Part Number: 194648-1CD
Revision: 1

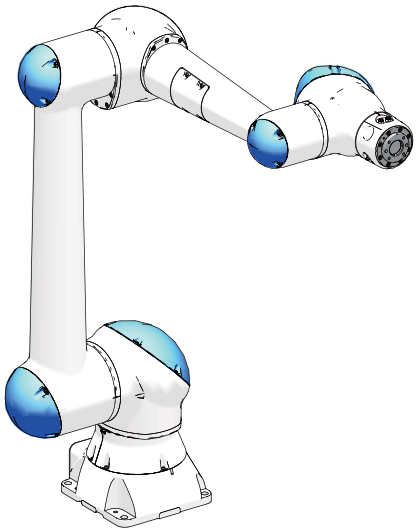
YASKAWA

MOTOMAN-HC10DTP
Quick Start Guide
Using the Programming Pendant

- Manipulator Type: YR-1-06VXCP10-A00
  (Built-In Air Hoses, Ethernet and I/O Cables Specification)
- Applicable Robot Controllers: YRC1000/YRC1000micro
- Programming Pendant Type: JZRCR-APP01-1

Have the following information available when contacting the YASKAWA Representative:

- System
- Primary Application
- Software Version *(Located on Programming Pendant by selecting: {Main Menu} - {System Info} - {Version})*
- Warranty ID *(Located on Robot Controller)*
- Robot Serial Number *(Located on Manipulator data plate)*
- Robot Sales Order Number *(Located on Robot controller data plate)*



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i.1 Introduction to This Manual

i.1.1 Intended Audience

This manual is for customers who are using a YASKAWA collaborative robot for the first time.

This manual describes the necessary operations in order, from installing the collaborative robot to teaching pick-and-place operation.

Read and understand this manual to ensure the correct usage of the product. Keep this manual in a safe place so that it can be referred to whenever necessary.

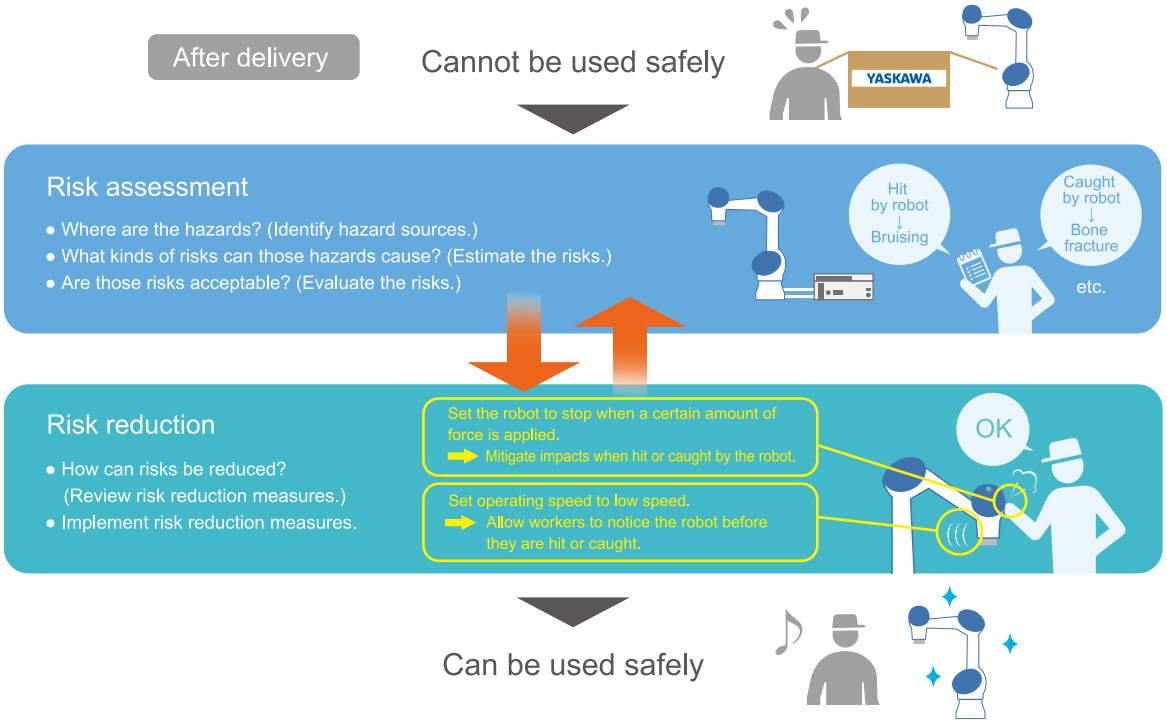
Note:

Assume that items not described in this manual are either prohibited or not possible.

General items related to safety are described in chapter 1 "Safety" in the instructions for the robot controller that will be used. Carefully read and understand the instructions before reading this manual and use the product correctly.

i.1.2 Precautions for Safely Using a Collaborative Robot

A collaborative robot cannot be used safely as-is and without a safety fence when delivered. The customer (including the system integrator) must conduct risk assessments and implement risk reduction measures on their own, and then check if potential hazards have been eliminated.



i.1.3 Applicable Products

This manual describes the following products.

Product		Type	Specifications
Robot Controller	YRC1000	ERAR-1000-06VX8-***	–
	YRC1000micro	ERBR-100-06VX8-***	–
Manipulator		YR-1-06VXCP10-A00	Built-in air hoses, Ethernet and I/O cables specification
Programming pendant		JZRCR-APP01-1	–

i.1.4 Related Manuals

The following manuals describe the precautions, control functions, usage procedures, and troubleshooting procedures when using a robot in detail.

Refer to these manuals for detailed procedures on using the product.

Category	Manual Name	Overview	Manual No. *1	
			YRC1000	YRC1000 micro
Manipulator	MOTOMAN-HC10DTP Instructions	Describes information about the manipulator, such as basic specifications, installation, and spare parts.	HW2480390	
	MOTOMAN-HC10DTP Maintenance Manual	Describes the maintenance procedures for the manipulator, such as precautions for inspections and procedures for replacing parts.	HW2480452	
	MOTOMAN-HC10DTP Setup Guide	Describes the setup procedures and manuals for users to refer to when installing the manipulator for the first time after the product has been delivered.	HW2380355	
Robot Controller	YRC1000/YRC1000micro Collaborative Operation Instructions	Describes information on collaborative operation functions and configuration procedures.	HW1484764	
	YRC1000/YRC1000micro Supplementary Instructions for HC Series	Describes the differences between standard robots and collaborative robots in the following main robot controller manuals. • Instructions • Maintenance Manual • Instructions for Functional Safety Function	HW1484756	HW1485285
	YRC1000/YRC1000micro Notes for Safe Operation	Describes the residual risks and safety precautions when using a robot.	R-AN-A308	R-AN-A309
	YRC1000/YRC1000micro Maintenance Manual	Describes the maintenance procedures for the robot controller, such as periodic inspections and procedures for replacing parts.	RE-CHO-A114	RE-CHO-A115
	YRC1000/YRC1000micro Options Instructions for Inform Language	Describes the instructions used by the robot controller.	RE-CKI-A466	RE-CKI-A468
	YRC1000/YRC1000micro Options Instructions for Concurrent I/O	Describes concurrent I/O, which is an I/O control function in the robot controller.	RE-CKI-A467	RE-CKI-A469
	YRC1000/YRC1000micro Operator's Manual	Describes the operating methods and procedures for the programming pendant.	RE-CSO-A051	RE-CSO-A058
	YRC1000/YRC1000micro Instructions	Describes the following items in details: • Robot safety precautions • Robot controller specifications, installation, and wiring • Robot control functions	RE-CTO-A221	RE-CTO-A222
	YRC1000/YRC1000micro Alarm Codes (Major Alarms) (Minor Alarms)	Describes the causes of and corrective actions for alarms.	RE-CER-A600	RE-CER-A601

*1 Read the manual for the robot controller that will be used.

i.2 Notes for Safe Operation

i.2.1 Safety Information

To prevent personal injury and equipment damage in advance, the following signal words are used to indicate safety precautions in this manual. The signal words are used to classify the hazards and the degree of damage or injury that may occur if a product is used incorrectly. Information marked as shown below is important for safety. Always read this information and heed the precautions that are provided.

⚠ DANGER

Indicates precautions that, if not heeded, are likely to result in loss of life, serious injury, or fire.

⚠ WARNING

Indicates precautions that, if not heeded, could result in loss of life, serious injury, or fire.

⚠ CAUTION

Indicates precautions that, if not heeded, could result in relatively serious or minor injury, or in fire.

NOTICE

Indicates precautions that, if not heeded, could result in property damage.

i.2.2 Visual Aids

The following aids are used to indicate certain types of information for easier reference.

Important

Indicates precautions or restrictions that must be observed. Also indicates alarm displays and other precautions that will not result in machine damage.

Term

Indicates definitions of difficult terms or terms that have not been previously explained in this manual.

Information Indicates supplemental information to deepen understanding or useful information.

i.2.3 General Precautions

- Figures provided in this manual are typical examples or conceptual representations. There may be differences between them and actual wiring, circuits, and products.
- The products shown in illustrations in this manual are sometimes shown with their covers or protective guards removed to illustrate detail. Always replace all covers and protective guards before the product is used.
- If a new copy of this manual is required because it has been lost or damaged, contact your nearest YASKAWA representative or one of the offices, and inform them of the manual number.
- This manual is subject to change without notice for product improvements, specifications changes, and improvements to the manual itself. The manual number of this manual will be updated and revisions issued when changes are made.
- Any and all quality guarantees provided by YASKAWA are null and void if the customer modifies the product in any way. YASKAWA disavows any responsibility for damages or losses that are caused by modified products.

i.3 Using This Manual

i.3.1 Terms

"MOTOMAN" is the product name for industrial robots manufactured by YASKAWA.

MOTOMAN consists of a manipulator, which is the robot itself, a robot control panel, a programming pendant, and a manipulator cable.

Interpret the devices described in this manual as shown below.

Device	Name in This Manual
Robot	Manipulator
Robot control panel	Robot controller

i.3.2 Trademarks

The product names and company names used in this manual are the trademarks or registered trademarks of the respective company. TM and the ® mark do not appear with product or company names in this manual.

1

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1.1 Unpacking the Shipping Crate

⚠ CAUTION

Always remove the manipulator from the crate using two or more workers.

There is a risk of back injury due to the mass of the manipulator and a risk the manipulator may fall over and be damaged.

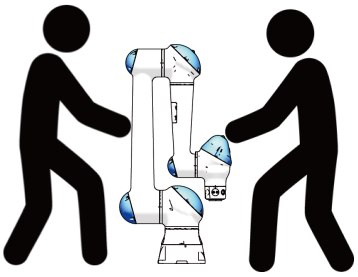
NOTICE

When the manipulator and controller are received in a shipping crate, unpack them in a level location near the installation location of the manipulator.

If the products are unpacked in an unstable location, there is a risk the manipulator and robot controller may fall over and be damaged.

The programing pendant may also be dropped and damaged.

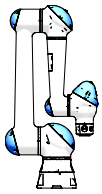
The mass of the manipulator is 48 kg. Always remove the manipulator from the crate using two or more workers.



1.2 Checking the Received Products

Confirm that all of the ordered products have been received.

1.2.1 Components in a Basic Robot System

Name		Standard/Option	Remarks
Manipulator		Standard component	Includes accessories.
Robot controller YRC1000 or YRC1000micro	YRC1000 	Standard component	Includes spare parts.
	YRC1000micro 	Standard component	Includes spare parts.
Programming pendant		Standard component	–
Pendant connection cable		Standard component	–
Manipulator cables (3 types)		Standard component	Connects the manipulator and robot controller. • Manipulator cable • Torque sensor cable (TQ) • Switch/lamp cable (SW)
CD-ROM (connected to a USB port)		Standard component	Contains PDF copies of the manuals.

1.2.2 Manipulator Accessories

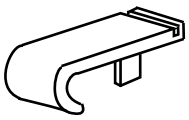
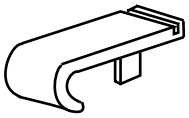
Purpose	Name	Type/Specifications		Quantity
Installing the manipulator	Hexagon socket head cap screw	M12 (length: 45 mm)		4
	Spring washer	M12		4
	Washer	M12		4
Home positioning of the manipulator's S-axis	Pin	HW1407797-5-85		1
Transporting the manipulator	Shipping bracket	HW1307411-1		1
	Hexagon socket head cap screw	M8 (length: 25 mm)		2
	Conical spring washer	M8		2
Grease replenishment for the manipulator	Union	KQ2F06-01N		6

1.2.3 YRC1000 Robot Controller Accessories

1. Replacement Fuses

Name	Quantity	Specifications	Type
10-A fuse	2	10 A, 500 VAC	FNQ-10 10A, 500VAC
		10 A, 600 VAC	SC-10 10A, 600VAC
Glass cartridge fuse	1	3.15 A, 250 V	02173.15P 3.15A, 250V
Micro fuse	1	1.0 A, 250 V	HM10 1.0A, 250V

2. Tools for Wiring

Name		Quantity	Type
Wiring tool for WAGO connectors		2	231-131
Wiring tool for WAGO connectors		1	734-230
Wiring tool for WAGO terminal block		1	210-119SB

Information

1. The fuses are replacement parts. Refer to the following manual for details on replacement procedures.
   YRC1000 Maintenance Manual (Manual No.: RE-CHO-A114)
2. Use the wiring tool for WAGO connectors when connecting wires to the control power supply unit and general-purpose I/O circuit board in the robot controller. Refer to the following manual for details on wiring procedures.
   YRC1000 Instructions (Manual No.: RE-CTO-A221)

1.2.4 YRC1000micro Robot Controller Accessories

1. Parts for Connecting the Primary Power Supply

> Important
> Cable clamps, power outlet plugs, and power wires (cables) are not included with the product. The customer is responsible for these parts.

Name		Quantity	Type
L-shaped angled plug for the primary power supply cable		1	CE05-8A18-10SD-D-BAS(R1)
End bell		1	CE3057-10A-1-D

2. Part for Short-Circuiting the Safety Signals

Name		Quantity	Type
Dummy connector (Safety) for short-circuiting the safety signals		1	CBL-AR001

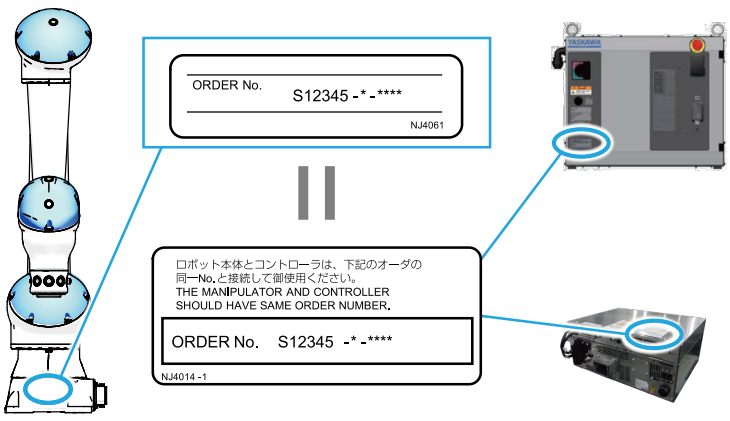
1.2.5 Verifying the Order Numbers

⚠ WARNING

Verify the order numbers on the robot and robot controller are the same. Each robot was configured with unique home position data at the factory. Use extra caution when installing multiple robots.

There is a risk of injury or damage due to malfunction.

Verify that the order numbers on the nameplates of the manipulator and robot controller match.



2

Transportation and Installation

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2.1 Transporting the Manipulator

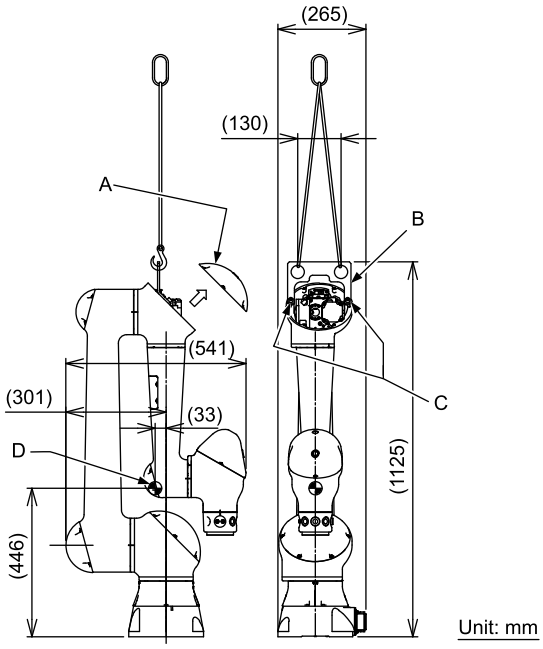
Mass: 48 kg (including the shipping bracket)

Table 2.1 Required Items

Name	Remarks
Phillips screwdriver	For mounting and removing the casing cover.
Hex key	For removing the shipping bracket.
Torque wrench	For mounting and removing the casing cover and mounting the shipping bracket.
Hanging tool	Example: Wire or nylon sling.
Shipping bracket (1 bracket), type: HW1307411-1	Included with the manipulator. These parts are all contained in the same bag as the transportation parts.
Hexagon socket head cap screw M8 (length: 25 mm) (2 screws)	
Conical spring washer M8 (2 washers)	

Important

When moving the manipulator to another location, such as when changing the production line, set the manipulator to the following transportation posture.

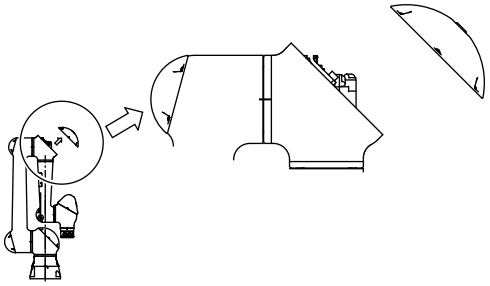


A	Casing cover	C	• Hexagon socket head cap screw M8 (length: 25 mm) (2 screws) • Conical spring washer M8 (2 washers)
B	Shipping bracket	D	Position of the center of gravity

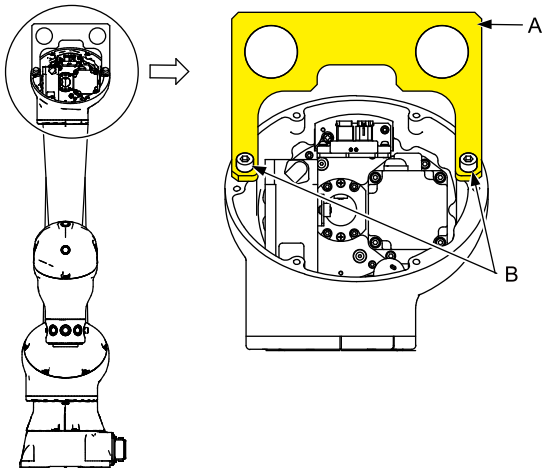
Table 2.2 Angle and Pulses of Each Axis When Shipped from the Factory

Axis	Pulses	Angle
S	0	0°
L	0	0°
U	-211268	-90°
R	0	0°
B	0	0°
T	0	0°

1. **Remove the manipulator casing cover.**

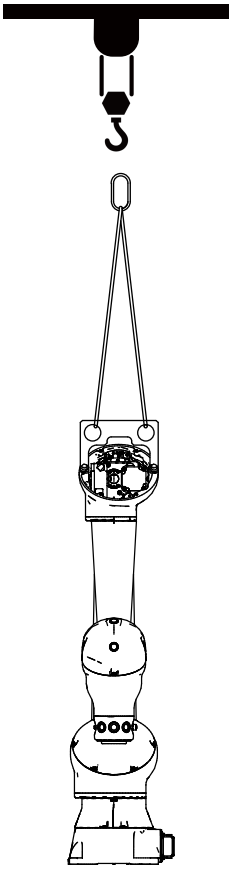


2. **Mount the shipping bracket using the hexagon socket head cap screws and conical spring washers to where the casing cover was removed. Tightening torque: 24.5 N·m (2.5 kgf·m)**



A	Shipping bracket	B	• Hexagon socket head cap screw M8 (length: 25 mm) (2 screws) • Conical spring washer M8 (2 washers)

3. **Pass the hook of the hanging tool through the two holes on the shipping bracket, hoist the manipulator with a crane, and transport it to the installation location.**



4. **Remove the shipping bracket.**
5. **Mount the casing cover. Tightening torque: 1.2 N·m (0.12 kgf·m)**

> Important
> Carefully store the transportation parts (shipping bracket, hexagon socket head cap screws, and conical spring washers) that were removed. The transportation parts are required when moving and transporting the manipulator again.

2.2 Installing the Manipulator

⚠ WARNING

Do not use the manipulator when it is not fixed to the installation surface with bolts.

The manipulator may fall over and cause injury or damage.

2.2.1 Required Items

Name	Type/Specifications		Quantity
Hexagon socket head cap screw *1	M12 (length: 45 mm)		4
Spring washer *1	M12		4
Washer *1	M12		4
Baseplate *2	A thickness of 32 mm or greater is recommended.		1
Anchor bolt *2	M12 or larger is recommended.		4

*1 Included with the manipulator.
*2 Not provided by YASKAWA.

2.2.2 Strength of the Installation Surface

The installation of the manipulator is critical for maintaining appropriate functionality. Design and construct a base that can fully withstand the maximum reaction force of the manipulator.

Important

Ensure the installation surface of the manipulator has a flatness of 0.5 mm or lower. If the flatness of the installation surface is poor, the manipulator may deform and lose appropriate functionality.

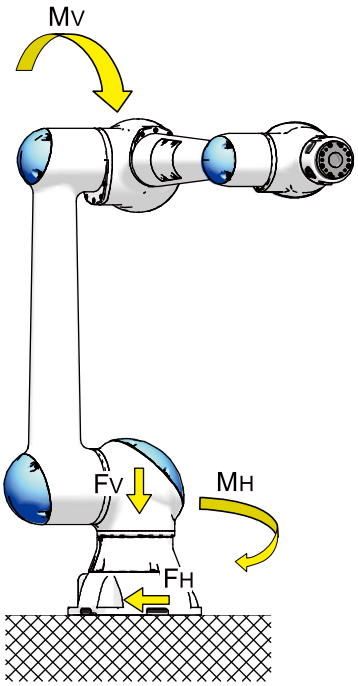
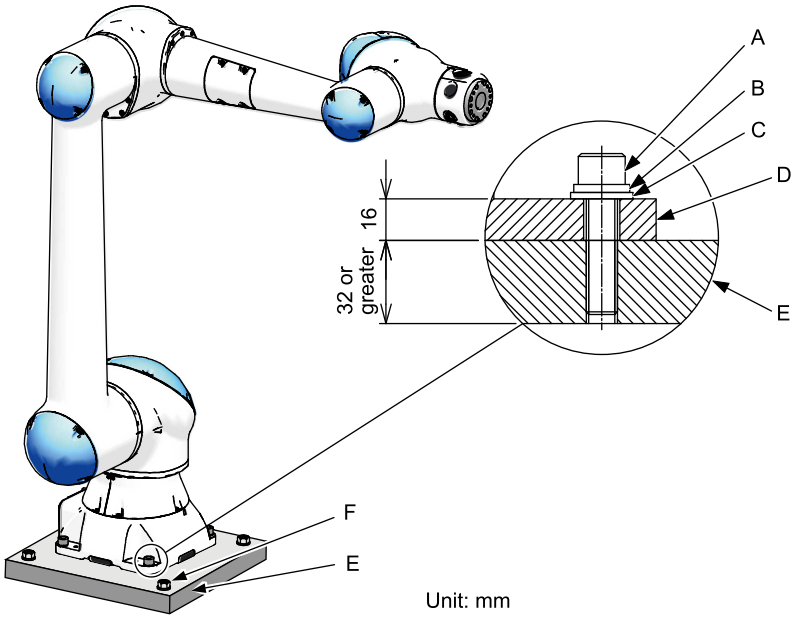


Table 2.3 Manipulator Installation Reaction Force/Torque

	When Rotating Horizontally		When Rotating Vertically	
	Reaction Force F_H	Torque M_H	Reaction Force F_V	Torque M_V
During an emergency stop	2600 N (265 kgf)	1842 N·m (188 kgf·m)	932 N (95 kgf)	1842 N·m (188 kgf·m)
During acceleration/ deceleration	834 N (85 kgf)	559 N·m (57 kgf·m)	343 N (35 kgf)	696 N·m (71 kgf·m)

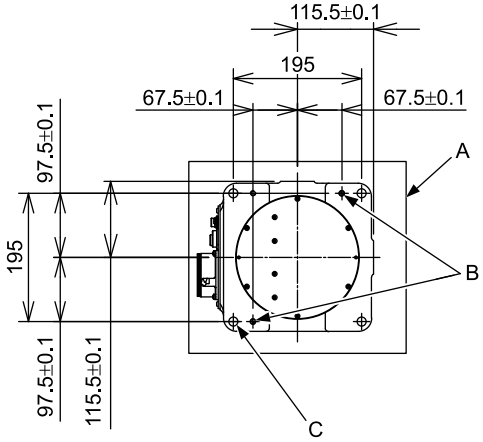
2.2.3 Fixing the Manipulator to the Floor

1. **Fix the baseplate to the floor with the anchor bolts.**
2. **Fix the manipulator to the baseplate with the hexagon socket head cap screws. (4 screws) Tightening torque: 84 N·m (8.6 kgf·m)**



Unit: mm

A	Hexagon socket head cap screw M12 (length: 45 mm) (4 screws)	D	Manipulator base
B	Spring washer M12 (4 washers)	E	Baseplate (with a thickness of 32 mm or greater is recommended)
C	Washer M12 (4 washers)	F	Anchor bolt (M12 or larger is recommended)



Unit: mm

A	Baseplate	C	Hole for mounting body: ϕ14 (4 places)
B	Reference hole: ϕ8H7 $(^{+0.015}_{0})$	–	–

2.2.4 Grounding the Manipulator

Ground the manipulator to a ground resistance of 100 Ω or less in accordance with all relevant local and national electrical codes. Connect the manipulator directly to the ground wire.

Table 2.4 Required Items

Name	Remarks
5.5 mm² or larger ground wire	This part is not provided by YASKAWA.
Spanner/wrench	For tightening the grounding bolt.

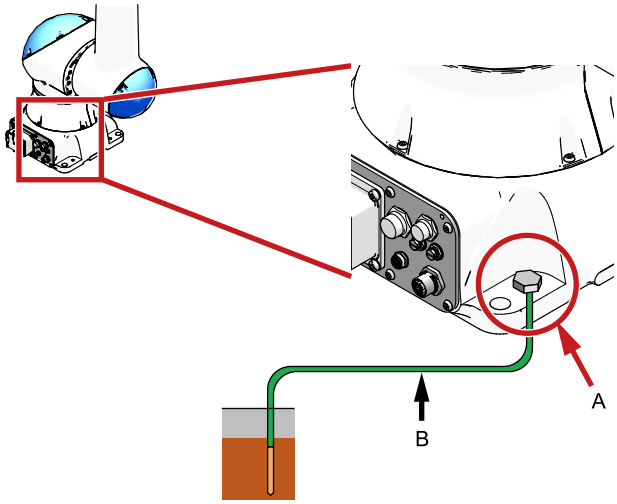
Important

- Do not share the ground wire for the manipulator with any other ground wires or grounding electrodes, such as those for electrical power, motors, or welders.
- Ground the manipulator in accordance with all relevant local and national electrical codes when using metallic ducts, metallic conduits, or cable trays to install cables.

⚠ WARNING

Always connect the ground terminal to a grounding electrode with a resistance of 100 Ω or less.

There is a risk of fire or electric shock.



A	Bolt M8 (for grounding) Included on the manipulator.	B	Ground wire (5.5 mm² or larger)

2.3 Transporting the YRC1000 Robot Controller

The mass of the YRC1000 robot controller depends on the model as given below.

Table 2.5 YRC1000 Robot Controller Mass

YRC1000 Robot Controller Model	Specifications	Approx. Mass (kg)
Small-capacity model	Specification for Japan	60
	Specification for Asia, North America, and Europe	70

As a basic rule, use a crane when transporting the YRC1000 robot controller.

NOTICE

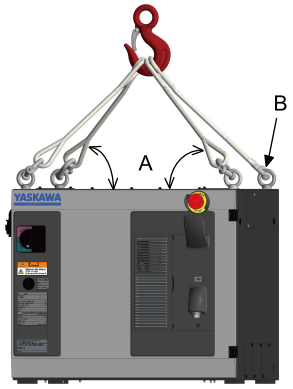
Transport the product so that it is not exposed to excessive vibration or shock.

Performance will be affected because this product is a precision machine.

Table 2.6 Required Items

Name	Remarks
Eye bolt	Included with the robot controller when shipped from the factory.
Hanging tool	This part is not provided by YASKAWA. Select a wire or nylon sling according to the mass of the robot controller.

1. **The eye bolts are attached to the robot controller when shipped from the factory. Check again that the eye bolts have been fastened before transporting the manipulator.**
2. **Pass the hanging tool through the eye bolts, hoist the robot controller with a crane, and transport it to the installation location.**



A	45° or wider	B	Eye bolt M12 (4 bolts)

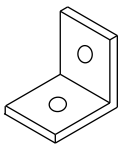
2.4 Installing the YRC1000 Robot Controller

A bracket for fixing the robot controller is not provided by YASKAWA. The recommended bracket is given below.

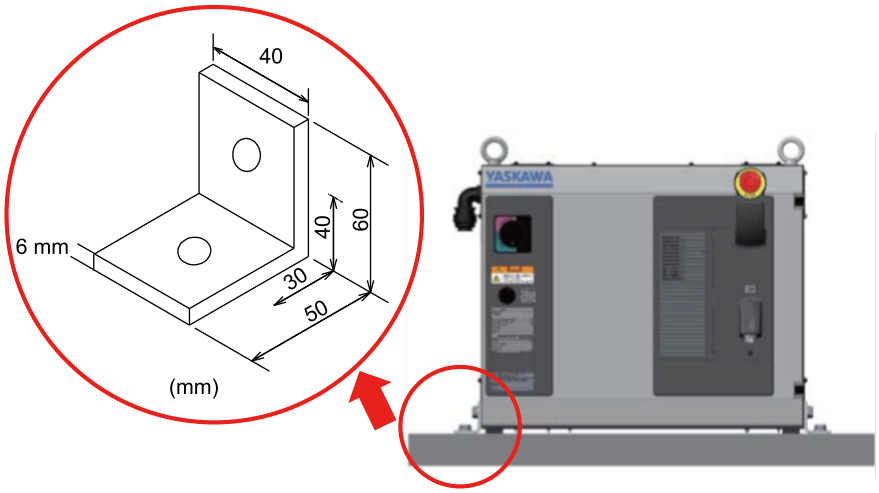
Information Refer to the following manual for details on the installation environment of the robot controller.

YRC1000 Instructions (Manual No.: RE-CTO-A221)

Table 2.7 Required Items (Recommended Items)

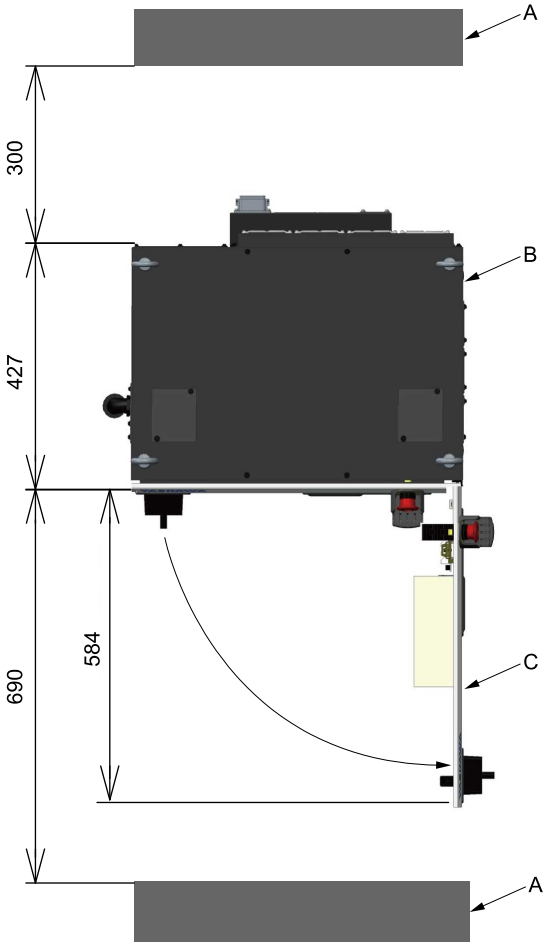
Name		Recommended Specifications	Quantity	Remarks
Mounting screw		M12 (length: 20 mm) **Note:** Select the screws based on a thread length of 14 mm for the sides of the robot controller.	4	Tightening torque: 45 N·m (4.6 kgf·m)
Fixing bracket		Hole ϕ14 (2 places) Plate thickness 6 mm	4	–

Use the screw holes (M12) on the sides of the robot controller to fix it to the floor or a pedestal.



Important

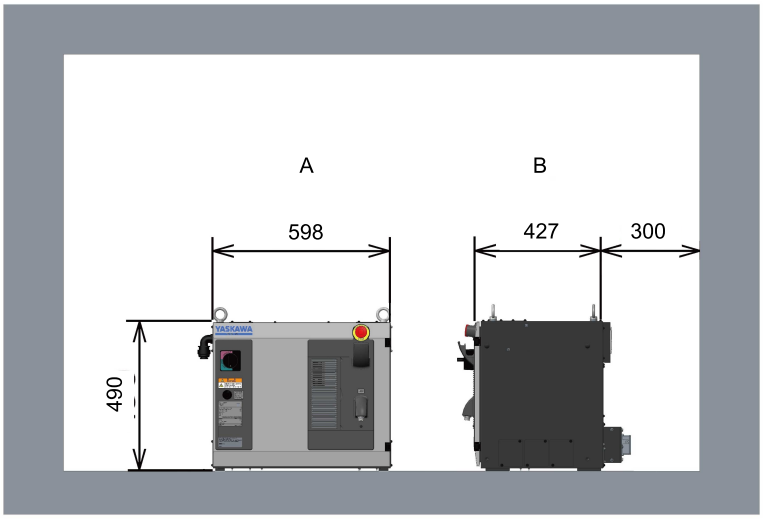
Ensure space to open the robot controller door for inspection.



A	Wall	C	Robot controller door
B	Robot controller	–	–

Important

For the work space during maintenance, install the YRC1000 robot controller in a location with a gap of approximately 300 mm or greater from the walls.



A	Front side of robot controller	B	Side of robot controller

2.5 Transporting the YRC1000micro Robot Controller

The mass of the YRC1000micro robot controller depends on the specifications as given below.

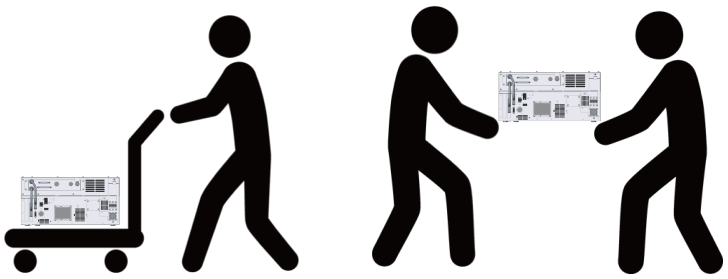
Table 2.8 YRC1000micro Robot Controller Mass

YRC1000micro Robot Controller Specifications	Approx. Mass (kg)
Specification for Japan, North America, and Asia	16.5
Specification for Europe	20

When transporting the YRC1000micro robot controller, use a cart or have two workers lift and carry the robot controller from its bottom. Be careful not expose the product to excessive vibration or shock during transport.

Note:

Use a lifter to lower the product from a rack or shelf.



2.6 Installing the YRC1000micro Robot Controller

A bracket for fixing the robot controller is not provided by YASKAWA.

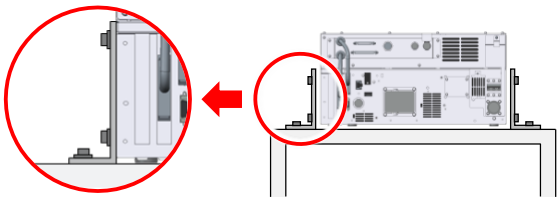


Figure 2.1 Installation Example of the YRC1000micro Robot Controller

Information Refer to the following manual for details on the installation environment of the robot controller.

YRC1000micro Instructions (Manual No.: RE-CTO-A222)

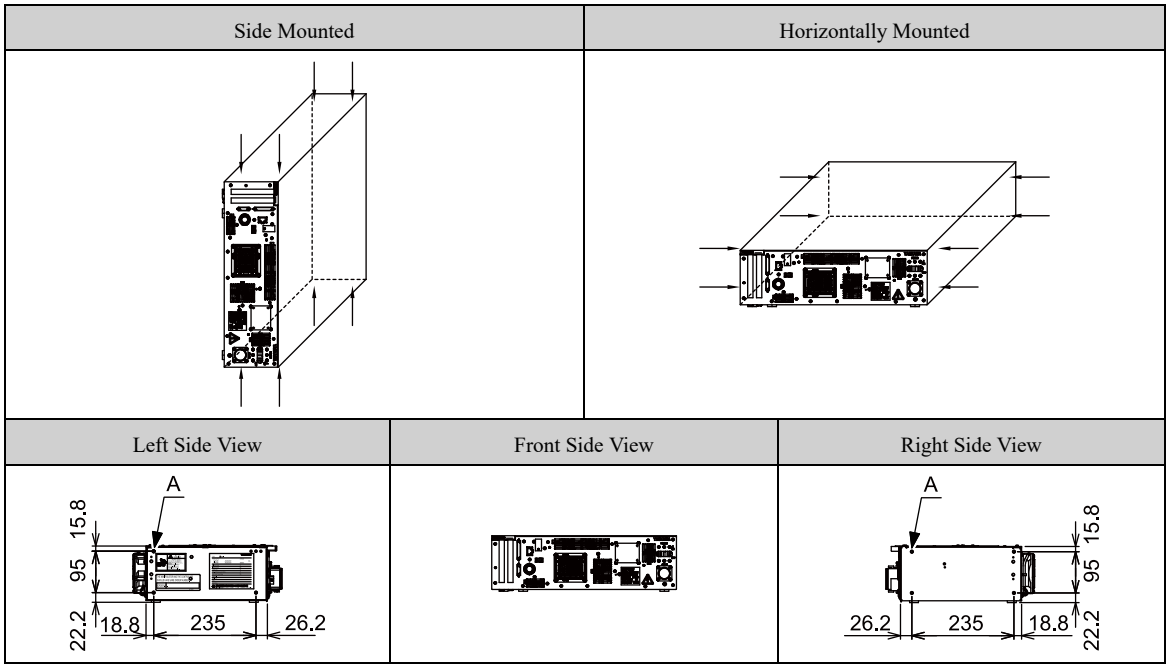
Table 2.9 Required Items

Name	Specifications	Quan-tity	Remarks
Mounting screw	M5 **Note:** Select screws with a thread length that is the thickness of the fixing bracket + 5 mm or less.	12	Material: Mild steel or a stronger material
Fixing bracket		4	Prepare fixing brackets according to the mounting method of the robot controller.

NOTICE

If the thread length of the mounting screws exceeds the thickness of the mounting bracket + 5 mm, the components inside the robot controller may be damaged.

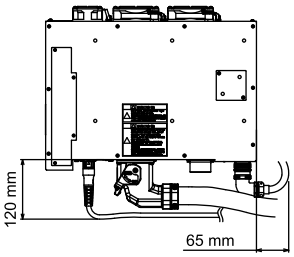
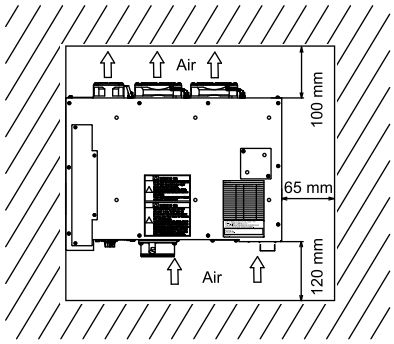
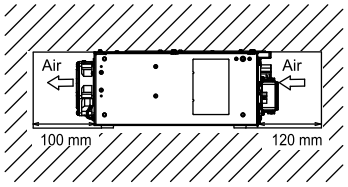
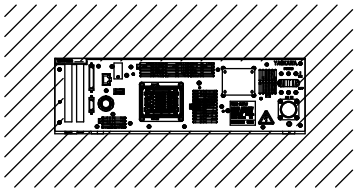
Use the screw holes M5 (8 places) on the sides of the robot controller to fix it to the floor or a pedestal.



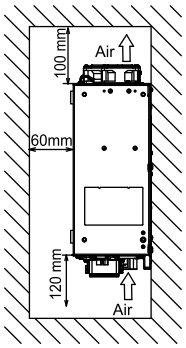
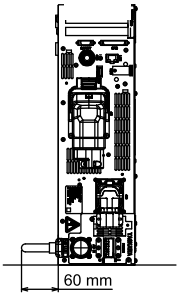
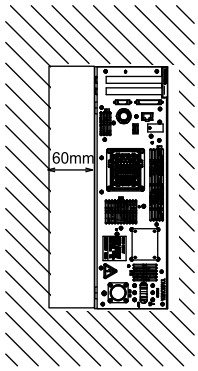
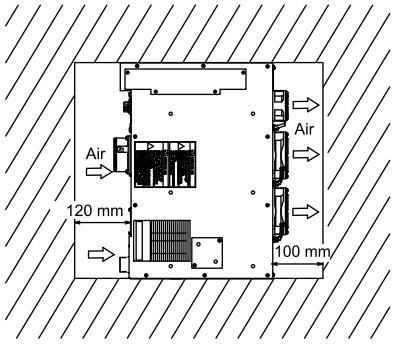
A M5 tapped holes (hole depth: 5 mm) (4 places)

Important

1. Ensure the following space when the YRC1000micro robot controller lays flat (horizontally mounted).

Space for Manipulator Cable	Top Side View
	
Left Side View	**Front Side View**
	

2. Ensure the following space when the YRC1000micro robot controller is side mounted.

Top Side View	Space for Manipulator Cable
	
Front Side View	**Right Side View**
	

Information The YRC1000micro robot controller is free-standing. Install the robot controller so that it is not exposed to excessive shock.

Refer to the mounting procedures in the following manual when side mounting the robot controller.

YRC1000micro Instructions (Manual No.: RE-CTO-A222)

3

Connecting the Robot Controller

3.1 Connecting the YRC1000 Robot Controller and Other Devices 36

3.1.1 Connecting the Manipulator 36

3.1.2 Connecting the Primary Power Supply 39

3.1.3 Connecting the Programming Pendant 42

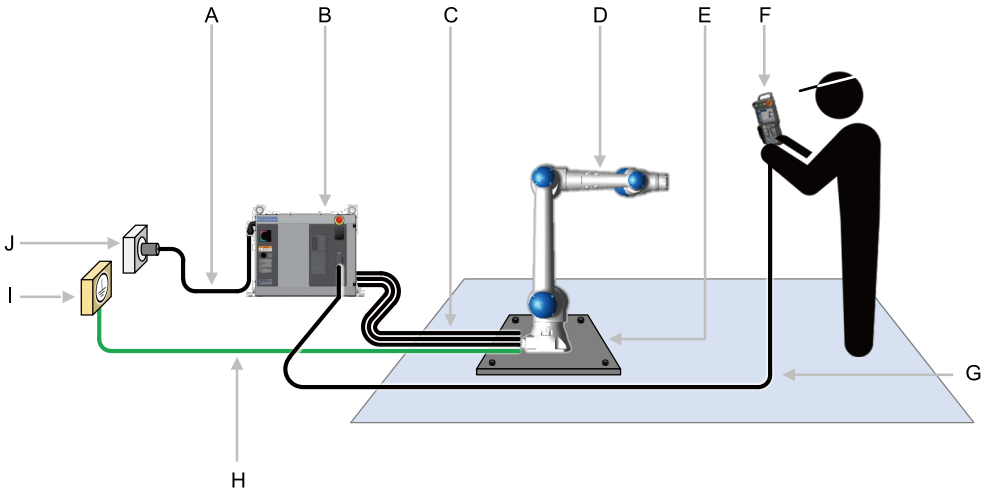
3.2 Connecting the YRC1000micro Robot Controller and Other Devices 43

3.2.1 Connecting the Manipulator 43

3.2.2 Connecting the Primary Power Supply 46

3.2.3 Connecting the Programming Pendant 47

3.1 Connecting the YRC1000 Robot Controller and Other Devices



Symbol	Name	Symbol	Name
A	Primary power supply cable	F	Programming pendant
B	Robot controller	G	Pendant connection cable
C	Manipulator cables (3 types)	H	Ground wire
D	Manipulator	I	Grounding equipment (earth)
E	Baseplate	J	Primary power supply

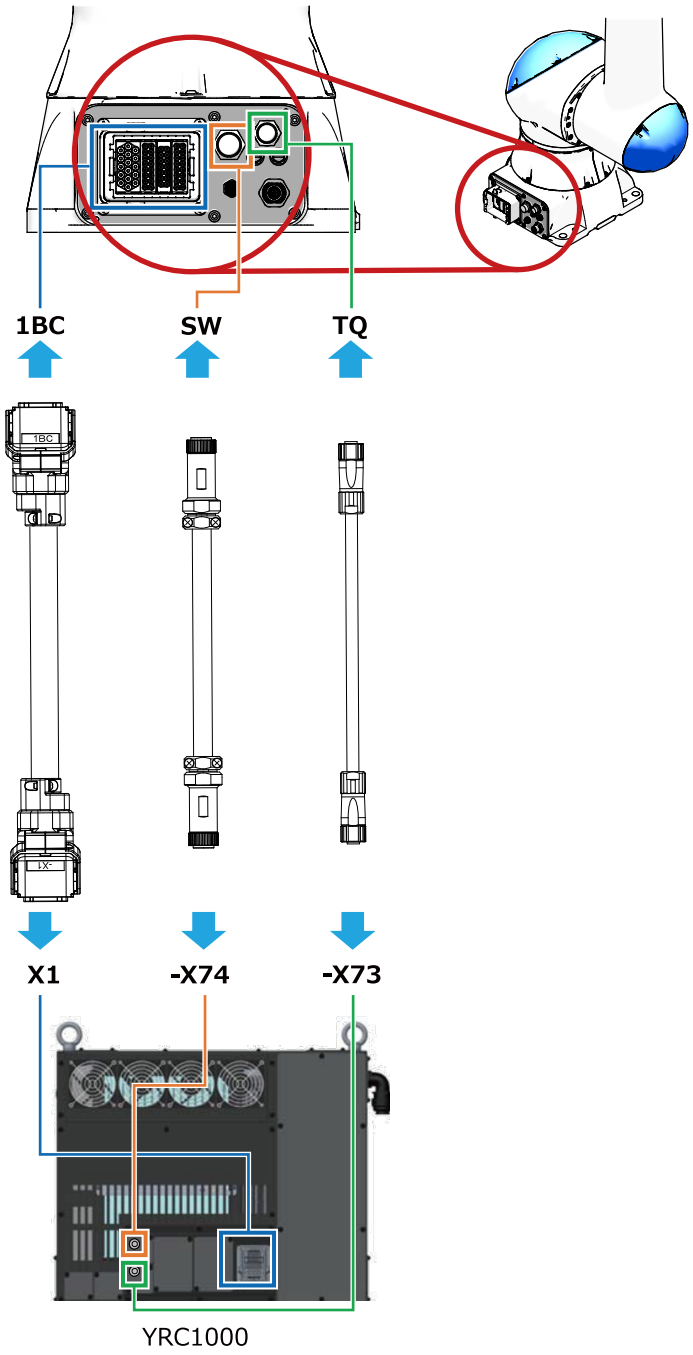
3.1.1 Connecting the Manipulator

Table 3.1 Required Items

Name	Specifications	Quantity	Remarks
Manipulator cable		1	Included with the manipulator.
Torque sensor cable		1	
Switch/lamp cable		1	
Power supply cable *1	Power requirement 1.0 kVA Cable size 3.5 mm^2	3	Robot controller breaker capacity: 15 A
Power outlet plug *1		1	
Ground wire *1		1	
Earth leakage breaker *2		1	–
Phillips screwdriver		1	–
Flat head screwdriver		1	–

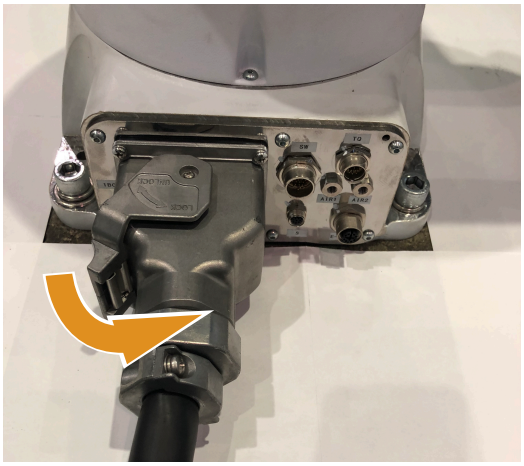
*1 Not provided by YASKAWA.
*2 Refer to the following manual for selecting the earth leakage breaker.

YRC1000 Instructions (Manual No.: RE-CTO-A221)

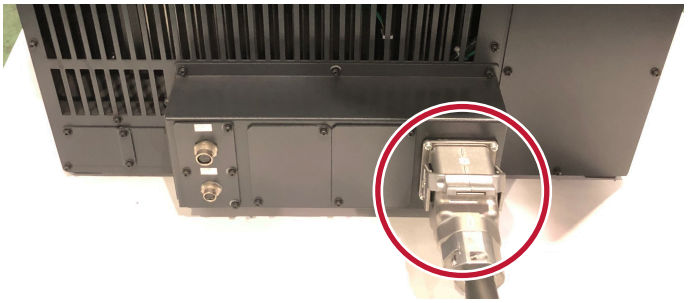


1. **Connect the 1BC connector on the manipulator cable to the manipulator.**

   Insert the manipulator cable into the 1BC connector, and turn the connector lever on the manipulator cable side to the locked position to connect the connector.

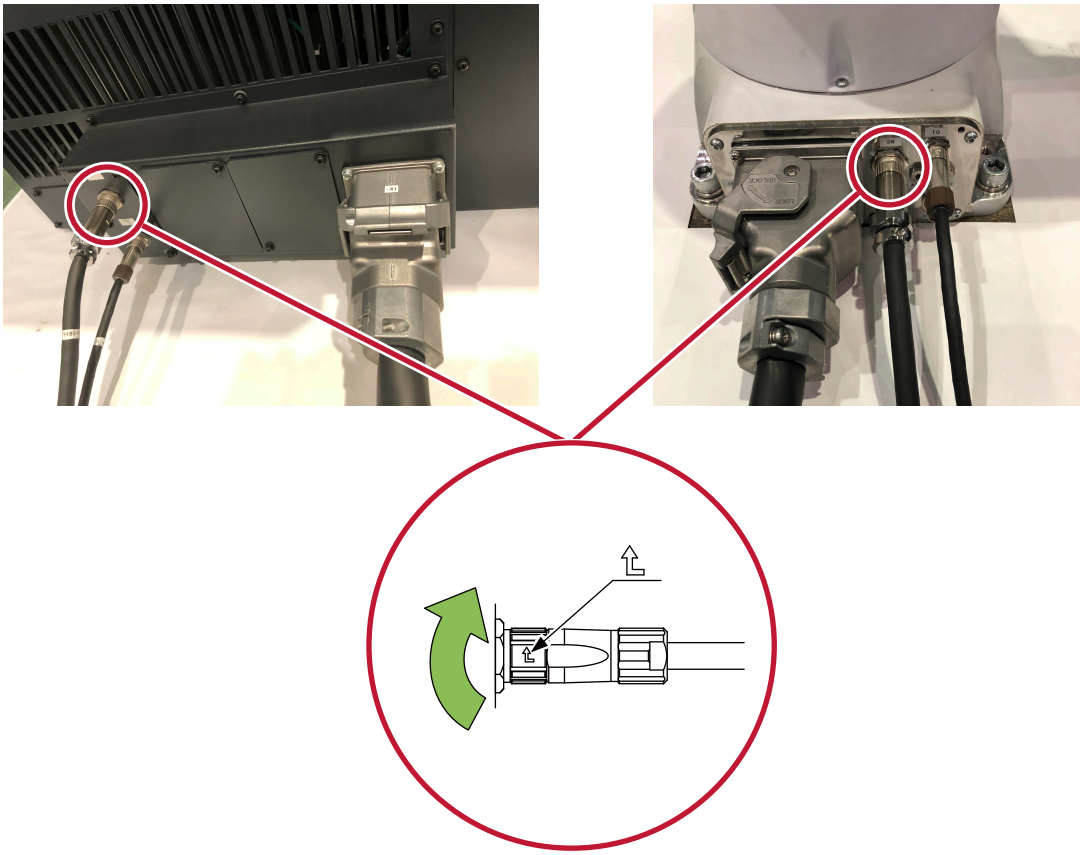


2. **Use the same procedure to connect the X1 connector on the manipulator cable to the robot controller.**

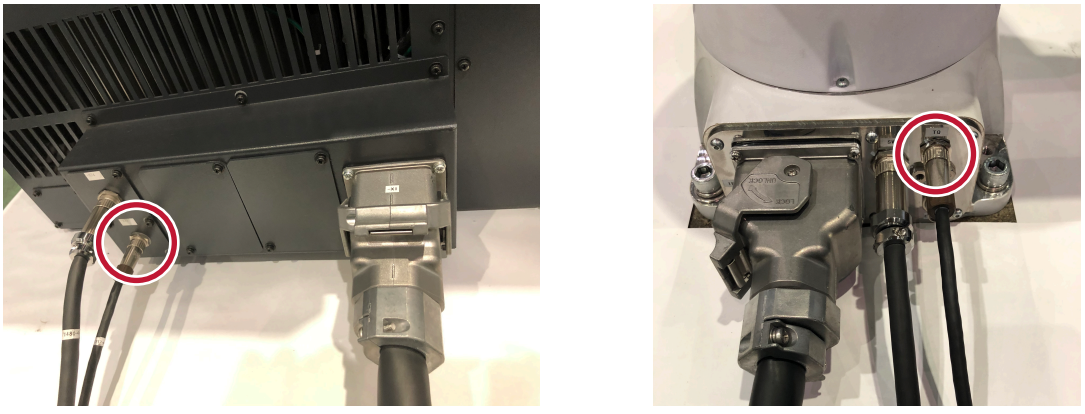


3. **Connect the switch/lamp cable to the [SW] connector on the manipulator and the [-X74] connector on the robot controller.**

Turn the tip of the cable connector with the arrow in the direction of the arrow to lock the cable.

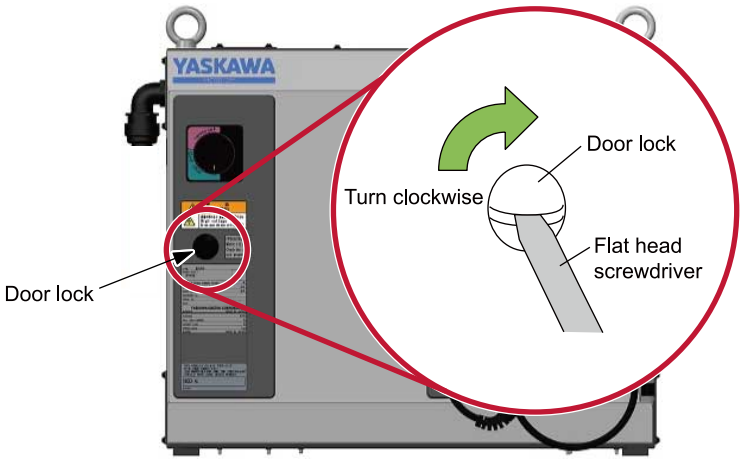


4. **Use the same procedure to connect the torque sensor cable to the [TQ] connector on the manipulator and the [-X73] connector on the robot controller.**

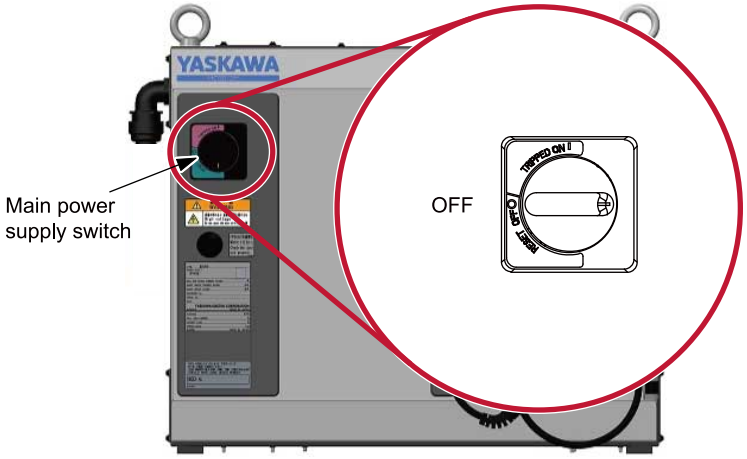


3.1.2 Connecting the Primary Power Supply

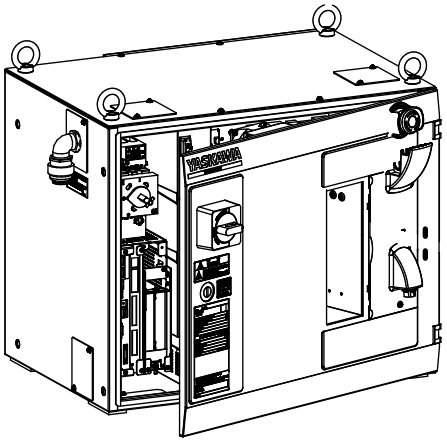
1. **Using a flat head screwdriver, rotate the door lock of the robot controller 90 degrees clockwise.**



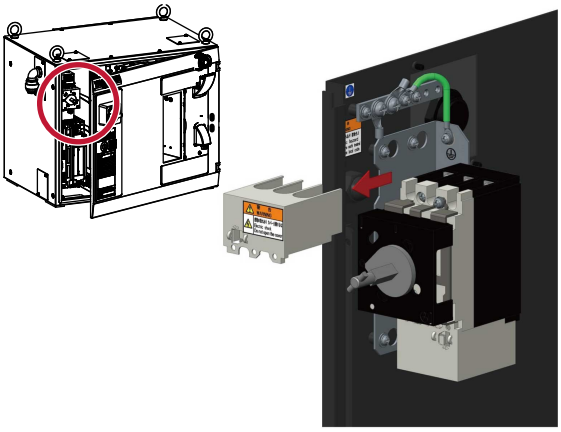
2. **Turn the main power supply switch to the OFF position.**



3. **Open the robot controller door.**



4. **Pull the breaker cover straight off.**



5. **Connect the ground wire to the ground terminal (M6 screw).**

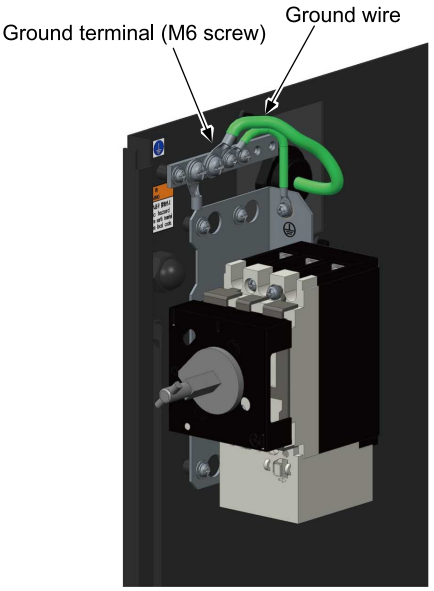
Power requirement: 1.0 kVA

Cable size (for flexible cable (3 cores)): 3.5 mm^2

Breaker capacity: 15 A

Note:

1. The ground wire is not provided by YASKAWA.
2. Ground the robot controller to a ground resistance of 100 Ω or less in accordance with all relevant local and national electrical codes.
   - Ground resistance of 100 Ω or less (200 to 240 VAC specification)
   - Ground resistance of 10 Ω or less (380 to 480 VAC specification)



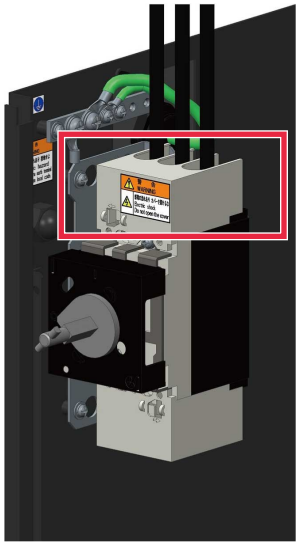
Important

- Always use an earth leakage breaker for a ground resistance of 100 Ω or less. Refer to the following manual for details.

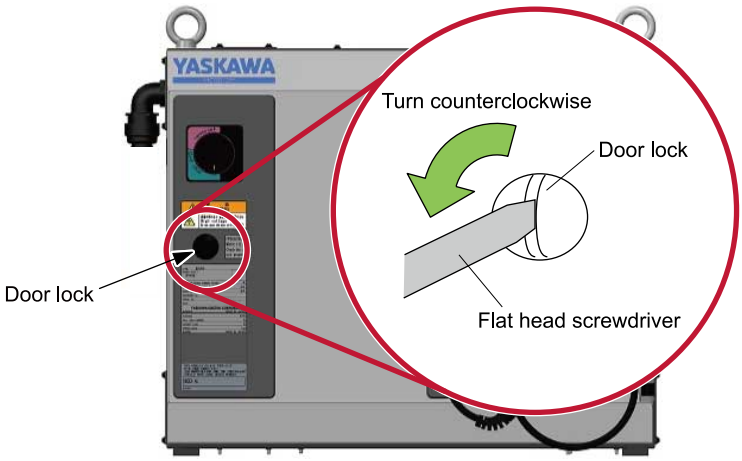
  YRC1000 Instructions (Manual No.: RE-CTO-A221)
- Do not share the ground wire for the robot controller with any other ground wires or grounding electrodes, such as those for electrical power, motors, or welders.
- Ground the robot controller in accordance with all relevant local and national electrical codes when using metallic ducts, metallic conduits, or cable trays to install cables.

6. **Connect the primary power supply.**

7. **Mount the breaker cover.**

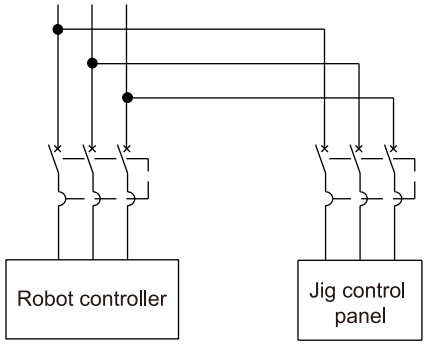


8. **Close the robot controller door and turn the door lock 90 degrees counterclockwise.**



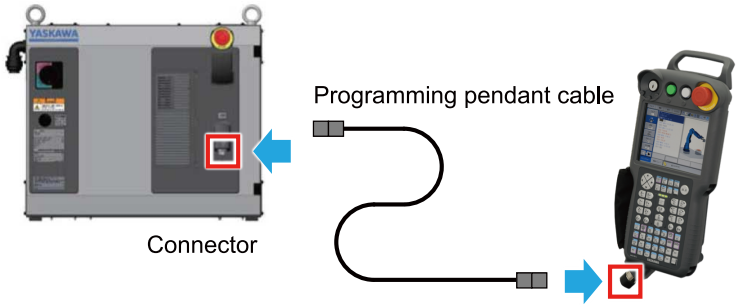
Important

Install a dedicated breaker for the robot controller to the primary power supply.



3.1.3 Connecting the Programming Pendant

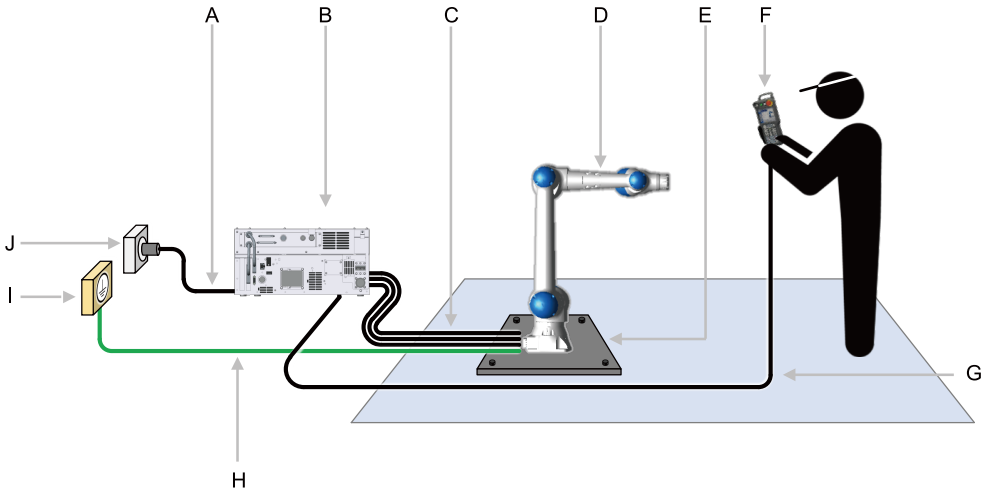
Use the cable to connect the robot controller and programming pendant.



Important

Insert the cable into the connector so that the arrow on connector of the robot controller is lined up with the triangle mark on the connector of the cable.

3.2 Connecting the YRC1000micro Robot Controller and Other Devices



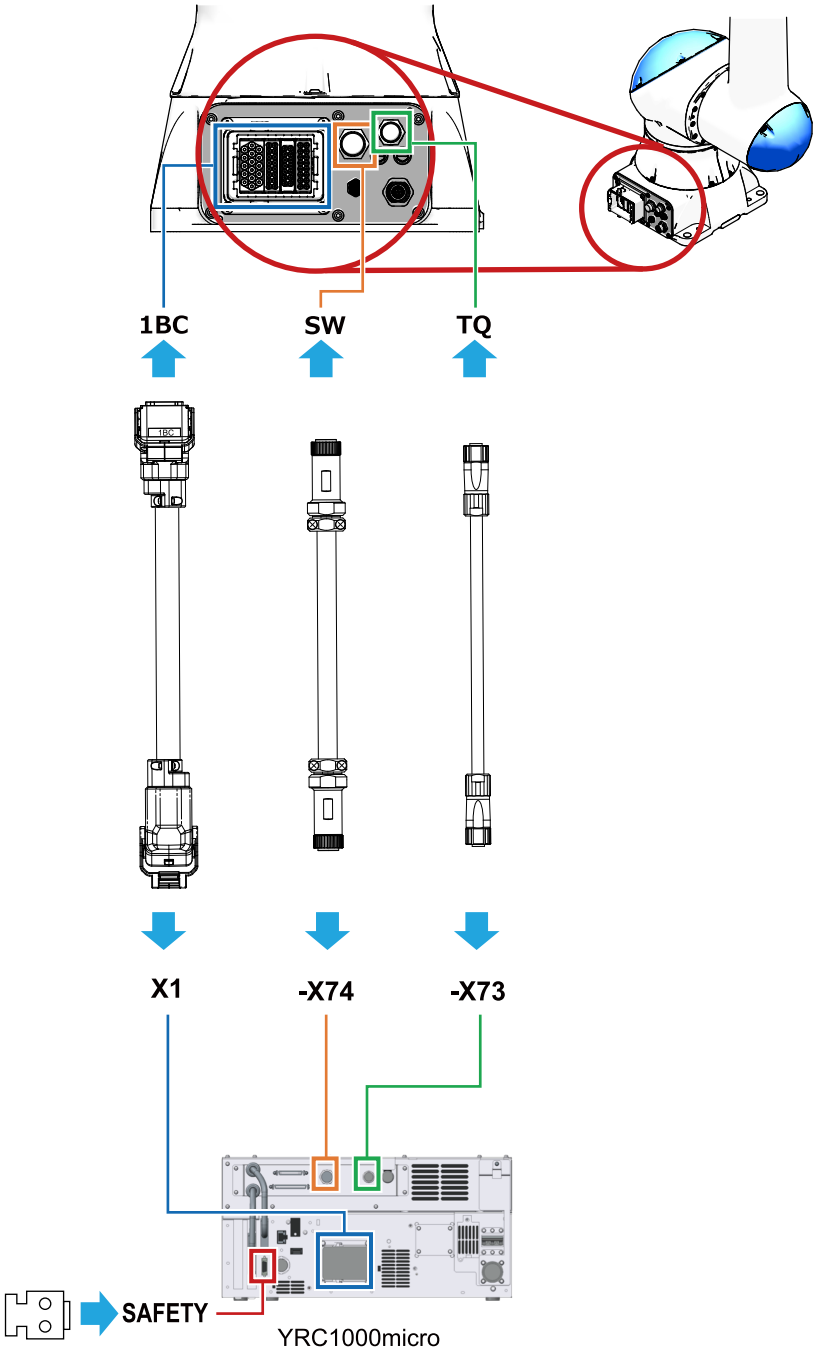
Symbol	Name	Symbol	Name
A	Primary power supply cable	F	Programming pendant
B	Robot controller	G	Pendant connection cable
C	Manipulator cables (3 types)	H	Ground wire
D	Manipulator	I	Grounding equipment (earth)
E	Baseplate	J	Primary power supply

3.2.1 Connecting the Manipulator

Table 3.2 Required Items

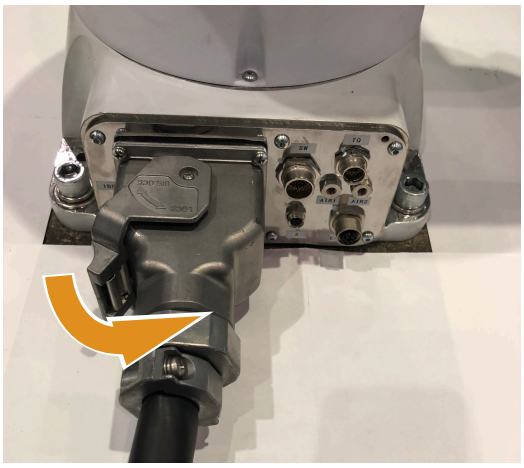
Name	Specifications	Quantity	Remarks
Manipulator cable		1	Included with the manipulator.
Torque sensor cable		1	
Switch/lamp cable		1	
Dummy connector for short-circuiting the safety signals		1	Included with the robot controller.
L-shaped angled plug for the primary power supply cable		1	
End bell		1	
Straight plug for the primary power supply cable		1	Must be purchased separately if the robot controller is side mounted.
Power supply cable *1	Power requirement 1.0 kVA Cable size 3.5 mm^2	3	Robot controller circuit protector capacity: 16 A
Cable clamp *1		1	
Power outlet plug *1		1	
Ground wire *1		1	
Circuit protector		1	
Phillips screwdriver		1	–

*1 Not provided by YASKAWA.



1. **Connect the 1BC connector on the manipulator cable to the manipulator.**

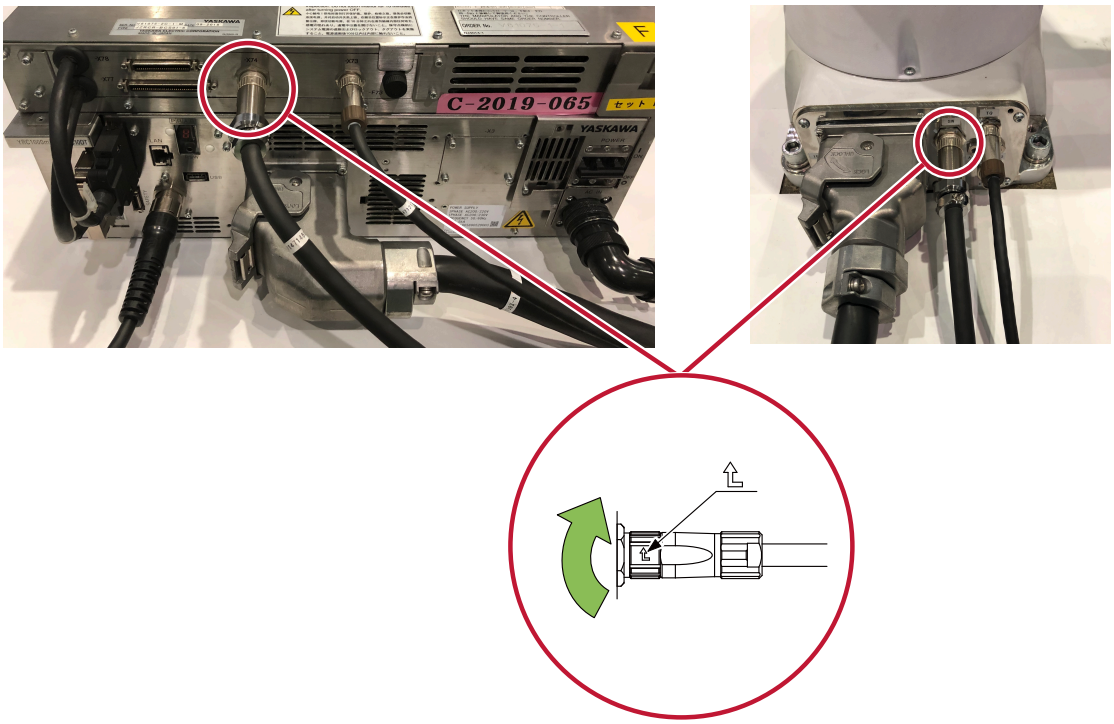
   Insert the manipulator cable into the 1BC connector, and turn the connector lever on the manipulator cable side to the locked position to connect the connector.



2. **Use the same procedure to connect the X1 connector on the manipulator cable to the robot controller.**

3. **Connect the switch/lamp cable to the [SW] connector on the manipulator and the [-X74] connector on the robot controller.**

Turn the tip of the cable connector with the arrow in the direction of the arrow to lock the cable.



4. **Use the same procedure to connect the torque sensor cable to the [TQ] connector on the manipulator and the [-X73] connector on the robot controller.**

5. **Connect the dummy connector for short-circuiting the safety signals to the SAFETY connector on the robot controller.**

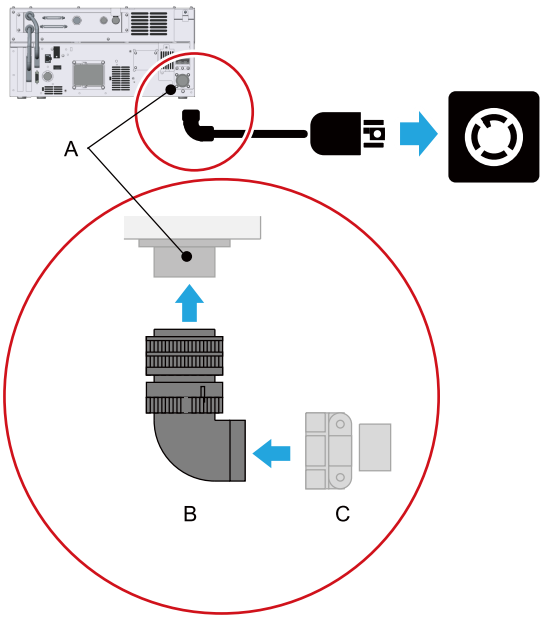
> Important
> Always connect the dummy connector for short-circuiting the safety signals. If this connector is not connected, protective stops and external emergency stops will occur.

3.2.2 Connecting the Primary Power Supply

1. **Connect the L-shaped angled plug for the primary power supply to the power supply connector on the robot controller.**
2. **Connect the primary power supply to the robot controller.**

Note:
Confirm that the circuit protector of the robot controller is turned OFF.

Note:
A straight type plug is required if the robot controller is side mounted.



A	Power supply connector	C	Cable clamp
B	L-shaped angled plug	–	–

Table 3.3 Power Supply Connector (ACIN) Pin Assignments on the YRC1000micro (Three-Phase Power Supply)

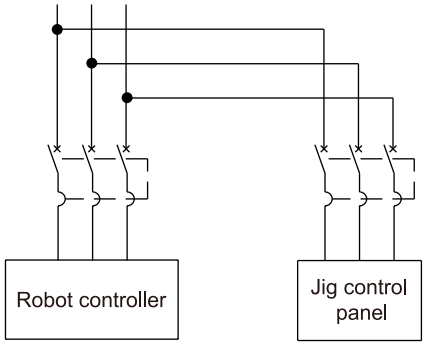
Pin No.	Signal Name	Description
A	L1	AC input (L1/R phase)
B	L2	AC input (L2/S phase)
C	L3	AC input (L3/T phase)
D	P.E.	Protective grounding

Table 3.4 Power Supply Connector (ACIN) Pin Assignments on the YRC1000micro (Single-Phase Power Supply)

Pin No.	Signal Name	Description
A	L1	AC input (L1/R phase)
B	N.C.	No connection
C	L3	AC input (L3/T phase)
D	P.E.	Protective grounding

Important

Install separate breakers for the primary power supply.

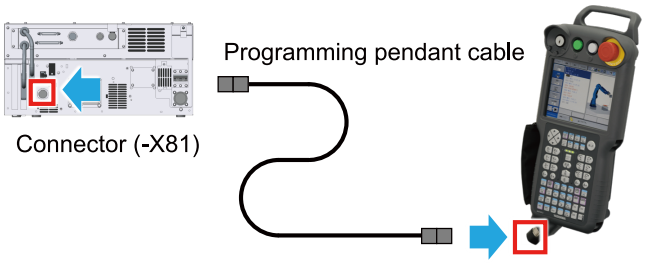


3.2.3 Connecting the Programming Pendant

Connect the cable to the [-X81] connector on the robot controller.

Note:

Confirm that the pins of the robot controller and cable connectors are aligned before inserting the connector.



Important

When the programming pendant is not used, attach the connector for short-circuiting the programming pendant safety signals to the [-X81] connector on the robot controller. The robot controller will not start if this connector is not attached.

4

Turning ON the Robot Controller Power Supplies

This chapter describes the how to turn ON/OFF the robot controller power supplies, how to check the power supplies, and how to reset alarms that may occur when the power supplies are turned ON.

4.1 Turning ON/OFF and Checking the Power Supplies 50

4.1.1 Turning ON the Main Power Supply 50

4.1.2 Checking Operation of the Emergency Stop Button and Servo Power 51

4.2 Corrective Actions for Alarms at Initial Startup 53

4.2.1 Correcting Alarm 6022 EXTERNAL FORCE ESTIMATION ERROR and Alarm 6004 ESCAPE FROM CLAMPING ERROR(PFL) 53

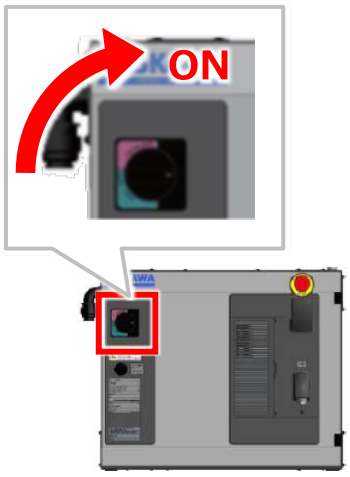
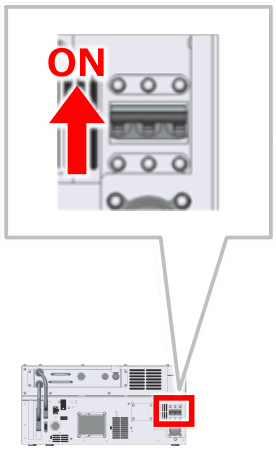
4.2.2 Correcting Alarm 4107 OUT OF RANGE(ABSO DATA) 58

4.1 Turning ON/OFF and Checking the Power Supplies

The main power supply and servo power are required to move the manipulator. Before moving the manipulator, first turn ON/OFF these power supplies and check the correct operation of the emergency stop button.

4.1.1 Turning ON the Main Power Supply

1. **Turn ON the main power supply to the robot controller.**

YRC1000	YRC1000micro
	

2. **Confirm that the startup window is displayed on the programming pendant.**

It will take approximately three minutes until the window is displayed.

The main power supply is working correctly when the startup window is displayed.

Refer to the following section if an alarm is displayed on the programming pendant.

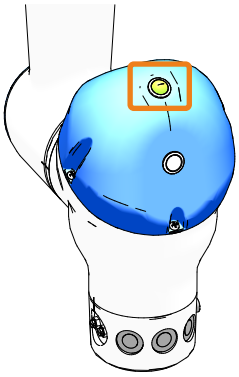
☞ *4.2 Corrective Actions for Alarms at Initial Startup on page 53*

This concludes the procedure.

4.1.2 Checking Operation of the Emergency Stop Button and Servo Power

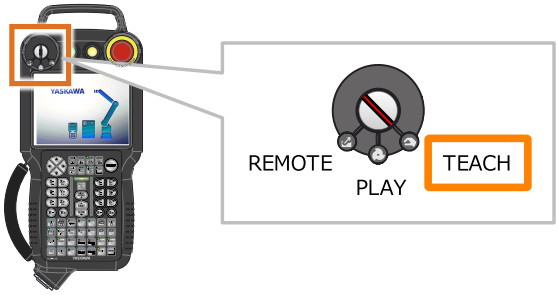
Confirm the operation to turn ON/OFF the servo power, and confirm that the servo power is canceled when the emergency stop button is pressed.

1. **Confirm that the collaborative operation LED on the manipulator is lit in green.**



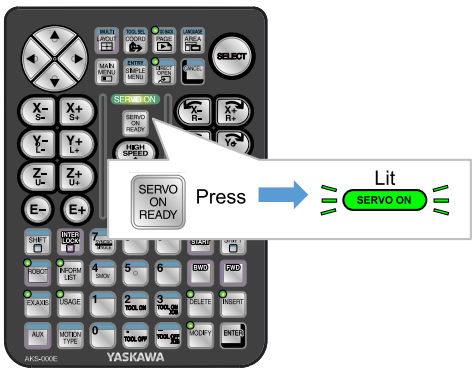
Information
- A green lit LED means collaborative operation is enabled. Enabled is the default setting. If the LED is not lit, the subsequent operations cannot be performed.
- If the dummy connector is not connected, protective stops and external emergency stops will occur. Connect the dummy connector when the manipulator is stopped. Refer to the following section for details on the dummy connector.
☞ *1.2.4 YRC1000micro Robot Controller Accessories on page 19*

2. **Confirm that the mode key on the programming pendant is set to TEACH.**

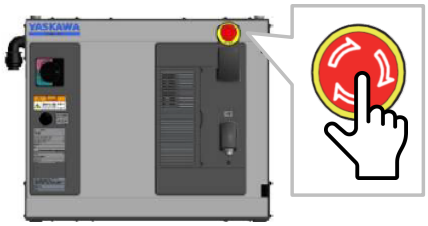


3. **Press [SERVO ON READY] on the programming pendant, and confirm that the [SERVO ON] lamp is lit in green.**

The [SERVO ON] lamp lit in green means the servo power has been turned ON.



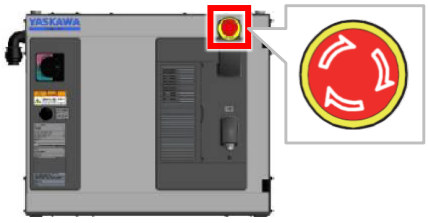
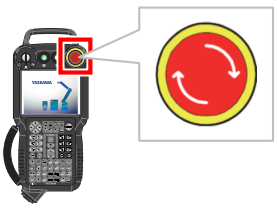
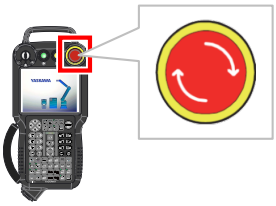
4. **Press the emergency stop button.**

YRC1000	YRC1000micro
There is an emergency stop button on the YRC1000.  The emergency stop button on the programming pendant can also be used. 	There is an emergency stop button on the programming pendant.  **Note:** The YRC1000micro is not equipped with an emergency stop button.

5. **Confirm that the [SERVO ON] lamp on the programming pendant goes out.**

   The [SERVO ON] lamp not lit means the servo power has been turned OFF.

6. **Turn the emergency stop button in the direction of the arrows to reset the emergency stop.**

YRC1000	YRC1000micro
 or 	

This concludes the procedure.

4.2 Corrective Actions for Alarms at Initial Startup

The following alarms may occur when the manipulator is first started.

If the following alarms occur, take the corrective actions described in the reference section.

Alarm No.	Alarm Name	Possible Cause	Reference Section
6022	EXTERNAL FORCE ESTIMATION ERROR	• A large force was applied when the power supply to the robot controller was turned ON. • The home positions of the torque sensors have greatly deviated.	☞ *4.2.1 Correcting Alarm 6022 EXTERNAL FORCE ESTIMATION ERROR and Alarm 6004 ESCAPE FROM CLAMPING ERROR (PFL) on page 53*
6004	ESCAPE FROM CLAMPING ERROR(PFL)	• The manipulator cannot perform the escape operation because a large force was applied when the power supply to the robot controller was turned ON. • The manipulator cannot perform the escape operation because the home positions of the torque sensors have greatly deviated.	
4107	OUT OF RANGE(ABSO DATA)	• The motor axis became misaligned when the power supply was turned OFF. • There is a difference that exceeds the allowable range in the position of the motor axis when the power supply was turned OFF and when it was turned ON.	☞ *4.2.2 Correcting Alarm 4107 OUT OF RANGE (ABSO DATA) on page 58*

Term

Escape Operation :

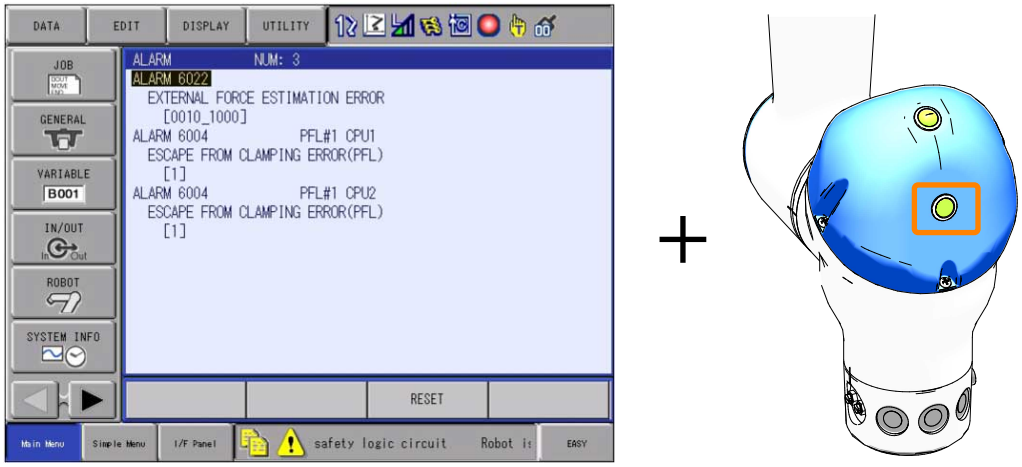
The operation in which the manipulator automatically moves in a safe direction from a clamped state.

4.2.1 Correcting Alarm 6022 EXTERNAL FORCE ESTIMATION ERROR and Alarm 6004 ESCAPE FROM CLAMPING ERROR(PFL)

Use the following procedure to reset alarm 6022 EXTERNAL FORCE ESTIMATION ERROR or alarm 6004 ESCAPE FROM CLAMPING ERROR(PFL) that occurs when the manipulator is first started.

Information If multiple alarms occur, use this procedure to reset both alarm 6022 and alarm 6004 in a single operation.

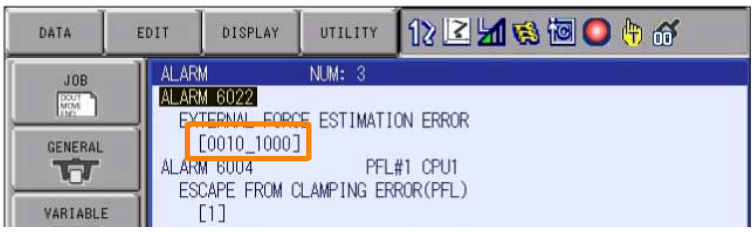
If an alarm occurs, an alarm window similar to the following will be displayed, and the resume switch will be lit.



1. **Check the axes on which the alarms occurred.**

   For alarm 6022, write down the axes on which the alarms occurred because these axes will be required later.

   Check the axes on which the alarms occurred with the numeric value of the subcode. Axes with the subcode value "1" are the axes on which the alarms occurred.

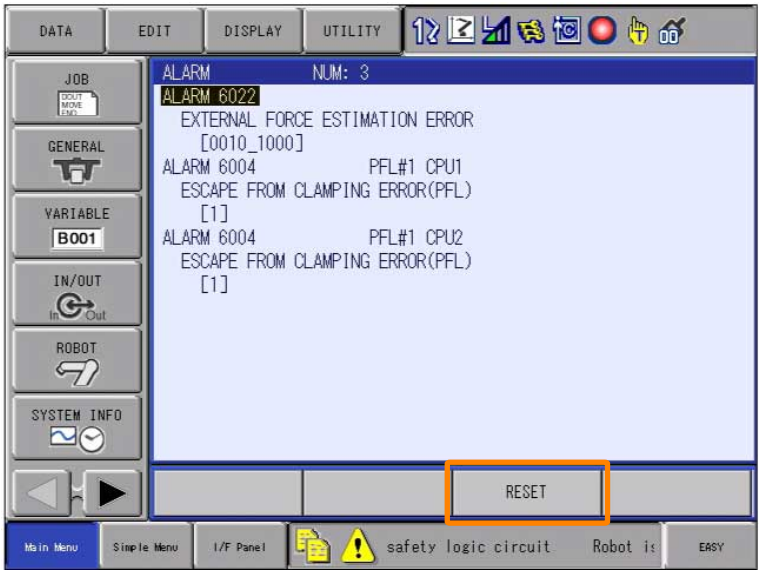


The relationship between subcode and axis is as follows:

Subcode	[	0	0	0	0	_	1	0	0	1	]
Relevant Axis		No relevant axis	No relevant axis	T-axis	B-axis		R-axis	U-axis	L-axis	S-axis	

In the above screenshot, the alarms occurred on the R-axis and S-axis.

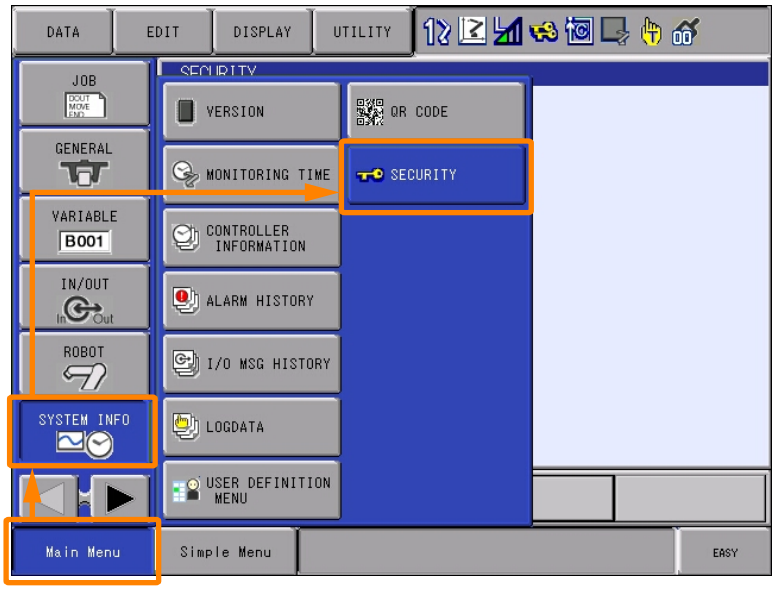
2. **Select {RESET} on the programming pendant.**



The alarm will be reset.

To change the settings, change the security mode to {SAFETY MODE}. Proceed to the next step.

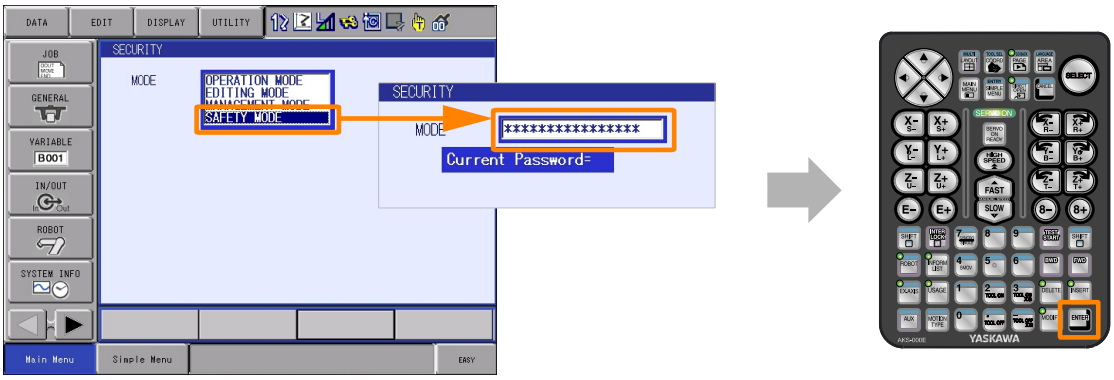
3. **Select {Main Menu} - {SYSTEM INFO} - {SECURITY} on the programming pendant.**



The SECURITY window will be displayed.

4. **Select {SAFETY MODE} for the mode, enter the password, and select [ENTER].**

The default password is "5555555555555555" (enter "5" 16 times).



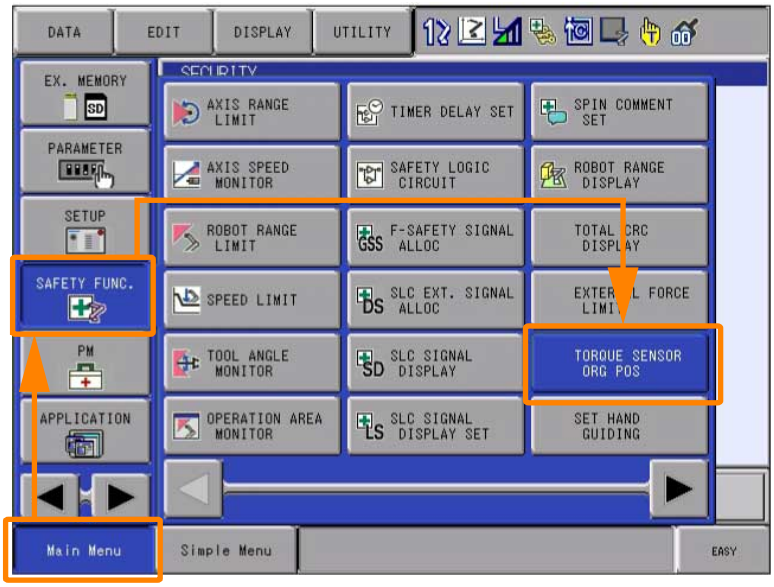
The security mode will be set to safety mode.

The rest of this procedure is the operation to set the home positions of the torque sensors again.

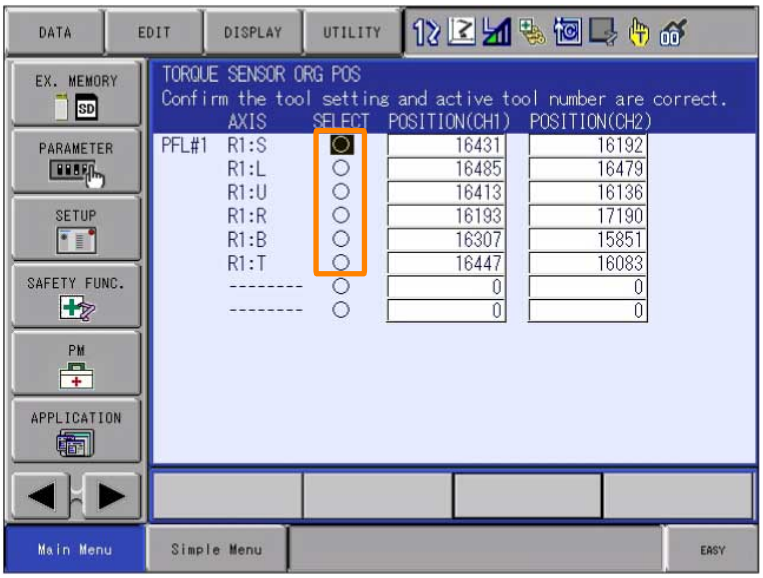
If the home positions of the torque sensors have deviated, such as due to receiving a large shock, erroneous detections will occur, such as a small external force being detected as a large external force.

Set the home positions of the torque sensors again according to the rest of this procedure to prevent erroneous detections.

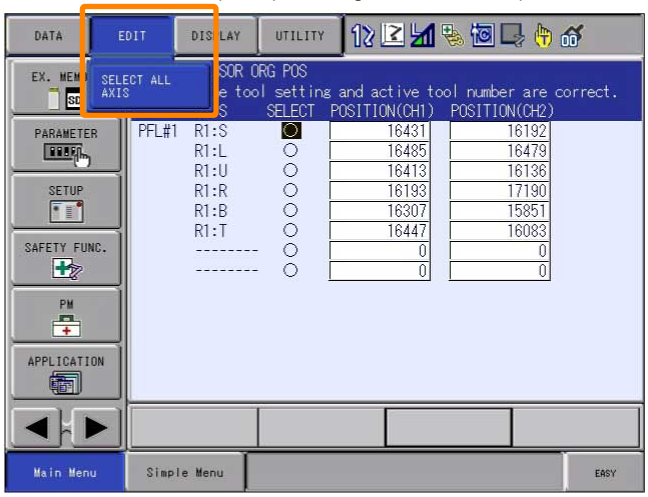
5. **Select {Main Menu} - {SAFETY FUNC.} - {TORQUE SENSOR ORG POS} on the programming pendant.**



6. **Select the axes on which the alarms occurred.**

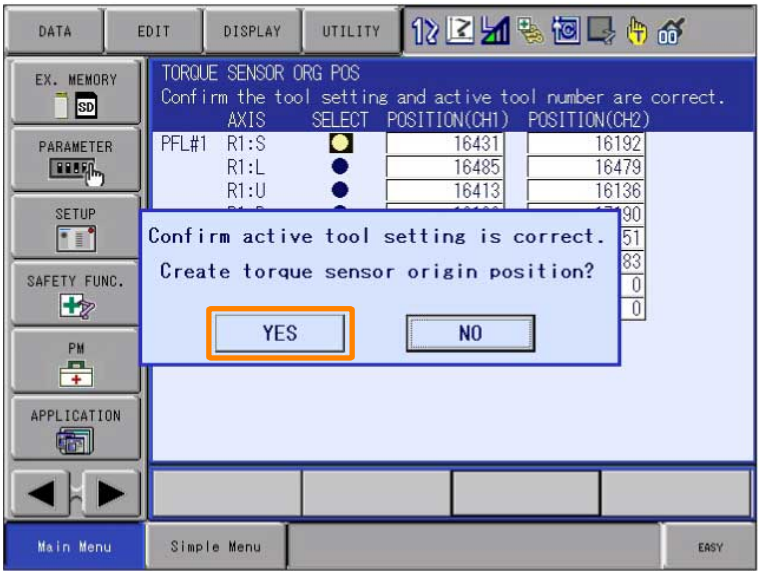


Information
- The home position of the torque sensor will be set again for the axes selected here.
- To select all axes, select {EDIT} at the top of the window - {SELECT ALL AXIS}.



A confirmation window will be displayed.

7. **Select {YES}.**

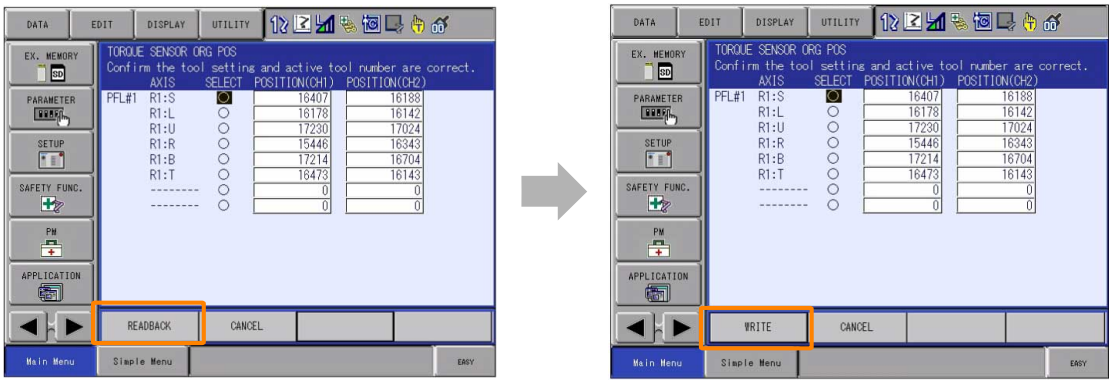


Information

The procedure assumes that {YES} is selected when nothing has been set for the tool information.

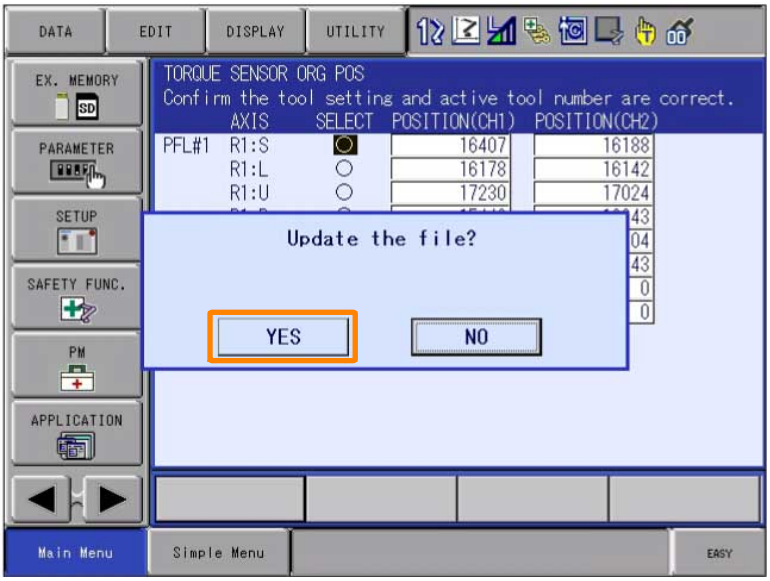
If this operation is performed after tool information was set, select {ROBOT} - {TOOL} to display the TOOL COORDINATE window. Confirm that the tool information is correct, and then select {YES}.

8. **Select {READBACK} - {WRITE}.**



A confirmation window will be displayed when transferring and saving the configured data to the robot controller is completed.

9. **Select {YES}.**

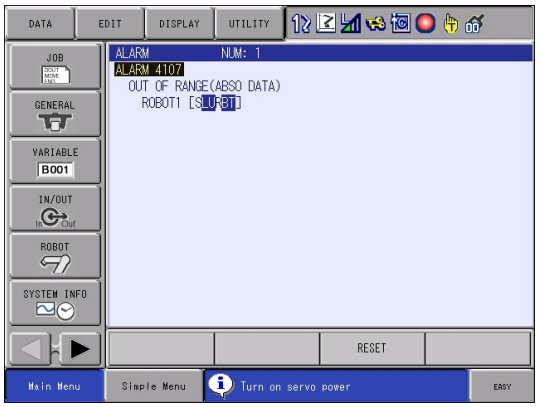


This concludes the procedure.

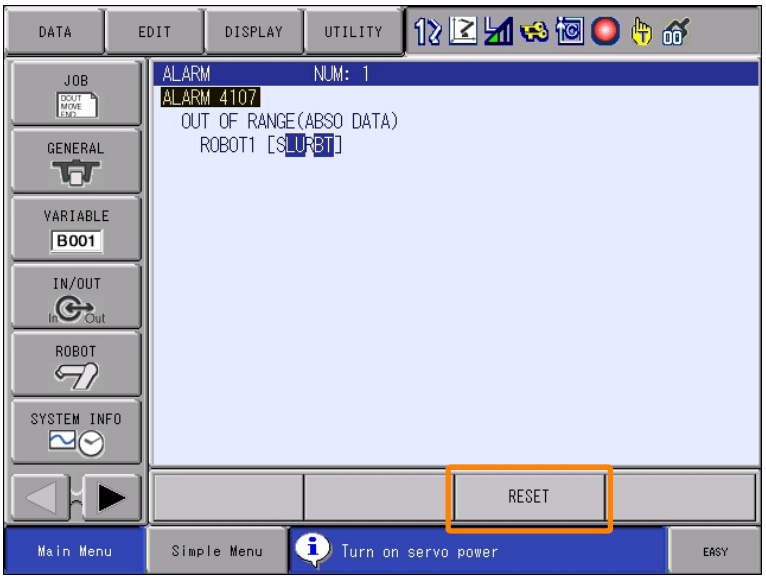
4.2.2 Correcting Alarm 4107 OUT OF RANGE(ABSO DATA)

Use the following procedure to reset alarm 4107 OUT OF RANGE(ABSO DATA) that occurs when the manipulator is first started.

If an alarm occurs, an alarm window similar to the following will be displayed on the programming pendant.



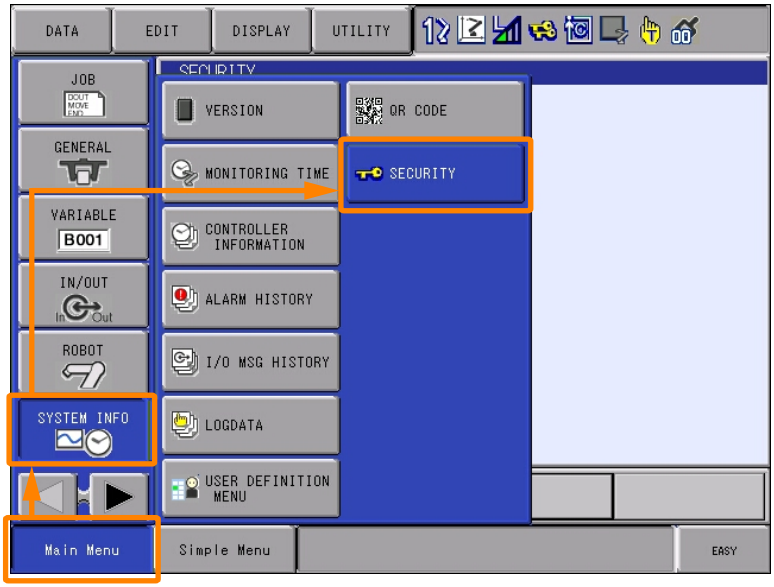
1. **Select {RESET} on the programming pendant.**



The alarm will be reset.

To change the settings, change the security mode to {SAFETY MODE}. Proceed to the next step.

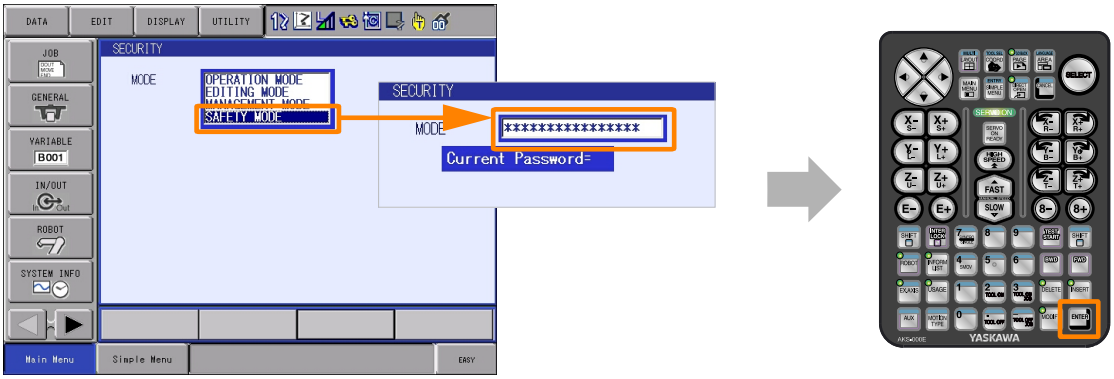
2. **Select {Main Menu} - {SYSTEM INFO} - {SECURITY} on the programming pendant.**



The SECURITY window will be displayed.

3. **Select {SAFETY MODE} for the mode, enter the password, and select [ENTER].**

The default password is "5555555555555555" (enter "5" 16 times).



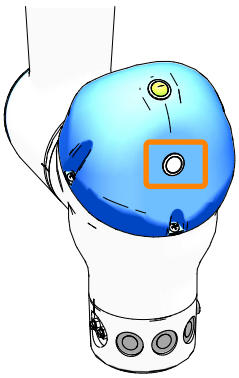
The security mode will be set to safety mode.

The rest of this procedure is the operation to confirm the position of the manipulator.

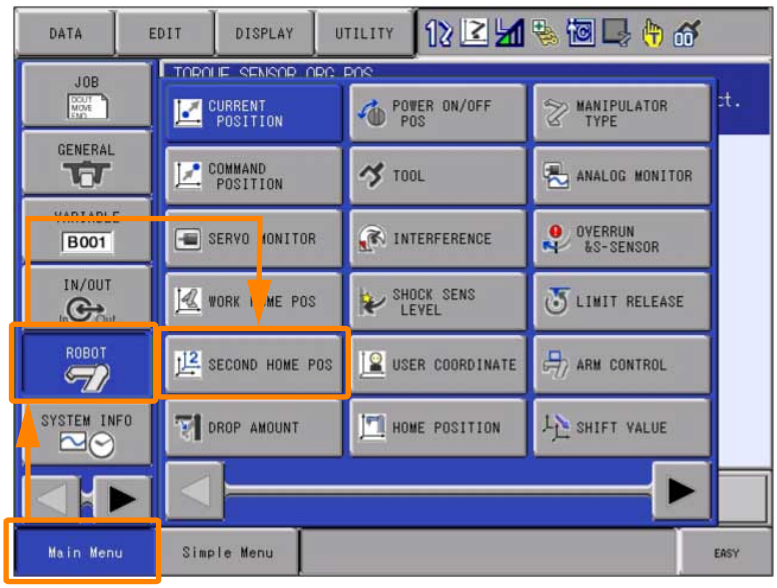
In the current state, there is a large difference between the position of the manipulator when the power supply was turned OFF and when the power supply was turned ON. The alarm occurred because of this difference in positions.

Confirm the position according to the rest of this procedure to eliminate this difference.

4. **If the resume switch on the manipulator is lit, press the resume switch to make it not lit.**

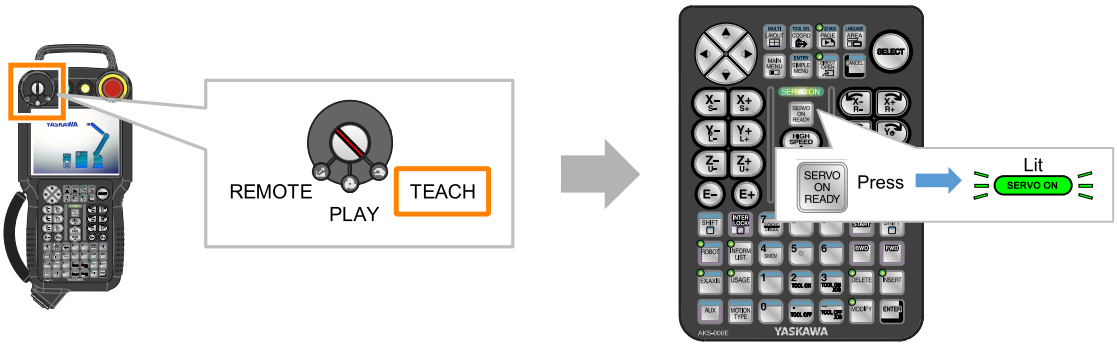


5. **Select {Main Menu} - {ROBOT} - {SECOND HOME POS} on the programming pendant.**

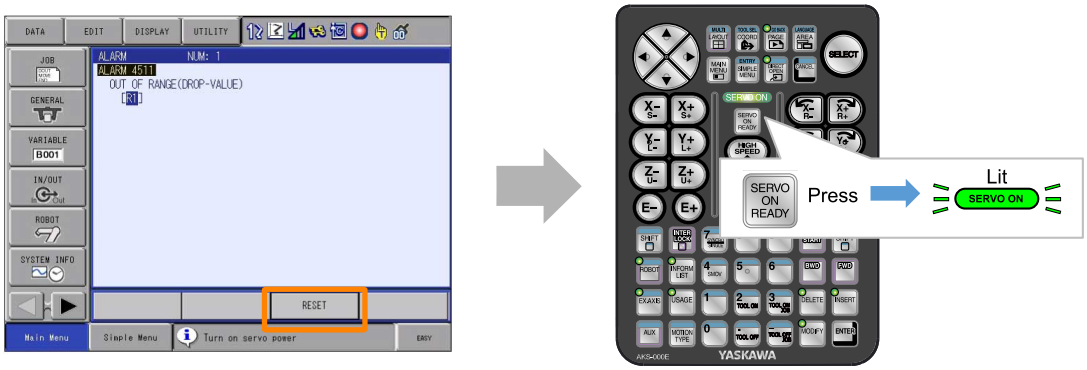


6. **Confirm that the mode key on the programming pendant is set to TEACH, and press [SERVO ON READY].**

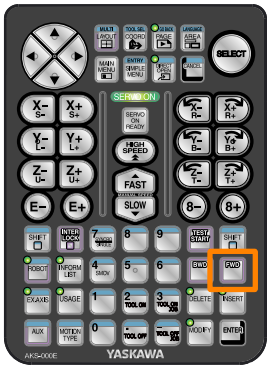
The servo power will be turned ON, and the [SERVO ON] lamp will be lit in green.



7. **If "ALARM 4511 OUT OF RANGE(DROP-VALUE)" is displayed, first press {RESET}, and then press [SERVO ON READY] on the programming pendant to turn ON the servo power again.**

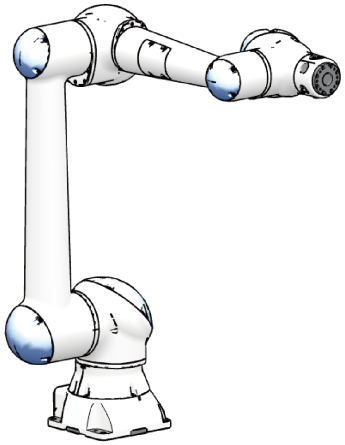


8. **Press and hold [FWD] while the [SERVO ON] lamp is lit on the programming pendant.**



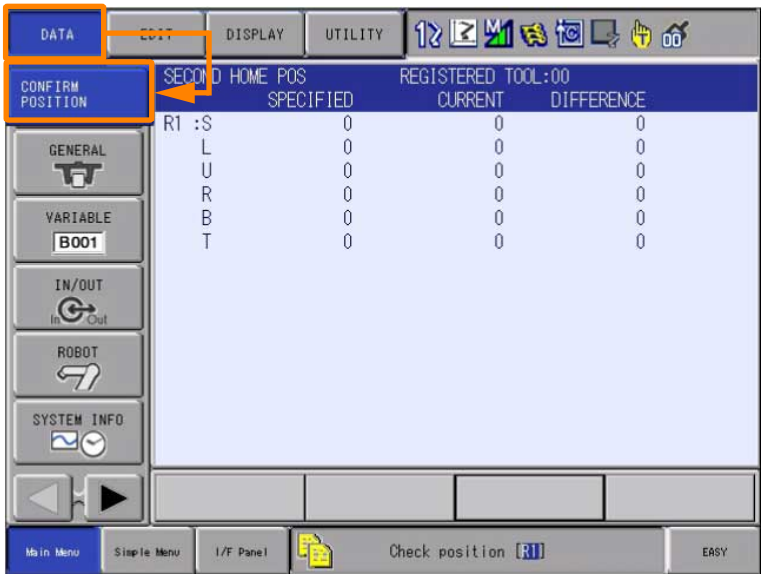
While [FWD] is pressed and held, the manipulator will move to the second home position posture.

Information The second home position posture is shown below.

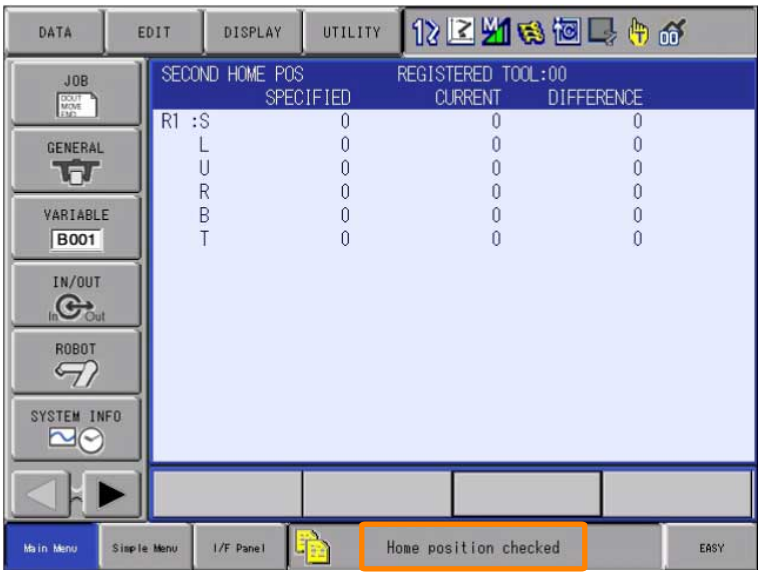


The manipulator will automatically stop at the second home position posture, and it will no longer move even if [FWD] is pressed.

9. **Confirm that the manipulator stopped at the second home position posture, and then select {DATA} - {CONFIRM POSITION} on the programming pendant.**



10. **Confirm that the "Home position checked" confirmation message was displayed.**



This concludes the procedure.

5

Controlling the Manipulator

This chapter describes jogging operations to move manipulator axes and direct teach operations to store operating positions in the manipulator.

5.1 Moving the Manipulator 64

5.1.1 Jogging Each Axis (Joint Coordinate System) 64

5.1.2 Cartesian Jogging 66

5.1.3 Direct Teach 69

5.1 Moving the Manipulator

This section describes the basic operations to move the manipulator.

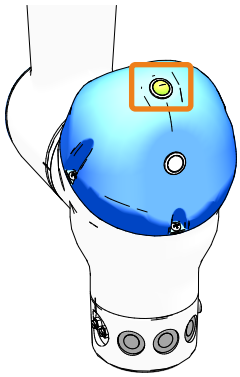
Operation	Description	Reference Section
Jogging Each Axis (Joint Coordinate System)	The operation to move each axis of the manipulator independently.	☞ *5.1.1 Jogging Each Axis (Joint Coordinate System) on page 64*
Cartesian Jogging	The operation to move in parallel to the X-axis, Y-axis, and Z-axis that are defined based on the manipulator.	☞ *5.1.2 Cartesian Jogging on page 66*
Direct Teach	The operation to manually move the manipulator to the desired position and store that position. The manipulator achieves continuous motion by moving between the recorded positions.	☞ *5.1.3 Direct Teach on page 69*

5.1.1 Jogging Each Axis (Joint Coordinate System)

Jogging is the most basic manipulator operation.

Use the following procedure to move the desired axis of the manipulator.

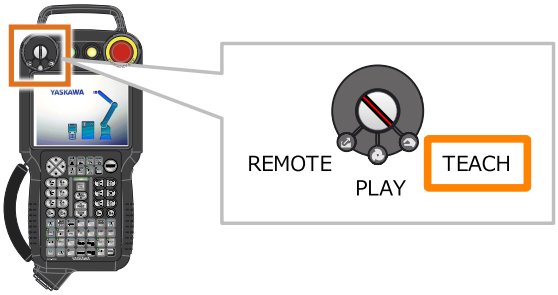
1. **Confirm that the collaborative operation LED is lit in green.**



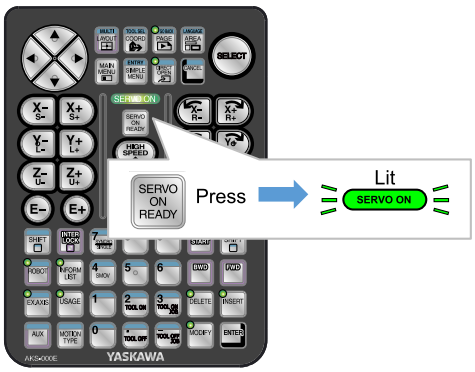
Information If the LED is not lit, the collaborative operation function is disabled. Refer to the following section and enable the collaborative operation function.

☞ *7.6 Enabling the Collaborative Operation Function on page 111*

2. **Set the mode key on the programming pendant to TEACH.**

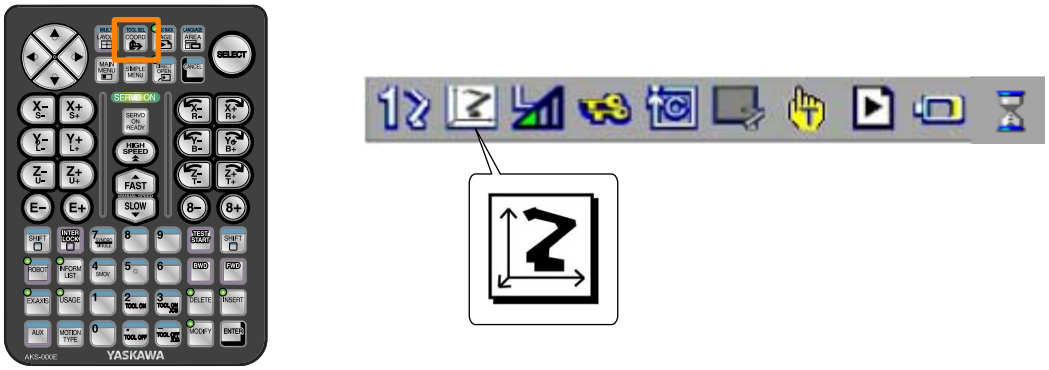


3. **Press [SERVO ON READY].**

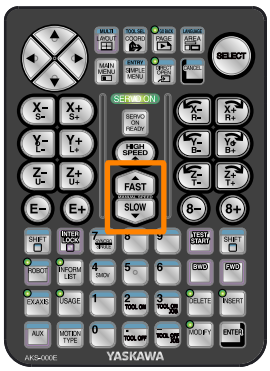


The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

4. **Press [TOOL SEL COORD] until the icon on the window changes to the joint coordinates system icon.**

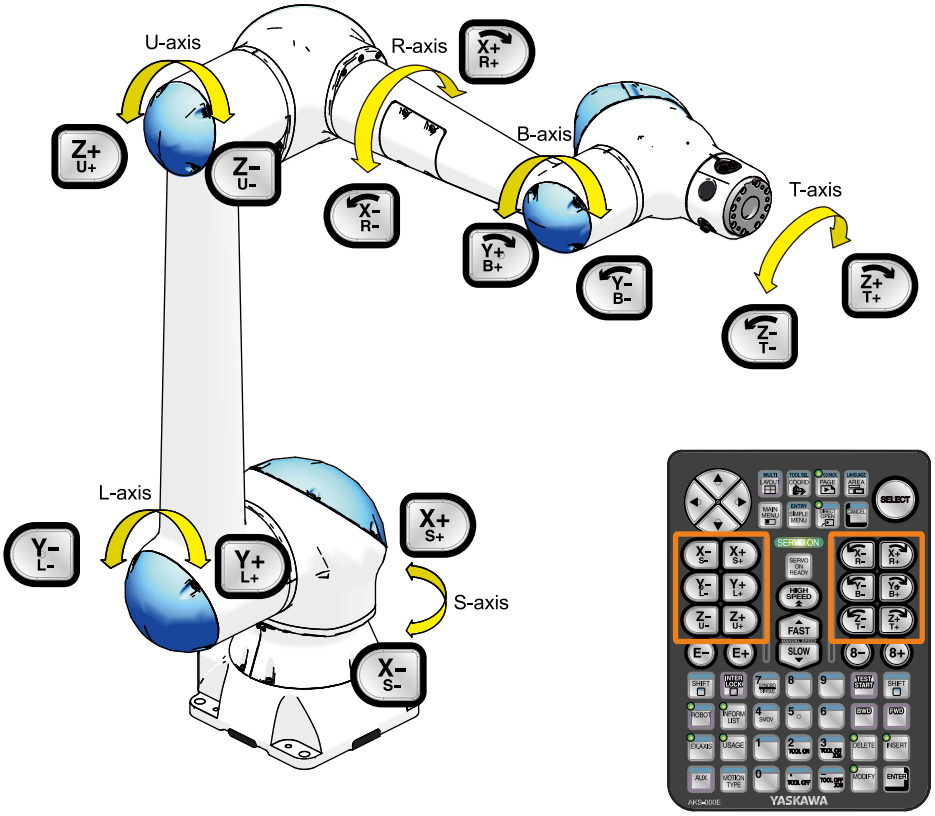


5. **Press MANUAL SPEED [FAST] or [SLOW] to change the speed at which the manipulator moves as required.**



Information Selecting medium speed at first is recommended to make it easier to check the movement of the manipulator.

6. **Press the axis keys on the programming pendant, and confirm the manipulator axis moves that corresponds to the pressed key.**

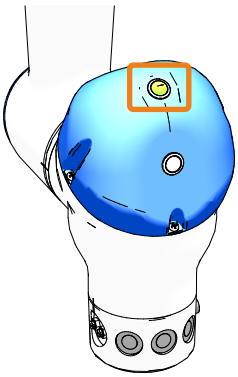


This concludes the procedure.

5.1.2 Cartesian Jogging

The operation to move in parallel to the X-axis, Y-axis, and Z-axis that are defined based on the manipulator. Use the following procedure.

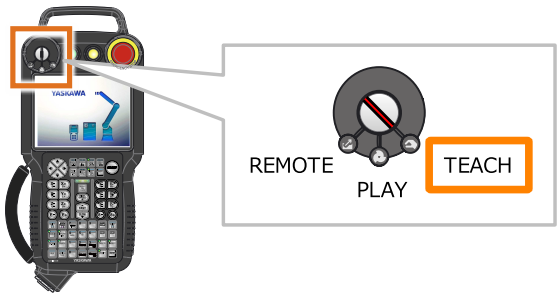
1. **Confirm that the collaborative operation LED is lit in green.**



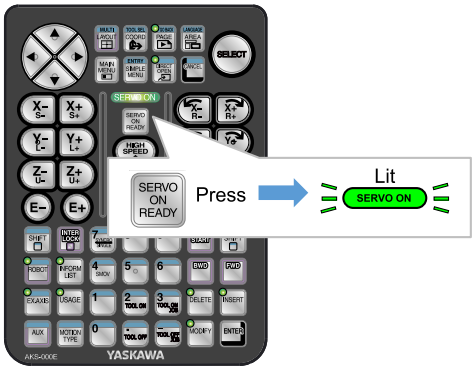
Information If the LED is not lit, the collaborative operation function is disabled. Refer to the following section and enable the collaborative operation function.

☞ *7.6 Enabling the Collaborative Operation Function on page 111*

2. **Set the mode key on the programming pendant to TEACH.**

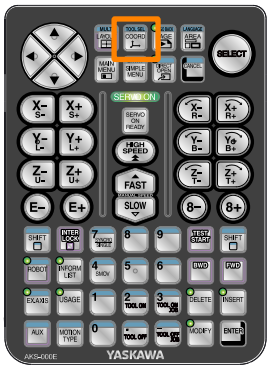


3. **Press [SERVO ON READY].**

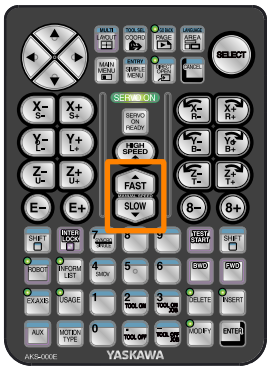


The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

4. **Press [TOOL SEL COORD] until the icon on the window changes to the Cartesian coordinates system icon.**



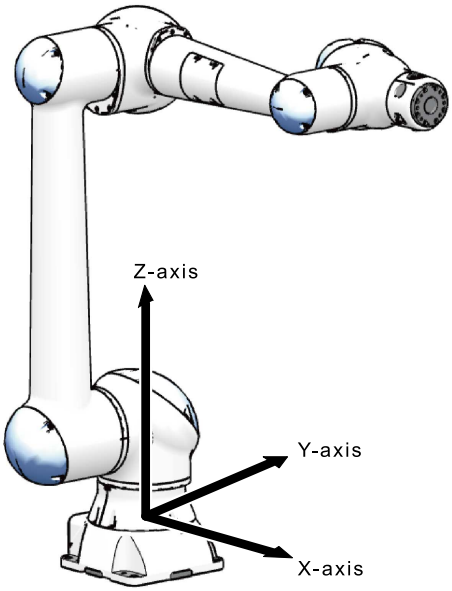
5. **Press MANUAL SPEED [FAST] or [SLOW] to change the speed at which the manipulator moves as required.**



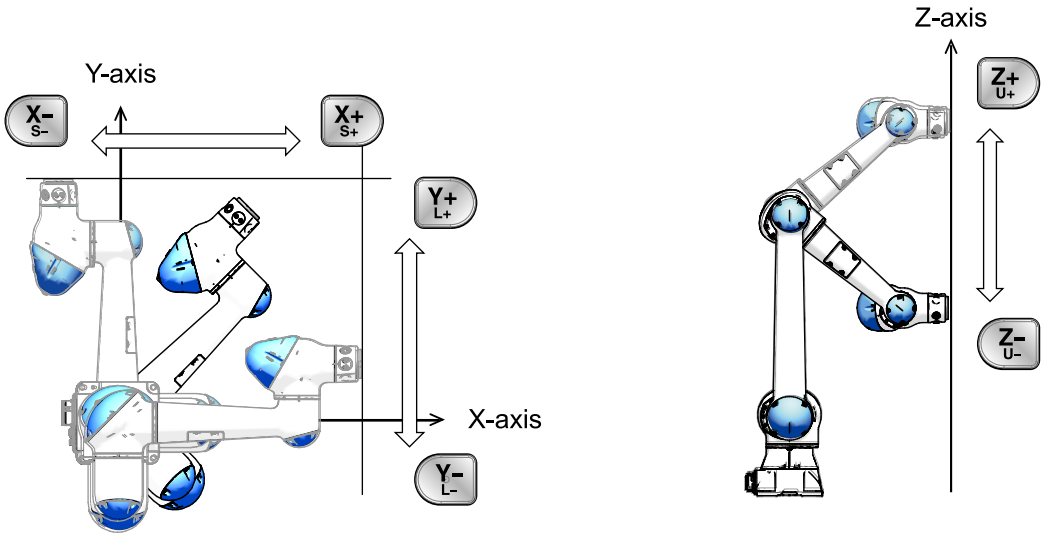
Information Selecting medium speed at first is recommended to make it easier to check the movement of the manipulator.

6. **Press the axis keys on the programming pendant, and confirm the manipulator moves in the direction that corresponds to the pressed key.**

- X-Axis, Y-Axis, and Z-Axis Directions That Are Defined Based on the Manipulator



- Relationship between Programming Pendant Axis Keys and Manipulator Movement



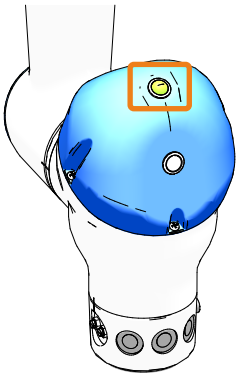
Information The illustration on the left is the view from directly above the manipulator.

This concludes the procedure.

5.1.3 Direct Teach

Direct teach is the operation to manually move the manipulator to the desired position and store that position. Use the following procedure.

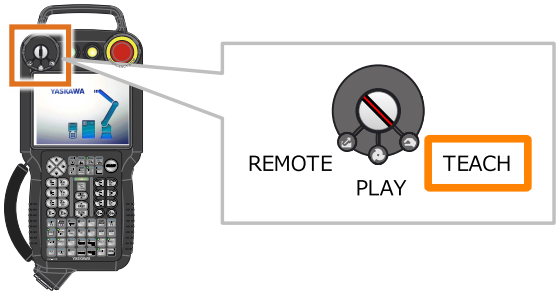
1. **Confirm that the collaborative operation LED is lit in green.**



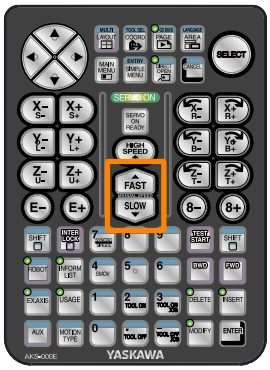
Information If the LED is not lit, the collaborative operation function is disabled. Refer to the following section and enable the collaborative operation function.

☞ *7.6 Enabling the Collaborative Operation Function on page 111*

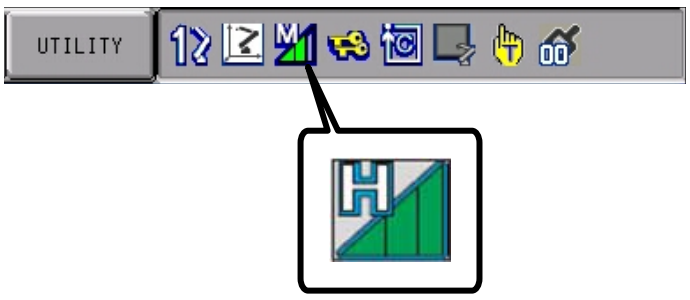
2. **Set the mode key on the programming pendant to TEACH.**



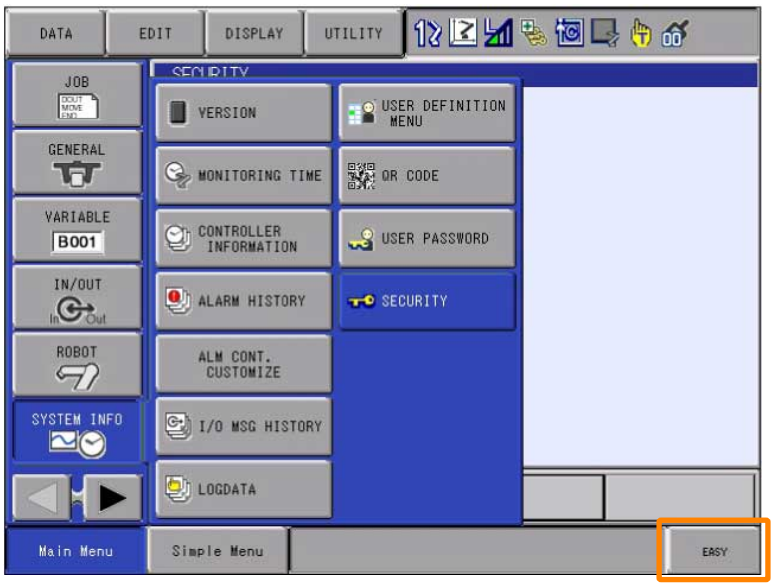
3. **Press MANUAL SPEED [FAST] or [SLOW] to change the speed at which the manipulator moves as required.**



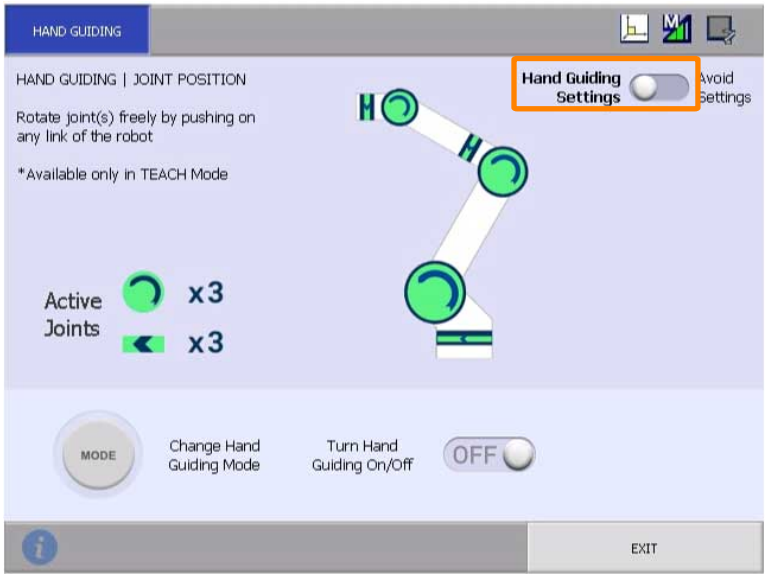
Information Selecting high speed is recommended to make it easier to move the manipulator.



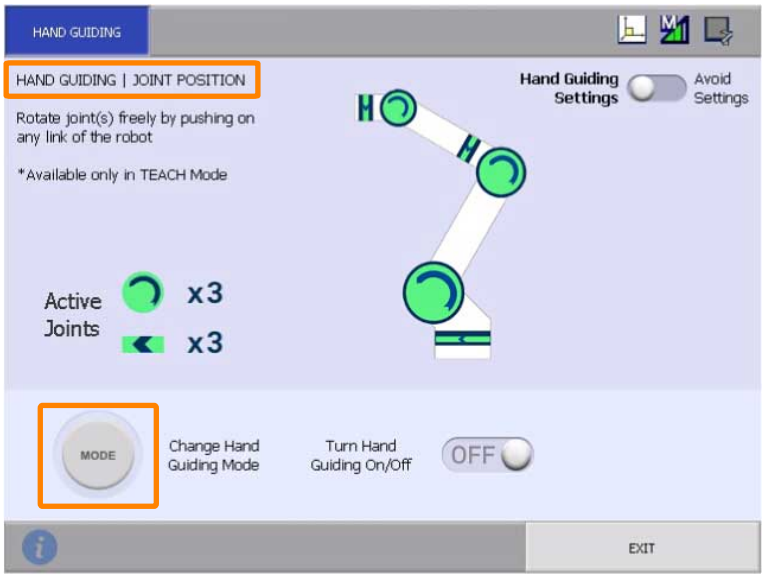
4. **Select {EASY}.**



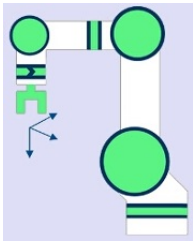
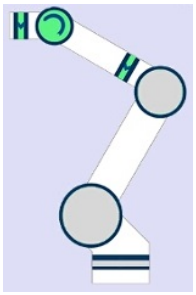
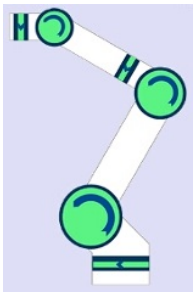
5. **Move the switch to {Hand Guiding Settings}.**



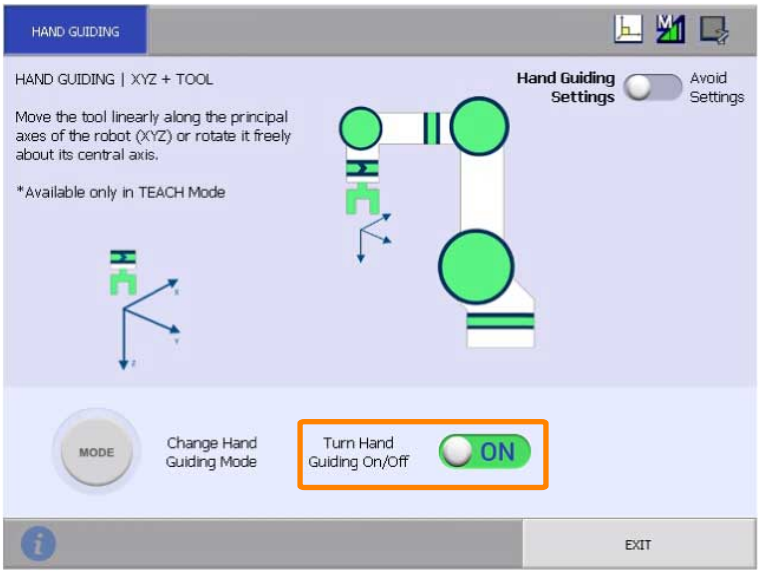
6. **Press {MODE} until the manipulator operation mode changes to the mode to select.**



Details on the operation modes are shown below. The axes that can be moved are displayed in green. The displayed changes each time {MODE} is pressed.

Operation Mode	Description	Icon
XYZ + Tool	The TCP moves while the manipulator is fixed in the tool posture. The tool rotates according to the external force torque applied to the T-axis.	
RBT	Only the R-axis, B-axis, and T-axis move.	
JOINT	Each axis moves.	

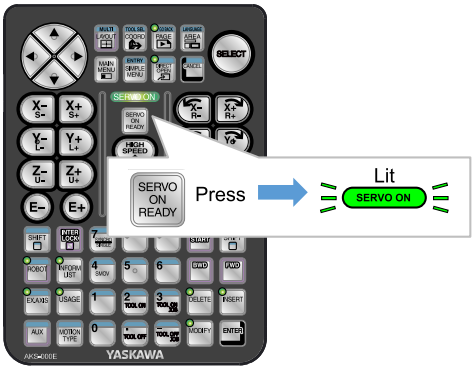
7. **Move the {Turn Hand Guiding On/Off} switch to {ON}.**



Direct teach mode will be enabled.

Information The maximum speed at which the robot can be moved during direct teach is limited to the manual speed during teach mode that is currently set.

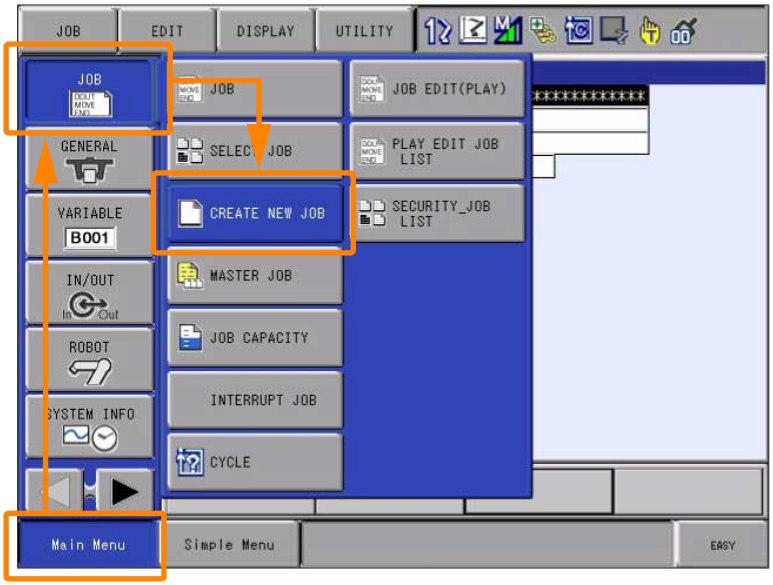
8. **Press [SERVO ON READY] on the programming pendant.**



The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

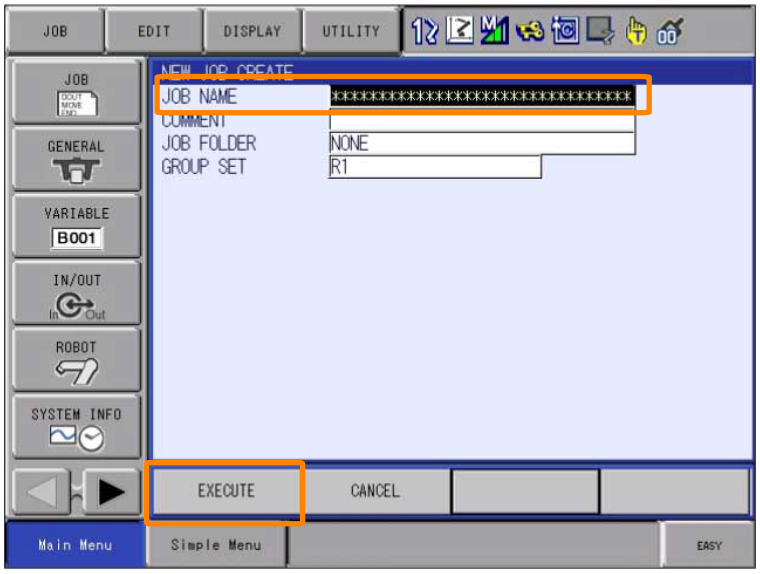
Information When using direct teach, the servo ON state will be maintained even if the enable switch on the back of the programming pendant is not squeezed.

9. **Select {Main Menu} - {JOB} - {CREATE NEW JOB}.**



The NEW JOB CREATE window will be displayed.

10. **Enter the job name and select {EXECUTE}.**



11. **Confirm that the manipulator can be manually moved while the [MOVE] button on the manipulator is pressed.**

12. **While the [MOVE] button on the manipulator is pressed, manually move the arm of the manipulator to the location to be taught.**

Information

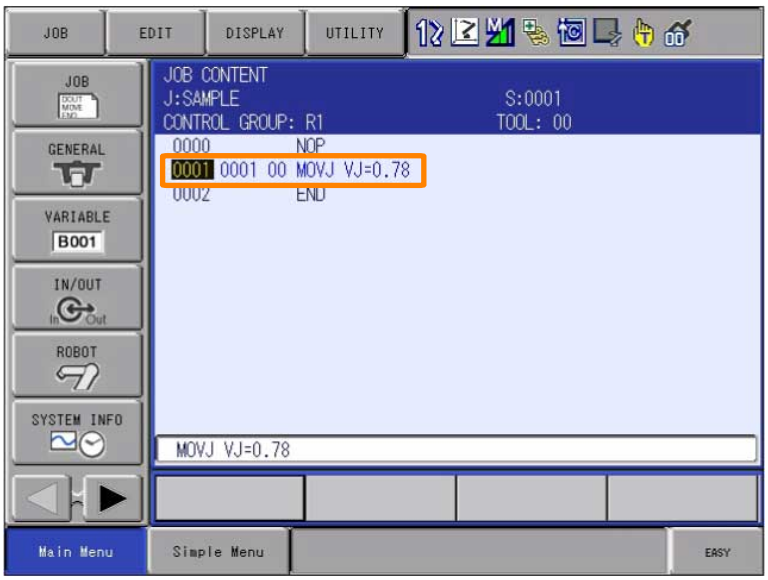
If the arm speed feels fast, tap (double-click) the [MOVE] button twice, and then move the arm when all three buttons are flashing. The arm will move slowly, and it will be easier to make fine adjustments because the feeling of arm coasting will be reduced.

13. **Release the [MOVE] button on the manipulator.**

14. **Press the [TEACH] button on the manipulator.**

The position of the manipulator will be saved when the [TEACH] button is pressed.

The saved content will be displayed on the programming pendant. The step number will be automatically added.



15. **Return to step 8 and repeat the steps until the series of manipulator movements is completed.**

This concludes the procedure.

6

Mounting and Wiring the Hand

6.1 Required Items 76

6.2 Mounting the Hand 77

6.3 Connecting the Air Hoses 81

6.4 Connecting the I/O Cables 82

6.1 Required Items

This manual describes the required preparations and installation work for the manipulator based on the following hand.

- Air gripper for collaborative robots manufactured by SMC (type: JMHZ2-16D-X7400B-DTP-N)

Table 6.1 Hands and Hand Accessories

Name	Quantity	Remarks
Hand (air gripper)	1	–
Protective cover (valve side)	1	–
Protective cover (switch side)	1	–
Hexagon socket head cap screw M4 (length: 10 mm)	4	For attaching protective covers
Parallel pin (diameter: 6 mm, length: 10 mm)	1	For positioning the hand
Hexagon socket head cap screw M6 (length: 23 mm)	4	For mounting the hand
Polyurethane tube	1	Outside diameter: ϕ4, length: 2 m
Accessory cable	1	For connecting the hand to the manipulator
One-touch fitting (KQ2L04-M5A1)	2	–
One-touch fitting (KQ2L06-08A)	1	–
One-touch fitting (KQ2H04-06A)	1	–

Table 6.2 Tools for Connecting the Air Hoses

Name	Quantity	Remarks
Union (for air inlet)	2	Air inlet on manipulator: M5 tapped hole
Union (for air outlet)	2	Air outlet on manipulator: outside diameter ϕ8
Air hose	4	–
Air supply equipment	1	–

Table 6.3 Tools for Connecting the I/O Cable

Name	Quantity	Remarks
General-purpose I/O terminal block	1	–
General-purpose I/O cable	1	–
I/O cable	1	–

Table 6.4 Tools

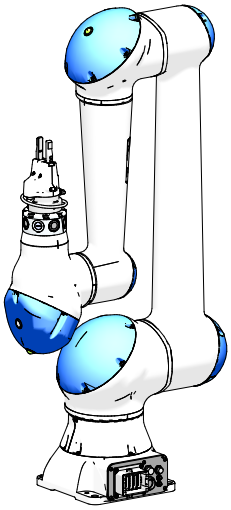
Name	Quantity	Remarks
Hex key (M4)	1	–
Hex key (M6)	1	–
Flat head screwdriver	1	For adjusting the fingers exhaust throttle valves

6.2 Mounting the Hand

1. **Jog the robot arm to a position that makes it easier to mount the hand.**

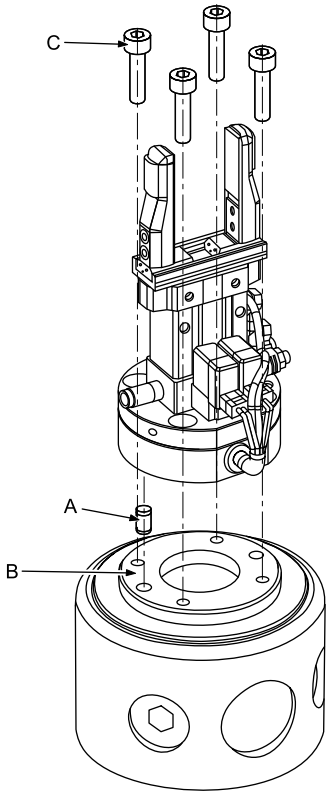
   Refer to the following section for details on jogging.

   ☞ *5.1.1 Jogging Each Axis (Joint Coordinate System) on page 64*



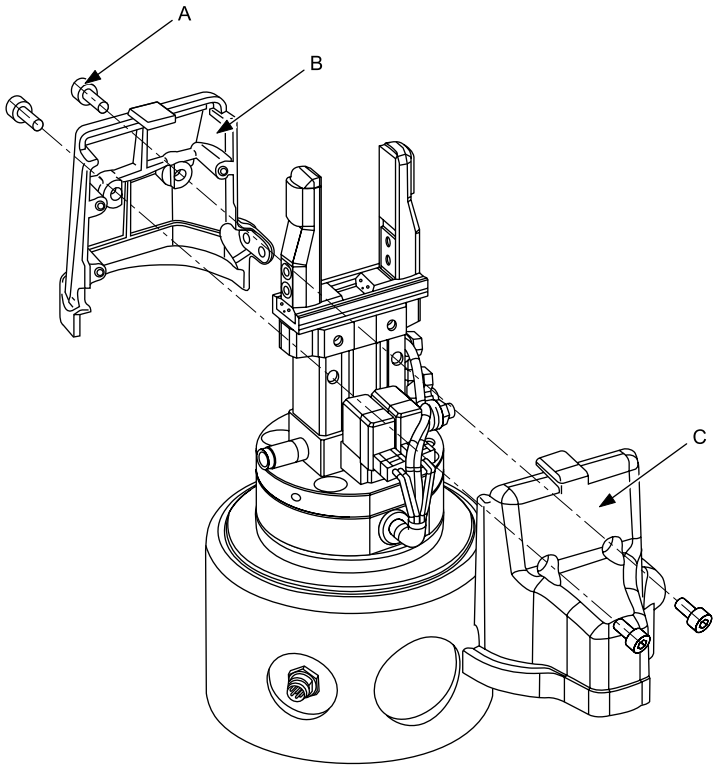
2. **Turn OFF the power supply to the robot controller and peripheral devices.**
3. **Confirm that the collaborative operation LED on the manipulator are not lit.**
4. **Insert the parallel pin into the flange surface of the T-axis of the manipulator.**

   Mount the hand aligned with the parallel pin to the manipulator and fix with the hexagon socket head cap screws M6 (length: 23 mm). Tightening torque: 5.2 N·m (0.53 kgf·m)



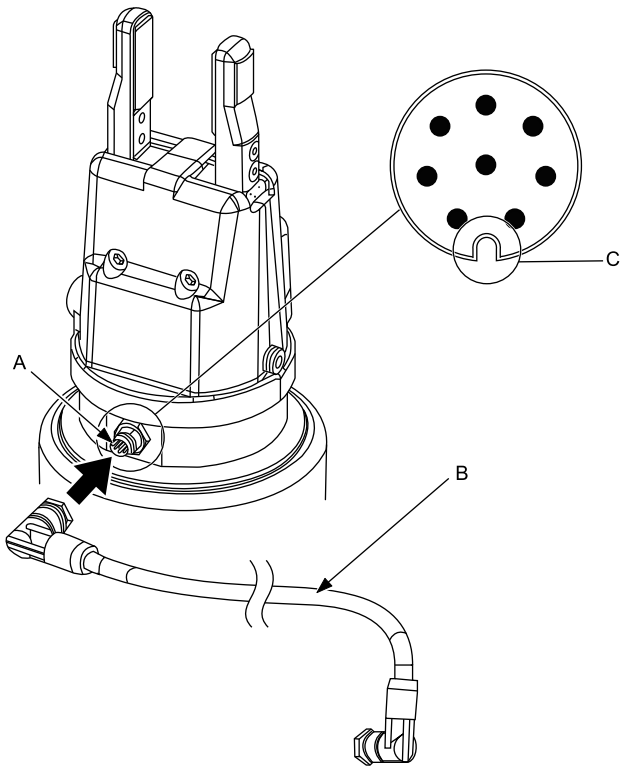
A	Parallel pin	C	Hexagon socket head cap screw M6 (length: 23 mm)
B	Flange surface of the T-axis of the manipulator	–	–

5. **Attach the protective covers to the hand and fix with the hexagon socket head cap screws M4 (length: 10 mm). Tightening torque: 1.0 N·m (0.10 kgf·m)**



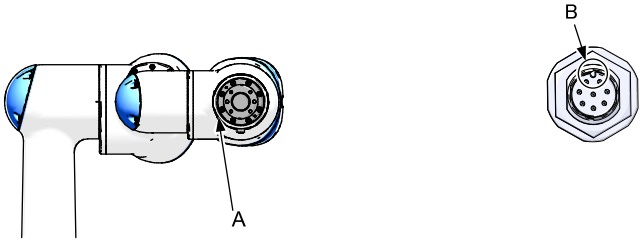
A	Hexagon socket head cap screw M4 (length: 10 mm)	C	Protective cover (valve side)
B	Protective cover (switch side)	–	–

6. **Connect the cable to the hand. Connect the cable connectors by first checking that the positioning key is aligned for both the hand-side and cable-side connectors.**



A	Connector for cable connection	C	Positioning key on hand-side connector
B	Accessory cable	–	–

7. **Connect the cable to the manipulator. Connect the cable to the I/O cable connector (S) on the manipulator. Connect the cable connectors by first checking that the positioning key is aligned for both the manipulator-side and cable-side connectors.**



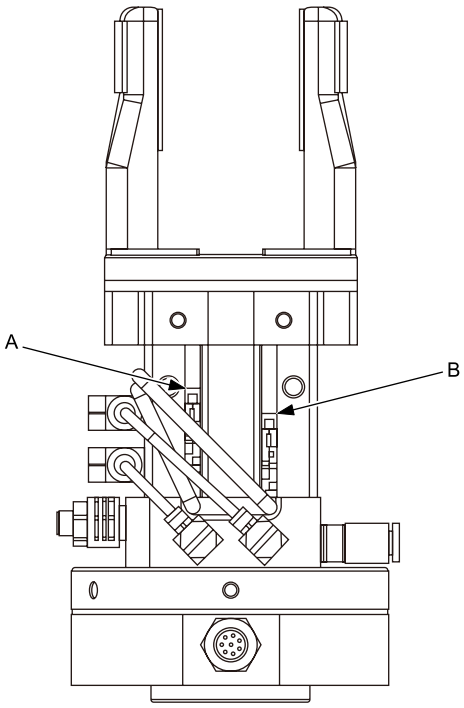
A	I/O cable connector (S)	B	Positioning key

8. **Connect the unions (included with the hand) to the air outlets on the T-axis flange of the manipulator, and connect the air hoses.**

Information

This note describes the adjustment method of the fingers opened/closed position.

The fingers section at the tip of the hand is set by default to respond at the opened limit and closed limit of the fingers. The fingers opened/closed position can be adjusted by changing the position of the auto switches. Fix the auto switches at the optimal positions for the shape of the workpiece.



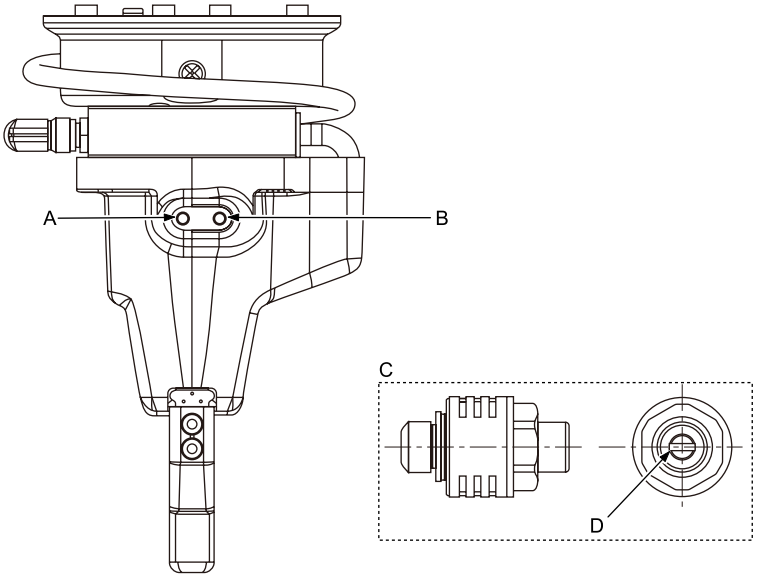
A	Fingers opened limit detection position	B	Fingers closed limit detection position

Information

This note describes the adjustment method of the fingers opening/closing speed.

Insert the flat head screwdriver into the throttle opening adjustment slot on the exhaust throttle valve and adjust the throttle opening.

Adjust the throttle openings of both exhaust throttle valves to be the same amount. Operation may be unstable if the difference between the throttle openings is too great.

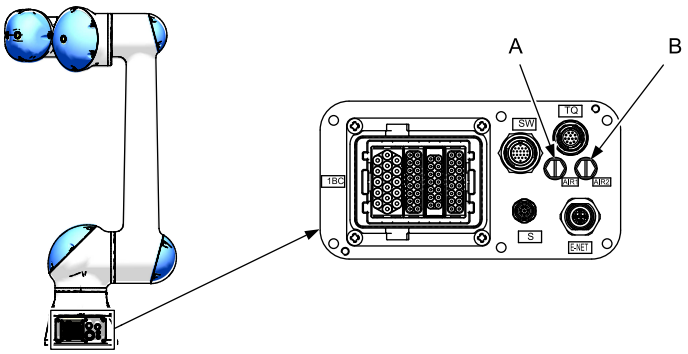


A	Exhaust throttle valve (for adjusting the opening speed of the fingers)	C	Enlarged view of the exhaust throttle valve
B	Exhaust throttle valve (for adjusting the closing speed of the fingers)	D	Throttle opening adjustment slot (use a flat head screwdriver)

6.3 Connecting the Air Hoses

The customer must prepare the air supply source, unions, and air hoses for driving the air gripper.

1. **Remove the plugs in the AIR1 and AIR2 inlets on the S-base part of the manipulator, and then connect the unions.**



A	AIR1 inlet	B	AIR2 inlet

2. **Connect the air hoses to the unions.**
3. **Connect the air hoses to the air supply equipment.**

6.4 Connecting the I/O Cables

To perform the hand open/close fingers operation, the manipulator and robot controller must be connected through the general-purpose I/O terminal block. Use the following connection example as a reference.

Note:

The connection example in this manual assumes the robot controller I/O is the NPN type (standard specification).

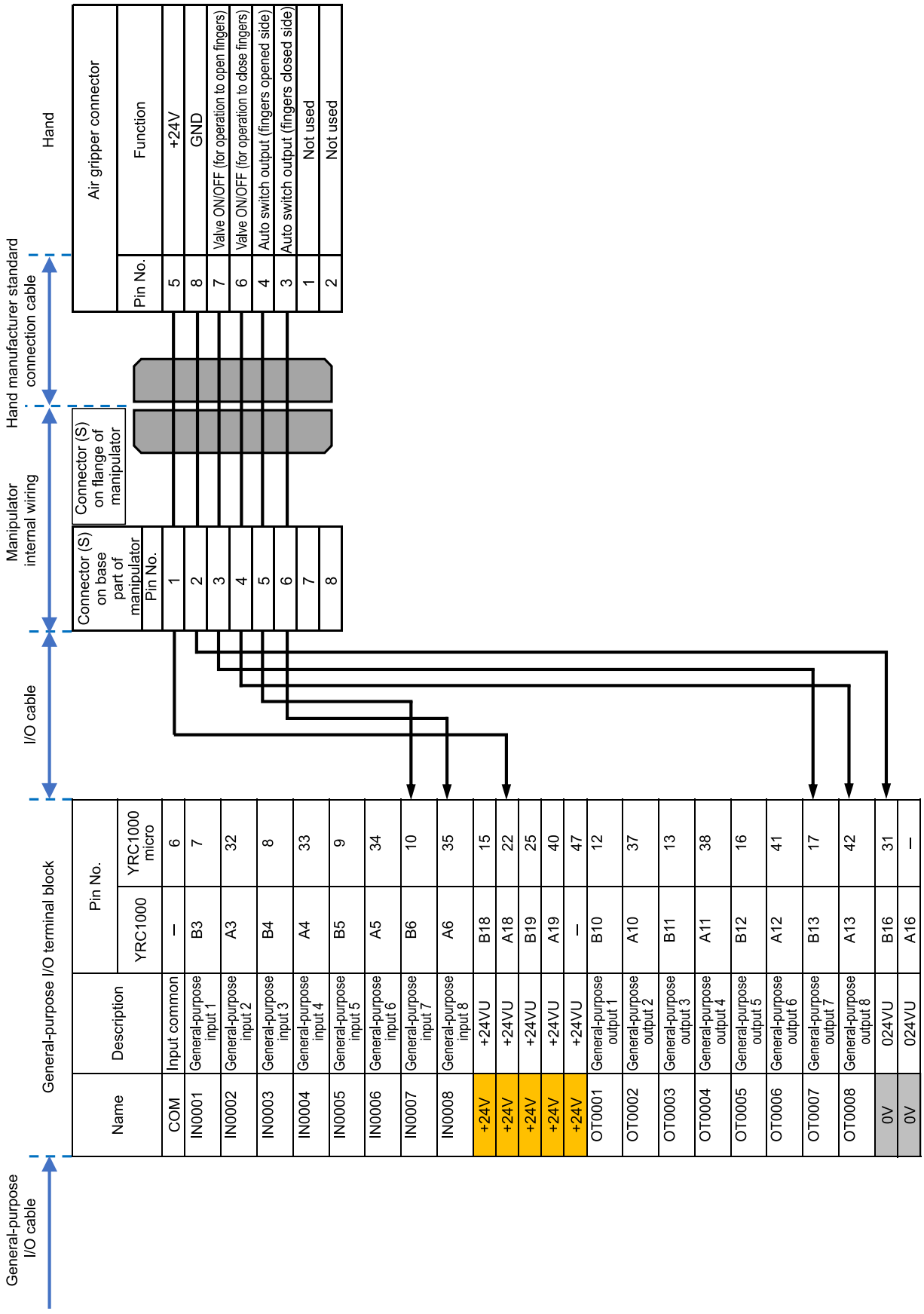
Important

The customer must prepare the following connections:

- Connecting the I/O cable to the general-purpose I/O terminal block
- Connecting the general-purpose I/O terminal block to the connector for the I/O cable on the S-base part of the manipulator

Information

Refer to the manual that is included with the end effector for the open/close fingers operation using simulated output for I/O from the pendant.


Hand
Hand manufacturer standard connection cable
Manipulator internal wiring
I/O cable
General-purpose I/O cable
Air gripper connector
Pin No.
Function
5 +24V
8 GND
7 Valve ON/OFF (for operation to open fingers)
6 Valve ON/OFF (for operation to close fingers)
4 Auto switch output (fingers opened side)
3 Auto switch output (fingers closed side)
1 Not used
2 Not used
Connector (S) on flange of manipulator
Connector (S) on base part of manipulator
Pin No.
1
2
3
4
5
6
7
8
General-purpose I/O terminal block
Name
Description
Pin No.
YRC1000
YRC1000 micro
COM Input common — 6
IN0001 General-purpose input 1 B3 7
IN0002 General-purpose input 2 A3 32
IN0003 General-purpose input 3 B4 8
IN0004 General-purpose input 4 A4 33
IN0005 General-purpose input 5 B5 9
IN0006 General-purpose input 6 A5 34
IN0007 General-purpose input 7 B6 10
IN0008 General-purpose input 8 A6 35
+24V +24VU B18 15
+24V +24VU A18 22
+24V +24VU B19 25
+24V +24VU A19 40
+24V +24VU — 47
OT0001 General-purpose output 1 B10 12
OT0002 General-purpose output 2 A10 37
OT0003 General-purpose output 3 B11 13
OT0004 General-purpose output 4 A11 38
OT0005 General-purpose output 5 B12 16
OT0006 General-purpose output 6 A12 41
OT0007 General-purpose output 7 B13 17
OT0008 General-purpose output 8 A13 42
0V 024VU B16 31
0V 024VU A16 —

7

Settings

This chapter describes the configuration procedures for the settings of the collaborative robot.

7.1 Temporarily Disabling the Collaborative Operation Function 86

7.2 Configuring a Tool File 89

7.3 Checking the Home Positions of the Torque Sensors and Setting the Home Positions Again 98

7.3.1 Checking the Home Positions of the Torque Sensors 98

7.3.2 Setting the Home Positions of the Torque Sensors Again 99

7.4 Setting External Force Limits 102

7.5 Configuring the Speed Limit Function 106

7.6 Enabling the Collaborative Operation Function 111

7.1 Temporarily Disabling the Collaborative Operation Function

The collaborative operation function must be disabled to temporarily disable external force monitoring and speed limits by collaborative operation.

⚠ WARNING

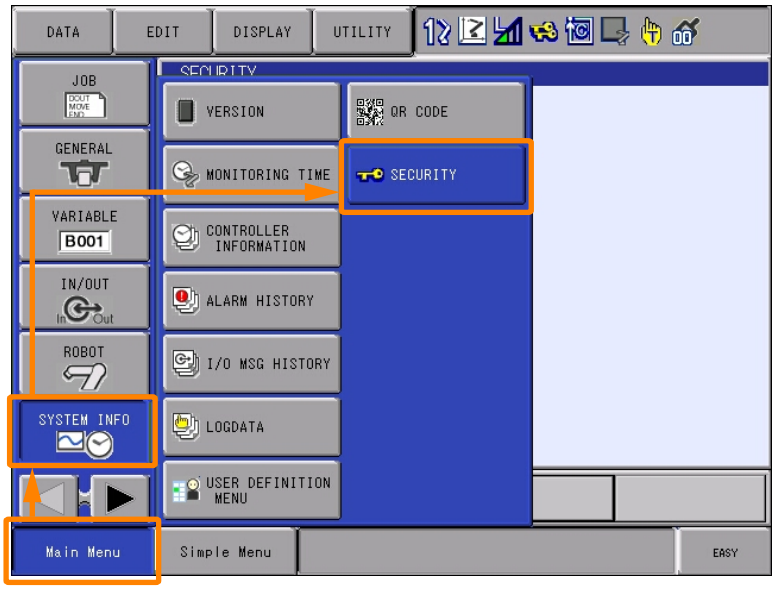
There is a risk of injury to the operator when the PFL function is disabled. Perform this operation only after a thorough risk assessment has been conducted.

When collaborative operation is disabled, the stop function when contact is made by PFL function and the escape from clamping function are also disabled. Always enable the collaborative operation function after the following settings are changed.

- **Tool settings**
- **Torque sensor home position**
- **Speed limit**
- **External force limits**

Use the following procedure to disable the collaborative operation function.

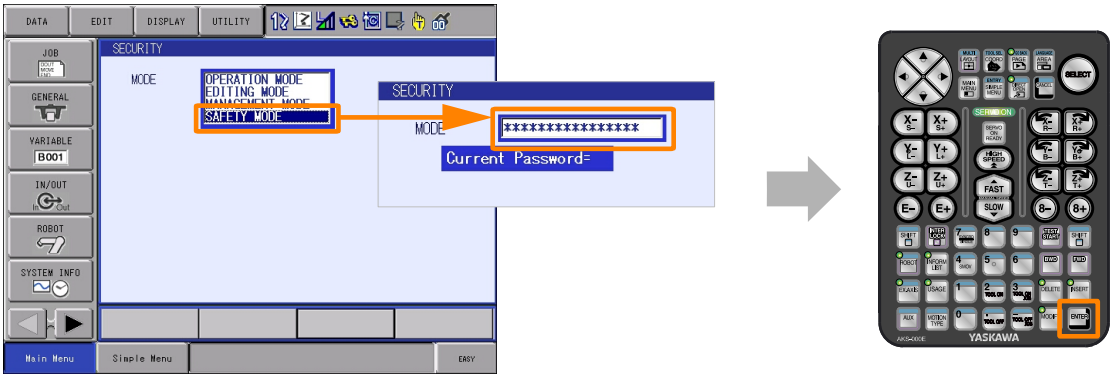
1. **Select {Main Menu} - {SYSTEM INFO} - {SECURITY} on the programming pendant.**



The SECURITY window will be displayed.

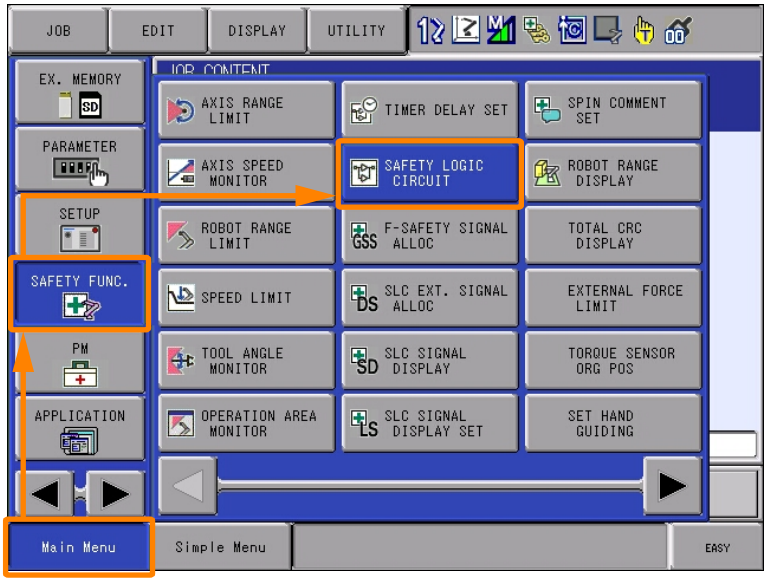
2. **Select {SAFETY MODE} for the mode, enter the password, and select [ENTER].**

The default password is "5555555555555555" (enter "5" 16 times).



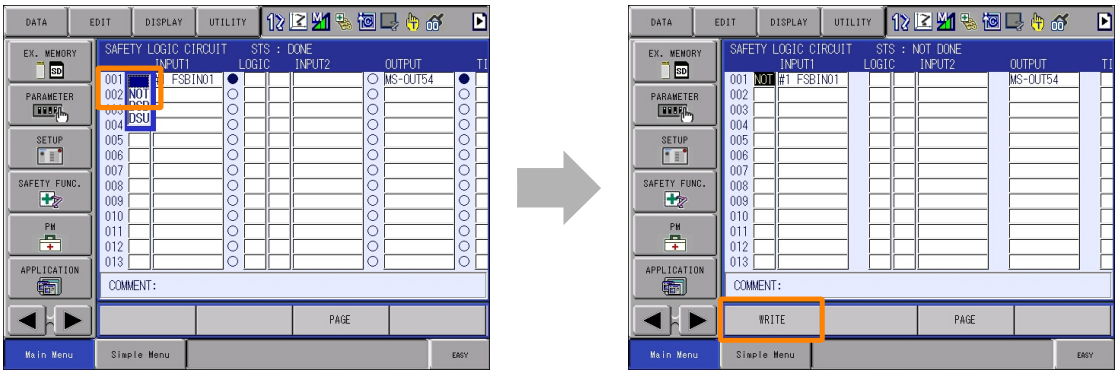
The security mode will be set to safety mode.

3. **Select {Main Menu} - {SAFETY FUNC.} - {SAFETY LOGIC CIRCUIT}.**

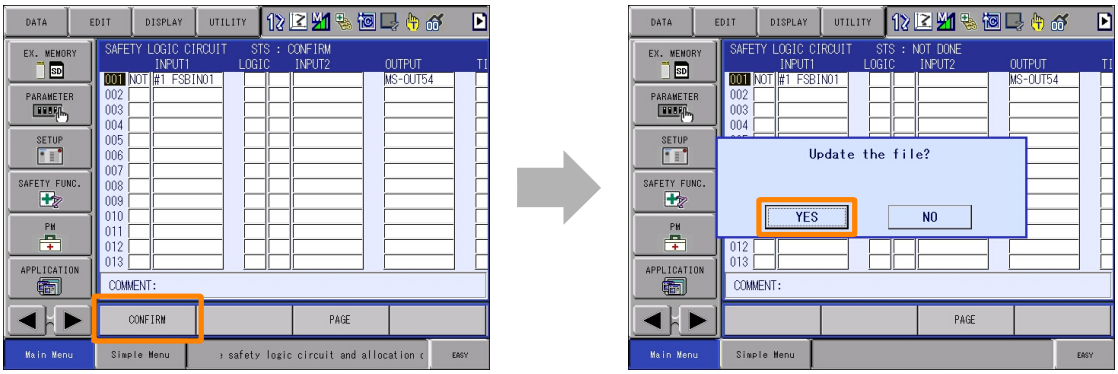


The SAFETY LOGIC CIRCUIT window will be displayed.

4. **To the left of line 1 "FSBIN01", select the blank, change this item to "NOT", and then select {WRITE}.**

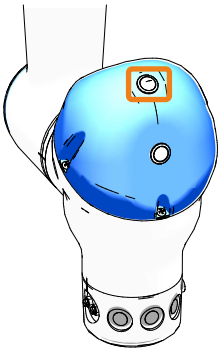


5. **Confirm that there are no mistakes in the safety logic circuit, and then select {CONFIRM} and {YES}.**

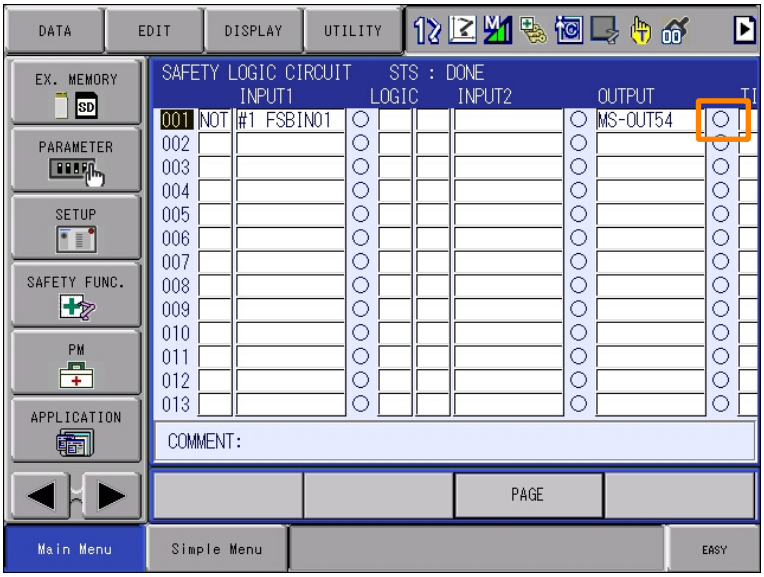


6. **Confirm that the collaborative operation LED on the manipulator is not lit.**

Information If alarm 6003 "UNDEFINED SPEED LIMIT(PFL)" is displayed, press {RESET} to reset the alarm.



7. **Confirm that the right side of {MS-OUT54} in the {OUTPUT} column is "○".**



The following table gives the details of the MS-OUT54 output signal.

Signal Name	Description
MS-OUT54	Enables and disables collaborative operation • ○ = OFF: Collaborative operation disabled • ● = ON: Collaborative operation enabled

This concludes the procedure.

7.2 Configuring a Tool File

In collaborative operation mode, the external force is calculated by canceling the tool mass. For this reason, the tool installed on the manipulator and the mass and position of the center of gravity of the workpiece to transport must be configured in advance. The configured content is managed by selection number.

The tool selection number must also be changed at each step of the manipulator program in accordance with changes in the status of the hand.

Example: When Grasping and Lifting a Workpiece on a Table with the Hand

- When the workpiece is not grasped, the tool mass is the mass of the hand only.
- When the workpiece is grasped and lifted, the tool mass is the mass of the hand and workpiece.

This section describes the configuration procedure that uses the automatic measurement for the tool load and the center of gravity, which can be used to easily configure a tool file.

Important

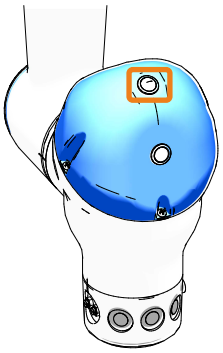
Automatic measurement for the tool load and the center of gravity can be used only when the manipulator is installed at an installation angle in relation to the ground of 0°.

Use the following procedure to configure a tool file.

1. **Confirm that the workpiece is at hand.**

   Information Prepare the workpiece in advance because it will be used in the rest of this procedure.

2. **Confirm that the collaborative operation LED is not lit.**

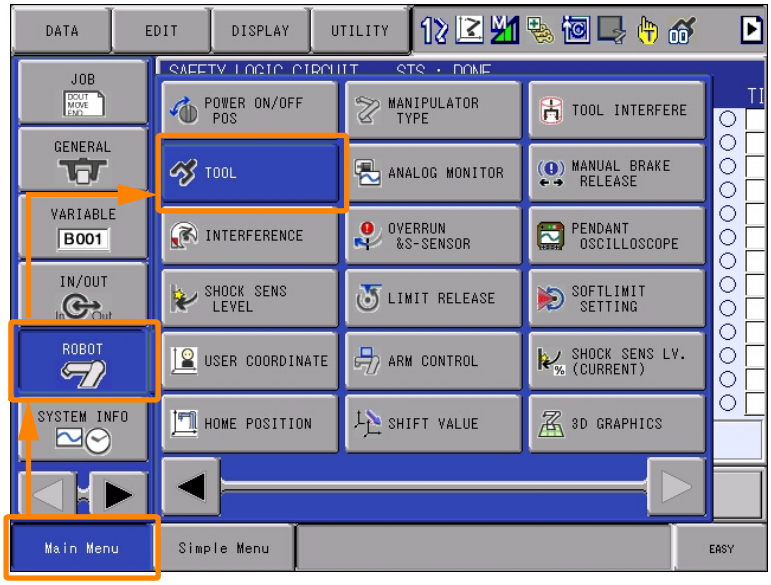


If the collaborative operation LED is lit, the collaborative operation function is enabled. Refer to the following section for the operating procedure to disable the function.

☞ *7.1 Temporarily Disabling the Collaborative Operation Function on page 86*

Information Always disable the collaborative operation function before continuing with the rest of this procedure. The subsequent operations may not correctly function if the collaborative operation function is enabled.

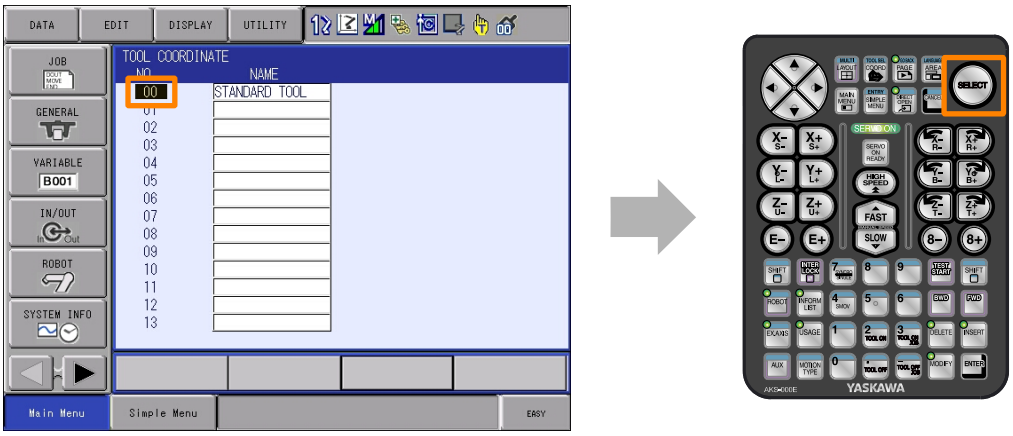
3. **Select {Main Menu} - {ROBOT} - {TOOL} on the programming pendant.**



The TOOL COORDINATE window will be displayed.

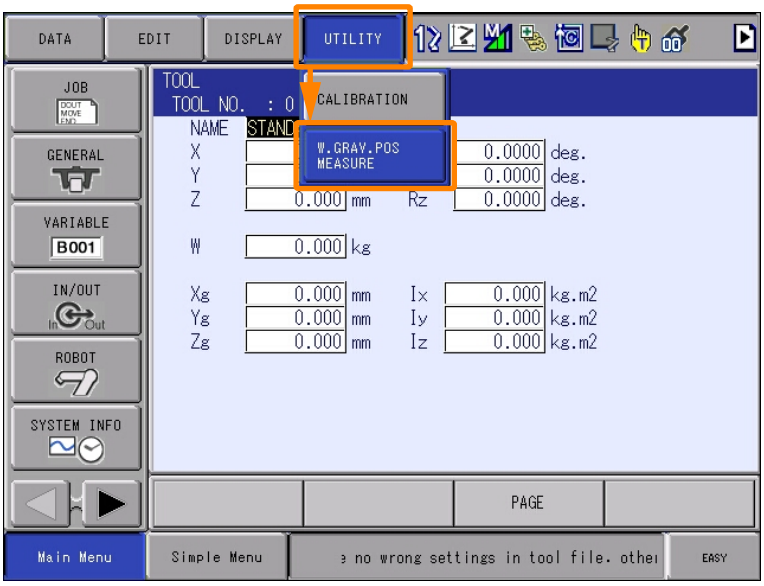
4. **Move the cursor to {00} under the {TOOL COORDINATE NO.} column, and press [SELECT].**

Information Data can be set in a maximum of 64 tool files. Information can be freely set in any tool file. Tool coordinates number 00 is selected here to make the procedure easier to understand.



The TOOL COORDINATE window for tool coordinates number 00 will be displayed.

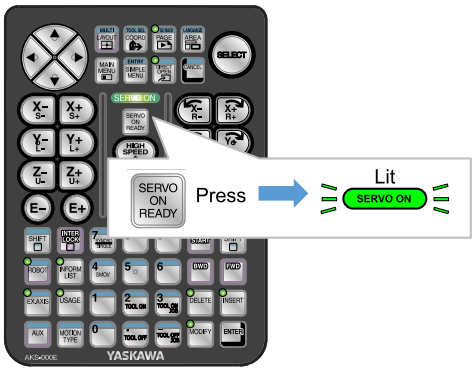
5. **Select {UTILITY} - {W.GRAV.POS MEASURE}.**



The W.GRAV.POS MEASURE window will be displayed.

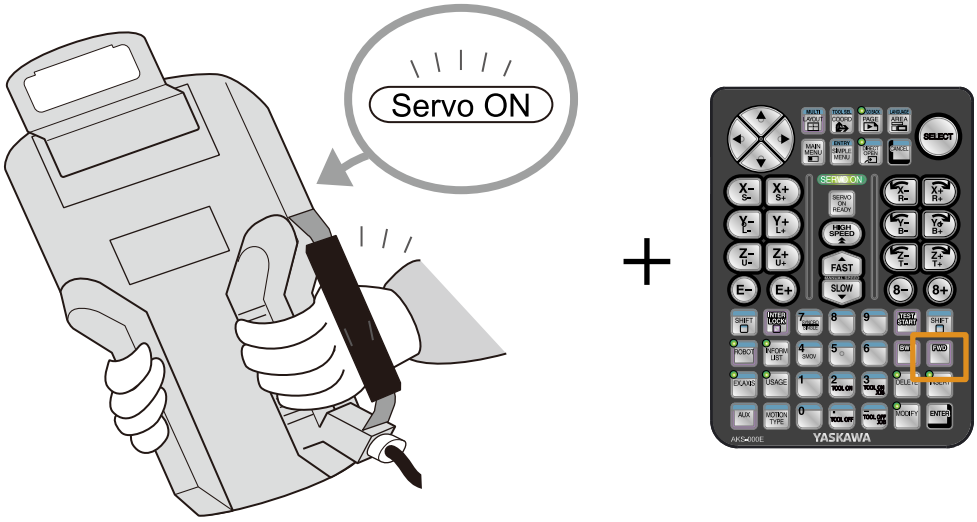
6. **Press [SERVO ON READY] on the programming pendant, and confirm that the [SERVO ON] lamp flashes green.**

Information When the collaborative operation function is enabled, the [SERVO ON] lamp is lit when [SERVO ON READY] is pressed. The [SERVO ON] lamp flashes here because the collaborative operation function is temporarily disabled for the configuration procedure.



7. **While squeezing the enable switch on the back of the programming pendant with the left hand (the [SERVO ON] lamp is lit on the programming pendant), press and hold [FWD] until the manipulator stops.**

Information The enable switch will turn OFF the servo if squeezed too firmly (when the [SERVO ON] lamp is not lit).



While [FWD] is pressed and held, the manipulator will move to the reference position to start measurements.

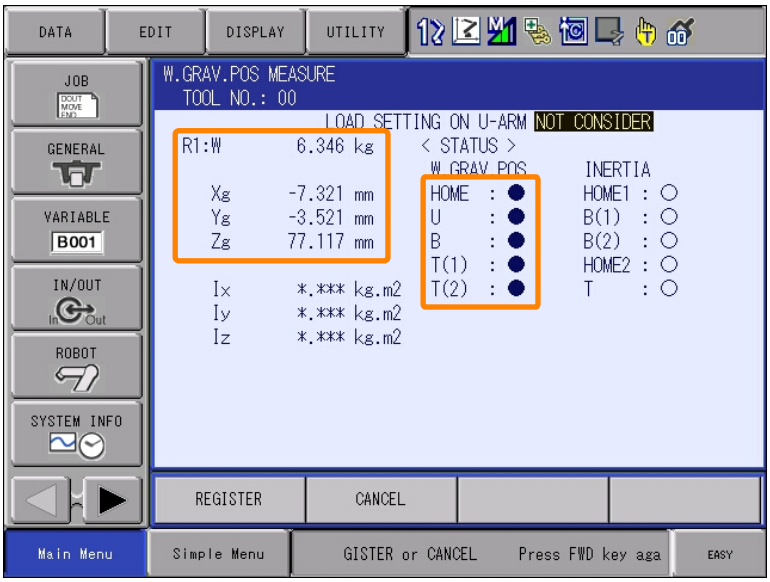
The manipulator will automatically stop at the reference position to start measurements, and it will no longer move even if [FWD] is pressed.

8. **When the manipulator stops moving, press and hold [FWD] again while squeezing the enable switch with the left hand.**

The manipulator will move and the mass and position of the center of gravity measurements will start. Press and hold [FWD] until the measurements are completed. It will take approximately three minutes until the automatic measurements for all axes are completed.

Important The measurements will be canceled if [FWD] is released during the measurements (before the items change to "●"). Redo the procedure from step 5.

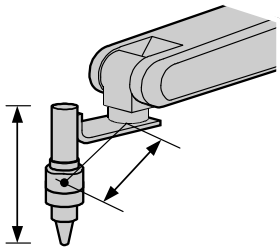
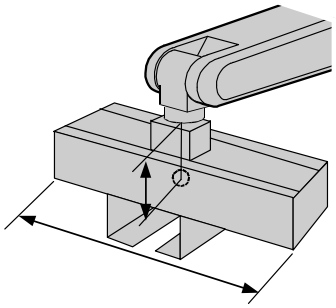
When the measurements are completed, the programming pendant will display "●" for all items. The measurement results will also be displayed.



Next, the inertia measurements will be taken. Proceed to the next step.

Important

If the moment of inertia around the position of the center of gravity is sufficiently small in regard to the moment of inertia found from the mass and position of the center of gravity, the measurements do not need to be taken. However, if the moment of inertia of the tool itself is large (as a general rule, the external dimensions of the tool are double the distance from the flange to the position of the center of gravity or larger), take the measurements.

Example of When Measurements Are Unnecessary	Example of When Measurements Are Necessary
 Measuring the moment of inertia around the position of the center of gravity is not necessary because the external dimensions of the tool are not large.	 Measuring the moment of inertia around the position of the center of gravity is necessary because the external dimensions of the tool are large.

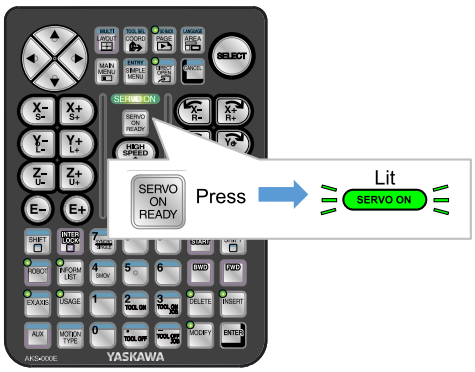
Term

Inertia :

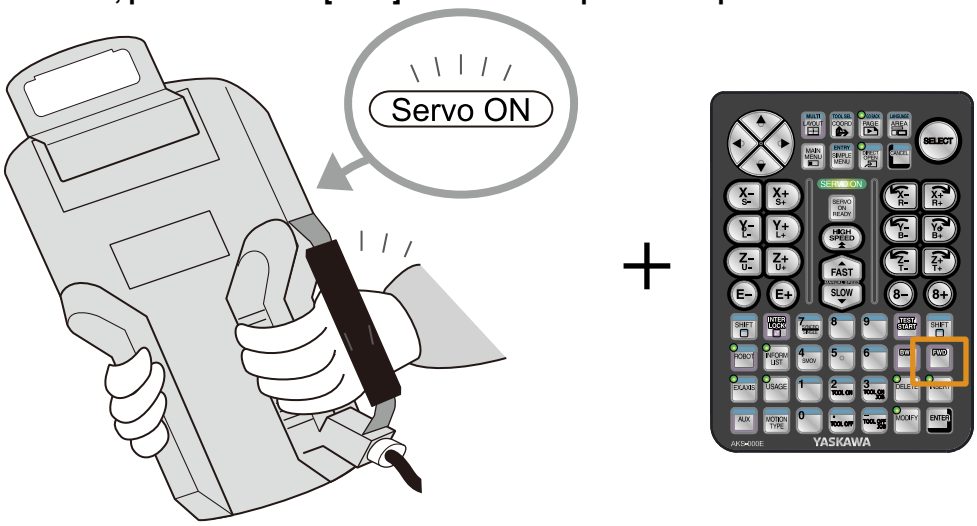
Also called moment of inertia. The moment of inertia is the amount of force required to rotate and stop an object.

For example, a heavy tool with large dimensions will have a large amount of inertia, so a large force will be required when the manipulator starts and stops moving the axis.

9. **Press [SERVO ON READY] on the programming pendant, and confirm that the [SERVO ON] lamp flashes green.**



10. **While squeezing the enable switch on the back of the programming pendant with the left hand, press and hold [FWD] until the manipulator stops.**



While [FWD] is pressed and held, the manipulator will move to reference position 1 to start measurements.

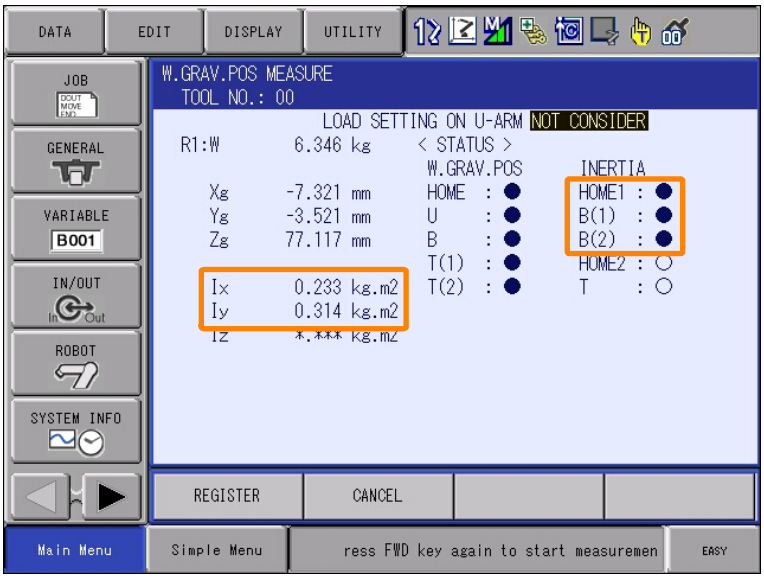
The manipulator will automatically stop at the reference position to start measurements, and it will no longer move even if [FWD] is pressed.

11. **When the manipulator stops moving, press and hold [FWD] again while squeezing the enable switch with the left hand.**

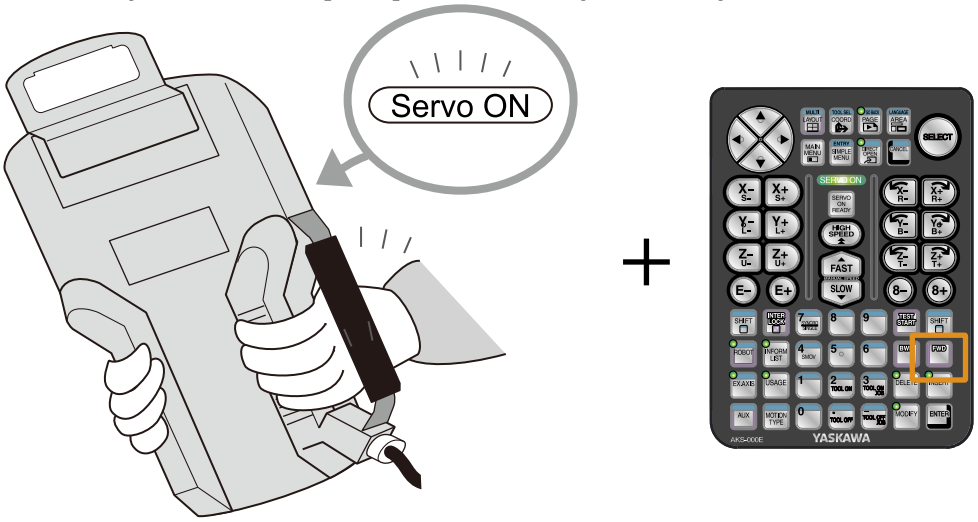
The manipulator will move and the measurements of the inertia of B-axis 1 and B-axis 2 will start. Press and hold [FWD] until the measurements are completed.

> Important
> The measurements will be canceled if [FWD] is released during the measurements (before the items change to "●"). Redo the procedure from step 9.

When the measurements are completed, the programming pendant will display "●" for the items. The measurement results will also be displayed.



12. **While squeezing the enable switch on the back of the programming pendant with the left hand, press and hold [FWD] until the manipulator stops.**



While [FWD] is pressed and held, the manipulator will move to reference position 2 to start measurements.

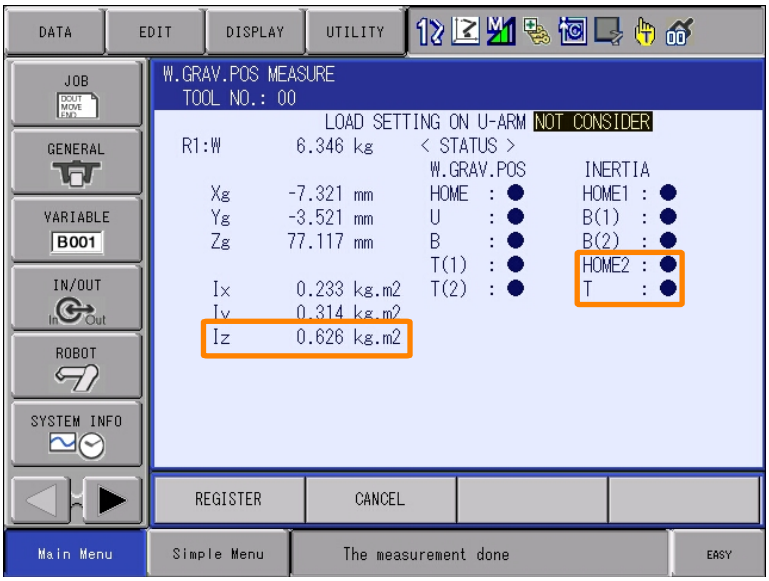
The manipulator will automatically stop at the reference position to start measurements, and it will no longer move even if [FWD] is pressed.

13. **When the manipulator stops moving, press and hold [FWD] again while squeezing the enable switch with the left hand.**

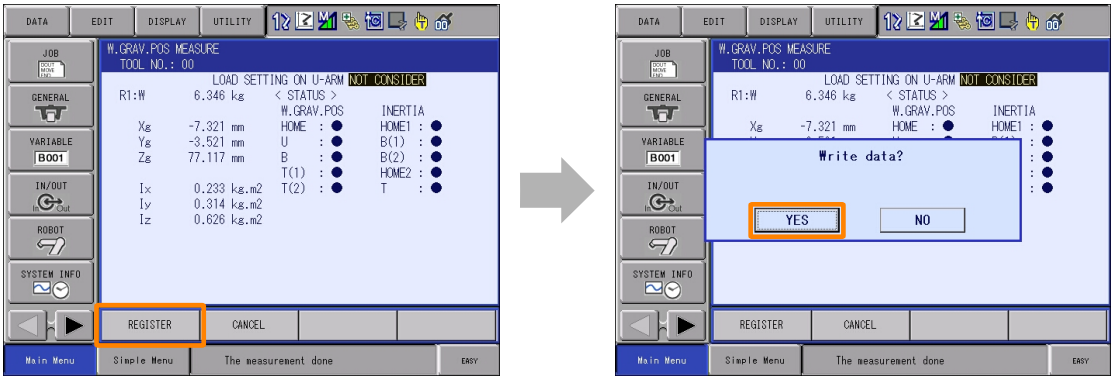
The manipulator will move and the measurements of the inertia of the T-axis will start. Press and hold [FWD] until the measurements are completed.

> Important
> The measurements will be canceled if [FWD] is released during the measurements (before the items change to "●"). Redo the procedure from step 12.

When the measurements are completed, the programming pendant will display "●" for the items. The measurement results will also be displayed.



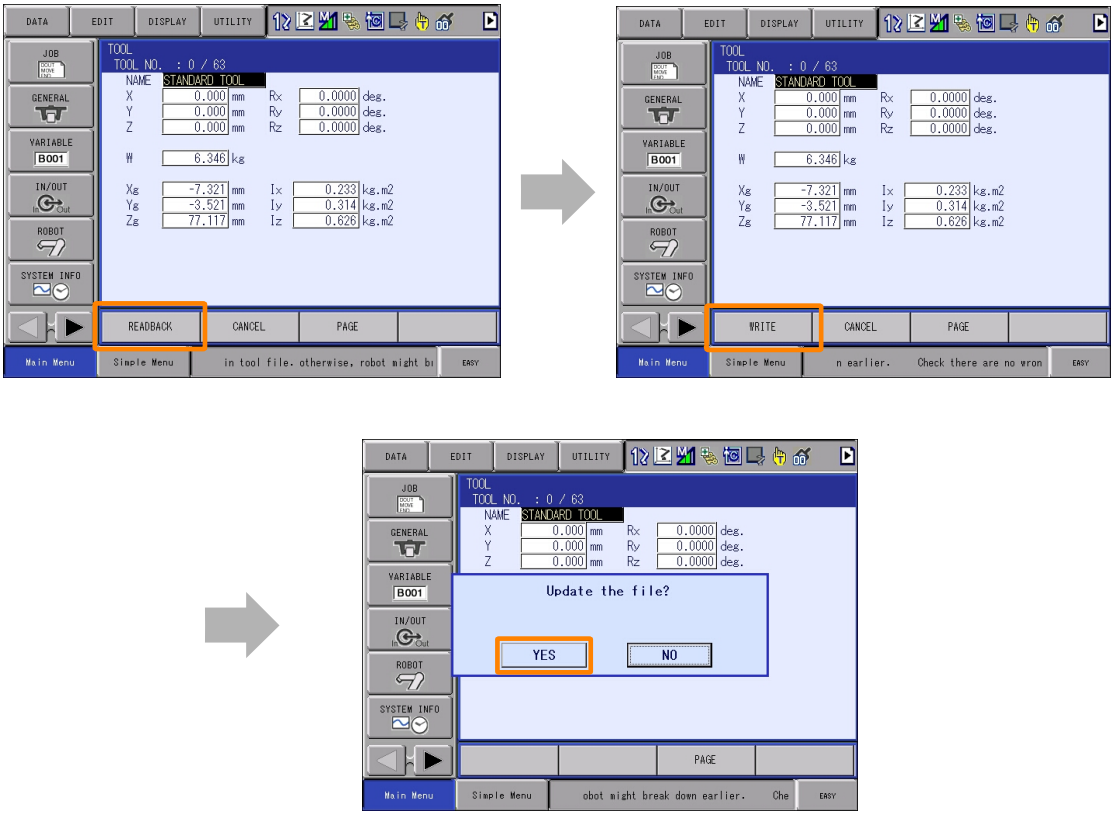
14. **Select {REGISTER}, and select {YES} on the confirmation window.**



The measurement results will be written to the robot controller.

Information Select {CANCEL} to display the TOOL window without registering the measurement data to the tool file.

15. **Select {READBACK} - {WRITE} - {YES} on the confirmation window.**



The measurement data will be registered in the tool file.

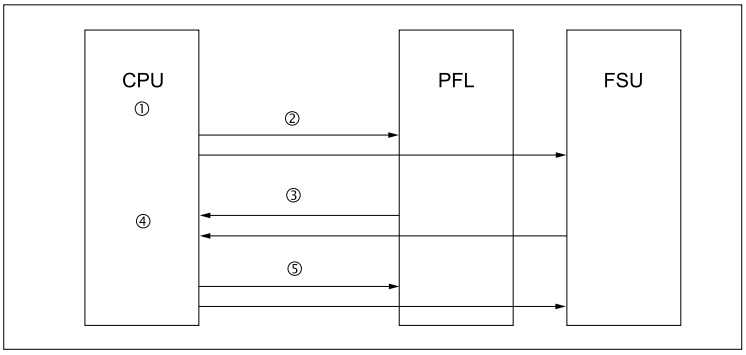
Term

Readback

Readback is the operation used to check if the data that was configured in the safety circuit board and PFL circuit board is correct.

Data related to safety functions is redundantly stored in the memory on the safety circuit board and PFL circuit board. The readback operation is required when data is changed on windows such as the safety function condition setting windows and tool windows.

Robot controller



PFL: PFL circuit board
FSU: Functional safety circuit board

①: A setting value is changed with the programming pendant.

②: The setting value is transferred to the PFL and FSU.

③: Answer data is sent from the PFL and FSU to the CPU (readback).

④: The CPU value and answer data value are compared.

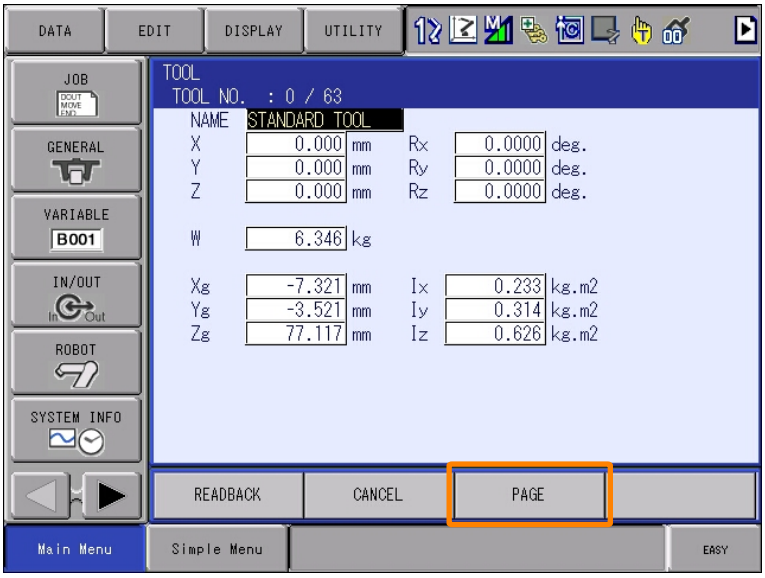
⑤: The setting value that was sent from the CPU is stored in the PFL and FSU.

This concludes only the procedure to register the information for the hand without a workpiece in tool coordinates number 00.

Next, register the information for the hand and workpiece when the workpiece is grasped and lifted in tool coordinates number 01.

Proceed to the next step.

16. **Select {PAGE}.**



The tool coordinates number of coordinates number 01 will be displayed.

17. **Set the hand to grasp the workpiece, and return to step 4 and repeat the configuration procedure in this state.**

Register the tool file with the hand grasping the workpiece in tool number 01.

The method to make the hand grasp the workpiece (method to open/close the hand) depends on the type of hand. Refer to the manual for the hand for the detailed operating procedure.

18. **When tool file configuration is completed, remove the workpiece from the hand.**

This concludes the procedure.

7.3 Checking the Home Positions of the Torque Sensors and Setting the Home Positions Again

The torque sensors built into the manipulator require regular inspections because deviations in the measured values will occur when the environment changes or the manipulator is mistakenly used, such as when the manipulator accidentally collides with something.

Information

Keeping a continuous record of the current torque values is recommended after the manipulator is installed. When the user changes the system (e.g., changes the tool), move the manipulator to the same posture each time, and record the current values on the monitor window. The user can compare this recorded data to the current values.

The following four conditions must be met when the allowable values and current values of torque are compared.

- The tool number matches the currently installed tool.
- The tool information is correct.
- When checking torque values, the values are recorded when the robot is set to the same posture (e.g., home position posture) each time.
- The current values on the monitor window do not exceed the values listed below.

If the values of the axes are larger than the torque values listed in the following table, adjust the torque sensors.

If values exceed the values in the following table, the external force estimation will be greatly affected. For this reason, adjusting the torque sensor for the relevant axis is highly recommended.

Axis	S	L	U	R	B	T
Torque Value	27.0 N·m	27.0 N·m	12.0 N·m	3.0 N·m	3.0 N·m	3.0 N·m

⚠ CAUTION

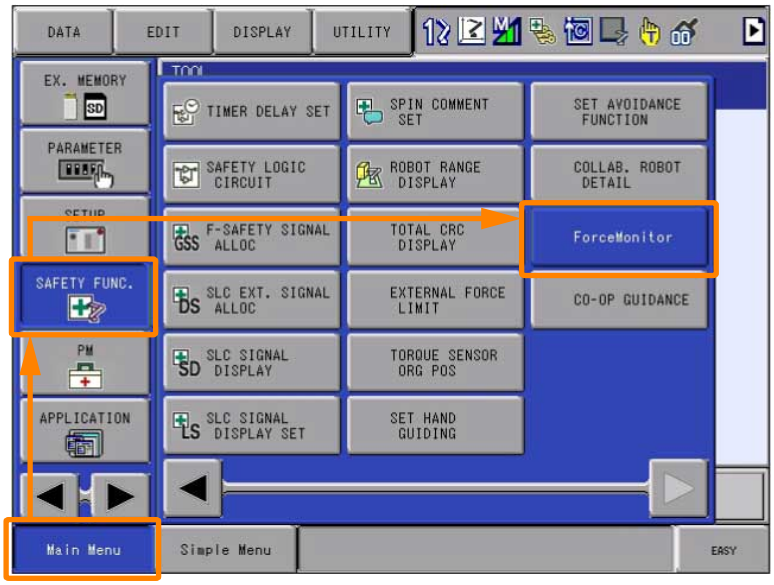
Even if the torque by external force is lower than the values given in the table above, adjust the torque sensors when there is a problem with the operation of the PFL function or escape from clamping function.

7.3.1 Checking the Home Positions of the Torque Sensors

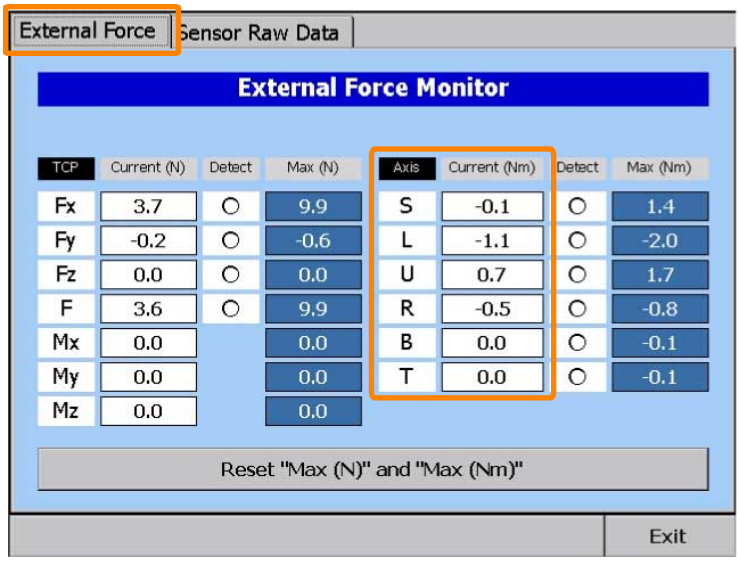
To check the status of the torque sensors, regularly open the External Force Monitor window with the manipulator set to the same posture and with the same load, record the torque values by external force of each axis on the right side of the window, and check if the difference between the values is growing larger from when the manipulator first started being used.

Use the following procedure to check the values.

1. **Select {Main Menu} - {SAFETY FUNC.} - {ForceMonitor} on the programming pendant.**



2. **Select {External Force}, and check the torque values by external force of each axis.**



3. **Compare the current values to the values when the manipulator first started being used and check if the difference between the values is growing larger.**

Information Recording these values each day is recommended because these values must be checked regularly.

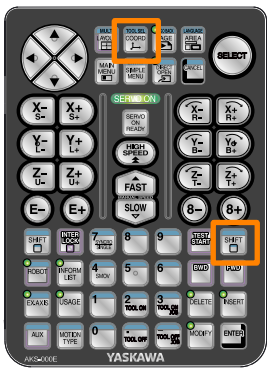
This concludes the procedure.

If the values exceed the thresholds as a result of the comparison, adjust the torque sensors according to the following procedure.

7.3.2 Setting the Home Positions of the Torque Sensors Again

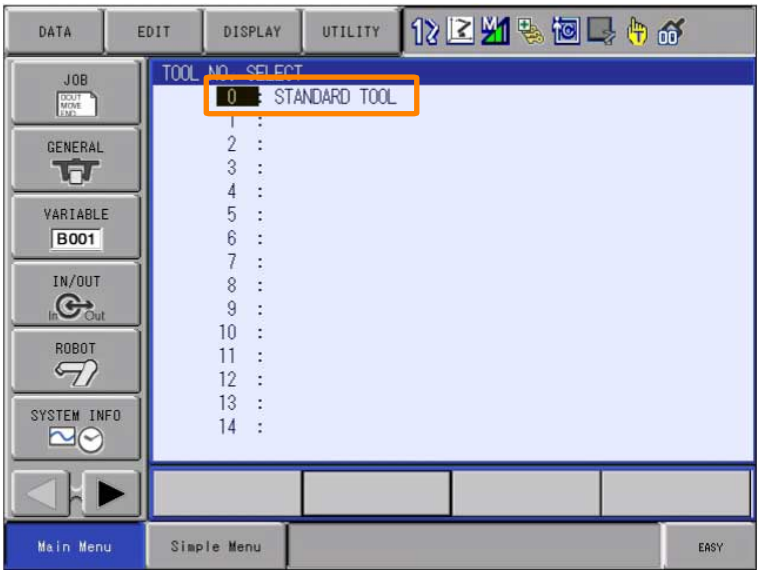
If the home positions of the torque sensors are checked and the threshold values were exceeded, the home positions of the torque sensors must be set again. Use the following procedure.

1. **Press [SHIFT] and [TOOL SEL COORD] on the programming pendant at the same time.**

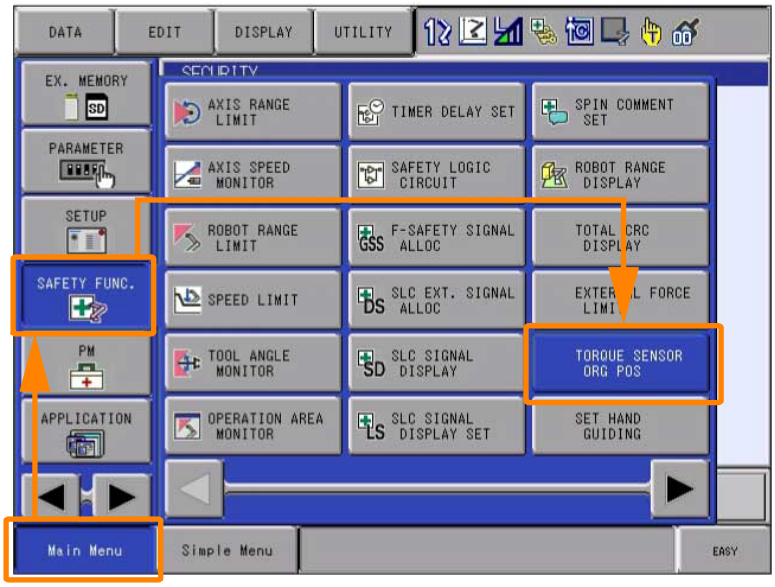


2. **Use the cursor keys to place the cursor on tool number 0.**

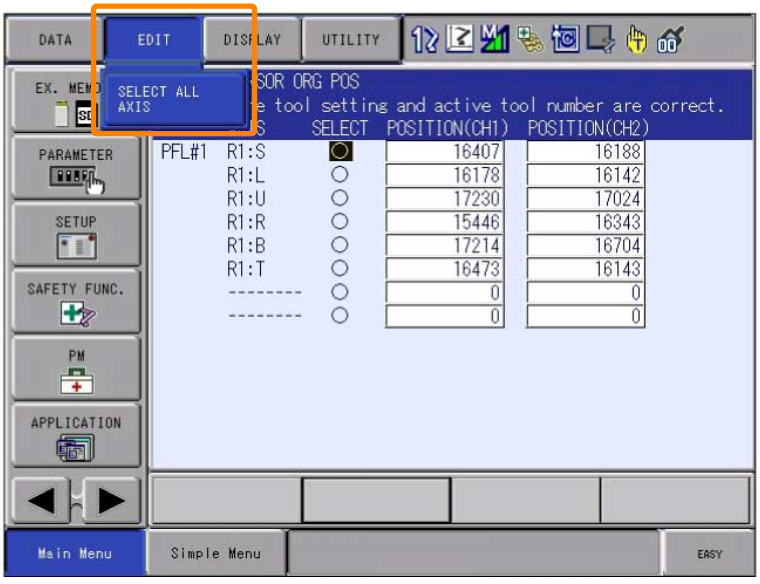
Information Select the tool file for the tool that is currently installed. In this example, tool number 0 is selected because the tool file for the currently installed tool is set to tool number 0.



3. **Select {Main Menu} - {SAFETY FUNC.} - {TORQUE SENSOR ORG POS} on the programming pendant.**

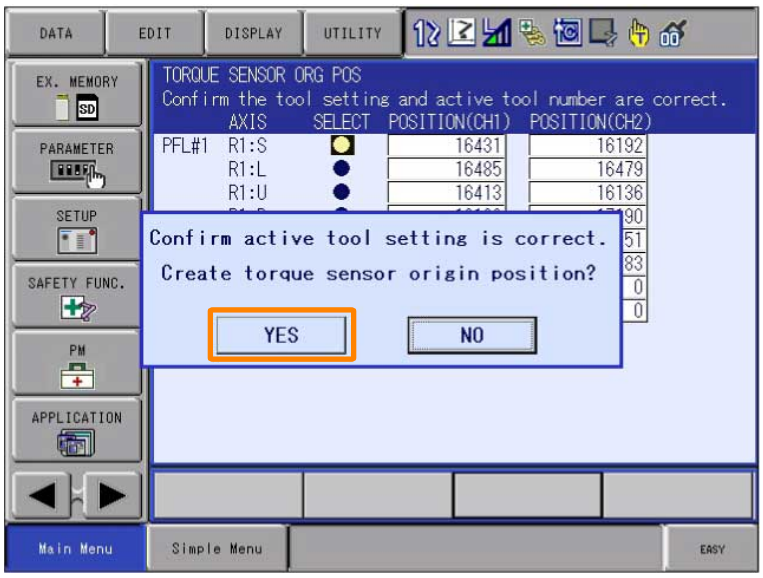


4. **Select {EDIT} - {SELECT ALL AXIS}.**



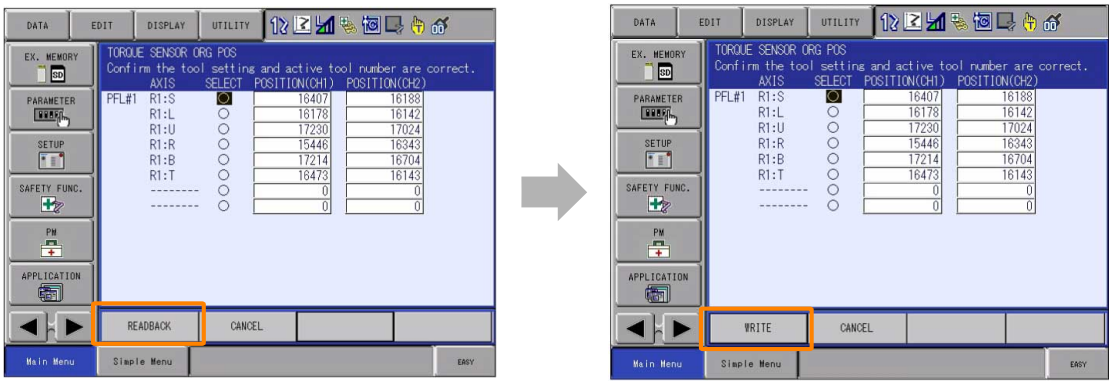
A confirmation window will be displayed.

5. **Select {YES}.**



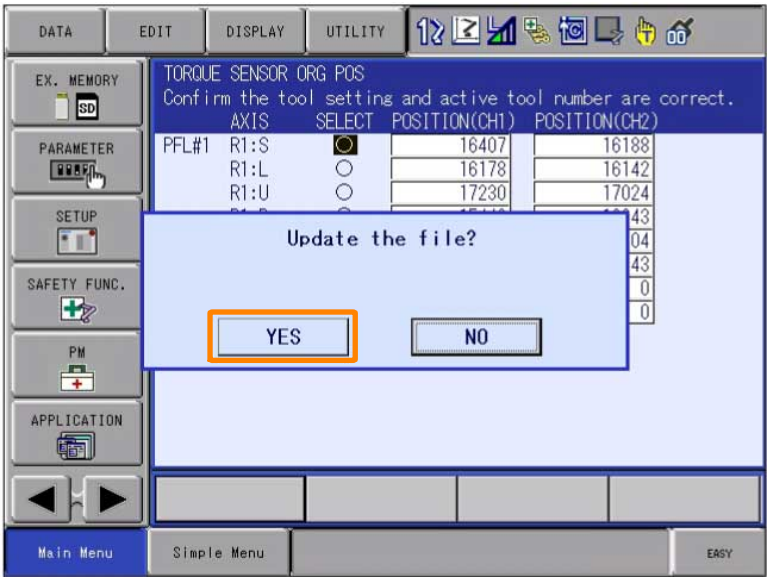
Information To check the contents of the tool information that was set, select {ROBOT} - {TOOL}, and select tool number 0 on the TOOL NO. SELECT window. Confirm that the tool information is correct, and then select {YES}.

6. **Select {READBACK} - {WRITE}.**



A confirmation window will be displayed when transferring and saving the configured data to the robot controller is completed.

7. **Select {YES}.**



This concludes the procedure.

7.4 Setting External Force Limits

The manipulator has an external force monitor function. This function stops the manipulator according to the external force that is applied to the manipulator.

The manipulator will stop when the preset external force limits are exceeded.

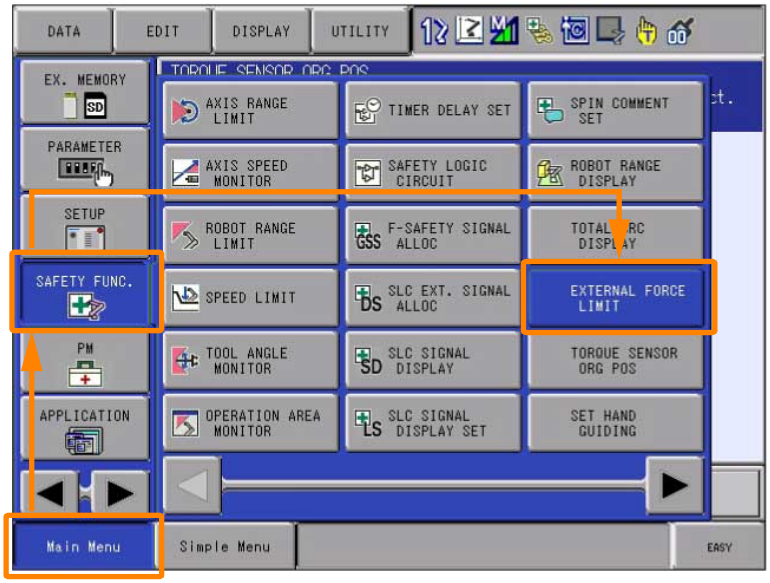
The external force limits (TCP resultant force and each X/Y/Z axis direction external force) are set to 100 N by default.

Up to 32 external force limits can be set.

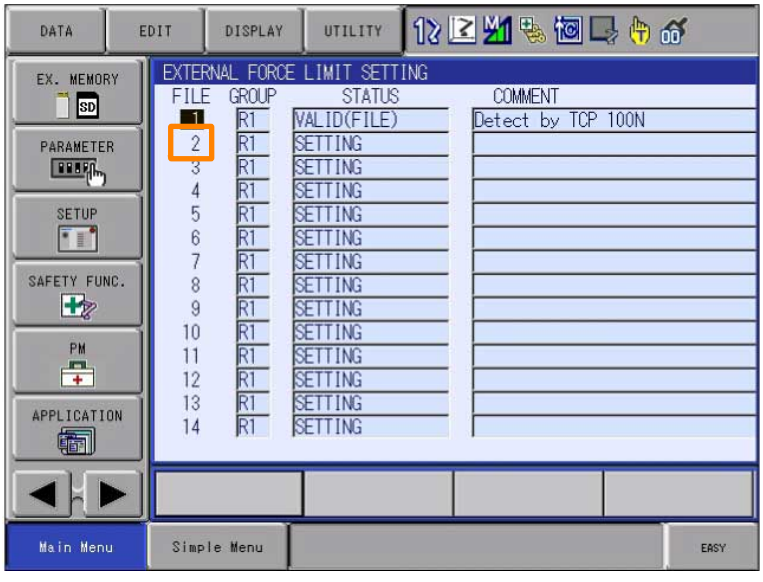
Use the following procedure to configure the external force limits that stop the manipulator.

This example shows the procedure to set external force limit 90 N in file number 2.

1. **Select {Main Menu} - {SAFETY FUNC.} - {EXTERNAL FORCE LIMIT} on the programming pendant.**

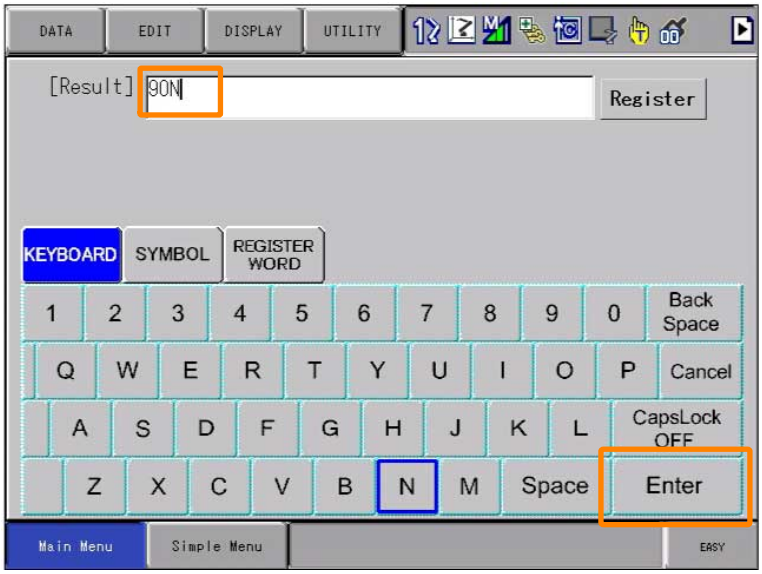


2. **Select the file number of the external force limit to set.**

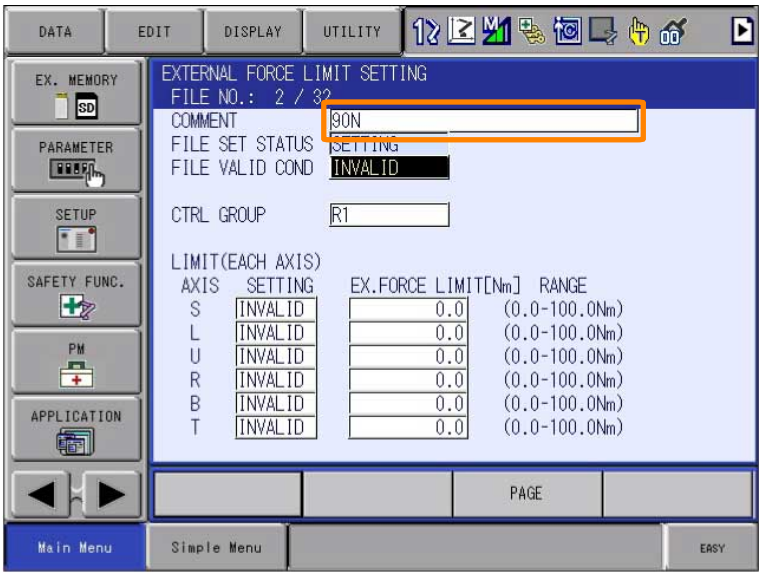


3. **Enter {COMMENT}.**

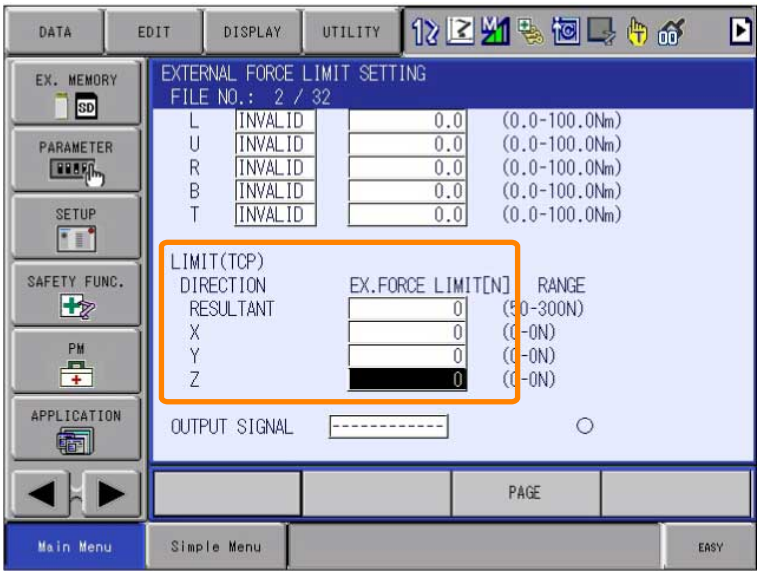
When selected, the text entry window will be displayed for the comment. Touch {Enter} to confirm the entered comment and return to the previous window.



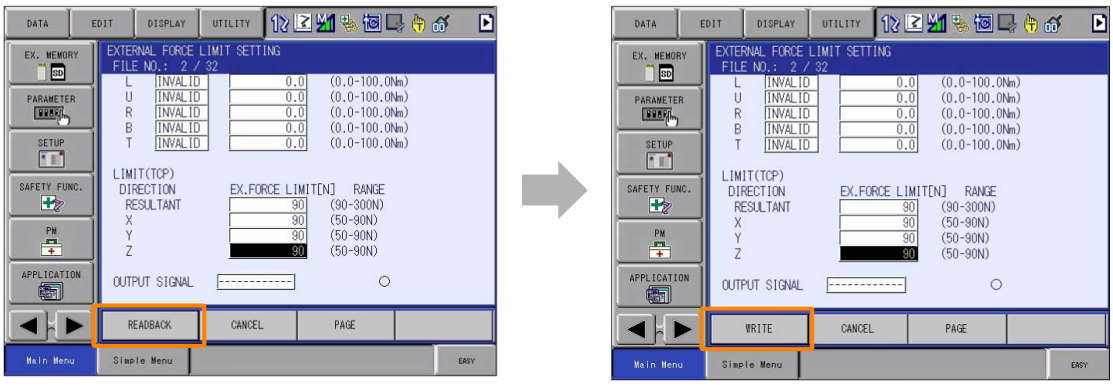
The content that was entered here will be displayed on the external force limit file selection window (from step 2). A comment that briefly describes the setting is recommended.



4. **Set {LIMIT(TCP)}.**



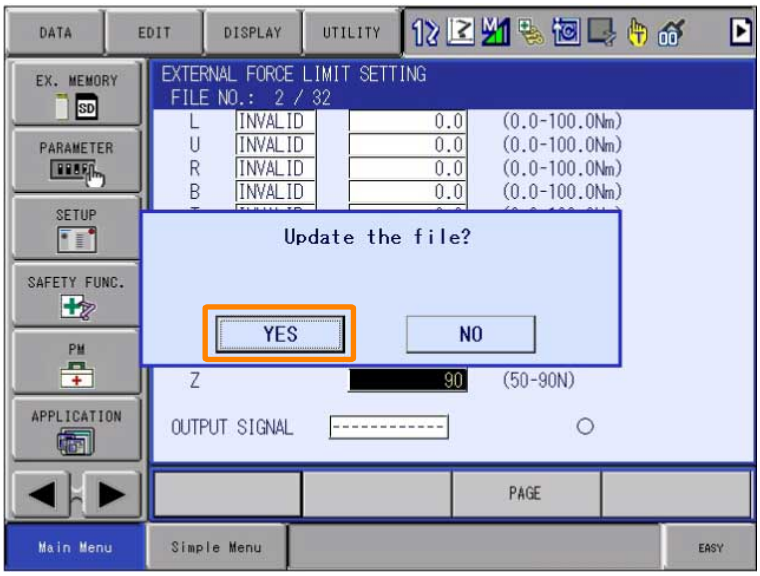
5. **Select {READBACK} - {WRITE}.**



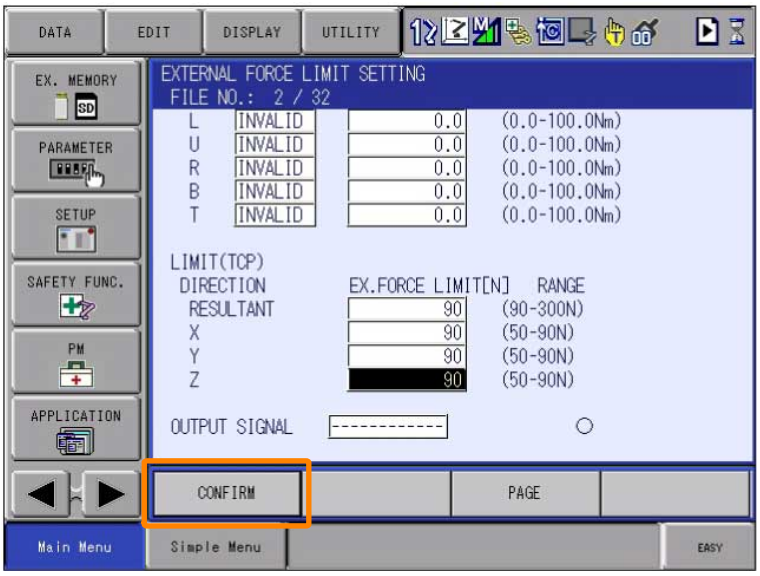
Information If {READBACK} is not displayed, one of the previous settings was not configured. Check the settings.

A confirmation window will be displayed when transferring and saving the configured data to the robot controller is completed.

6. **Select {YES}.**

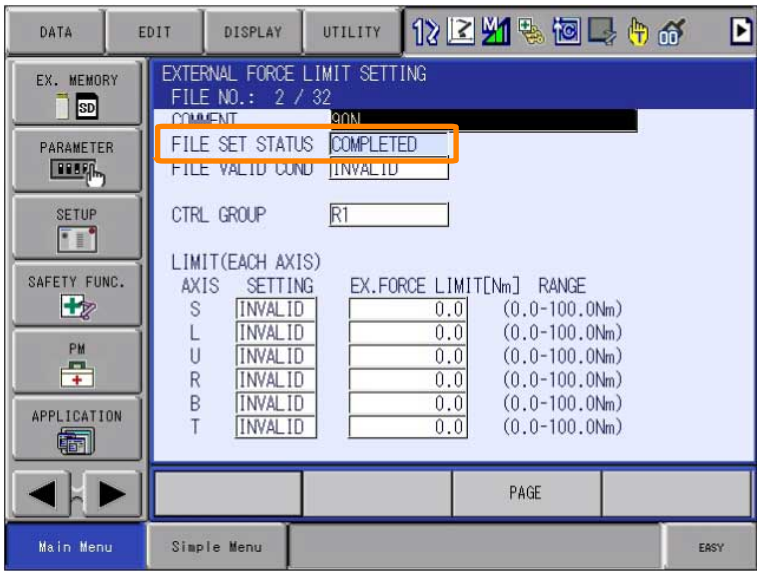


7. **Select {CONFIRM}.**



{FILE SET STATUS} will change from "CONFIRMING" to "COMPLETED", and the setting will be applied to the CPU in the robot controller.

8. **Confirm that {FILE SET STATUS} is "COMPLETED".**



The labels displayed in {FILE SET STATUS} and the meanings are shown below.

Label	Description
SETTING	Immediately after initialization or the data is being set.
CONFIRMING	{WRITE} was pressed after the data was set and the data was transferred to the robot controller.
COMPLETED	{CONFIRM} was pressed after the external force limit was confirmed.

9. **To set multiple external force limits, return to step 2 and repeat the settings.**

Important: Up to 32 external force limits can be set, but keep the number of valid files to five or less. Six or more files can be valid at the same time, but the external force judgments may take more time than normal.

Information: If all external force monitor files are invalid, the external force monitor function will be disabled.

This concludes the procedure.

7.5 Configuring the Speed Limit Function

The speed limit function performs monitoring to ensure the manipulator control points do not exceed the set speed. The monitored control points are the TCP (tool center point) and FCP (flange center point).

TCP speed 250 mm/s is the default setting.

> Important
> The default speed limit provides no guarantees regarding manipulator safety. Always conduct a risk assessment and configure the speed limit again based on those results.

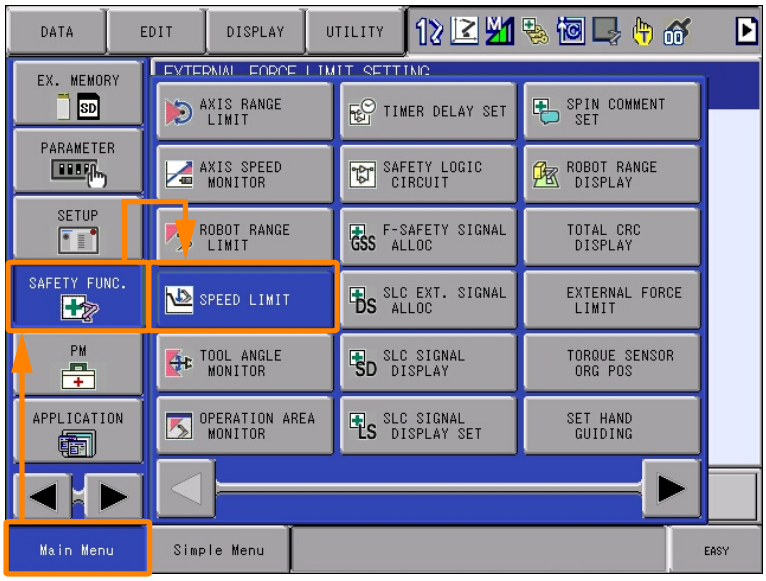
The speed limit function has two monitor types: speed limit and stop monitor.

Monitor Type	Description
Speed limit	The TCP speed and FCP speed are monitored to ensure the set speed is not exceeded. When the speed limit is enabled, the teaching speed at that time is first lowered to the speed limit if the teaching speed is faster than the speed limit. The time until monitoring is started from when the conditions file becomes valid can be set in the conditions file as the detection delay time. If an error was detected for the monitoring result, power to the motor is turned OFF using machine safety. An alarm also occurs to provide notification of the error.
Stop monitor	The stop position of the TCP or FCP is monitored to confirm that the points do not move.

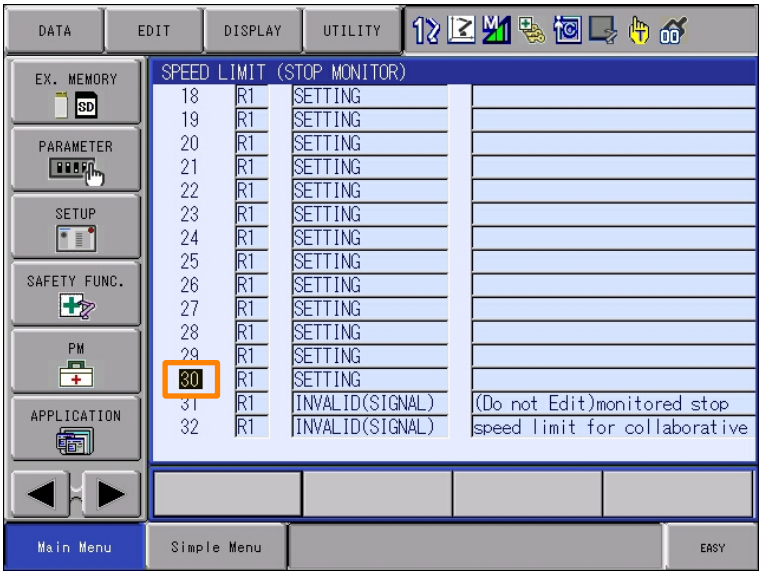
Use the following procedure to configure the speed limit function.

This example shows the procedure to set TCP speed 100 mm/s in file number 30.

1. **Select {Main Menu} - {SAFETY FUNC.} - {SPEED LIMIT} on the programming pendant.**

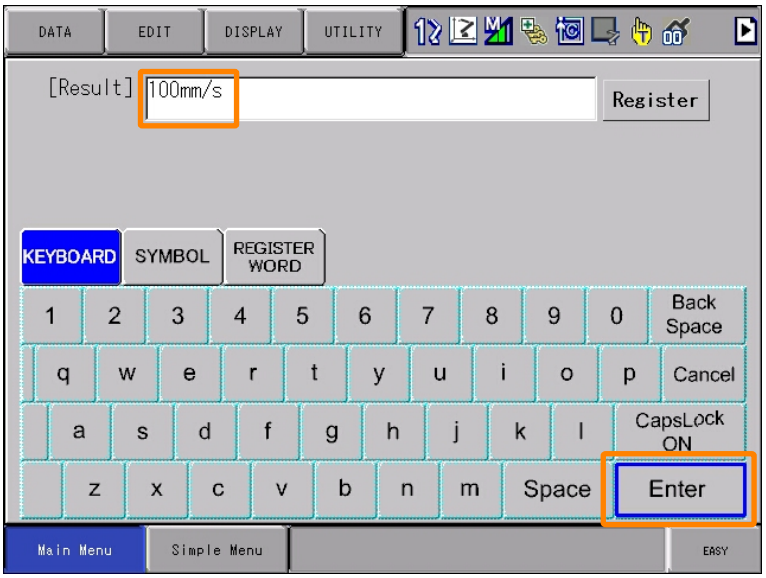


2. **Select the speed limit file number to set.**

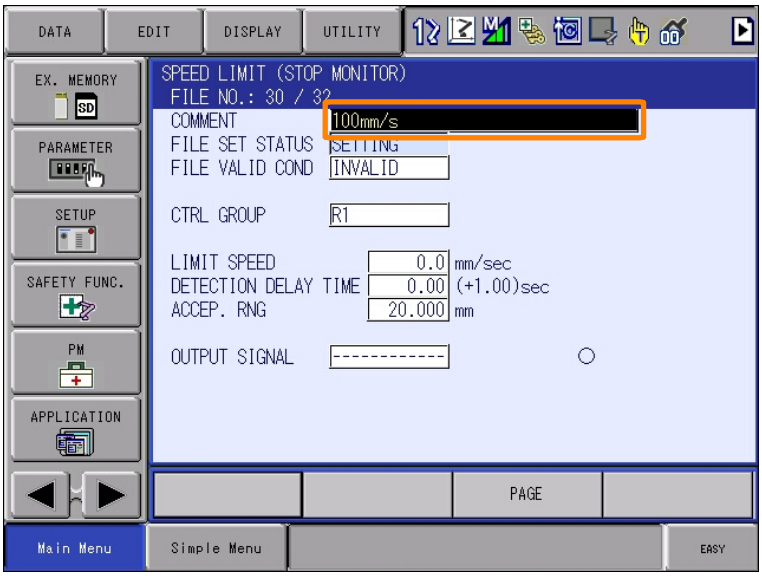


3. **Enter {COMMENT}.**

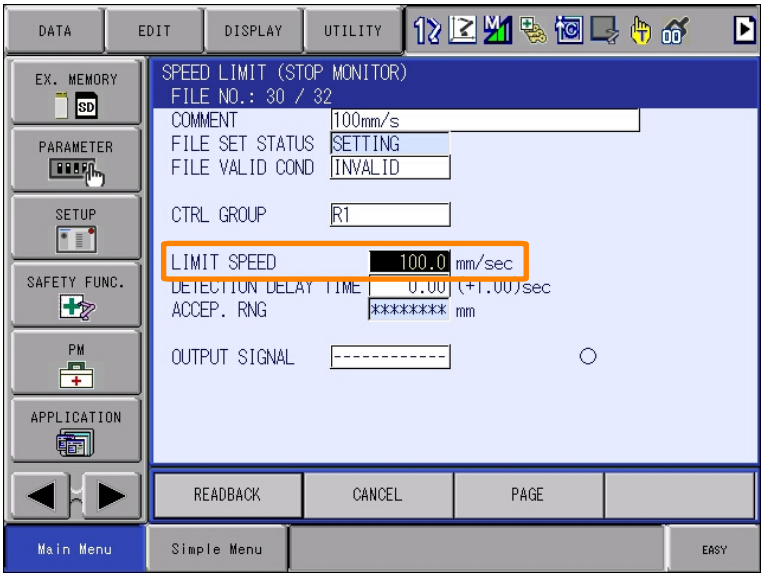
When selected, the text entry window will be displayed for the comment. Touch {Enter} to confirm the entered comment and return to the previous window.



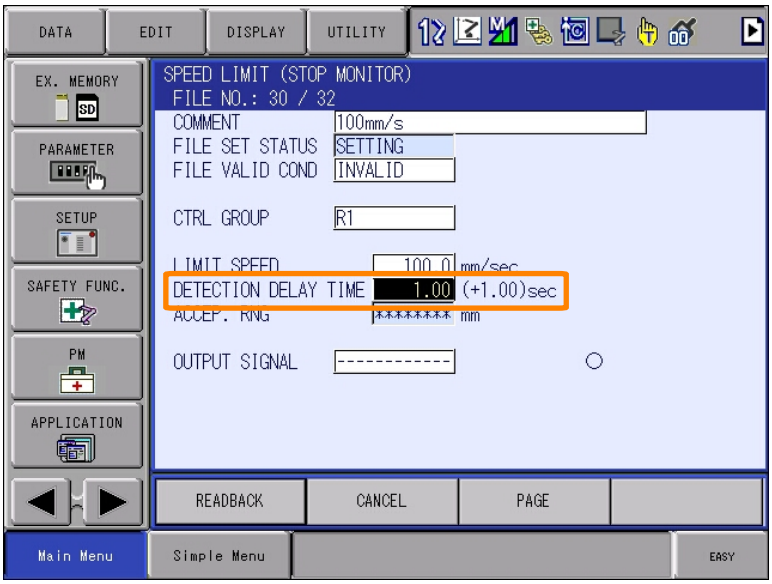
The content that was entered here will be displayed on the speed limit file selection window (from step 2). A comment that briefly describes the setting is recommended.



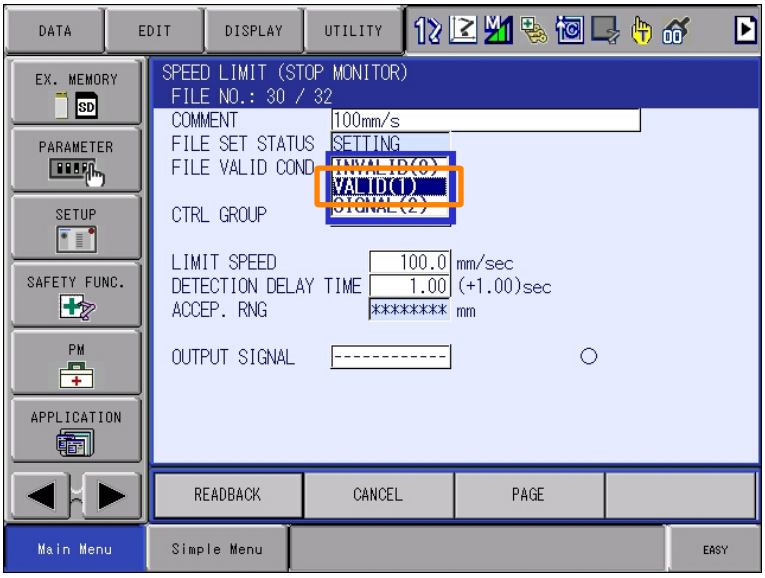
4. **Set {LIMIT SPEED}.**



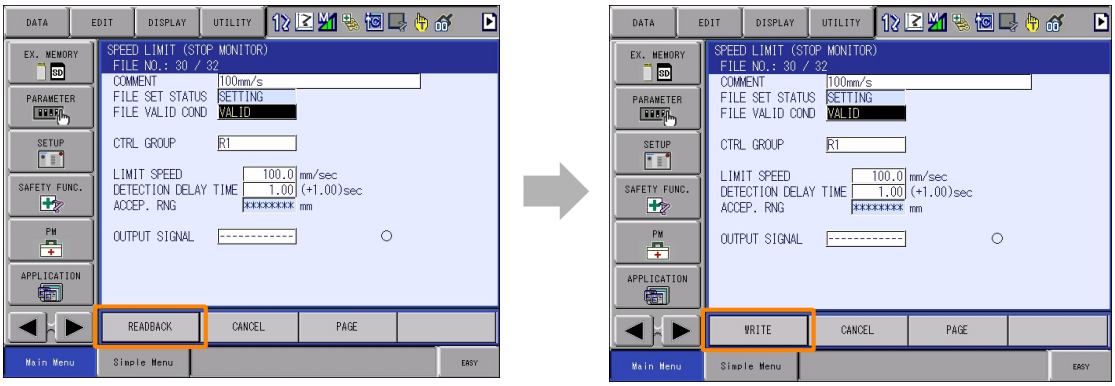
5. **Set {DETECTION DELAY TIME} as required.**



6. **Set {FILE VALID COND} to "VALID".**



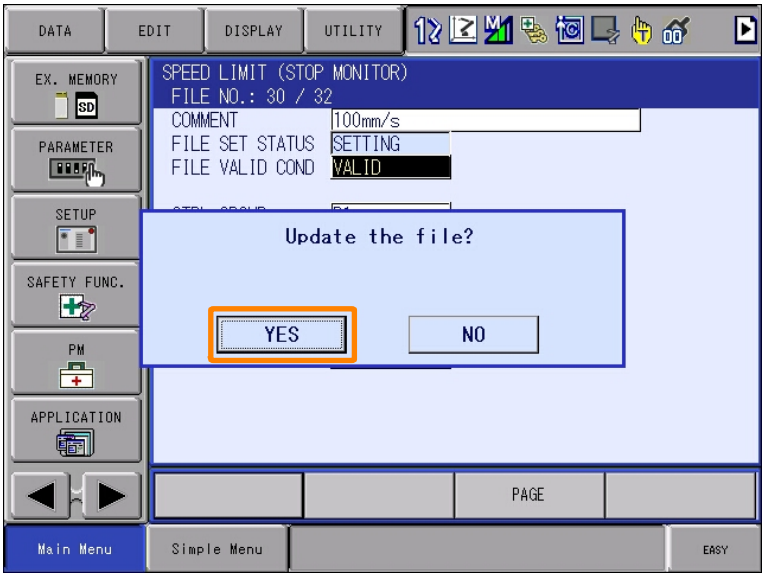
7. **Select {READBACK} - {WRITE}.**



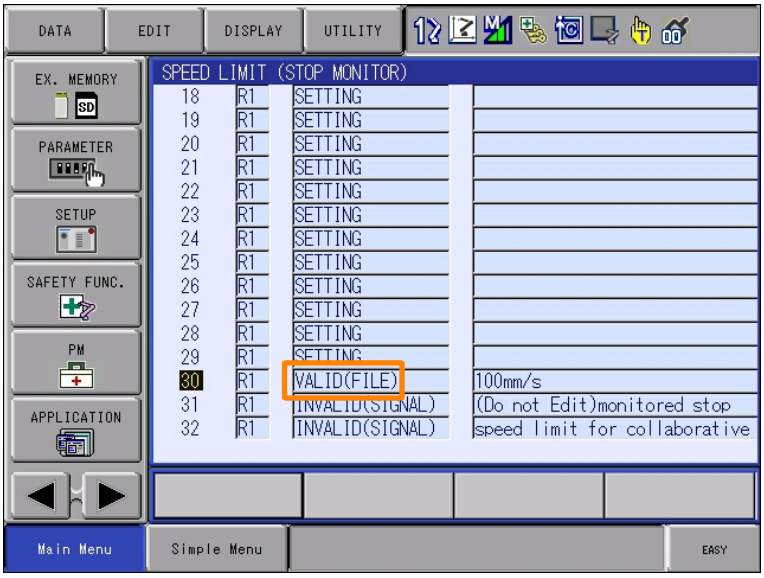
Information If {READBACK} is not displayed, one of the previous settings was not configured. Check the settings.

A confirmation window will be displayed when transferring and saving the configured data to the robot controller is completed.

8. **Select {YES}.**



9. **Confirm that the configured file is valid.**



This concludes the procedure.

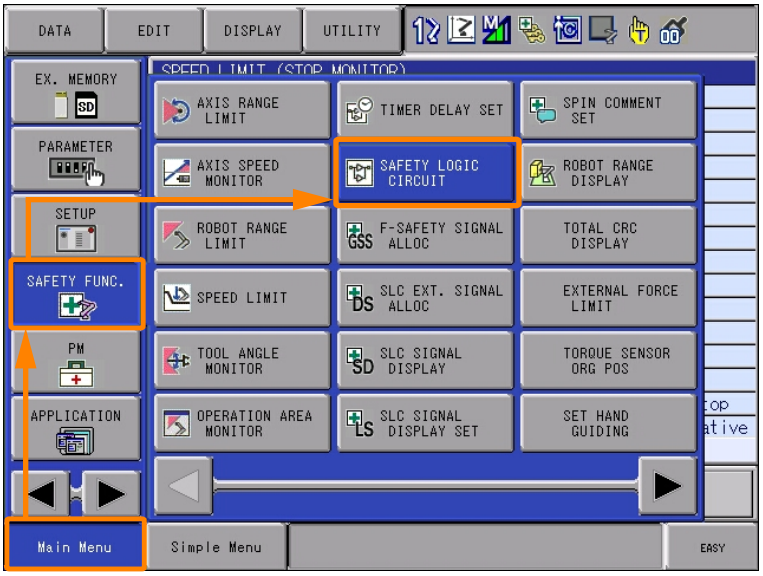
7.6 Enabling the Collaborative Operation Function

To configure the collaborative operation function, the collaborative operation function was temporarily disabled.

Therefore, when the collaborative operation function configuration shown in "*7.2 Configuring a Tool File on page 89*" to "*7.5 Configuring the Speed Limit Function on page 106*" is completed, the collaborative operation function must be enabled.

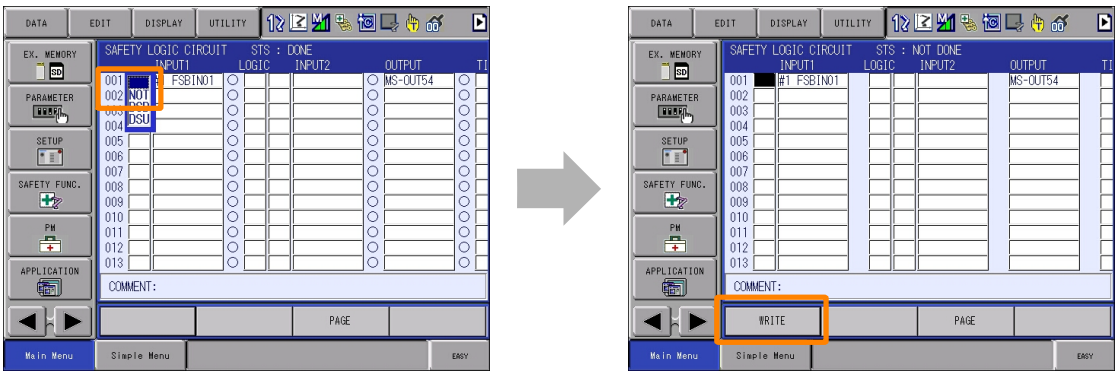
Use the following procedure to enable the collaborative operation function.

1. **Select {Main Menu} - {SAFETY FUNC.} - {SAFETY LOGIC CIRCUIT}.**

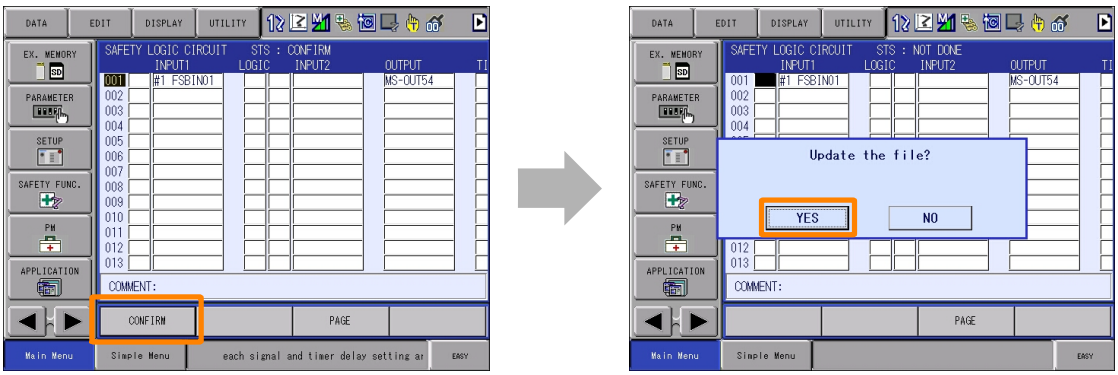


The SAFETY LOGIC CIRCUIT window will be displayed.

2. **To the left of line 1 "FSBIN01", select "NOT", make this item blank, and then select {WRITE}.**

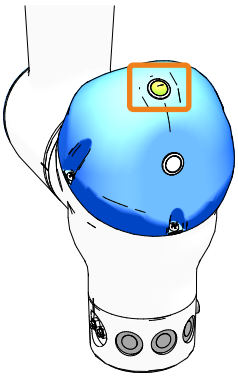


3. **Confirm that there are no mistakes in the safety logic circuit, and then select {CONFIRM} and {YES}.**

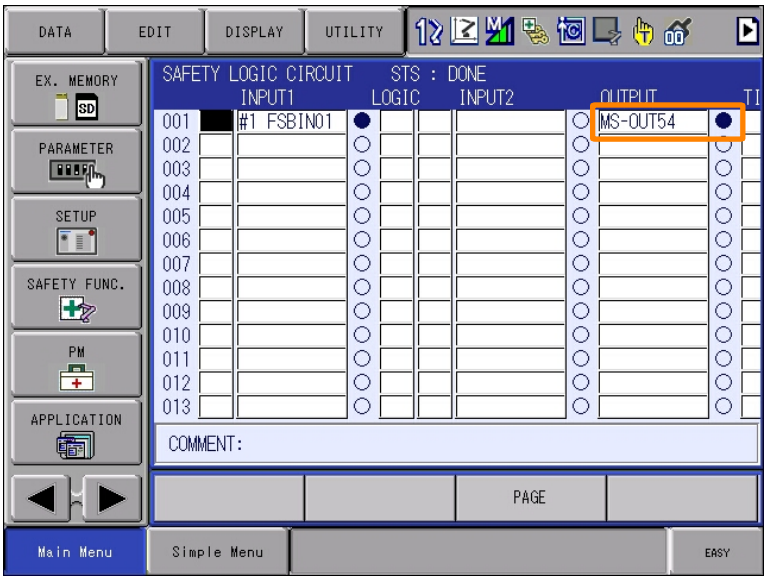


4. **Confirm that the collaborative operation lamp on the manipulator is lit in green.**

> Important
>
> When tool file number 1 is set, the collaborative operation lamp will not be lit because the collaborative operation function is disabled inside the manipulator. First perform the following operation, and then confirm again that the collaborative operation lamp is lit.
>
> <Reset Procedure>
>
> Jog the tip of the manipulator approximately 5 mm (move a driven axis (e.g., B-axis) instead of a rotary axis (e.g., T-axis)).
>
> Refer to the following section for details on jogging.
>
> ☞ *5.1.1 Jogging Each Axis (Joint Coordinate System) on page 64*



5. **Confirm that the right side of {MS-OUT54} in the {OUTPUT} column is "●".**



The following table gives the details of the MS-OUT54 output signal.

Signal Name	Description
MS-OUT54	Enables and disables collaborative operation • ○ = OFF: Collaborative operation disabled • ● = ON: Collaborative operation enabled

This concludes the procedure.

8

Programming

This chapter describes how to create a program according example movements and how to move the manipulator using that program.

8.1 Explanation of the Sample Program 114

8.1.1 Overview 114

8.2 Creating a Program with Direct Teach 115

8.2.1 Creating a Program 115

8.2.2 Registering Manipulator Positions in the Program Using Direct Teach 117

8.2.3 Adding and Changing Programming 122

8.2.4 Confirming Operation Step by Step 132

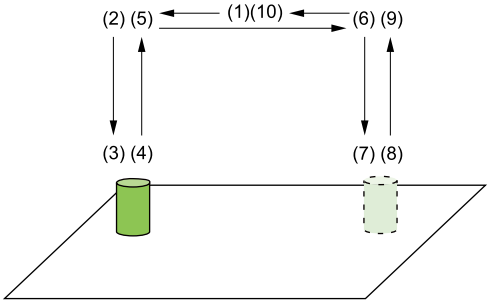
8.2.5 Running the Created Program 134

8.1 Explanation of the Sample Program

8.1.1 Overview

In this chapter, a program that moves the position of a workpiece from the left edge to the right edge will be created.

An illustration that shows the workpiece positions and the path of the tip of the manipulator is shown below, as well as the sample program that achieves this motion.



Line No.	Step	Tool	Instruction/Additional Items		
0000			NOP		
0001	0001	00	MOVJ	VJ=10.00	
0002	0002	00	MOVJ	VJ=25.00	
0003	0003	00	MOVL	V=100.0	
0004	0004	01	MOVL	V=100.0	
0005			DOUT	OT#(7) OFF	Close hand instruction
0006			DOUT	OT#(8) ON	
0007			WAIT	IN#(8)=ON	Confirmation of hand closed sensor
0008	0005	01	MOVL	V=100.0	
0009	0006	01	MOVJ	VJ=25.00	
0010	0007	01	MOVL	V=100.0	
0011	0008	00	MOVL	V=100.0	
0012			DOUT	OT#(8) OFF	Open hand instruction
0013			DOUT	OT#(7) ON	
0014			WAIT	IN#(7)=ON	Confirmation of hand opened sensor
0015	0009	00	MOVL	V=100.0	
0016	0010	00	MOVJ	VJ=25.00	
0017			END	END	

This program uses the tool shown below. The following four signals must be connected to open and close this tool.

Appearance of Tool	Signal Name	Signal Application
	Open fingers signal	Used for the open hand instruction.
	Close fingers signal	Used for the close hand instruction.
	Auto switch output (fingers opened) signal	Used for confirmation of the hand opened sensor.
	Auto switch output (fingers closed) signal	Used for confirmation of the hand closed sensor.

The descriptions for this program assume the above signals have been connected as described in the following section.

☞ *6.4 Connecting the I/O Cables on page 82*

8.2 Creating a Program with Direct Teach

This section describes the procedure to create a sample program using direct teach. The description is split into the following steps.

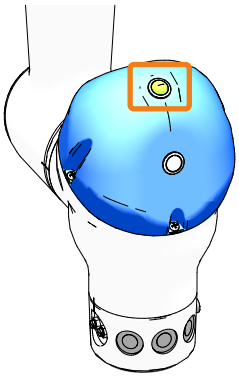
Step	Task	Applicable Device	Reference Section
1	Creating a Program	Programming pendant	☞ *8.2.1 Creating a Program on page 115*
2	Registering Manipulator Positions in the Program Using Direct Teach	Manipulator	☞ *8.2.2 Registering Manipulator Positions in the Program Using Direct Teach on page 117*
3	Adding and Changing Programming	Programming pendant	☞ *8.2.3 Adding and Changing Programming on page 122*
4	Confirming Operation Step by Step	Programming pendant	☞ *8.2.4 Confirming Operation Step by Step on page 132*
5	Running the Created Program	Programming pendant	☞ *8.2.5 Running the Created Program on page 134*

8.2.1 Creating a Program

To use direct teach, a program must be created (job registered) in advance.

Information The program that moves the robot is called a job.

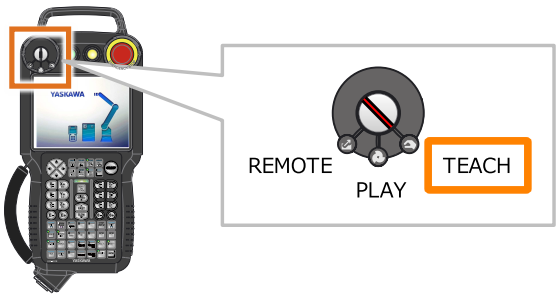
1. **Confirm that the collaborative operation LED is lit in green.**



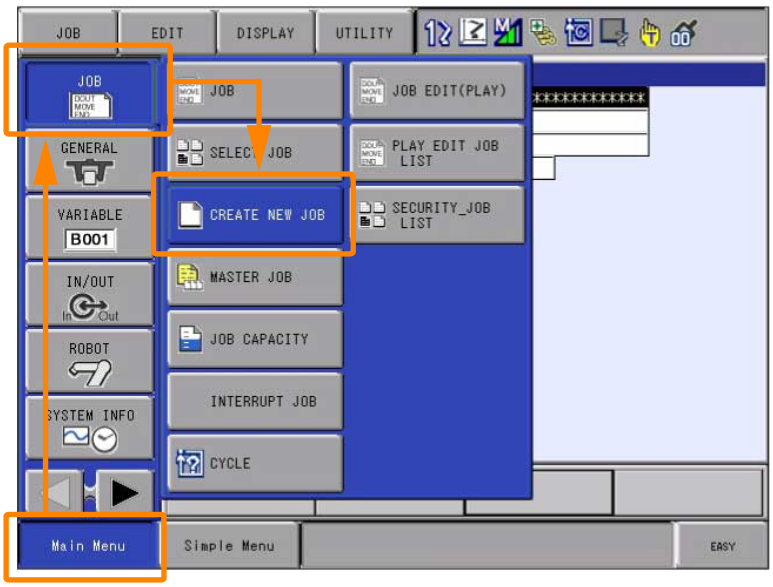
Information If the LED is not lit, the collaborative operation function is disabled. Refer to the following section and enable the collaborative operation function.

☞ *7.6 Enabling the Collaborative Operation Function on page 111*

2. **Set the mode key on the programming pendant to TEACH.**

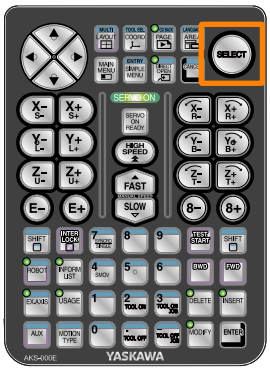


3. **Select {Main Menu} - {JOB} - {CREATE NEW JOB} on the programming pendant.**

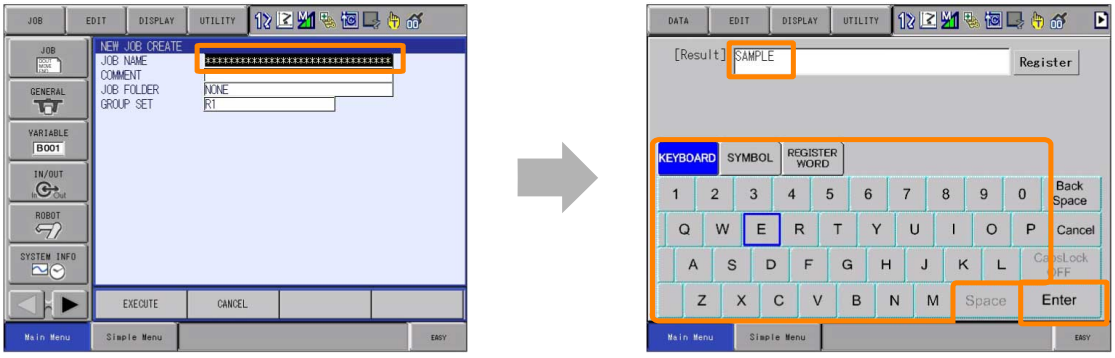


The NEW JOB CREATE window will be displayed.

4. **Press [SELECT] on the programming pendant.**



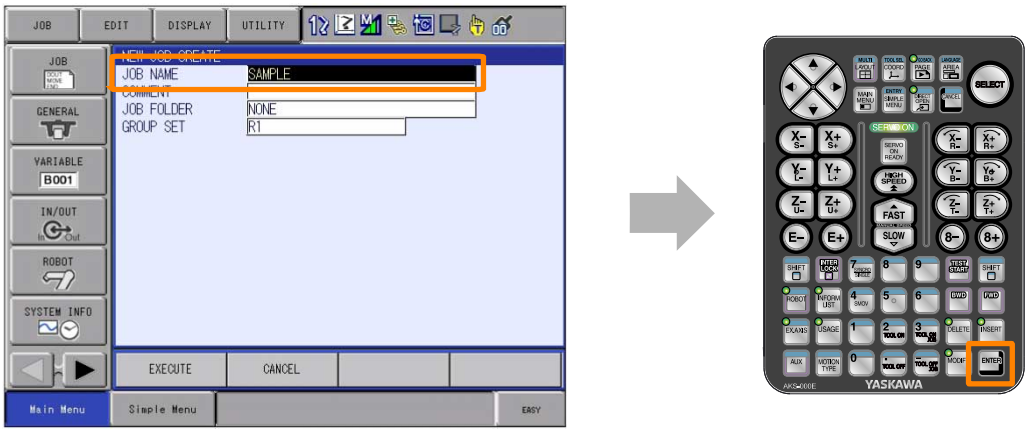
5. **Touch the programming pendant screen, enter the name of the job, and touch {Enter}.**



The NEW JOB CREATE window will be displayed again.

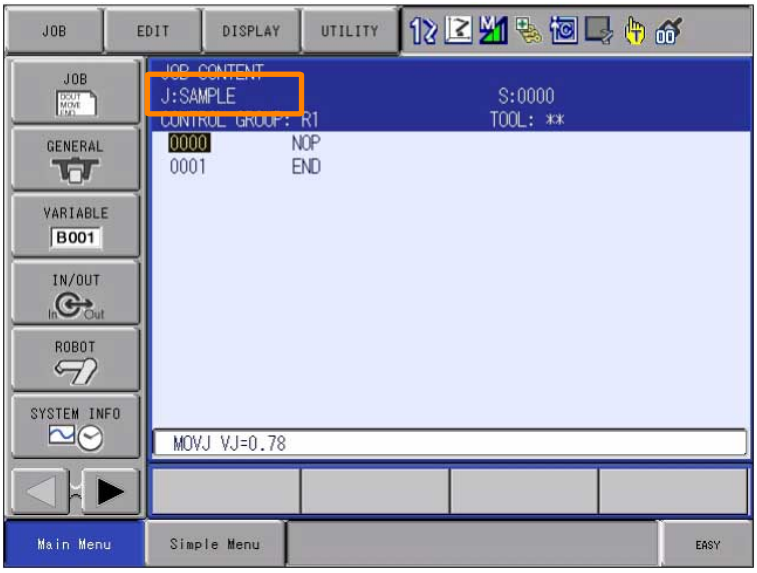
6. **Confirm {JOB NAME}, and press [ENTER].**

Information {COMMENT}, {JOB FOLDER}, and {GROUP SET} can also be set, but the job will be registered with the default settings here.



The JOB CONTENT window will be displayed.

7. **Confirm that the job name that was registered is displayed.**



Information When a job is created, the following two instructions are automatically inserted into the job.
- NOP: The first instruction of the program (start instruction).
- END: The last instruction of the program (end instruction).

This concludes the procedure. Proceed to the next step.

8.2.2 Registering Manipulator Positions in the Program Using Direct Teach

Register the manipulator positions in the program using direct teach.

1. **Confirm that the following procedure was completed.**

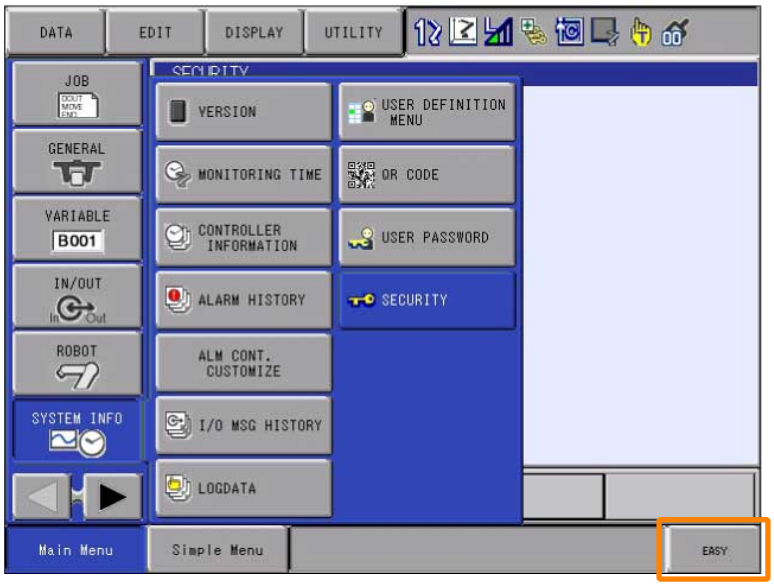
☞ *8.2.1 Creating a Program on page 115*

2. **Confirm again that the collaborative operation LED is lit in green and the mode key on the programming pendant is set to TEACH.**

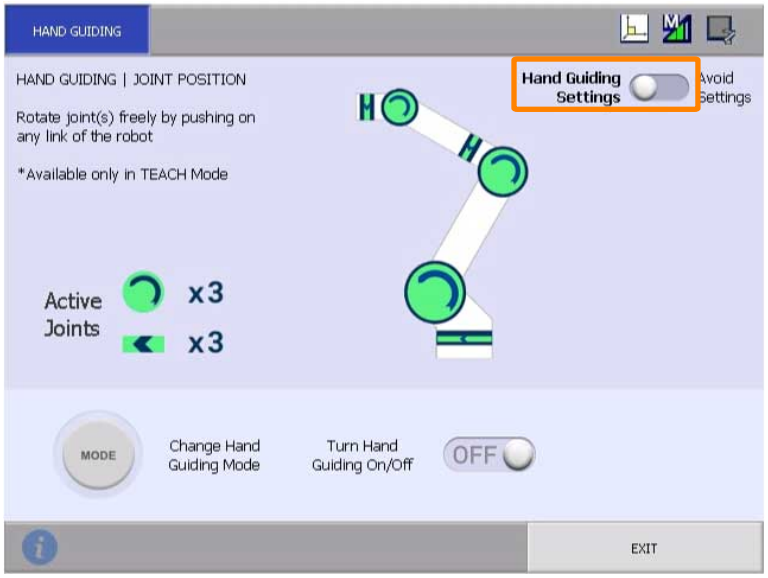
Information If the LED is not lit, the collaborative operation function is disabled. Refer to the following section and enable the collaborative operation function.

☞ *7.6 Enabling the Collaborative Operation Function on page 111*

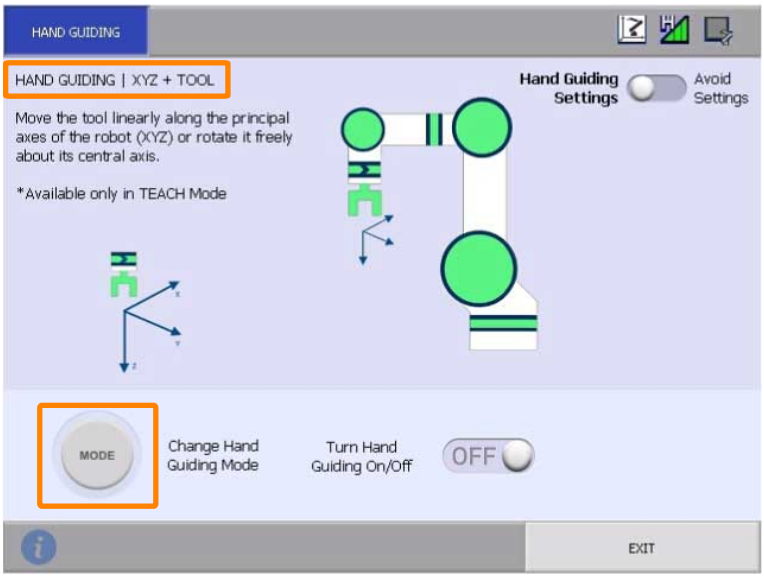
3. **Select {EASY}.**



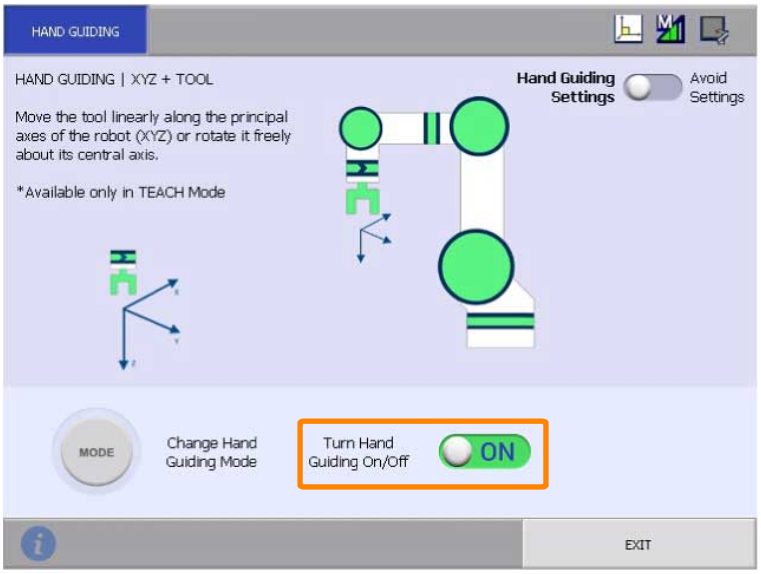
4. **Move the switch to {Hand Guiding Settings}.**



5. **Press {MODE} until {HAND GUIDING} becomes {XYZ + TOOL}.**



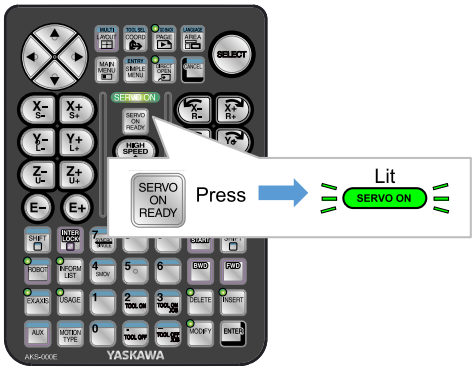
6. **Set {Turn Hand Guiding On/Off} to {ON}.**



Direct teach mode will be enabled.

Information The maximum speed at which the manipulator can be moved during direct teach is limited to the manual speed during teach mode that is currently set.

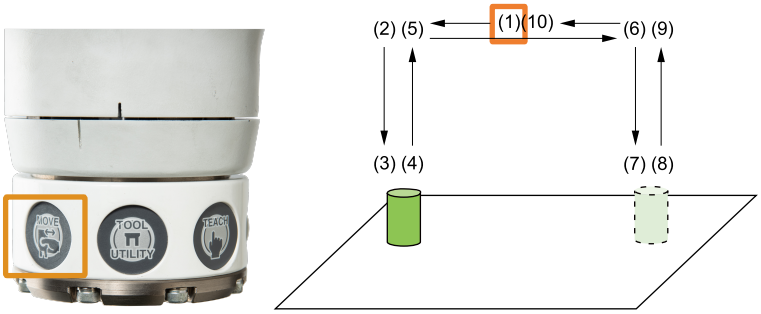
7. **Press [SERVO ON READY] on the programming pendant.**



The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

Information When using direct teach, the servo ON state will be maintained even if the enable switch on the back of the programming pendant is not squeezed.

8. **While the [MOVE] button on the manipulator is pressed, move the manipulator to position (1).**



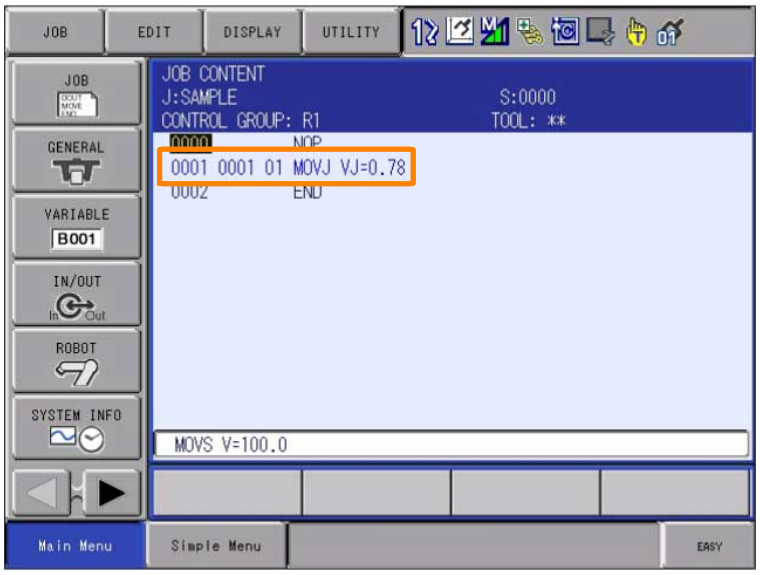
Information If the arm speed feels fast, tap (double-click) the [MOVE] button twice, and then move the arm when all three buttons are flashing. The arm will move slowly, and it will be easier to make fine adjustments because the feeling of arm coasting will be reduced.

9. **Release the [MOVE] button on the manipulator.**

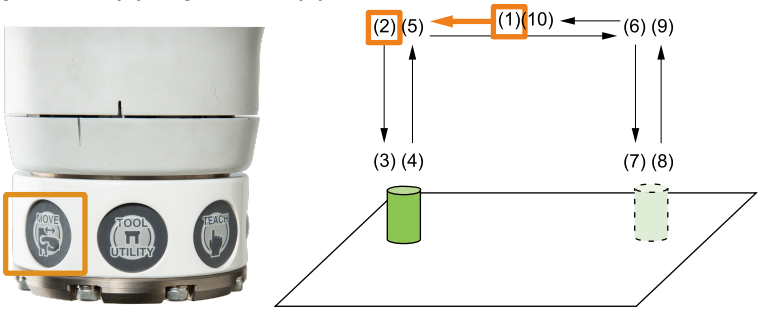
10. **Press the [TEACH] button on the manipulator.**

The position of the manipulator will be registered as step 1 when the [TEACH] button is pressed.

Information "MOVJ VJ=0.78" will be displayed because the position is registered with the default instruction and speed.

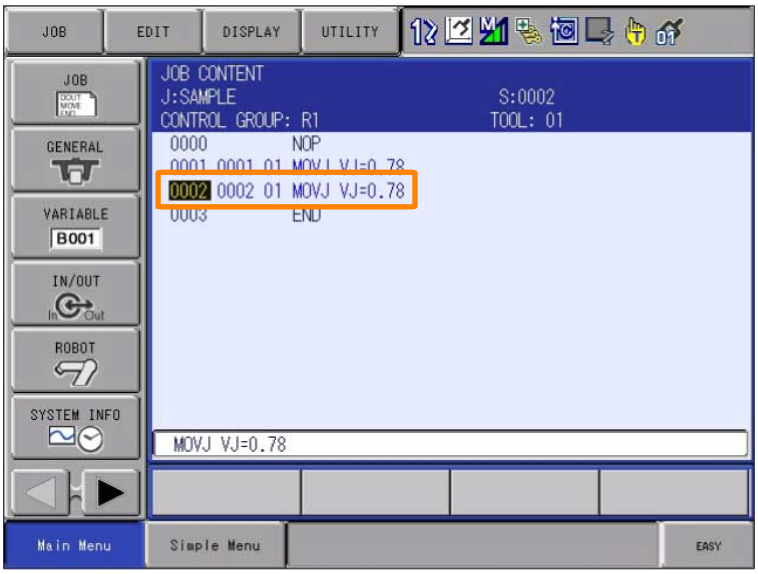


11. **While the [MOVE] button on the manipulator is pressed, move the manipulator from position (1) to position (2).**



12. **Release the [MOVE] button on the manipulator.**
13. **Press the [TEACH] button on the manipulator.**

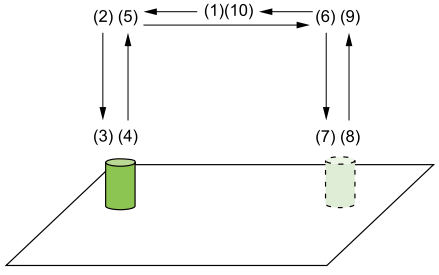
The position of the manipulator will be registered as step 2 when the [TEACH] button is pressed.

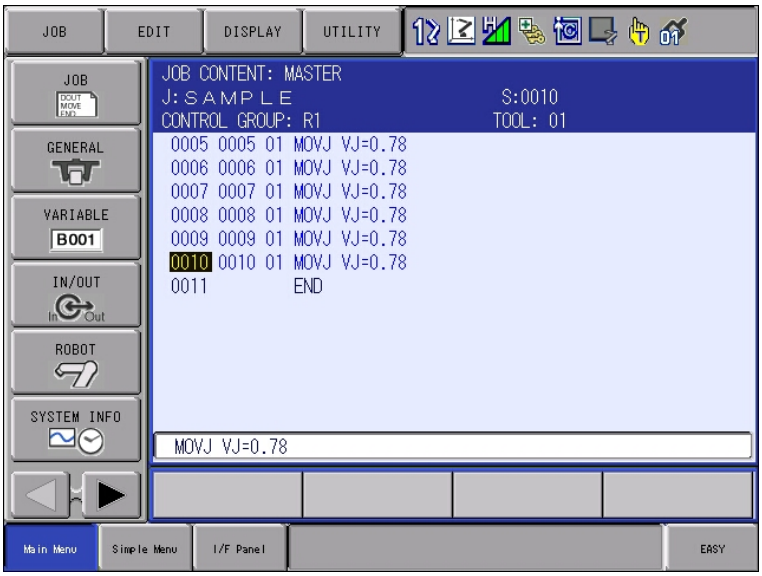


14. **Repeat steps 11 to 13 and register positions (3) to (10) in the program.**

The step numbers that are registered and the descriptions of positions (1) to (10) are shown below.

For the positions in (4) and (8), register the same position as the previous step in order to switch the tool information.

Manipulator Position		Step	Description of Position
	(1)	0001	Start job position
	(2)	0002	Above grasp workpiece position
	(3)	0003	Grasp workpiece position
	(4)	0004	Grasp workpiece position
	(5)	0005	Above grasp workpiece position
	(6)	0006	Above release workpiece position
	(7)	0007	Release workpiece position
	(8)	0008	Release workpiece position
	(9)	0009	Above release workpiece position
	(10)	0010	End job position



Information The speed of manipulator motion, opening and closing the hand, the tool files, and other settings are configured after this procedure. This procedure registers the positions of the manipulator only.

This concludes the procedure. Proceed to the next step.

8.2.3 Adding and Changing Programming

Instructions can be added to and changed in the program in which the manipulator positions were registered.

This section describes the following four operations.

Operation	Reference Section
Set the Start Job Position (Step 1) and End Job Position (Step 10) to the Same Location	☞ *(1) Set the Start Job Position (Step 1) and End Job Position (Step 10) to the Same Location on page 122*
Change the Motion and Speed of the Manipulator	☞ *(2) Change the Motion and Speed of the Manipulator on page 124*
Add Instructions to Close and Open the Hand	☞ *(3) Add Instructions to Close and Open the Hand on page 127*
Change the Tool File	☞ *(4) Change the Tool File on page 130*

(1) Set the Start Job Position (Step 1) and End Job Position (Step 10) to the Same Location

Setting the same position for the start job position (step 1) and end job position (step 10) is recommended.

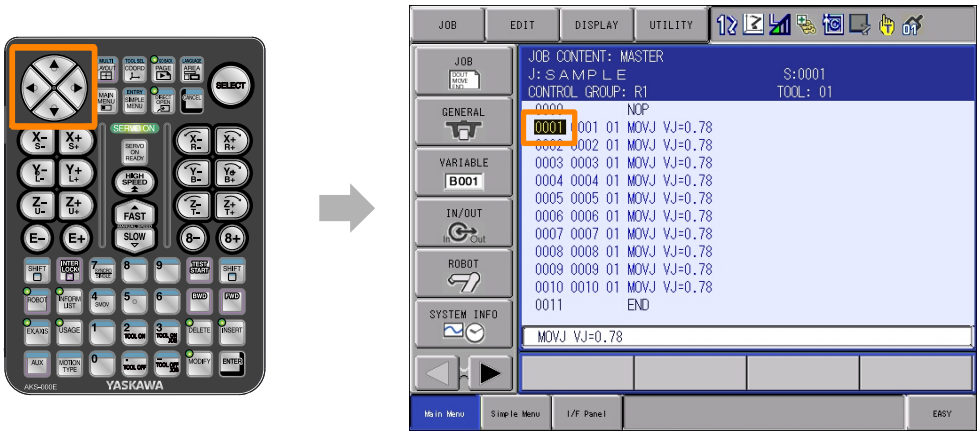
Each position that was registered with direct teach is a position that was registered by sight, so there will be slight deviations in the positions. For this reason, use the following procedure to set the start job position (step 1) and end job position (step 10) to the same position.

1. **Confirm that the following procedure was completed.**

   ☞ *8.2.2 Registering Manipulator Positions in the Program Using Direct Teach on page 117*

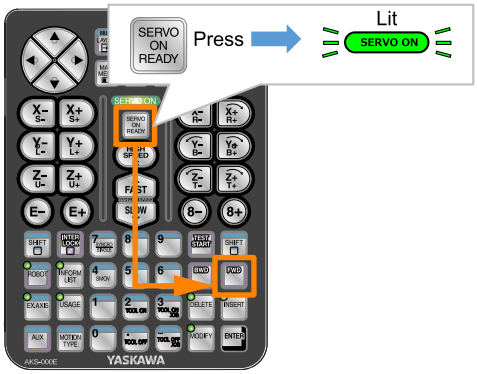
2. **Move the cursor to step 1 by pressing the cursor keys on the programming pendant, and confirm the cursor is flashing.**

   If the cursor is not flashing, the manipulator is at the step 1 position. Proceed to the step 4.

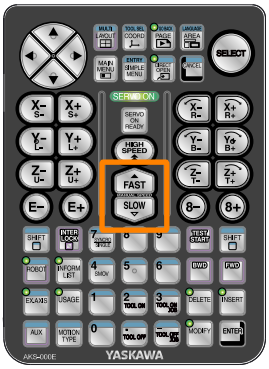


3. **Press [SERVO ON READY], and press and hold [FWD] while the [SERVO ON] lamp is lit.**

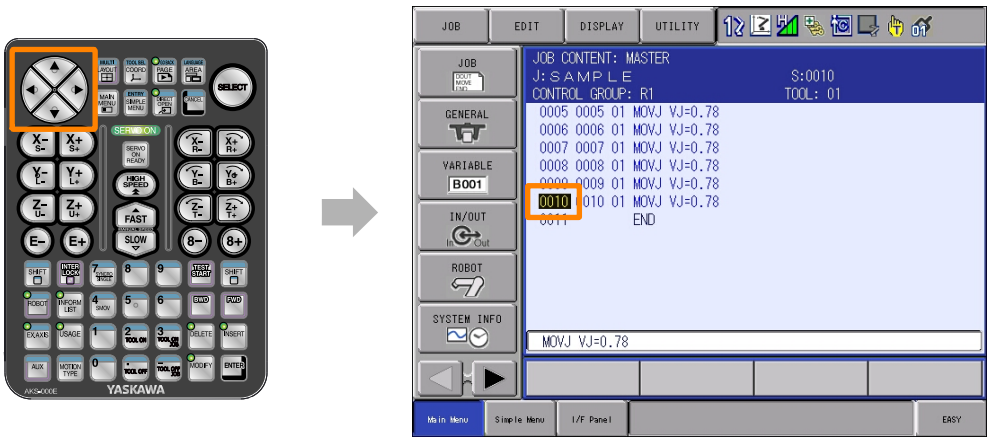
Press and hold [FWD] until the step 1 cursor changes from flashing to solid.



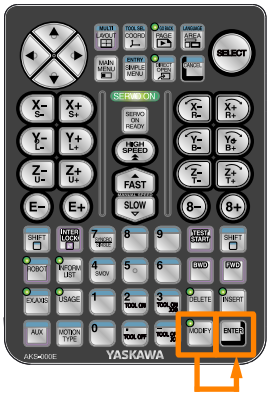
Information If the movement speed seems slow or fast, press MANUAL SPEED [FAST] or [SLOW] to change the speed at which the manipulator moves.



4. **Move the cursor to step 10 by pressing the cursor keys on the programming pendant.**



5. **Press [MODIFY] - [ENTER] on the programming pendant.**



The position of step 10 will be set to the same position as step 1.

This concludes the procedure. Proceed to the next step.

(2) Change the Motion and Speed of the Manipulator

The manipulator motions registered with direct teach are all registered with the MOVJ instruction at the set speed.

The program described in this manual uses the MOVL instruction and MOVJ instruction depending on the position where the manipulator moves. The differences between these instructions are described below.

Instruction	Manipulator Path
MOVL	The manipulator moves along a linear path.
MOVJ	The path of the manipulator is not limited to a straight line.

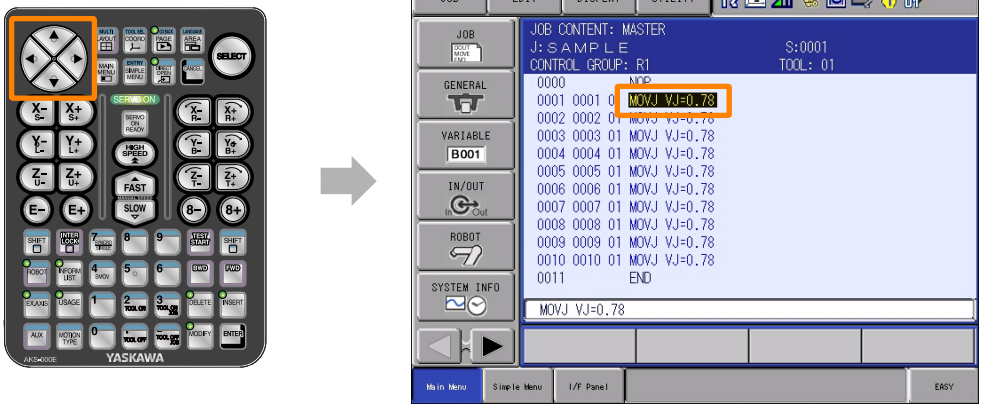
The sample program uses the MOVL instruction for the steps before and after the motion to close and open the hand. The sample program uses the MOVJ instruction for all other steps.

To recreate the sample program, change the instructions and speeds. Use the following procedure.

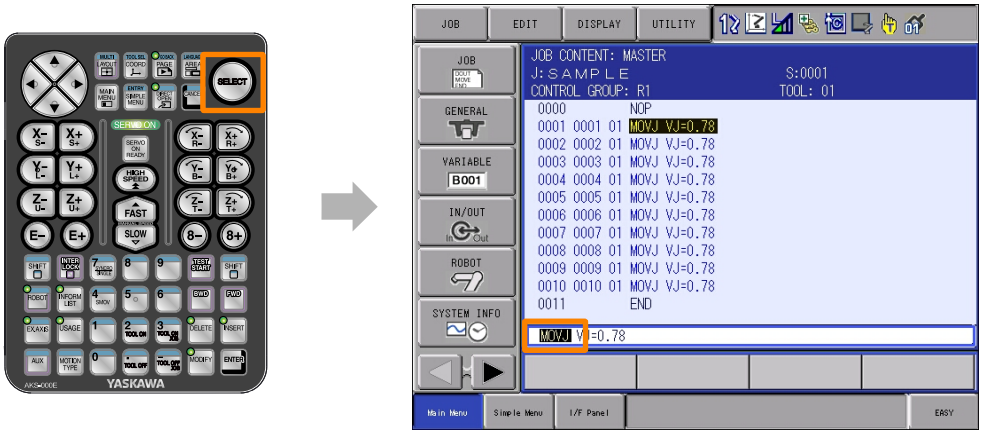
1. **Confirm that the following procedure was completed.**

   ☞ *8.2.2 Registering Manipulator Positions in the Program Using Direct Teach on page 117*

2. **Move the cursor to the instruction on step 1 by pressing the cursor keys on the programming pendant.**

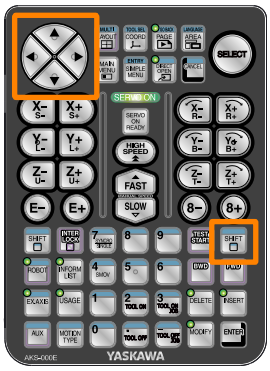


3. **Press [SELECT].**



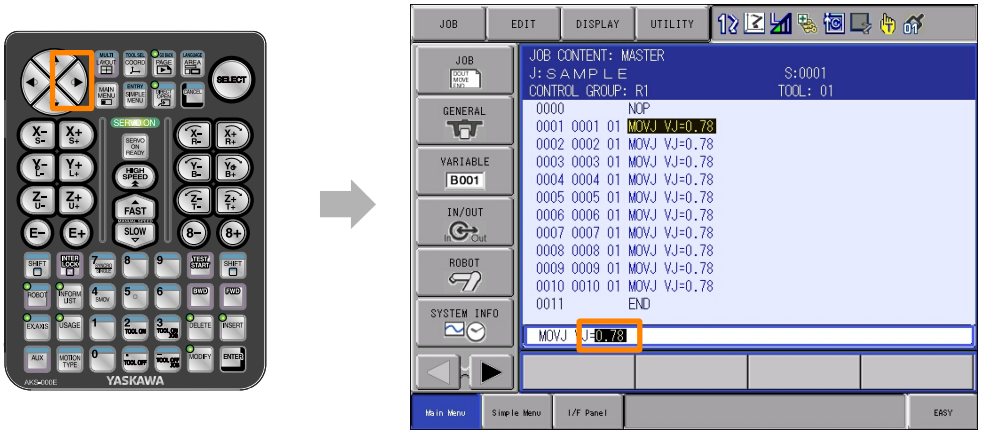
The cursor will be displayed in the instruction area.

4. **Press [SHIFT] and the cursor key at the same time.**



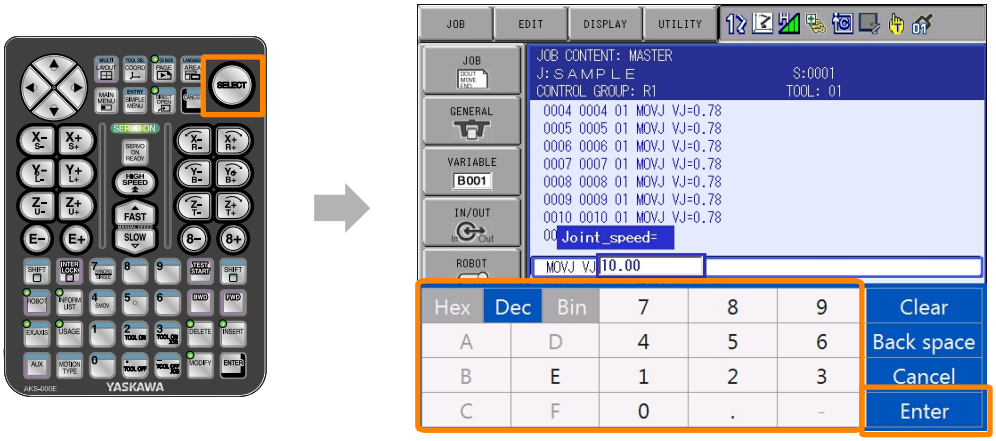
The instruction will change as follows each time the cursor key is pressed.
MOVJ → MOVL → MOVC → MOVS → (pattern repeats)

5. **When the instruction changes to "MOVJ", press the right cursor key.**

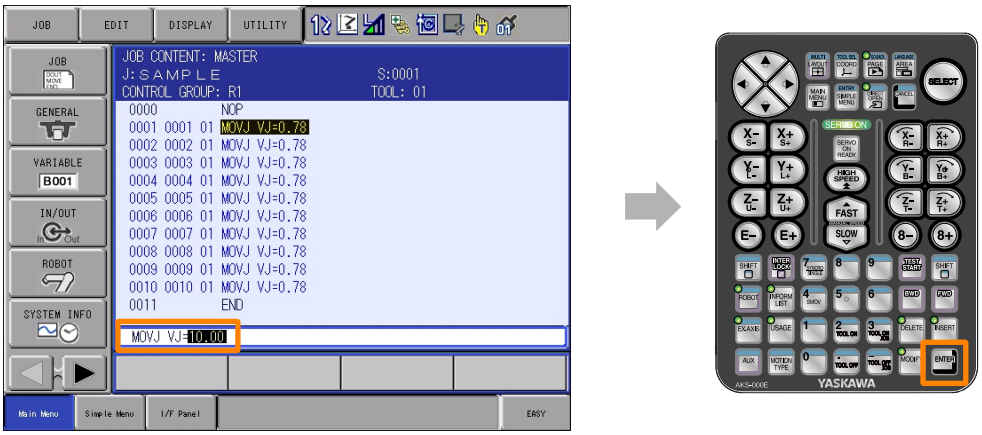


The cursor will be displayed in the numeric value area.

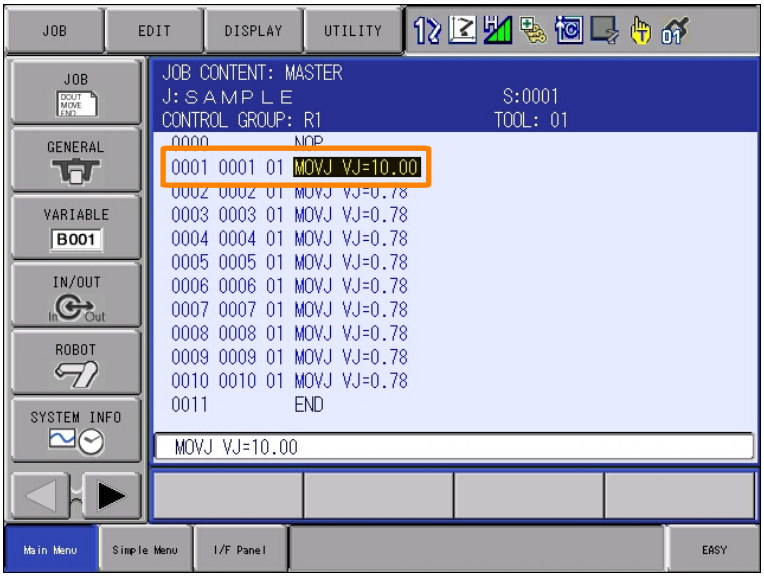
6. **Press [SELECT], enter "10.00" for the speed with the number buttons, and then touch {Enter}.**



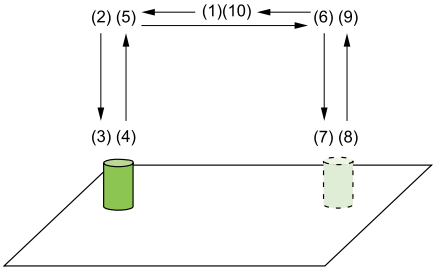
7. **Confirm the instruction and numeric value, and then press [ENTER].**

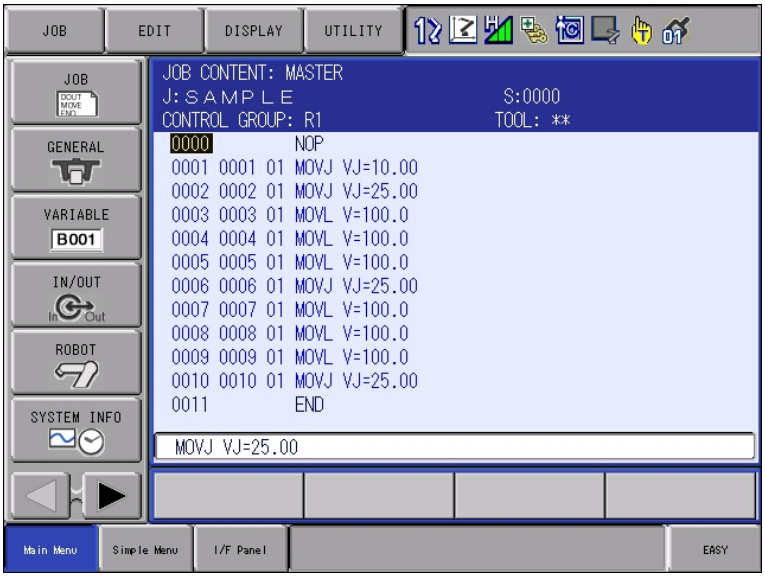


8. **Confirm that the instruction and speed for step 1 have changed.**



9. **Repeat steps 2 to 8 and change the following instructions and speeds as shown in the table.**

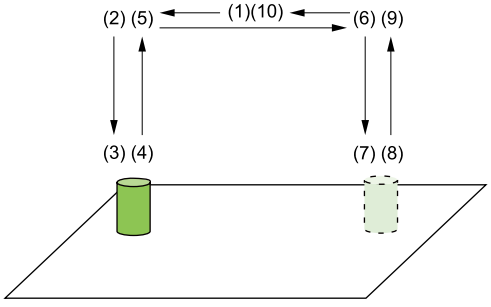
Manipulator Position		Step	Description of Position
	(1)	0001	MOVJ VJ=10.00
	(2)	0002	MOVJ VJ=25.00
	(3)	0003	MOVL V=100.0
	(4)	0004	MOVL V=100.0
	(5)	0005	MOVL V=100.0
	(6)	0006	MOVJ VJ=25.00
	(7)	0007	MOVL V=100.0
	(8)	0008	MOVL V=100.0
	(9)	0009	MOVL V=100.0
	(10)	0010	MOVJ VJ=25.00



This concludes the procedure. Proceed to the next step.

(3) Add Instructions to Close and Open the Hand

At position (4) in the sample program, the manipulator will close the hand and grasp the workpiece. At position (8), the manipulator will open the hand and release the workpiece.



The instructions to close and open the hand are not in the program that was created up to this point. These instructions must be added to the program.

Three instructions are required to close the hand, and three instructions are required to open the hand.

Information The descriptions here assume the hand has been installed and wired as described in the following section.

☞ *6 Mounting and Wiring the Hand on page 75*

- Close the Hand

Instruction	Description
DOUT OT#(7) OFF	Turns OFF output signal #7. OT#(7) on the manipulator is the open fingers signal.
DOUT OT#(8) ON	Turns ON output signal #8. OT#(8) on the manipulator is the close fingers signal.
WAIT IN#(8)=ON	Waits until input signal #8 is turned ON. IN#(8) on the manipulator is the auto switch output (fingers closed) signal. This signal provides confirmation of the hand closed sensor.

- Open the Hand

Instruction	Description
DOUT OT#(8) OFF	Turns OFF output signal #8. OT#(8) on the manipulator is the close fingers signal.
DOUT OT#(7) ON	Turns ON output signal #7. OT#(7) on the manipulator is the open fingers signal.
WAIT IN#(7)=ON	Waits until input signal #7 is turned ON. IN#(7) on the manipulator is the auto switch output (fingers opened) signal. This signal provides confirmation of the hand opened sensor.

Use the following procedure.

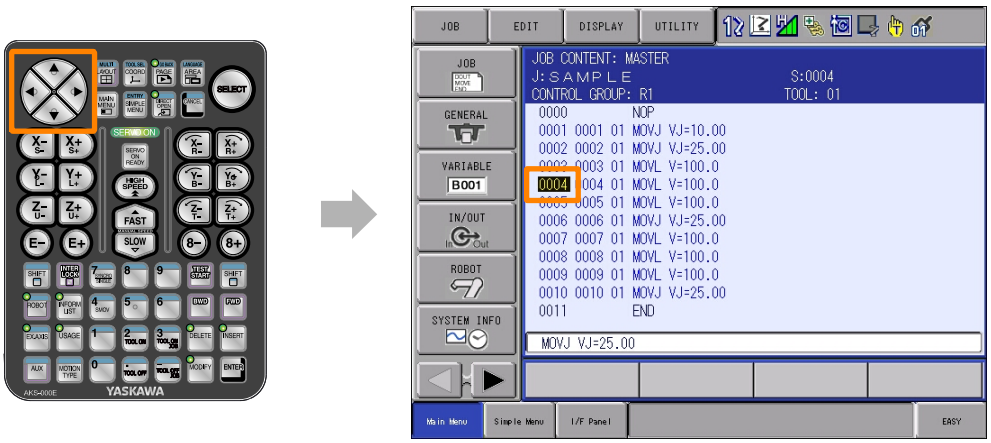
1. **Confirm that the following procedure was completed.**

   ☞ *(2) Change the Motion and Speed of the Manipulator on page 124*

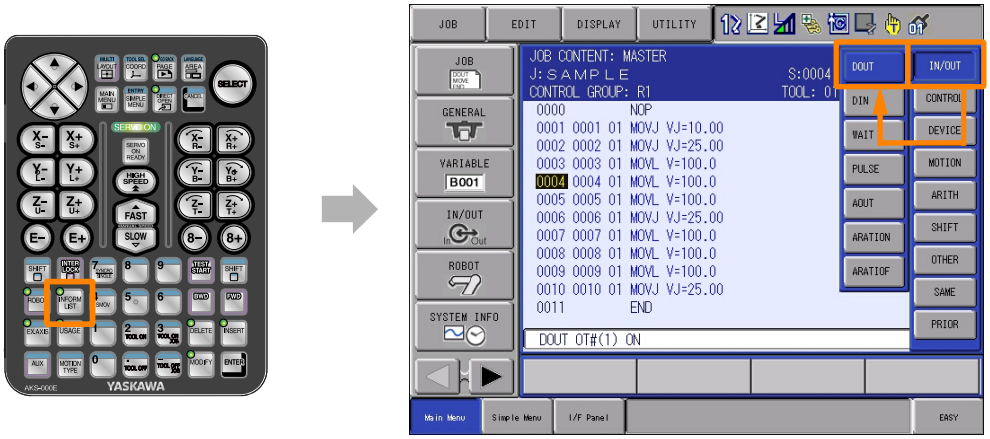
   First, the procedure to add the DOUT instruction to close the hand at position (4) will be described.

2. **Move the cursor to line number 0004 by pressing the cursor keys on the programming pendant, and confirm the cursor is not flashing.**

   Information The instruction will be added to the line below the cursor position. Place the cursor on line number 0004 here.

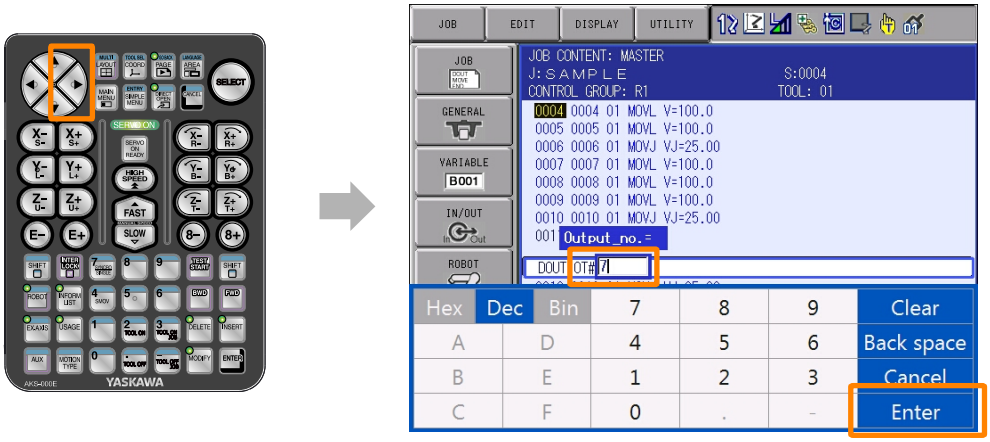


3. **Press [INFORM LIST] on the programming pendant, and touch {IN/OUT} - {DOUT} on the window.**

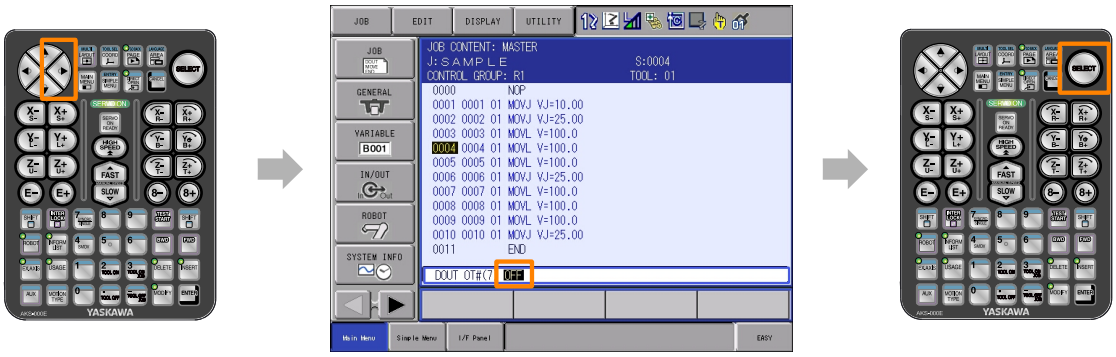


"DOUT" will be displayed at the bottom of the window.

4. **Move the cursor to "#(1)" with the cursor keys on the programming pendant, enter "7", and touch {Enter}.**

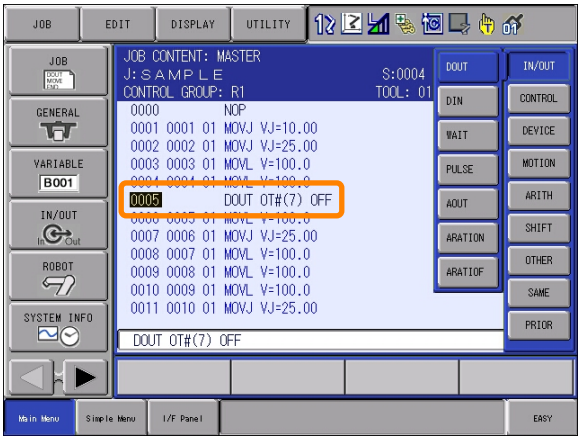


5. **Move the cursor to "ON" with the cursor keys on the programming pendant, and press [SELECT] to toggle ON/OFF.**



6. **Press [INSERT] - [ENTER] on the programming pendant.**

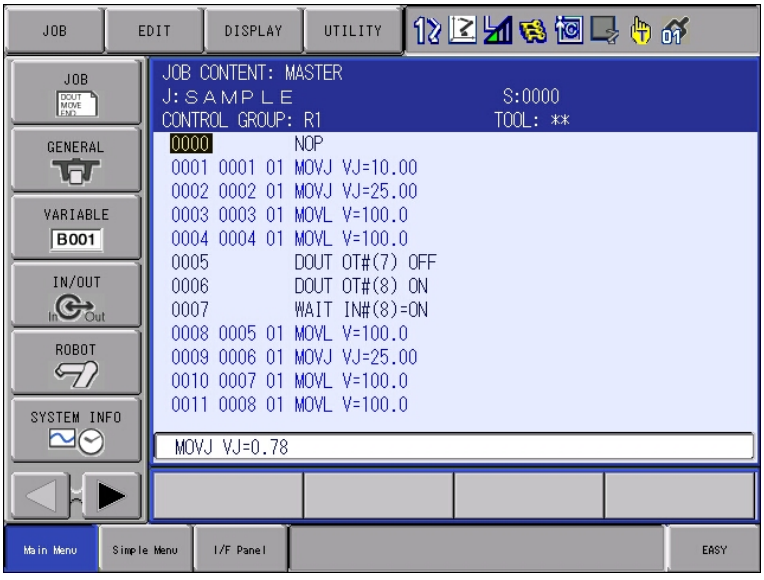
The DOUT instruction will be added to line number 0005.



7. **Repeat steps 2 to 6 and add/set the rest of the instructions.**

The line numbers at which to add the instructions and the details of those instructions are shown next.

Line No.	Step	Tool	Instruction/Additional Items	
0000			NOP	
0001	0001	00	MOVJ VJ=10.00	
0002	0002	00	MOVJ VJ=25.00	
0003	0003	00	MOVL V=100.0	
0004	0004	01	MOVL V=100.0	
0005			DOUT OT#(7) OFF	Close hand instruction
0006			DOUT OT#(8) ON	
0007			WAIT IN#(8)=ON	Confirmation of hand closed sensor
0008	0005	01	MOVL V=100.0	
0009	0006	01	MOVJ VJ=25.00	
0010	0007	01	MOVL V=100.0	
0011	0008	00	MOVL V=100.0	
0012			DOUT OT#(8) OFF	Open hand instruction
0013			DOUT OT#(7) ON	
0014			WAIT IN#(7)=ON	Confirmation of hand opened sensor
0015	0009	00	MOVL V=100.0	
0016	0010	00	MOVJ VJ=25.00	
0017			END END	



This concludes the procedure. Proceed to the next step.

(4) Change the Tool File

The sample program grasps the workpiece and moves it to a different location. For this reason, the tool file with the information for when the hand is not grasping the workpiece and the tool file with the information for when the hand is grasping the workpiece must be changed in the program.

Use the following procedure.

1. **Confirm that the following procedure was completed.**

   ☞ *(3) Add Instructions to Close and Open the Hand on page 127*

2. **Create the following two tool files.**

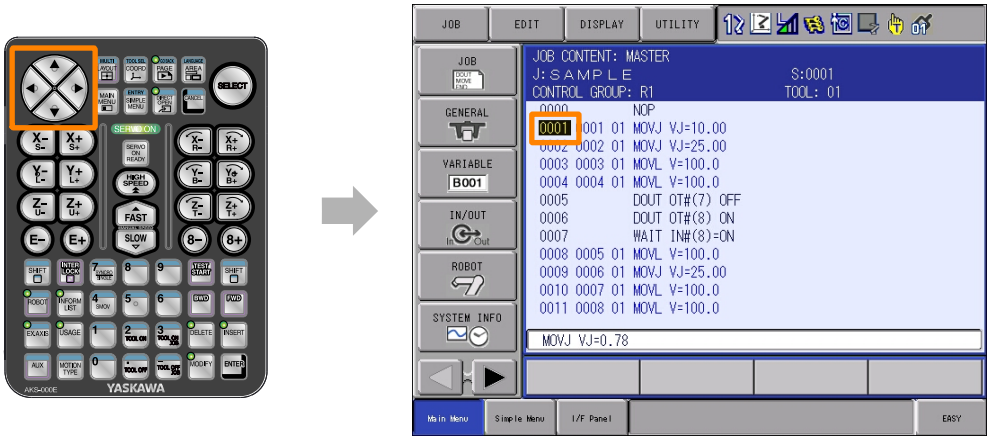
   - Information for when the hand is not grasping the workpiece
   - Information for when the hand is grasping the workpiece

   Refer to the following section for details on creating a tool file.

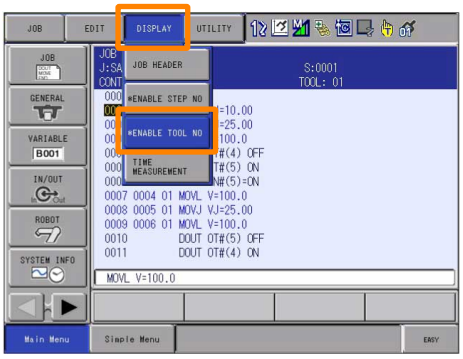
   ☞ *7.2 Configuring a Tool File on page 89*

3. **Press the cursor keys on the programming pendant to place the cursor on the step with the tool number to change.**

   Information Place the cursor on step 1 here because the tool number of step 1 will be changed from 01 to 00.

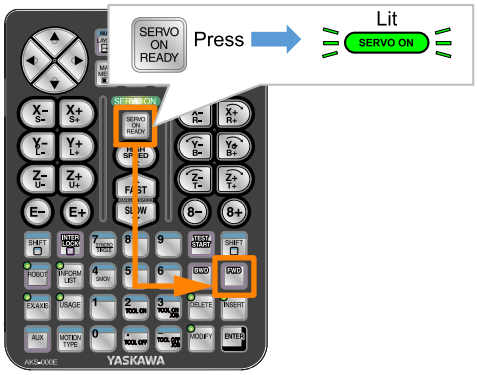


   Information If the tool number column is not displayed, touch {DISPLAY} - {ENABLE TOOL NO}.

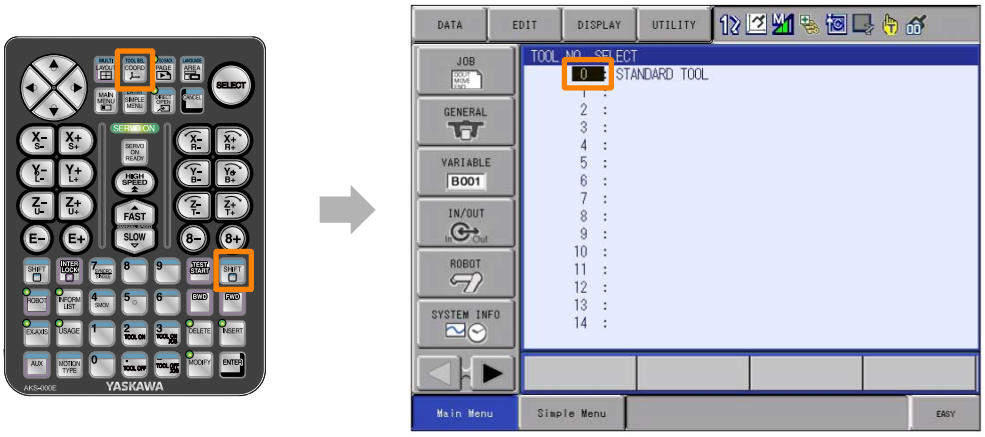


4. **Press [SERVO ON READY], and press and hold [FWD] while the [SERVO ON] lamp is lit.**

   Press and hold [FWD] until the step 1 cursor changes from flashing to solid.

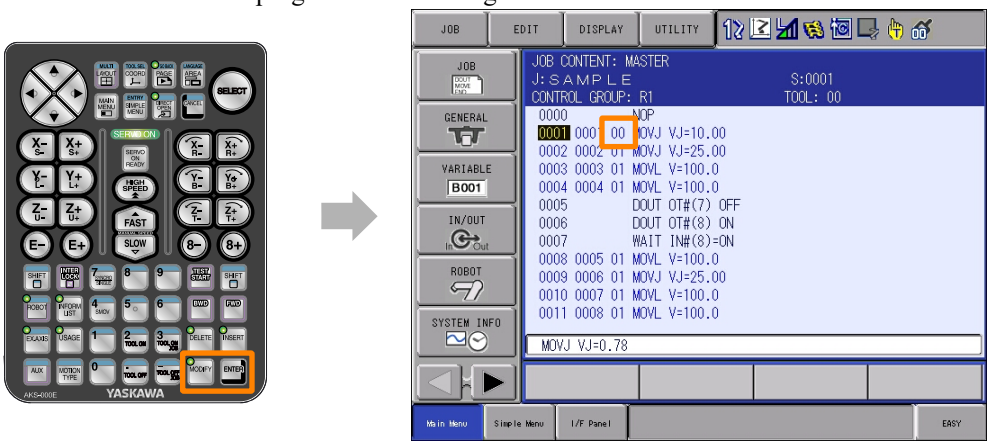


5. **Press [SHIFT] and [TOOL SEL COORD] to display the TOOL NO. SELECT window, and place the cursor on the tool number to change.**

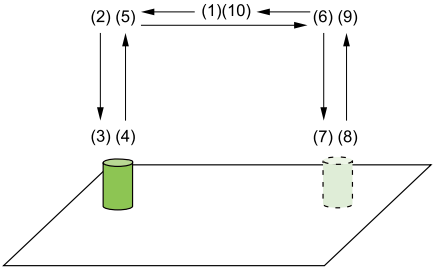


6. **Press [MODIFY] and [ENTER] at the same time.**

The tool number of the program will be changed.



7. **Repeat steps 3 to 6 and change the tool numbers as shown in the table.**

Manipulator Position		Step	Tool No.
	(1)	0001	00
	(2)	0002	00
	(3)	0003	00
	(4)	0004	01
	(5)	0005	01
	(6)	0006	01
	(7)	0007	01
	(8)	0008	00
	(9)	0009	00
	(10)	0010	00

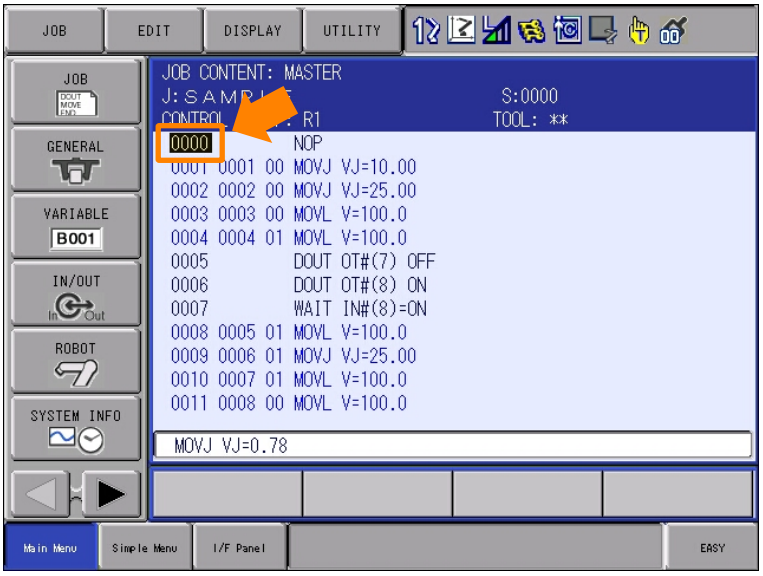
This concludes the procedure. Proceed to the next step.

8.2.4 Confirming Operation Step by Step

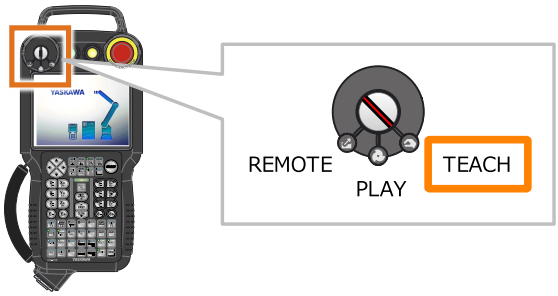
When creating the program is completed, confirm the operation of the manipulator while stepping through the created program (operation step by step).

1. **Confirm that nobody is near the manipulator.**

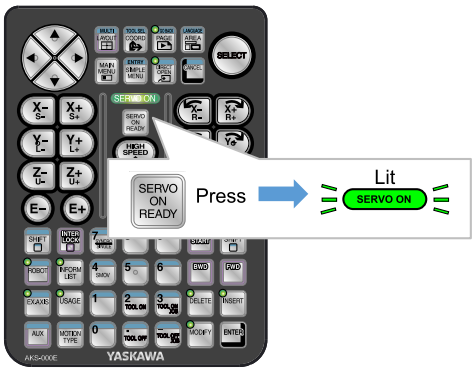
2. **Move the cursor on the programming pendant window to the first line (line number 0000) of the program that was created.**



3. **Set the mode key on the programming pendant to TEACH.**



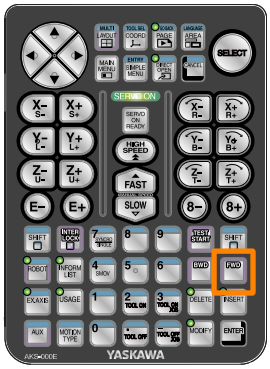
4. **Press [SERVO ON READY].**



The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

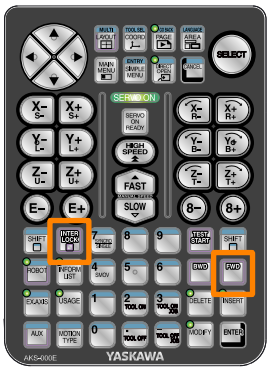
5. **Press and hold [FWD].**

The manipulator will move according to the programmed content on the line number of the cursor.



6. **Confirm that the manipulator moves according to the created program.**
7. **Run the program up to line number 0004 with steps 5 and 6 to confirm the operation of the manipulator.**

   The hand must be opened and closed for line numbers 0005 to 0007 and 0012 to 0014. Use the following operation to open and close the hand.
8. **While pressing [INTERLOCK] on the programming pendant, press [FWD].**



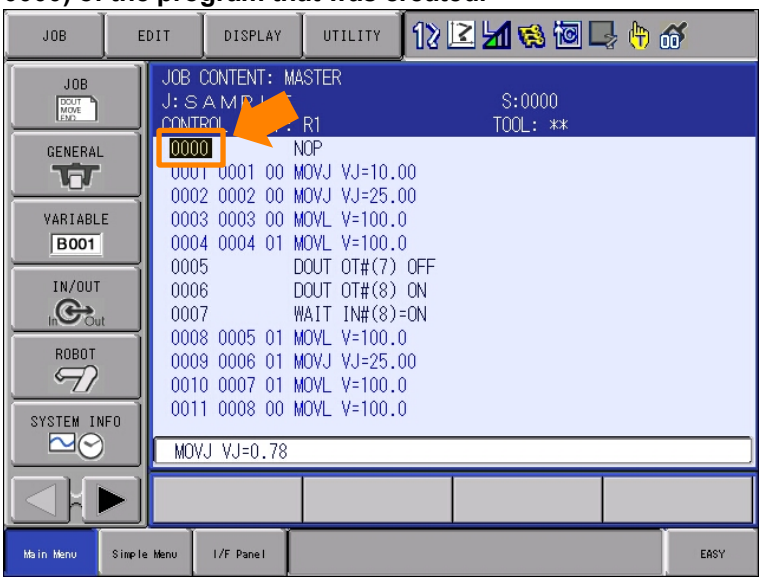
9. **Run the program up to the end with steps 5 and 8 to confirm the operation of the manipulator.**

This concludes the procedure.

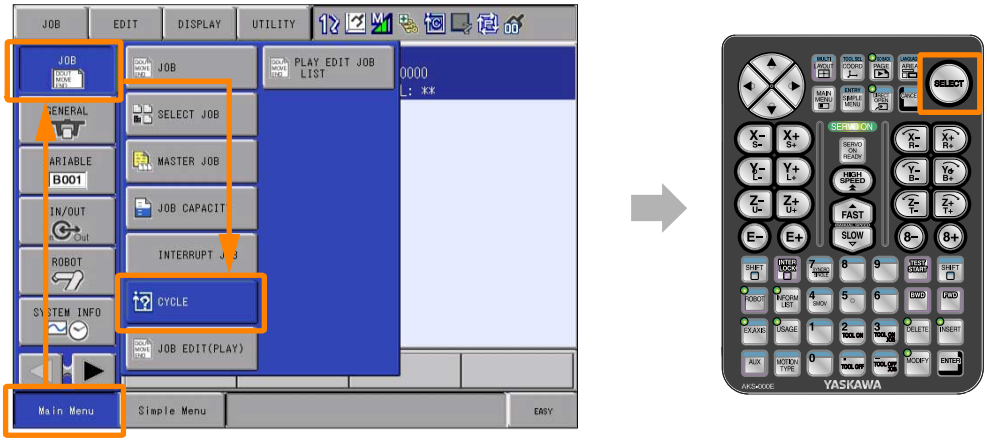
8.2.5 Running the Created Program

When confirming the operation of the manipulator is completed with step operation, run the program that was created for one cycle, and confirm that the manipulator moves as expected.

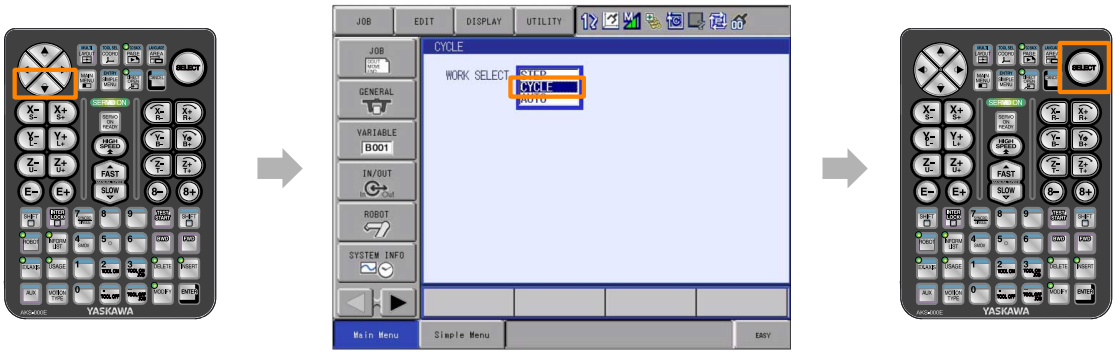
1. **Confirm that nobody is near the manipulator.**
2. **Move the cursor on the programming pendant window to the first line (line number 0000) of the program that was created.**



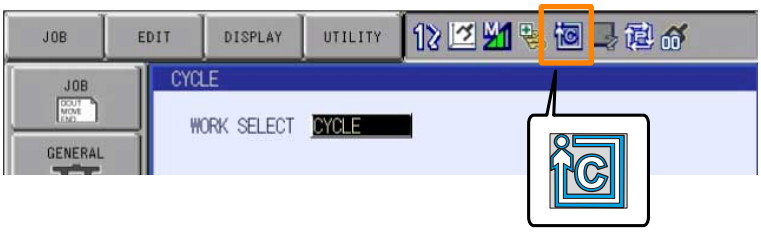
3. **Touch {JOB} - {CYCLE} on the programming pendant, and press [SELECT].**



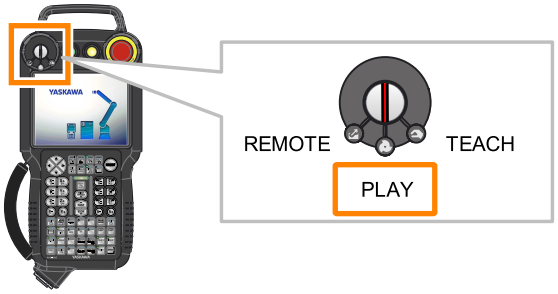
4. **Use the cursor keys to place the cursor on "CYCLE", and press [SELECT].**



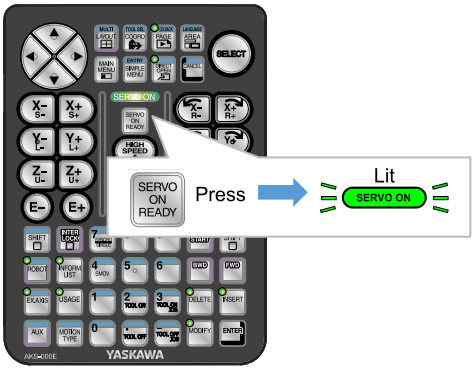
5. **Confirm that the icon on the programming pendant window changed to "CYCLE".**



6. **Set the mode key on the programming pendant to PLAY.**



7. **Press [SERVO ON READY].**



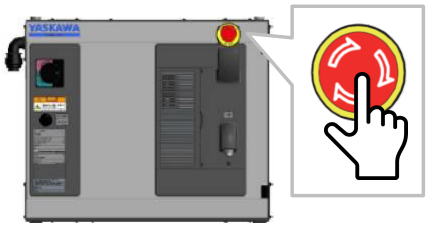
The [SERVO ON] lamp will be lit in green and the servo power will be turned ON.

8. **Press the start button.**

The start button will be lit, and the manipulator will start operation.

9. **Confirm that the manipulator moves according to the created program.**

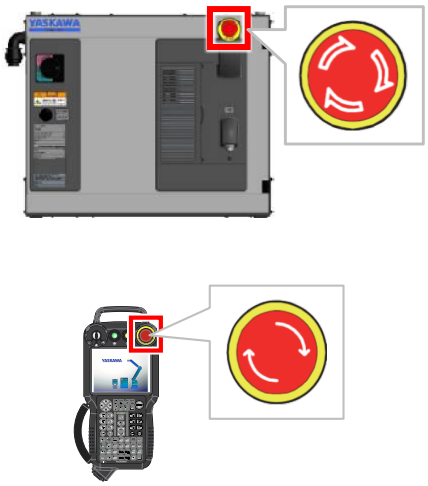
10. **Press the emergency stop button.**

YRC1000	YRC1000micro
There is an emergency stop button on the YRC1000.  The emergency stop button on the programming pendant can also be used. 	There is an emergency stop button on the programming pendant.  **Note:** The YRC1000micro is not equipped with an emergency stop button.

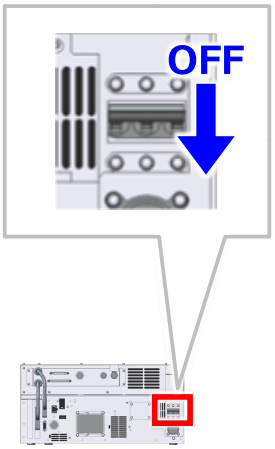
11. **Confirm that the [SERVO ON] lamp on the programming pendant goes out.**

The [SERVO ON] lamp not lit means the servo power has been turned OFF.

12. **Turn the emergency stop button in the direction of the arrows to reset the emergency stop.**

YRC1000	YRC1000micro
 or	

13. **Turn OFF the main power supply to the robot controller.**

YRC1000	YRC1000micro
	

This concludes the procedure.

Revision History

Date of Publication	Rev. No.	Section	Revised Contents
July 2023	<1>	1.2.3	Changed contents of "YRC1000 Robot Controller Accessories".
		2.1	Changed contents of "Transporting the Manipulator".
		2.2.3	Changed contents of "Fixing the Manipulator to the Floor".
		2.3	Changed contents of "Transporting the YRC1000 Robot Controller".
		4.2.1	Changed contents of "Correcting Alarm 6022 EXTERNAL FORCE ESTIMATION ERROR and Alarm 6004 ESCAPE FROM CLAMPING ERROR(PFL)".
		Chapter 6	Changed contents of "Mounting and Wiring the Hand".
		7.1	Changed contents of "Temporarily Disabling the Collaborative Operation Function".
		Chapter 8	Changed contents of "Programming".
November 2021	-	-	First edition

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Using the Programming Pendant

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