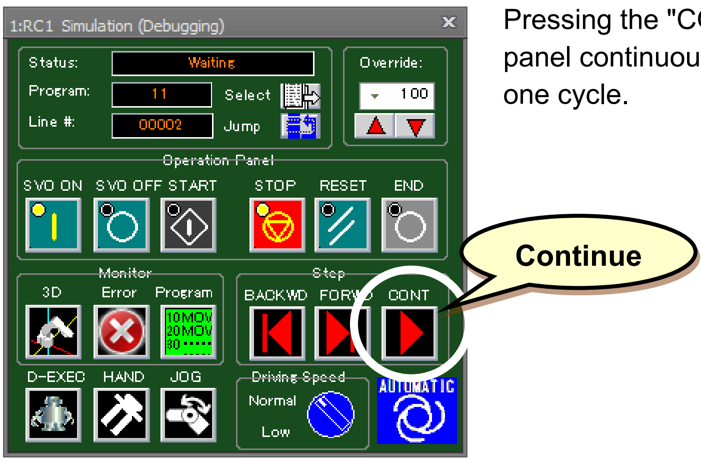


Input the step number of the line to be executed.

The execution line moves.



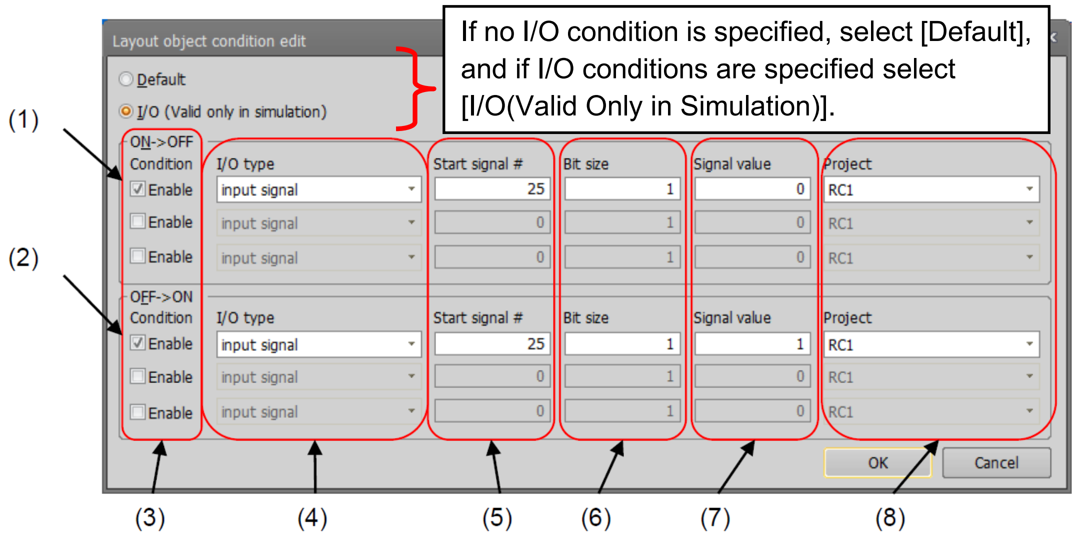
(12-3) Execute the program continuously.



Pressing the "CONT" button on the operation panel continuously executes the program for one cycle.

(13) Changing the layout display conditions

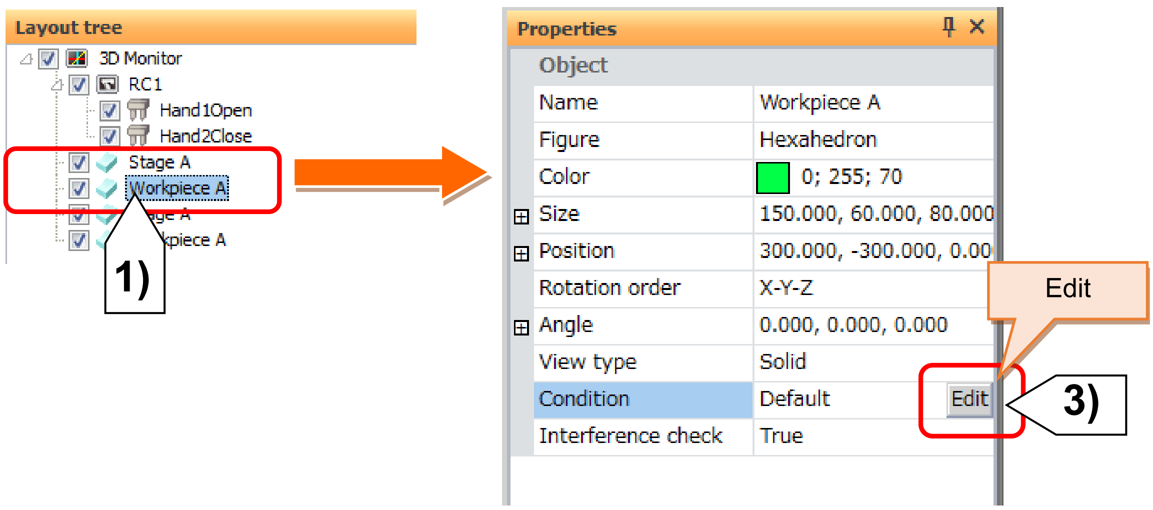
By specifying the I/O conditions for the layout parts, the corresponding parts can be displayed or hidden. This function is valid only during simulation.

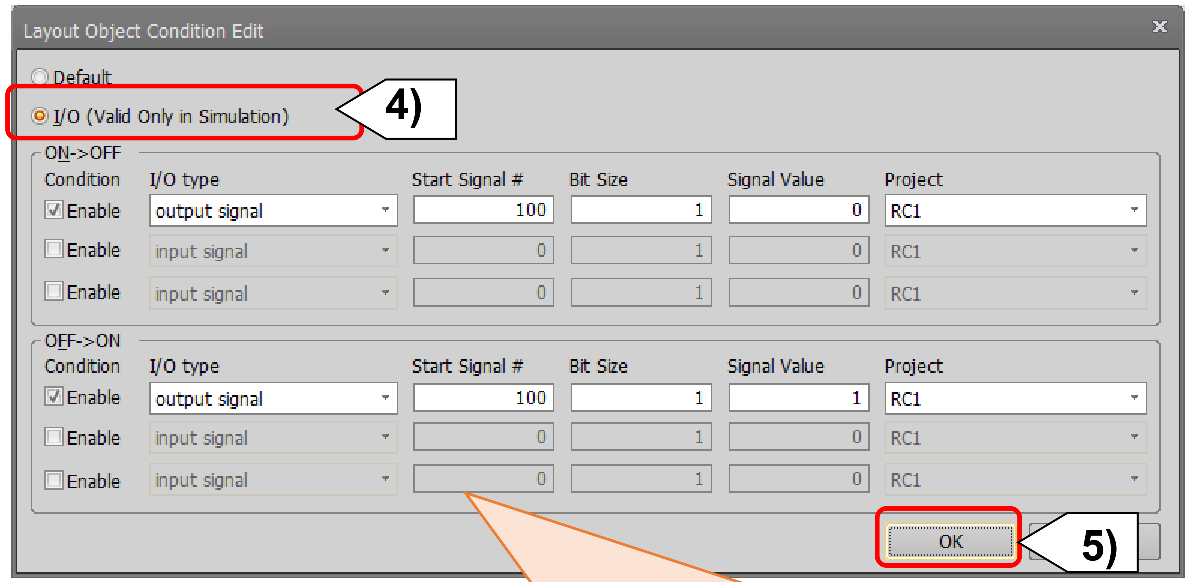


1) ON→OFF
   Set the conditions to hide the target layout parts.
2) OFF→ON
   Set the conditions to display the target layout parts.
3) Condition
   I/O conditions can be set by selecting [I/O].
4) I/O type:
   Specify the I/O type.
5) Start signal #
   Specify the I/O Start number.
6) Bit size
   Specify the number of bits (number of registers) from the I/O start signal.
7) Signal value
   Specify the numeric values to be compared with the I/O status.
8) Project
   Specify the target projects (robots) those I/O conditions are checked while using the 3D Monitor of the whole workspace. The projects do not need to be set in the 3D Monitor for each project.

(13-1) Setting the display conditions for the layout configuration parts.

1) Select the part for which display conditions are set in [Layout tree].
2) Attributes of the selected part are displayed in the [Properties] window.
3) Click "Edit" in the [Condition] field.
4) The [Layout Object Condition Edit] window will display. Select "I/O (Valid Only in Simulation).
5) Input display conditions, and click "OK".





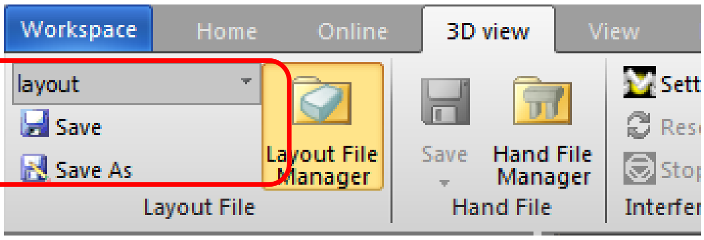
Setting example)
ON→OFF
Output signal, start number: 100, number of bits: 1, signal status: 0
OFF→ON
Output signal, start number: 100, number of bits: 1, signal status: 1

Program description:
Display → Hide: M_Out(100)=0
Hide → Display: M_Out(100)=1

(13-2) Save the layout file.

1) Click "Save" or "Save as" in the [Layout File] group in the [3D view] tab.

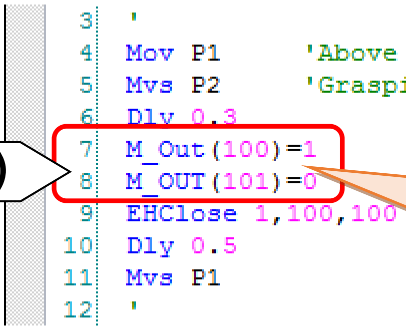
1)



(13-3) Setting the display conditions for the robot program.

1) Open the program, and describe commands of the parts display conditions.

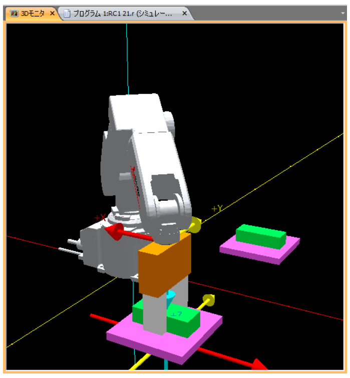
1)

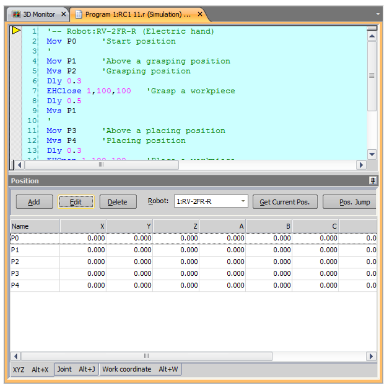


Example)
Display → Hide: M_Out(100)=1
Hide → Display: M_Out(101)=0

(13-4) Carry out debugging and check the program operation.

Debugging



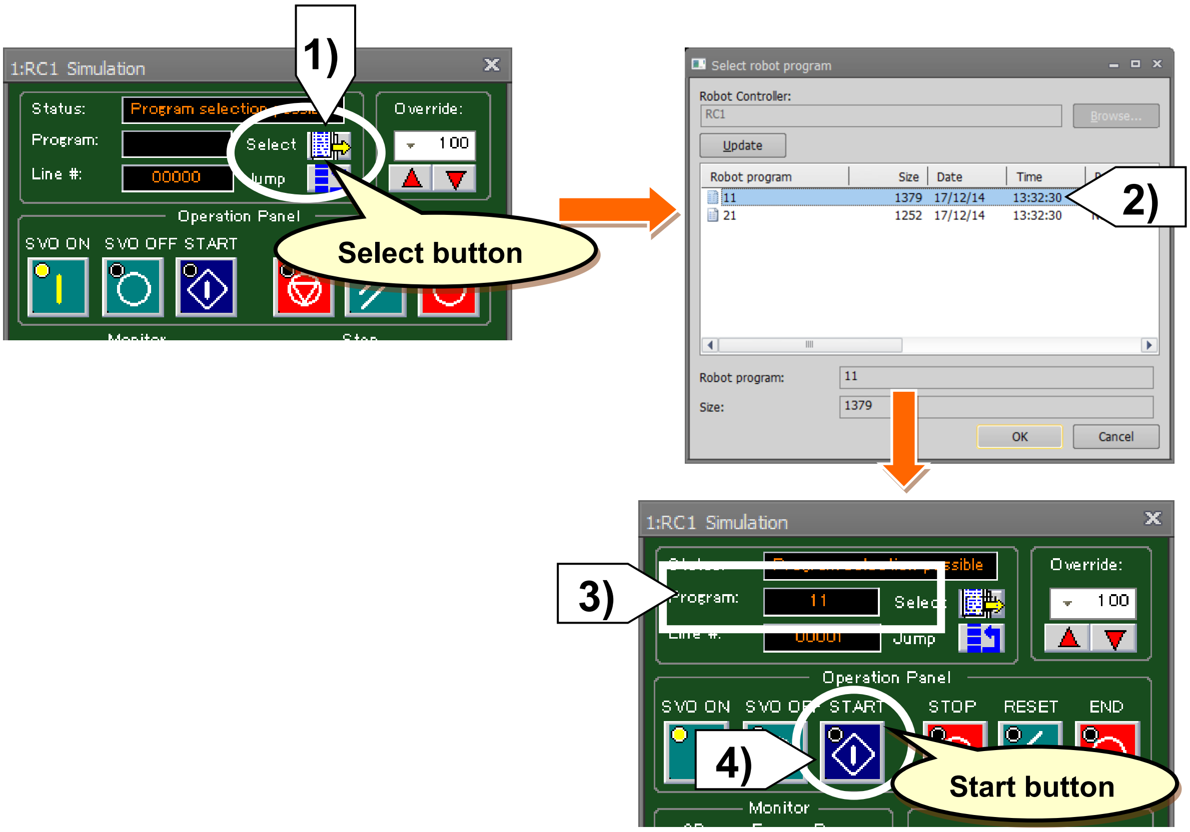


For the debugging method, refer to "(12) Carrying out debugging" in this chapter.

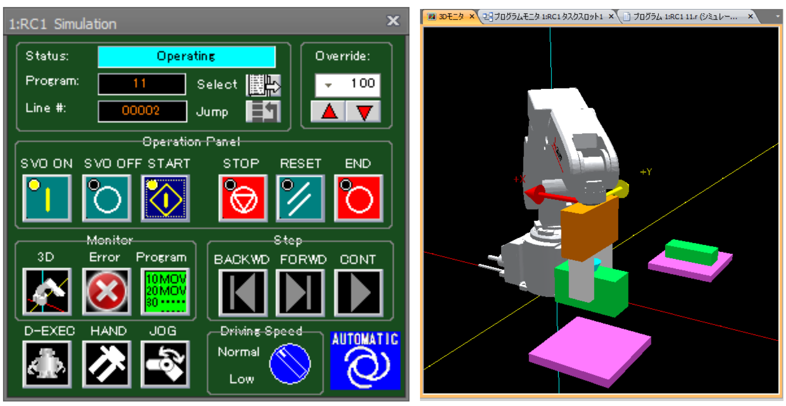
(14) Automatic operation

(14-1) Select the program and perform the automatic operation.

1) Click the "Select" button in the operation panel.
2) Select the program.
3) The selected program name is displayed in "Program" in the operation panel.
4) Press the "START" button in the operation panel.



(14-2) Check if the robot operation and the program are correct.



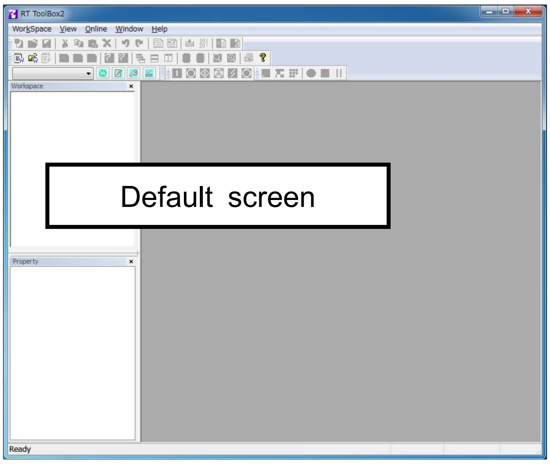
Appendix 3: How to operate RT ToolBox2

Appendix 3.1 Starting/Ending RT ToolBox2

(1) Start

Double-click the shortcut on the desktop.
Or, select the [Start] button → [All Programs] → [MELSOFT], and select [RT ToolBox2].

Shortcut icon

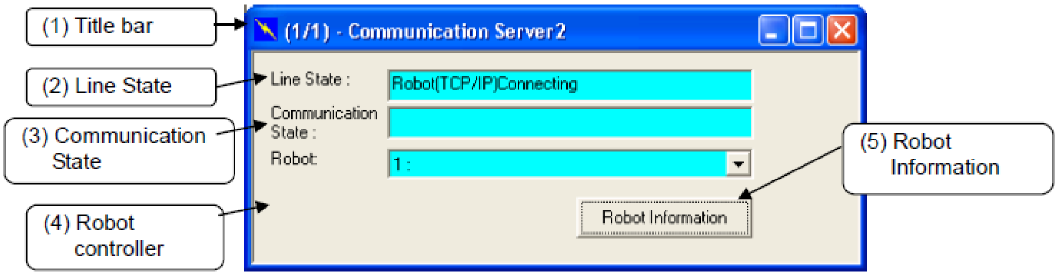


(2) Communication server

When RT ToolBox2 starts, "Communications Server2" starts while minimized in the taskbar. Restore the minimized Communications Server2 to its original size to check the connection status of the robot.

Since Communications Server2 has functions to connect the robot with robot controllers and virtual controllers during simulation, do not end it manually.

Minimized Com munications Se



Circuit status (Ex.: yellow: stand-by, light blue, blue: connected, red: connection error)

(3) End

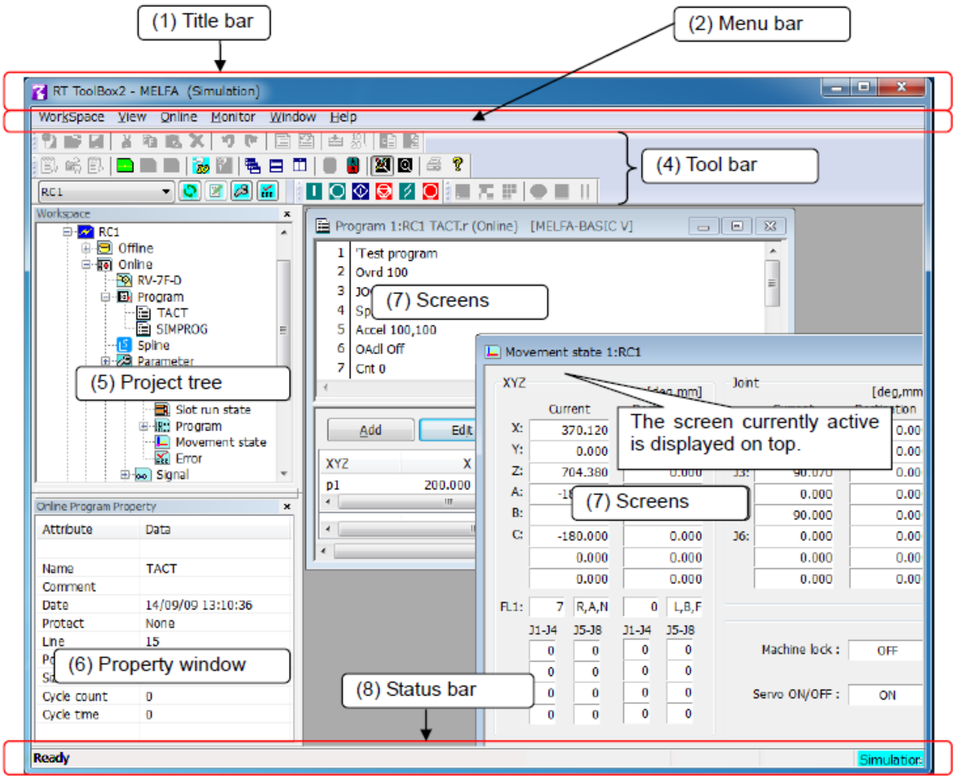
Click [WorkSpace] → [Exit] on the menu bar. Or, click the [X] button in the upper right of the window.

When RT ToolBox2 closes, Communications Server2 automatically ends.

Appendix 3.2 Explanation of the RT ToolBox2 screen

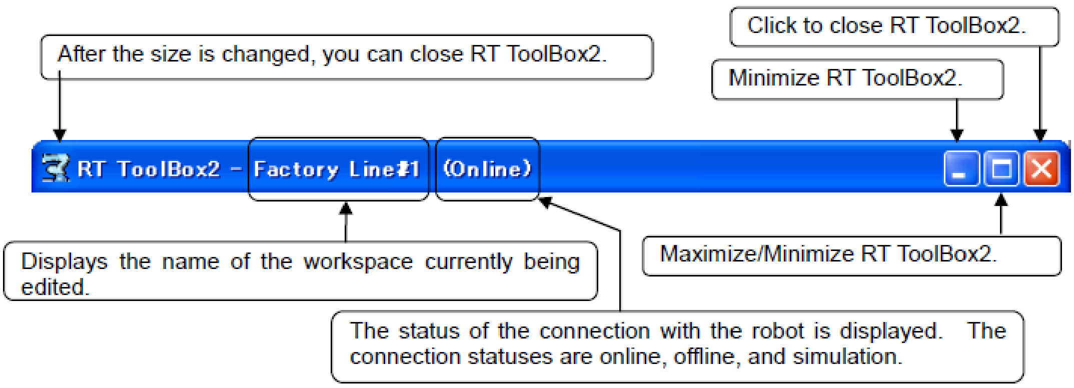
(1) Main screen

The configuration of the RT ToolBox2 main screen is as follows.



(1) Title bar

The name of the workspace currently being edited is displayed.



(2) Menu bar

The names of menu items that can be used in RT ToolBox2 are displayed.
Selecting the menu item displays a drop-down menu, and various functions are available.
The display and enabled/disabled status of the menu bar differ depending on the currently active window.

(3) Drop-down menu

The names of functions that can be used in RT ToolBox2 are displayed.

(4) Tool bar

Functions assigned to the menu bar will display as buttons.
The display of the tool bar differs depending on the currently active window and connection status of the robot.

(5) Project tree
All projects registered in the workspace will display by function in a list.
The Program Editing window and Monitor window can be started.

(6) Properties window
Various attributes in the workspace currently being edited can be checked.
Clicking an item in the project tree displays the attributes.

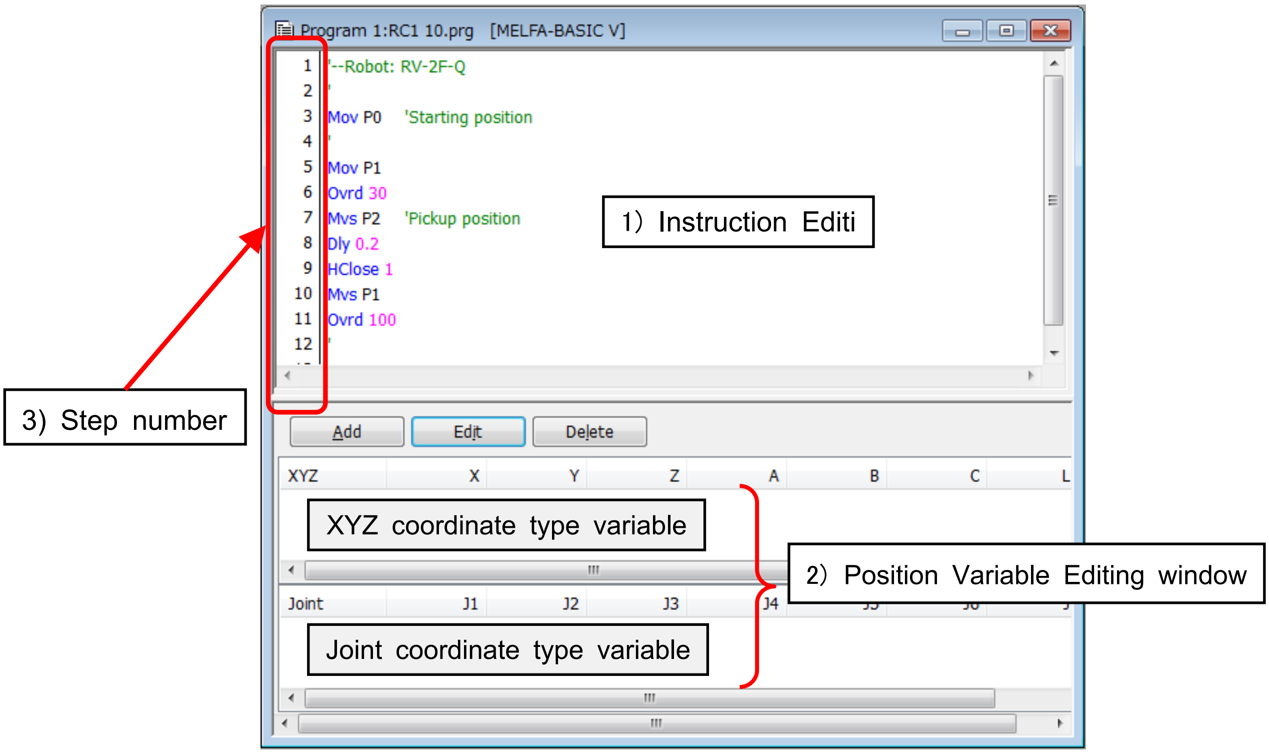
(7) Window
Windows such as the Program Editing window and Monitor window started from the project tree are displayed. The currently active window is displayed to the foreground.

(8) Status bar
Status information such as RT ToolBox3 modes (Offline, Online, Simulation) and the position of the cursor while editing a program is displayed.

(2) Program Editing window

The upper section is the Program Instruction Statement Editing window, and the lower section is the Position Variable Editing window.

Drag the boundary of these windows and change the position of the upper and lower window separation.



1) Instruction Statement Editing window
Write the program here. Programs can be input in the same way as a general editor like Notepad. Input of [Enter] (line break) at the end of each line is not required.

2) Position Variable Editing window
Edit the position variables. The upper part is a variable list for the XYZ coordinate type, and lower part is that for the joint coordinate type.

3) Step number
During programming, step numbers are automatically numbered by pressing the [Enter] key on the keyboard.

Appendix 3.3 Creating a new project

■ Workspace and project

RT ToolBox2 has workspaces and projects.
Information for one controller is managed as a single project.
A workspace can manage 32 projects at maximum.
Multiple workspaces cannot be edited at the same time. Register projects to be referred at the same time in a single workspace.

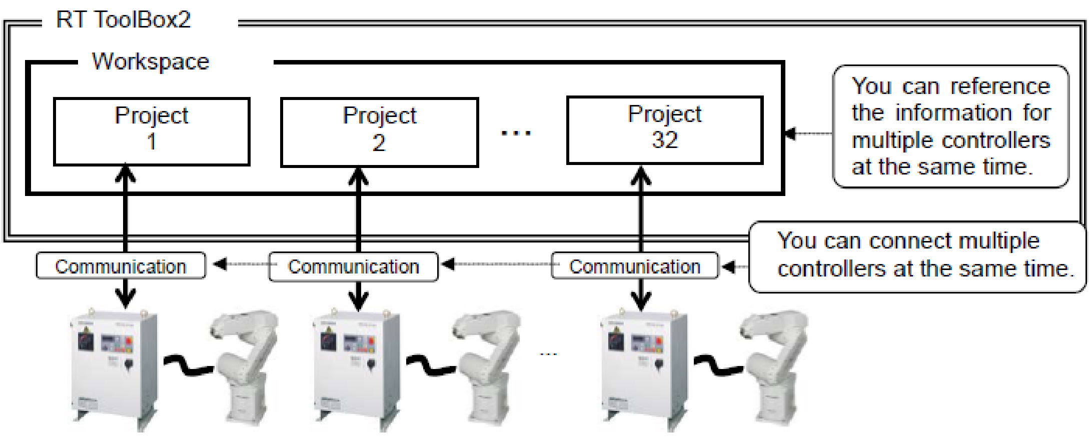
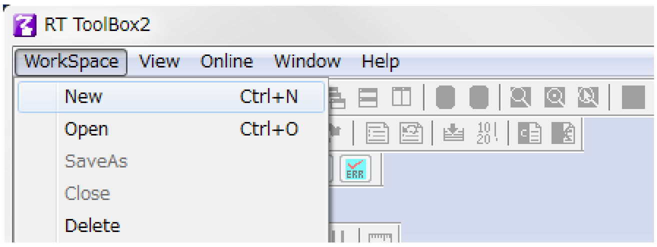


Image for using multiple robot controllers

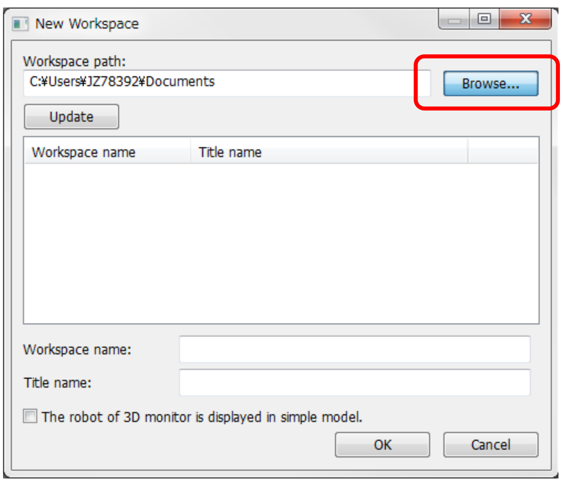
(1) Creating a workspace and project

(1-1) Create a new workspace.



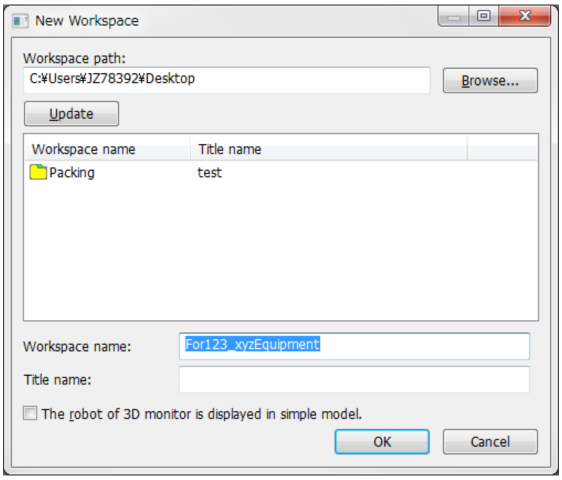
Click "New" in the WorkSpace tab.

(1-2) Choose the folder in which the workspace is to be created.



Click "Browse" in the Workspace path field and select a folder in which the workspace is to be created.

(1-3) Enter a workspace name.

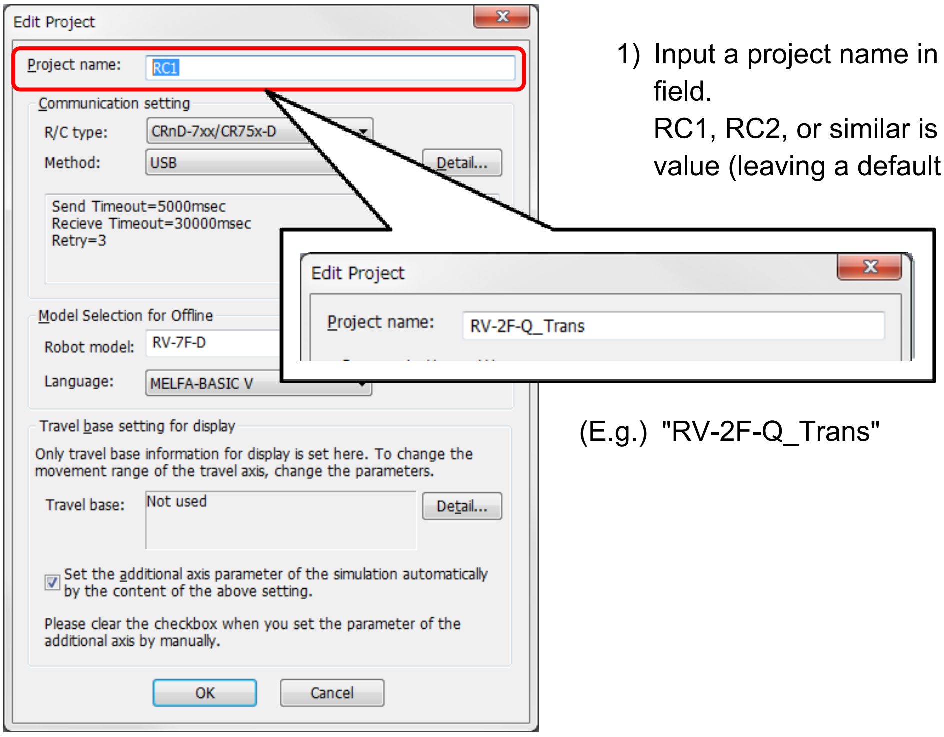


Input a workspace name in the "Workspace name" field, then click "OK".
(Ex.) For123_xyzEquipment

A folder with the workspace name input here is created in the folder selected in (1-2).
(This folder is the workspace.)

*Workspace information is automatically saved.

(1-4) The Edit Project window is displayed.

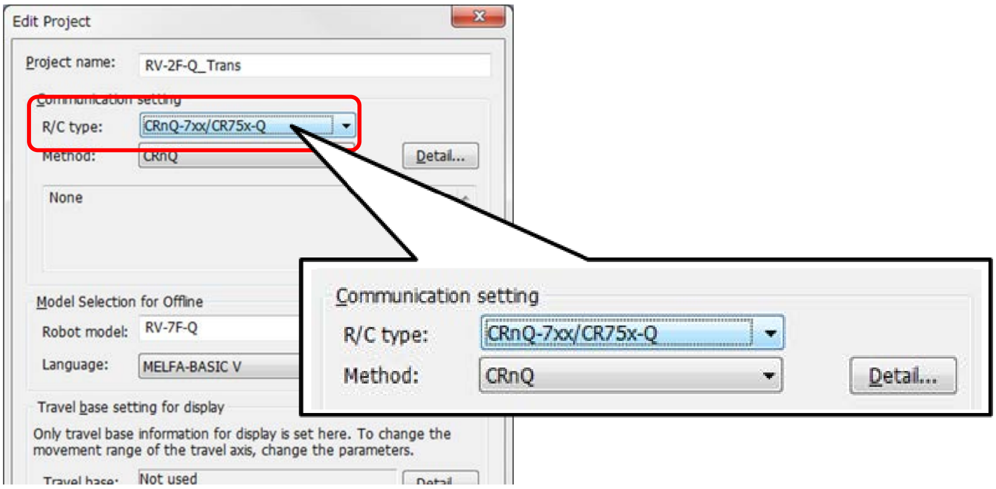


1) Input a project name in the "Project name" field.
RC1, RC2, or similar is input as a default value (leaving a default value is acceptable).

(E.g.) "RV-2F-Q_Trans"

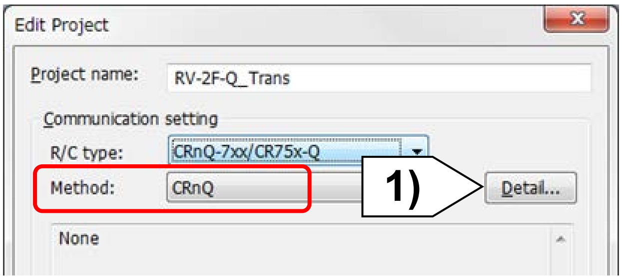
(2) Communication settings (F Series iQ Platform compatible)

(2-1) Change the R/C type field in "Communication setting" to "CRnQ-7xx/CR75x-Q".

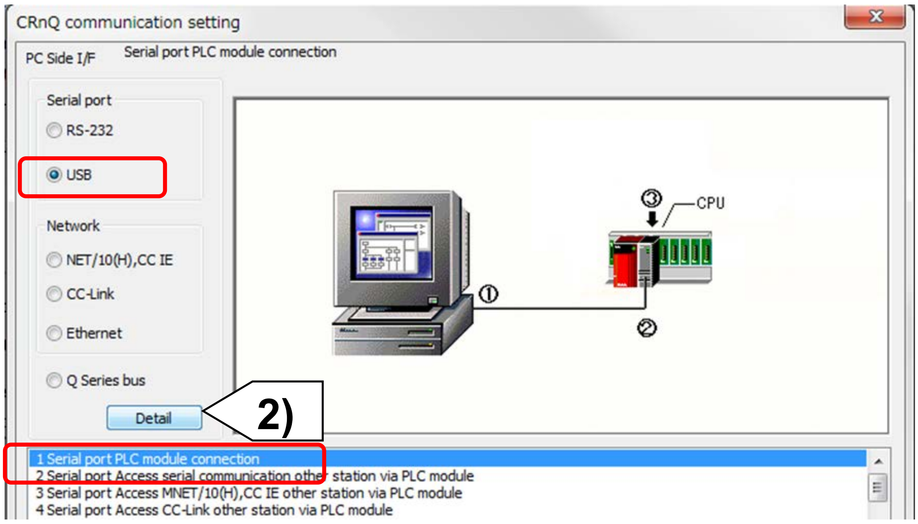


(2-2) Configure the details of the communication settings.

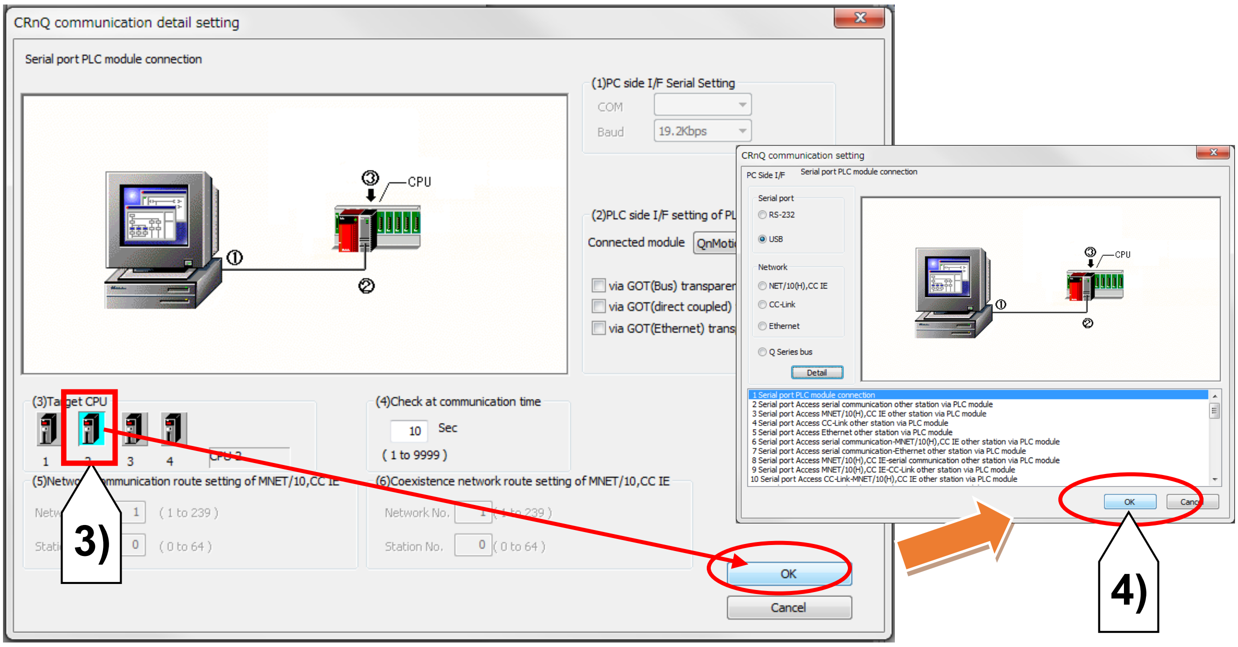
1) Check that "CRnQ" is selected in the "Method" field, then click the "Detail" button.



2) The CRnQ communication setting window opens.
Select "USB" for PC Side I/F and "1 Serial port PLC module connection" for the route, then click the "Detail" button.

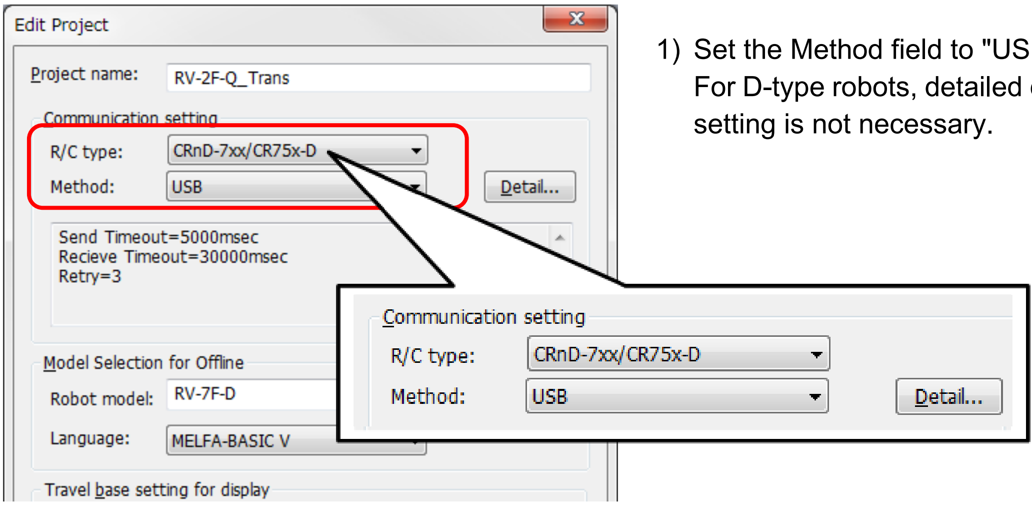


3) The CRnQ communication detail setting window opens.
Select "2" for "Target CPU" in the CRnQ-R Communication Detail Setting window, then click the "OK" button.
4) The window returns to the CRnQ communication setting window. Click the "OK" button and the window returns to the Edit Project window.



(3) Communication settings (F Series stand-alone)

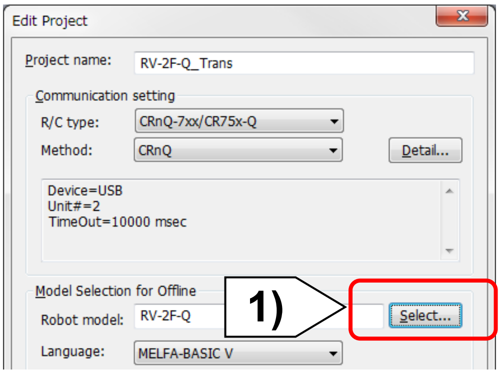
(3-1) Change the controller field "R/C type" in "Method" to "CRnD-7xx/CR75x-D".



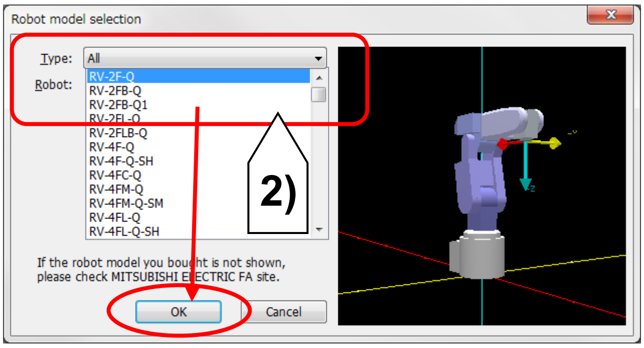
1) Set the Method field to "USB".
For D-type robots, detailed communication setting is not necessary.

(4) Offline robot settings

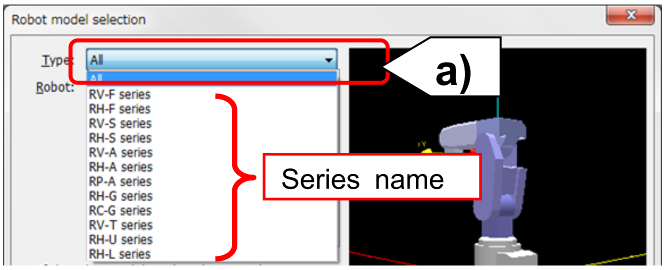
(1) Select the robot.



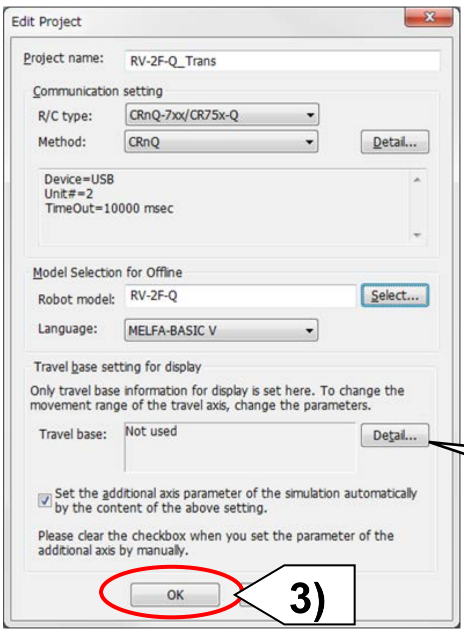
1) Click "Select" in the Robot model field.



2) Select a robot from the Robot list in the Robot model selection window, then click "OK".



a) Click "Type" to display the series names.
Selecting a series name displays model lists by series, making it easier to select robots.



While using a travel base, configure the travel axis display settings here.

3) After completion of the communication settings and robot model name selection, click "OK" to display the main screen.

* While changing the project settings, refer to "Appendix 3.9 Editing and adding a project".

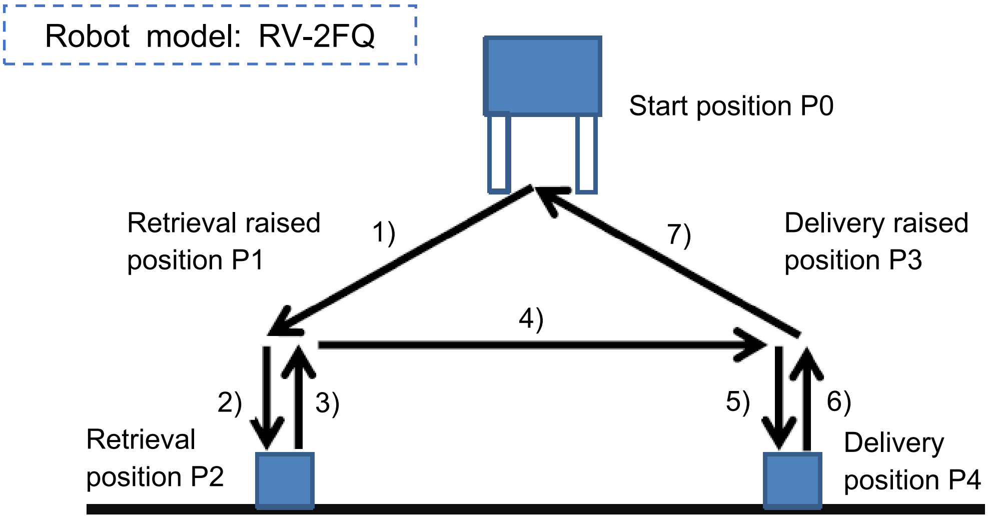
Appendix 3.4 Creating a program

(1) Preparation

Decide the details of the following items in preparation for program creation.

- Robot operation position and operation order
- The robot operation position variable name
- I/O signal functions and numbers (if necessary)

* In the sections that follow, we will create an example program that performs the operation in the figure below.



Pick Up!

Characters that cannot be used as a program file name

The file names shown below cannot be used as program file names.

① Program names that cannot be used on a personal computer

When the program name in the robot controller is the same as a Windows "reserved word", attempting to open the program in the Program Editing window causes an error. In this case, the program name needs to be changed in the controller.

"Reserved word" is a special character string used by Windows on the system, and this cannot be used as a file name on a personal computer. "Reserved word" includes the following.

AUX, COM1 to COM9, CON, LPT1 to 9, NUL, PRN

② Program names that cannot be used on the robot controller

Program names shown below cannot be used on the robot controller.

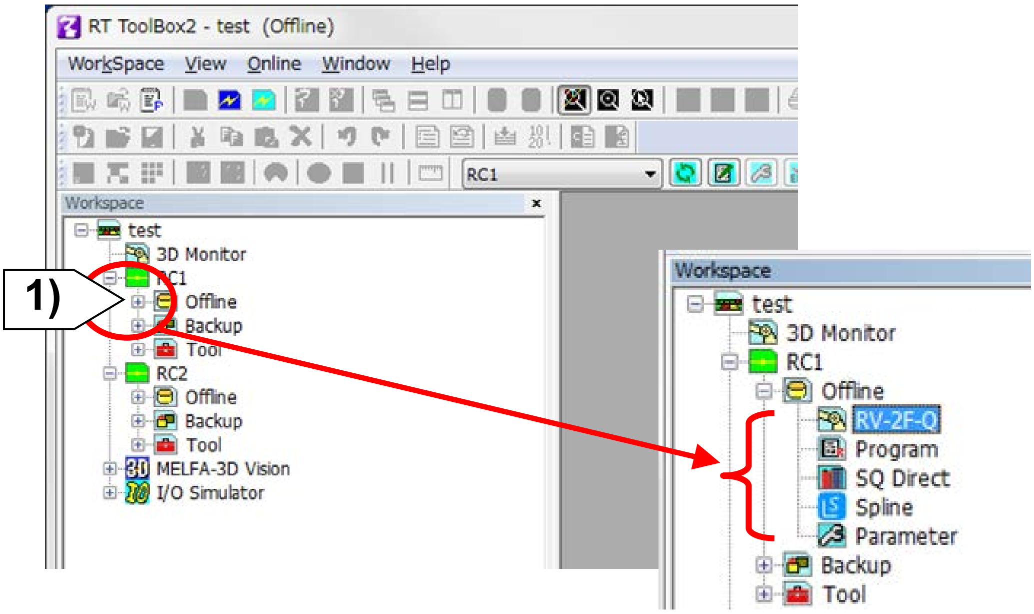
1. Overlong program names (13 characters or longer)
2. Program names that include character strings other than alphabetic characters or numbers (two-byte characters cannot be used)
3. Character strings starting with 0

If program names that include any of these are attempted to be used, a warning occurs at new program creation, program copy, program name change, program conversion, and drag and drop operations.

(2) Creating a program

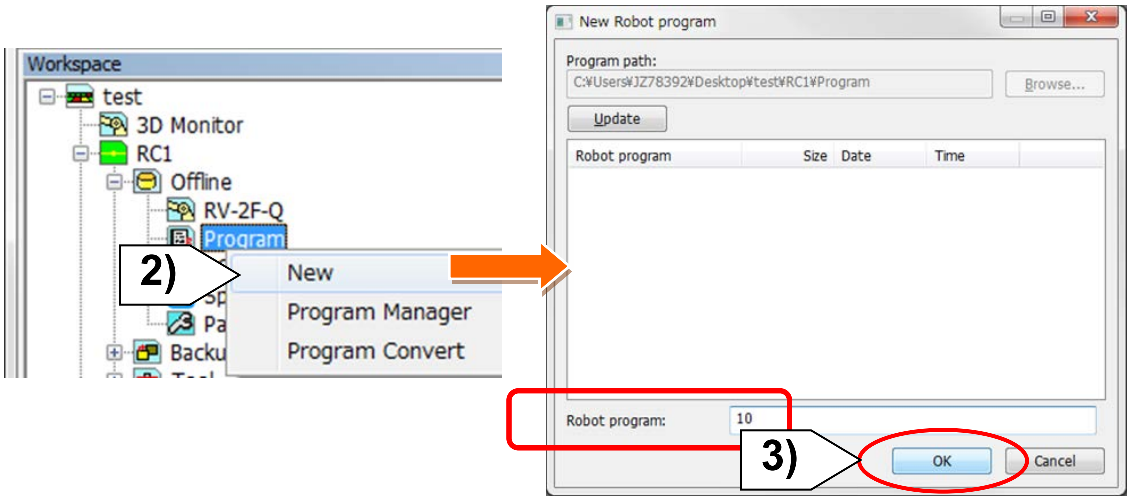
(1) Create a new program file. (Offline status)

1) Click the [+] mark at the left of "Offline" in the project tree to expand offline items.

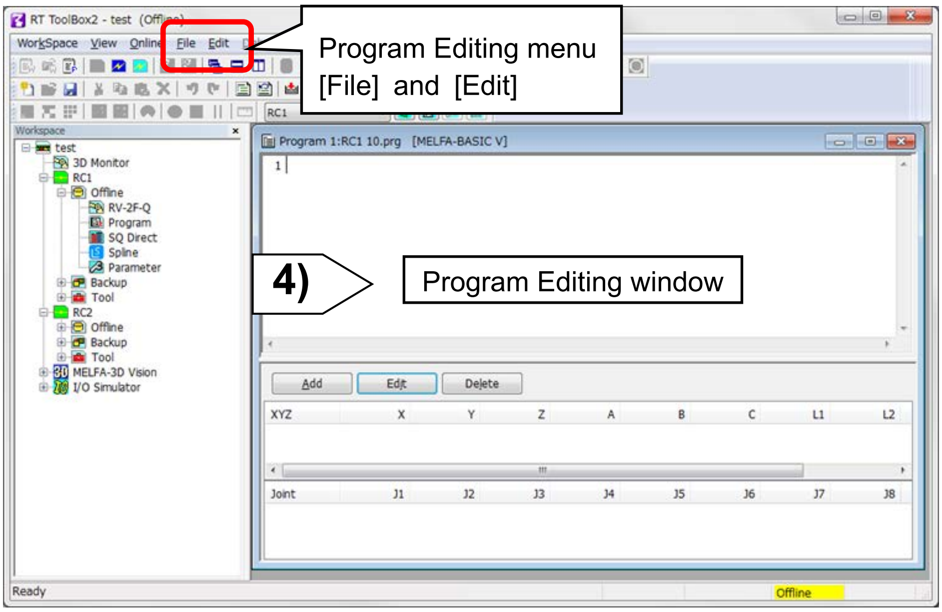


2) Right-click [Program] under [Offline] in the project tree to display a sub menu. Select "New".
3) In the Robot program field, input the robot program file name, and click "OK".

* There are restrictions on the characters that can be used for the program file names and the number of characters.
For details, refer to "Characters that cannot be used as a program file name" on the previous page.



4) The Program Editing window opens.
The Program Editing menu is displayed on the menu bar.



(2) Input the program. (Offline status)

1) Input the program in the Program Editing window.
The following diagram shows the program that is designed to perform the operation shown in "Appendix 3.4 (1) Preparation" as an example.
* For details of robot program instructions, refer to the instruction manual "Detailed explanations of functions and operations".

For pneumatic hands

Program 1:RC1 11.prg [MELFA-BASIC V]

```
'-- Robot:RV-2F-Q (Air hand)
HOpen 1
'
Mov P0    'Start position
'
Mov P1    'Above a pickup position
Mvs P2    'Pickup position
Dly 0.3
HClose 1  'Grasp a workpiece
Dly 0.5
Mvs P1
'
Mov P3    'Above a placing position
Mvs P4    'Placing position
Dly 0.3
HOpen 1   'Releace a workpiece
Dly 0.5
Mvs P3
'
Mov P0
'
End
```

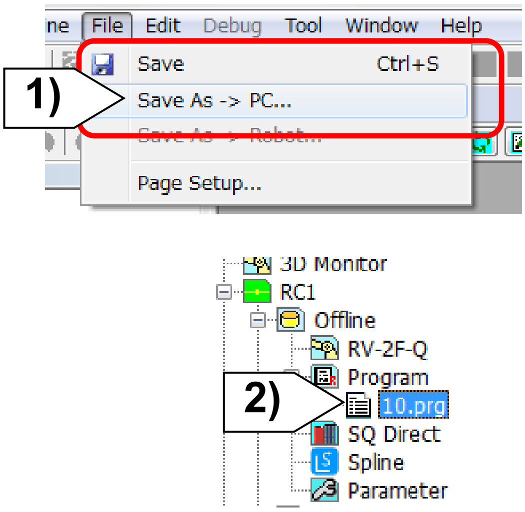
For electrically operated hands

Program 1:RC1 21.prg [MELFA-BASIC V]

```
'-- Robot:RV-2FQ (Electric hand)
EHOpen 1,100,100
'
Mov P0    'Start position
'
Mov P1    'Above a pickup position
Mvs P2    'Pickup position
Dly 0.3
EHClose 1,100,100   'Grasp a workpiece
Dly 0.5
Mvs P1
'
Mov P3    'Above a placing position
Mvs P4    'Placing position
Dly 0.3
EHOpen 1,100,100    'Releace a workpiece
Dly 0.5
Mvs P3
'
Mov P0
'
End
```

(3) Saving the robot program

(1) Save the robot program in the RT ToolBox2 project (personal computer).



1) With the Program Editing window open, select "Save" or "Save As → PC" on the "File" menu.
If "Save As → PC" is selected, the "Save As" window is displayed.

2) The saved programs are displayed under Program in the project tree.
(The programs saved in the project folder on the personal computer are displayed here.)

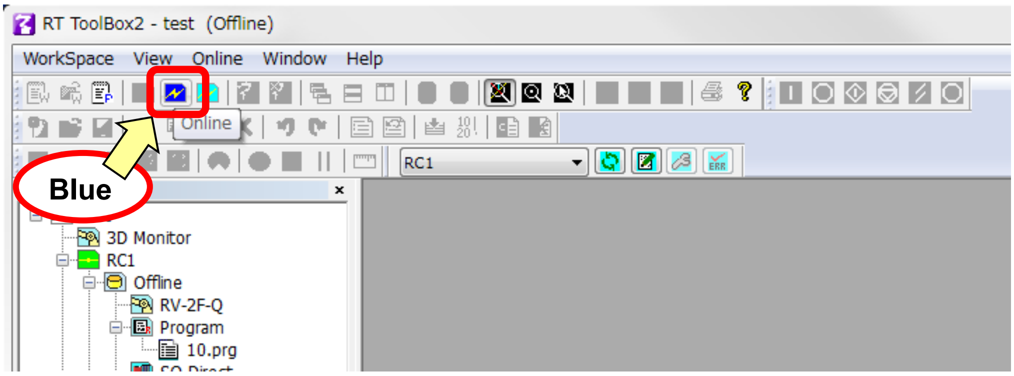
3) After saving the programs, close the Program Editing window.

(4) Connecting to the robot controller

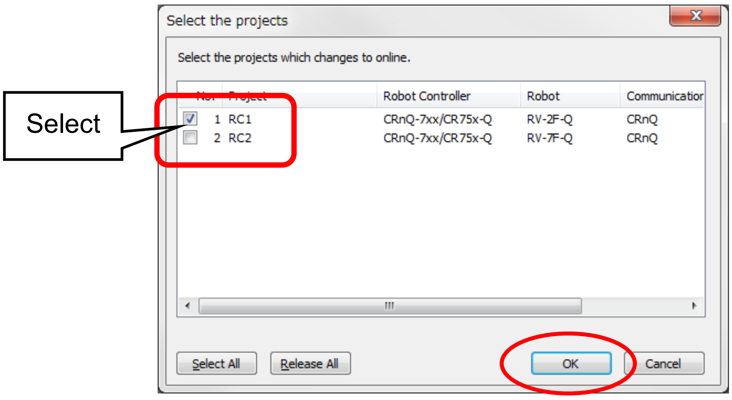
Connect RT ToolBox2 to the robot controller.

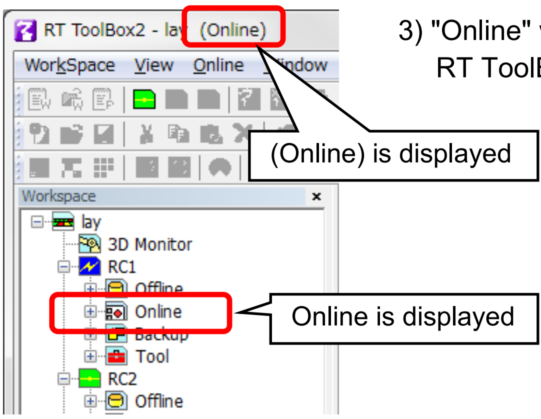
(1) Activate the Online state of RT ToolBox2.

1) Click the [Online] icon (blue) or, click [Online] → [Online] on the menu.



2) If there are multiple projects, then Select the projects window will display Select which project's mode to change, then click "OK".

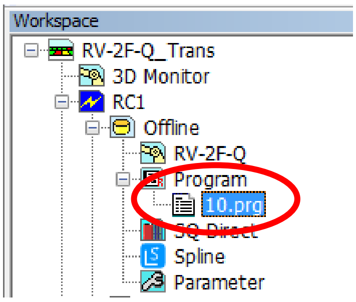




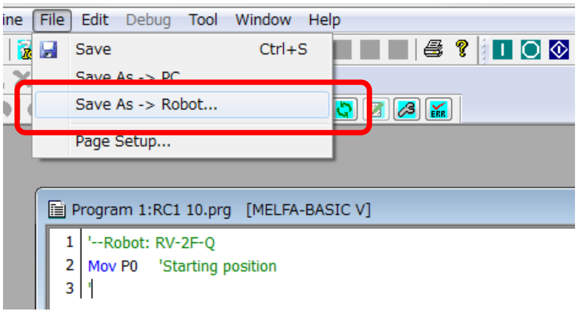
3) "Online" will display in the project tree, and RT ToolBox3 is connected to the robot

Writing the program to the robot controller

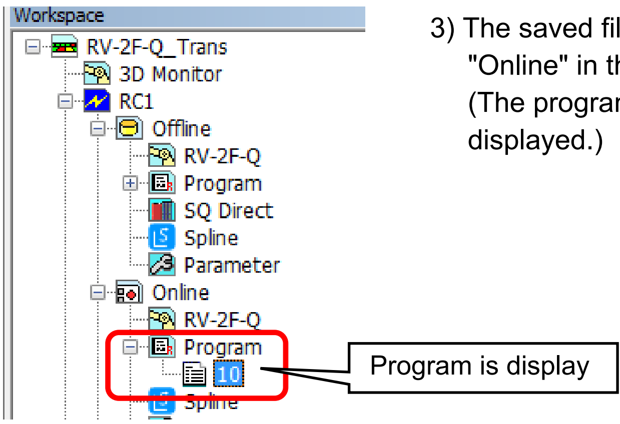
(5-1) Open the program.



1) Open the program from [Program] under [Offline] in the project tree.
(double-click or right-click)



2) Select "Save As → Robot" in "File" on the menu.
The "Save As Robot Program" window appears.
Click "OK".
(To change the file name, input another file name.)

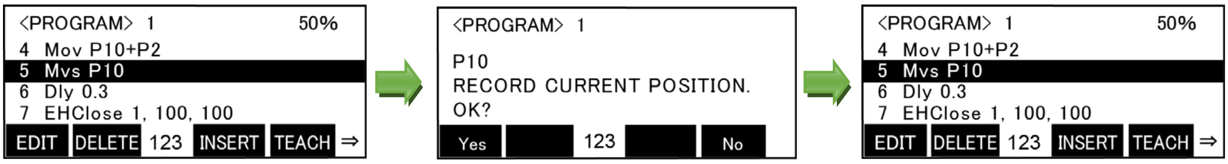


3) The saved file names are displayed in Program under "Online" in the project tree.
(The programs saved in the robot controller are displayed.)

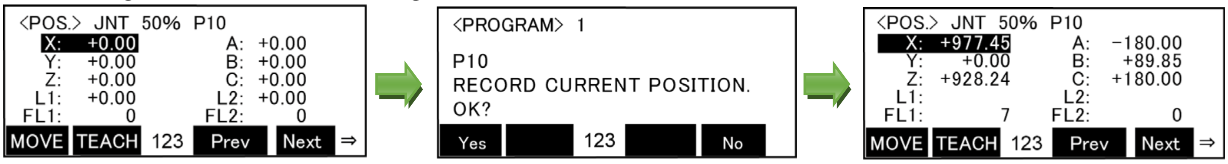
Appendix 3.5 Teaching position

1) Open the program with the robot controller. For details of the procedure, refer to " Chapter 3 3.1 Displaying the program".
2) Move the robot to the operation position with the JOG operation, and register the position to the position variable used in the program. For details of the procedure for teaching operations using the teaching box, refer to "Chapter 3 3.2 Teaching the current position".
3) To check the registered position data, refer to "Chapter 3 3.3 Checking the registered position data (position jump) " (if necessary).
4) When position teaching is complete, save the program. For details of the procedure for saving programs, refer to "Chapter 3 3.5 Saving a program".

Teaching in the Instruction Editing window



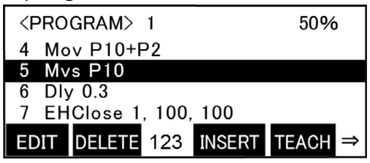
Teaching in the Position Editing window



Appendix 3.6 Debug

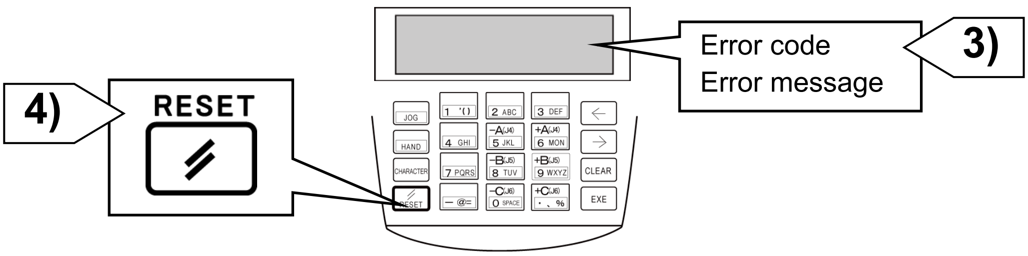
1) Execute the program by one line at a time (step operation) to check if the program operates normally.
2) For details of the procedure for the step operation using the teaching box, refer to "Chapter 3 3.6 Executing step operation".

Executing the program in the Instruction Editing window



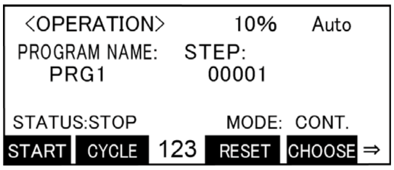
3) If an error occurs, check the error code and error message displayed on the teaching box.
4) Press the [RESET] button on the teaching box to clear the error.
5) Refer to " Appendix 9: List of Error Codes" and take measures for errors.

When errors occur



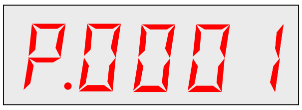
Appendix 3.7 Automatic operation

1) Run the program for automatic operation.
2) Before automatic operation, check that no one is within the robot's operation range, and that the program operates normally by step operation. Set a slow speed at first.
3) For details of the automatic operation procedure using the teaching box, refer to "Chapter 3 3.7. Performing automatic operation (T/B) ".



4) For details of the procedure for automatic operation using the operation panel, refer to "Chapter 3 3.8. Performing automatic operation (O/P) (F Series) ".

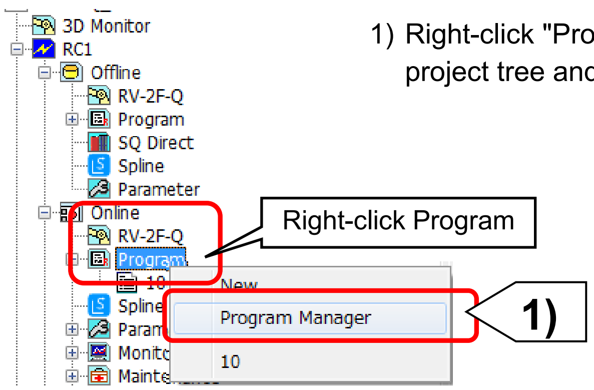
STATUS NUMBER on the controller/drive unit
operation panel (O/P)



Appendix 3.8 Saving the programs (robot → personal computer)

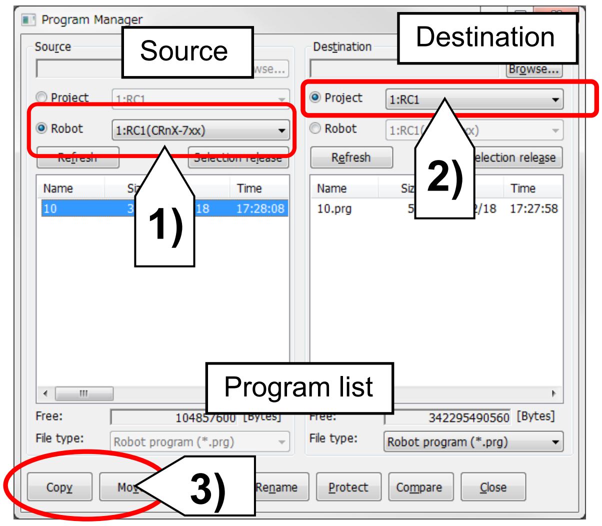
Save the programs in the robot controller to a personal computer.

(1) Open the Program Manager window.

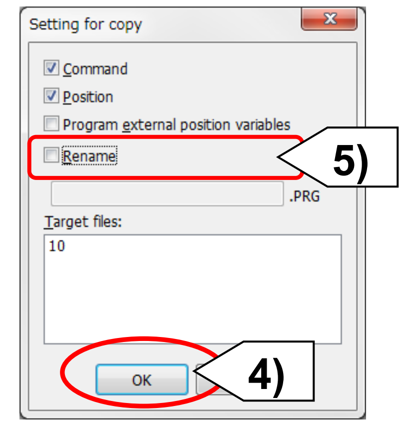


1) Right-click "Program" under "Online" in the RT ToolBox2 project tree and select "Program Manager".

(2) Select and save the programs.



1) Select the programs to be saved. Select "Robot" for Source, and select the robot controller. The list of programs in the controller is displayed. Select the programs to be saved.
2) Specify the destination. Select "Project" for destination. (A list of programs is displayed within the program window.)
3) Click "Copy" in the bottom of the window.



4) If the file name is not changed in the Setting for copy window, click "OK".
5) To change the file name, select "Rename", input a new name in the field below, then click "OK".

◆◇◆The procedures for automatic operation are complete.◆◇◆

Appendix 3.9 Editing and adding a project

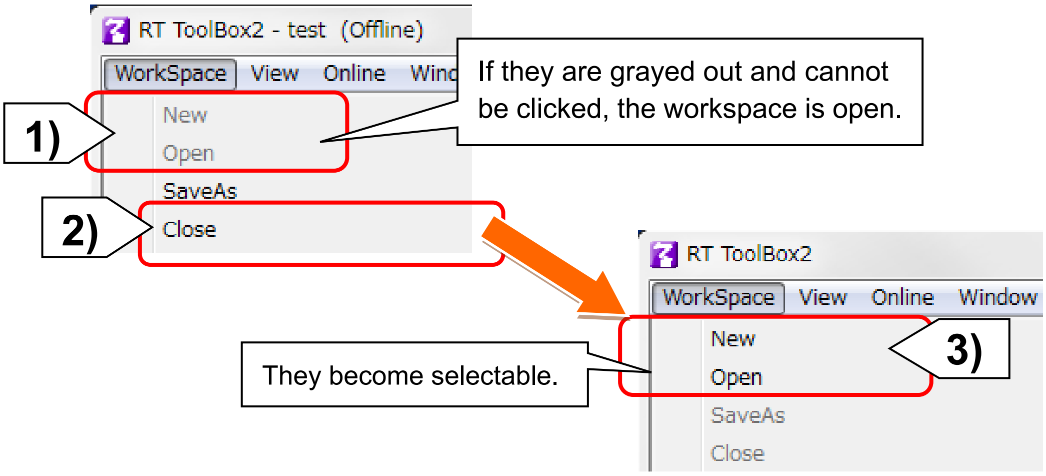
Edit and add projects in the offline state.

(1) Opening a workspace

(1-1) Close the workspace currently in operation.

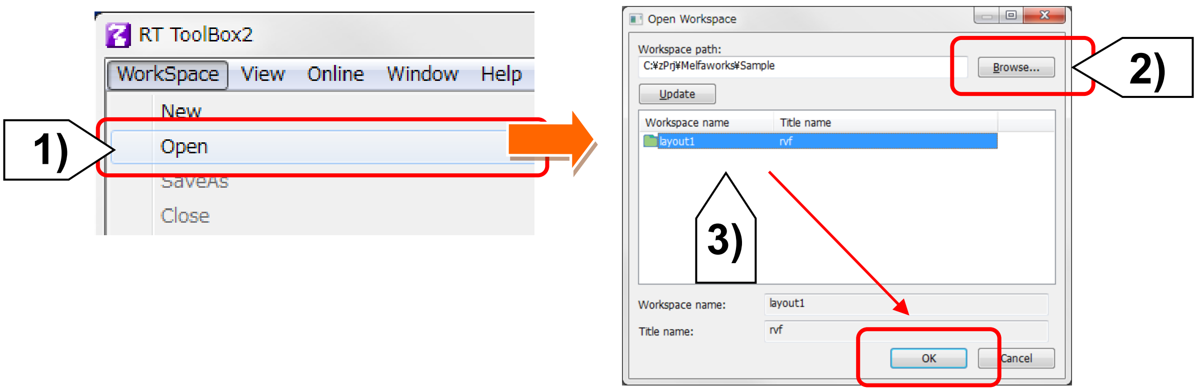
* When opening other workspaces, or creating new workspaces, it is necessary to close the workspace currently in operation.

1) If [New] and [Open] cannot be selected from [WorkSpace] on the menu bar, the workspace is open.
2) Click [Close] from [WorkSpace] on the menu bar and close the currently open workspace.
3) The menu items [New] and [Open] become selectable.



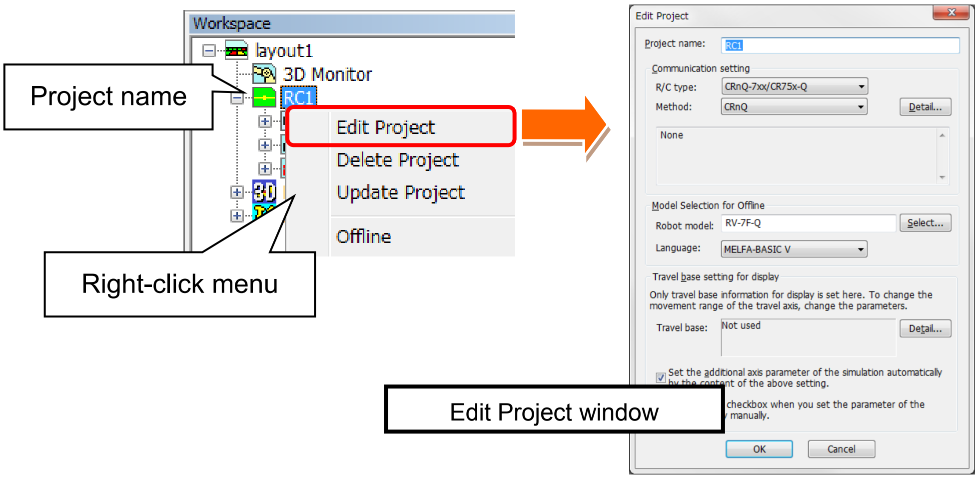
(1-2) Open the workspace.

1) Click [WorkSpace] → [Open] on the menu bar.
2) Click "Browse" to select a workspace location.
3) Select the workspace name, then click "OK".



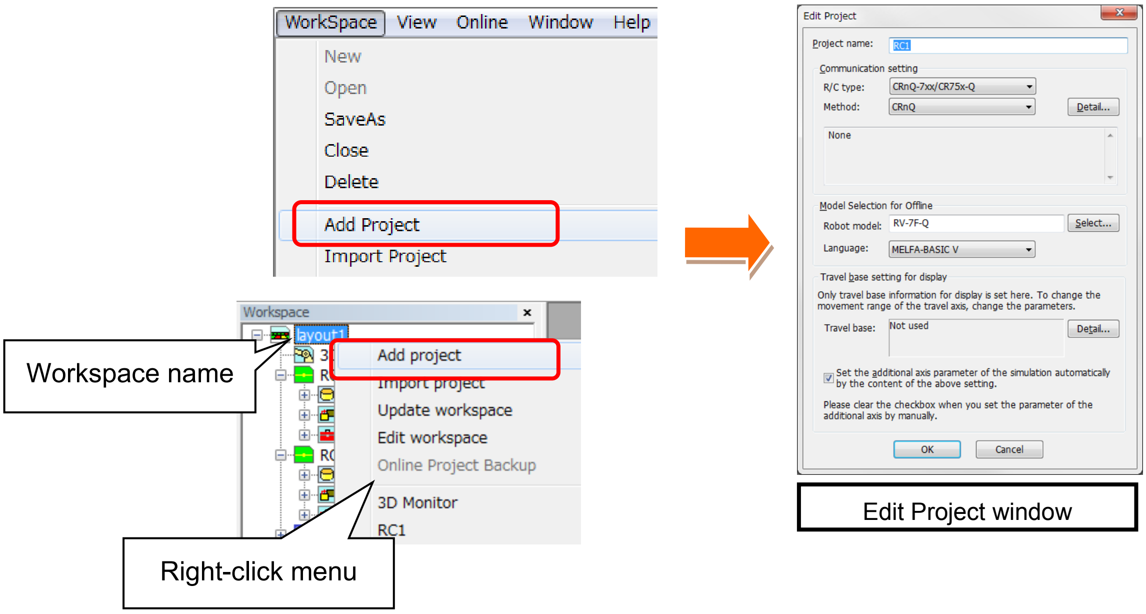
(2) Editing the project

1) Display the Edit Project window. Double-click the project name in the project tree.
Or, select the project name in the project tree, and select "Edit Project" from the right-click menu. For details on editing the project, refer to "Appendix 3.3 Creating a new project".



(3) Adding the project

1) Click [WorkSpace] → [Add project] on the menu bar.
Or, select the workspace name in the project tree, right-click and select "Add project" to display the Edit Project window.
For details on editing the project, refer to "Appendix 3.3 Creating a new project".



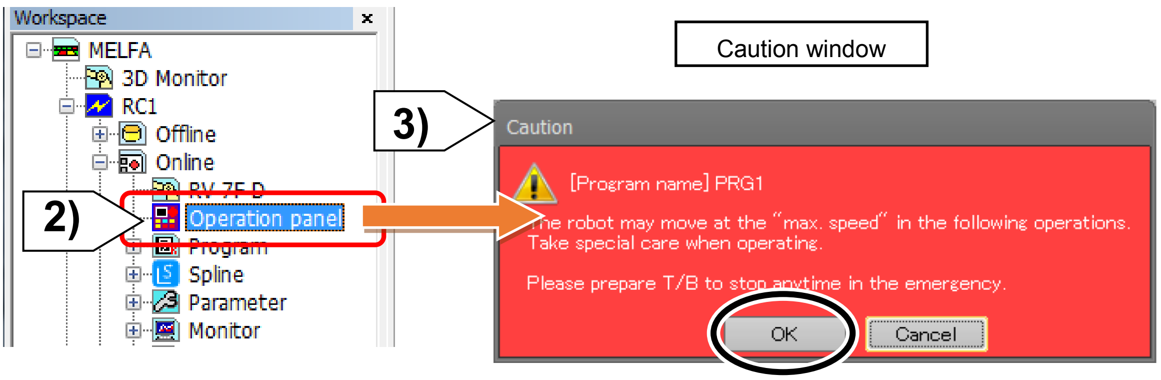
Appendix 3.10 Operation panel

⚠Danger	The robot may operate at 100% speed during the program operation and debugging. Pay attention to safety around the robot. Before using the operation panel, prepare a T/B in hand and set the robot in a state in which an emergency stop can be made at any time.

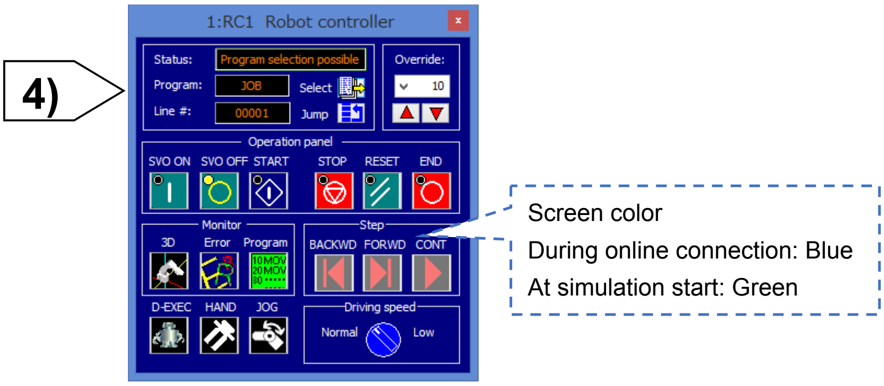
For RT ToolBox2, the operation panel that operates a robot can be started at online connection and simulation start.
Robot programs, hand operation, and JOG operation can be performed in the operation panel.
Program debugging can be carried out by step operation.
Although Hand operation and JOG operation can be performed on the robot, pay full attention to robot's surroundings.

(1) Starting the operation panel (at online connection)

1) Connect RT ToolBox2 to the robot controller.
   For details of connection methods, refer to "Appendix 3.4 Creating a program (4) Connecting to the robot controller".
2) Click [Online] in the project tree, and double-click [Operation panel].
3) When starting the program or carrying out direct execution, the Caution window is displayed.
   Clicking the [OK] button starts the robot operation. Therefore, check the safety around the robot and prepare a T/B before starting the robot operation.

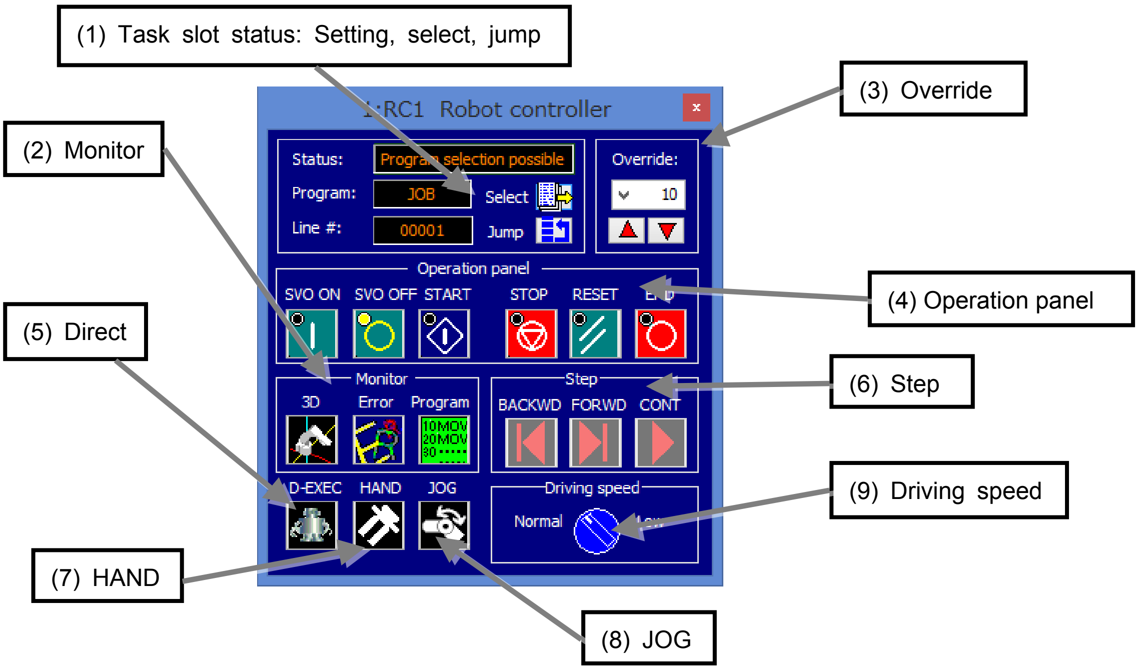


4) Click [OK] in the Caution window, and the operation panel is displayed.



(2) Main screen

Programs selected in the operation panel and programs in the debug state can be executed.
When the program is opened in the debug state, it can be executed by step operation.



1) Task slot status and specification
Displays the task slot status, selected program, and line number being executed.
• Click the [Select] button to specify the program to be executed.
• Click the [Jump] button to specify the program execution line.

2) Monitor
Displays the 3D monitor, Error monitor window, and Program monitor window.

3) Override
Displays and sets the robot speed override.

4) Operation panel
Starts, stops, resets, and ends the program operation, and turns the servo ON/OFF.

5) Direct
Performs a direct execution of an instruction (regardless of the robot program).

6) Step
Controls the program in the debug state.
• [FORWD], [BACKWD]: Executes one line of the robot program, and moves the execution line to the previous or next line.
• [CONT]: Executes a program that has stopped by a breakpoint or the stop command continuously from the stopped line.

7) HAND
Operates the robot hand. Click this button to display the Hand Operation window.
In addition to the opening and closing of each hand, hand alignment and home position return can be performed.
(To open and close the electrically operated hand, perform direct execution.)

8) JOG
Performs the JOG operation on the target robot.(For details, refer to "(3) JOG Operation window" on the next page)
Click this button to display the JOG Operation window.

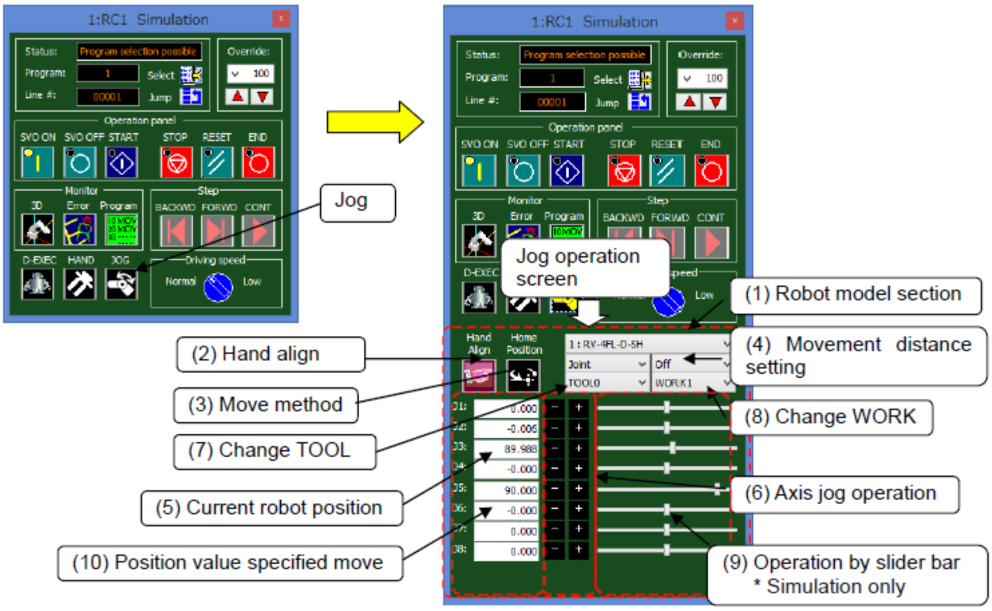
9) Driving speed
Selects the robot driving speed from Normal to Low.
When Low is selected, the robot moves at the maximum JOG operation speed.

(3) JOG Operation window

The robot JOG operations displayed in the robot view can be performed in the online or simulation mode. Click the "JOG" button in the operation panel to display the JOG Operation window.

To perform JOG operation online (when connected to a robot controller), the personal computer needs to be set to acquire operation rights.

When the MODE key of the robot controller is set to "Automatic" and external I/O signals are used, set inputs of operation rights from external I/O to OFF.



1) Robot model selection

Selects the robot model to be operated when multiple robots are connected.

2) Hand Align

Aligns the posture of the hand attached to the robot in units of 90 degrees.
This feature moves the robot to the position where the A, B and C components of the current position are set at the closest values in units of 90 degrees.

3) Move method

Select the method in which the robot moves. For details of the movement method, refer to "Appendix 3.14 Simulation function (2) JOG operation".

4) Movement distance setting

Selects the robot movement distance. Selectable move distances are "off", "High", and "Low".

5) Current robot position

6) Axis JOG operation

Performs the JOG operation on each robot axis.
The robot moves while holding down the [+] or [-] button with the mouse.

7) Change TOOL

8) Change Workpiece

9) Operation by slider bar

When Joint or XYZ jog is selected, the corresponding coordinate axis can be moved by moving the slider bar to the left and right. The slider bar can be moved only in the simulation mode.

10) Move the robot by inputting coordinates.

Specify the joint or XYZ coordinates directly to move the robot.

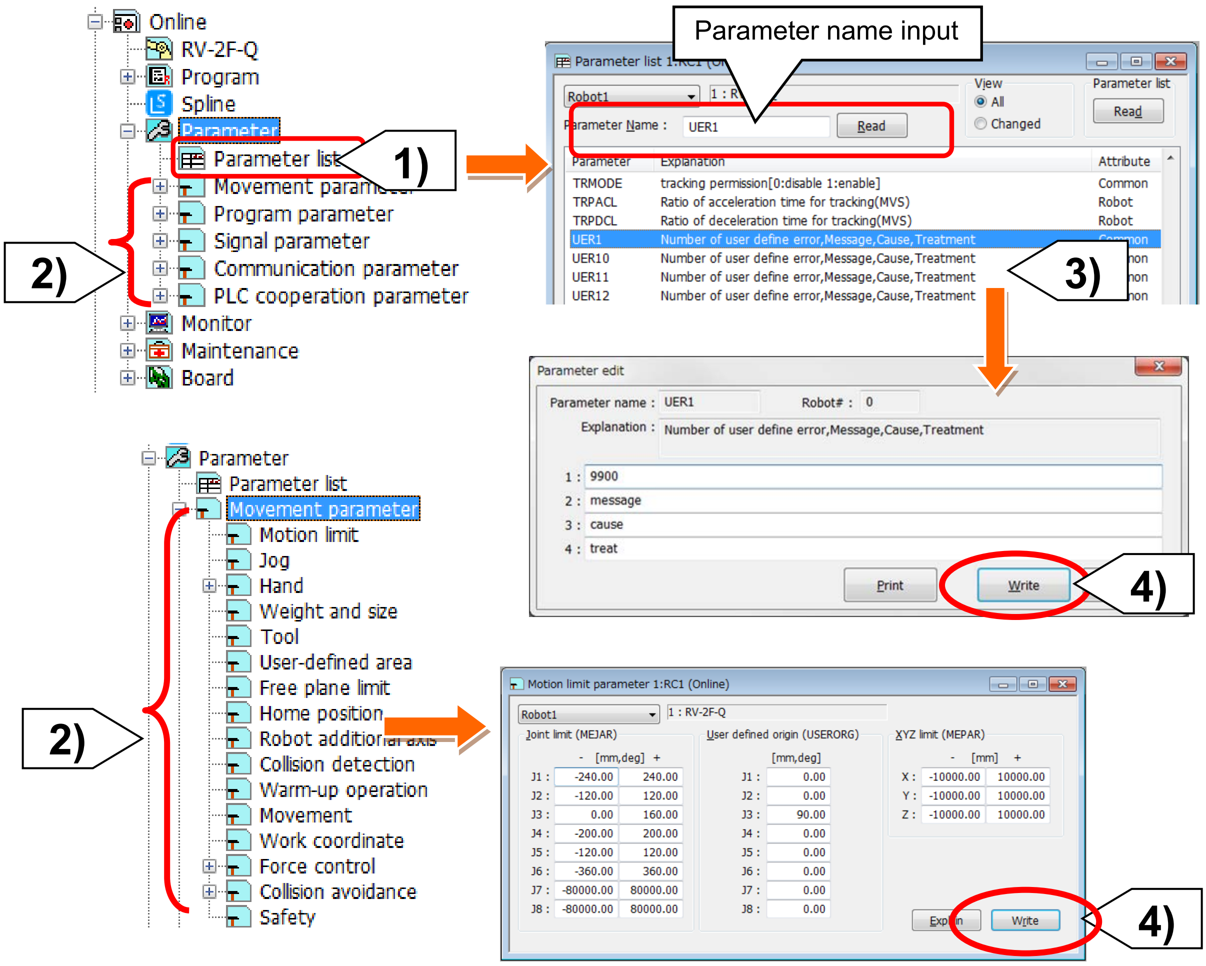
Appendix 3.11 Parameter setting

The parameter information set in the robot controller can be referred to and overwritten.
Set the parameters with the robot controller connected to RT ToolBox2.
To set parameters in the robot controller, select [Parameter] under [Online].
Expanding the items in [Parameter] displays items to start each parameter setting window.
Frequently used parameters are described in " Appendix 7: Frequently Used Parameters".
* For details of parameters, refer to the instruction manual "Detailed explanations of functions and operations".

Referring to and overwriting the parameter information

[Reference]
1) Expand [Online] → [Parameter] in the project tree, and double-click [Parameter list].
2) Or, expand each parameter under [Parameter], and double-click the parameter.
3) For [Parameter List], double-click the parameters displayed in the list.
After inputting a parameter in "Parameter Name", click the "Read" button to search for the parameter.

[Overwrite]
4) To change parameters, change the parameter values and click "Write".
5) To enable the changed parameter values, power on the robot controller again.



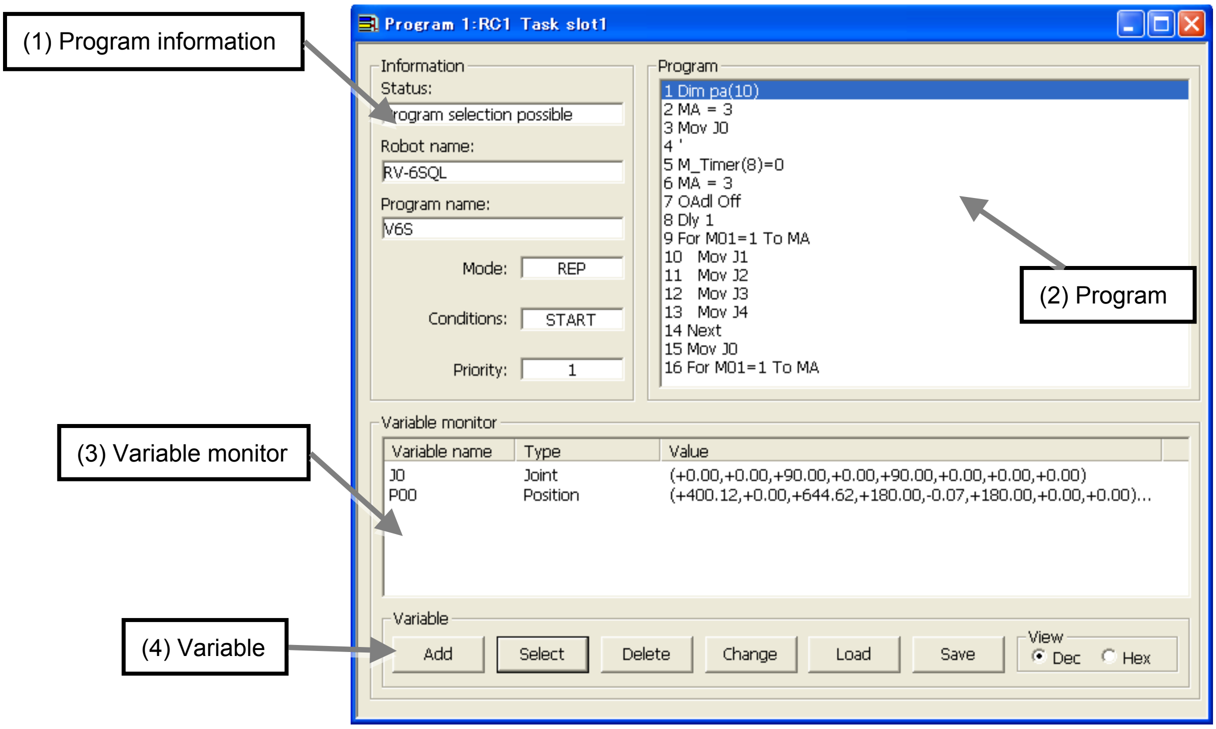
Appendix 3.12 Monitoring function

Monitor the items related to the operation of the connected robot.

(1) Program monitoring

The program information in operation can be monitored.

Information such as the line currently being executed, variable values, robot posture, and position



information can be checked.

1) Program information
The program name currently selected, its operation status, and the model name of the connected robot can be checked.

2) Program
The currently selected programs are displayed. The line currently being executing is highlighted.

3) Variable monitor
The names of the variables used in the selected programs can be checked.
The variables to be monitored can be selected with the buttons displayed at bottom of the window.

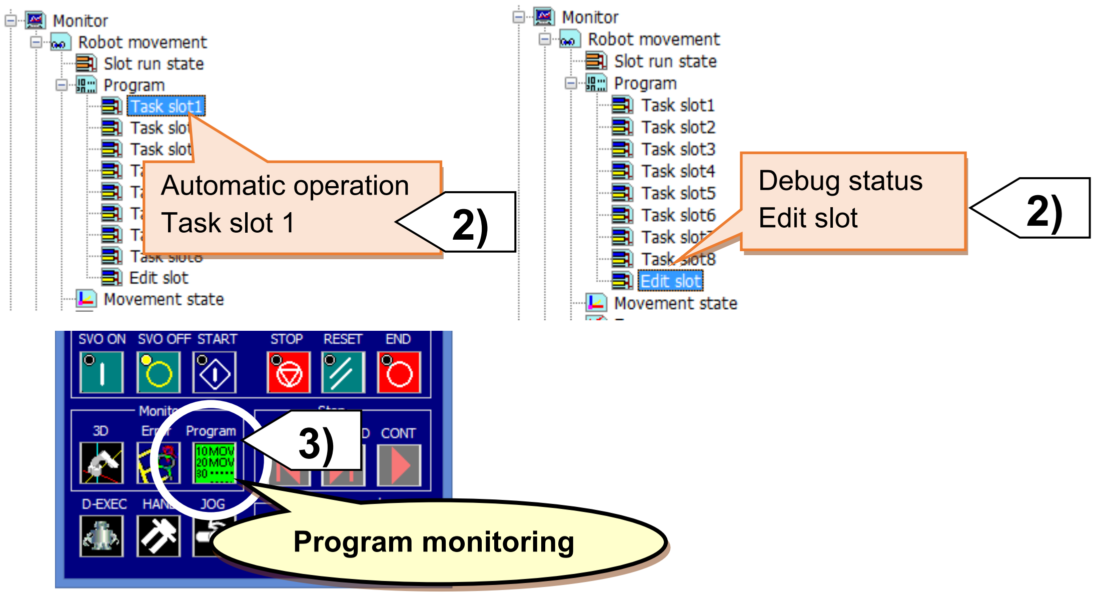
4) Variables
Add or select variables to be monitored.
Information currently being monitored can be saved to a file.
The saved variable names and types can be read from the file, and they can be set as variables to be monitored.

How to display the Program window

1) With the program open or being executed, click [Online] → [Monitor] → [Robot Movement] → [Program] for the target project in the project tree.

2) For automatic operation, double-click "Task slot1". For debug state, double-click "Edit slot".

3) Clicking [Monitor] → [Program] in the operation panel also displays the program monitor (it is not necessary to select a task slot in the project tree).

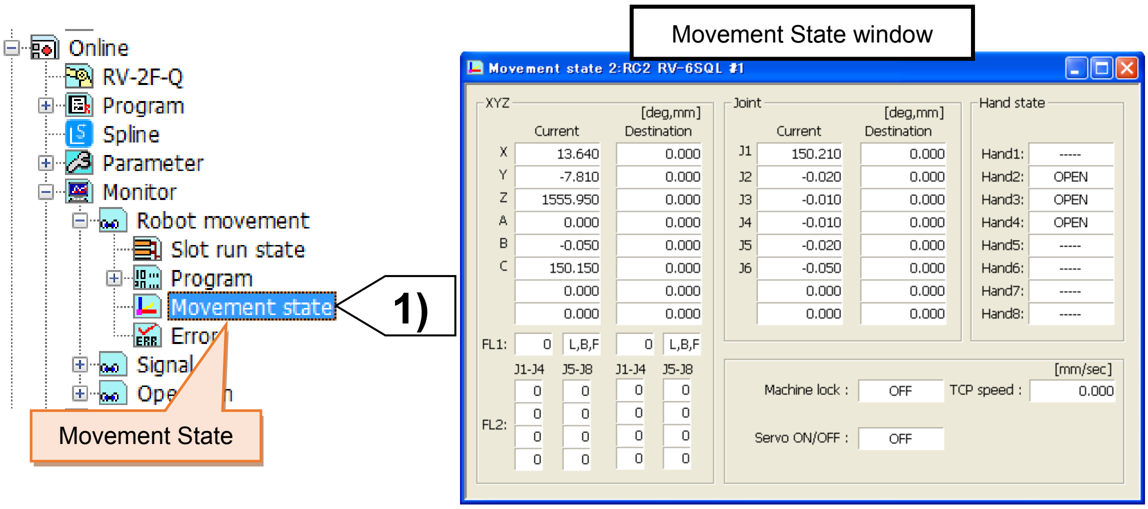


(2) Movement State

The current position, target position, and hand opening/closing status of the robot can be checked.

How to display the movement state

1) Double-click [Online] → [Monitor] → [Robot Movement] → [Movement State] for the target project in the project tree.

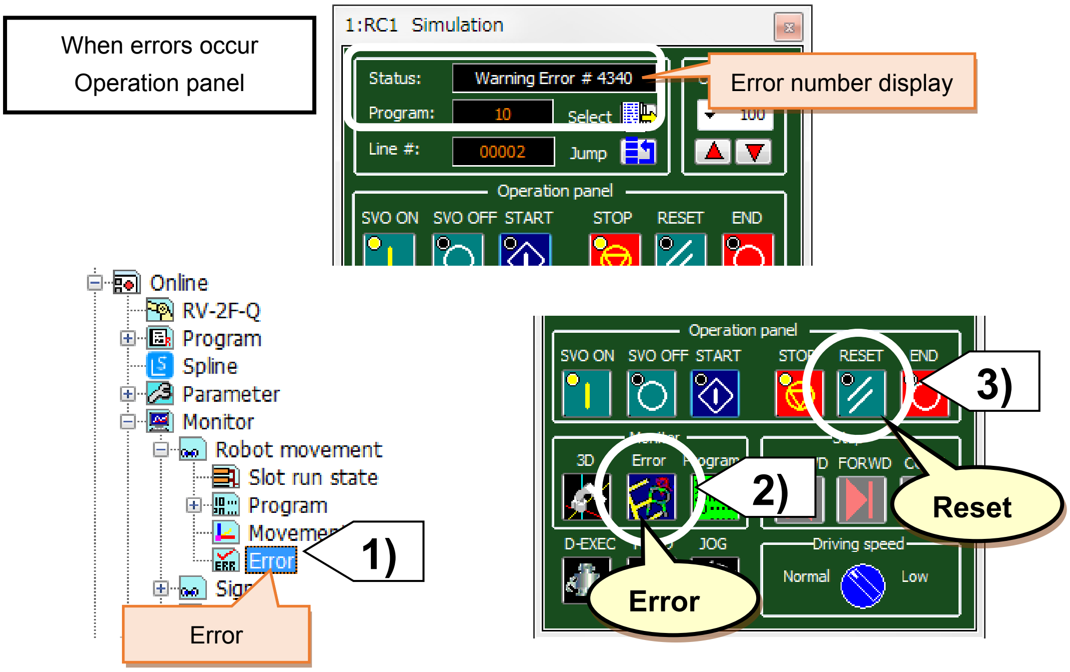


(3) Error monitoring

The errors currently occurring are displayed.
In the Error Detail window, details (causes and recovery methods) of errors that have occurred can be checked.

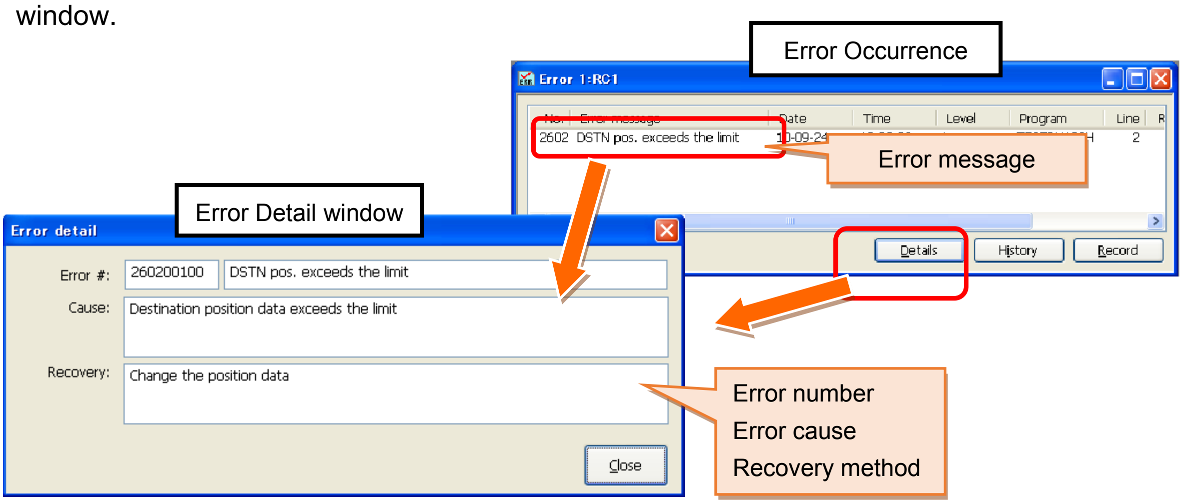
How to display the Error window

1) Double-click [Online] → [Monitor] → [Robot Movement] → [Error] for the target project in the project tree.
2) Clicking [Monitor] → [Error] in the operation panel also displays the error.
3) To reset the error, click [RESET] in the operation panel.



How to display the Error Detail window

1) Select the error and click the [Details] button, or double-click the error message on the Error window.



(4) Signal monitoring

The status of signals input to the robot controller from external equipment and signals output from the robot controller to external equipment can be checked on the General Purpose Signal monitor.

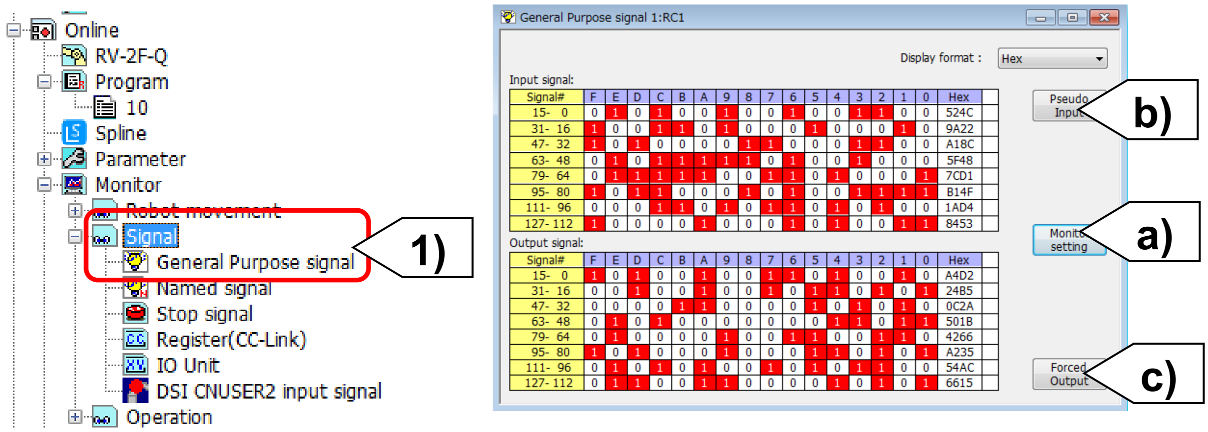
a) Monitor settings: Signals displayed on the monitor can be set in a continuous range.

b) Pseudo-input: Signals are input to the robot controller from a personal computer, not from external equipment.

c) Forced output: Signals can be forcibly output to external equipment from the robot controller.

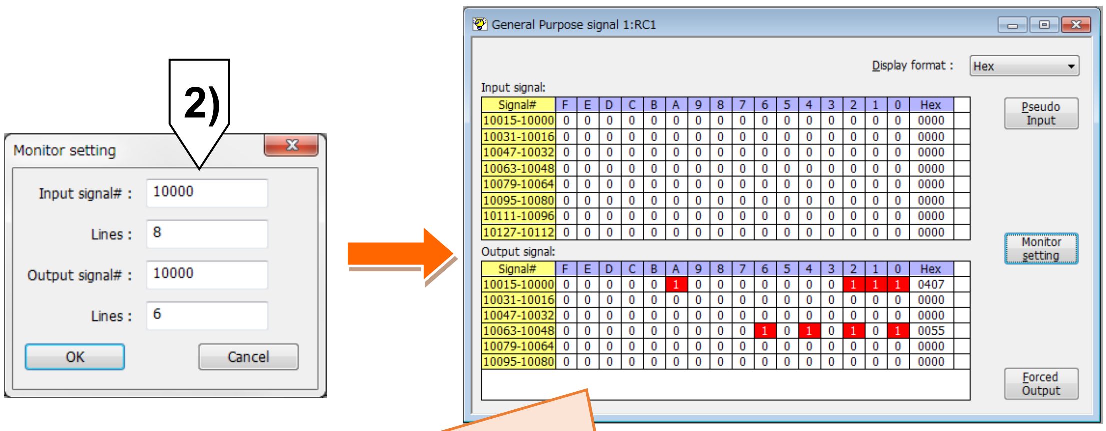
How to display the General Purpose Signal monitor

1) Expand [Online] → [Monitor] → [Signal] for the target project in the project tree, and select "General Purpose Signal".



How to set the signals that are displayed

1) Click the Monitor Setting button (a) to display the Monitor Setting window.
2) Input the start numbers of the signals displayed in [Input signal#] and [Output signal#], set their display ranges in [Lines], and then click the [OK] button.



Example)
Input signal: Signal number 10000 or later, 8 lines displayed
Output signal: Signal number 10000 or later, 6 lines displayed

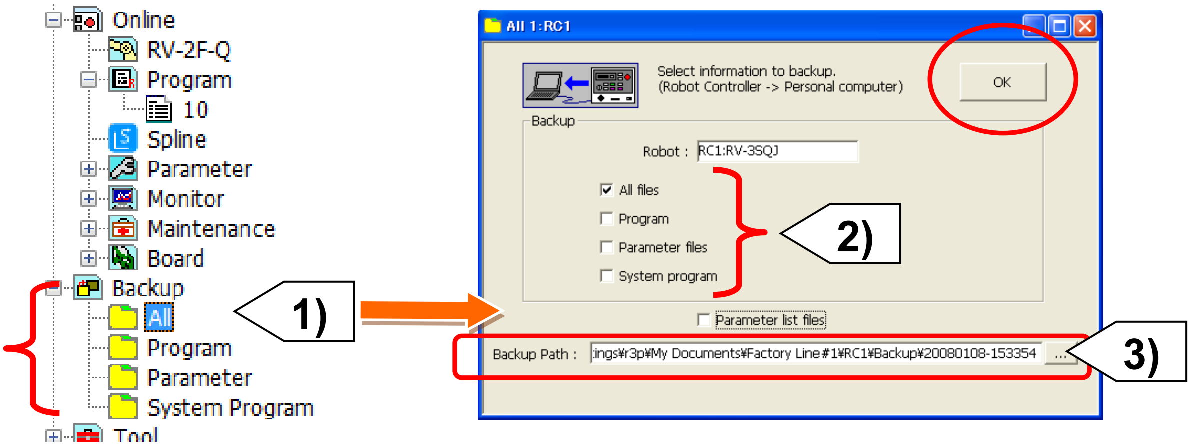
Appendix 3.13 Backup and restore

Set the parameters with the robot controller connected to RT ToolBox2.

(1) Backup (robot → personal computer)

Save the information in the robot controller to a file in a personal computer.

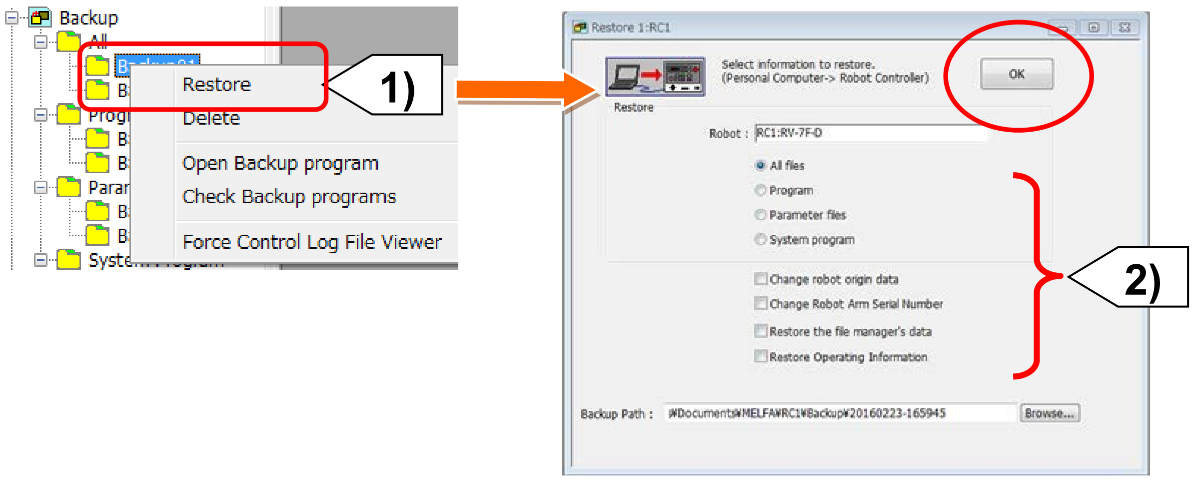
1) Expand [Online] → [Backup] in the project tree, and double-click the items to be backed up.
2) The backup method can be changed by selecting the check box in the window.
3) Specify the backup destination, and click "OK".
4) The Confirmation window is displayed, and the backup starts.
5) When the backup has completed, the backup data is displayed under [Backup] in the project tree.



(2) Restore (personal computer → robot)

Transfer information back up on the personal computer to the robot controller.

1) Expand [Backup] in the project tree, select the items to be restored, and select "Restore" from the right-click menu.
2) Specify the restoration method, and click "OK".

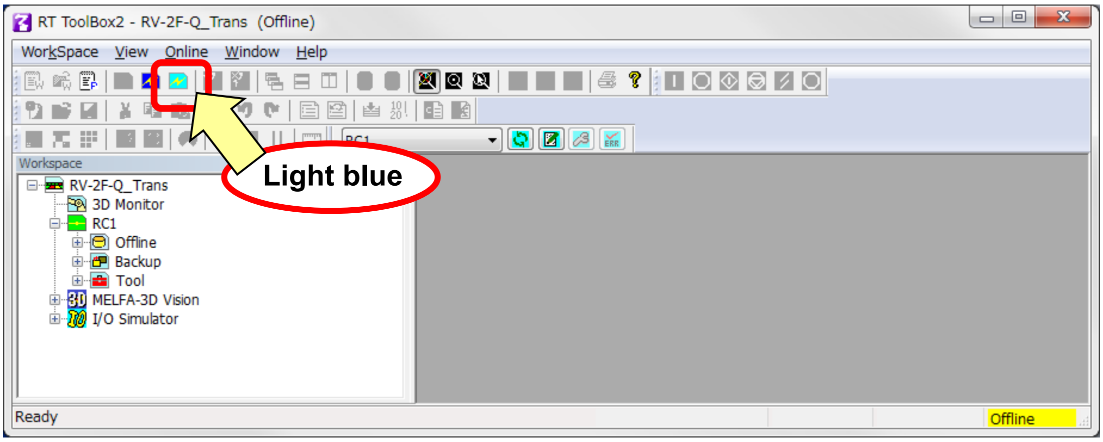


Appendix 3.14 Simulation function

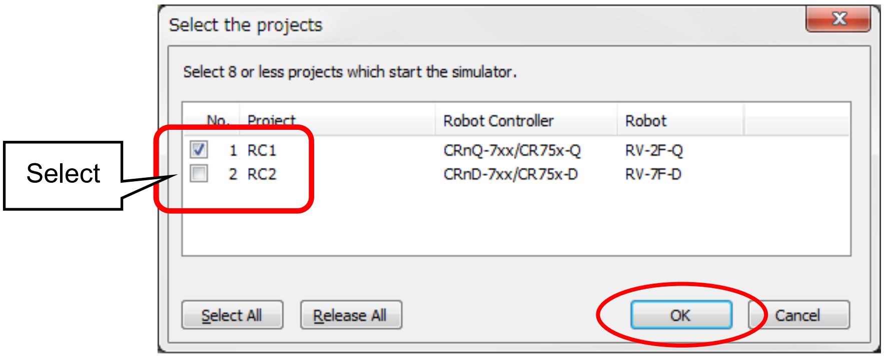
(1) Starting the simulator

(1-1) Start the simulator.

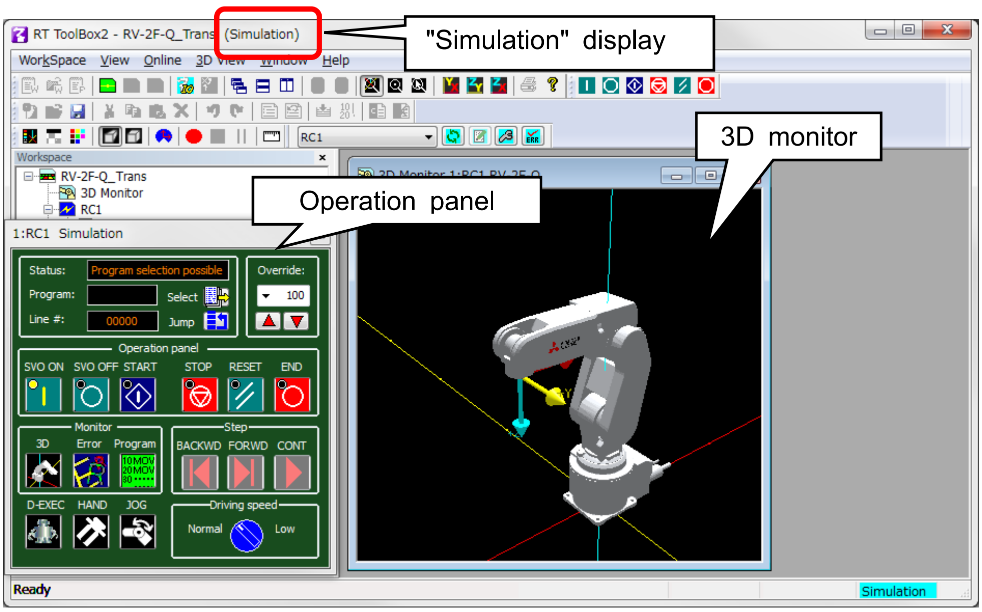
1) Click the [Simulation] icon. (light blue)



2) If there are multiple projects, then Select the projects window will display Select the project to be executed, then click "OK".

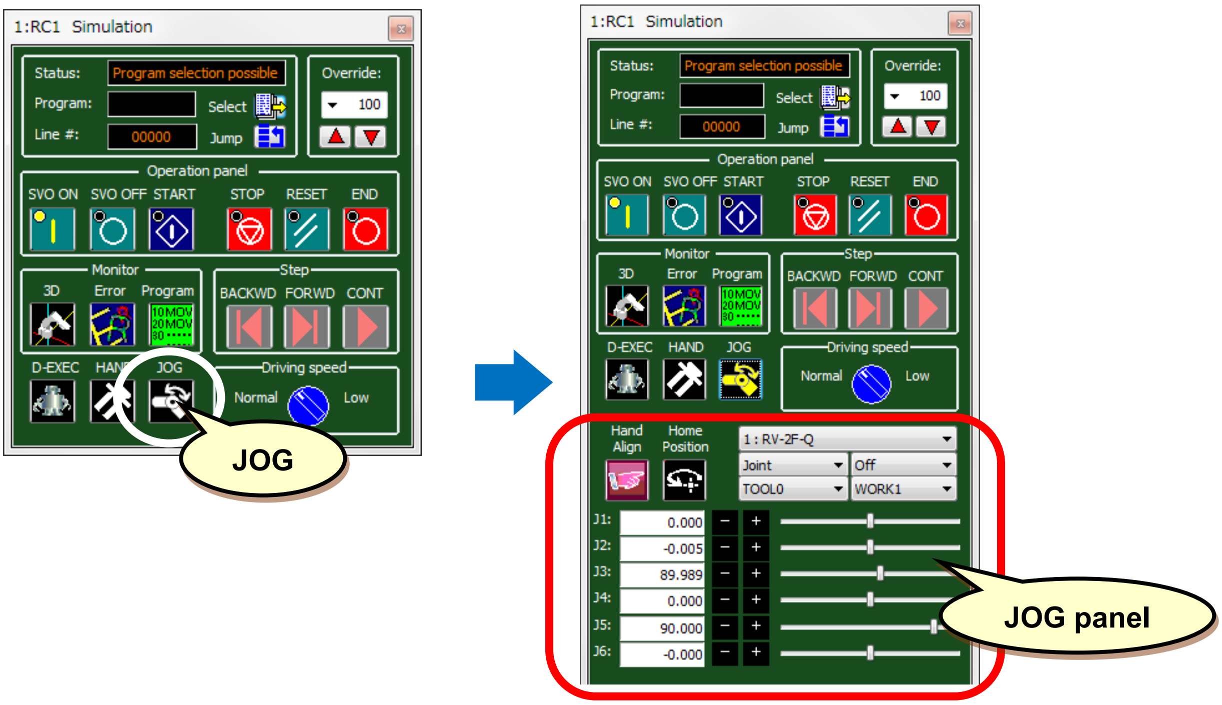


3) The simulator starts.

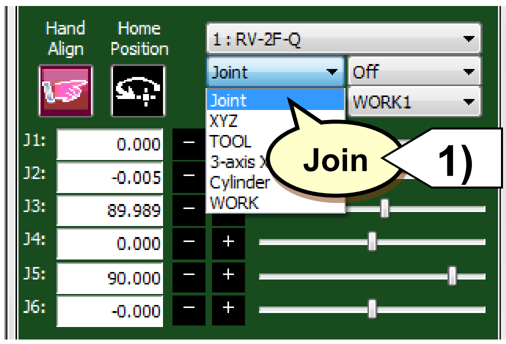


(2) JOG operation

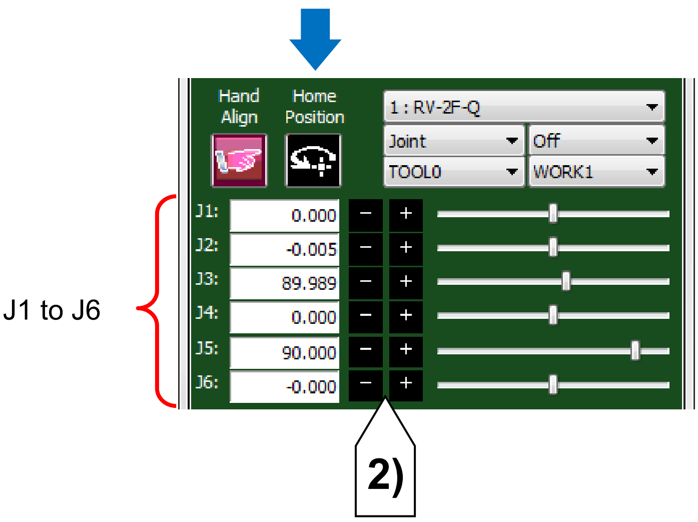
(2-1) Click the "JOG" button to open the JOG panel.

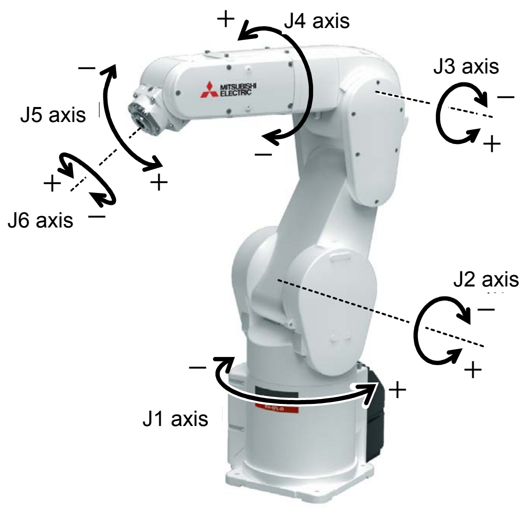


(2-2) Check the operation in the Joint JOG mode.



1) Select "Joint" for "JOG mode".
2) Click [-] or [+] for J1 to J6, and check that the robot operates.

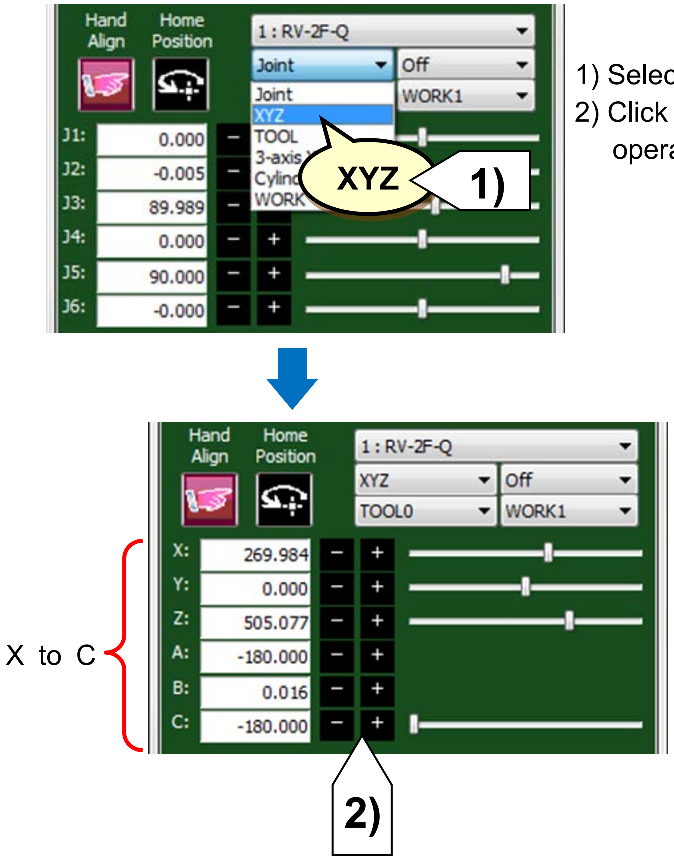


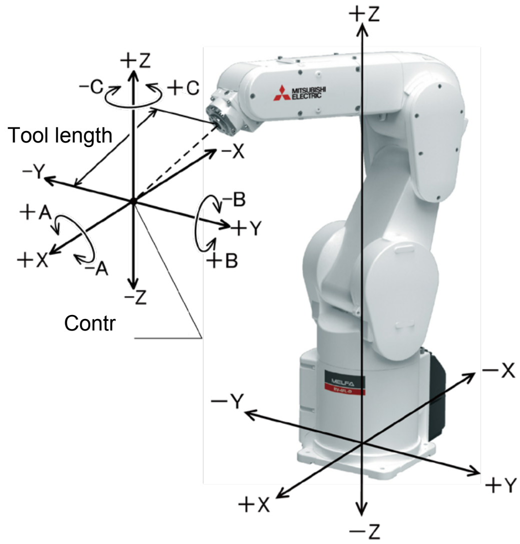


Joint JOG mode
(For the RV type)

(2-3) Check the XYZ jog mode operation.

1) Select "XYZ" for "JOG mode".
2) Click [-] or [+] for X to C, and check that the robot operates.

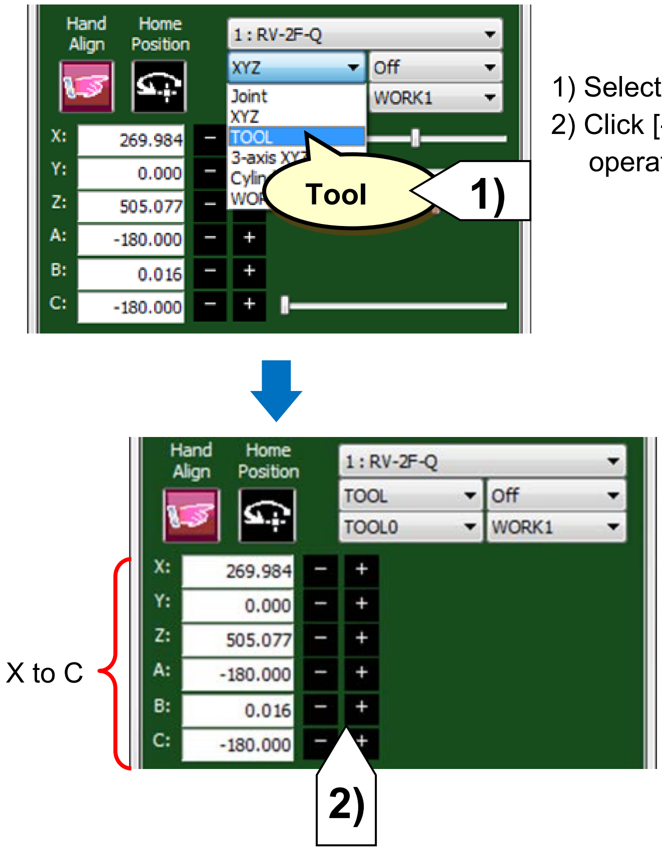


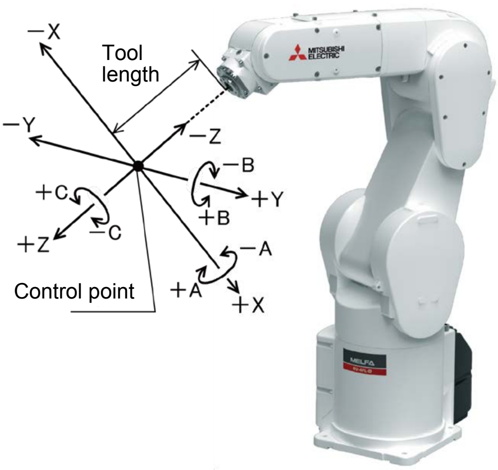


XYZ JOG mode
(For the RV type)

(2-4) Check the operation in the TOOL JOG mode.

1) Select "TOOL" for " JOG mode".
2) Click [-] or [+] for X to C, and check that the robot operates.

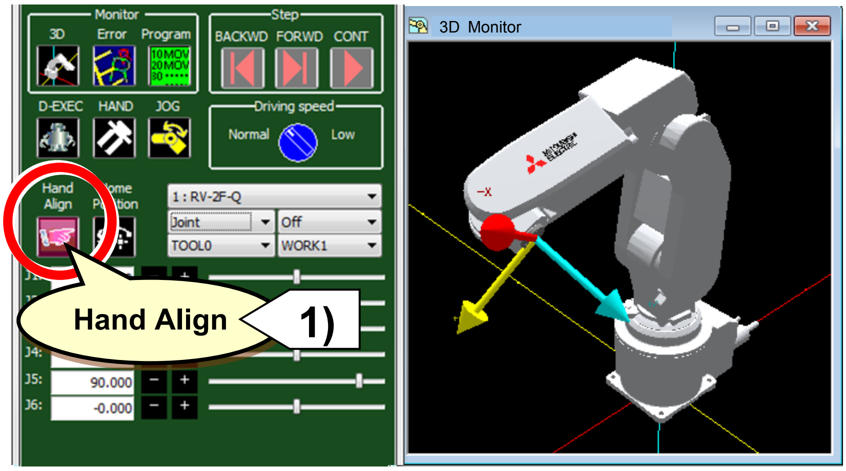




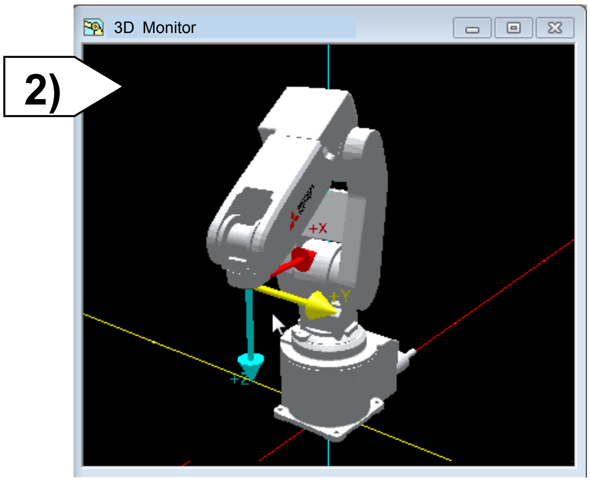
TOOL JOG mode
(For the RV type)

(3) Hand alignment

(3-1) Check the hand alignment operation (correct the robot posture).



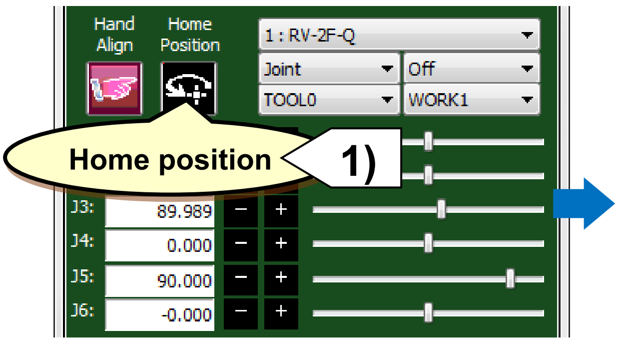
1) Click the "Hand Align" button.

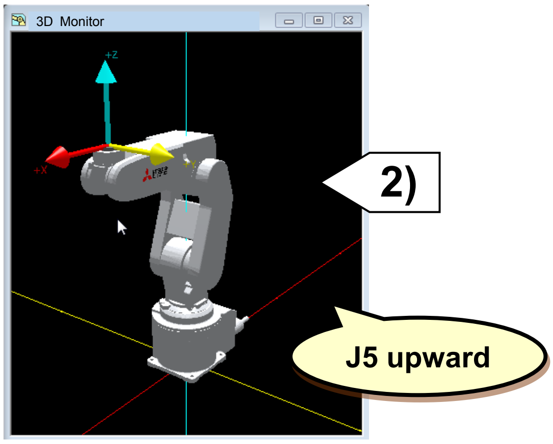


2) The hand moves to the closest posture in increments of 90 degrees.
If the hand almost faces the side, it completely turns to the side. If the hand almost faces upward, it completely turns upward.

(4) Home position return

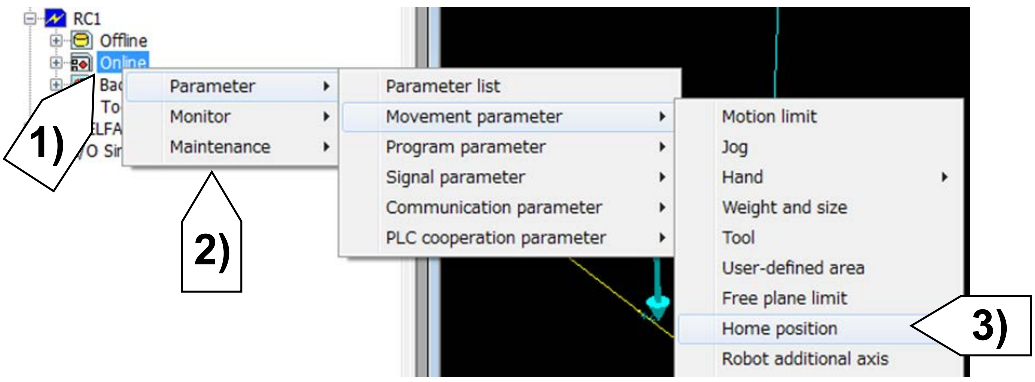
(4-1) Perform the home position return operation.



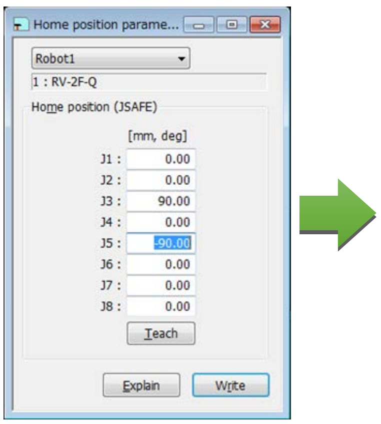


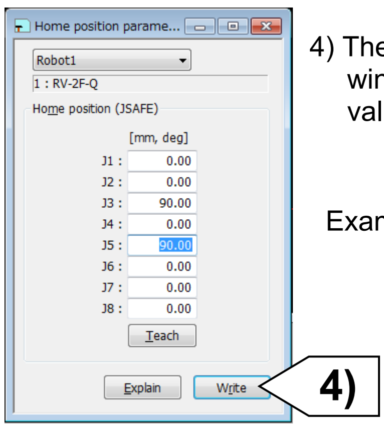
1) Click the "Home position" button.
2) Move to (J1, J2, J3, J4, J5, J6) = (+0.00, +0.00, +90.00, +0.00, -90.00, +0.00) set in the parameter "JSAFE".

(4-2) Change the home position.



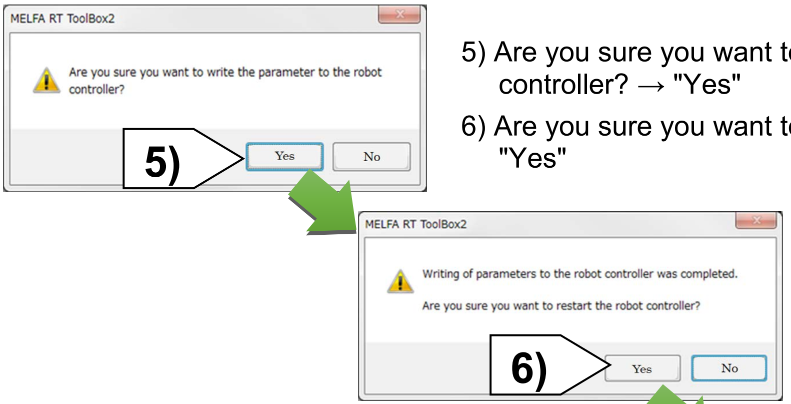
1) Right-click [Online] in the project tree to display a sub menu.
2) Move the cursor to [Online] to display another sub menu, then move the cursor to [Movement parameter].
3) In the same way as above select [Home Position] in the displayed menu, click [Home position].





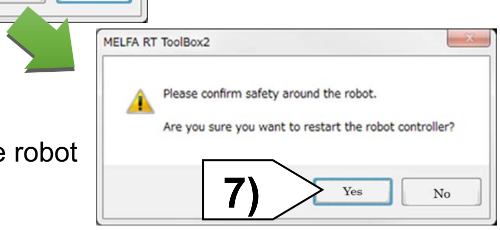
4) The Home Position Parameter window will display. Change the values and click [Write].

Example) Changing the J5 axis value from "-90" to "+90"

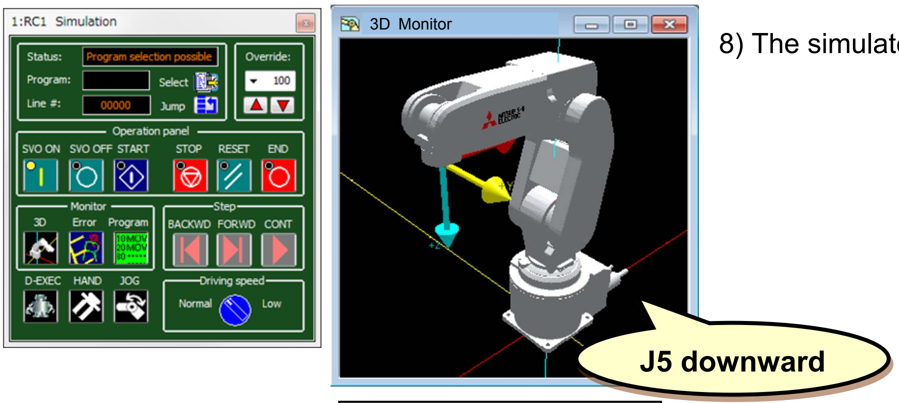


5) Are you sure you want to write the parameter to the robot controller? → "Yes"

6) Are you sure you want to restart the robot controller? → "Yes"



7) Are you sure you want to restart the robot controller? → "Yes"



Posture after restart

8) The simulator restarts.

(5) Creating a hand

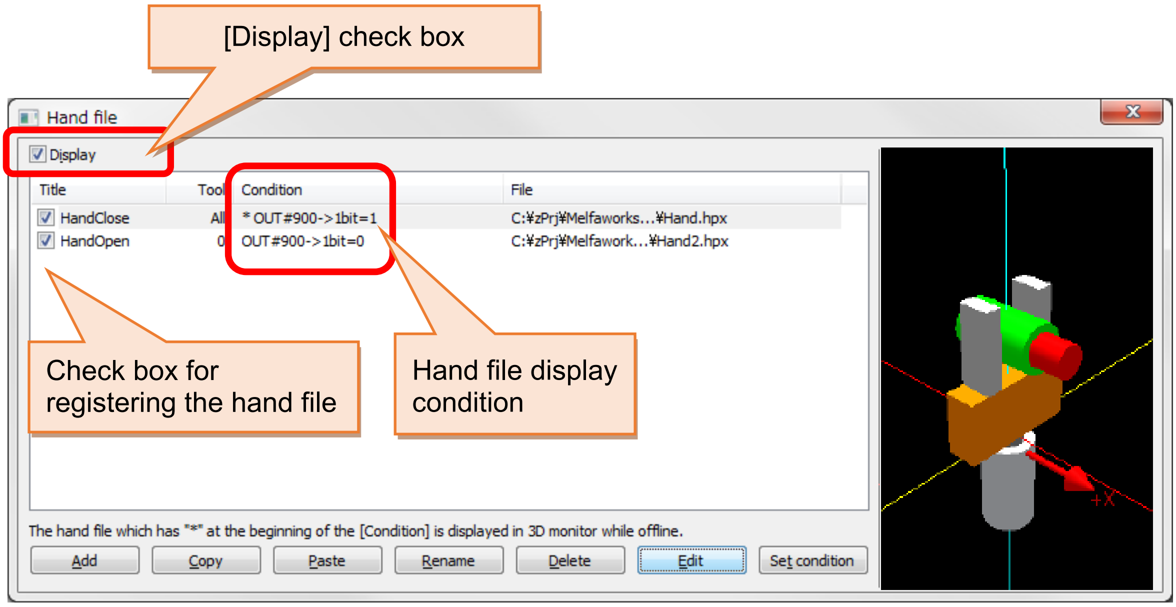
Display the hand in robot tool in the 3D Monitor. The hands to be displayed can be switched depending on the signal status.

<Hand file manager window>

Click [3D View] → [Hand] on the menu bar to display the "Hand file" window.

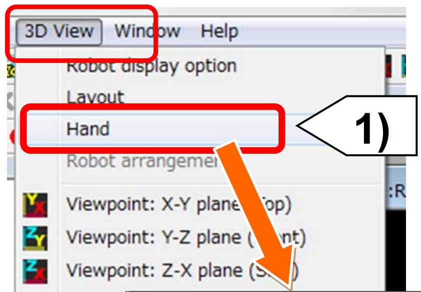
Hand files displayed in this window are displayed as hands of the robot on the 3D Monitor window.

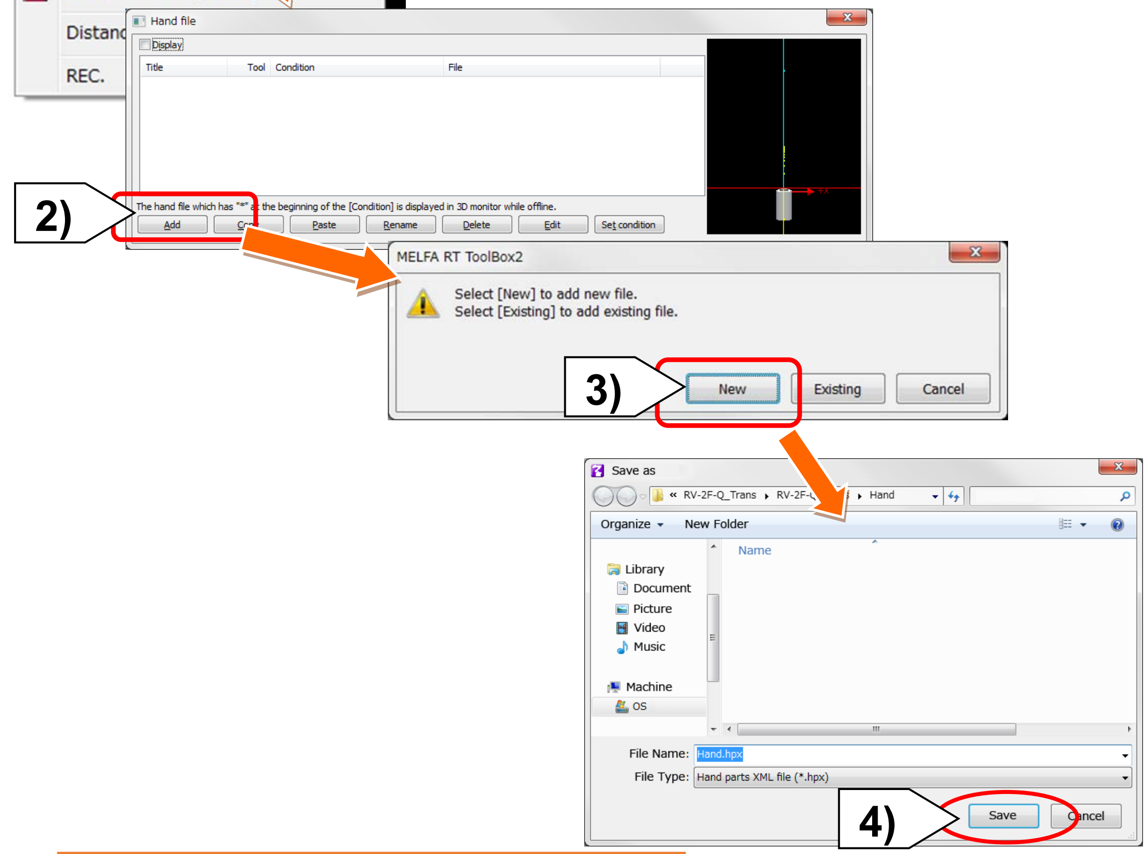
If the [Display] check box is deselected, no hands are displayed at all. Deselecting the check boxes for registering each hand file hides the hand files.

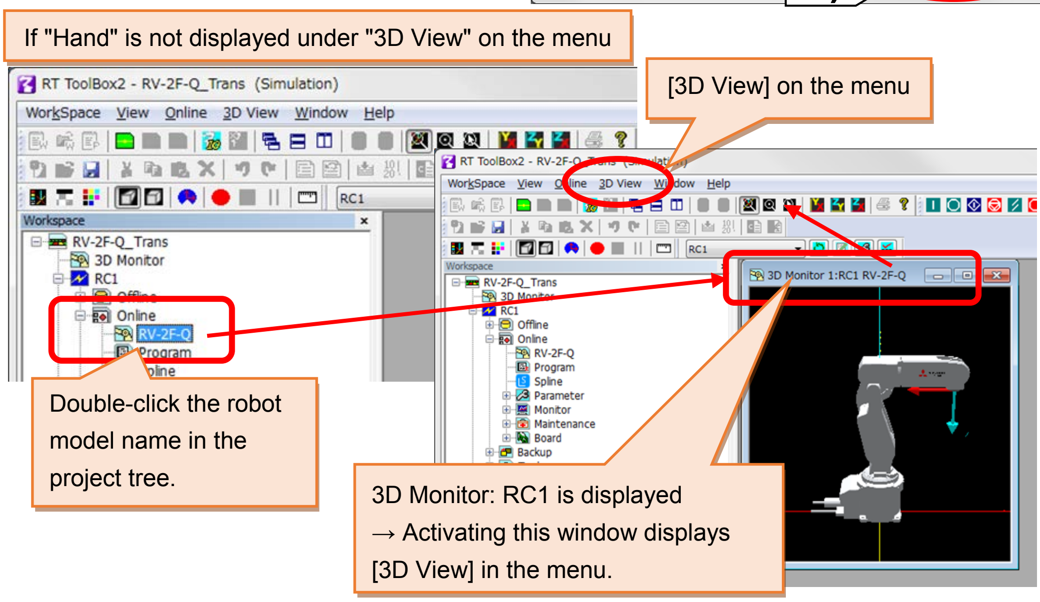


(5-1) Create a hand setting file.

1) Select [Hand] from [3D View] in the menu.
2) Click [Add] in the Hand file window.
3) To create a new hand file, select [New].
(To correct the existing file, select [Existing].)
4) Input the file name, and click [OK].
→ The hand setting file is created.







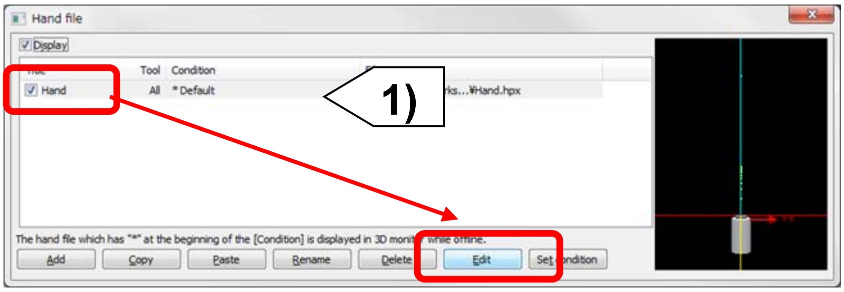
(5-2) Creating hand component parts.

There are four types of 3D parts that can be set as hands: cuboids, cylinders, spheres, and 3D models.

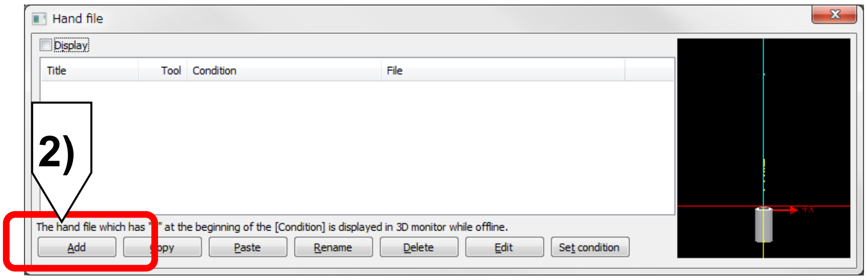
· Cuboids, cylinders, spheres: Specify the size in RT ToolBox2.

· 3D models: Read data created in CAD beforehand.
Readable format: STL (Stereolithography), OBJ (Wavefront format), etc.

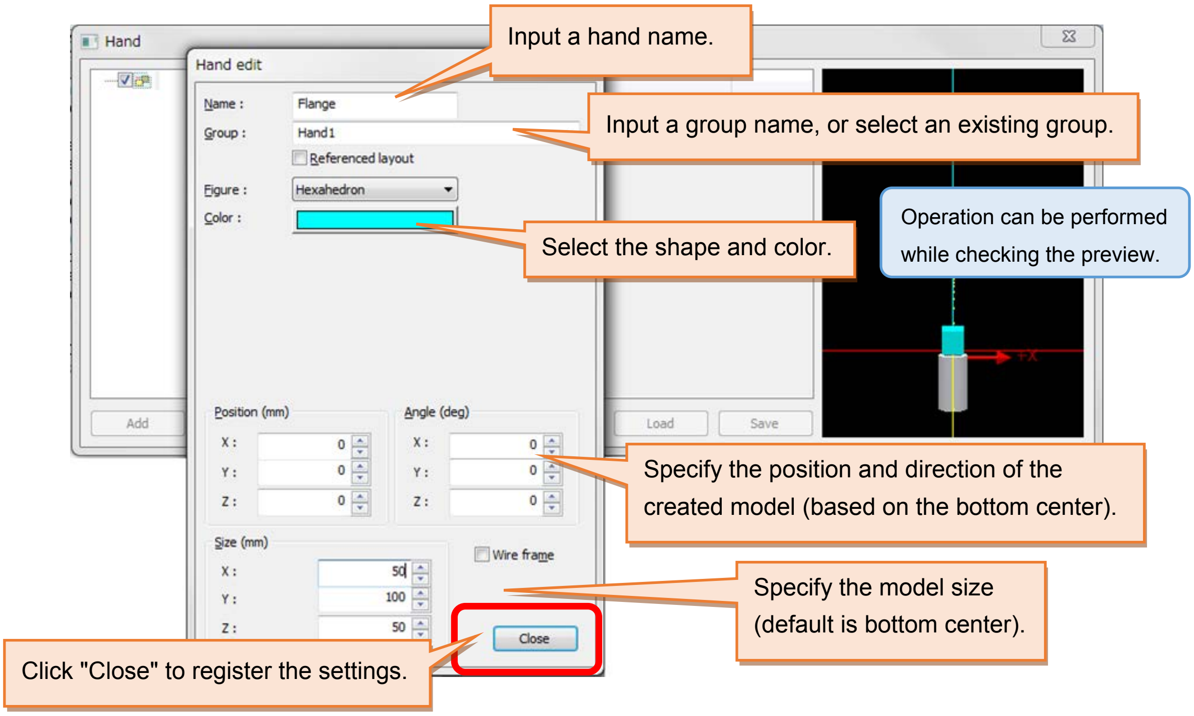
1) Select the hand file to be edited (Ex.: Hand), and click [Edit] in the Hand file window.



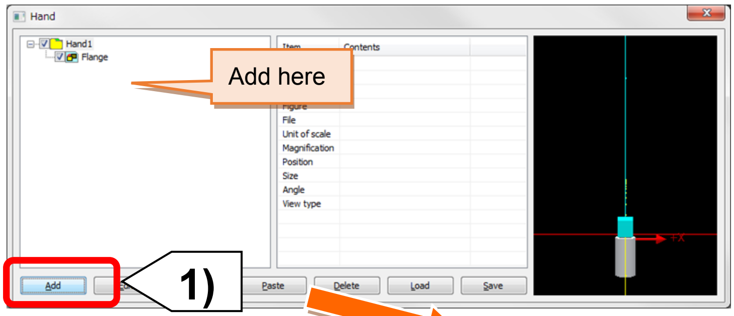
2) To create a new file, click [Add].



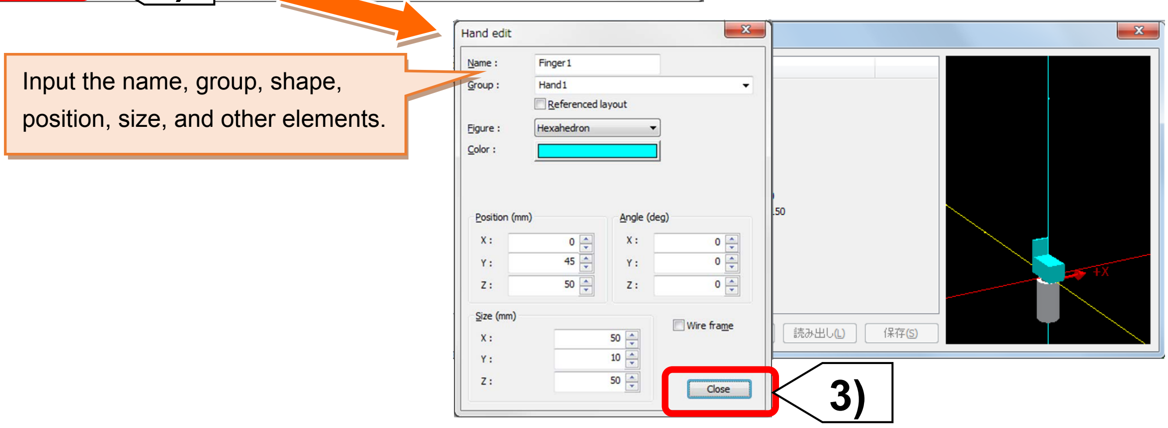
3) Set the 3D part shape and click [Close] in the Hand edit window.



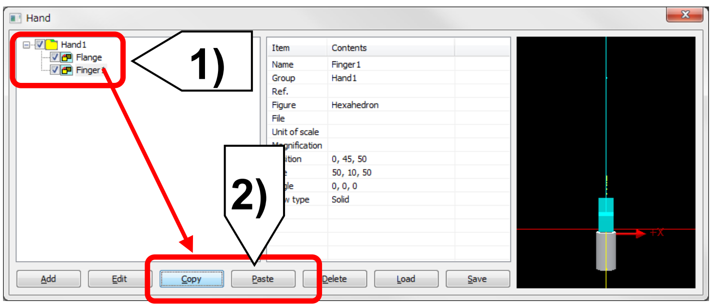
(5-3) Adding parts to the hand.



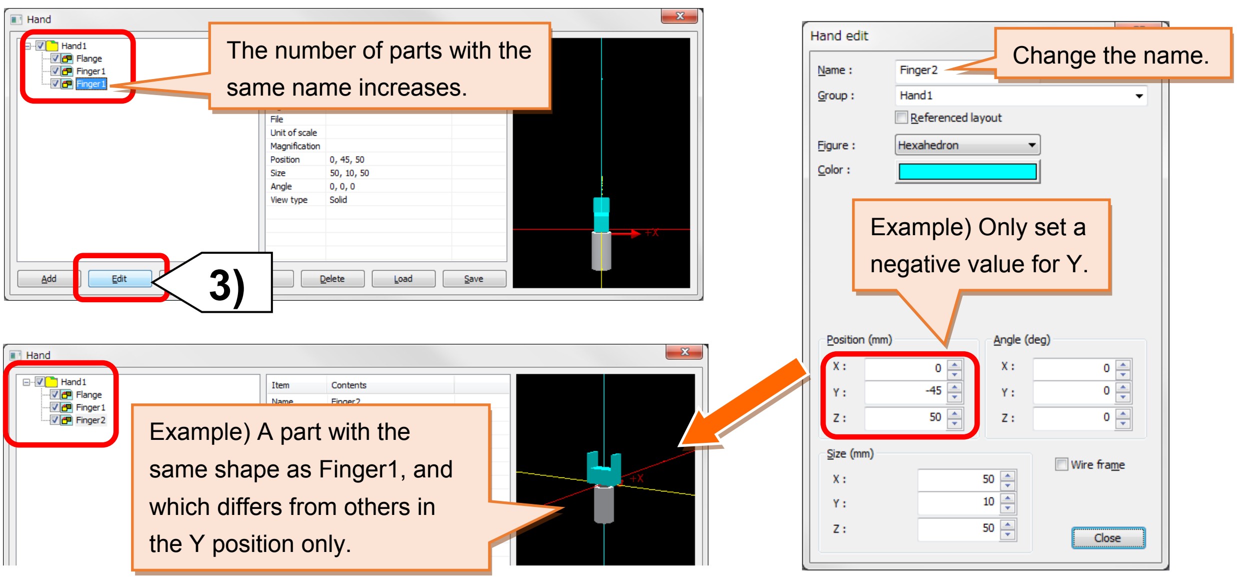
1) Click [Add].
   (Right-click the window to display the menu.)
2) Input the name, group, position, direction, size, and other elements.
3) Click [Close].



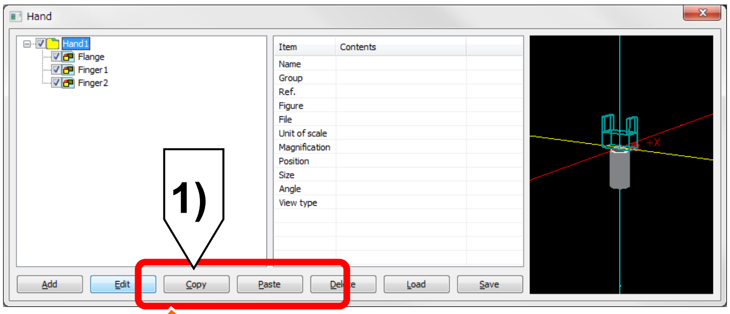
(5-4) Copy an existing hand part to create a new part.

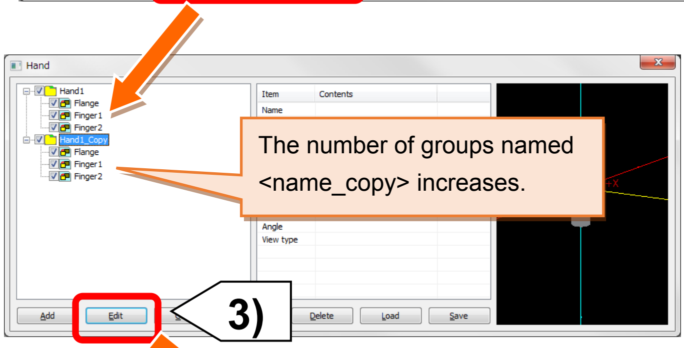


1) Select the part to be copied, and click [Copy].
   (Or, right-click the window to display the menu.)
2) Click [Paste].
3) A part with the same name is added. Click [Edit] and change the information.

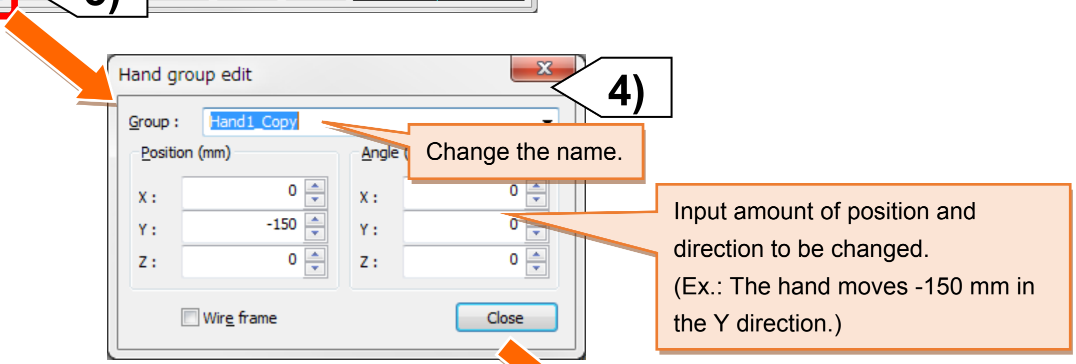


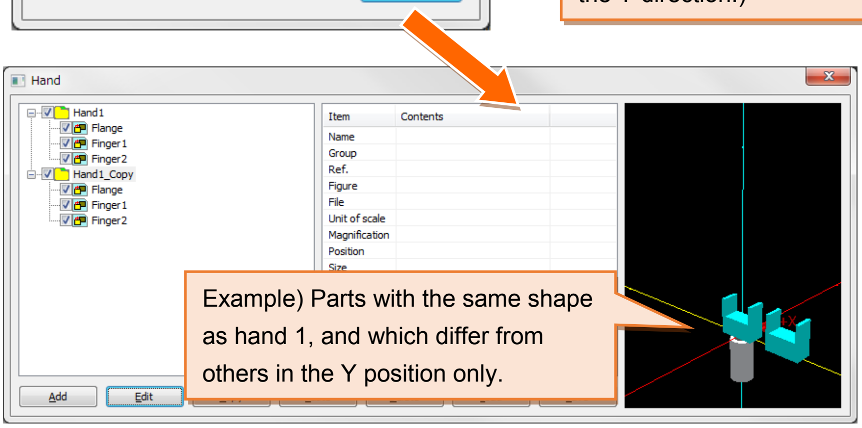
The parts can be edited, copied, and pasted in a group.



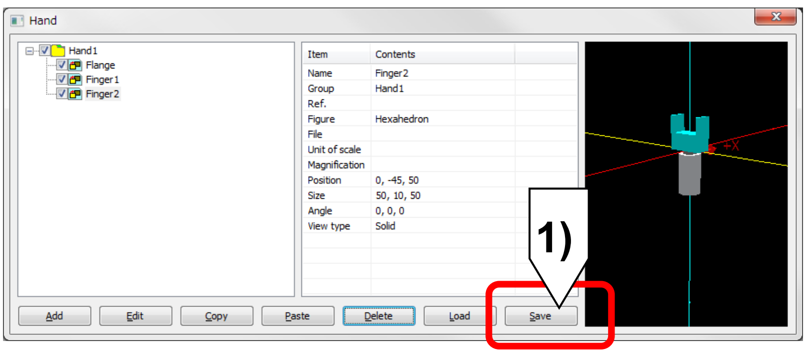


1) Select the group, and click [Copy] → [Paste].
2) A new group is added.
3) Select the new group, then click [Edit].
4) Input the group name and amount of position and direction to be changed.





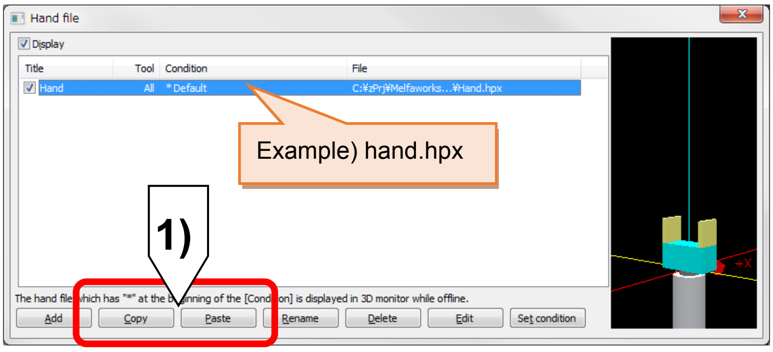
(5-5) Save the hand setting file.

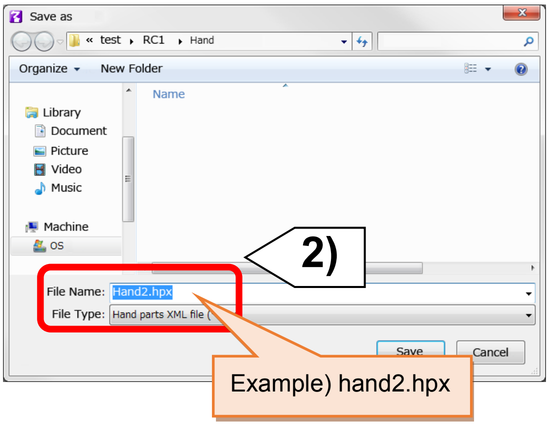


1) Click [Save].

In the save completion window, click "YES".

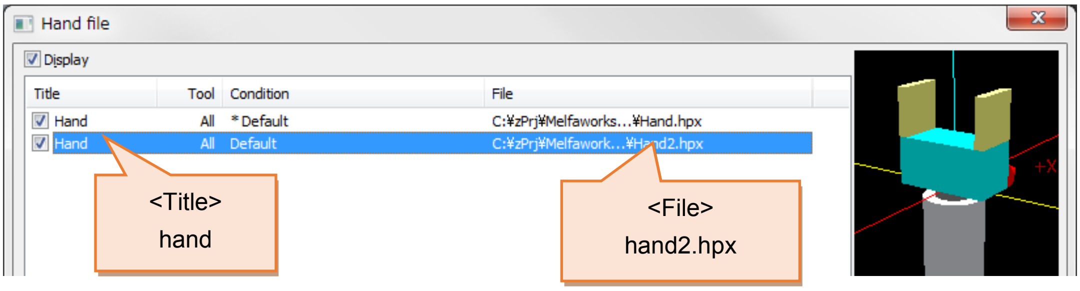
(5-6) Copy the hand setting file to create a new hand setting file.





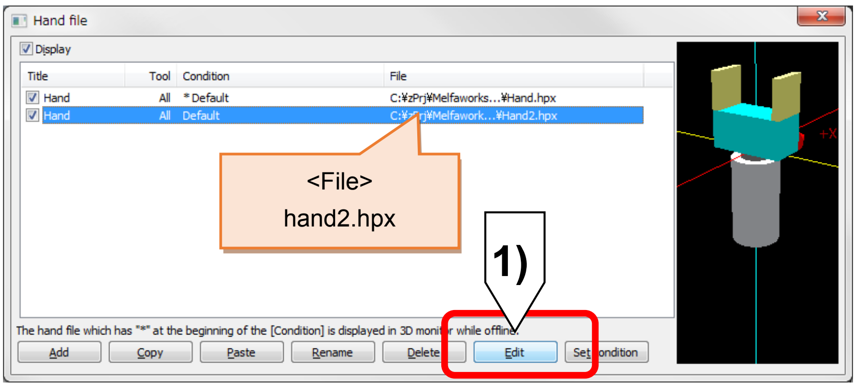
1) Select the hand setting file, and click [Copy] → [Paste].

2) The <Save as> window is displayed. Input a new hand file name, and click "Save".

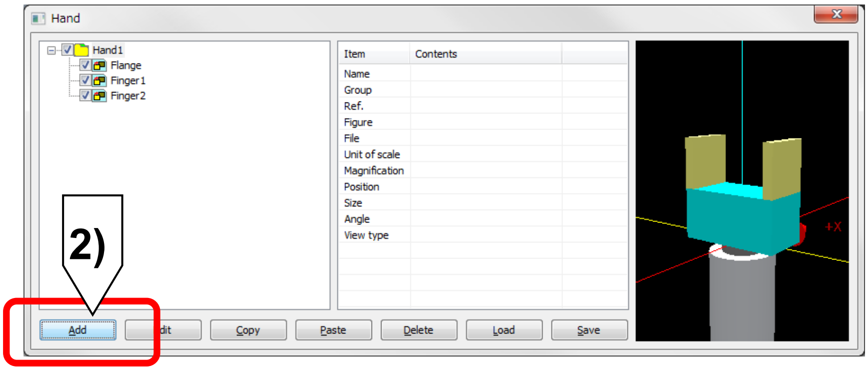


(5-7) Changing the hand to a hand holding a workpiece (hand closed).

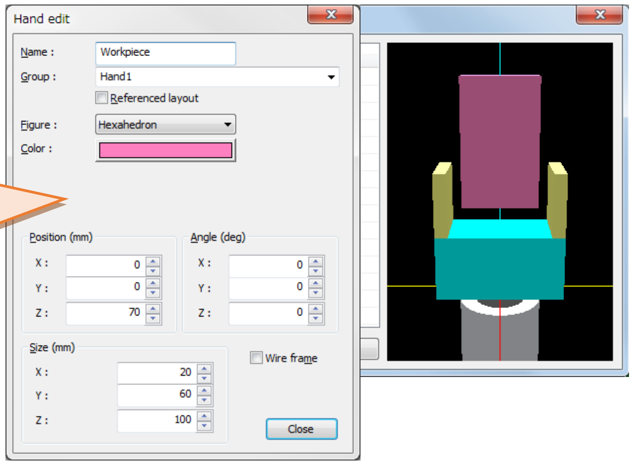
1) Select the second hand (hand2.hpx), and click [Edit].



2) Add a new part (workpiece).

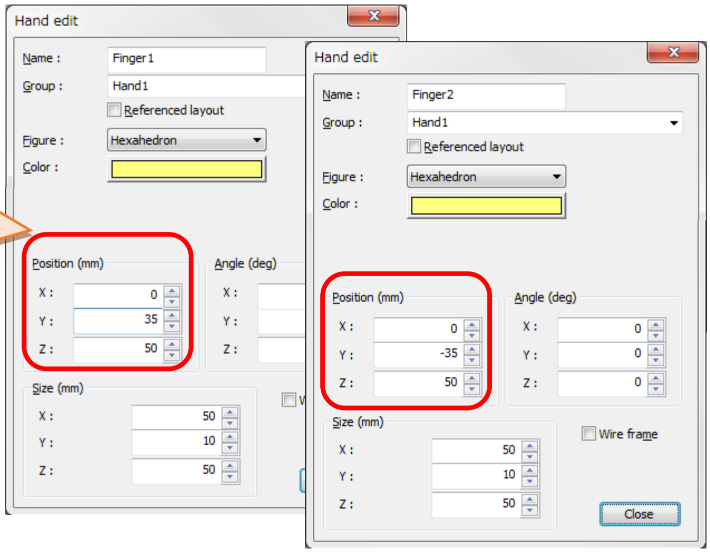


3) Add a new part (workpiece).



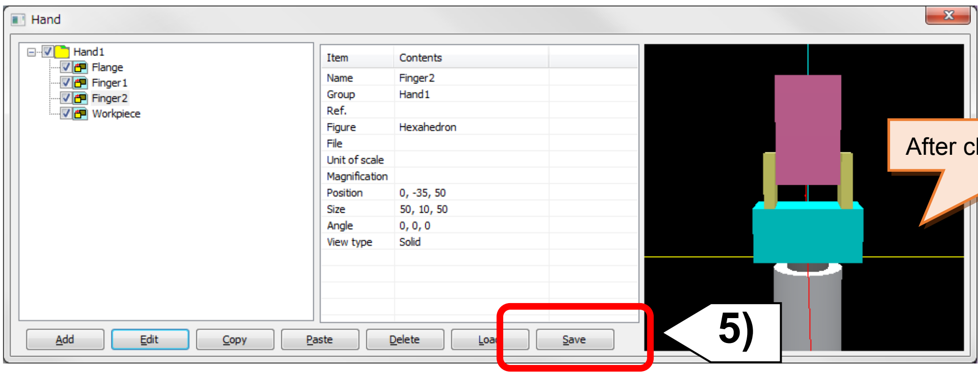
Ex.) Workpiece
Position (0, 0, 70)
Rotation (0, 0, 0)
Size (20, 60, 100)

4) Change the positions of Finger 1 and 2, and close the hand fingers.



Example) Change the Y value of the finger operation direction
Finger 1 position (0, 35, 50)
Finger 2 position (0, -35, 50)

5) Save the settings.

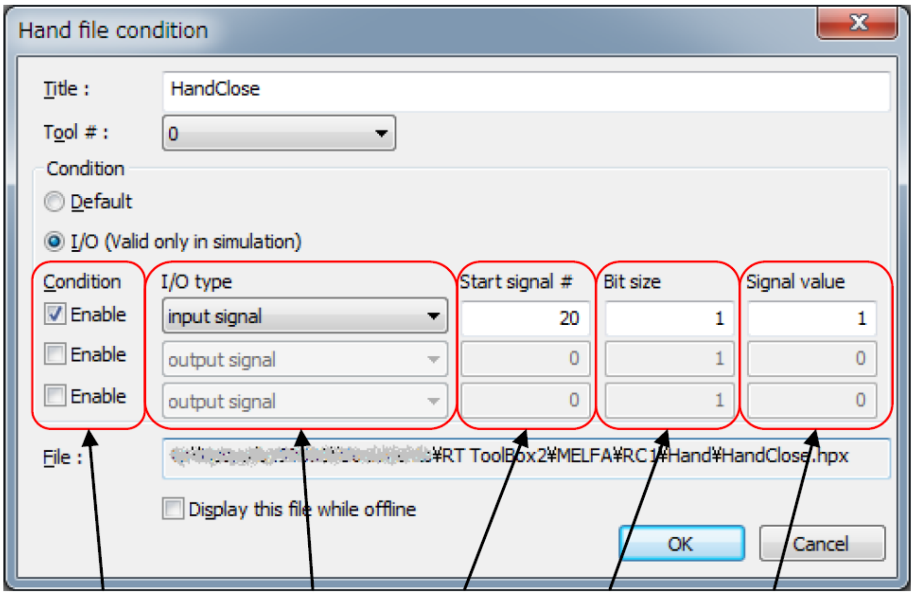


After change = hand closed

(6) Setting the hand display conditions

By setting the hand display conditions, the hand can be displayed only when the I/O status or the tool with which the specified target hand file is selected.

When a hand file for which display conditions are set is selected and the [Set condition] button is clicked in the Hand file window, the "Hand file condition" window is displayed.



(1) (2) (3) (4) (5)

<Tool number>

Specify the tool number to display the target hand file. This condition is valid both during simulation and during connection with the actual controller.

<Condition>

Specify the I/O conditions to display the target hand file. These conditions are valid only during simulation.

If no I/O condition is specified, select [Default], and if I/O conditions are specified, select [I/O]. When all the conditions are satisfied, the hand file is displayed.

1) Condition

I/O conditions can be set by selecting [I/O].

2) I/O type

Specify the I/O type.

3) Start signal #

Specify the I/O Start number.

4) Bit size

Specify the number of bits (number of registers) from the I/O start signal.

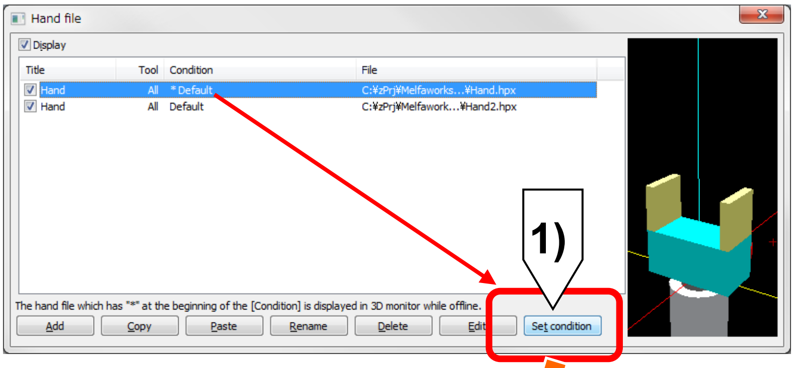
5) Signal value

Specify the numeric values to be compared with the I/O status.

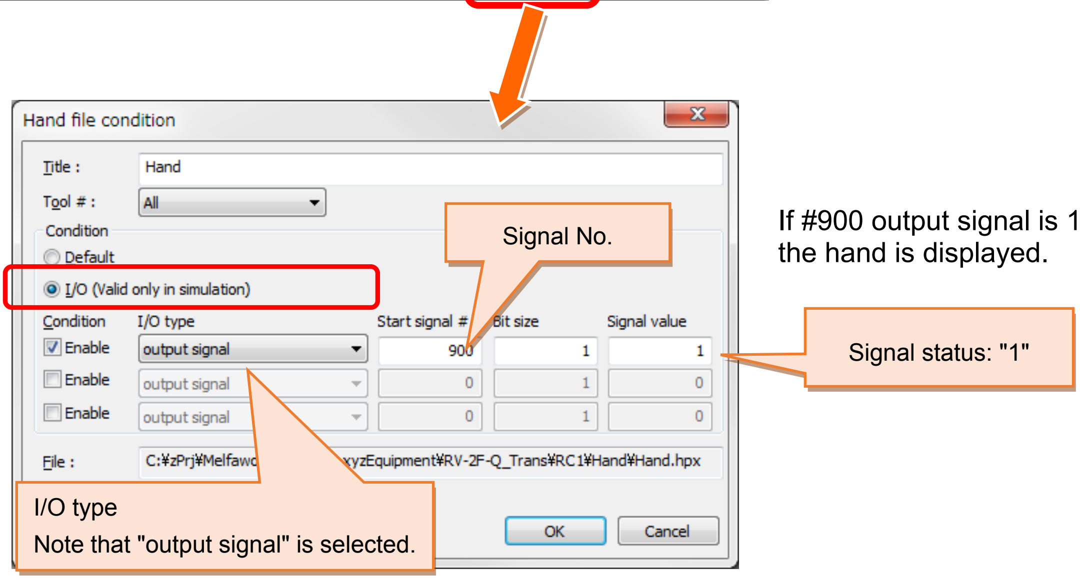
<Hand files displayed when Offline>

The target hand file is displayed offline.

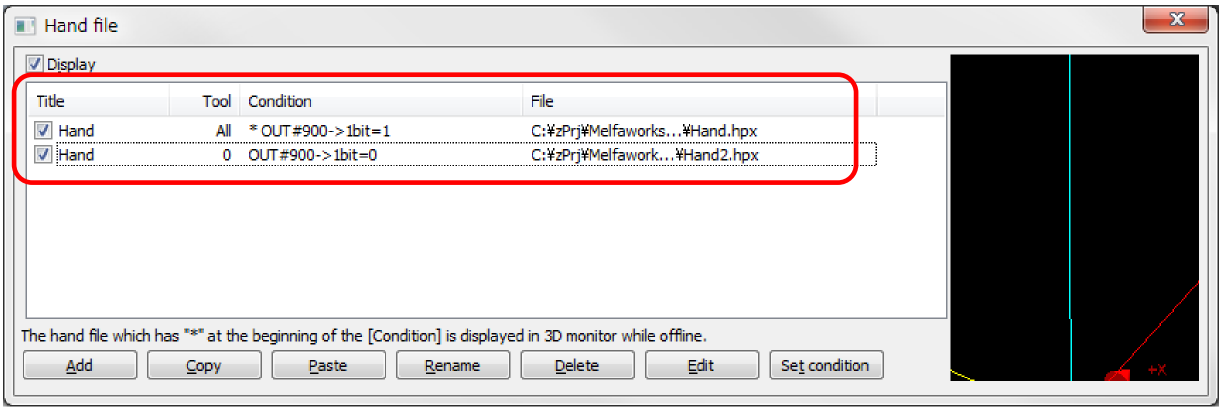
(6-1) Setting the display conditions for the hand.



1) Select the hand, and click "Set condition".
2) Input values in the Hand file condition window, then click "OK".
3) After the setting, click "OK".



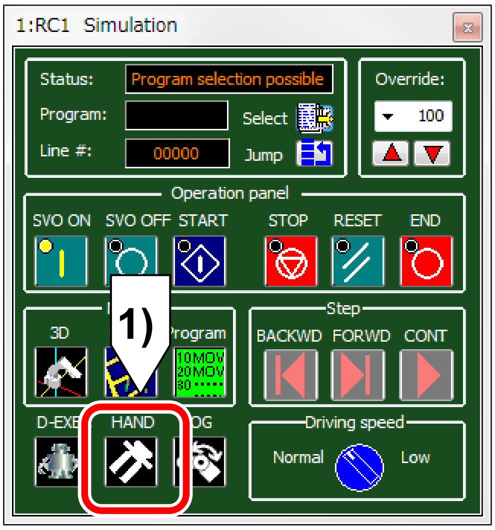
If #900 output signal is 1, the hand is displayed.



Example) Settings are configured to display the hand in the 1st line if output #900 is ON, and the hand in the 2nd line if the output #900 is OFF.

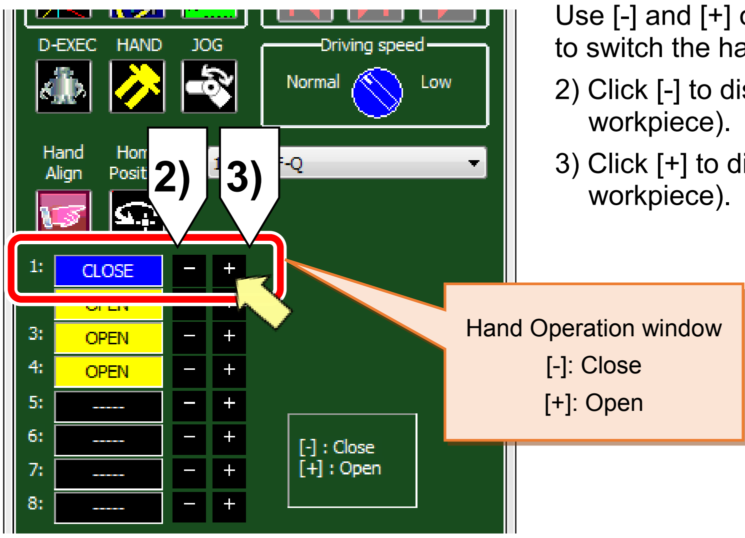
(7) Hand open/close operation

(7-1) The hand open/close operation can be checked on the operation panel.



1) Click the "HAND" button in the operation panel to display the Hand Operation panel.

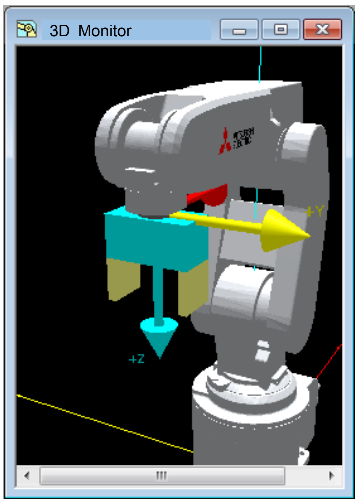
Operation panel



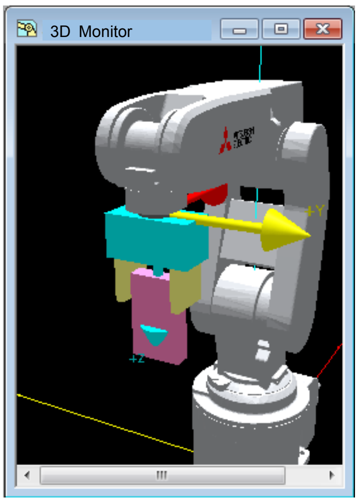
Use [-] and [+] of hand 1 (number on the far left) to switch the hand display on the 3D Monitor.

2) Click [-] to display the closed hand (with workpiece).

3) Click [+] to display the open hand (without workpiece).



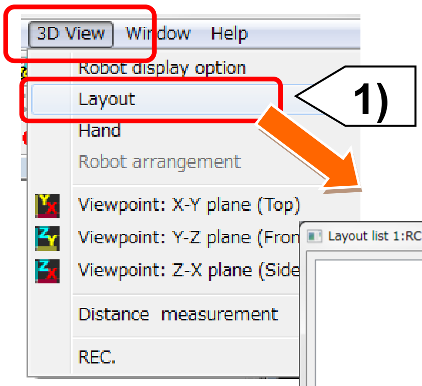
[+]: Open



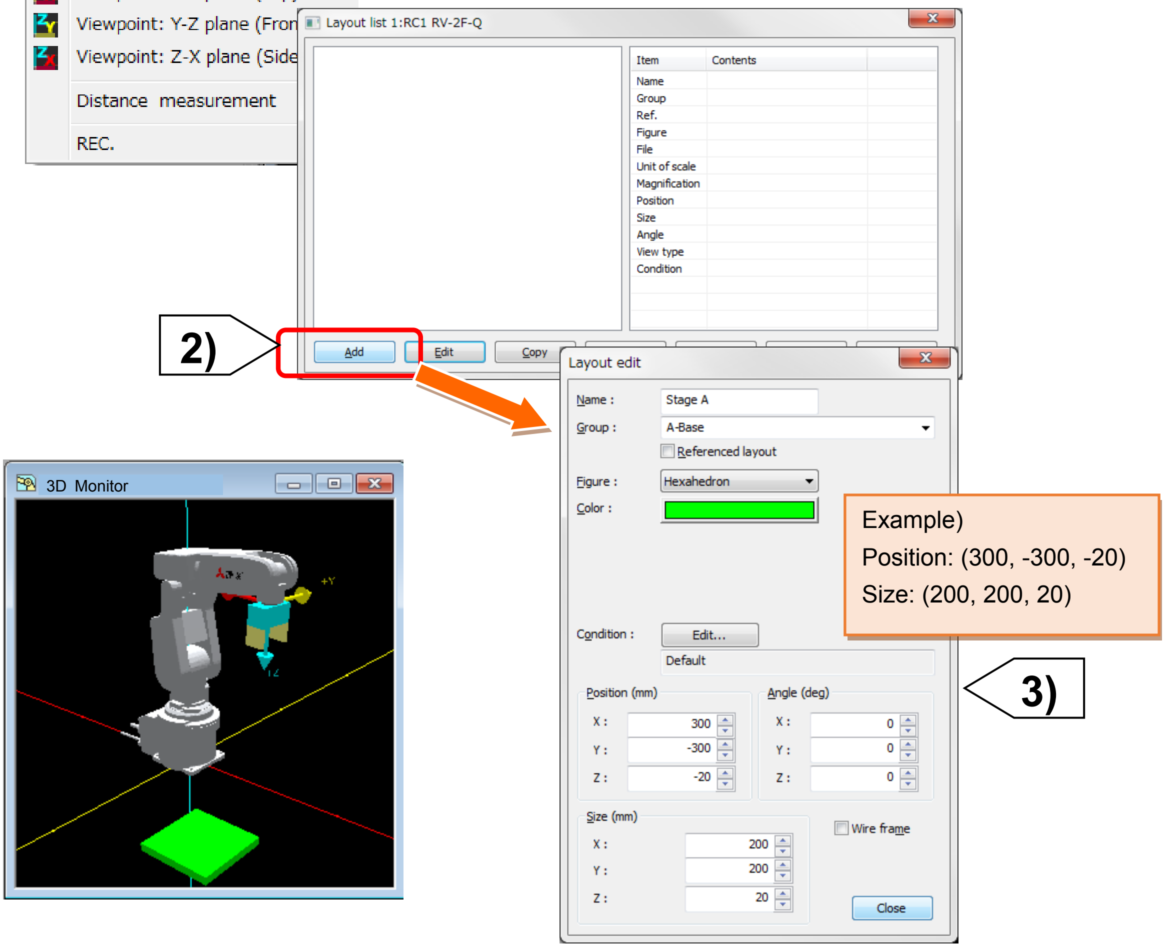
[-]: Close

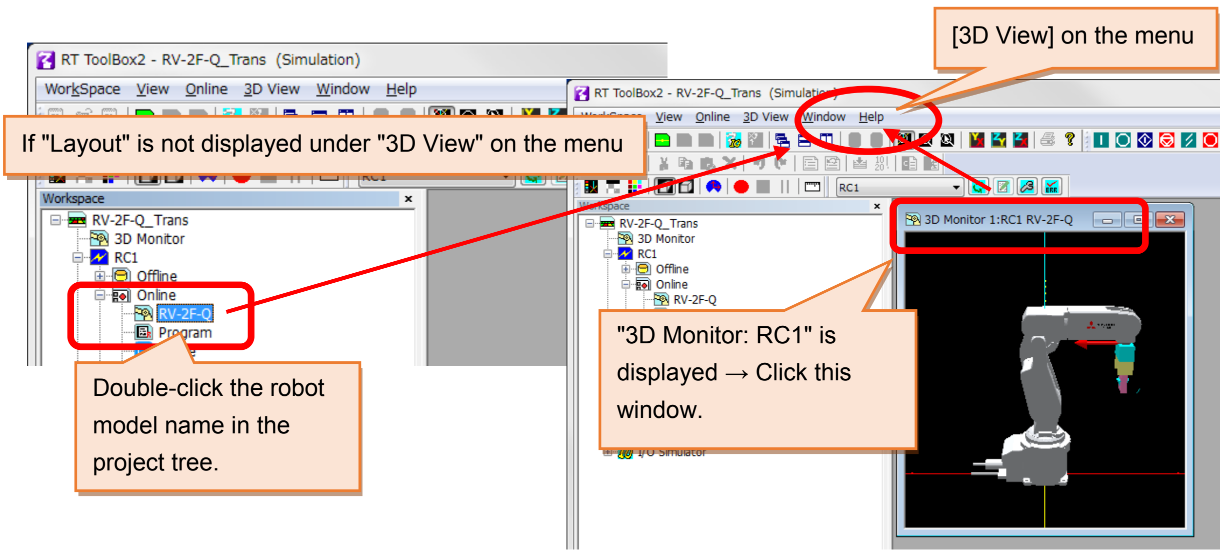
(8) Creating a layout

(8-1) Create layout component parts.



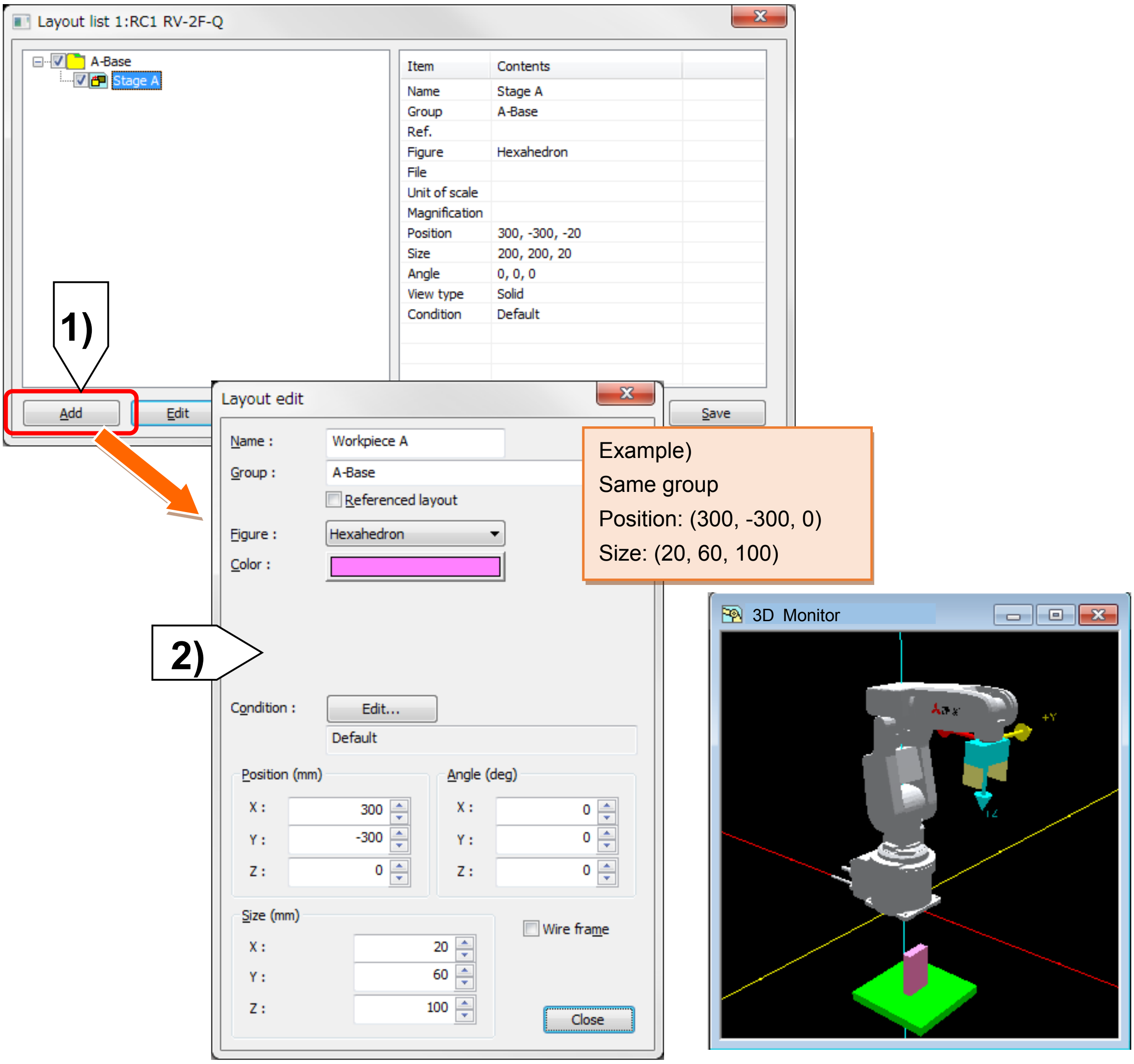
1) Select [Layout] from [3D View] on the menu.
2) Click [Add] in the Layout list window.
3) Create layout component parts in the Layout list window.
The procedure is the same as when creating a hand.



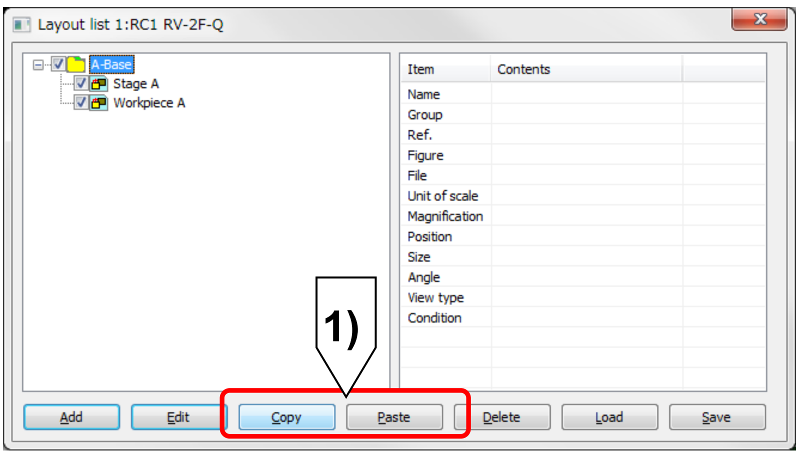


(8-2) Adding layout component parts (workpieces).

1) Click [Add] in the Layout list window.
2) Create a part (workpiece) in the Layout edit window.

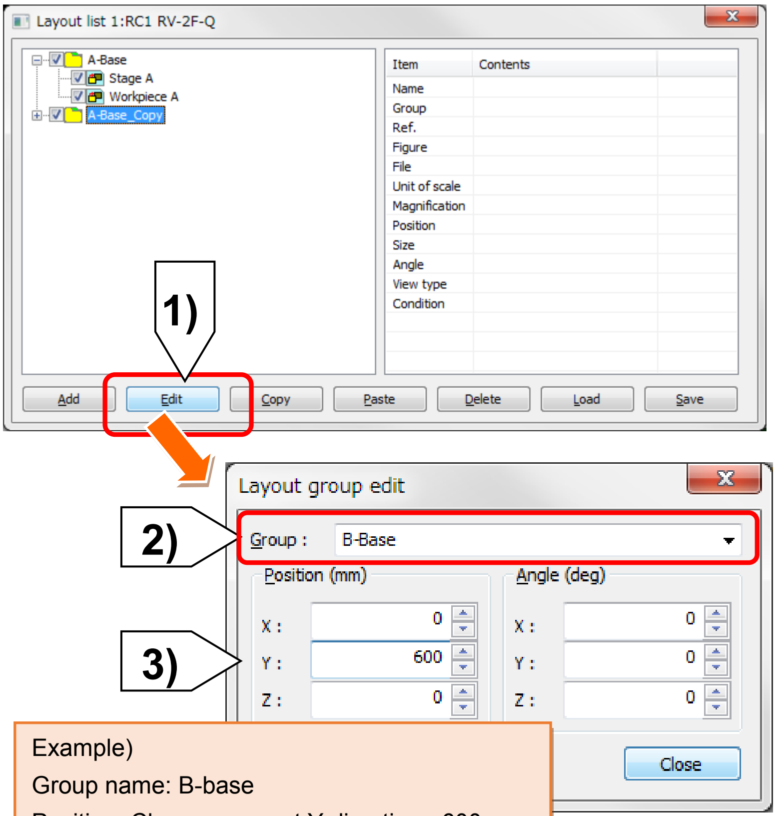


(8-3) Copying the layout group.



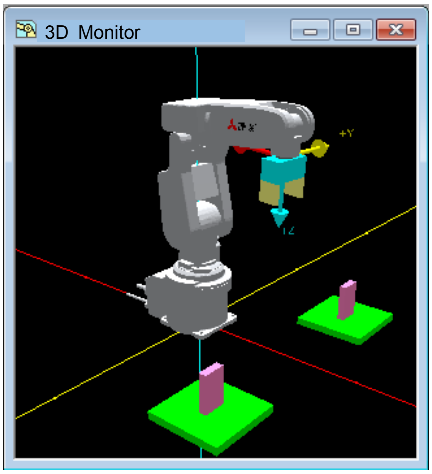
1) Select the group, and click [Copy] → [Paste] in the Layout list window.

(8-4) Changing the name and position of the group that was copied.

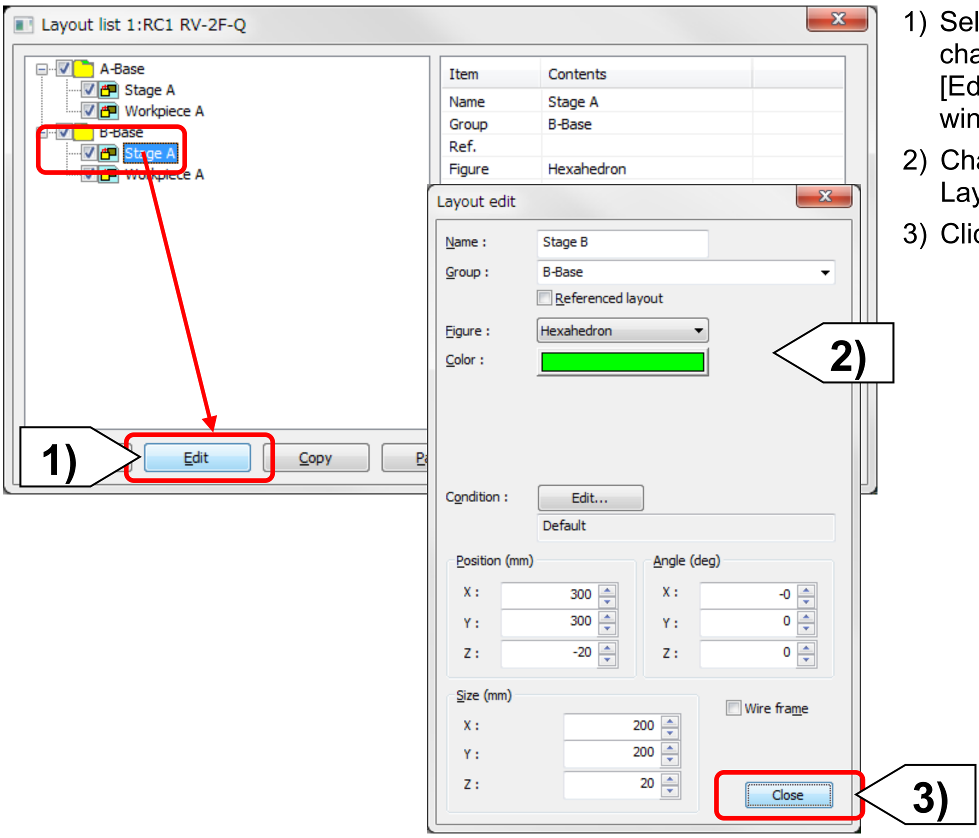


Example)
Group name: B-base
Position: Change amount Y direction +600 mm

1) Select the group, and click [Edit] in the Layout list window.
2) Change the group name in the Layout group edit window.
3) Input the movement and rotation amount.

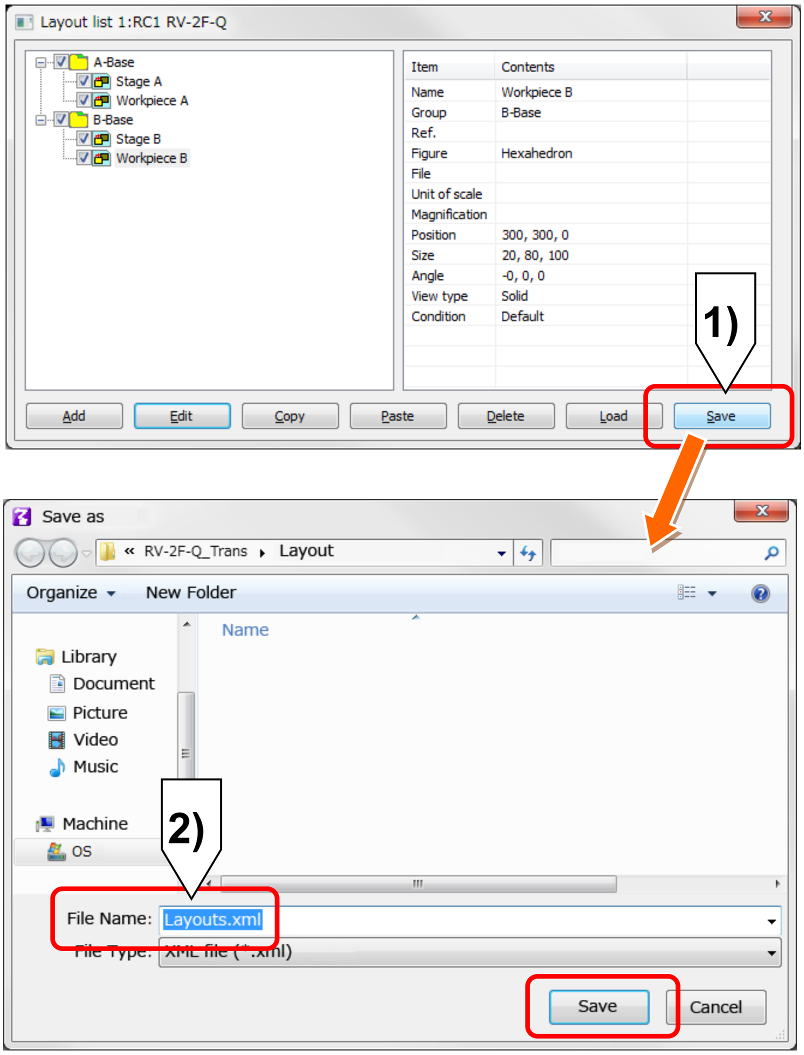


(8-5) Change the name, position and direction, and size of the component parts as necessary.



1) Select the parts to be changed, and click [Edit] in the Layout list window.
2) Change the parts in the Layout edit window.
3) Click [Close].

(8-6) Save the layout file.



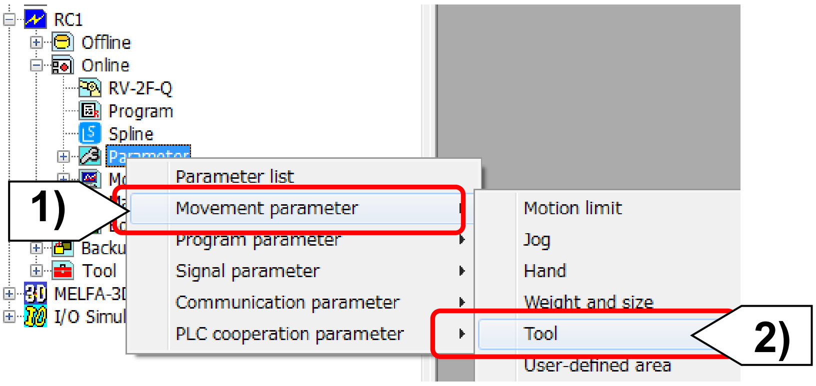
1) Click [Save] in the Layout list window.
2) Specify a preferred file name. layout.xml is input as the default value. This may be saved as is (without change).

(9) Setting the tool length

By setting the tool length, the robot tool coordinate can be used.
Using the robot tool coordinate can operate the robot along the hand surface direction and make the change of the hand posture and workpiece posture held by the hand easier.
For details of the robot tool coordinate, refer to "Chapter 4 Robot Language 4.2 Program instructions Position operation in the robot tool coordinate system".

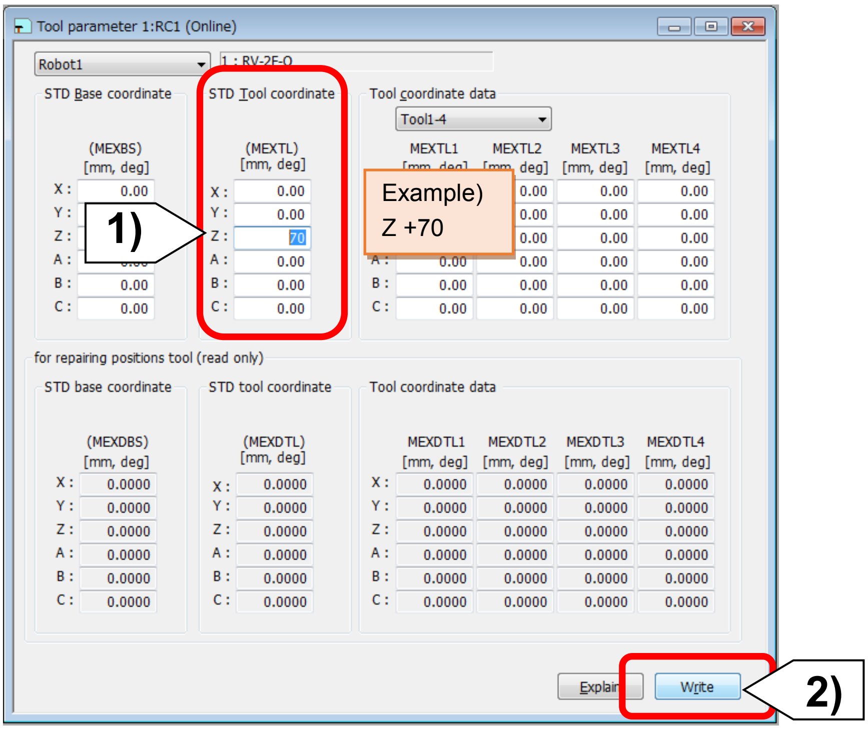
(9-1) Displaying the Tool parameter window.

1) Right-click [Parameter] under [Online] in the project tree to display a sub menu.
2) Move the cursor to [Movement parameter] to display another sub menu, then click [Tool].



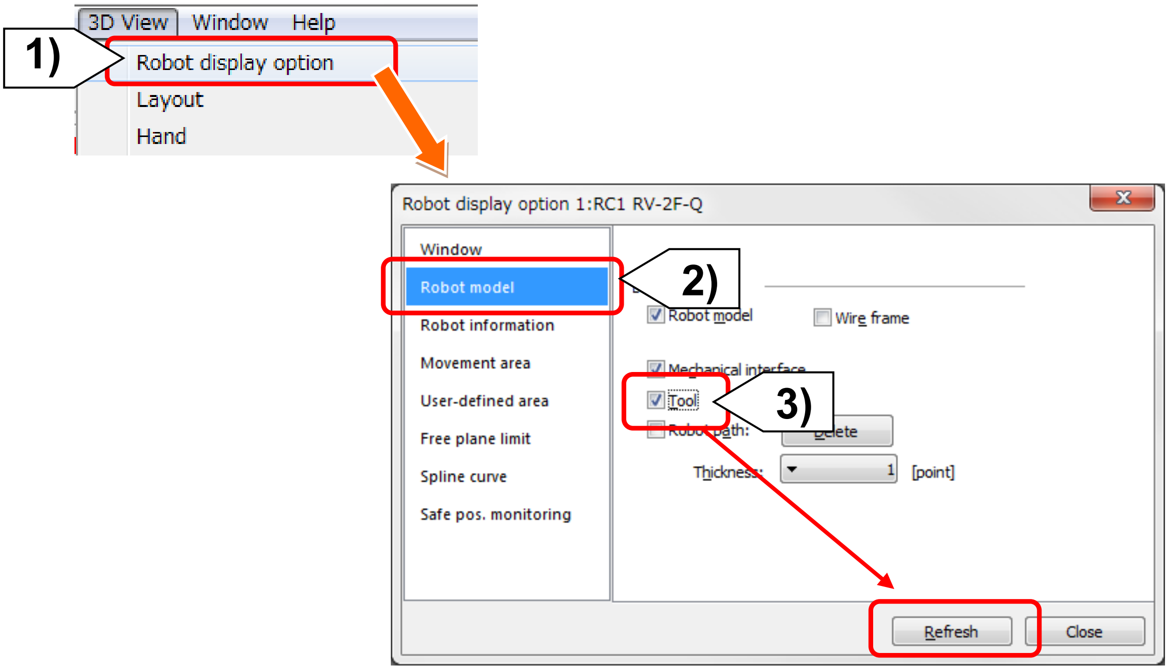
(9-2) Inputing the tool length in the tool coordinate system.

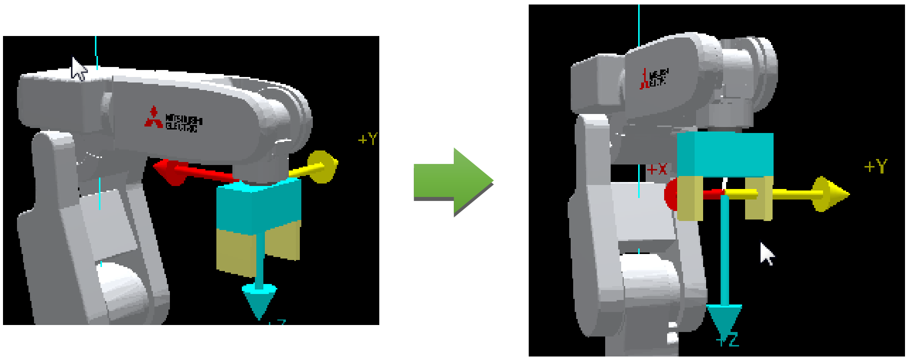
1) Input the tool data in the tool coordinate system. Signs are based on the flange coordinates of the robot.
2) Click the [Write] button.
3) Confirmation window for writing data to the controller → Click "YES".
4) Write completion window → Click "OK".



(9-3) Check the tool on the 3D monitor.

1) Click [3D View] → [Robot display option] from the menu.
2) Select [Robot model] on the left menu in the Robot display option window.
3) Check [Tool] in Display items and click [Refresh].





Before setting the tool length
(Flange center)

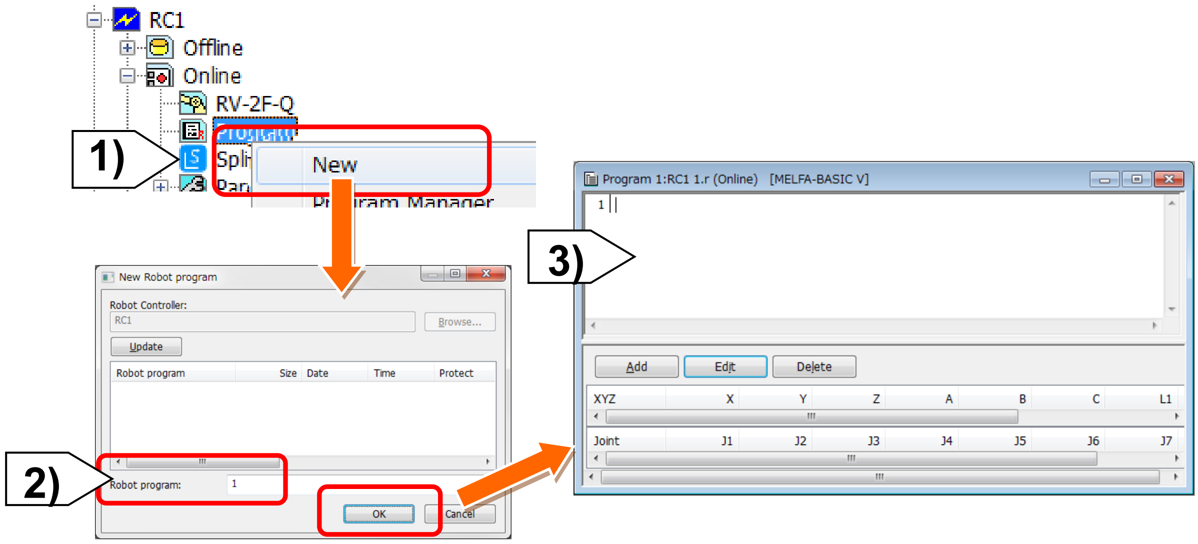
After setting the tool length

[Caution] If the program operated by the simulator has an electric hand instruction, home position return of multi-function electric hand needs to be performed in the program.

(10) Creating a robot program

(10-1) Create a new robot program.

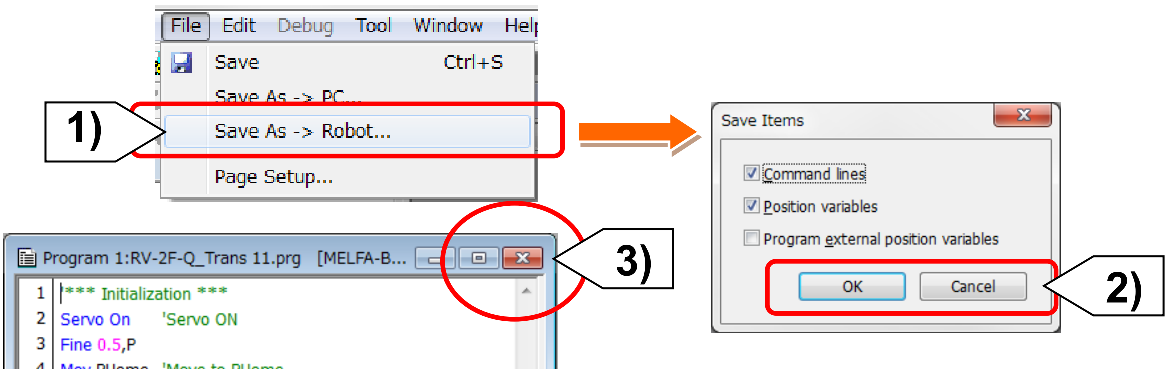
1) Right-click [Program] from [Online] or [Offline] in the project tree, and select "New" from the sub menu.
2) Input the robot program file name, and click "OK".
3) The new Program Editing window opens. Write the program (instruction statement) here.



* If the program operated by the simulator has an electric hand instruction, home position return of multi-function electric hand needs to be performed in the program.

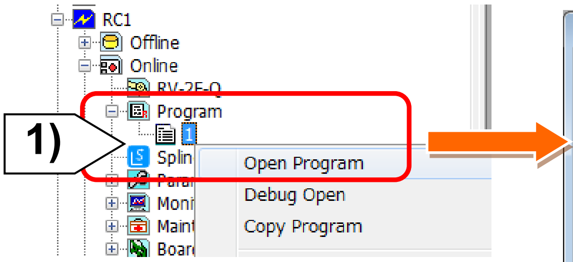
(10-2) Saving the robot program.

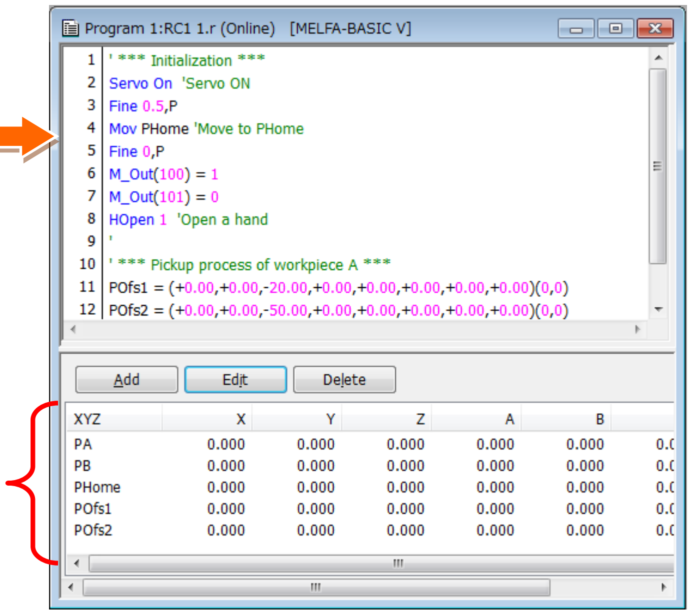
1) Select "Save As → Robot" in "File" on the menu.
2) Check the items to be written, and click [OK].
   If no error is displayed, the items are written to the robot controller.
3) Click [× (Close)] in the Program Editing window, and close the program.



(10-3) When the program is opened again, the position data required for the program will be clear.

1) Select the program file from Program in the project tree, right-click and select "Open Program".
2) Check the items to be read, and click "OK".
3) Since the position variable used in the program is registered in the position data field, it is clear which position variables are required for teaching.

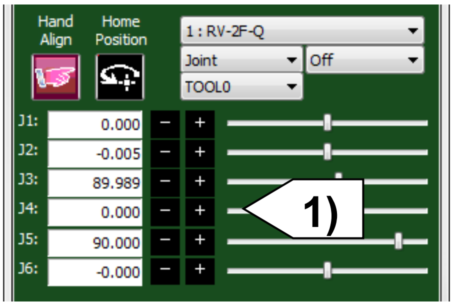




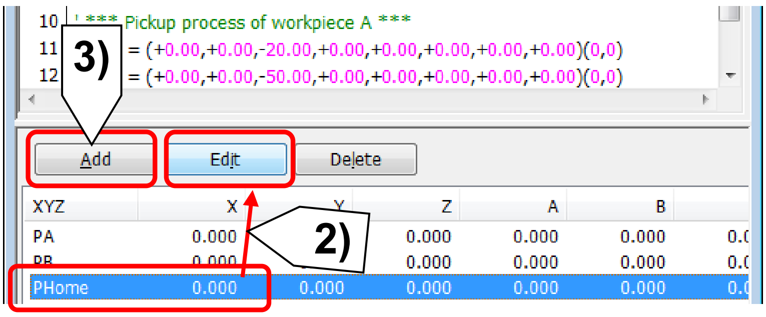
Example)
Teaching for PA, PB, and PHome is necessary.
(POfs1 and POfs2 are set in the program.)

(11) Teaching operation

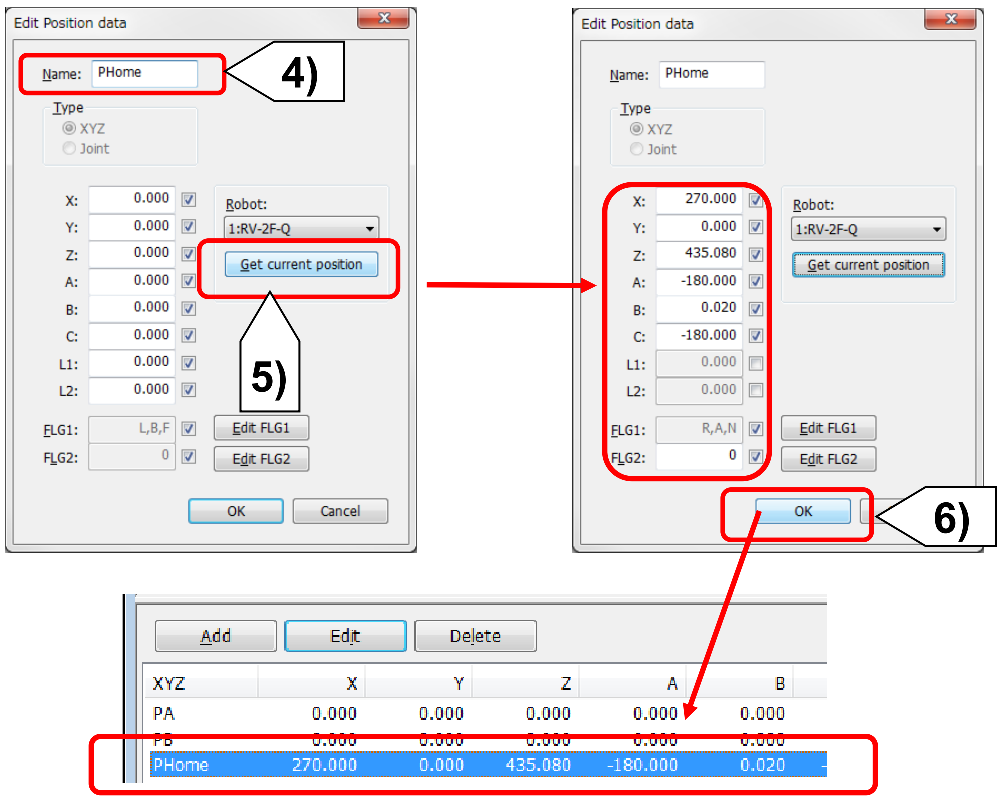
(11-1) Acquiring position data. (Method 1) (JOG operation → current position reading)



1) To acquire the desired position data, move the robot arm to the desired position by using the JOG operation. (For details, refer to "Appendix 2.2 (2) JOG operation".)
2) When incorporating positions into existing position variables, select the position variable and click "Edit" in the Position Variable Editing window.
3) To create a new position variable, click "Add".



4) To create a new position variable or change the variable name, input a variable name in the Edit Position data window.
   * If an existing variable name is input, it will be overwritten.
   (An overwrite confirmation message is not displayed)
5) Clicking "Get current position" in the Edit Position data window inputs position data.
6) Check the position data and variable name, and press the "OK" button.

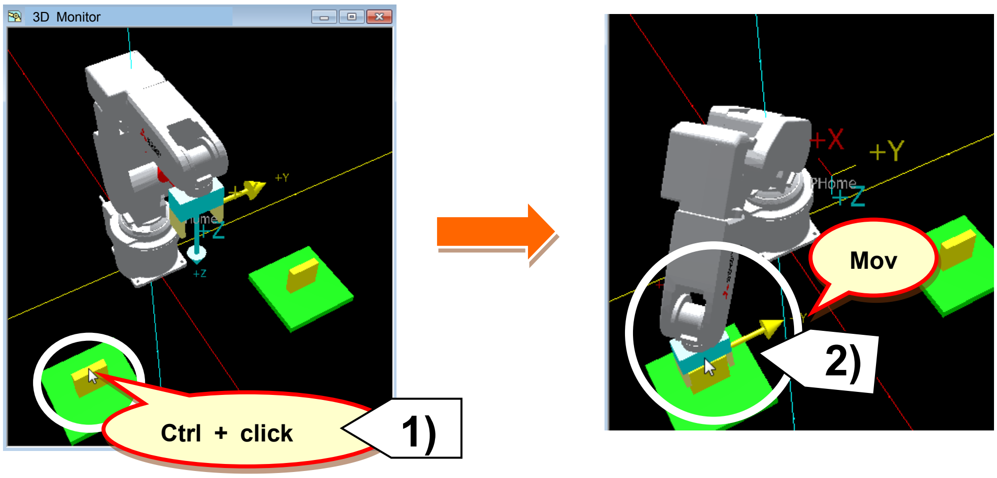


(11-2) Acquiring position data. (Method 2) (Robot click movement → current position reading)

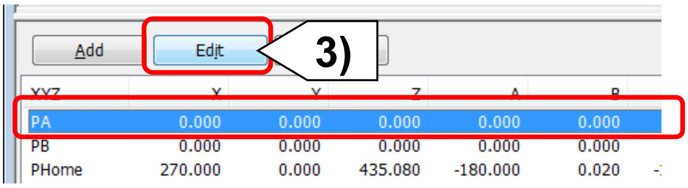
By clicking the object in the 3D Monitor window while pressing the Ctrl key with the simulation started, the robot moves to the position which has been clicked.

- When no object is set at the position which has been clicked or the position is outside the robot operation range, the robot does not move.
- The robot body does not move based on the posture and status of the multi-rotation joint. This is because the robot body moves independently while maintaining the posture and status of the multi-rotation joint.
- This operation is invalid during the robot operation.

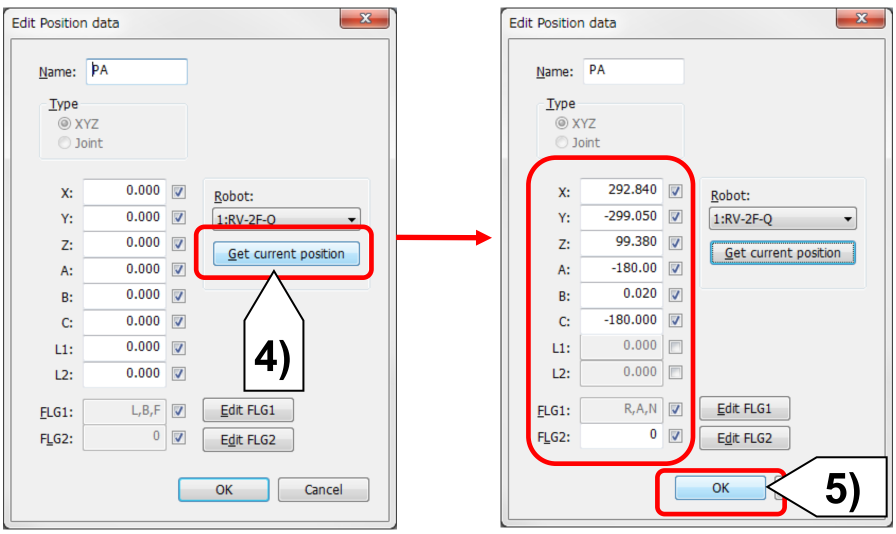
1) Click the top center of the target layout configuration part of the 3D Monitor while pressing the [Ctrl] key.
2) The robot moves to the position which has been clicked.



3) Select the position variable and click "Edit" in the Position Variable Editing window.

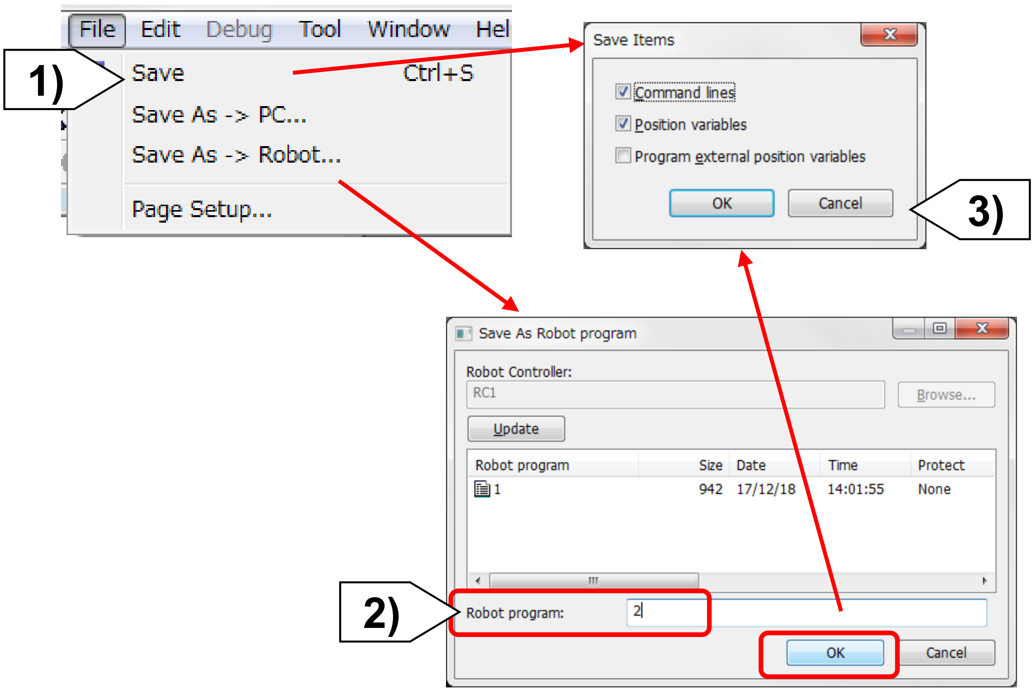


4) Clicking "Get current position" in the Edit Position data window inputs position data.
5) Check the position data and variable name, and click "OK".



(11-3) Saving the program.

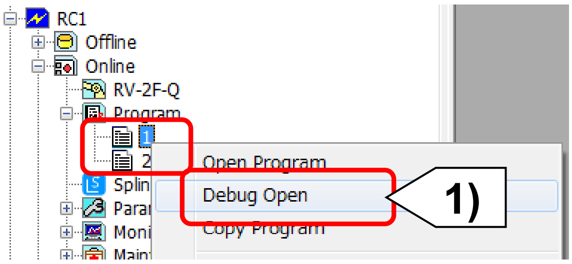
1) Select [Save] or [Save As → Robot] from [File] on the menu.
(If [File] is not on the menu, click the Program Editing window.)
2) If [Save As → Robot] is selected, input the file name in the "Save As Robot program" window.
3) Check the items to be written, and click [OK].



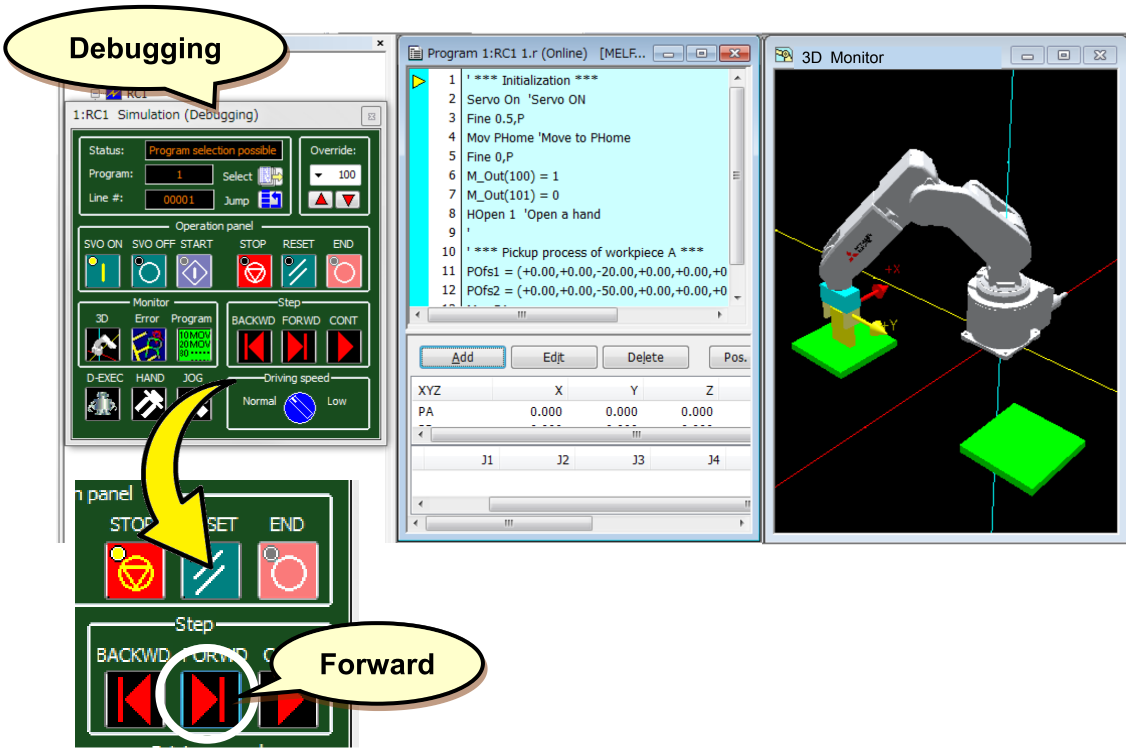
(12) Debugging

(12-1) Check the program operation with Step operation.

1) Right-click the corresponding program from [Program] under [Online] in the project tree, and select "Debug Open" from the sub menu.

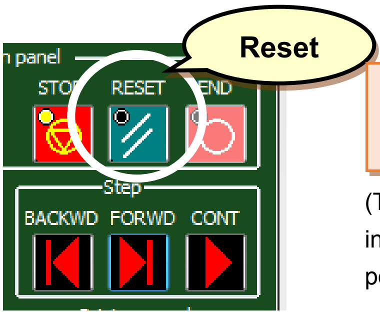


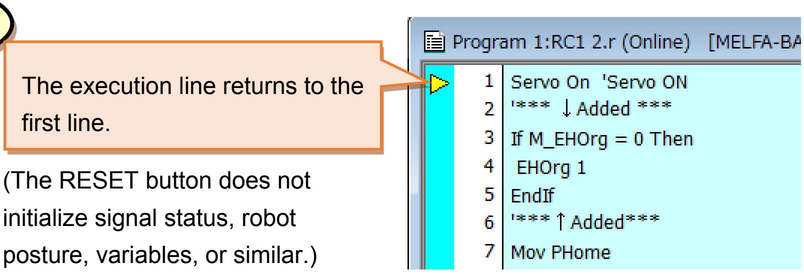
2) Pressing the "FORWD" button on the operation panel executes the program by one step. Check the posture and operation of the robot by executing the program by one step.



(12-2) Return the program execution line to the first line.

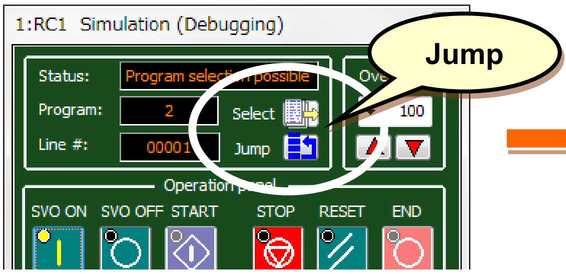
[Reset]
Pressing the "RESET" button in the operation panel returns the program to the first line.

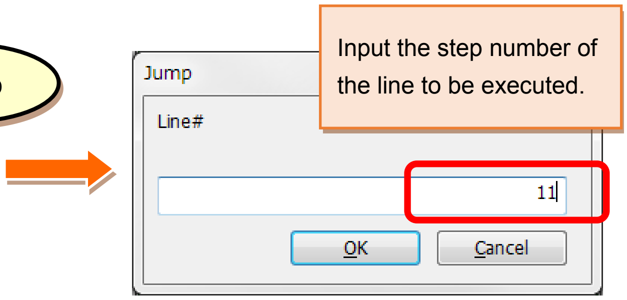


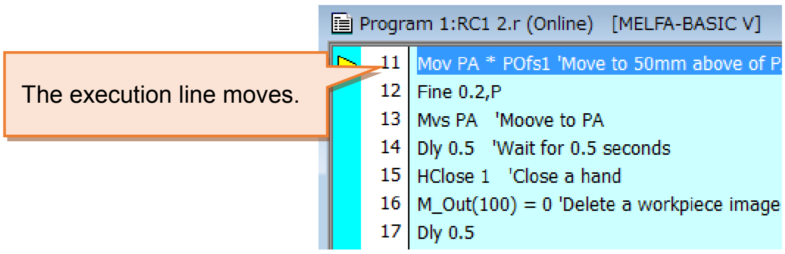


(The RESET button does not initialize signal status, robot posture, variables, or similar.)

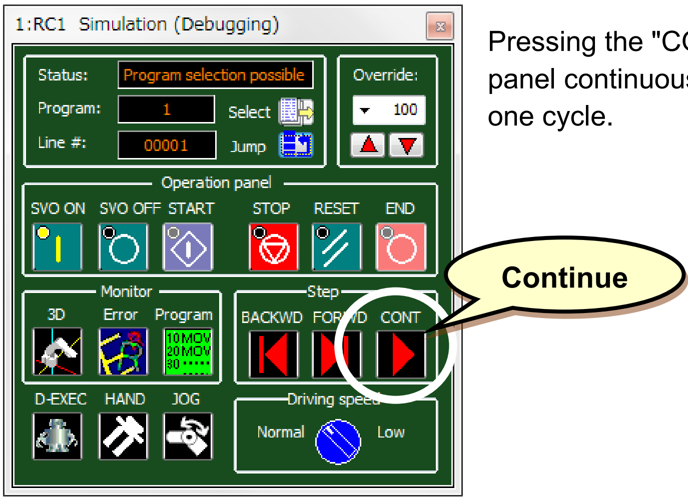
[Jump]
Pressing the "Jump" button in the operation panel specifies the execution line.







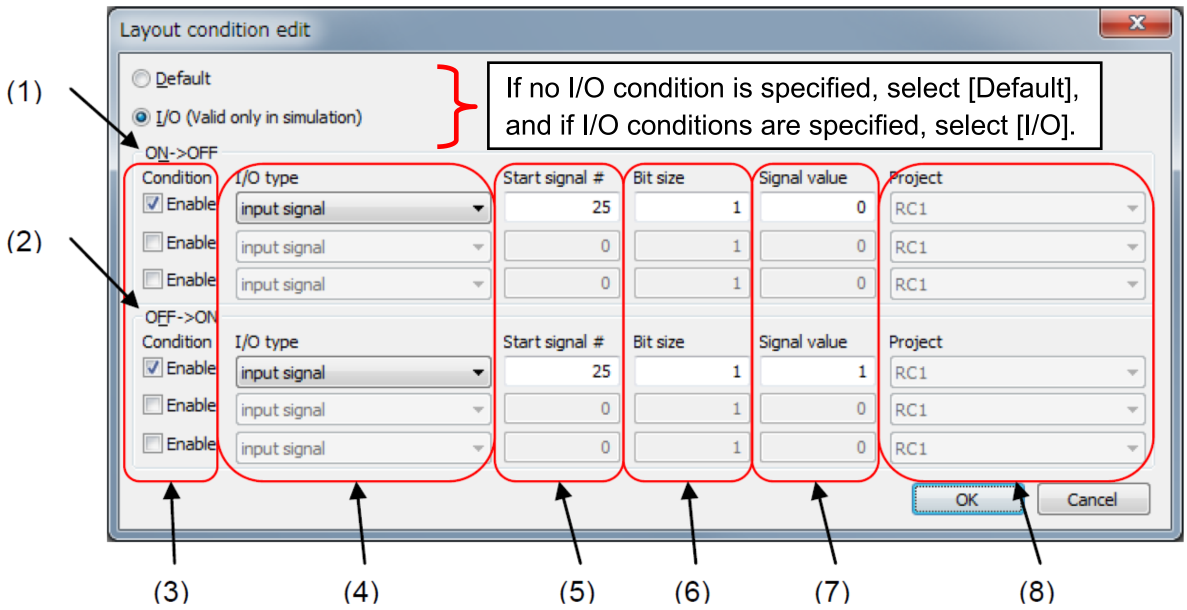
(12-3) Execute the program continuously.



Pressing the "CONT" button on the operation panel continuously executes the program for one cycle.

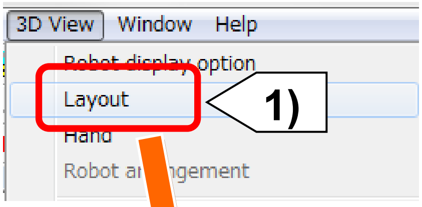
(13) Changing the layout display conditions

Click the [Edit...] button in the "Layout edit" window to display the "Layout condition edit" window.
By specifying the I/O conditions for the layout parts, the corresponding parts can be displayed or hidden. This function is valid only during simulation.

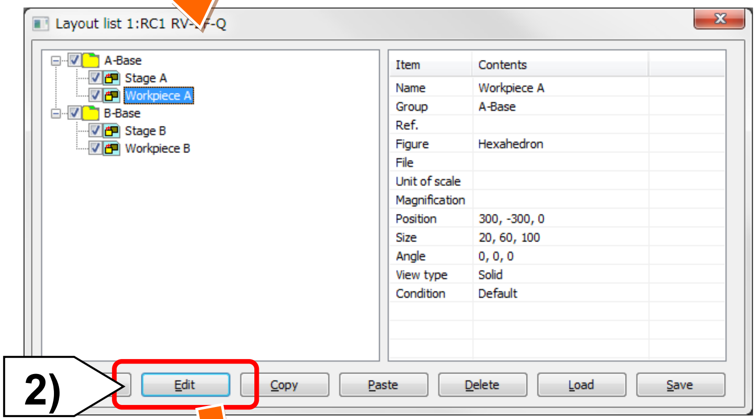


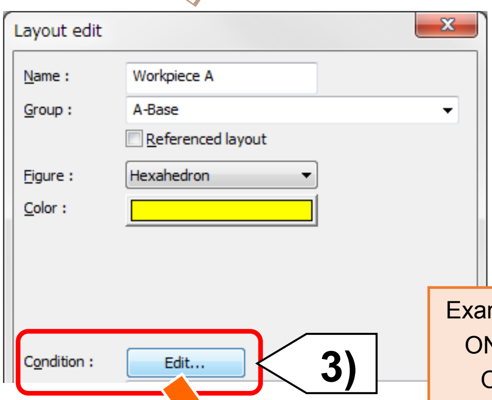
1) ON→OFF
   Set the conditions to hide the target layout parts.
2) OFF→ON
   Set the conditions to display the target layout parts.
3) Condition
   I/O conditions can be set by selecting [I/O].
4) I/O type
   Specify the I/O type.
5) Start signal #
   Specify the I/O Start number.
6) No. of bits
   Specify the number of bits (number of registers) from the I/O start signal.
7) Signal value
   Specify the numeric values to be compared with the I/O status.
8) Project
   Specify the target projects (robots) whose I/O conditions are checked when using the 3D Monitor of the whole workspace. The projects do not need to be set in the 3D Monitor of each project.

(13-1) Setting the display conditions for the layout configuration parts.



1) Select [Layout] from [3D View] on the menu.
2) Select the parts to be set, and click "Edit" in the Layout list window.

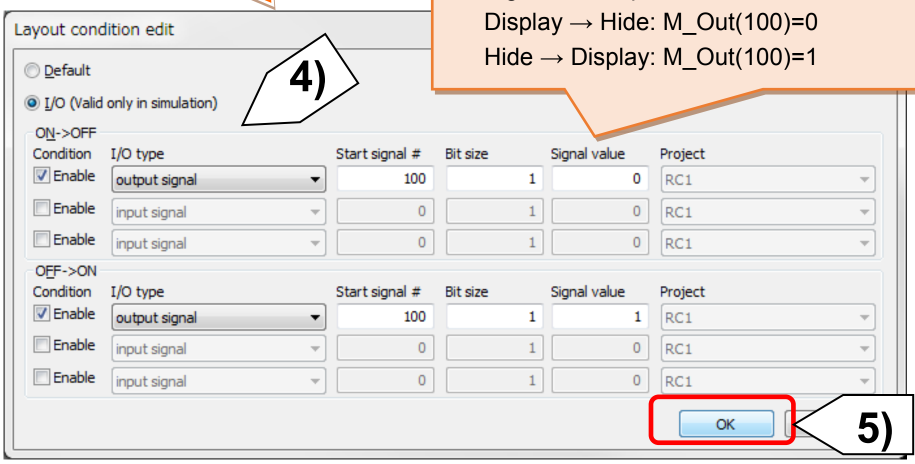




3) Click [Edit] in Condition in the Layout edit window to display the Layout condition edit window.
4) In the Layout condition edit window:
   • Select "I/O (Valid Only in Simulation)".
   • Set signals for ON→OFF and OFF→ON.
5) Click "OK".

Example)
ON→OFF
Output signal, start number: 100, number of bits: 1, signal status: 0
OFF→ON
Output signal, start number: 100, number of bits: 1, signal status: 1

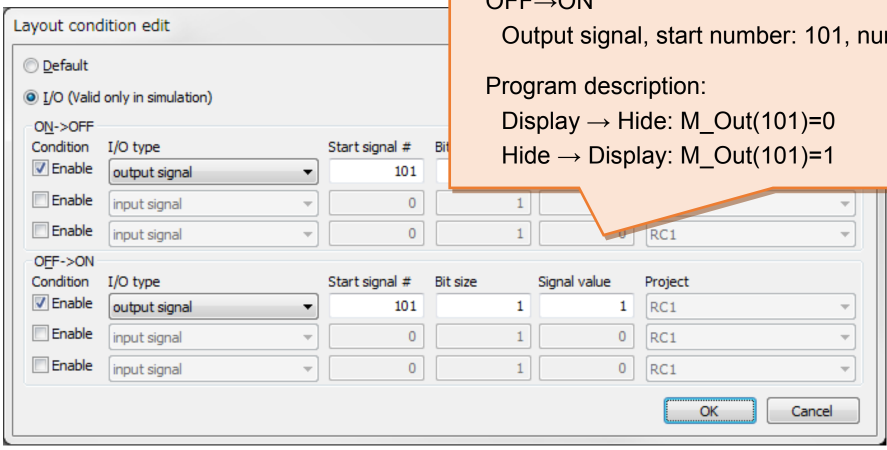
Program description:
Display → Hide: M_Out(100)=0
Hide → Display: M_Out(100)=1



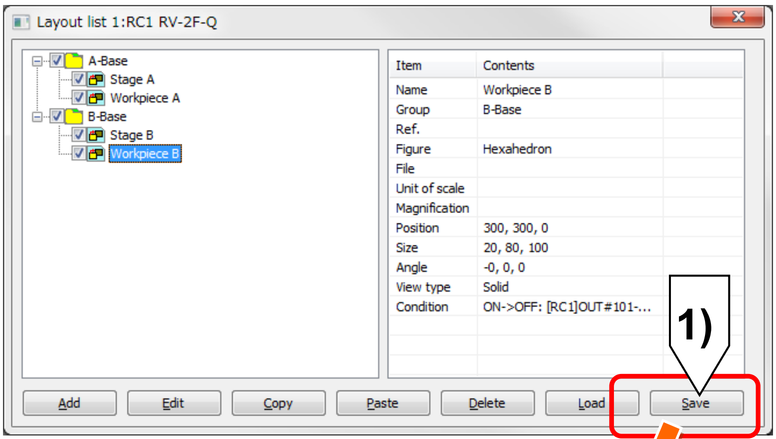
6) To set other parts, perform steps 1) to 5).
(Configure settings for each part.)

Example)
ON→OFF
Output signal, start number: 101, number of bits: 1, signal status: 0
OFF→ON
Output signal, start number: 101, number of bits: 1, signal status: 1

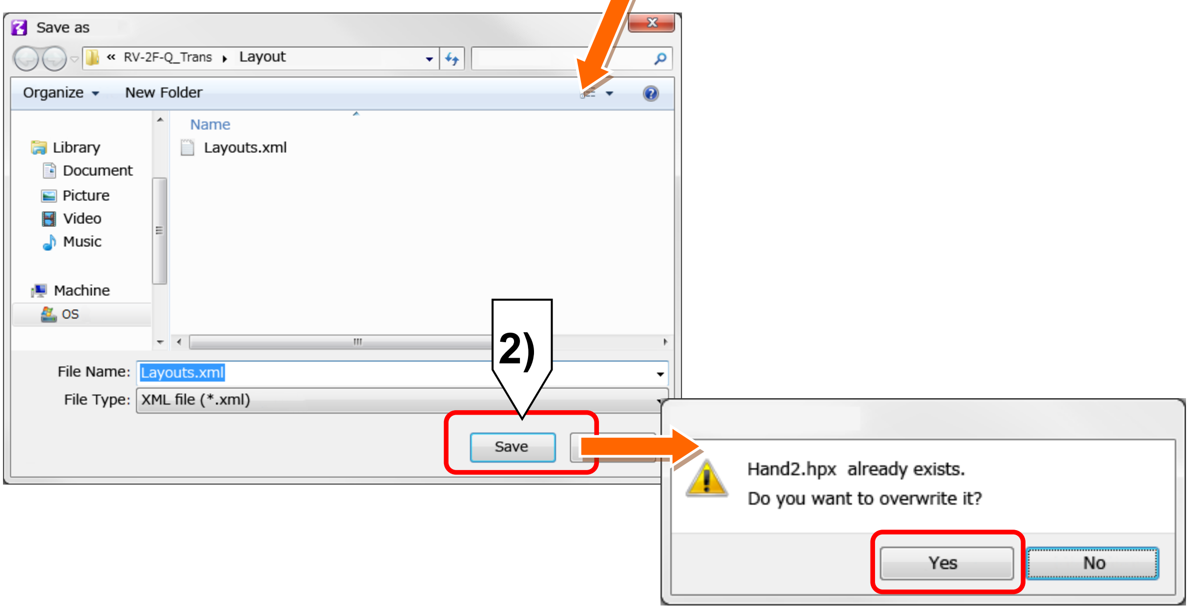
Program description:
Display → Hide: M_Out(101)=0
Hide → Display: M_Out(101)=1



(13-2) Save the layout file.

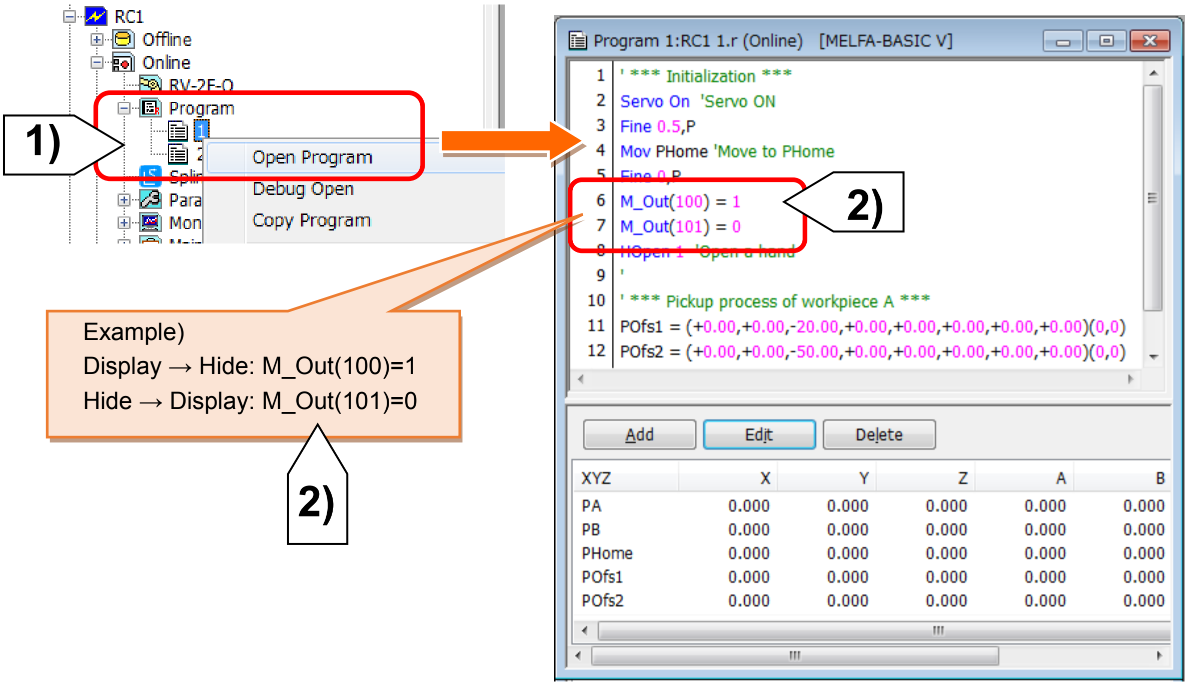


1) Click [Save] in the Layout list window.
2) Overwrite and save the file as is.

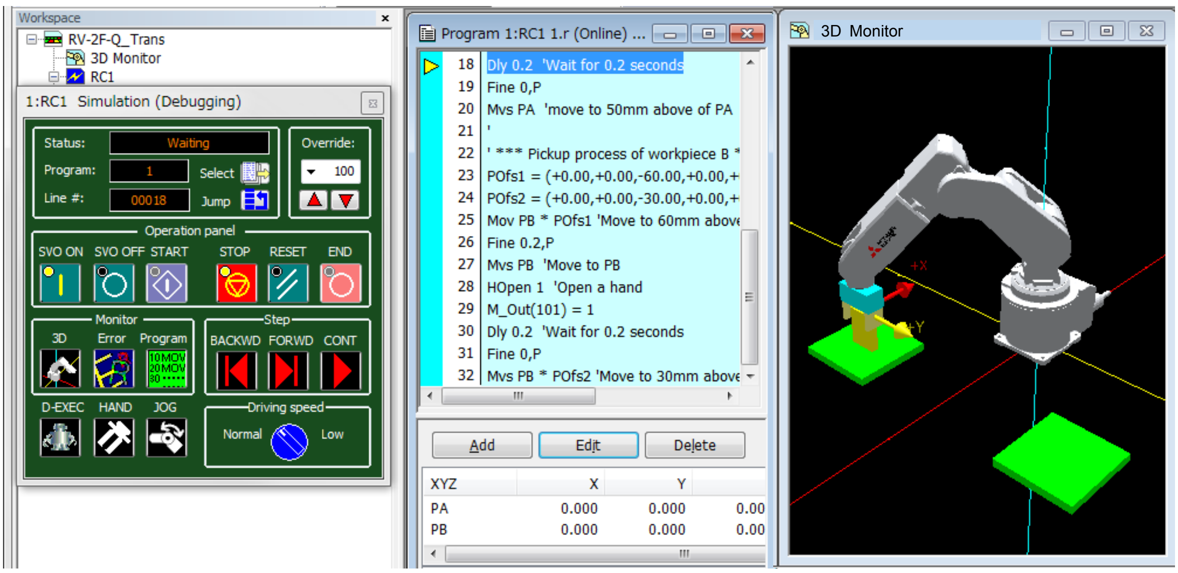


(13-3) Setting the display conditions for the robot program.

1) Select the program file from Program in the project tree, right-click and select "Open Program". Check the items to be read and click "OK".
2) Describe commands of the parts display conditions.



(13-4) Carry out debugging and check the program operation.

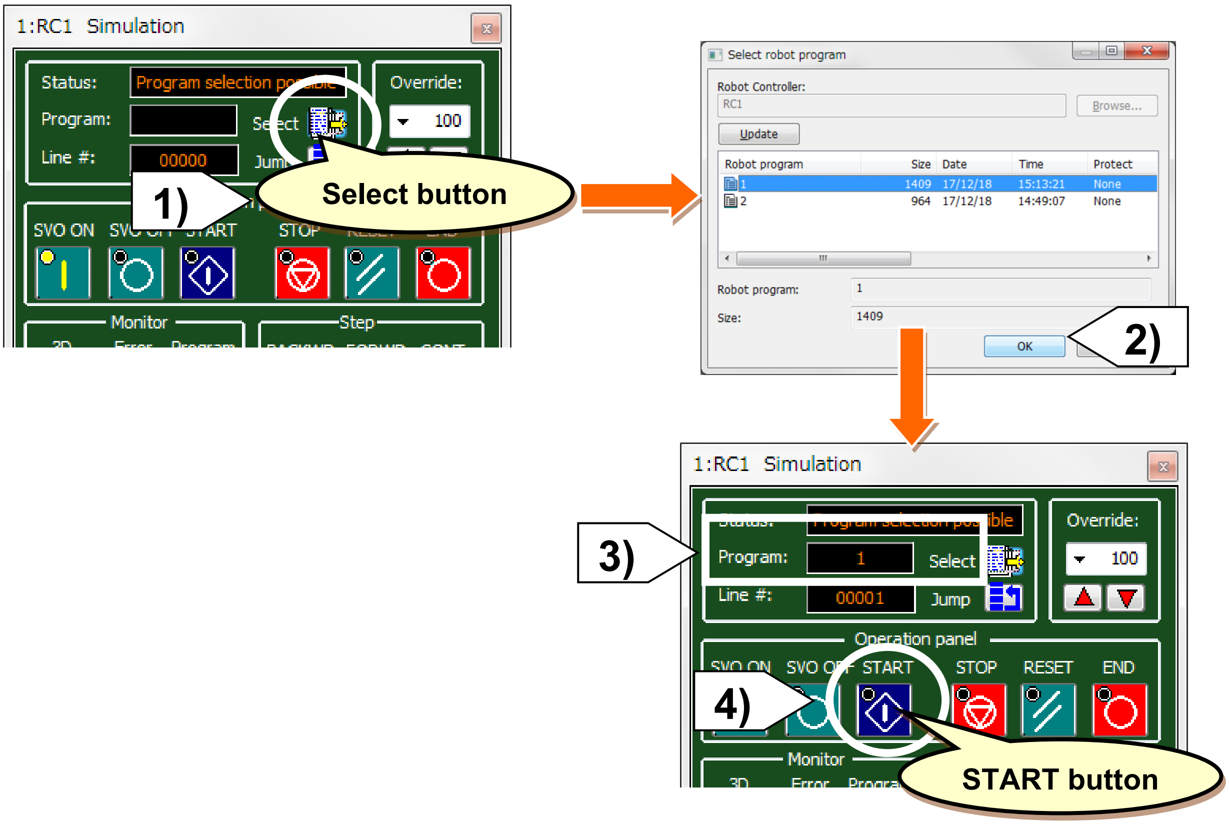


For the debugging method, refer to "(12) Carrying out debugging" in this chapter.

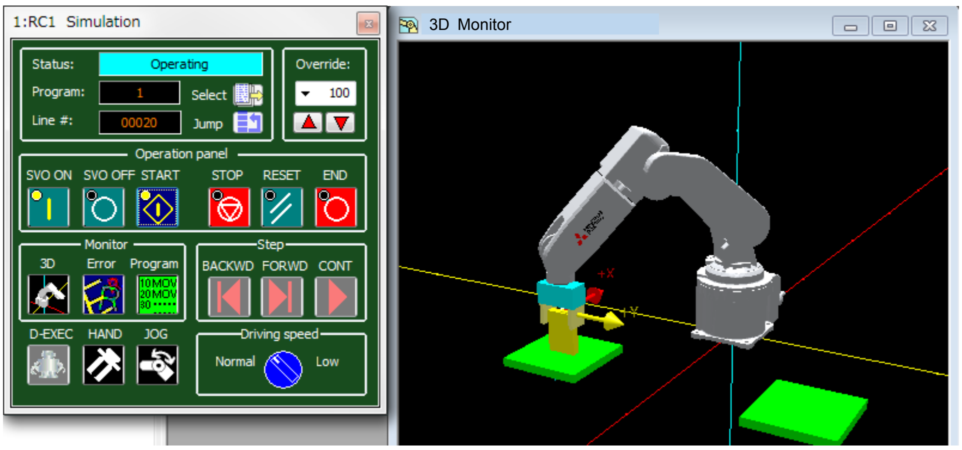
(14) Automatic Operation

(14-1) Select the program and perform the automatic operation.

1) Click the "Select" button in the operation panel.
2) Select the program.
3) The selected program name is displayed in "Program" in the operation panel.
4) Press the "START" button in the operation panel.



(14-2) Check if the robot operation and the program are correct.



<< MEMO >> * Use this page to write down notes.

Appendix 4: MELFA-BASIC

Appendix 4.1 Branch instruction

(1) Select Case (Select Case)

This instruction executes one of multiple statement blocks according to the conditional expression value.

If the condition matches one of the Case items, the process will be executed until the Break, next Case, Default, or End Select.

If the condition does not match any of the Case items but Default is described, that block will be executed.

```
Select <Condition>
    Case <Expression>
        [Process]
      Break
    Default <Expression>
        [Process]
      Break
End Select
```

Program example

```
1 Select MCNT
```

Value of MCNT

```
2 Case Is <= 103
        Mov P1
4       Break
```

MCNT <= 10
Execute Mov P1 and skip the Select statement.

```
5 Case 11
6 Case 12
7       Mov P2
8       Break
```

MCNT = 11 or 12
Execute Mov P2 and skip the Select statement.

```
9 Case 13 To 18
10      Mov P4
11      Break
```

13 <= MCNT <= 18
Execute Mov P4 and skip the Select statement.

```
12 Default
13      M_Out(10)=1
14      Break
```

Other than the above
Execute M_Out(10)=1 and skip the Select statement.

```
15 End Select
```

End

(1-5) While-WEnd (While End)

This instruction repeats the program between the While statement and WEnd statement as long as the loop conditions are satisfied.

Program example

```
1 M=1
2 While M1 <= 5
••••••
15 M1=M1+1
16 WEnd
```

M1 repeats the processes 1 to 5.

<< MEMO >> * Use this page to write down notes.

Appendix 5: iQ Platform Compatible (MELSEC Q Series Compatible) (F Series)

Appendix 5.1 Input/output function

(1) Setting the PLC CPU parameters

Set the multi-CPU parameters using GX Works2. The following examples apply for a system having one PLC CPU and one robot CPU.

1) Number of CPU modules
   Set the number of CPU modules mounted on the main base unit in the multi-CPU system.
2) With multi-CPU synchronous startup, it takes 10 to 15 seconds for the system to start up after the robot CPU power is turned ON. Thus, set simultaneously setup for the multi-CPU system (check the box).
3) Set the number of multi-CPU high-speed communication area setting points as a "K word unit". The robot CPU uses less than 1K word, but this should be set to 1K word.

(2) Setting the robot CPU parameters

Set the multi-CPU parameters using RT ToolBox2.

Setting the robot CPU parameters

<table>
<tr><th>Parameter name</th><th>Details</th><th>Default setting</th></tr>
<tr><td>QMLTCPUN</td><td>Number of multi-CPU modules setting
Set the number of multi-CPU modules mounted in the main base unit of the multi-CPU system.
Range: 1 to 4</td><td>2</td></tr>
<tr><td>QMLTCPUn
=1 to 4</td><td>Multi-CPUn unit high-speed communication area setting (n=1 to 4)
Set the number of points for sending and receiving data between each CPU module when using high-speed communication function between 1 to 4 units in a multi-CPU system. The parameter setting values must match all CPUs. If the parameter setting values do not match, an error will occur in the PLC CPU. Make sure that each CPU parameter value matches.
Element 1: Size of user's free area (K points)
Range: 1 to 14 (maximum)
Setting range according to number of CPU modules
<table>
<tr><th>No. of CPUs</th><th>Setting range</th></tr>
<tr><td>2</td><td>0 to 14K points</td></tr>
<tr><td>3</td><td>0 to 13K points</td></tr>
<tr><td>4</td><td>0 to 12K points</td></tr>
</table>
Element 2: Number of automatically refreshed points (points)
Range: 0 to 14335
The robot CPU does not support the automatic refresh area, so always set the number of automatic refresh area points to 0.
Element 3: Size of system area (K points)
Range: 1 or 2
Element 4: Multi-CPU synchronous startup (1: Enable, 0: Disable)
The robot CPU takes time to start up, so basically this setting must not be changed. Leave it set to 1 (Enable synchronization). All CPUs must be set to the same setting.</td><td>1,0,1,1</td></tr>
<tr><td>IQMEM Note 1)</td><td>Select the shared memory expansion function. A function is assigned for each bit. (1: Enable, 0: Disable)
15 0
00000000 00000000
bit2-3, 5-15 are not use
bit0: Shared memory expansion function
bit1: PLC direct execution function
bit4: Multi-robot cooperative control function</td><td>00000000
00000000</td></tr>
<tr><td>IQSPEC Note 1)</td><td>Set the functions of the drive unit for the iQ Platform compatible robot.
A function is assigned for each bit. (1: Enable, 0: Disable)
15 0
00000000 00000000
bit1-15 is not used
bit0: Shared memory write direction
=0: Execute read/write in order from head to last address
=1: Execute read in order from head, and write in order from last address</td><td>000000000000
0001</td></tr>
</table>

Note 1) Refer to the separate "Instruction Manual / iQ Platform compatible expansion function manual (BFP-A8787)" for details on this function (expansion function: PLC direct execution function).

(3) Correspodendence of CPU shared memory and robot input/output signals

With the PLC CPU, the CPU's shared memory is accessed as U3E0\G1000. The robot CPU No.n CPU shared memory is accessed as U3En\G10000. (n = 1 to 3, up to three robot CPUs can be used.) The robot CPU's input/output signal numbers are 10000 to 18191 respectively. Note that the PLC side uses word devices, and the robot side uses bit devices.
The correspondence of the CPU shared memory and robot input/output signals is shown below. This cannot be changed.

Correspondence of CPU shared memory and robot input/output signals

PLC (word device)		Robot (bit device)	
Output	U3E0\G10000 to U3E0\G10511	Input	Robot CPU No.1 / 10000 to 18191
	U3E0\G10512 to U3E0\G11023		Robot CPU No.2 / 10000 to 18191
	U3E0\G11024 to U3E0\G11535		Robot CPU No.3 / 10000 to 18191
Input	U3E1\G10000 to U3E1\G10511	Output	Robot CPU No.1 / 10000 to 18191
	U3E2\G10000 to U3E2\G10511		Robot CPU No.2 / 10000 to 18191
	U3E3\G10000 to U3E3\G10511		Robot CPU No.3 / 10000 to 18191

(4) Program example of sequence ladder

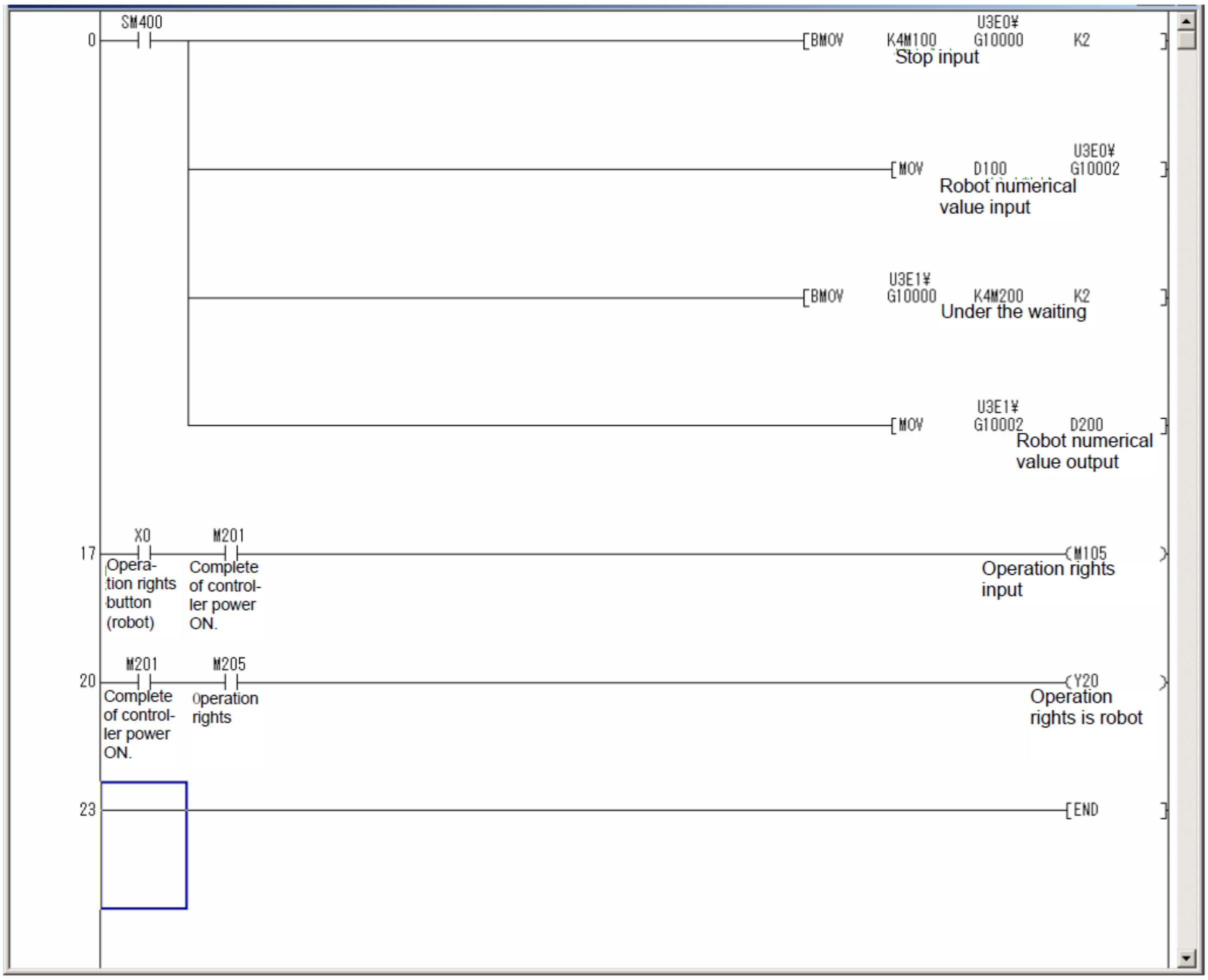
An example for turning the operation panel's "Robot operation right enable button: X0" ON, set the operation panel's "Robot operation rights enabled lamp: Y20" and output the robot's operation right enabled state is shown below.
The multi-CPU is configured of the No. 1 unit: PLC QnUD(H)CPU and No. 2 unit: robot Q172DRCPU.

[Explanation]

<Lines 0 to16 > M100 to M131 are written into the U3E0\G10000 and U3E0\G10001 shared device memory, and are handled as the input from the PLC to the robot. The U3E1\G10000 and U3E1\G10001 shared device memory is read as the M200 to M231 bit device, and handled as the output from the robot to the PLC.

<Lines 17 to 22 > When X0 turns ON, M105 turns ON and U3E0\G10000 bit 5 of the PLC corresponding to M105 turns ON. Then, the robot input 10005 turns ON, and the operation rights assigned to the dedicated input signal are enabled. When the operation rights are enabled, the robot output 10005 assigned to the dedicated output signal turns ON, and the robot's U3E1\G10000 bit 5 turns ON. This causes the PLC M205 corresponding to the U3E1\G10000 bit 5 to turn ON, and Y20 to turn ON. In this example, bit device M201 (U3E0\G10000 bit 1, or robot output 10001) indicates the completion of the controller power ON (outputs that external input signal can be received).

Example of sequence ladder



(5) Dedicated input/output signal assignment (Default settings)

The default dedicated input/output signal assignments are shown below.

Dedicated input/output signal assignment (default settings)

Parameter name	Input signal name (* Operation rights required)	Output signal name	Input	Output	G device Note1)
STOP	Stop input (assignment cannot be changed)	Output stopped (assignment cannot be changed)	10000	10000	G10000
RCREADY	-	Controller power ON complete	-	10001	
ATEXTMD	-	Remote mode output	-	10002	
TEACHMD	-	Teach mode output	-	10003	
ATTOPMD	-	OP mode output	-	10004	
IOENA	Operation rights input	Operation rights output	10005	10005	
START	Start input (*)	Running output	10006	10006	
STOPSTS	-	Inputting stop signal	-	10007	
SLOTINIT	Program reset (*)	Program selectable output	10008	10008	
ERRRESET	Error reset input	Outputting error occurrence	10009	10009	
SRVON	Servo ON input (*)	Outputting servo ON	10010	10010	
SRVOFF	Servo OFF input	Outputting servo ON not possible	10011	10011	
CYCLE	Cycle stop input	Outputting cycle stop operation	10012	10012	
SAFEPOS	Retract position return signal (*)	Outputting retract point return	10013	10013	
BATERR	-	Battery voltage low	-	10014	
OUTRESET	General-purpose output signal reset (*)	-	10015	-	
HLVLERR	-	Outputting high level error	-	10016	G10001
LLVLERR	-	Outputting low level error	-	10017	
CLVLERR	-	Outputting warning level error	-	10018	
EMGERR	-	Outputting emergency stop	-	10019	
PRGSEL	Program selection input	-	10020	-	
OVRDSEL	Override selection input	-	10021	-	
PRGOUT	Program No. output request	Outputting program No.	10022	10022	
LINEOUT	Step No. output request	Outputting step No.	10023	10023	
OVRDOUT	Override value output request	Outputting override value	10024	10024	
ERROUT	Error No. output request	Outputting error No.	10025	10025	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	
-	-	-	-	-	

Parameter name	Input signal name (* Operation rights required)	Output signal name	Input	Output	G device Note 1)
IODATA	Numeric input 0	Numeric output 0	10032	10032	G10002
	Numeric input 1	Numeric output 1	10033	10033	
	Numeric input 2	Numeric output 2	10034	10034	
	Numeric input 3	Numeric output 3	10035	10035	
	Numeric input 4	Numeric output 4	10036		
	Numeric input 5	Numeric output 5	10037		
	Numeric input 6	Numeric output 6	10038		
	Numeric input 7	Numeric output 7	10039		
	Numeric input 8	Numeric output 8	10040		
	Numeric input 9	Numeric output 9	10041		
	Numeric input 10	Numeric output 10	10042		
	Numeric input 11	Numeric output 11	10043		
	Numeric input 12	Numeric output 12	10044		
	Numeric input 13	Numeric output 13	10045		
	Numeric input 14	Numeric output 14	10046		
	Numeric input 15	Numeric output 15	10047		
HNDCNTL1	-	Hand output signal status 900	-	10048	G10003
	-	Hand output signal status 901	-	10049	
	-	Hand output signal status 902	-	10050	
	-	Hand output signal status 903	-	10051	
	-	Hand output signal status 904	-	10052	
	-	Hand output signal status 905	-	10053	
	-	Hand output signal status 906	-	10054	
	-	Hand output signal status 907	-	10055	
HNDSTS1	-	Hand input signal status 900	-	10056	
	-	Hand input signal status 901	-	10057	
	-	Hand input signal status 902	-	10058	
	-	Hand input signal status 903	-	10059	
	-	Hand input signal status 904	-	10060	
	-	Hand input signal status 905	-	10061	
	-	Hand input signal status 906	-	10062	
	-	Hand input signal status 907	-	10063	
USRAREA	-	User-defined area 1	-	10064	G10004
	-	User-defined area 2	-	10065	
	-	User-defined area 3	-	10066	

Parameter name	Input signal name (* Operation rights required)	Output signal name	Input	Output	G device Note 1)
USRAREA	-	User-defined area 4	-	10067	G10004
	-	User-defined area 5	-	10068	
	-	User-defined area 6	-	10069	
	-	User-defined area 7	-	10070	
	-	User-defined area 8	-	10071	

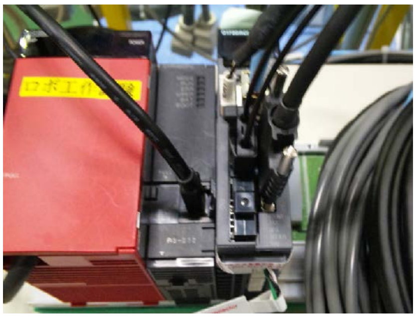
Note 1) The device addresses are common for multi-CPUs. (Address viewed from PLC Side.)

Appendix 5.2 Setting the multi-CPU (using GX Works2)

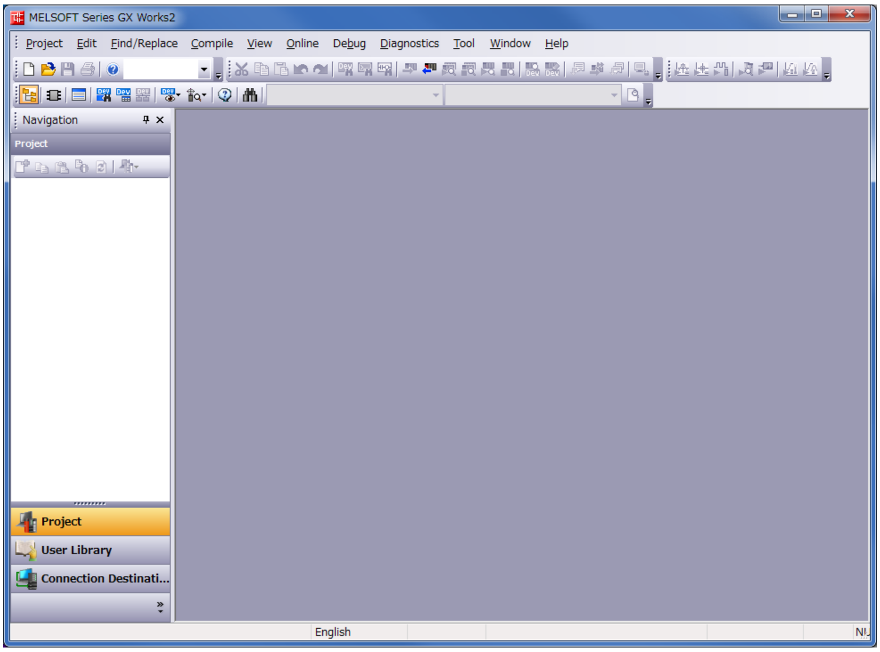
The steps for setting the PLC communication, multi-CPU and personal computer support software are explained in this section.
These examples apply for when the personal computer and PLC are connected with a USB cable.
In the following explanation, the PLC parameters are set with "GX Works2".
When using "GX Developer", refer to "Appendix 5.3 Setting Multi-CPU (Using GX Developer) " in this chapter.

(1) Setting GX Works2

1) GX Works2 is used to set PLC communication and write the settings to the PLC.
   GX Works2 is also used to set the multi-CPU.
   Connect the PLC and personal computer with a USB cable.

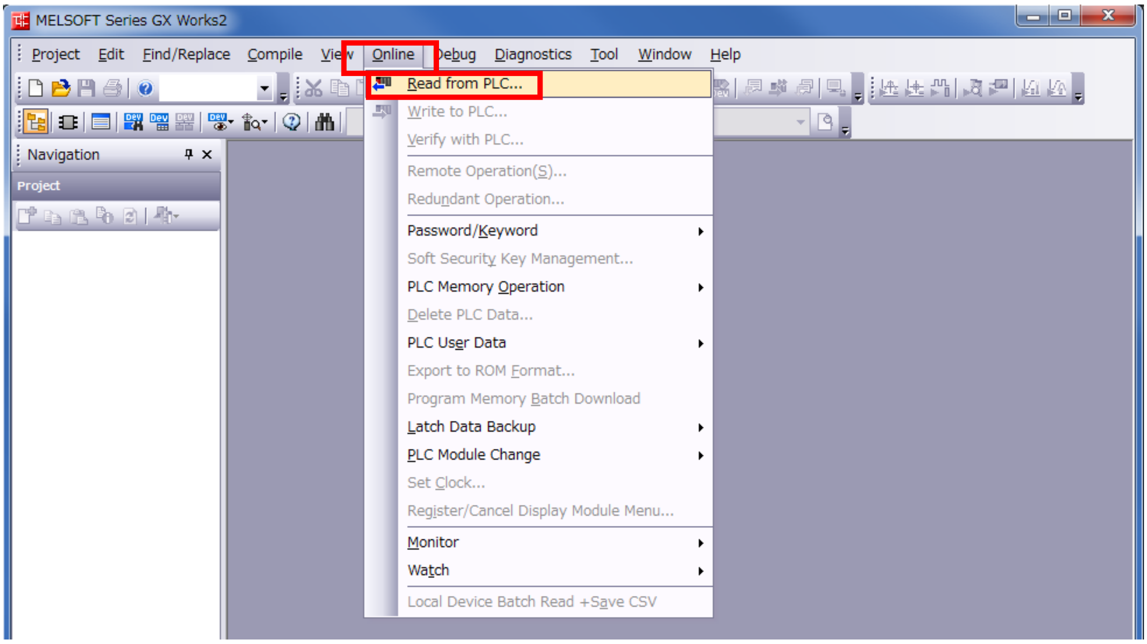


2) Start up GX Works2.

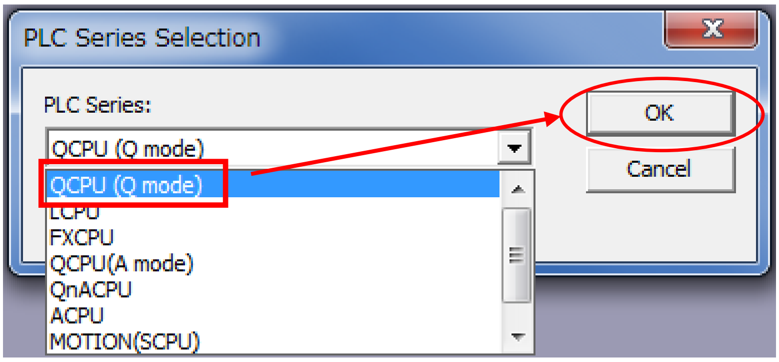


Start up screen

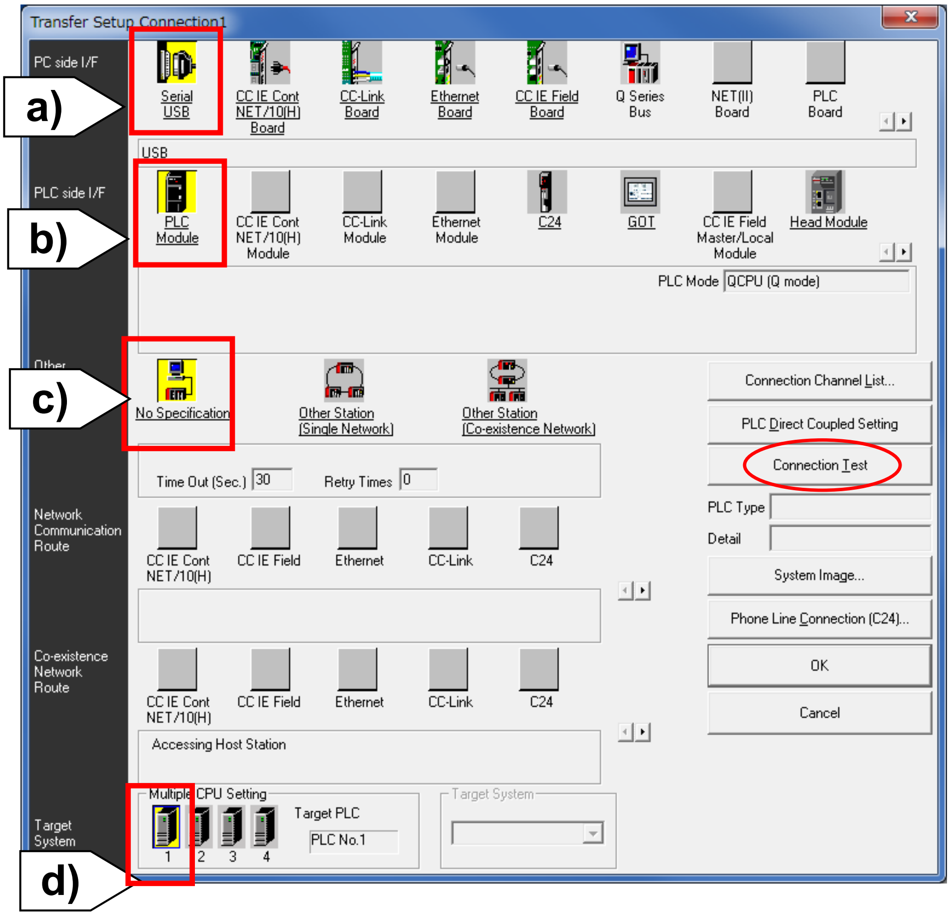
3) Select "PC READ" under "ONLINE".



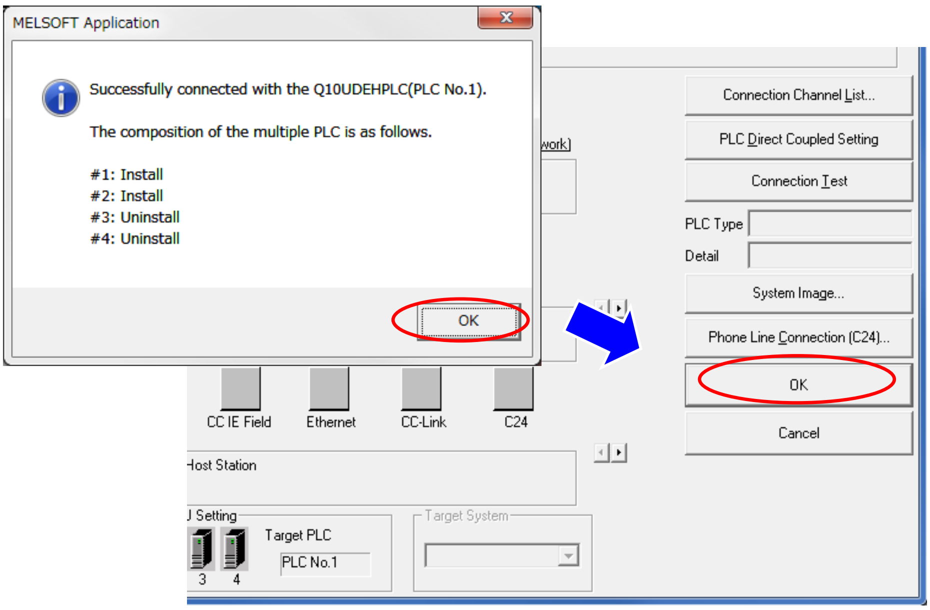
4) The "SELECT PC SERIES" window opens. Select "QCPU (Q MODE)" and then click "OK".



5) The "CONNECTION" window opens.
 a) Select "SERIAL USB" for Personal Computer I/F
 b) Select "CPU MODUEL" for PLC I/F
 c) Select "NO OTHER STATION" for Other station Designation
 d) Select "PLC No.1" for Target System
 Click "Communication Test".

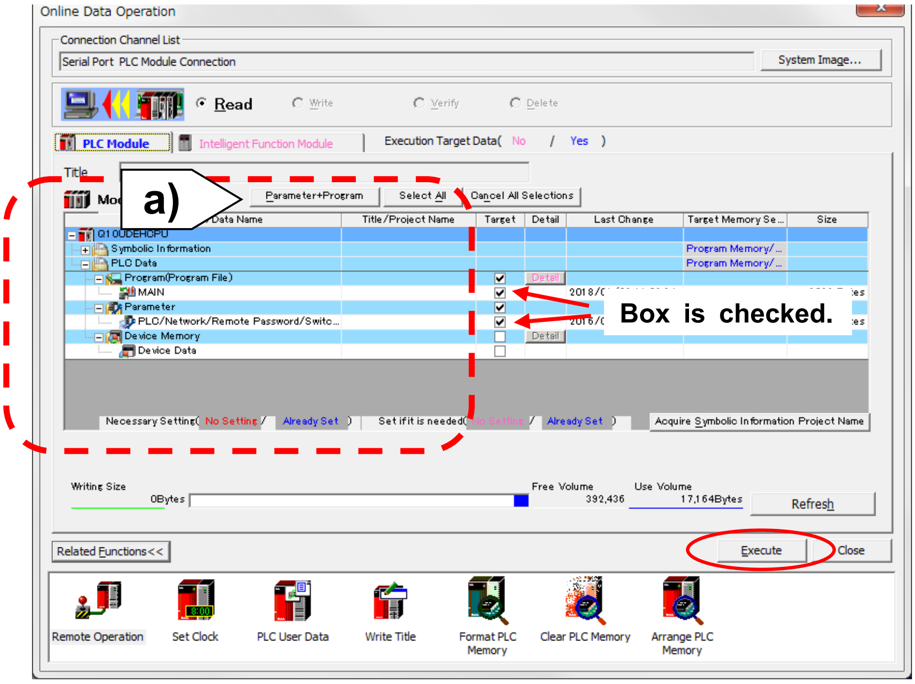


6) The connection status appears on the "MELSOFT APPLICATION" window. When "OK" is clicked, the "CONNECTION" window appears again. Click "OK" again.

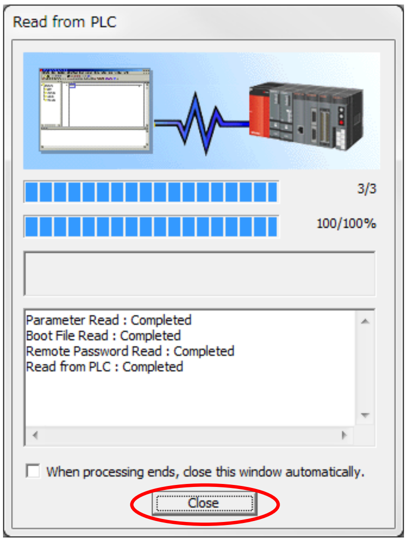


7) The "ONLINE DATA OPERATION" window opens.

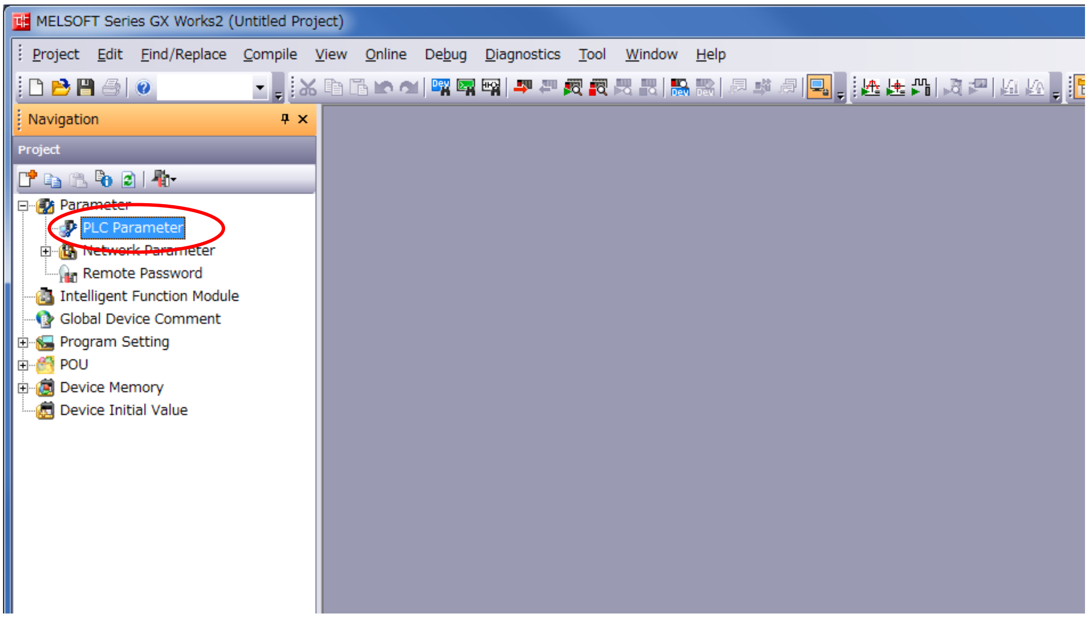
a) Click "Parameter + Program", and confirm that the check box for the corresponding data (program, parameter) is checked. Check the box if it is not checked yet.
Click the "EXECUTE" button.



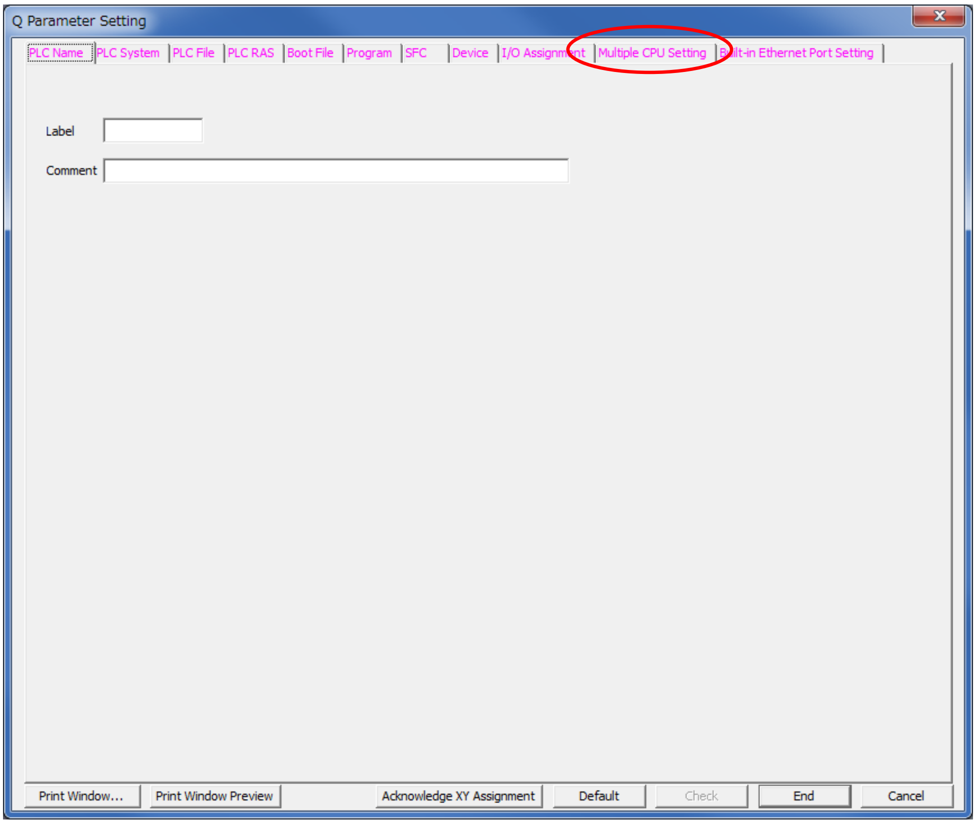
8) The "PC READ" window opens, and data is read from the PLC. When all of the data has been read out, click the "CLOSE" button.
The "ONLINE DATA OEPRATION" screen opens again, so click "CLOSE" again.



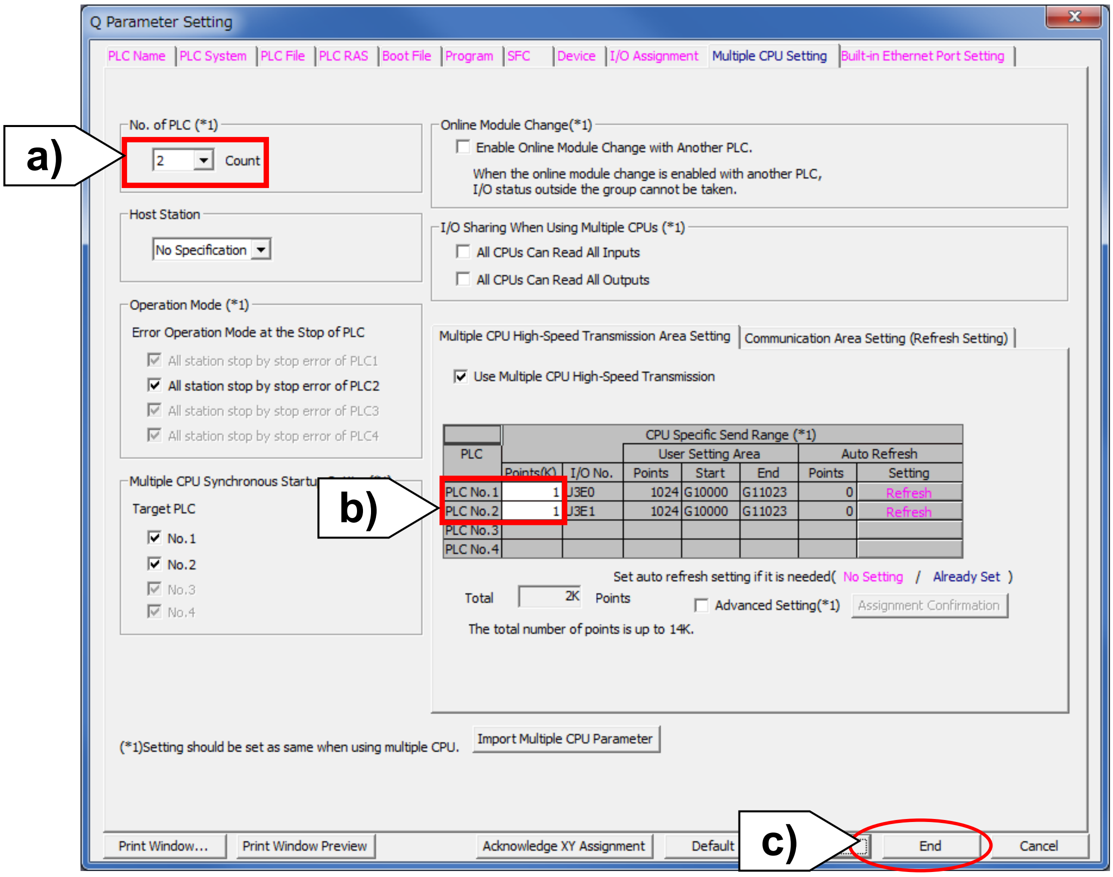
9) Click "PC PARAMETER" under "PARAMETER" shown on the left of the screen.



10) The "Q PARAMETER SETTING" window opens.
Select the "MULTI CPU SETTING" tab.

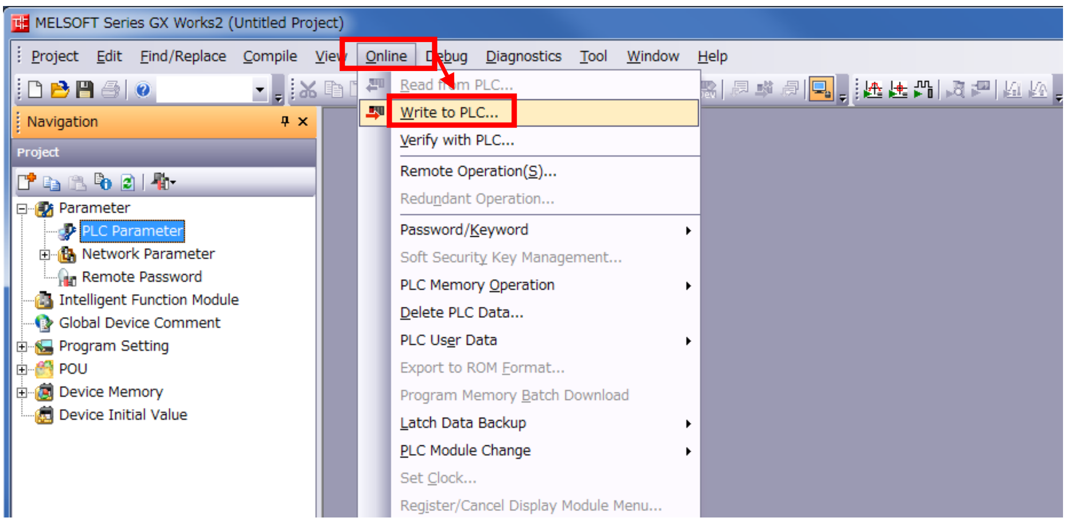


11) Perform the following on the "MULTI CPU SETTING" screen.
   a) Change "NO. OF CPU MODULES" to "2 MODULES".
   b) Change the No. of points for the No. 1 and No. 2 units in "MULTI-CPU HIGH-SPEED COMMUNICATION AREA SETTING" to "1". (The initial value is "7").
   c) Click the "END SETTING" button.



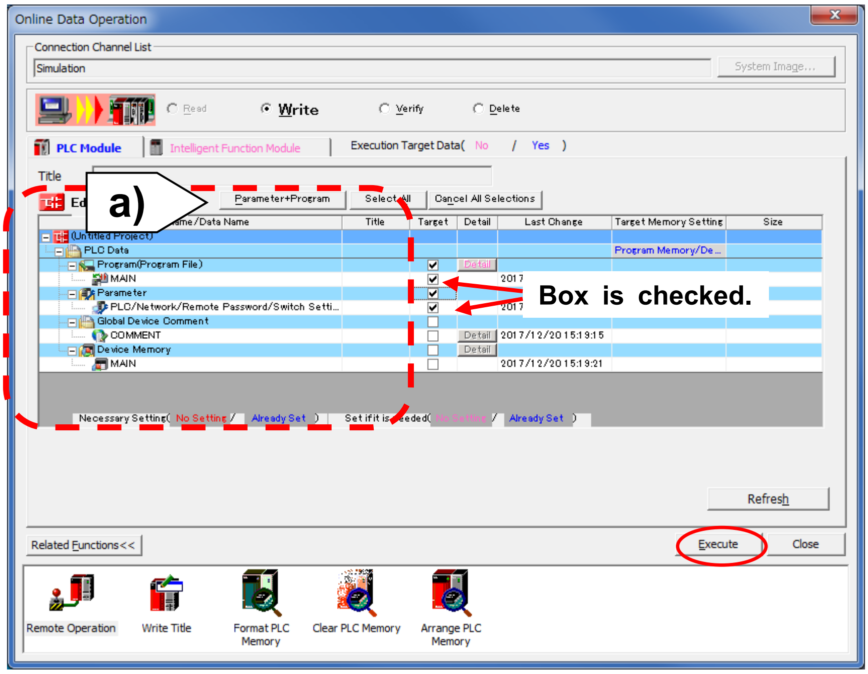
Note) Do not set the robot's CPU.

12) Write the set parameters to the PLC.
   Select "PC WRITE" from the "ONLINE" tab.



13) The "ONLINE DATA OPERATION" window opens.

a) Click "PARAMETER + PROGRAM", and confirm that the check box for the corresponding data (program, parameter) is checked. Check the box if it is not checked yet.
Click the "EXECUTE" button.



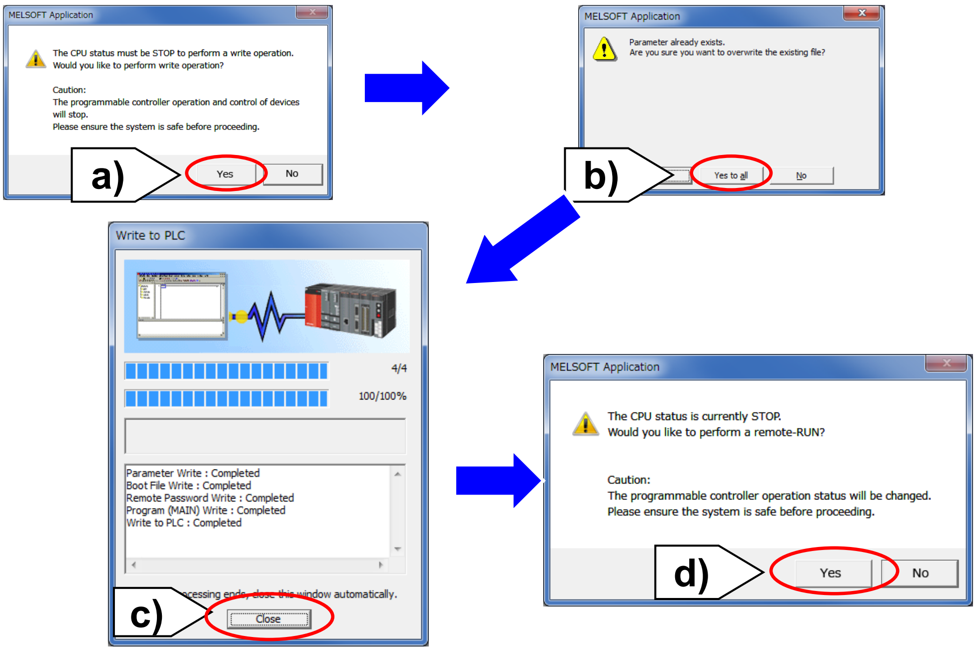
14) a) A window opens and the message "Execute PC write?" appears. Click "YES".

b) The message "Overwrite?" appears, so click "ALL".

c) The message "WRITING COMPLETE" appears. When all writing has been completed, click "CLOSE".

d) The message "Is remote-RUN executed?" appears. Click "Yes".

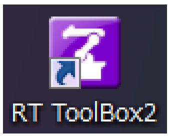
This completes the settings on the GX Works2 side.



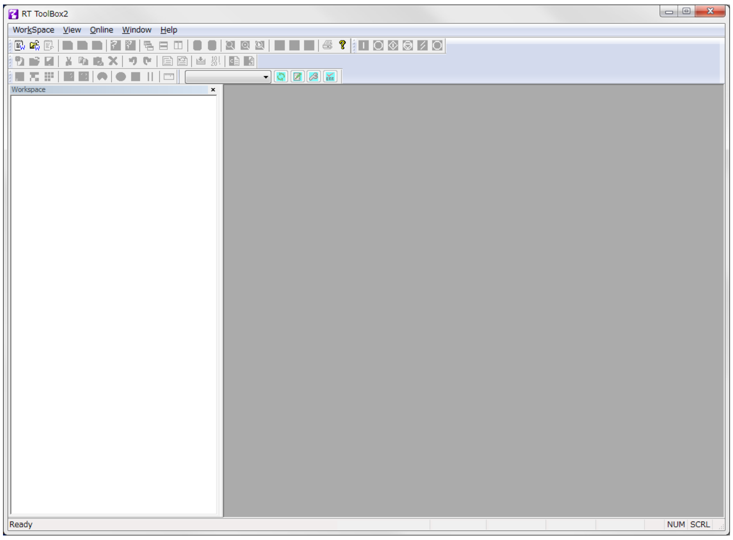
Next, set the personal computer support software "RT ToolBox2".

(2) Setting RT ToolBox2

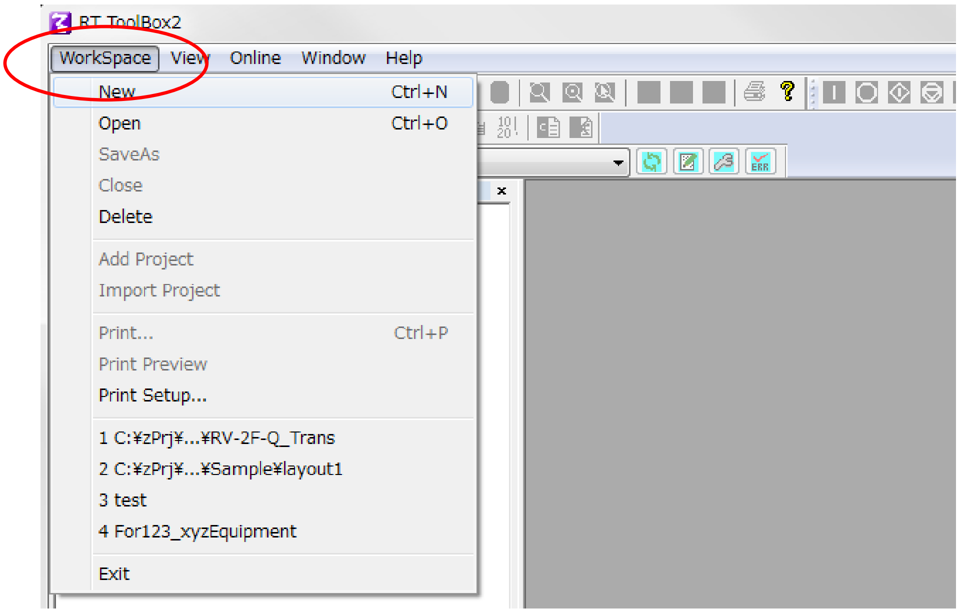
1) Complete the settings for communicating with the personal computer support software. First, start up the personal computer support software (RT ToolBox2).



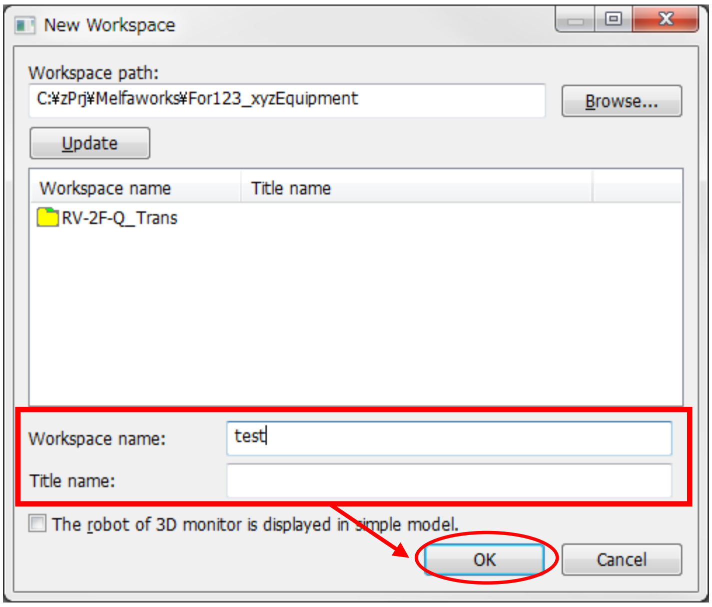
Click the icon shown on the left.
The following screen will open.



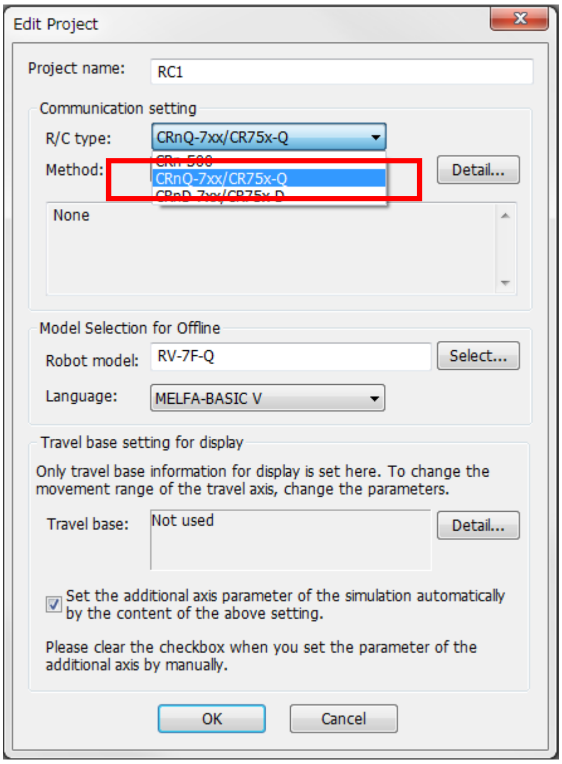
2) Select "NEW" from "WORKSPACE" on the top.



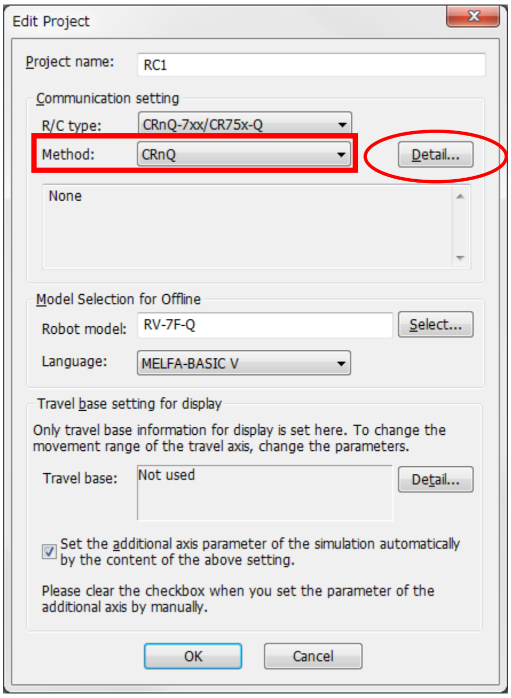
3) Create a new workspace.
Input the workspace name and title, and click the OK button.



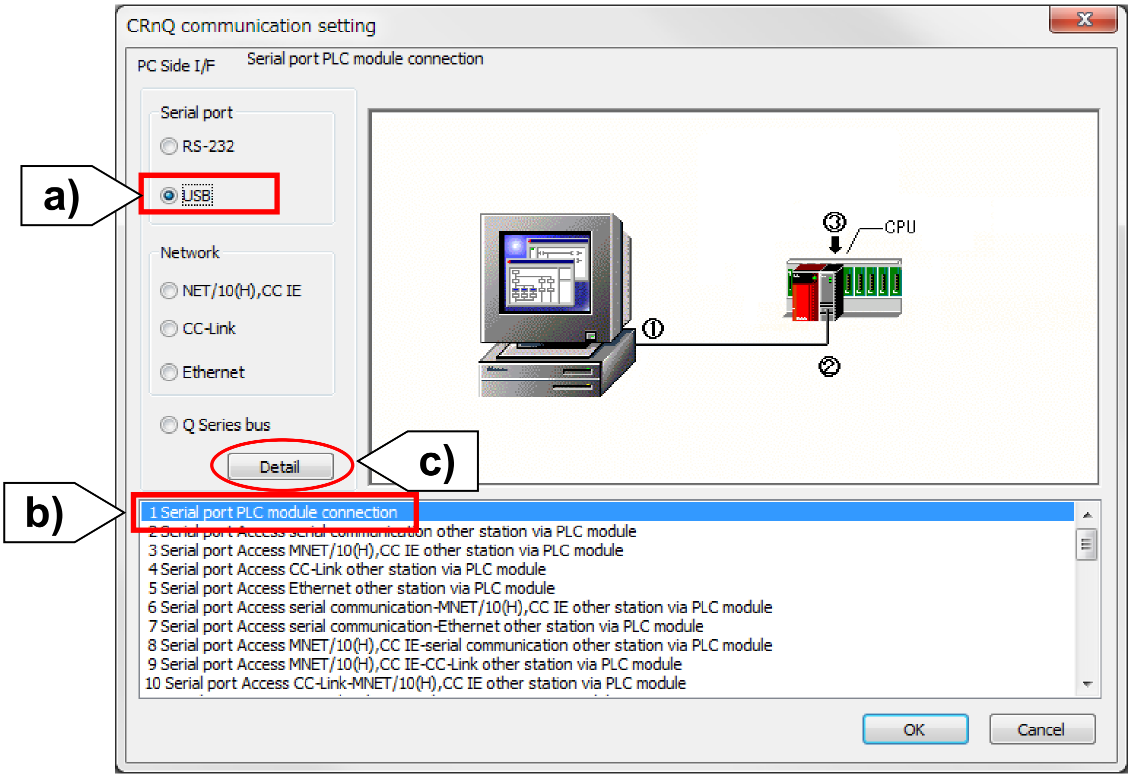
4) Select "CRnQ-7xx/CR75x-Q" from the CONTROLLER tab on the "EDIT PROJECT" window.



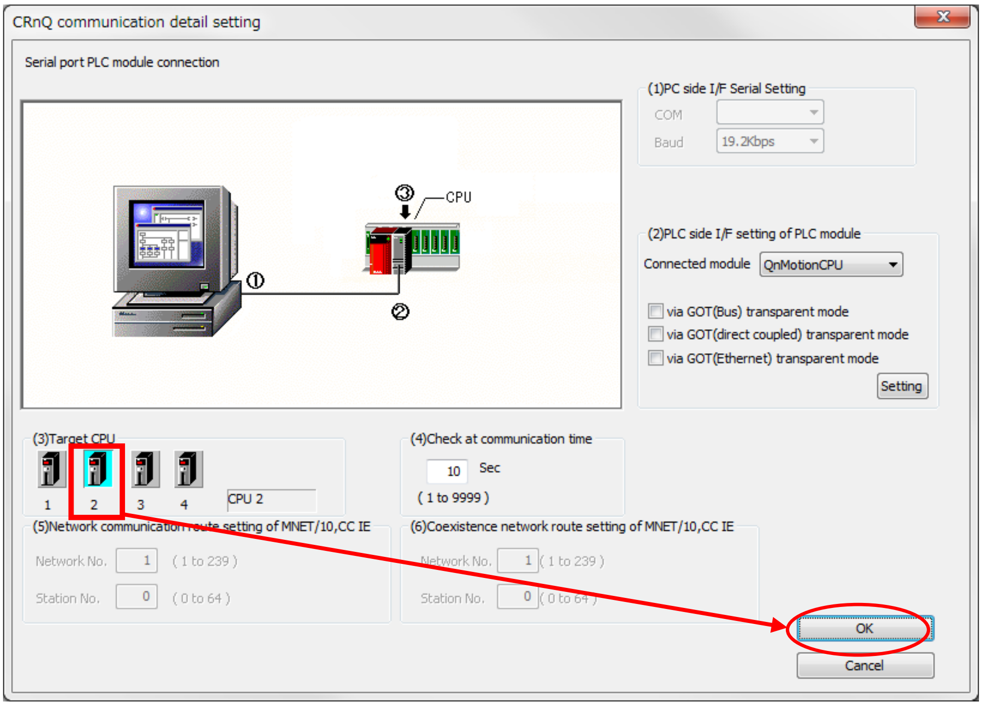
5) Check that "CRnQ" is selected in the "COMMUNICATION" tab. Next, click the "DETAIL SETTINGS" button.



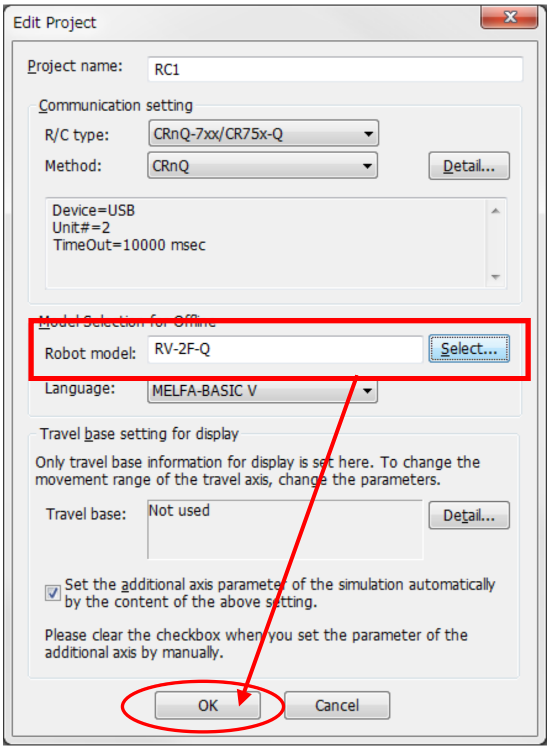
6) Complete the detailed settings.
a) Set "USB" for the Personal Computer I/F setting, and
b) Set ROUTE to "1 SERIAL COMMUNICATION CPU MODUEL CONENCTION".
c) Click the "DETAIL SETTINGS" button.



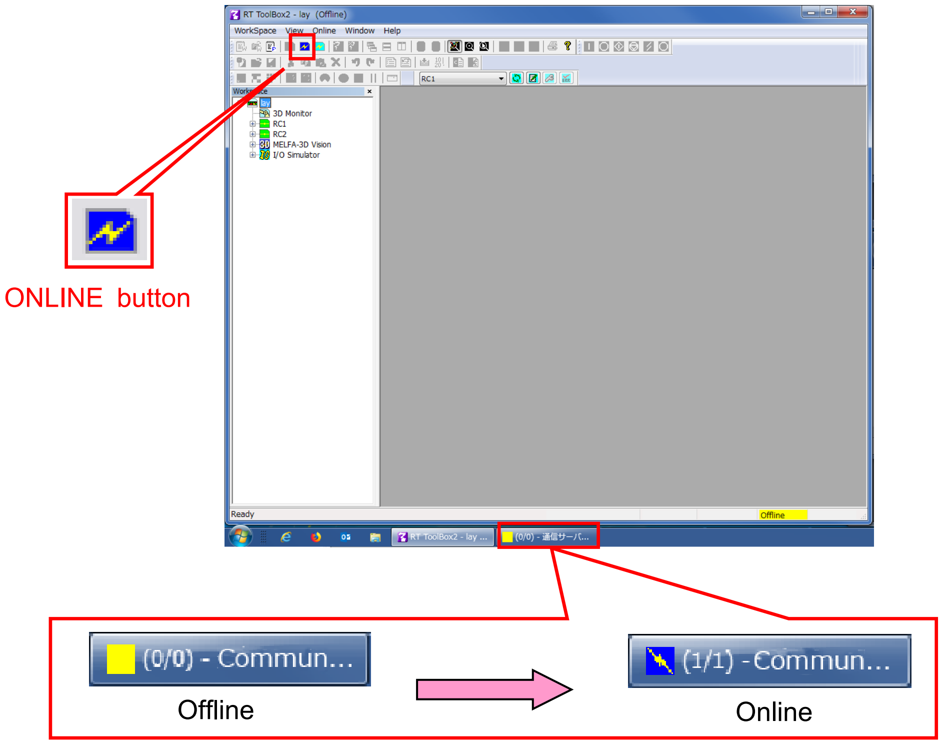
7) In the DETAIL SETTINGS window, set "TARGET CPU" to "No. 2 unit" and click the "OK" button.
The "CRnQ COMMUCNIATION" screen opens again, so click the "OK" button.



8) Select the model name under "OFFLINE ROBOT SETTING". Click "OK" after selecting.
This completes the communication settings.

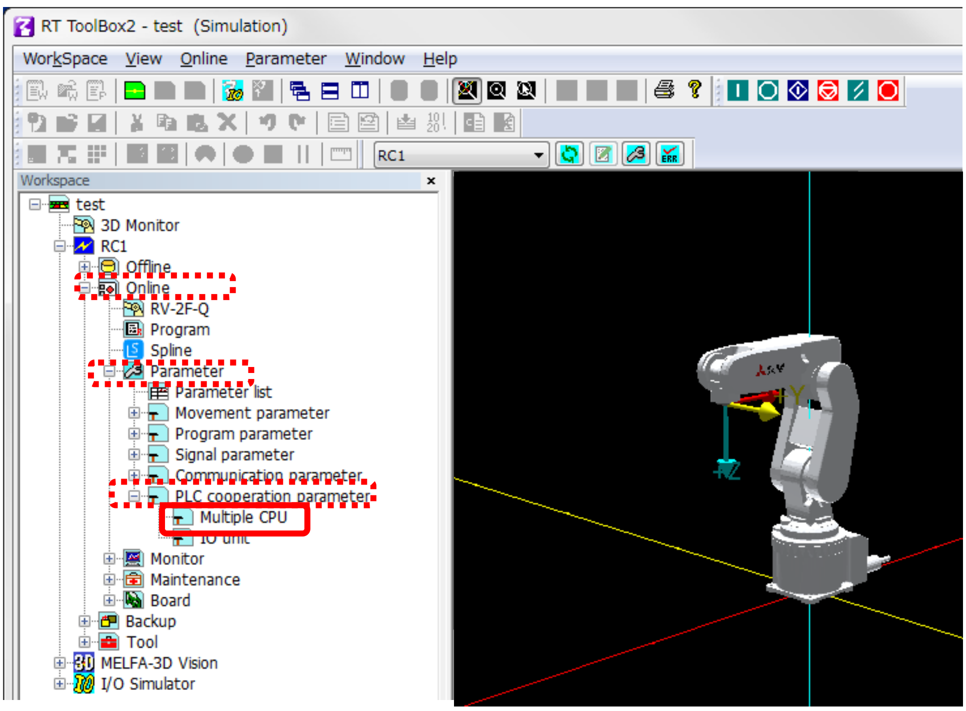


9) Complete the "MULTI-CPU SETTINGS" next.
First, activate the online state between the robot and RT ToolBox2 to enable communication and work with the robot.
Click the "ONLINE" button and wait for the communication server to change to online.

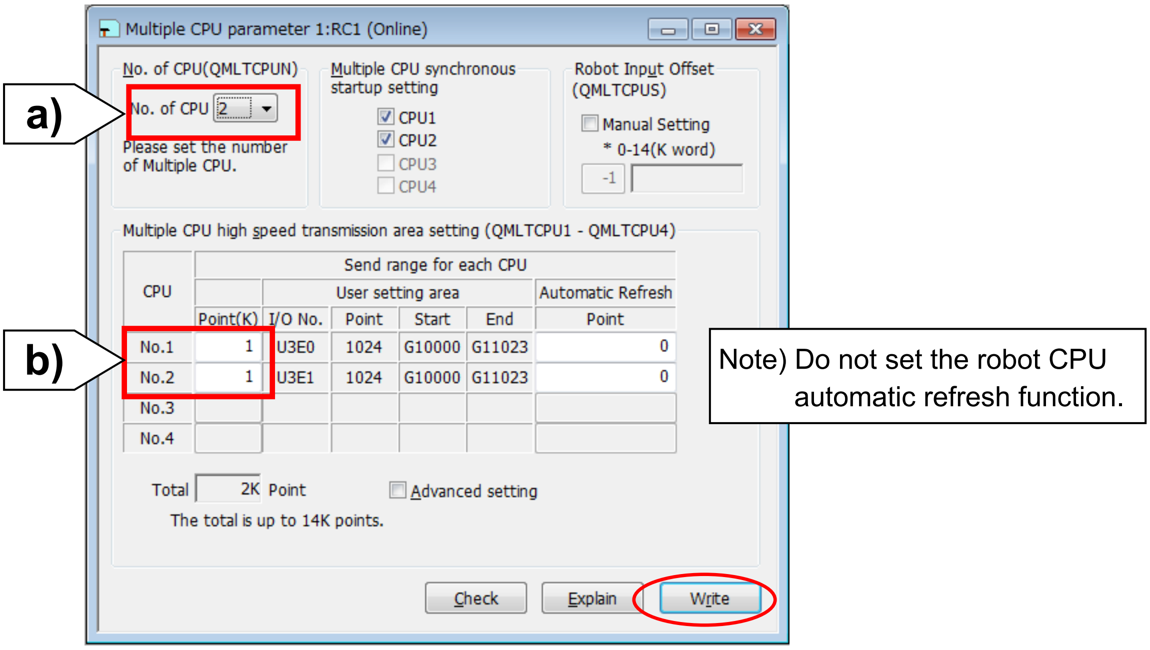


Click the ONLINE button. The communication server will change to online shortly.

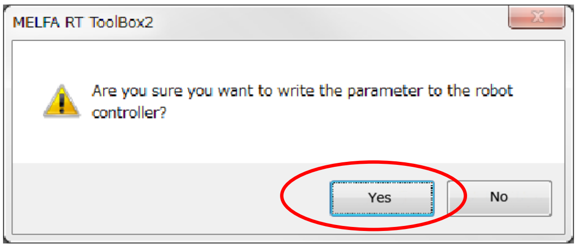
10) Expand "Online" → "Parameter" → "PLC cooperation parameter" in Workspace, and click" Multiple CPU".



11) The MULTI CPU SETTING screen opens
The same settings as "(1) GX Works2" step "11" are made here.
a) Change "NO. OF CPU MODULES" to "2 MOUDLES".
b) Change the No. of points (K) for the No. 1 and No. 2 units in "MULTI-CPU HIGH-SPEED COMMUNICATION AREA SETTING" to "1".
After inputting the setting value, click the "WRITE" button.



12) The write confirmation screen opens, so click "YES".

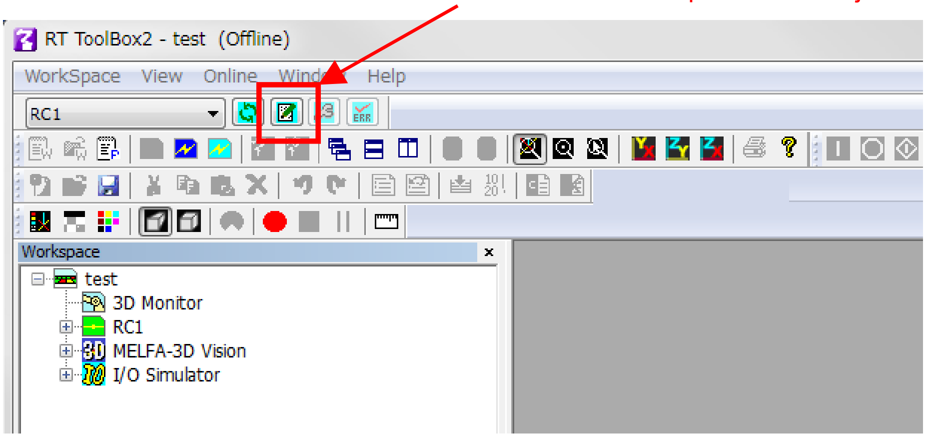


13) Close the MULTI CPU SETTING screen.
This completes the setting of the multi-CPU on the robot CPU side.
To enable the changed parameters, turn both the drive unit and robot CPU power OFF and ON.

This completes the settings.

[Reference] After creating the project, open "Edit Project" with the button shown below to change each setting again.

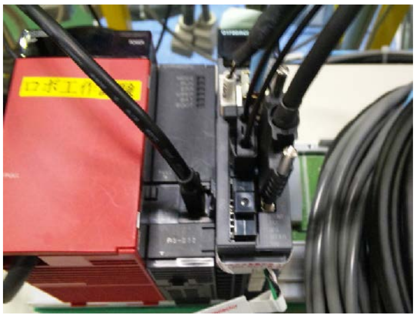
Click this button to open "Edit Project".

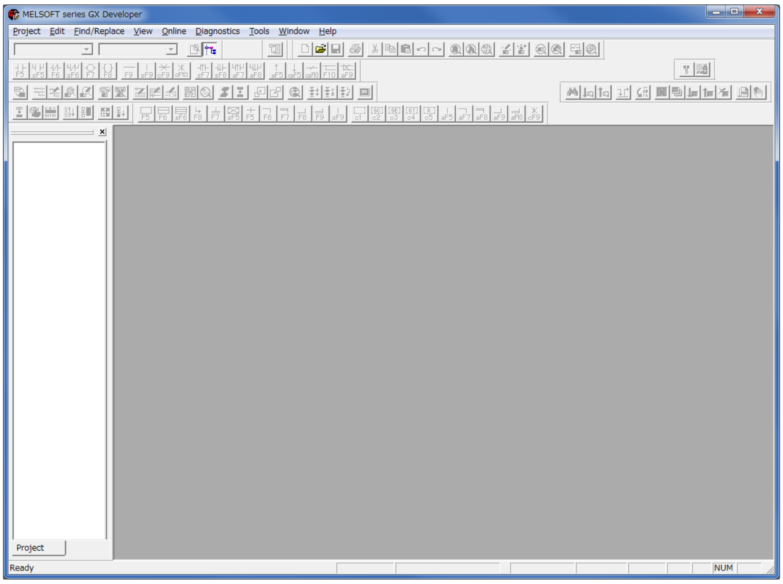


Appendix 5.3 Setting Multi-CPU (Using GX Developer)

The steps for setting the PLC communication, multi-CPU and personal computer support software are explained in this section.
These examples apply for when the personal computer and PLC are connected with a USB cable.

1) GX Developer is used to set PLC communication and write the settings to the PLC.
GX Developer is also used to set the multi-CPU.
Connect the PLC and personal computer with a USB cable.

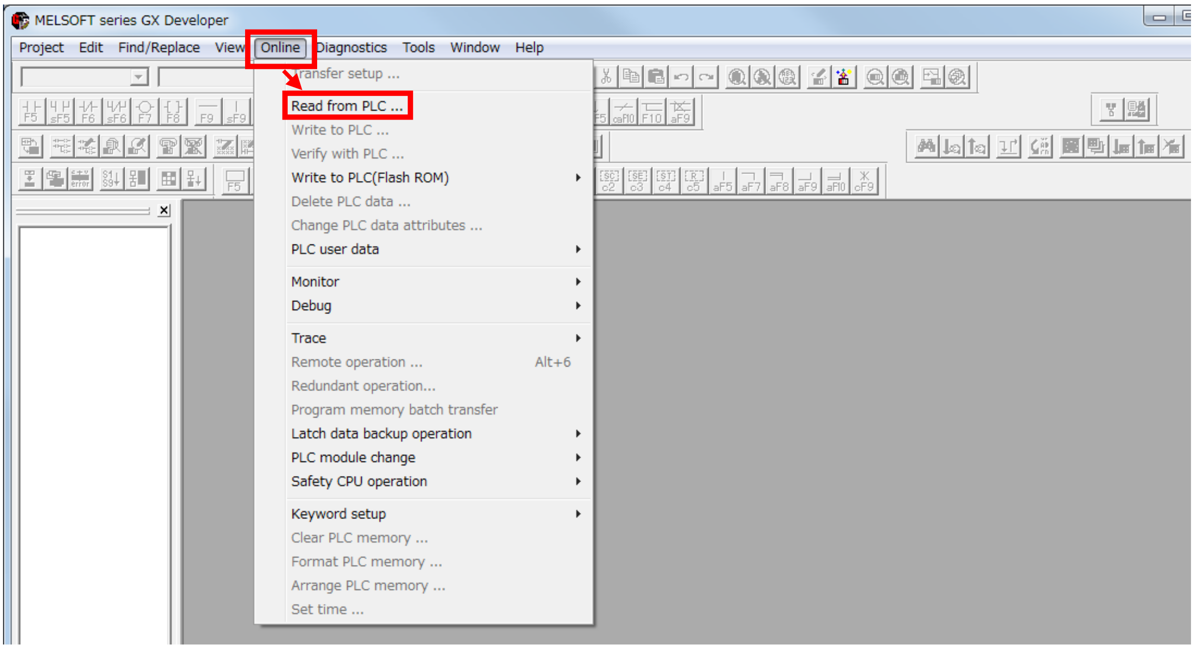




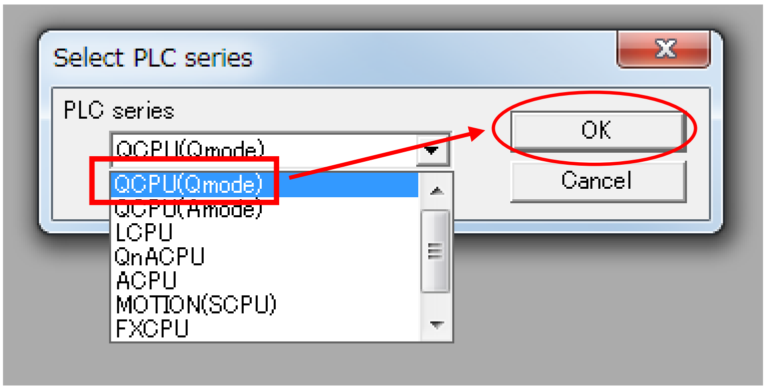
Screen at start up

2) Start up GX Developer.

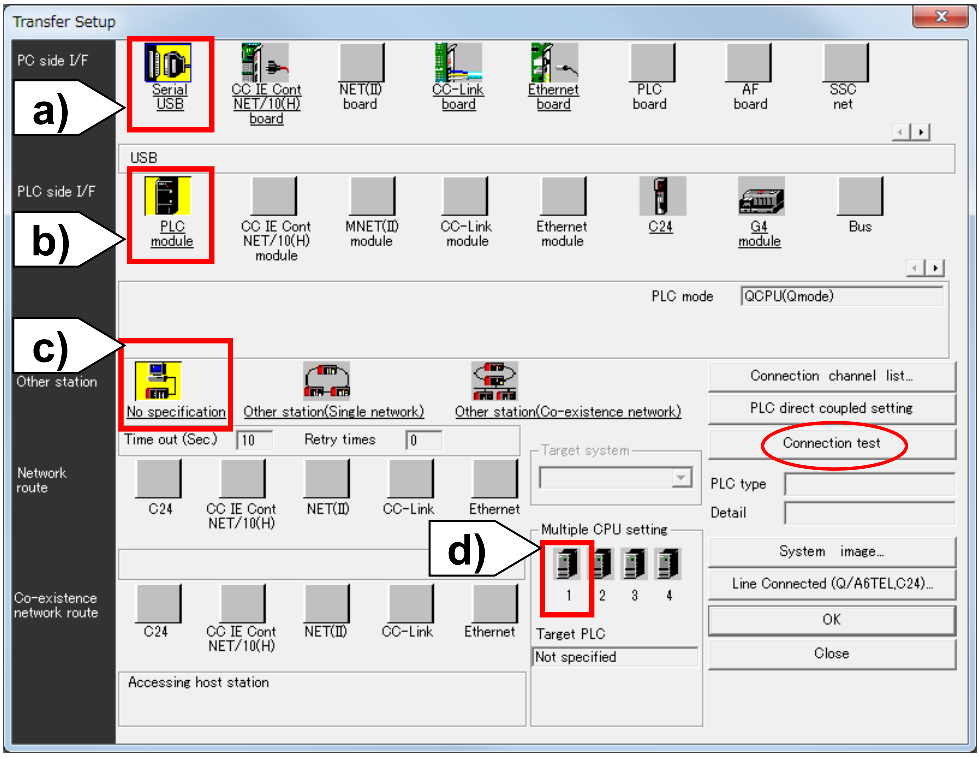
3) Select "PC READ" from "ONLINE"



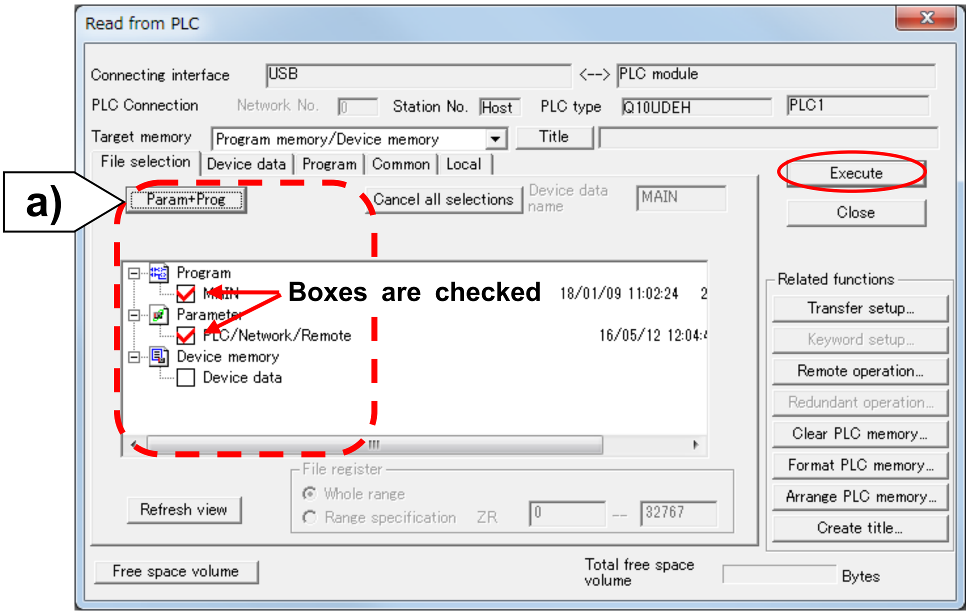
4) The "SELECT PC SERIES" window opens. Select "QCPU (Q MODE)" for the PLC Series, and then click OK.



5) The "CONNECTION" window opens.
a) Select "SERIAL USB" for Personal Computer I/F
b) Select "CPU MODUEL" for PLC I/F
c) Select "No Specification" for Other Station Setting
d) Select "PLC No.1" for Target PLC
Click "Communication Test".

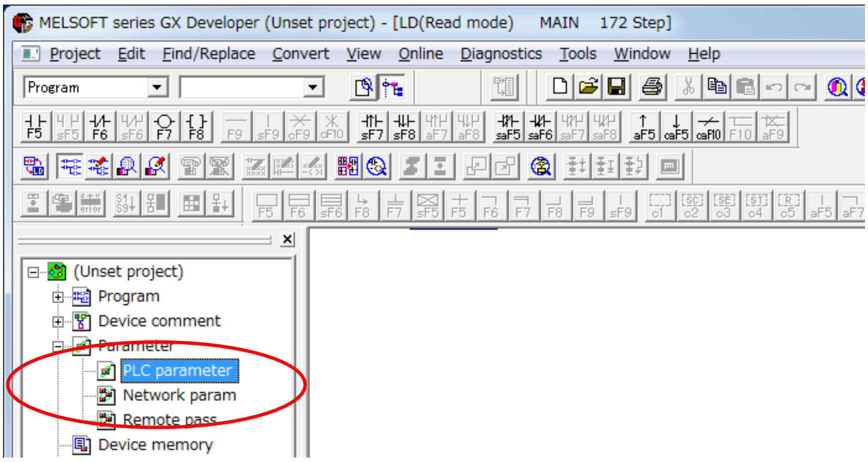


6) The "PC READ" window opens.
a) When "PARAMETER + PROGRAM" is clicked, the boxes for the corresponding data are checked. Click the "EXECUTE" button.

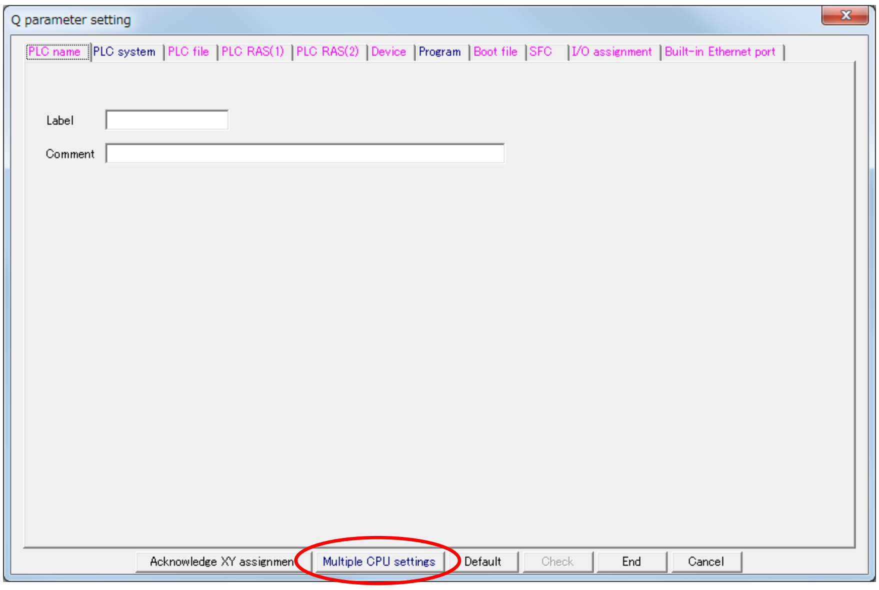


7) The data is read from the PC and the message "Finished" appears. This completes the communication test.

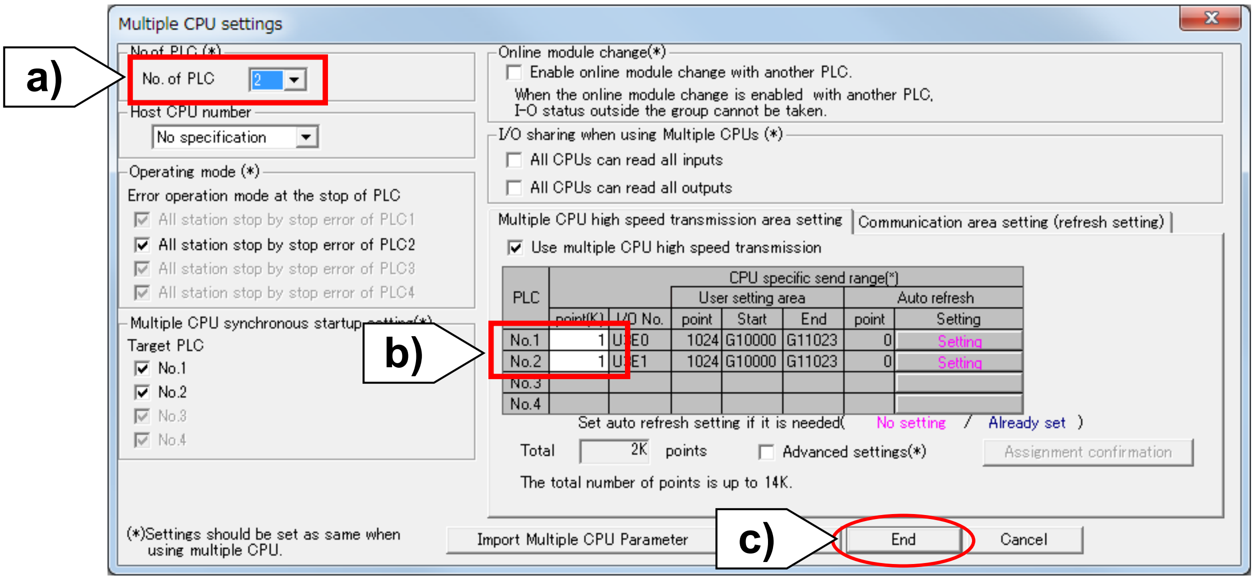
8) Click "PC PARAMETER" under "PARAMETER" shown on the left of the screen.



9) The "Q PARAMETER SETTING" window opens.
10) Click the "MULTI CPU SETTING" button.

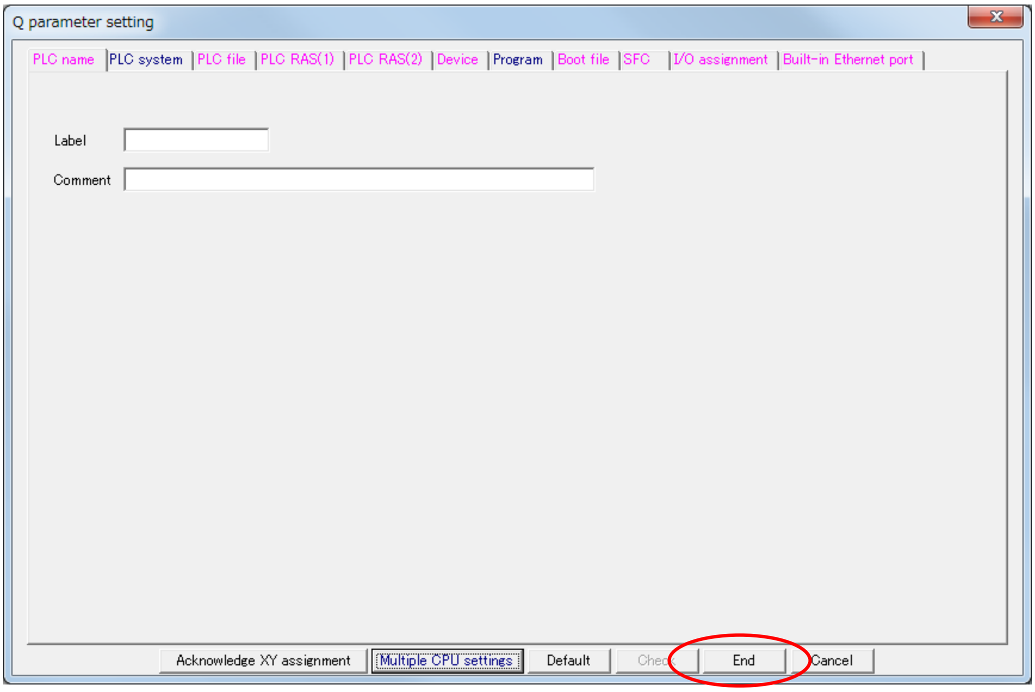


11) The MULTI CPU SETTING screen opens
   a) Change "NO. OF CPU MODULES" to "2 MODULES".
   b) Change the No. of points for the No. 1 and No. 2 units in "MULTI-CPU HIGH-SPEED COMMUNICATION AREA SETTING" to "1".
   c) Click the "SETTING COMPLETE" button.

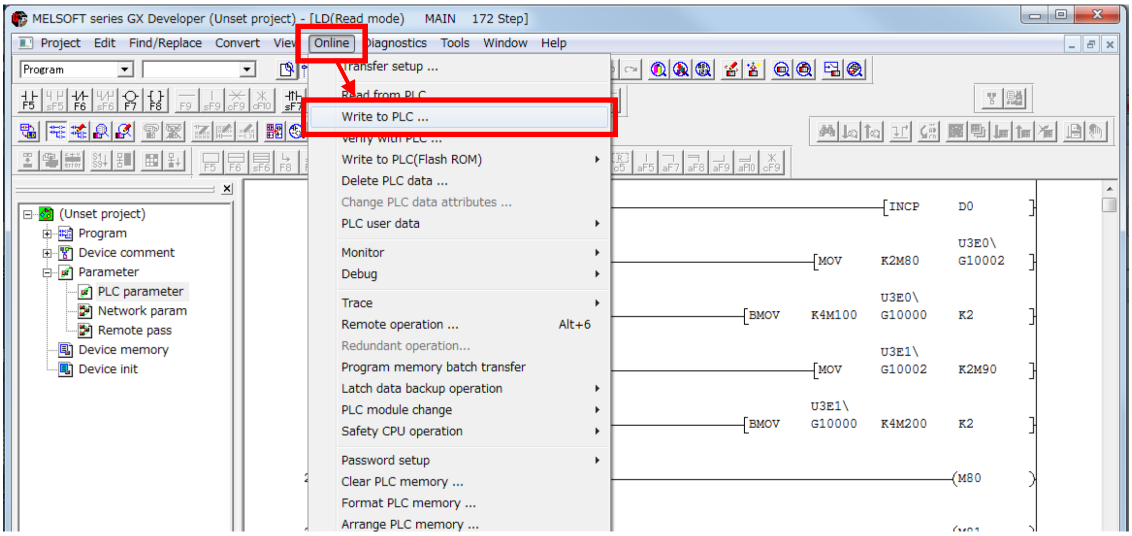


Note) Do not set the robot CPU.

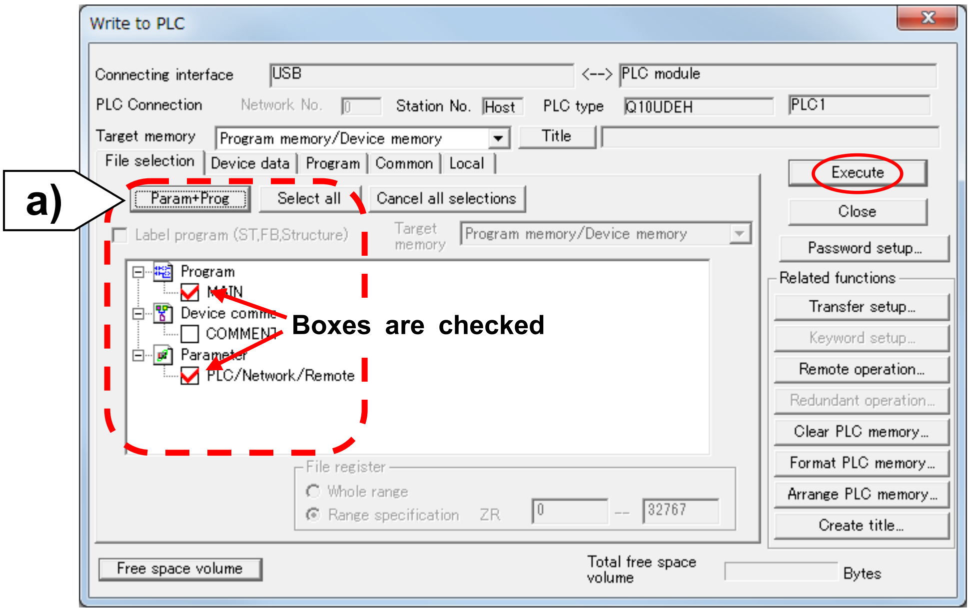
12) The "MULTI CPU SETTING" buttons will change to blue. (Initially these are pink.)
   Press the "SETTING COMPLETE" button again.



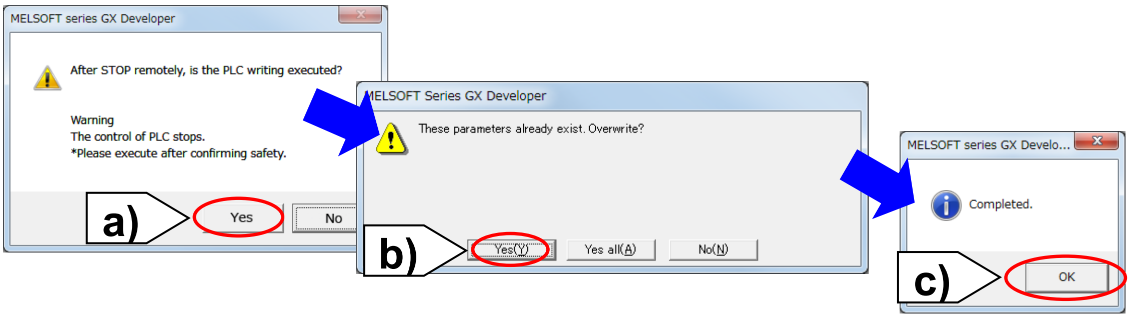
13) Write the set parameters to the PLC.
Select "PC WRITE" from the "ONLINE" tab.



14) The "PC WRITE" window opens.
a) When "PARAMETER + PROGRAM" is clicked, the boxes for the corresponding data are checked. Click the "EXECUTE" button.



15) a) A window opens and the message "Execute PC write?" appears. Click "YES".
b) The message "Overwrite?" appears, so click "ALL".
c) The message "WRITING COMPELTE" appears. This completes the settings on the GX Developer side.



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Appendix 6: Robot Start up and Maintenance

Appendix 6.1 Starting up after purchasing the robot

Step	Item	Reference and Instruction Manuals	Remarks
1	Check the product Check the optional parts	Product inspection report Standard specifications	Order form Delivery form
2	Install the robot arm and controller/drive unit Remove the fixing brackets	Standard specifications From robot arm setup to maintenance	Enclosed parts
3	Check and wire the controller/drive unit's primary power specifications (also connect the ground)	Standard specifications From controller setup, basic operations to maintenance	
4	Connect the device connection cables Connect the T/B	Standard specifications From controller setup, basic operations to maintenance	Final confirmation of specifications
5	With Emergency Stop applied, turn ON the controller's control power (Wait 15 sec.)	Standard specifications From controller setup, basic operations to maintenance	Confirmation of safety
6	Alarm "H0060" is the controller's emergency stop Alarm "H0070" is the T/B's emergency stop Cancel the emergency stop and press the [RESET] key	Troubleshooting	Confirmation of emergency stop function
7	Origin setting (data method) Input the enclosed mechanism origin data into the controller	From robot arm setup to maintenance	Operate with T/B
8	After setting the origin, check the movement of all axes with jog feed	From robot arm setup to maintenance Detailed explanation of functions and operations	
9	After confirming the movement, attach the optional parts and hand related parts	From robot arm setup to maintenance From controller setup, basic operations to maintenance	Check hand movement

This completes startup of the robot.

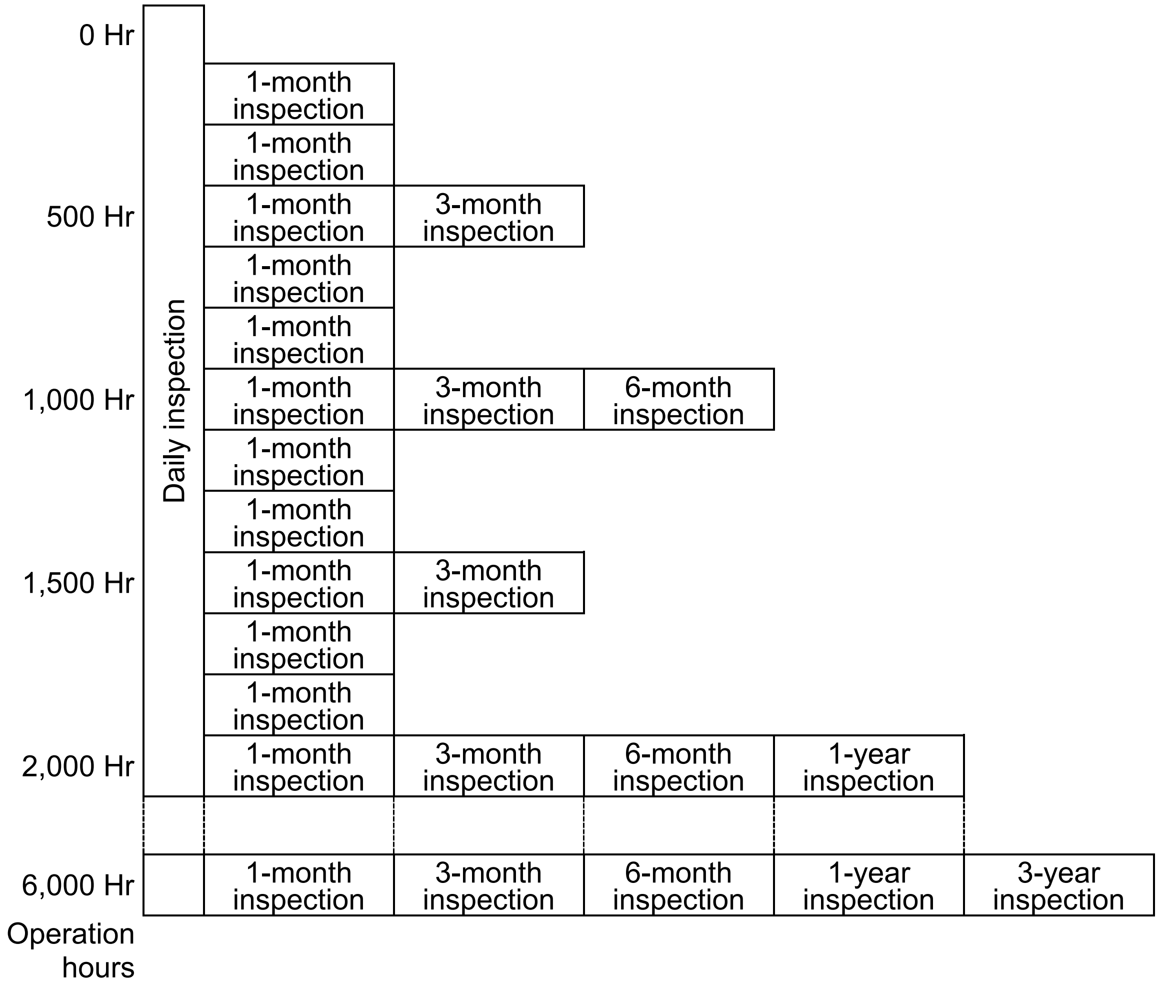
Appendix 6.2 Maintenance

(1) Maintenance and inspection timing

Maintenance and inspection includes inspections that are performed daily and periodic inspections that are performed at a set timing.

Inspection schedule

In addition to the monthly inspection, add items that are inspected every three months (estimating 500Hr operation hours) as shown below.



<Guide to inspection timing>
1 shift
8Hr/day × 20 days/month × 3 months = approx. 500Hr
10Hr/day × 20 days/month × 3 months = approx. 600Hr

2 shifts
15Hr/day × 20 days/month × 3 months = approx. 1,000Hr

[Caution] As shown above, when running two shifts, perform the 3-month inspection, 6-month inspection and 1-year inspection when half the period has passed.

(2) Daily inspection items

The daily inspection items differ according to the purchased model. (An example is shown below.)

Step	Inspection Item (Details)	Action when problem is found
Before power ON (Check the following inspection items before turning the power ON.)		
1	Are any of the robot mounting bolts loose? (Visual)	Securely tighten the bolts.
2	Are any of the cover tightening screws loose? (Visual)	Securely tighten the screws.
3	Are any of the hand mounting bolts loose? (Visual)	Securely tighten the bolts.
4	Is the power cable correctly connected? (Visual)	Securely connect.
5	Are the device connection cables between the robot controller and the drive unit correctly connected? (Visual)	Securely connect.
6	Are there any cracks on the robot? Is any foreign matter attached, or are there any obstacles?	Replace with a new part, or take remedial measures.
7	Are there any problems in the pneumatic system? Are there any air leaks, built up drainage or broken hoses? Is the air source normal? (Visual)	Discharge the drainage, and fix the air leak (replace the part).
After power ON (Monitor the robot while turning the power ON.)		
1	Is there any abnormal movement or abnormal sound when the power is turned ON?	Refer to Troubleshooting and take actions.
During operation (Try moving with an original program)		
1	Check that none of the movement points are deviated. Check the following items if there is any deviation. 1. Are any of the mounting bolts loose? 2. Are any of the hand mounting bolts loose? 3. Is the position of the jigs other than the robot deviated? 4. If the position deviation cannot be eliminated, refer to "Troubleshooting", check the state and take actions.	Refer to Troubleshooting and take actions.
2	Is there any abnormal movement or abnormal sound? (Visual)	Refer to Troubleshooting and take actions.

(3) Periodic inspection items

The inspection items differ according to the purchased model. (An example is shown below.)

Step	Inspection Item (Details)	Action when problem is found
1-month inspection items		
1	Are any of the robot arm bolts or screws loose?	Securely tighten the bolts.
2	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
3-month inspection items		
1	Is the timing belt properly tensed?	Adjust the timing belt if it is loose or too tight.
6-month inspection items		
1	Are the timing belt teeth heavily worn?	Replace if any of the teeth are missing or if there is marked wear.
1-year inspection items		
1	Replace the backup battery in the robot arm.	
2	Are the timing belt teeth heavily worn?	Replace if any of the teeth are missing or if there is marked wear.
3	Is the timing belt properly tensed? Is the timing belt causing positional deviation?	Adjust the tension if the timing belt is too loose or too tight.
3-year inspection items		
1	Lubricate the reduction gears for each axis.	

◆◇◆Periodically service the robot to ensure correct and safe use for a long time.◆◇◆

Appendix 7: Frequently Used Parameters

Parameter	Parameter name	No. of arrays No. of characters	Details explanation	Factory setting
Joint operation range	MEJAR	Real number 16	Specify the overrun limit value of the joint coordinate system. Set the operation range for each axis. It is not recommended to expand the operation range. The robot may hit a mechanical stopper. Note) When the J1 offset angle (J1OFFSET) is set for a vertical 5-axis type robot, the joint operation range of the J1-axis cannot be changed. Minus and plus directions (-J1, +J1, -J2, +J2,......-J8, +J8) Unit: deg	Setting value per mechanism
XYZ movement range	MEPAR	Real number 6	Specify the overrun limit value of the XYZ coordinates system. Limit the operation range of the robot in the XYZ coordinates system. Set up the robot in the controller and then set this parameter to prevent it from hitting peripheral devices during manual operation. Minus and plus directions (-X, +X, -Y, +Y, -Z, +Z) Unit: mm	(-X, +X, -Y, +Y, -Z, +Z) = -10000, 10000, -10000, 10000, -10000, 10000
User-defined area	Set the user-defined area(s) (up to 32 areas) and specify robot behavior in those areas.			
	AREA*CS * indicates 1 to 32.	Integer 1	Set the coordinate system of the user-defined area(s)*. (* = 1 to 32) 0: World coordinate system (compatible with the conventional robots) 1: Base coordinate system	0
	AREA*P1 * indicates 1 to 32.	Real number 8	Set the position coordinate of the diagonal point 1, posture data, and additional axis coordinate of the user-defined area*. They are defined from the first element in order of X, Y, Z, A, B, C, L1, and L2.	(X, Y, Z, A, B, C, L1, L2) = 0.0, 0.0, 0.0, -360.0 -360.0, -360.0, 0, 0
	AREA*P2 * indicates 1 to 32.	Real number 8	Set the position coordinate of the diagonal point 2, posture data, and additional axis coordinate of the user-defined area*. They are defined from the first element in order of X, Y, Z, A, B, C, L1, and L2.	(X, Y, Z, A, B, C, L1, L2) = 0.0, 0.0, 0.0, +360.0, +360.0, +360.0, 0, 0
Free plane limit	Set the overrun limit value in the free plane. The coordinates of the three points create a plane and the area which does not include the origin is outside the operation range. Use the following three types of parameters to set up to eight limits.			
	SFC*P * indicates 1 to 8.	Real number 9	Specify three points to create a plane. X1, Y1, Z1: Origin position on the plane X2, Y2, Z2: Position on the X-axis of the plane X3, Y3, Z3: Position on the X-Y plane in the +Y-axis direction	(X1, Y1, Z1, X2, Y2, Z2, X3, Y3, Z3) = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
	SFC*ME * indicates 1 to 8.	Integer 1	Specify the mechanism number which enables the free plane limit. Set the number within the range of 1 to 3. (normally set to 1)	0

Parameter	Parameter name	No. of arrays No. of characters	Details explanation	Factory setting
	SFC*AT * indicates 1 to 8.	Integer 1	Specify whether to enable or disable the set free plane limit. 0: Disable (initial value) 1: Enable (The operable area is at the robot coordinate origin side.) -1: Enable (The operable area does not include the robot coordinate origin.)	0 (Disable)
Home position	JSAFE	Real number 8	Specify the home position. The robot moves to the home position by executing Mov P_SAFE in the robot program or inputting the SAFEPOS signal of the external signal. (J1, J2, J3, J4, J5, J6, J7, J8) Unit: deg	The setting varies depending on the model.
Standard tool coordinate	MEXTL	Real number 6	Set the initial values for the relationship between the hand tip (control point) and the mechanical interface (hand mounting surface). In the factory setting, the mechanical interface is set as the control point. Change this setting to attach the hand and set the hand tip as the control point. (Posture control can be performed on the hand tip at the XYZ or tool jog.) (X, Y, Z, A, B, C) Unit: mm for XYZ, deg for ABC	(X, Y, Z, A, B, C) = 0.0, 0.0, 0.0, 0.0, 0.0, 0.0
Hand/workpiece conditions (Used for optimized acceleration/ deceleration or impact detection)	Set the hand and workpiece conditions in the program when Oadl ON (initial value) is set. Up to eight conditions can be set and the combination of the conditions used can be selected with the LoadSet instruction. Note) Set the hand and workpiece conditions correctly. If the conditions set are less than the actual mounted load, the life of mechanical components used in the robot may be shortened.			
	HNDDAT0	Real number 7	Set the initial conditions of the hand. (Specify them in the tool coordinate system.) These values are used just after power-on. To use impact detection during the jog operation, set the actual hand conditions. Failure to do so could lead to incorrect impact detection. (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm	The setting varies depending on the model.
	HNDDAT* * indicates 1 to 8.	Real number 7	Set the conditions of the hand. (Specify them in the tool coordinate system.) (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm	Standard load ,0.0,0.0,0.0,0.0,0.0,0.0
	WRKDAT0	Real number 7	Set the initial conditions of the workpiece. (Specify them in the tool coordinate system.) These values are used just after power-on. (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm	0.0,0.0,0.0,0.0,0.0,0.0, 0.0
	WRKDAT* * indicates 1 to 8.	Real number 7	Set the conditions of the workpiece. (Specify them in the tool coordinate system.) (Weight, size X, size Y, size Z, center of gravity X, center of gravity Y, center of gravity Z) Unit: Kg, mm	0.0,0.0,0.0,0.0,0.0,0.0, 0.0

Parameter	Parameter name	No. of arrays No. of characters	Details explanation	Factory setting
	HNDHOLD* * indicates 1 to 8.	Integer 2	Set whether or not to hold a workpiece when HOPEN* or HCLOSE* is executed. (Setting for OPEN/CLOSE) (Not holding/holding = 0/1)	0,1
Jog setting	JOGJSP	Real number 3	Specify the joint jog feed amount and step operation speed. (Inching H, inching L, maximum override) Inching H: Feed amount when the jog speed is High Unit: deg Inching L: Feed amount when the jog speed is Low Unit: deg Maximum override: Operation is performed under OP override × maximum override.	Setting value per mechanism
	JOGPSP	Real number 3	Specify the XYZ jog feed amount and step operation speed. (Inching H, inching L, maximum override) Inching H: Feed amount when the jog speed is High Unit: mm Inching L: Feed amount when the jog speed is Low Unit: mm Maximum override: Operation is performed under OP override × maximum override. Operation exceeding the maximum speed of 250 mm/s cannot be performed.	Setting value per mechanism
Hand input/output type	HIOTYPE	Integer 1	Set the electrical specifications (source/sink) of the built-in air hand interface. Set them according to the specifications of the solenoid valve and others used. -1: Not set/0: Source/1: Sink	-1

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Appendix 8: Dedicated input/output

Dedicated input/output signals have the functions shown in the table below.

These functions are used by the parallel input/output unit by assigning the signal No. in the parameter. The signal No. is assigned by the signal No. used in the order of "input signal" and "output signal" in each parameter. Refer to the parameter setting method. Furthermore, when -1 is assigned for the signal No., this signal will not be used.

Set input/output parameters either in the T/B parameter screen, or with the maintenance tools of the personal computer support software (optional). Additionally, an example signal timing diagram is in "Controller INSTRUCTION MANUAL Detailed explanations of functions and operations" for your reference.

Dedicated input/output signals are enabled when the controller mode is "AUTOMATIC", and the operation rights input signal (IOENA) is ON.

Dedicated input/output list

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
RCREADY	Input	-	-		-1 (No meaning), 10001	-1 (No meaning), -1
	Output	Controller power ON complete	After turning the power ON, outputs that an external input signal can be received.			
ATEXTMD	Input	-	-		-1 (No meaning), 10002	-1 (No meaning), -1
	Output	Remote mode output	Outputs that the controller mode is "AUTOMATIC". This is the remote mode. The condition is that this signal is ON for the control with an external signal.			
TEACHMD	Input	-	-		-1 (No meaning), 10003	-1 (No meaning), -1
	Output	Teach mode output	Outputs that the controller mode is "MANUAL".			
ATTOPMD	Input	-	-		-1 (No meaning), 10004	-1 (No meaning), -1
	Output	Automatic mode output	Outputs that the controller mode is "AUTOMATIC".			
IOENA	Input	Operation rights input signal	Enables/disables operation rights for the external signal control.	Level	10005, 10005	5, 3
	Output	Operation rights output signal	Outputs operation rights enabled status for the external signal control. When the controller mode is set to "AUTOMATIC", the operation rights input signal is ON, and no other devices acquire operation rights, the operation rights are acquired from the external signal.			

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
START (Operation rights required)	Input	Start input	Starts the program. To start the specified program, select the program in the program select signal "PRGSEL" and the numeric value input "IODATA", and then input the start signal. When the parameter "PST" is enabled, the program number is read from numerical value input (IODATA) and the program starts. (Program selection will not be required.) During the multi-task operation, this parameter executes all task slots. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT**" will not be executed.	Edge	10006,	3,
	Output	Running output	Outputs that the program is running. During the multi-task operation, if at least one task slot is running, this parameter is ON. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT*" will not be executed.		10006	0
STOP	Input	Stop input	Stops the running program. (Slots that have start-up conditions of ALWAYS and ERROR setting is excluded.) Stop input is fixed to input signal 0, and this number cannot be changed. During the multi-task operation, this parameter stops all task slots. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT**" will not be executed. Normal open and normal close may be changed using the parameter INB.	Level	10000 (Cannot be changed),	0 (Cannot be changed),
	Output	Output stopped	Outputs that the program is stopped. Turns ON when slot multi-task is not running, and at least one slot is suspending. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT**" will not be executed.		10000	-1
STOP2	Input	Stop input	Stops the running program. (Specifications are the same as the one for the STOP parameter.) Unlike the STOP parameter, the signal number can be changed.	Level	-1,	-1,
	Output	Output stopped	Outputs that the program is stopped. (Specifications are the same as the one for the STOP parameter.)		-1	-1

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
STOPSTS	Input	-	-		-1 (No meaning), 10007	-1 (No meaning), -1
	Output	Inputting stop signal	Outputs that the stop signal is being input. (Logical ADD of all devices.)			
SLOTINIT (Operation rights required)	Input	Program reset	Cancels the program stop state, and returns the program execution line to the first line. Executing a program reset makes it possible to select a program. When used with multi-task, this parameter resets the program for all task slots. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT**" will not be executed.	Edge	10008,	-1,
	Output	Program selectable output	Outputs that program is selectable. When the program is running/not stopped, this parameter is ON. During the multi-task operation, if all task slots are running/not stopped, this parameter is ON. However, slots with a starting condition that is set to ALWAYS or ERROR via a parameter "SLT**" will not be executed.		10008	-1
ERRRESET	Input	Error reset [INPUT] signal	Clears the error.	Edge	10009, 10009	2, 2
	Output	Error [OUTPUT] signal	Outputs that there an error.			
SRVON (Operation rights required)	Input	Servo ON [INPUT] signal	Turns the robot servo power ON. With a multi-mechanism configuration, the servo power supplies for all mechanisms will be turned ON.	Edge	10010,	4,
	Output	Servo ON enabled [OUTPUT] signal	When the robot servo power is ON, this parameter is ON. When the servo power is OFF, this parameter is OFF. With a multi-mechanism configuration, this output turns ON when the servo of at least one mechanism is ON.		10010	1
SRVOFF	Input	Servo OFF [INPUT] signal	Turns the robot servo power OFF. (All mechanisms are supported.) While this signal is being input, servo ON cannot be executed.	Level	10011,	1,
	Output	Servo ON disabled [OUTPUT] signal	This output indicates a status where the servo power supply cannot be turned ON. (Echo back)		10011	-1

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
AUTOENA	Input	Automatic operation enabled input	Disables automatic operation when inactive. If this signal is inactive, and the AUTOMATIC mode is entered, a low level error L5010 will occur. This input is used to interlock the operations via the operation panel with the I/O signals. Use of this input is not a requirement.	Level	-1,	-,1
	Output	Automatic operation enabled output	Outputs the automatic operation enabled status.		-1	-1
CYCLE	Input	Cycle stop [INPUT] signal	Starts the cycle stop.	Edge	10012, 10012	-1, -1
	Output	In cycle stop operation [OUTPUT] signal	Outputs that the cycle stop is operating. Turns OFF when the cycle stop is completed.			
MELOCK (Operation rights required)	Input	Machine lock [INPUT] signal	Sets/releases the machine lock state for all mechanisms. This parameter can be set or released when all slots are in the program selection state. Signal level will be set to Level when program selection is enabled.	Level	-1,	-1,
	Output	In machine lock status [OUTPUT] signal	Outputs the machine lock status. This parameter turns ON when at least one mechanism is in the machine lock state. During the machine lock status, the robot will not move, and program operation will be enabled.		-1	-1
SAFEPOS (Operation rights required)	Input	Home position return [INPUT] signal	Requests the Home position return operation. This signal initiates a joint interpolation movement to the position set by the parameter "JSAFE". The speed is determined by the override setting. Make sure the robot does not interfere with any peripheral devices.	Edge	10013,	-1,
	Output	Returning to home position [OUTPUT] signal	Outputs that Returning to home position is taking place.		10013	-1
BATERR	Input	-	-		-1 (No meaning), 10014	-1, -1
	Output	Battery voltage low	Outputs that the controller battery voltage is low. The output is turned OFF when the controller power supply is reconnected after battery replacement. This signal is also output under the following conditions. The cumulative time when the controller power supply is turned OFF exceeds 14600 hours. The output is turned OFF if the battery depletion time is reset.			

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
OUTRESET (Operation rights required)	Input	General-purpose output signal reset	Resets the general-purpose output signal. The operation at the input is set with parameters ORST0 to ORS18160.	Edge	10015,	-1,
	Output	-	-		-1 (No meaning)	-1 (No meaning),
HLVLERR	Input	-	-		-1 (No meaning), 10016	-1 (No meaning), -1
	Output	High level error [OUTPUT] signal	Outputs that a high level error is occurring.			
LLVLERR	Input	-	-		-1 (No meaning), 10017	-1 (No meaning), -1
	Output	Low level error [OUTPUT] signal	Outputs that a low level error is occurring.			
CLVLERR	Input	-	-		-1 (No meaning), 10018	-1 (No meaning), -1
	Output	Warning level error [OUTPUT] signal	Outputs that a warning level error is occurring.			
EMGERR	Input	-	-		-1 (No meaning), 10019	-1 (No meaning), -1
	Output	Emergency stop [OUTPUT] signal	Outputs that an emergency stop is occurring. [EMGERR output conditions] External emergency stop error: H0050, H0051 (Dual line is faulty) Operation panel emergency stop error: H0060, H0061 (Dual line is faulty) T/B emergency stop error: H0070, H0071 (Dual line is faulty) Door switch signal faulty: H0039, H0040 (Dual line is faulty) Wiring error of EMGIN connector: H0141			
SnSTART (n=1 to 32) (Operation rights required)	Input	Slot n start [INPUT]	Starts each slot. n = 1 to 32	Edge	-1, -1	-1, -1
	Output	Slot n in operation [OUTPUT]	Outputs the running status of each slot. n = 1 to 32			
SnSTOP (n=1 to 32)	Input	Slot n stop [INPUT]	Stops each slot. n = 1 to 32	Level	-1, -1	-1, -1
	Output	Slot n suspended [OUTPUT]	Outputs that each slot has temporarily stopped and the program is suspended. n = 1 to 32			
MnSRVOFF (n=1 to 3)	Input	Mechanism n servo OFF [INPUT] signal	Turns OFF the servo for each mechanism. n = 1 to 32 The servo cannot be turned ON while this signal is being input.	Level	-1,	-1,
	Output	Mechanism n servo ON enabled [OUTPUT] signal	Outputs the servo ON disabled status. (Echo back)		-1	-1
MnSRVON (n=1 to 3) (Operation rights required)	Input	Mechanism n servo ON [INPUT] signal	Turns the servo ON for each mechanism. n = 1 to 3	Edge	-1, -1	-1, -1
	Output	Mechanism n servo ON [OUTPUT] signal	Outputs the servo ON status. n = 1 to 3			
MnMELOCK (n=1 to 3) (Operation rights required)	Input	Mechanism n machine lock [INPUT] signal	Sets/releases the machine lock status of each mechanism. n = 1 to 3	Edge	-1, -1	-1, -1
	Output	Mechanism n machine lock [OUTPUT] signal	Outputs that the machine is in the lock state. n = 1 to 3			

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
BRKLOCK	Input	Brake lock [INPUT]	This input signal is turned ON to lock the brake during servo ON. This function is available for all of the axes with brakes.	Level	-1,	-1,
	Output	Brake locked [OUTPUT]	This output signal is turned ON when the Brake lock [INPUT] signal is turned ON.		-1	-1
PRGSEL (Operation rights required)	Input	Program selection [INPUT] signal	Designates the setting value for the program No. with numeric value input signals. Select the program for slot 1. Output this signal when at least 15ms has elapsed following the output to the numerical input (IODATA). This signal should also be output to the robot for at least 15ms.	Edge	10020	-1,
	Output	-	-			
OVRDSEL (Operation rights required)	Input	Override selection [INPUT] signal	Designates the setting value for the override with the numeric value input signals. Output this signal when at least 15ms has elapsed following the output to the numerical input (IODATA). This signal should also be output to the robot for at least 15ms.	Edge	10021	-1,
	Output	-	-			
IODATA	Input	Numeric input (Start bit number, end bit number)	Reads the numerical values as binary values. Program number is read by the PRGSEL. If the parameter "PST" is enabled, it is read by the Start signal. Override is read by the OVRDSEL. The bit width can be set arbitrarily. However, the accuracy of output values cannot be guaranteed when they exceed the set bit width. Output this input to the robot for at least 15ms before inputting PRGSEL or other setting signals.	Level	Note 2) 10032 (Start bit) 10047 (End bit),	Note 2) -1 (Start bit), -1 (End bit),
IODATA	Output	Numeric output (Start bit number, end bit number)	Outputs the numerical values as a binary value. · Program number (Output by the PRGOUT), · Override (Output by the OVRDOUT), · Line number (Output by LINEOUT), · and error number (output in ERROUT) are output. The bit width can be set arbitrarily. However, the accuracy of output values cannot be guaranteed when they exceed the set bit width. Read this signal after at least 15ms has elapsed following the input of a program number (PRGOUT) or other signal to the robot.		10032 (Start bit), 10047 (End bit)	-1 (Start bit), -1 (End bit),

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
PRGOUT	Input	Program No. output request	Outputs the program number for task slot 1 to the numerical output (IODATA). Read the numerical output (IODATA) signal after at least 15ms has elapsed following the input of this signal to the robot.	Edge	10022,	-1,
	Output	Program No. [OUTPUTTING] signal	Outputs the "program number output in progress" status to the numerical output.		10022	-1
LINEOUT	Input	Line No. [OUTPUT REQUEST]	Outputs the line number for task slot 1 to the numerical output (IODATA). Read the numerical output (IODATA) signal after at least 15ms has elapsed following the input of this signal to the robot.	Edge	10023,	-1,
	Output	Line No. [OUTPUTTING] signal	Outputs the "line number output in progress" status to the numerical output.		10023	-1
OVRDOUT	Input	Override value output request	Outputs the OP override the numerical output (IODATA). Read the numerical output (IODATA) signal after at least 15ms has elapsed following the input of this signal to the robot.	Edge	10024,	-1,
	Output	Override value [OUTPUTTING] signal	Outputs the "override output in progress" status to the numerical output.		10024	-1
ERROUT	Input	Error No. output request	Outputs the error number to the numerical output (IODATA). Read the numerical output (IODATA) signal after at least 15ms has elapsed following the input of this signal to the robot.	Edge	10025,	-1
	Output	Error No. [OUTPUTTING] signal	Outputs the "error number output in progress" status to the numerical output.		10025	-1
JOGENA (Operation rights required)	Input	JOG valid [INPUT] signal	Carries out the JOG operation of the designated axis in the designated mode. Operation takes place while this signal is ON.	Level	-1,	-1,
	Output	JOG valid [OUTPUT] signal	Outputs that the JOG operation is carried out.		-1	-1
JOGM	Input	JOG mode [INPUT] (start No., end No.)	Designates the JOG mode. 0/1/2/3/4/5 = Joint/XYZ/Cylindrical/3-axis XYZ/tools/Works (Ex-T)	Level	Note 3) -1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)	Note 3) -1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)
	Output	JOG mode [OUTPUT] (start No., end No.)	Outputs the current JOG mode.			
JOGMENO	Input	JOG mechanism number [INPUT] (start No., end No.)	Designates the mechanism number. If this parameter is not specified, the mechanism number is fixed to machine 1.	Level	-1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)	-1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)
	Output	JOG mechanism number [OUTPUT] (start No., end No.)	Outputs the current mechanism number.			

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output iQ Platform compatible	Signal number at factory default Input, Output Standalone
JOG+	Input	JOG feed plus side for 8-axis (start No., end No.)	Designates the JOG operation axes. Joint JOG mode: J1, J2, J3, J4, J5, J6, J7, and J8 axes from the start number XYZ JOG mode: X, Y, Z, A, B, C, L1, and L2 axes from the start number CYLINDER JOG mode: X, θ, Z, A, B, C, L1, and L2 axes from the start number 3-axis XYZ JOG mode: X, Y, Z, J4, J5, and J6 axes from the start number TOOL JOG mode: X, Y, Z, A, B, and C axes from the start number WORK JOG mode (Ex-T JOG mode): X, Y, Z, A, B, and C axes from the start number	Level	Note 4) -1, -1	Note 4) -1, -1
	Output	-	-			
JOG-	Input	JOG feed minus side for 8-axis (start No., end No.)	Designates the JOG operation axes. Joint JOG mode: J1, J2, J3, J4, J5, J6, J7, and J8 axes from the start number XYZ JOG mode: X, Y, Z, A, B, C, L1, and L2 axes from the start number CYLINDER JOG mode: X, θ, Z, A, B, C, L1, and L2 axes from the start number 3-axis XYZ JOG mode: X, Y, Z, J4, J5, and J6 axes from the start number TOOL JOG mode: X, Y, Z, A, B, and C axes from the start number WORK JOG mode (Ex-T JOG mode): X, Y, Z, A, B, and C axes from the start number	Level	Note 4) -1, -1	Note 4) -1, -1
	Output	-	-			
JOGWKNO	Input	Workpiece coordinate number	Specify the workpiece coordinate number (Ex-T coordinates number) for the standard of WORK JOG operation with numerical values from 1 to 8. Note) This input signal is read with the edge (change from OFF to ON) of JOG valid input signal: JOGENA. When you change the workpiece coordinate number, change JOG valid input signal: JOGENA from OFF to ON first.	Level	Note 3) -1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)	Note 3) -1 (Start bit), -1 (End bit), -1 (Start bit), -1 (End bit)
	Output		Outputs the current value input into the workpiece coordinate number (Ex-T coordinate number).			
JOGNER (Operation rights required)	Input	Temporarily ignore JOG operation error [INPUT] signal	Temporarily ignores errors that cannot be reset during JOG operation. *This signal is applicable to only machine 1.	Level	-1,	-1,
	Output	Temporarily ignore JOG operation error [OUTPUT] signal	Outputs that the error is being ignored temporarily. *This signal is applicable to only machine 1.		-1	-1

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output iQ Platform compatible	Standalone
HNDCNTLn (n=1 to 3)	Input	-	-			
	Output	Mechanism n hand [OUTPUT] signal status (start No., end No.)	Outputs the hand output (n=1) 900 to 907 status. Outputs the hand output (n=2) 910 to 917 status. Outputs the hand output (n=3) 920 to 927 status. Example) To output the four points from 900 through 903 to general-purpose output signals 3, 4, 5 and 6, set the HNDCNTL1 to (3, 6).		HNDCNTL1 10048 (Start bit), 10055 (End bit)	-1 (Start bit), -1 (End bit)
HNDSTSn (n=1 to 3)	Input	-	-			
	Output	Mechanism n hand [INPUT] signal status (start No., end No.)	Outputs the hand input (n=1) 900 to 907 status. Outputs the hand input (n=2) 910 to 917 status. Outputs the hand input (n=3) 920 to 927 status. Example) To output the four points from 900 through 903 to general-purpose output signals 3, 4, 5 and 6, set the HNDSTS1 to (3, 6).		HNDSTS1 10056 (Start bit), 10063 (End bit)	-1 (Start bit), -1 (End bit)
HANDENA	Input	Hand control permission [INPUT]	Permit or prohibit control of the robot by the external signal. 1/0 = permitted/prohibited Note) The control of the robot hand is available during automatic execution. For safety, ensure that there is an interlock of the robot and external equipment, such as the sequencer. When the control of robot hand by an external signal is permitted, the commands "HOpen/HClose", of a program becomes invalid.	Level	-1,	-1,
	Output	Hand control permission [OUTPUT]	Outputs the permission condition of robot hand control by the external signals. 1/0 = permitted/prohibited When the Hand control permission [INPUT] signal is turned ON and T/B is not available, this signal turns ON.		-1	-1
HANDOUT	Input	Hand output control signal	Set the external input-signal range for controlling the robot hand. The input signal set up here is matched in order with the hand signal set up by parameter: HANDTYPE. Element 1: Hand output control signal start number Element 2: Hand output control signal end number	Edge	-1, -1	-1, -1
	Output	-	-			
HNDERRn (n=1 to 3)	Input	Mechanism n hand error [INPUT] signal	Requests the hand error occurrence. A low level error No. 30 will be generated.	Level	-1,	-1,
	Output	Mechanism n pneumatic error [OUTPUT] signal	Outputs that a pneumatic pressure error is occurring.		-1	-1

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
AIRERRn (n=1 to 5)	Input	Mechanism n pneumatic pressure error [INPUT] signal	Request the pneumatic pressure error occurrence. A low level error No. 31 will be generated.	Level	-1,	-1,
	Output	Mechanism n pneumatic error [OUTPUT] signal	Outputs that a pneumatic pressure error is occurring.		-1	-1
USRAREA	Input	-	-		Note 5) 10064 (Start bit), 10071 (End bit)	Note 5) -1 (Start bit), -1 (End bit)
	Output	User-designated area 32-points (start No., end No.)	Outputs that the robot is in the user-designated area. The output is made sequentially for areas 1, 2 and 3, as designed from the one closest to the start number. The area is set with parameters AREA1P1, AREA1P2 to AREA32P1, and AREA32P2. Setting example) When USRAREA is used as an example: If only area 1 is used, USRAREA: 8, 8 → Setting valid If area 1,2 are used, USRAREA: 8, 9 → Setting valid USRAREA: -1,-1 → Setting invalid USRAREA: 8,-1 → Setting invalid (No Error) USRAREA: -1,8 → Setting invalid (No Error) USRAREA: 9,8 → Setting invalid (Error L6643)			
MnPTEXC (n=1 to 3)	Input	-	-		-1 (No meaning),	-1 (No meaning),
	Output	Warning for maintenance parts replacement time	Outputs that the replacement time of maintenance parts has been reached.	Level	-1	-1
MnWUPENA (n=1 to 3) (Operation rights required)	Input	Mechanism n warm-up operation mode enable [INPUT] signal	Enables the warm-up operation mode of each mechanism. (n=1 to 3) Note) To switch the warm-up operation mode enable/disable using this input signal, it is necessary to enable the warm-up operation mode with the WUPENA parameter, etc. If the warm-up operation mode has been disabled with a parameter, inputting this input signal will not enable the mode.	Level	-1,	-1,
	Output	Mechanism n warm-up operation mode [OUTPUT] signal	Outputs that the warm-up operation mode is enabled. (n=1 to 3)		-1	-1
MnWUPMD (n=1 to 3)	Input	-	-		-1 (No meaning),	-1 (No meaning),
	Output	Mechanism n warm-up operation status [OUTPUT] signal	Outputs that the status is the warm-up operation status, and thus the robot will operate at a reduced speed. (n=1 to 3)		-1	-1

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
PSSLOT	Input	Position data output slot number specification	Specifies the slot numbers (1 to 32) for the output targets of position data. Load target programs in slots specified here in advance. *Unless the input signal of parameter: PSOUT (position data output instruction) on the external device side is OFF, the slot number will not be changed.	Level	-1 (input start bit), -1 (input end bit), -1 (output start bit), -1 (output end bit) *Input/output are both maximum 6 bit width	
	Output	Position data output slot number [OUTPUT]	Outputs the slot numbers (response) for the current output targets of position data.			
PSTYPE	Input	Position data type specification	Specifies the data type for the output targets of position data. 1/0 = Joint-type variable/position-type variable *Unless the input signal of parameter: PSOUT (position data output instruction) on the external device side is OFF, the position data type will not be changed.	Level	-1 , -1	
	Output	Position data type [OUTPUT]	Outputs the data type (response) for the current output targets of position data. 1/0 = Joint-type variable/position-type variable			
PSNUM	Input	Position number specification	Specifies the output target position data numbers (joint-type variable/position-type variable numbers). Position data number range: 0 to 65535 Example) When the output target is P100, specify the number "100" between the input start bit and input end bit. (Note) Variables including "0" in higher level digits such as "P001" cannot be specified. *Unless the PSOUT input signal (position data output instruction) is OFF on the external device side, the position data number will not be changed.	Level	-1 (input start bit), -1 (input end bit), -1 (output start bit), -1 (output end bit) *Input/output are both maximum 16 bit width	
	Output	Specified position number [OUTPUT]	Outputs the number (response) of the position data that is the current output target. Outputs the position number specified on the input side.			

Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
PSOUT	Input	Position data output command	A command which outputs the specified robot position data. When this signal changes from OFF to ON (edge), this parameter outputs the output position data that is the current output target to the signal number specified in parameter: PSPOS (position data output bit area), and while this signal remains ON (level), the output status is maintained. (The real time update is not carried out.) Edge: Position data output update Level: Output value retained 0 to 1: Position data output update 1: Output status retained 0: Output target position data can be changed	Edge + Level	-1 , -1	
	Output	Position data [OUTPUTTING]	Outputs that the specified position data is being output. [Output information] OFF: Position data not yet output ON: Position data being output			
PSPOS	Input	-	-	-	-1, (No meaning) -1	
	Output	Position data output signal range (Note 7)	Specifies the start number of the signal range that outputs the position data. The range is 8-axis coordinates (32 bit × 8 axes) and structure flag (32 bit × 2 elements), and requires a consecutive 320-bit range. The following ranges can be set. (1)CR800-R Series 10000 to 17872: CPU buffer memory (2)CR800-D Series 2000 to 3632: PROFIBUS 6000 to 7728: CC-Link Array of position data to output Position-type variable: X,Y,Z,A,B,C,L1,L2,FL1,FL2 Joint-type variable: J1,J2,J3,J4,J5,J6,J7,J8 Outputs each coordinate value as an integer ×1000. (mm, degrees) On external device side, recognize the values as 1/1000 ones. For FL1 and FL2, values are output as it is. Data range that can be output Signed integer: -2147483648 to 2147483647			

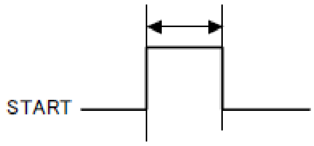
Parameter name	Class	Name	Function	Signal level	Signal number at factory default Input, Output	
					iQ Platform compatible	Standalone
TMPOUT	Input	Temperature [OUTPUT REQUEST]	Outputs the temperature inside the robot controller to the numerical output (IODATA). The temperature is output as a binary integer. Read the numerical output (IODATA) signal after at least 15ms has elapsed following the input of this signal to the robot.	Edge	-1 , -1	
	Output	Temperature [OUTPUT] signal	Outputs "Temperature output in progress" status to the numerical output.	-		
RSTBAT	Input	Battery cumulative time reset	Resets the battery cumulative time.	-	-1,	
	Output	Reset [COMPLETE]	Outputs that the reset has been completed.		-1	
RSTGRS	Input	Maintenance forecast reset (Grease)	Reset the grease information of the maintenance forecast. *The axis bit pattern is specified by the parameters IODATA or DIODATA.	-	-1,	
	Output	Reset [COMPLETE]	Outputs that the reset has been completed.		-1	
RSTBLT	Input	Maintenance forecast reset (belt)	Reset the belt information of the maintenance forecast. *The axis bit pattern is specified by the parameters IODATA or DIODATA.	-	-1,	
	Output	Reset [COMPLETE]	Outputs that the reset has been completed.		-1	
SVDATA	Input	-	-	-	-1 (No meaning)	-1, -1, -1 (Start register) -1 (End register)
	Output	Load factor data	The maximum load factor (%) of J1 axis to J8 axis is output from the register number specified as the 3rd element of this parameter to the number specified as the 4th element. The outputted load factor is updated with every 2 seconds. (CC-Link register supported)			
DOORSTS1	Input	-	-	-	-1,	-1,
	Output	Door switch 1 status	Outputs the status of the door switch 1 system.		-1	-1
DOORSTS2	Input	-	-	-	-1,	-1,
	Output	Door switch 2 status	Outputs the status of the door switch 2 system.		-1	-1
DOORSTS	Input	-	-	-	-1,	-1,
	Output	Door switch status	Outputs that the logical ADD of the door switch 1 and 2 systems. This signal turns ON when both of the systems 1 and 2 are ON.		-1	-1

Note 1) The meanings of the signal level are explained below.

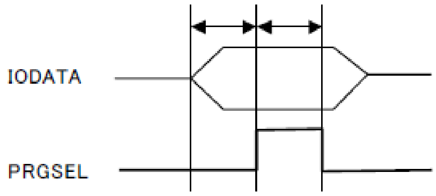
Level: → The designated function is validated when the signal is ON, and the function is invalidated when the signal is OFF.
Make sure the signal is turned ON for at least 15ms.

Edge: → The designated function is validated when the signal changes from the OFF to ON state, and the function maintains the original state even when the signal returns to the OFF state.

Secure 15 ms or more.



Secure 15 ms or more.



Note 2) Set in the order of input start No. input end No. output start No. and output end No. When using as the input or output of an actual value, use from the start No. to the end No. and express as a binary. The start No. indicates the low-order bit, and the end No. indicates the high-order bit. Set only the numbers required to express the numerical values.
For example, when using for program selection and only programs 1 to 6 are available, the expression can be created by setting 3 bits. Up to 16 bits can be set.

Assignment examples are shown below.

Example) To set the start input signal in general-purpose input 10016, and the operating output signal in general-purpose output 10026
Parameter START= {10016, 10026}

Example) When setting 4 bits of numerical input to general-purpose inputs 10027 to 10030, and 5 bits of numerical output to general-purpose outputs 10027 to 10031
Parameter IODATA = {10027, 10030, 10027, 10031}

Note 3) Set in the order of input start No. input end No. output start No. and output end No.
Use the value from the start No. to the end No. and express as a binary. The start No. indicates the low-order bit, and the end No. indicates the high-order bit. Set only the numbers required to express the numerical values.
For example, when using only the joint mode and XYZ mode at JOG mode input (JOGM), the expression can be created by setting 1 bits.

Note 4) Set in the order of an input starting No. and then an input end No. Specify the J1/X axis for the start No. and the J8/L2 axis for the end No. at its maximum.
For example, when using a 6-axis robot, only 6 bits need to be set.
Even if using a 4-axis robot, when using the XYZ mode, the C axis is required, so 6 bits must be set.
Up to 8 bits can be set.

Note 5) Set in the order of output start No. and output end No. The start number specifies area 1, while the end number specifies area 32 at the maximum.
For example, when only two areas are used, only 2 bits need to be set. Up to 32 bits can be set.

Note 6) The range of values that can be set in the parameters above are 0 to 255, 2000 to 3951, 6000 to 8047, and 10000 to 18191.

<< MEMO >> * Use this page to write down notes.

Appendix 9: List of Error Codes

This chapter describes only errors that may occur during practice of this course.
(Errors not described in this chapter may occur depending on the conditions and error detection timing.)
For the errors not described in the list, refer to the following manuals.

- CR800 Series Controller INSTRUCTION MANUAL Troubleshooting (BFP-A3480)
- CR750/CR751/CR760 Series Controller INSTRUCTION MANUAL Troubleshooting (BFP-A8871)

[Classification of the first letter of error numbers. → H: High level error, L: Low level error, C: Caution (Warning). "n" at the end of the last digit of the error No. in this list indicates the axis number (1 to 8).]

Error No.	Error message	Check item	Solution
H0045	Faulty Line (T/B ENABLE switch)	The user lost grip of the ENABLE switch during operation of the teaching box. (Only 1 of the 2 ENABLE switch contacts is being operated)	Ensure that the ENABLE switch is properly pressed down.
H0046	Faulty wiring (Enabling Device)	The enabling device is turned off.	Turn on the enabling device.
H0050	EMG signal is input (external)	The external emergency stop switch on the display panel is pressed.	Release the external emergency stop switch on the display panel.
H0051	The external emergency stop is being input. Or, the fuse of the safety unit is blown.	The external emergency stop switch on the display panel is pressed. (If the emergency stop of T/B turns on, this error may occur simultaneously.)	Release the external emergency stop switch on the display panel.
H0060	EMG signal is input (O.Panel)	The emergency stop switch on the operation panel of the controller/drive unit is pressed.	Release the emergency stop switch on the operation panel of the controller/drive unit.
H0061	The emergency stop for the controller front part is being input	The emergency stop switch on the operation panel of the controller/drive unit is pressed.	Release the emergency stop switch on the operation panel of the controller/drive unit.
H0070	EMG signal is input. (T.Box)	The emergency stop switch of the teaching box is pressed. Or, the teaching box is disconnected.	Release the emergency stop switch of the teaching box.
H0071	The T/B emergency stop is input	The emergency stop switch of the teaching box is pressed. Or, the teaching box is disconnected.	Release the emergency stop switch of the teaching box.
H0074	Faulty line (T/B Enable/Disable)	The state of the duplicated T/B enabled/disabled switch line does not match.	Switch the TB ENABLE switch correctly.
H0075	T/B communication error	The teaching box is disconnected. Or, the teaching box is not connected.	Connect the teaching box correctly. (When the teaching box is not required, connect the dummy plug.)
C0150	Undefined robot serial number	Undefined robot serial number	Input the robot serial number.
H094n	Servo amplifier overload 1	Operations with high loads (including collisions) were performed for more than the permissible time.	Decrease the operation speed or extend the acceleration/deceleration time.
H096n	Excessive error 1	Deviation of the instructed position and actual position (including impacts) has been exceeded. (Additionally, this error may occur during emergency-stop deceleration.)	Check the load and robot pressing force, etc.
H098n	Excessive error 3	Deviation of the instructed position and actual position exceeded with no current flowing to the motor.	Check the connection of motor power line (such as the machine cable and the locomotion-axis cable).

Error No.	Error message	Check item	Solution
H101n	Collision detection	A collision was detected.	If the robot has stopped by interference with peripheral equipment, move the arm to part from peripheral equipment using jog operation. Depending on the severity of the collision, the collision detection error may occur again. If this occurs, turn on the servo power again and do jog operation. If it still recurs, release the brake and move the arm by hand.
H109n *	Servo AMP initialization error	The initial communication between the servo amplifier failed.	Turn the power off and on once. (For Qtype, turn on the drive unit, then the robot CPU.)
H112n *	Encoder ABS position data lost	The current position data in the position detector was lost. The voltage of the robot-arm or additional axis's backup battery may be dropping.	Set up the origin by ABS method after replacing the batteries.
C133n	Encoder battery voltage low	The battery voltage supplied to the position detector dropped.	Replace the backup battery. (Even if this warning occurs, along as the controller is turned on again, it will operate perfectly. However, if battery consumption is intense, the Encoder ABS position data lost error (H112n) may occur when the controller is turned on again. It is recommended to replace the battery at the earliest opportunity.)
C1690	Cannot brake operation (DEADMAN)	The servo cannot be turned on while the enable switch is off.	Turn the enable switch on before operating.
C1700	Cannot brake operation (EMG)	The brakes cannot be released while the emergency stop is input.	Release the emergency stop state before operating.
C1710	Cannot brake operation (SRVON)	The brakes cannot be operated during servo on.	Turn the servo off before operating.
L182n	Position data inconsistent. Check origin	The motor rotated during power off because of external force or vibration, or the multiple rotation information of the encoder holding was not correct.	Check the origin, re-install if shifting.
L2000	The servo is OFF	The start instruction (including jog operation) was performed while the servo was off or before turning on the servo was completed.	Turn the servo on and then restart.
H213n	Jn Speed is excessive (command)	When moving by the linear interpolation (or circle interpolation) or XYZ jog having a singular point, the speed of an axis (especially 4 or 6 axis) exceeds the limit near a singular point.	Change the movement position. Or, lower moving speed by the Ovrd command and Spd command.
L2601	Start pos. exceeds the limit	The start position is outside the operation range (JOINT movement range, Narrow angle/Wide angle, or XYZ movement range).	Adjust the start position data.
L2602	DSTN pos. exceeds the limit	The target position is outside the operation range (JOINT movement range, Narrow angle/Wide angle, or XYZ movement range).	Adjust the target position data.

Error No.	Error message	Check item	Solution
L2603	Med pos. data exceeds the limit	The intermediate position is outside the operation range (JOINT movement range, Narrow angle/Wide angle, or XYZ movement range).	Check that the intermediate path at the linear interpolation and the route at circle interpolation are not outside the operation range. Or, correct the data of the start position, intermediate position, or target position.
L2800	Illegal position data	This may occur for a position to which the robot cannot reach at singular point passage or position data where a circle or an arc cannot be generated at circle interpolation.	Confirm the error occurrence line, check if the position is outside the operation range when transmitting the singular point with the position variable value, and correct the value.
L2801	Illegal position data (start)	This may occur for a start position to which the robot cannot reach.	Confirm the error occurrence line, check that the value of the start position does not indicate the position to which the robot cannot reach, and correct the value.
L2802	Illegal position data (dstn)	This may occur for a target position to which the robot cannot reach.	Confirm the error occurrence line, check that the value of the target position does not indicate the position to which the robot cannot reach, and correct the value.
L2803	Illegal assisting position data (intmed)	The intermediate path at the linear interpolation and the route at circle interpolation are the position to which the robot cannot reach.	Confirm the error occurrence line and confirm that there is no position to which the robot cannot reach. And, correct the data of start position, midway position, or target position.
L2810	Structure flag inconsistent.	The structure flag of the start point and target point do not match.	Adjust the position data.
L3110	Argument value range over (Def Plt command)	A pallet created by the argument (start point, end point A, end point B, and diagonal) (of the Def Plt command) is outside the operation range.	Correct the value (data) of the argument (start point, end point A, end point B, and diagonal) of the Def Plt command.
L3285	Cannot execute (RUN or WAI)	A program is edited or deleted while the program is running or suspended.	Reset the program (cancel the suspended state).
L3850	Undefined PLT	The Def Plt command is not defined.	Use it after defining a pallet with the Def Plt command.
L4130	Illegal program name	An illegal character was used in the program name.	Change the program name. (Only numbers and alphabetic characters can be used.)
L4140	The program was not found	The designated program was not found. (It is not registered with a name that can be selected. Or, it has already deleted.)	Designate a different program, or create the designated program.
L4170	The program is being edited	The program is being edited.	Close the program being edited.
L4180	Program is running	The program is running.	Stop the program.
L4190	The program is selected	The program is preparing to execute.	Reset the program.
L4220	Syntax error	There is an error in the syntax of the input command statement. (Includes spaces, commas, periods and misspelt words.)	Re-input in the correct syntax after checking the contents.

Error No.	Error message	Check item	Solution
L4340	The variable is not defined	The variable has not been defined. (Data is not registered)	Define the variable.
H5000	TB Enable key is ON	The T/B ENABLE switch is set to "ENABLE" when the MODE switch of the operation panel is set to "AUTOMATIC".	Invalidate the T/B ENABLE switch, or change the key of the operation panel to the teach mode.
L5600	Cannot execute during an error	An operation is performed during an error.	Reset the error.
C7500	No battery voltage (Only for F Series)	The battery is spent.	Replace the battery of the controller. If a file is broken, write the backup file.
C7510	Battery voltage low (R/C) (Only for F Series)	The battery will be spent soon.	Replace the battery of the controller. (If you do not have a new battery, resetting allows you to use the controller until it is powered off.)
C7520	Battery consumption time is over (Only for F Series)	The battery will be spent soon.	Replace the batteries of both the robot arm and controller, and perform the battery cumulative time reset operation.
L8145	Home position return of multi-function electric hand 1 is not complete	Home position return of the multi-function electric hand 1 is not complete.	Perform the home position return. (The home position of the electric hand is lost when the power supply is turned ON.)

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