MELFA

Industrial Robots

Instruction Manual
(Setup, Basic Operation, Maintenance)

CR2/CR2A/CR2B
Controller

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⚠ Safety Precautions

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

⚠ CAUTION

All teaching work must be carried out by an operator who has received special training. (This also applies to maintenance work with the power source turned ON.)
→ Enforcement of safety training

⚠ CAUTION

For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠ WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠ CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠ WARNING

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠ CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠ CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠ CAUTION

Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

⚠ CAUTION Do not stop the robot or apply emergency stop by turning the robot controller's main power OFF.
If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

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

⚠WARNING

For using RH-5AH/10AH/15AH.
While pressing the brake releasing switch on the robot arm, beware of the arm which may drop with its own weight.
Dropping of the hand could lead to a collision with the peripheral equipment or catch the hands or fingers.

Revision history

Date of print	Specifications No.	Details of revisions
1999-06-16	BFP-A5991Z-*	・First print
1999-09-24	BFP-A5991Z-a	・Error in writing correction.
1999-11-12	BFP-A5991	・Error in writing correction.
2000-03-21	BFP-A5991-A	・"Removing and Installing the R6CPU Option Fixing Plate" is added. ・"The procedures for installing the pneumatic hand interface" is added. ・"Replacing the battery" is changed. ・Error in writing correction.
2000-12-18	BFP-A5991-B	・Error in writing correction.
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2001-10-31	BFP-A5991-E	・Standard configuration of RH-5AH series was added.
2002-02-20	BFP-A5991-F	・Error in writing correction.
2002-03-18	BFP-A5991-G	・CR2A-MB (controller protection box) was added. ・Error in writing correction.
2003-01-27	BFP-A5991-H	・"Cleaning of the radiating fins in the controller protection box (CR2A-MB)" was added. ・"Removal of the protection sheet on the teaching pendant" was added. ・"MC control output (AXMC) for addition axes" was added. ・Error in writing correction.
2003-10-29	BFP-A5991-J	・CR2B-574 controller was added. ・Error in writing correction.

■ Introduction

Thank you for purchasing the Mitsubishi industrial robot.
This instruction manual explains the unpacking methods, installation, basic operation, maintenance and inspection of the controller.
The optional equipments and power supply voltage are different according to connecting robot type.
Refer to separate "Standard Specifications Manual" for detail.
Always read through this manual before starting use to ensure correct usage of the robot.
The information contained in this document has been written to be accurate as much as possible. Please interpret that items not described in this document "cannot be performed."

・No part of this manual may be reproduced by any means or in any form, without prior consent from Mitsubishi.
・The details of this manual are subject to change without notice.
・An effort has been made to make full descriptions in this manual. However, if any discrepancies or unclear points are found, please contact your dealer.
・Please contact your nearest dealer if you find any doubtful, wrong or skipped point.

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1 Before starting use

This chapter explains the details and usage methods of the instruction manuals, the basic terminology and the safety precautions.

1.1 Using the instruction manuals

1.1.1 The details of each instruction manuals

The contents and purposes of the documents enclosed with this product are shown below. Use these documents according to the application.
For special specifications, a separate instruction manual describing the special section may be enclosed.

Safety Manual	Explains the common precautions and safety measures to be taken for robot handling, system design and manufacture to ensure safety of the operators involved with the robot.
Standard Specifications	Explains the product's standard specifications, factory-set special specifications, option configuration and maintenance parts, etc. Precautions for safety and technology, when incorporating the robot, are also explained.
Robot Arm Setup & Maintenance	Explains the procedures required to operate the robot arm (unpacking, transportation, installation, confirmation of operation), and the maintenance and inspection procedures.
Controller Setup, Basic Operation and Maintenance	Explains the procedures required to operate the controller (unpacking, transportation, installation, confirmation of operation), basic operation from creating the program to automatic operation, and the maintenance and inspection procedures.
Detailed Explanation of Functions and Operations	Explains details on the functions and operations such as each function and operation, commands used in the program, connection with the external input/output device, and parameters, etc.
Troubleshooting	Explains the causes and remedies to be taken when an error occurs. Explanations are given for each error No.

1.1.2 Symbols used in instruction manual

The symbols and expressions shown in Table 1-1 are used throughout this instruction manual. Learn the meaning of these symbols before reading this instruction manual.

Table 1-1 : Symbols in instruction manual

Symbol	Meaning
⚠DANGER	Precaution indicating cases where there is a risk of operator fatality or serious injury if handling is mistaken. Always observe these precautions to safely use the robot.
⚠WARNING	Precaution indicating cases where the operator could be subject to fatalities or serious injuries if handling is mistaken. Always observe these precautions to safely use the robot.
⚠CAUTION	Precaution indicating cases where operator could be subject to injury or physical damage could occur if handling is mistaken. Always observe these precautions to safely use the robot.
[JOINT]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
[＋／ＦＯＲＷＤ] ＋ [＋ Ｘ] （Ａ）　　（Ｂ）	This indicates to press the (B) key while holding down the (A) key. In this example, the [+/Forward] key is pressed while holding down the [+X/+Y] key.
[ＳＴＥＰ／ＭＯＶＥ] ＋([ＣＯＮＤ]→[ＲＰＬ ↓]) （Ａ）　　（Ｂ）　（Ｃ）	This indicates to hold down the (A) key, press and release the (B) key, and then press the (C) key. In this example, the [Step/Move] key is held down, the [Condition] key is pressed and released, and the [Replace ↓ key is pressed.
Ｔ／Ｂ	This indicates the teaching pendant.

1.2 Safety Precautions

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

⚠ CAUTION

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→ Enforcement of safety training

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For teaching work, prepare a work plan related to the methods and procedures of operating the robot, and to the measures to be taken when an error occurs or when restarting. Carry out work following this plan. (This also applies to maintenance work with the power source turned ON.)
→ Preparation of work plan

⚠ WARNING

Prepare a device that allows operation to be stopped immediately during teaching work. (This also applies to maintenance work with the power source turned ON.)
→ Setting of emergency stop switch

⚠ CAUTION

During teaching work, place a sign indicating that teaching work is in progress on the start switch, etc. (This also applies to maintenance work with the power source turned ON.)
→ Indication of teaching work in progress

⚠ DANGER

Provide a fence or enclosure during operation to prevent contact of the operator and robot.
→ Installation of safety fence

⚠ CAUTION

Establish a set signaling method to the related operators for starting work, and follow this method.
→ Signaling of operation start

⚠ CAUTION

As a principle turn the power OFF during maintenance work. Place a sign indicating that maintenance work is in progress on the start switch, etc.
→ Indication of maintenance work in progress

⚠ CAUTION

Before starting work, inspect the robot, emergency stop switch and other related devices, etc., and confirm that there are no errors.
→ Inspection before starting work

1.2.1 Precautions given in the separate Safety Manual

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

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

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

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

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

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

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

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

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If the robot controller main power is turned OFF during automatic operation, the robot accuracy could be adversely affected.

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

2 Unpacking to installation

2.1 Confirming the products

Confirm that the parts shown in the standard configuration of the controller shown in Table 2-1 are enclosed with the purchased product.
Users who have purchased options should refer to the separate "Standard Specifications". The primary power supply cable and grounding cable must be prepared by the customer.

Table 2-1 : Standard configuration

No.	Part name	Type	Qty.	Remarks
1	Controller	CR2-532 CR2-532M CR2A-572 CR2B-574	1 of these units	With machine cable. The fixing plate of memory cassette is attached to the CR2A-572/CR2B-574 controller.
2	Safety Manual	BFP-A8006	1 copy	
3	Standard Specifications	BFP-A8026	1 of these copy	RV-4A/5AJ/3AL/4AJL series type. (CR2-532/CR2-532M controller)
		BFP-A8228		RV-4A/5AJ/3AL/4AJL series type. (CR2A-572 controller)
		BFP-A8174		RH-5AH/10AH/15AH series type.
		BFP-A8322		RV-6S series type.
4	Instruction Manual (Robot arm setup and maintenance)	BFP-A8034	1 of these copy	RV-4A/5AJ/3AL/4AJL series type. (CR2-532/CR2-532M controller)
		BFP-A8229		RV-4A/5AJ/3AL/4AJL series type. (CR2A-572 controller)
		BFP-A8175		RH-5AH/10AH/15AH series type.
		BFP-A8323		RV-6S series type.
5	Instruction Manual (Controller setup, basic operation and maintenance)	BFP-A5991	1 copy	This book
6	Instruction Manual (Detailed explanations of functions and operations)	BFP-A5992	1 copy	
7	Instruction Manual (Troubleshooting)	BFP-A5993	1 copy	
8	Guarantee Card		1 copy	

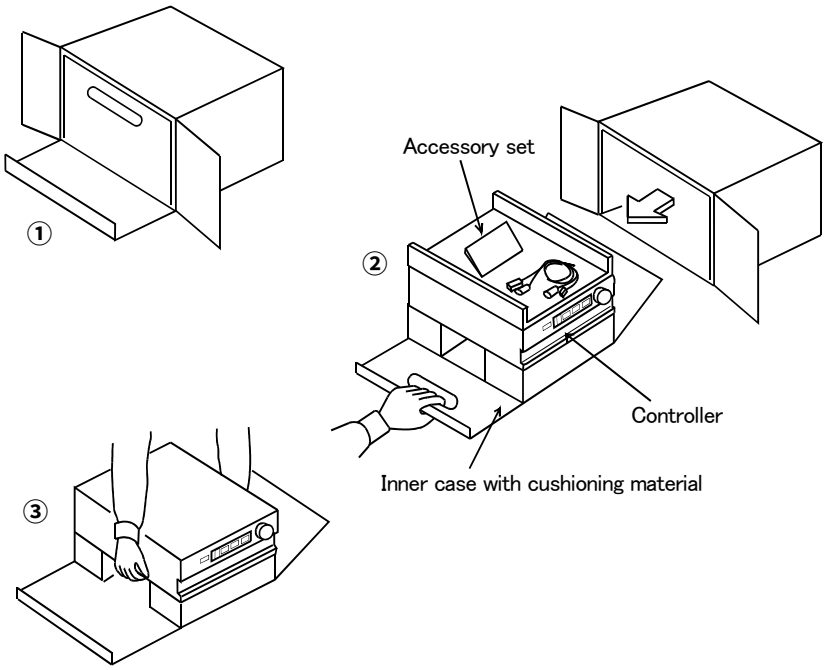
2.2 Installation

2.2.1 Unpacking procedures

The following shows how to unpack the controller.
The unpacking method differs, depending on the controller being used.
When the CR2-532/CR2A-572 controller is used, refer to " ■ For the CR2-532/CR2A-572/CR2B-574 Controller". When the CR2-532M controller is used, refer to " ■ For the CR2-532M Controller" on page 7.

■ For the CR2-532/CR2A-572/CR2B-574 Controller

<CR2-532/CR2A-572/CR2B-574>



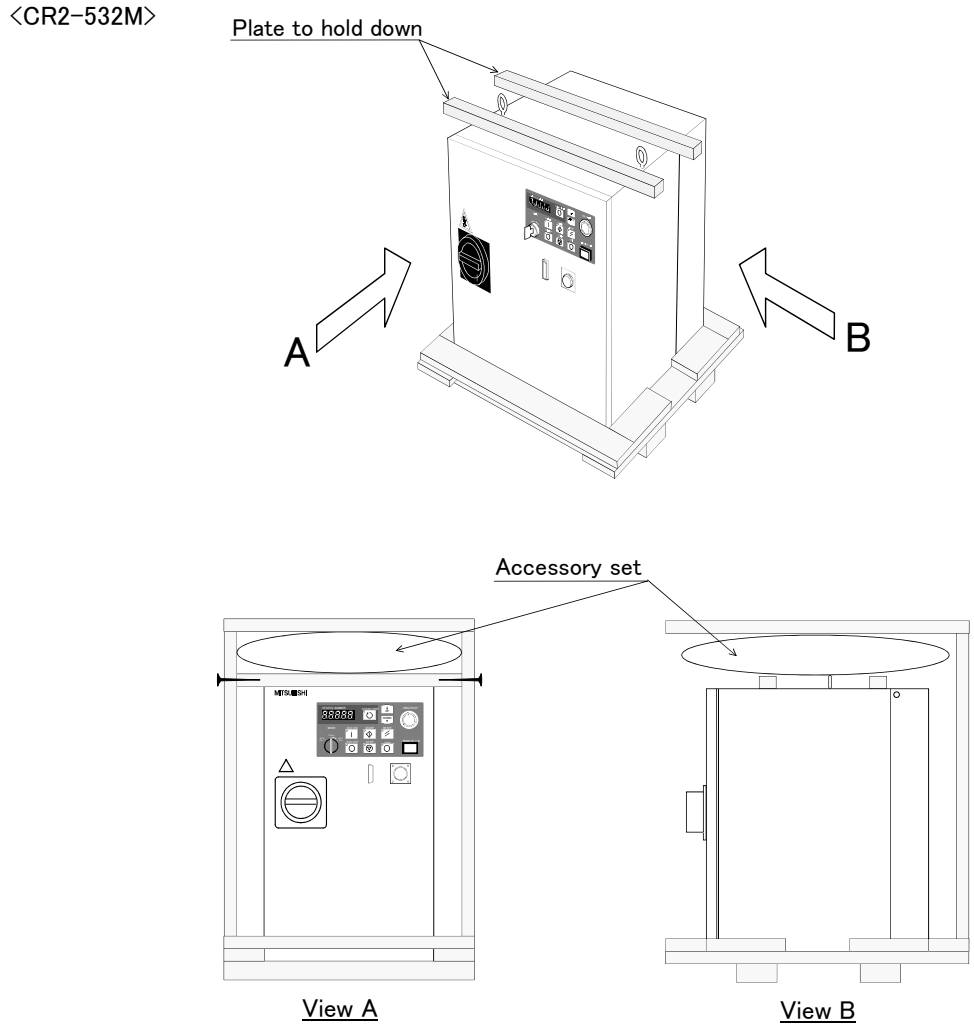
[Caution] The packaging material is required when transporting the controller again, so keep it in safekeeping.

Fig.2-1 : Unpacking the controller (CR2-532/CR2A-572/CR2B-574)

The controller is shipped from the factory packaged in cardboard. Unpack the controller with the following procedure.

(1) Open the front of the outer cardboard box.
(2) Hold the handle on the inner case (cardboard) with cushioning material, and pull it out.
(3) Remove the accessory set placed on the controller.
(4) Hold the controller with both hands, and remove the inner case with cushioning material.
Exercise caution, since the center of gravity of the controller is located toward the front of the unit.
(5) Set down the controller to complete the unpacking procedure.

■ For the CR2-532M Controller



[Caution] The packaging material is required when transporting the controller again, so keep it in safekeeping.

Fig.2-2 : Unpacking the controller (CR2-532M)

The controller is shipped from the factory packaged in wood frame. Unpack the controller with the following procedure.

(1) Remove the wood frame.
(2) Remove the accessory set placed on the top of the controller.
(3) Attach the wire hooks to the eye bolts enclosed with the controller, and suspend the controller with a crane to remove it from the packaging material.

2.2.2 Transportation procedures

The following shows how to transport the controller.
The transportation method differs, depending on the controller being used.
When the CR2-532/CR2A-572/CR2B-574 controller is used, refer to " ■ For the CR2-532/CR2A-572/CR2B-574 Controller".
When the CR2-532M controller is used, refer to " ■ For the CR2-532M Controller".

■ For the CR2-532/CR2A-572/CR2B-574 Controller

The controller must always be transported by two workers.

<CR2-532/CR2A-572/CR2B-574>

Fig.2-3 : Transporting the controller (CR2-532/CR2A-572/CR2B-574)

(1) Transport the controller by placing hands between the lower clearance created with the rubber foot on the front and back sides, and lifting up the controller. Do not hold the switches or connectors.

■ For the CR2-532M Controller

<CR2-532M> Mass : 35kg

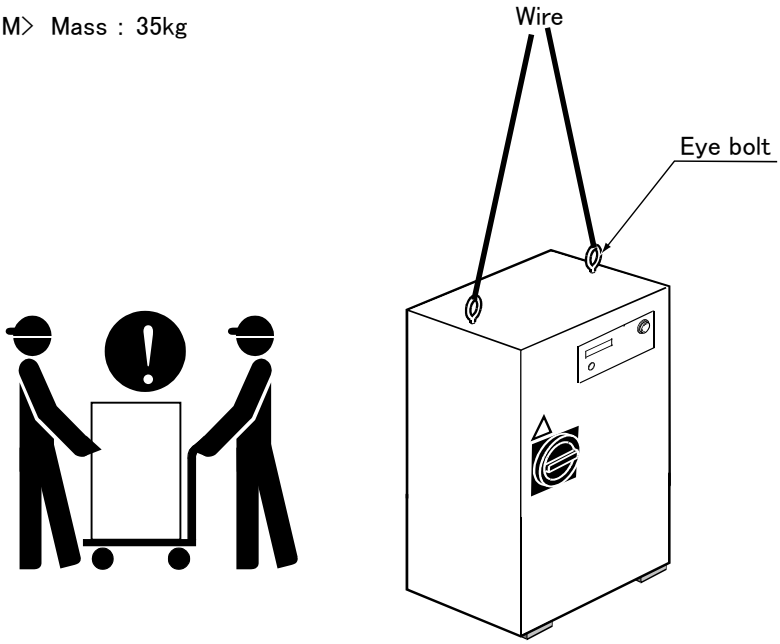


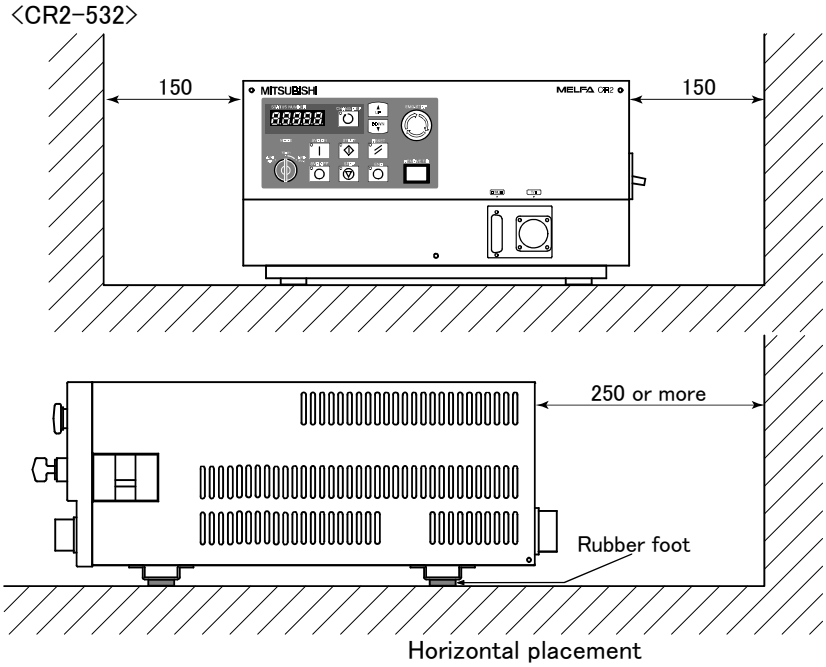
Fig.2-4 : Transporting the controller (CR2-532M)

(1) Two workers must transport the controller using a crane or lifter.

2.2.3 Installation procedures

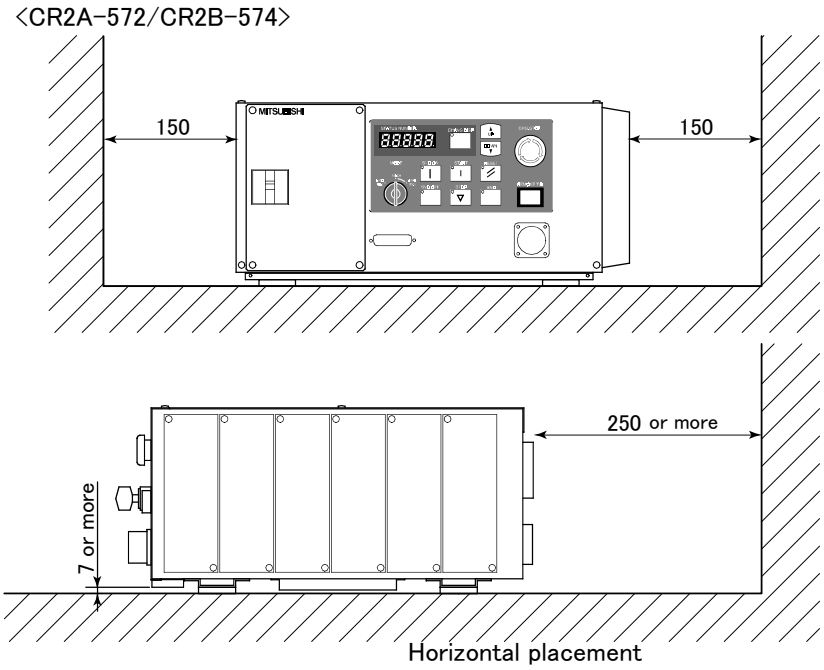
The installed size according to controller's type-identifier is shown as follows.

■ For the CR2-532/CR2A-572/CR2B-574 Controller



⚠CAUTION

Remove the rubber foot (4 positions) of the bottom and fix it when fixing the CR2-532 controller with the installation screw.



*The left figure shows the CR2A-572 controller for example. The RS-232C connector is installed vertically as the controller type is "CR2B-574".

⚠CAUTION

Use the rubber foot (4 positions) at the bottom of the controller as it is, or put the spacer, and leave the space between the installation side and the controller installation side more than 7mm when you fix the controller with the installation screw.
In the other case, the air intake hole at the bottom of the controller is occupied, and temperature rises in the board, and causes the trouble.

Fig.2-5 : Installation dimensions(CR2-532/CR2A-572/CR2B-574)

(1) For the CR2-532 controller, do not block the ventilation holes on the sides of the controller.
For the CR2A-572/CR2B-574 controller, do not block the air intake hole at the bottom of the controller.

(2) When storing the controller in a cabinet, etc., take special care to the heat radiating properties and ventilation properties so that the ambient temperature remains within the specification values.

The controller can be placed vertically. Contact your nearest dealer for information.

■ For the CR2-532M Controller

<CR2-532M>

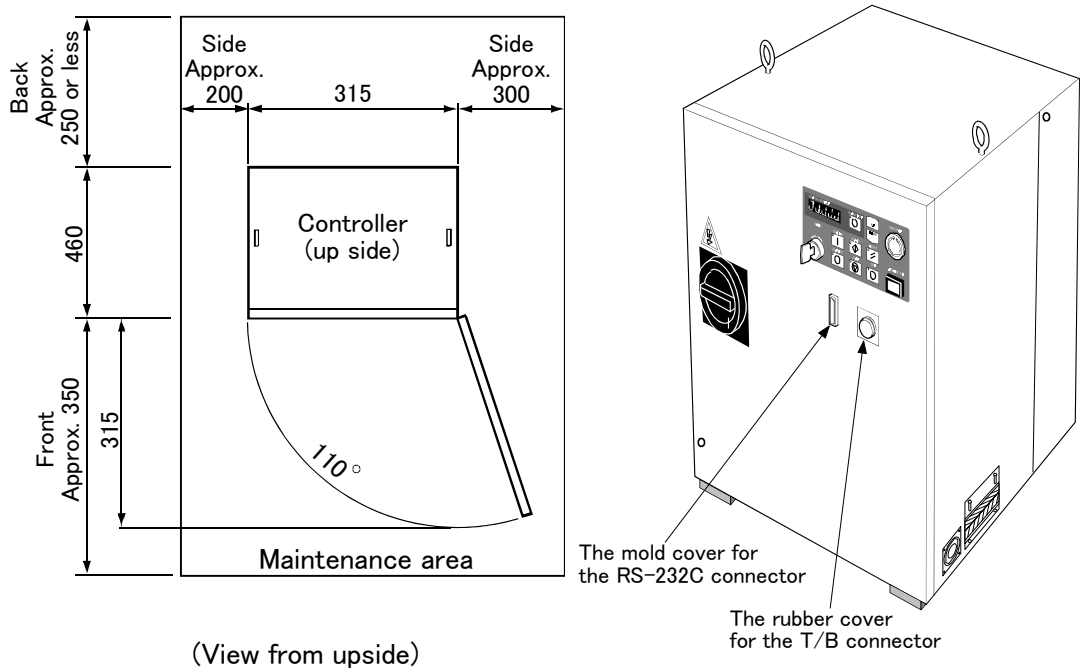


Fig.2-6 : Installation dimensions (CR2-532M)

(1) Install the controller so that it is level.

⚠CAUTION

Install the rubber cover for the T/B connector when the T/B un-connection.
In the same way, install the mold cover for the RS-232C connector when the RS-232C cable un-connection. When it is not so, it has the possibility that the controller breaks down due to the penetration such as oil.

2.2.4 Connecting the power cable and grounding cable

The following shows how to connect the power and grounding cables.
The cable-connection method differs, depending on the controller being used.
When the CR2-532 controller is used, refer to " ■ For the CR2-532 Controller". When the CR2A-572/CR2B-574 controller is used, refer to " ■ For the CR2A-572/CR2B-574 Controller" on page 12. When the CR2-532M controller is used, refer to " ■ For the CR2-532M Controller" on page 13.

■ For the CR2-532 Controller

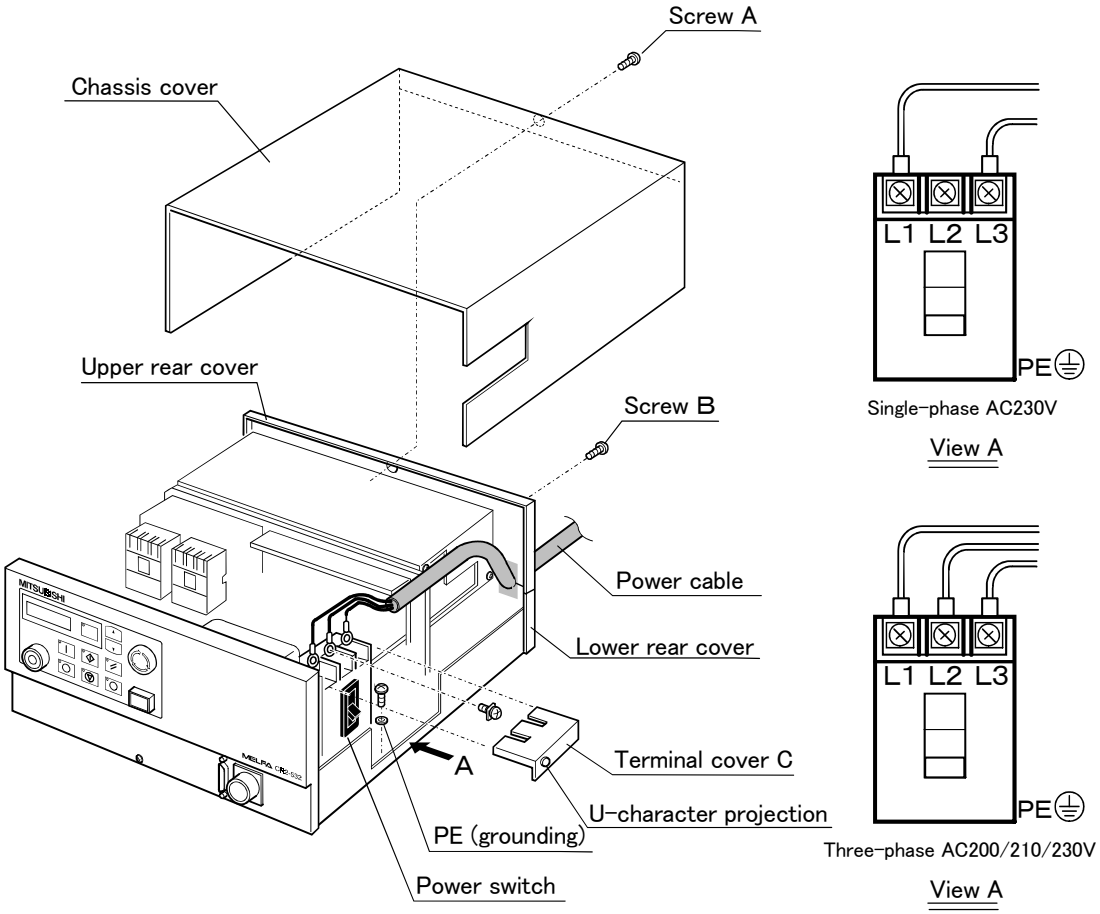


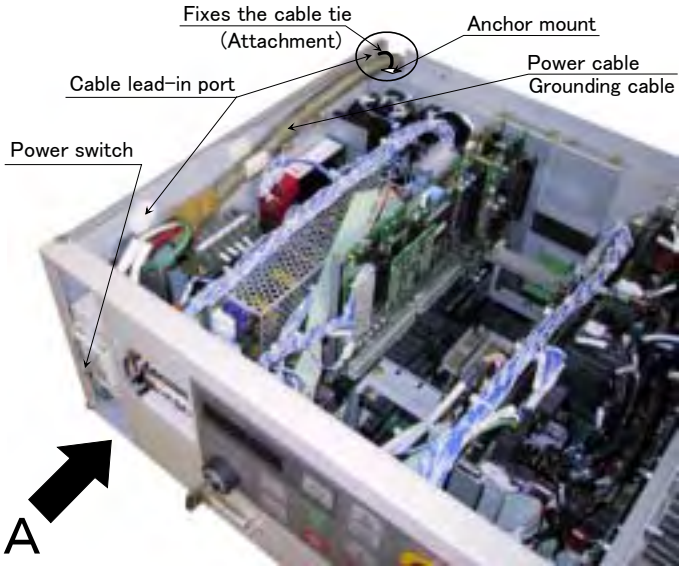
Fig.2-7 : Connecting the power cable and grounding cable(CR2-532)

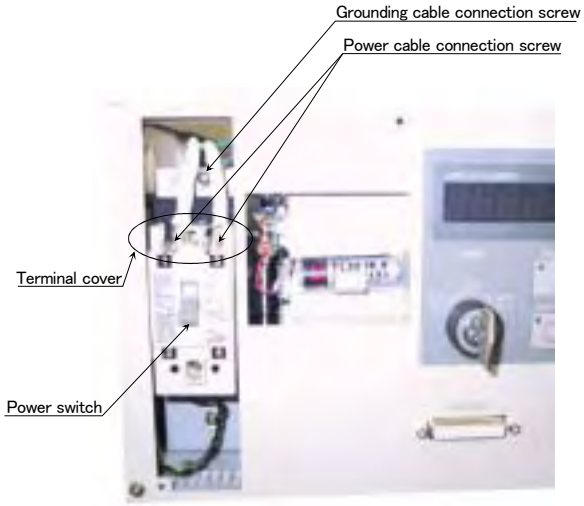
(1) Prepare the power cable and grounding cable (both must be AWG#14(2mm^2) or more thickly).
(2) Remove the controller's chassis cover. Remove screw A, slide the cover by approx. 100mm to the back side, and lift it upward.
(3) Remove the upper rear cover by removing the four screws B on the rear side.
(4) Confirm that the primary power supply matches the specifications.
(5) Confirm that the primary power supply is OFF and that the power switch on the controller is OFF.
(6) Pull out the power switch terminal cover C by pulling on the U-character projection on the front with fingers.
(7) Connect the power cable to the power switch terminals. (L1, L2 and L3 from left)
(8) Connect the grounding cable to the controller chassis screw hole (M4) at the right side of the power switch. (PE mark)
(9) Press in the power switch terminal cover C (removed in step (6)), until a "click" is heard.
(10) Install the upper rear cover.
At this time, sandwich the power cable and grounding cable with the rubber bushing installed on the lower rear cover and upper rear cover. If required, cut the rubber bushing to a round shape.
(11) Securely fix the chassis cover (removed in step (2)) with screw A. The chassis cover is structured to sandwich the chassis sides, so carefully fit and slide it into position, and then fix.

This completes the connection of the power and grounding cables of the CR2-532 controller.

■ For the CR2A-572/CR2B-574 Controller

*The left figure shows the CR2A-572 controller for example. The RS-232C connector is installed vertically as the controller type is "CR2B-574".





View from A

Fig.2-8 : Connecting the power cable and grounding cable (CR2A-572/CR2B-574)

(1) Prepare the power cable and grounding cable (both must be AWG#14(2mm^2) or more thickly).
(2) Remove the controller's chassis cover (top board) by removing the four installation screws. To remove the chassis cover, slide it to the rear and then lift it. Also, remove the battery cover from the front of the controller by removing the four installation screws.
(3) Confirm that the primary power supply matches the specifications.
(4) Confirm that the primary power supply is OFF and that the power switch on the controller is OFF.
(5) Pull out the terminal cover of the power switch.
(6) Insert the power cable and grounding cable from the cable lead-in port on the side or rear of the controller.
(7) Connect the power cable to the power switch terminals.
(8) Connect the grounding cable with the screw hole (M4) on the controller's chassis, located above the power switch (PE marking).
(9) Press in the power switch terminal cover, until a "click" is heard.
(10) Re-install both the controller's chassis and the battery cover back.

This completes the connection of the power and grounding cables of the CR2A-572/CR2B-574 controller.

■ For the CR2-532M Controller

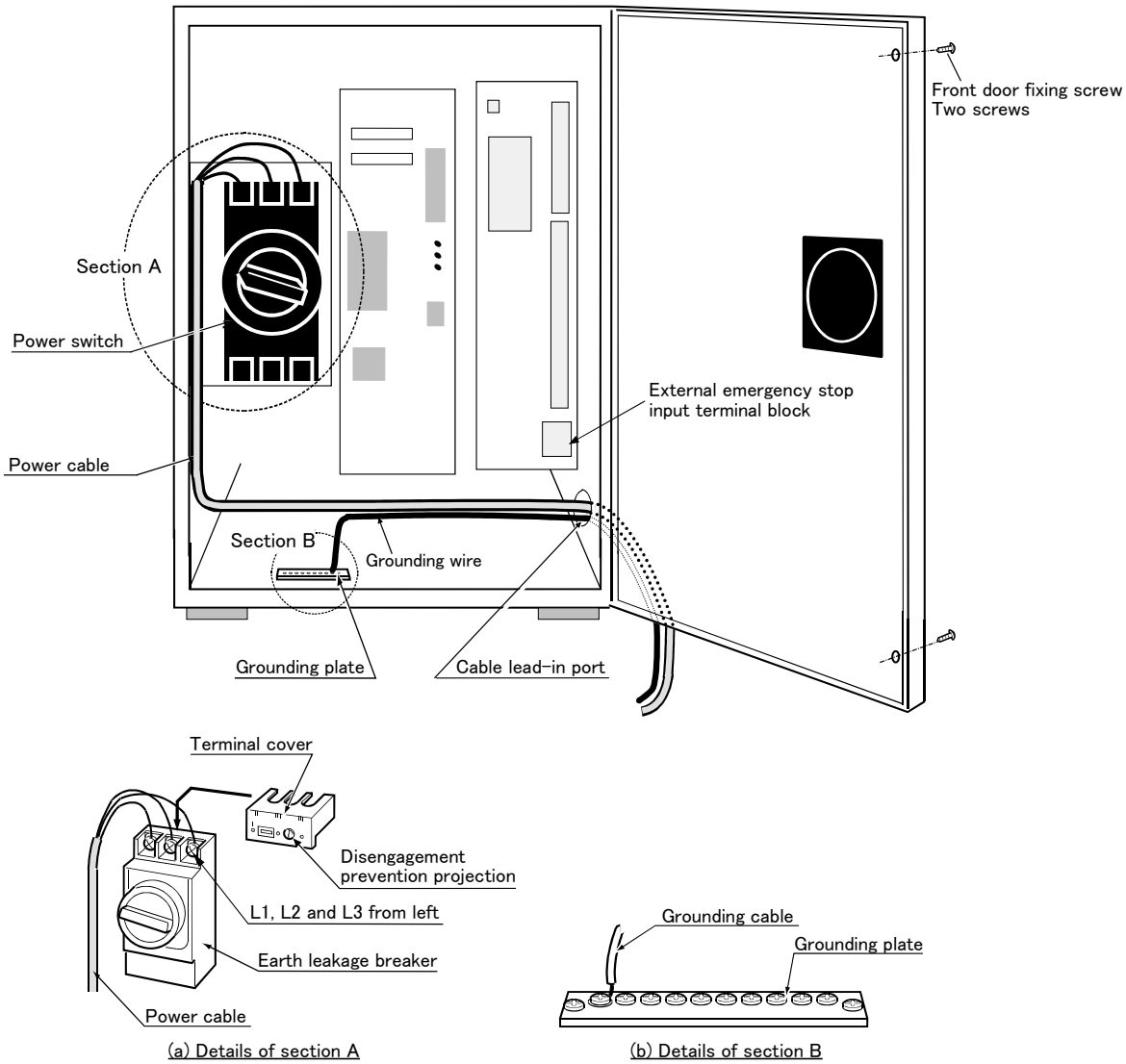


Fig.2-9 : Connecting the power cable and grounding cable (CR2-532M)

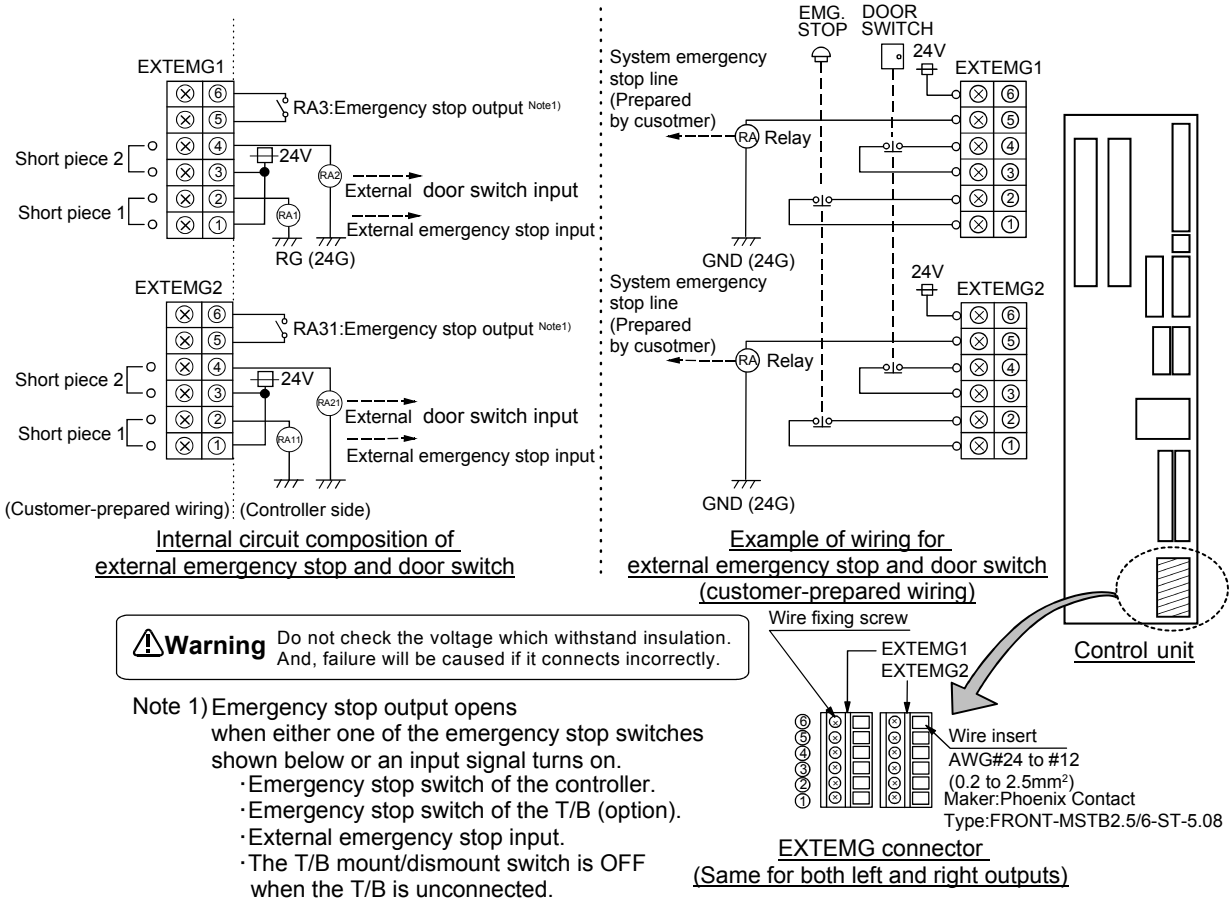
(1) Prepare the power cable and grounding cable (both must be AWG#14(2mm^2) or more thickly).
(2) Loosen the two screws fixing the controller's front door, and open the front door.
(3) Pull out the disengagement prevention projection on the terminal cover surface of the earth leakage breaker by disengaging it with your finger.
(4) Confirm that the primary power matches the specifications.
(5) Confirm that the primary power is OFF and that the controller power switch is OFF.
(6) Insert the power cable and grounding cable from the cable lead-in port on the bottom of the controller.
(7) Connect the power cable to the power switch terminal. (L1, L2 and L3 from left)
(8) Connect the grounding cable to the grounding plate terminal.
(9) Insert the power switch terminal cover removed in step (3) until a "click" is heard.
(10) Close the controller's front door, and fix with the fixing screws.

This completes the connection of the power and grounding cables of the CR2-532M controller.

2.2.5 Connecting the external emergency stop

The following shows how to connect the external emergency stop.
Please note that the connection method differs, depending on the controller being used.
When the CR2-532/CR2-532M controller is used, refer to " ■ For the CR2-532/CR2-532M Controller".
When the CR2A-572/CR2B-574 controller is used, refer to " ■ For the CR2A-572/CR2B-574 Controller" on page 15.

■ For the CR2-532/CR2-532M Controller



⚠Warning Do not check the voltage which withstand insulation. And, failure will be caused if it connects incorrectly.

Note 1) Emergency stop output opens when either one of the emergency stop switches shown below or an input signal turns on.
- ·Emergency stop switch of the controller.
- ·Emergency stop switch of the T/B (option).
- ·External emergency stop input.
- ·The T/B mount/dismount switch is OFF when the T/B is unconnected.

Fig.2-10 : Connecting the external emergency stop (CR2-532/CR2-532M)

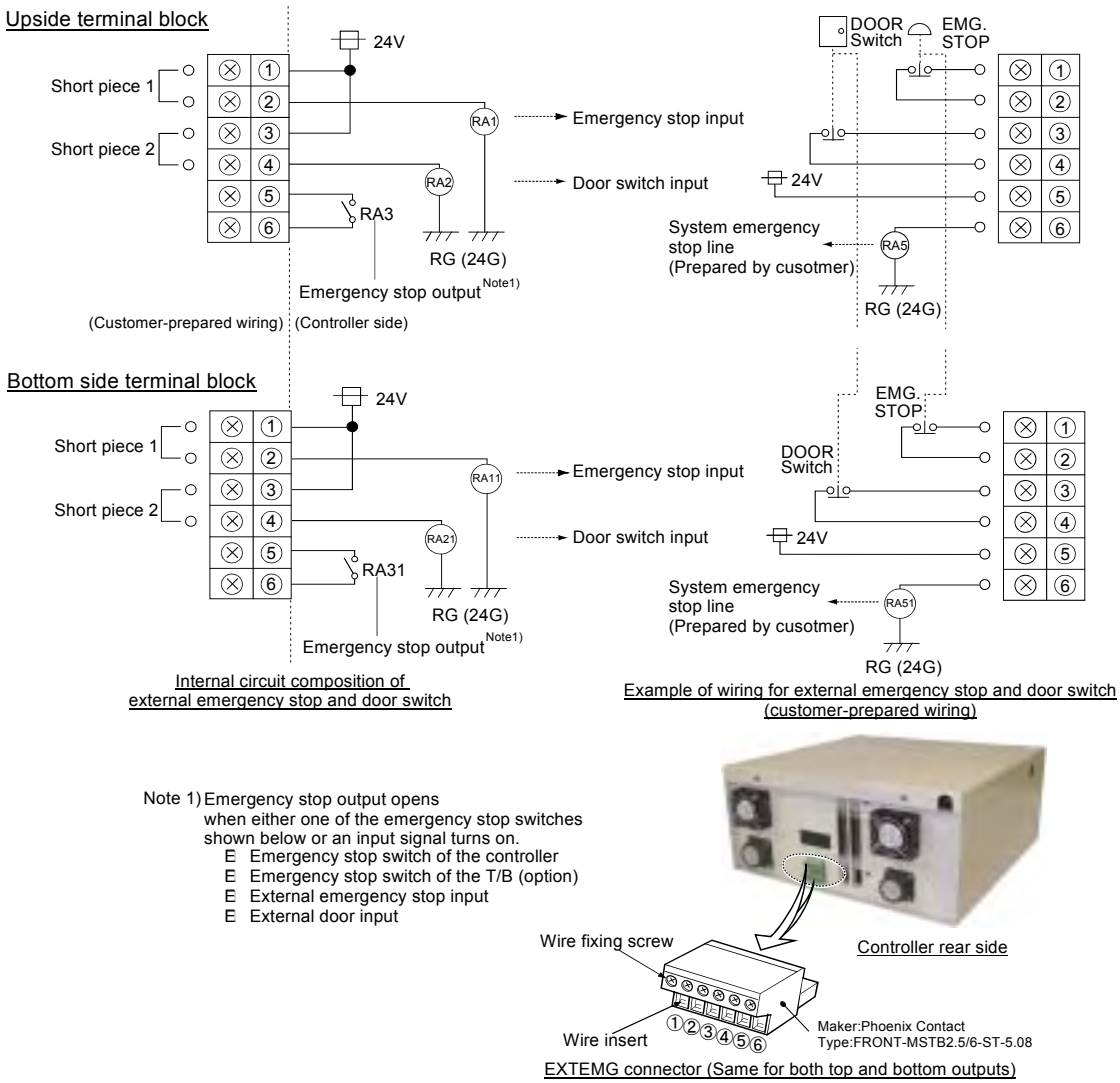
For safety purposes, install the External emergency stop switch at an easy-to-operate place.
The external emergency stop input and door switch input terminal block are short-circuited with a short bar (short piece) as shown in Fig. 2-10.
Connect the external emergency stop switch and door switch with the following procedures. The emergency stop circuit in the controller is redundant (duplex), so use a 2-contact type switch for the emergency stop switch.

1) Prepare the emergency stop switch and door switch.
2) Loosen the wire fixing screw on the terminal block, and remove the short bars 1 and 2.
3) Securely connect the external emergency stop contact across "1-2" on the terminal block, and connect the door switch contact across "3-4" on the terminal block. The connection method is indicated below.

[Caution] When wiring the emergency stop switch (duble emergency line type), wire both contacts to the two terminal blocks on the controller. If both contacts are wired to only one of the terminal blocks, errors cannot be cancelled using the door switch.

This completes the connection of the external emergency stop of the CR2-532/CR2B-532M controller.

■ For the CR2A-572/CR2B-574 Controller



Note 1) Emergency stop output opens when either one of the emergency stop switches shown below or an input signal turns on.
- Emergency stop switch of the controller
- Emergency stop switch of the T/B (option)
- External emergency stop input
- External door input

Fig.2-11 : Connecting the external emergency stop (CR2A-572/CR2B-574)

For safety purposes, install the external emergency stop switch and door switch at an easy-to-operate place. The external emergency stop input and door switch input terminal block are short-circuited with a short bar (short piece) as shown in Fig. 2-11.
Connect the external emergency stop switch and door switch with the following procedures. The emergency stop circuit in the controller is redundant (duplex), so use a 2-contact type switch for the emergency stop switch.

1) Prepare the emergency stop switch and door switch.
2) Loosen the wire fixing screw on the terminal block, and remove the short bars 1 and 2.
3) Securely connect the external emergency stop contact across "1-2" on the terminal block, and connect the door switch contact across "3-4" on the terminal block. The connection method is indicated below.
   a) Loosen the wire fixing screw on the terminal block, and open the wire insertion port.
   b) Peel 5 to 7mm of the sheath off the wire (AWG24 to 16 recommended).
   c) Insert the wire into the wire insertion port.
   d) Securely tighten the wire fixing screw to fix the wire.

[Caution] When wiring the emergency stop switch (duble emergency line type), wire both contacts to the two terminal blocks on the controller. If both contacts are wired to only one of the terminal blocks, errors cannot be cancelled using the door switch.

This completes the connection of the external emergency stop of the CR2A-572/CR2B-574 controller.

2.2.6 Magnet contactor control connector output (AXMC) for addition axes (When using the CR2A-572/CR2B-574 controller)

When an additional axis is used, the servo ON/OFF status of the additional axis can be synchronized with the servo ON/OFF status of the robot itself by using the output contact (AXMC1) provided on the back of the controller and configuring a circuit so that the power to the servo amplifier for the additional axis can be turned off when this output is open.

Fig. 2-12 shows an example of its circuit, and Fig. 2-13 show the layout drawings of the output contact (AXMC1). When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

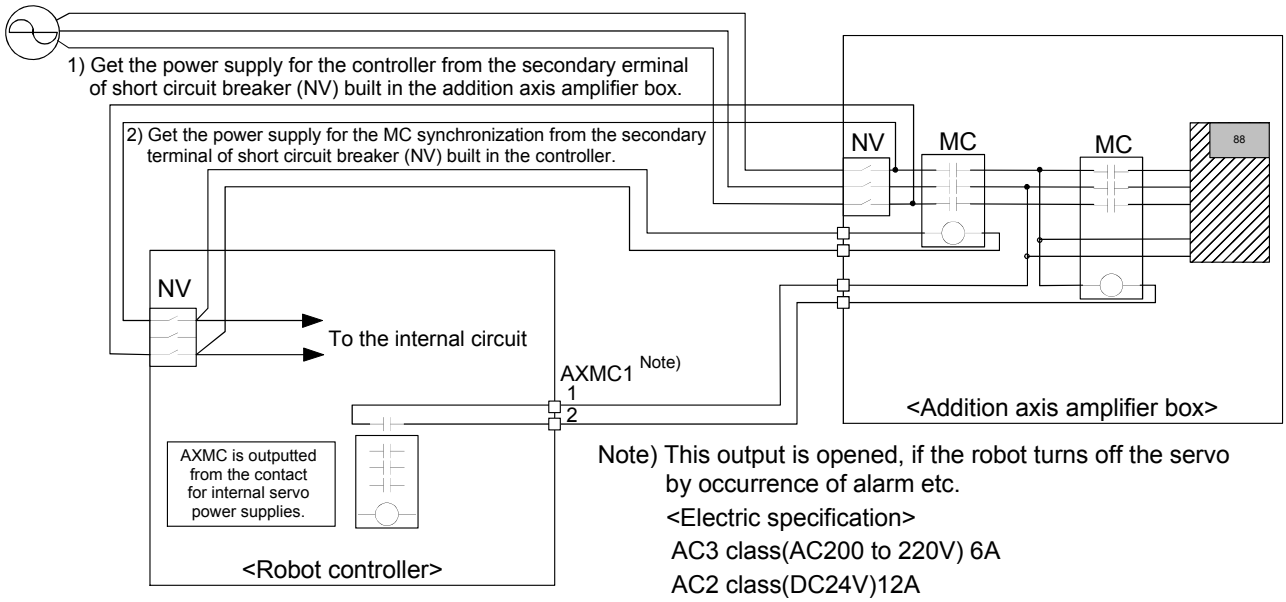


Fig.2-12 : Example of circuit for addition axes of Magnet contactor control output.

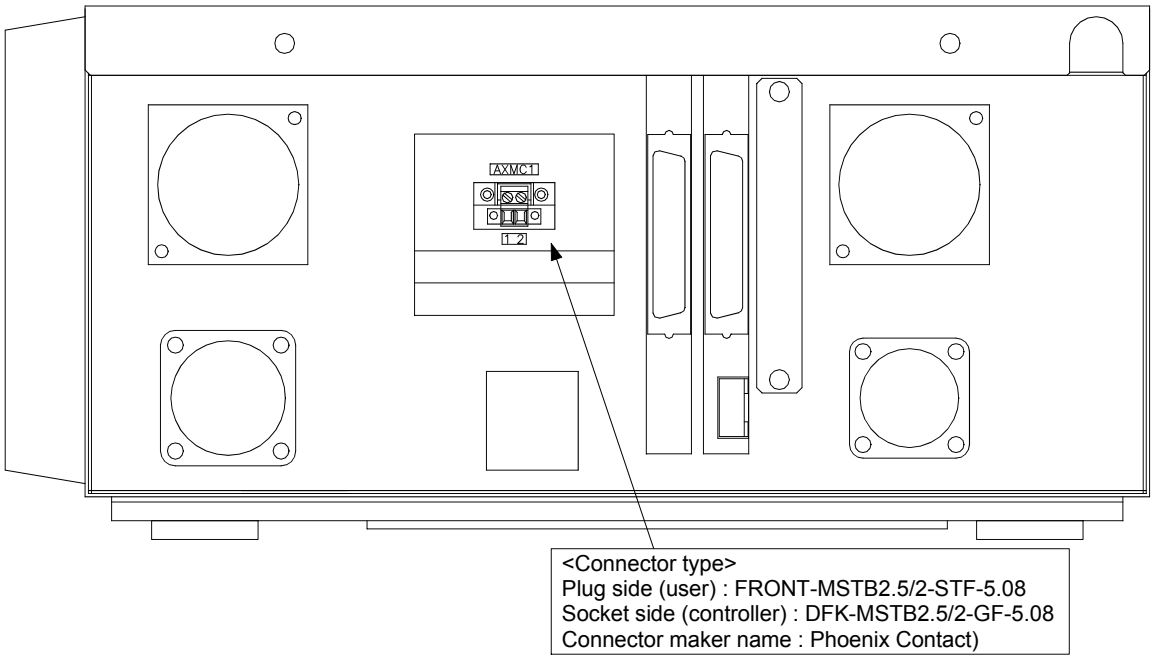


Fig.2-13 : Arrangement figure of the AXMC1 connector.

2.2.7 Connecting to the robot arm

Refer to the separate manual "Robot arm setup and maintenance", and connect the controller and robot arm with machine cables.

⚠CAUTION

The machine cable connectors are dedicated for the controller side and robot arm side, so take special care when connecting.
If connected incorrectly, the connector pins could bend or break. Thus, even if connected correctly, the robot will not operate correctly, creating a dangerous situation.

2.3 Setting the origin

Refer to the separate manual "Robot arm setup and maintenance", and set the origin.

2.4 Confirming the operation

Refer to the separate manual "Robot arm setup and maintenance", and confirm the robot operation with jog operation.

3 Installing the option devices

The T/B can be installed in the power OFF state as described in the separate manual "Robot arm setup and maintenance", or can be installed/removed in the power ON state as described in "4.2.1 Installing and removing the T/B" on page 39 of this manual. Refer to the respective explanations.
Refer to the separate "Standard Specifications" for the optional devices other than those described in this manual.
The method of installation of option equipment differs, depending on the controller being used. When the CR2-532 control is used, refer to "3.1For the CR2-532 Controller". When the CR2A-572/CR2B-574 control is used, refer to "3.2 For the CR2A-572/CR2B-574 Controller" on page 21. When the CR2-532M control is used, refer to "3.3 For the CR2-532M Controller" on page 23.

3.1 For the CR2-532 Controller

To install an option card in the control unit (R6x2CPU) when the CR2-532 controller is used, remove the R6x2CPU's option fixing plate. The procedures are explained in "3.1.1Removing and Installing the R6x2CPU Option Fixing Plate" below, so refer to that section when installing the option card.

3.1.1 Removing and Installing the R6x2CPU Option Fixing Plate

The option card, mounted on the control unit (R6x2CPU), is mounted after removing the R6x2CPU option fixing plate. The procedure of removing is explained below.

⚠CAUTION Confirm that the controller's main power supply and controller power switch are OFF before starting this work. Wait at least three minutes after turning the power OFF before removing the controller chassis cover.

(1) Wait at least three minutes after turning the power OFF, and then remove the controller chassis cover. (Refer to Fig. 3-1.) To remove the cover, remove the one installation screw A, and slide the cover approx. 100mm toward the back. Then, lift it up.
(2) Remove the upper rear cover by removing the four installation screws B on the back. (Refer to Fig. 3-1.)

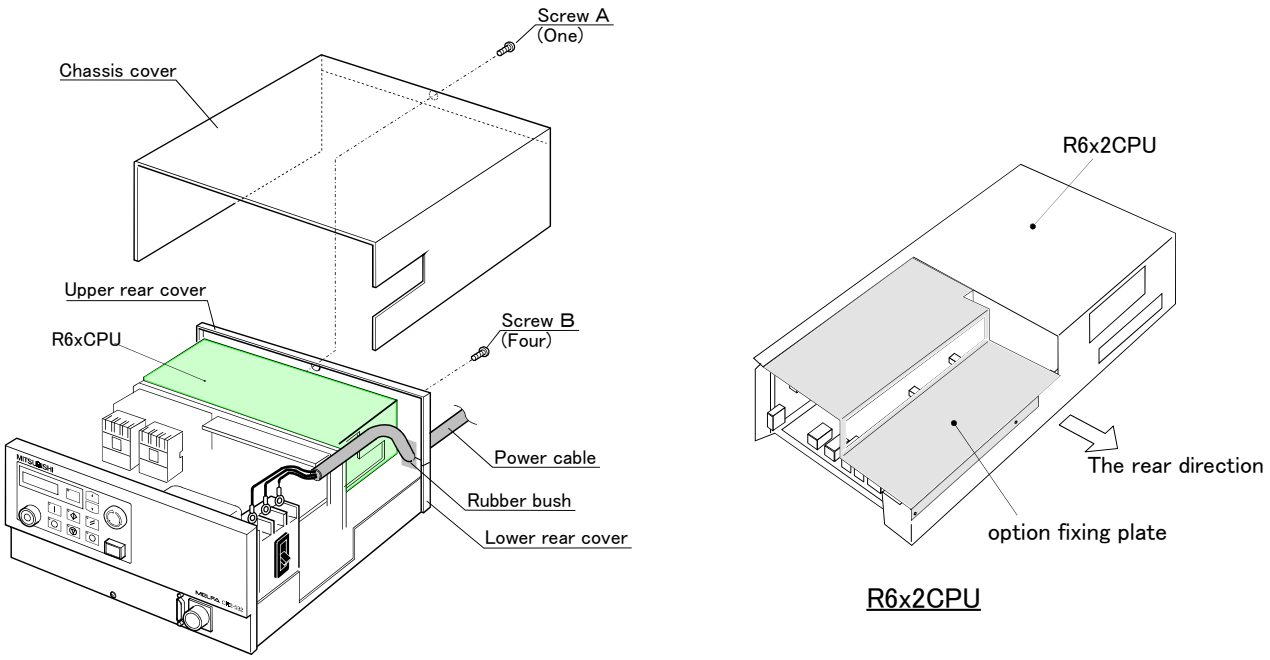
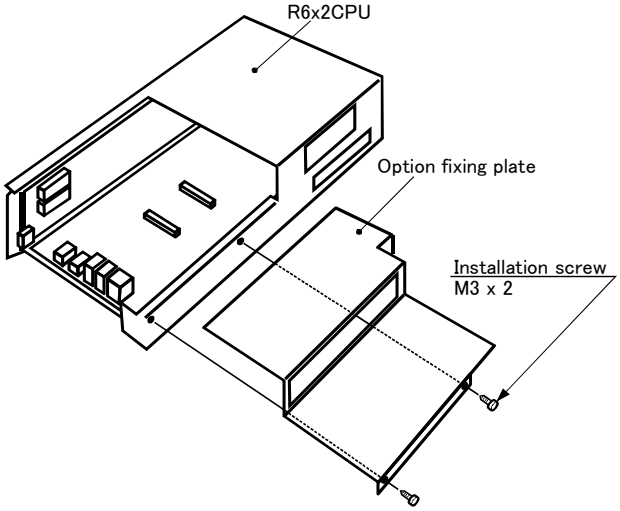
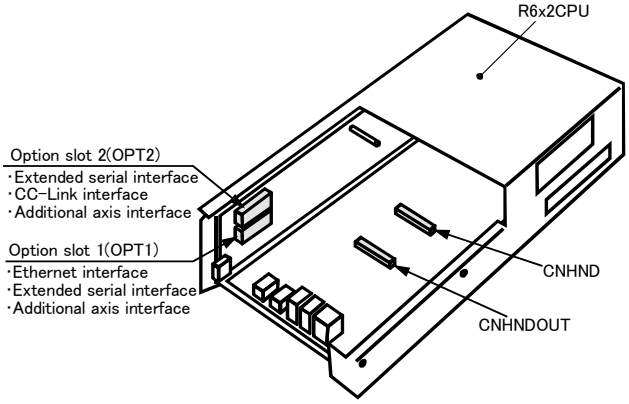


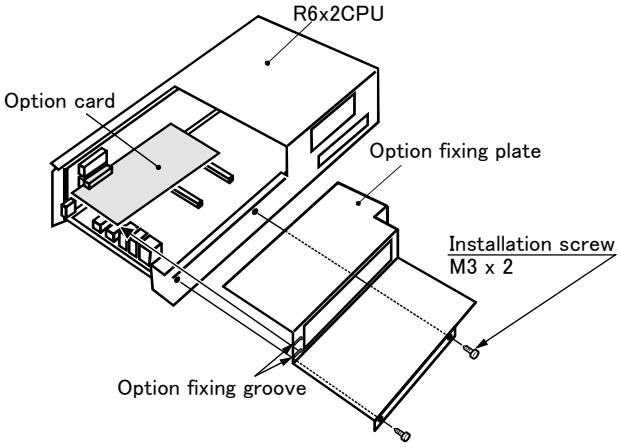
Fig.3-1 : Remove the R6x2CPU(CR2-532)



(3) Remove the three M3 screws to remove the R6x2CPU option fixing plate.



(4) Insert the option card.
The position of the slot will differ according to the options. Refer to the instruction manual of the option being used, check the slot position, and then insert the option.



(5) Install the option fixing plate, removed in step "(3)", onto the R6x2CPU.
When the option card has been inserted into option slot 1 or 2, install so that the option card fits into the option fixing groove on the option fixing plate, and then fix securely with screws.

(6) Install the controller cover.
Return the upper rear cover, removed in step "(2)". Sandwich the power cable and grounding cable with the rubber bushing installed on the lower rear cover and upper rear cover. After installing, securely fix with screws.
Return the Chassis cover, removed in step "(1)", and then fix securely with screws.

This completes the removal and installation of the R6x2CPU of the CR2-532 controller.

3.1.2 The procedures for installing the pneumatic hand interface

The procedures for installing the pneumatic hand interface, mounted on R6x2CPU, are explained below.

⚠CAUTION Confirm that the controller's main power supply and controller power switch are OFF before starting this work.

(1) Refer to steps "(1)" to "(3)" section "3.1.1Removing and Installing the R6x2CPU Option Fixing Plate", and remove the controller over. Remove the R6x2CPU option fixing plate.

(2) The pneumatic hand interface is mounted on the RZ181 card in the R6x2CPU.
Install by securely inserting the CNHDNOUT/CNHND connectors on the card into the pneumatic hand interface connectors.

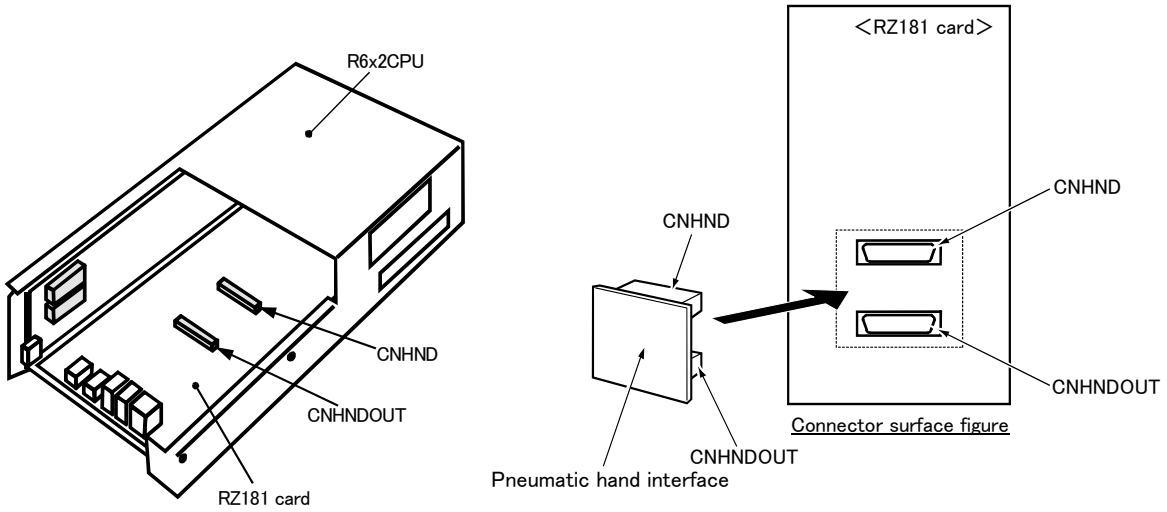


Fig.3-2 : Installing the pneumatic hand interface (CR2-532)

(3) Refer to steps "(5)" and "(6)" of section "3.1.1Removing and Installing the R6x2CPU Option Fixing Plate", and install the R6x2CPU option fixing plate, and return the controller cover.

This completes the installation of the CR2-532 controller's pneumatic hand interface.

3.2 For the CR2A-572/CR2B-574 Controller

3.2.1 Installing the Option Card

Mount the option card to the option slot, which is located inside the controller.
The following shows the mounting procedure

⚠CAUTION To remove the chassis cover (top board), wait at least three minutes after the power of the supply source is shut off. Also, do not supply power until the top board is reinstalled. Failure to follow this instruction will cause electric shock.

*The left figure shows the CR2A-572 controller for example. The RS-232C connector is installed vertically as the controller type is "CR2B-574".

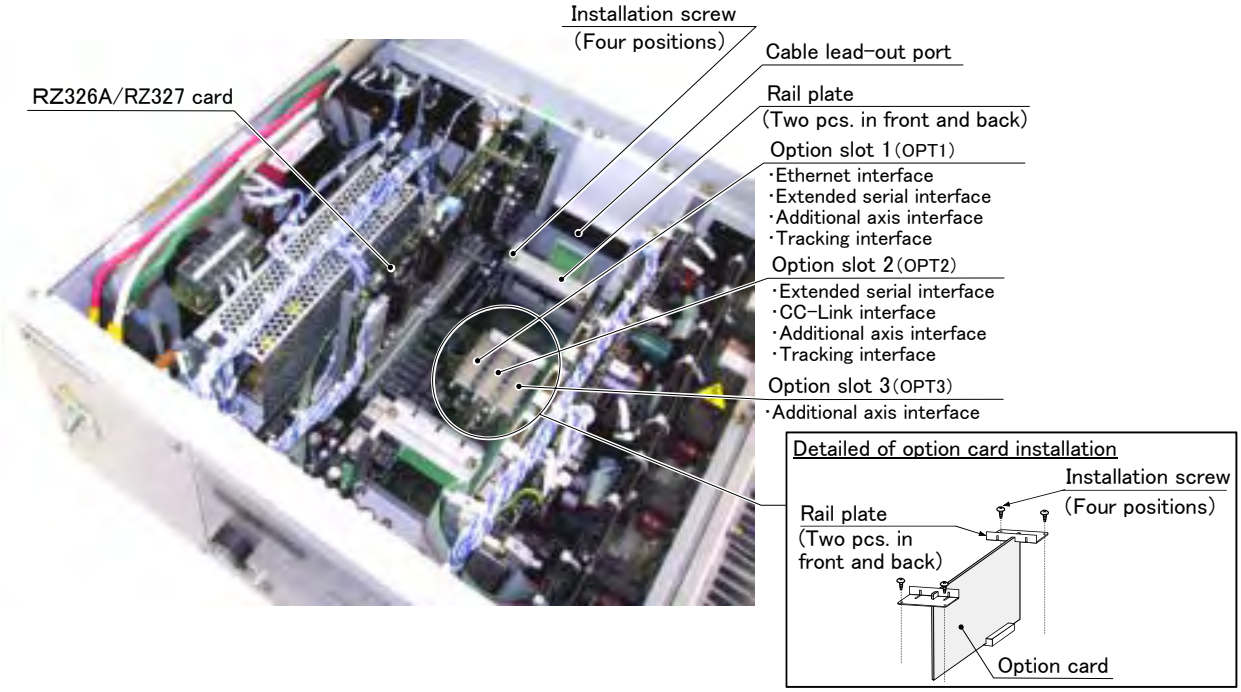


Fig.3-3 : Installing the Option Card (CR2A-572/CR2B-574)

(1) Shut off the power of the supply source and wait at least three minutes. Then, remove the chassis cover (top board) by removing the four installation screws.
(2) Insert the option card to be mounted into the corresponding slot, and fix with the rail plate. Lead any required cables from the cable lead-out port on the rear side.
The position of the slot will differ according to the options. Refer to the instruction manual of the option being used, check the slot position, and then insert the option.
(3) Reinstall the top board of the controller.

This completes the installation of the option card of the CR2A-572/CR2B-574 controller.

3.2.2 The procedures for installing the pneumatic hand interface

Mount the pneumatic hand interface to the RZ326A/RZ327 card, which is located inside the controller.
The following shows the mounting procedure

⚠CAUTION To remove the chassis cover (top board), wait at least three minutes after the power of the supply source is shut off. Also, do not supply power until the top board is reinstalled. Failure to follow this instruction will cause electric shock.

*The left figure shows the CR2A-572 controller for example. The RS-232C connector is installed vertically as the controller type is "CR2B-574".

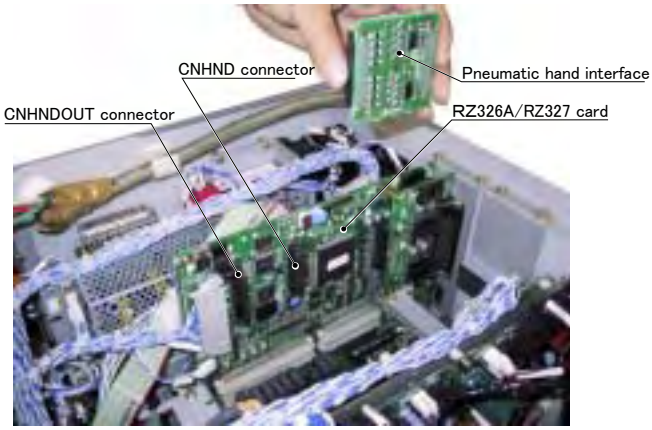


Fig.3-4 : Installing the pneumatic hand interface (CR2A-572/CR2B-574)

(1) Shut off the power of the supply source and wait at least three minutes. Then, remove the chassis cover (top board) by removing the four installation screws.
(2) Insert the pneumatic hand interface into the connector of the RZ326A/RZ327 card. Align both connectors and insert the pneumatic hand interface securely in place.
(3) Reinstall the top board of the controller.

This completes the installation of the pneumatic hand interface of the CR2A-572/CR2B-574 controller.

3.3 For the CR2-532M Controller

To install an option card in the control unit (R6x2CPU) when the CR2-532 controller is used, remove the R6x2CPU's option fixing plate. The procedures are explained in "3.3.1Removing and Installing the R6x2CPU (Installing the Option Card)" below, so refer to that section when installing the option card.

3.3.1 Removing and Installing the R6x2CPU (Installing the Option Card)

The option card, mounted on the control unit (R6x2CPU), after removing the R6x2CPU option fixing plate. The procedure of removing is explained below.

⚠CAUTION

Confirm that the controller's main power supply and controller power switch are OFF before starting this work. Wait at least three minutes after turning the power OFF before opening the controller front door.
On the R6x2CPU, the cables are connected with the connectors and terminal block. Take care not to pull the cables when removing.

(1) Wait at least three minutes after turning the power OFF, then loosen the fixing screws on the controller front door, and open the front door.
(2) Remove the two M5 screws (top/bottom) fixing the R6x2CPU, and then pull out the R6x2CPU. Take care not to pull the cables at this time.
(3) Disconnect the connectors and FG cable connected to the R6x2CPU, and pull out the unit. The connectors and terminal block to be disconnected are shown in Fig. 3-5 (c)

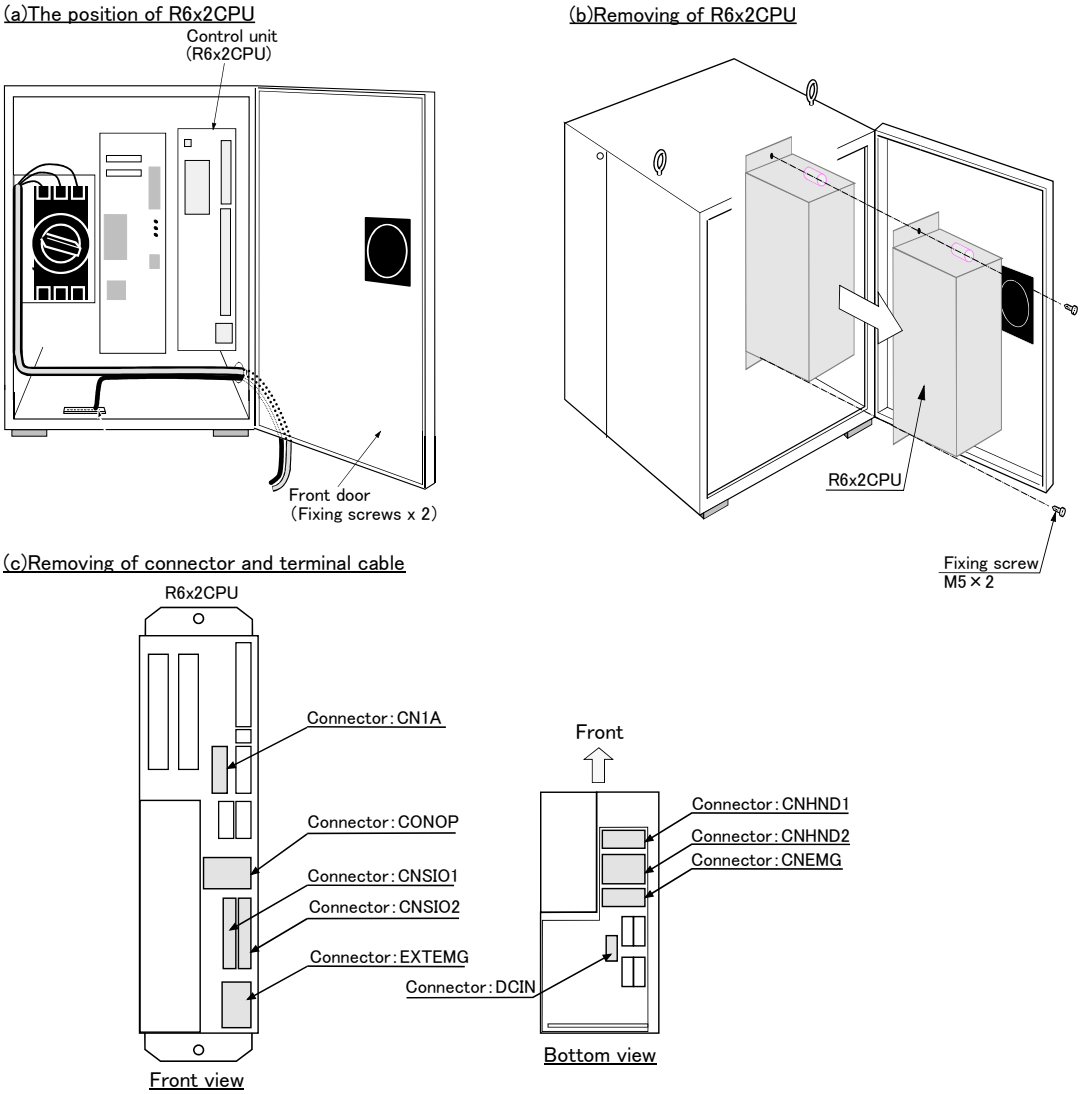
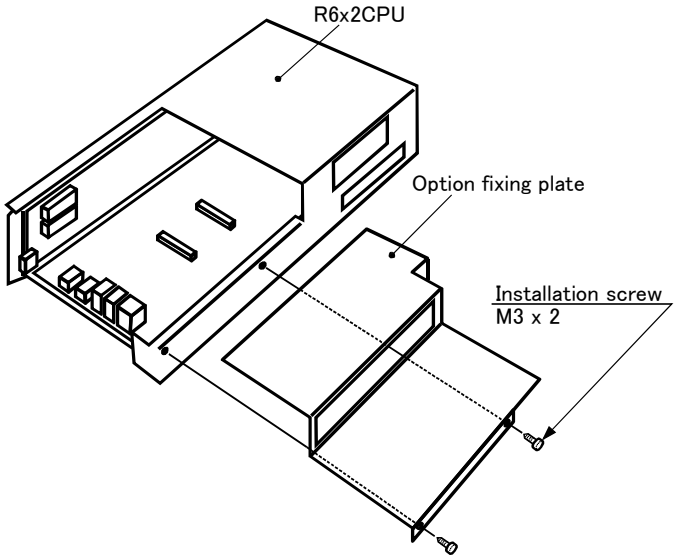
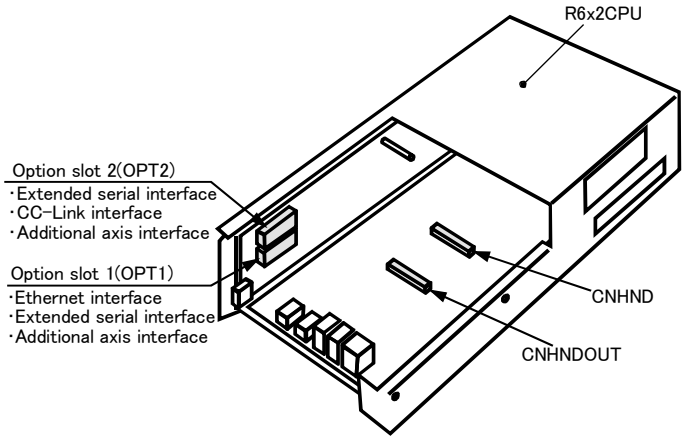


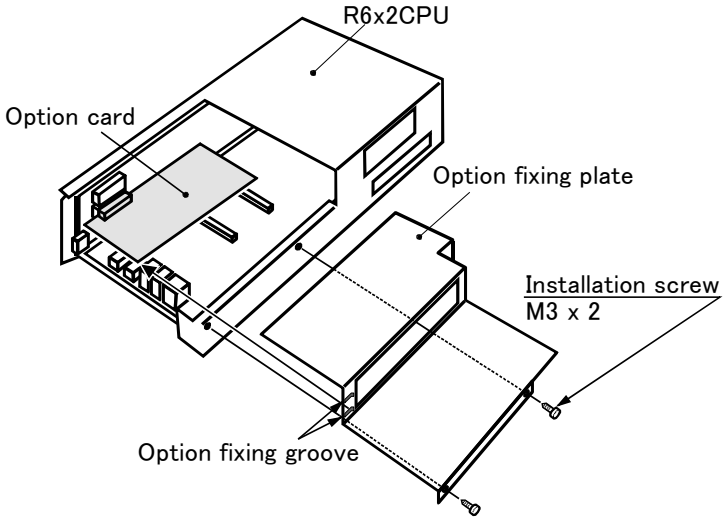
Fig.3-5 : Remove the R6x2CPU (CR2-532M)



(4) Remove the three M3 screws to remove the R6x2CPU option fixing plate.



(5) Insert the option card.
The position of the slot will differ according to the options. Refer to the instruction manual of the option being used, check the slot position, and then insert the option.



(6) Install the option fixing plate, removed in step "(4)", onto the R6x2CPU.
When the option card has been inserted into option slot 1 or 2, install so that the option card fits into the option fixing groove on the option fixing plate, and then fix securely with screws.

(7) Install the R6x2CPU onto the controller.
Connect the connectors and FG cables disconnected in step "(3)", and then securely fix the R6x2CPU onto the controller at the original position with the screws removed in step "(2)". Close the controller's front door, and fix with the fixing screws.

This completes the removal and installation of the R6x2CPU of the CR2-532M controller.

3.3.2 The procedures for installing the pneumatic hand interface

The procedures for installing the pneumatic hand interface, mounted on R6x2CPU, are explained below.

⚠CAUTION Confirm that the controller's main power supply and controller power switch are OFF before starting this work.

(1) Refer to steps "(1)" to "(4)" section "3.3.1Removing and Installing the R6x2CPU (Installing the Option Card)", and remove the controller over. Remove the R6x2CPU option fixing plate.

(2) The pneumatic hand interface is mounted on the RZ181 card in the R6x2CPU.
Install by securely inserting the CNHDNOUT/CNHND connectors on the card into the pneumatic hand interface connectors.

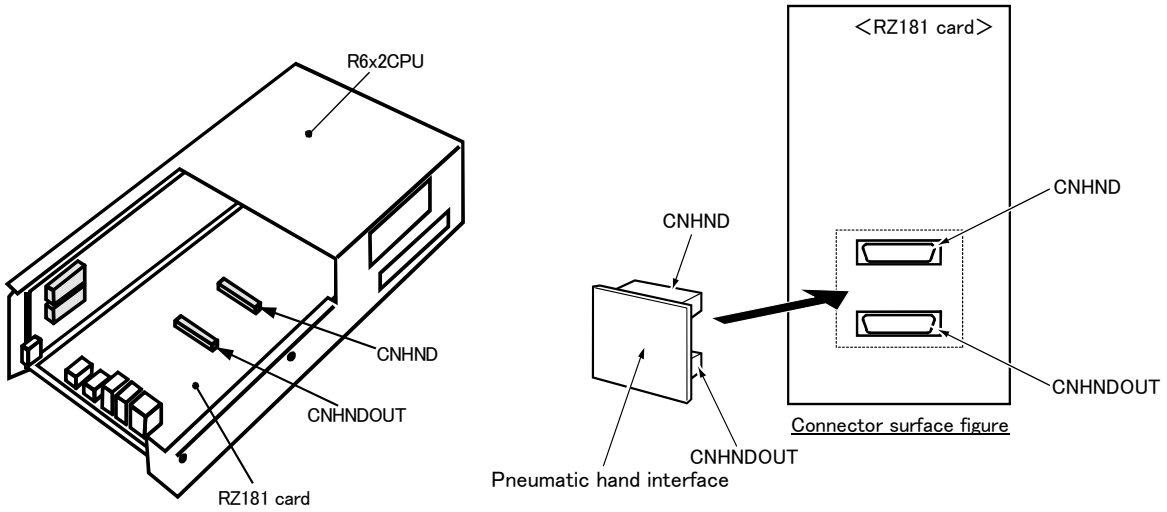


Fig.3-6 : Installing the pneumatic hand interface(CR2-532M)

(3) Refer to steps "(6)" and "(7)" of section "3.1.1Removing and Installing the R6x2CPU Option Fixing Plate", and install the R6x2CPU option fixing plate, and return the controller cover.

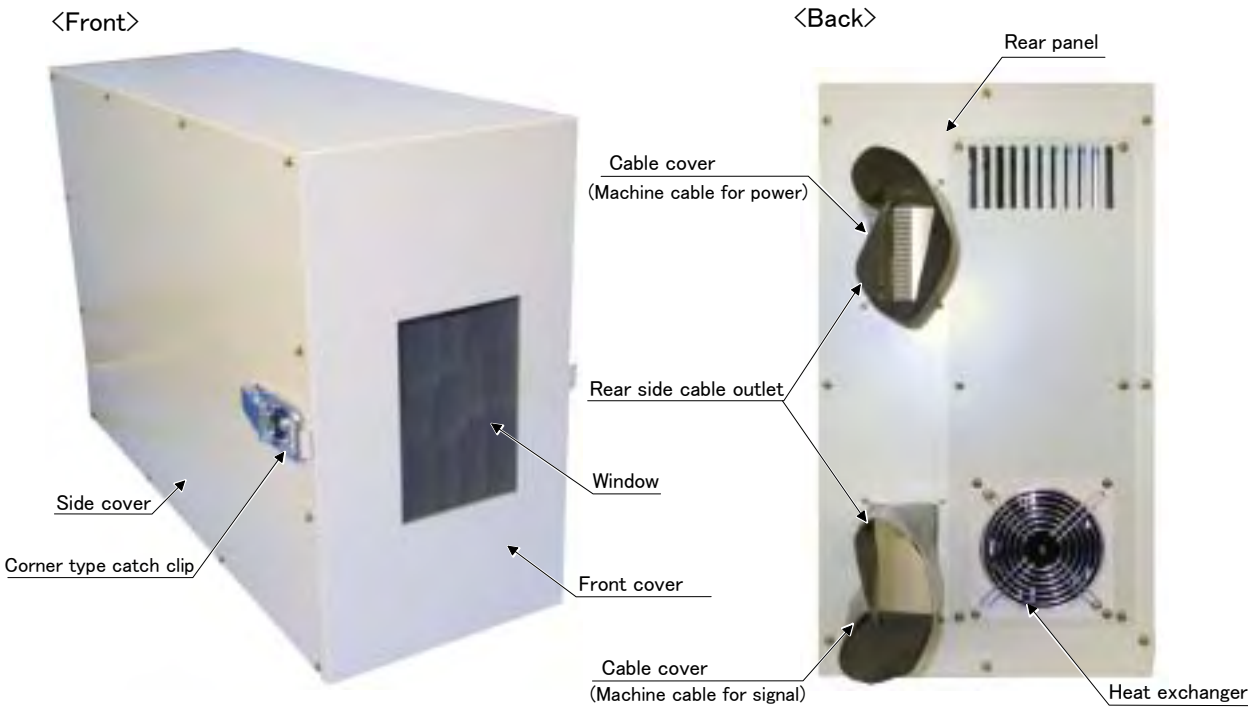
This completes the installation of the CR2-532M controller's pneumatic hand interface.

3.4 Installation of the controller protection box (CR2A-MB) (CR2A-574 controller only)

Shows the installation method of using the controller protection box (hereinafter referred to as the protection box) to protect the CR2A-572 controller from using environment such as oil-mist in the following.
For outside dimensions, refer to separate manual "Standard specifications manual".

3.4.1 Name of each part

Fig. 3-7 shows the names of each part of the protection box. Put the CR2A-572 controller in this box, and use it.



Name of each part of CR2A-MB

The installation state of the controller

Fig.3-7 : Name of each part of protection box (CR2A-MB)

3.4.2 Confirmation before installation

(1) Confirming the products

The configuration part of the protection box is shown in Table 3-1. Confirm the parts.

Table 3-1 : Configuration device

Part name	Type	Qty.	Remarks
Controller protection box	CR2A-MB	1 unit	
Serial number posting label		1	
Protection seal transparent		1	Protection for the serial number posting label
Cable tie		2	
Power supply wiring cable		1	For connecting the power relay terminal and the controller inside the box.
Grounding cable		1	For connecting the FG terminal and the controller inside the box.
Rubber foot installation screw	M4 × 10	4	For changing the rubber foot.
External emergency stop box (Controll box)	HW1X-BV402R	1 unit	Dual emergency line. Install at a location outside the protection box where operation can be performed easily. The outside dimensions is shown in Fig. 3-10.

(2) Customer preparation parts

Prepare the cable etc. which show in the following by the customer.

- Power cable(AWG#14(2mm^2)) ..... 2 cables
- Grounding cable(AWG#14(2mm^2))..... 1 cables
- External emergency stop box cables(AWG#24 ～ 16 recommendation) 2 cables
- External emergency stop box cable clamp ..... 1 piece

Fit the size to the use external emergency stop box cable, and make preparation.

Table 3-2 shows the recommendation cable clamp as a reference.

Table 3-2 : Cable clamp for external emergency stop box (recommendation)

Type	JIS wiring tube	Adaptation cable outside diameter	Manufacturer
OA-W1606	G1/2	4 ～ 6φ	OHM electric Corp
OA-W1608		6 ～ 8φ	
OA-W1609		7 ～ 9φ	
OA-W1611		9 ～ 11φ	
OA-W1613		11 ～ 13φ	

(3) Copy of the manufacture number of the controller.

Write the manufacture number (serial number) printed on the rear of CR2A-572 controller to the attached serial number copy seal by immortality ink.

3.4.3 Unpacking procedures

The protection box is shipped from the factory packaged in cardboard.

Unpack the cardboard packing, and take out the protection box and accessories.

3.4.4 Transportation procedures

Transport the protection box by placing hands between the lower clearance created with the rubber foot on the front and back sides, and lifting up. (Mass of the protection box: 16 kg.)

3.4.5 Installation procedures

(1) Installation dimensions

Secure and install the space shown in the Fig. 3-8.

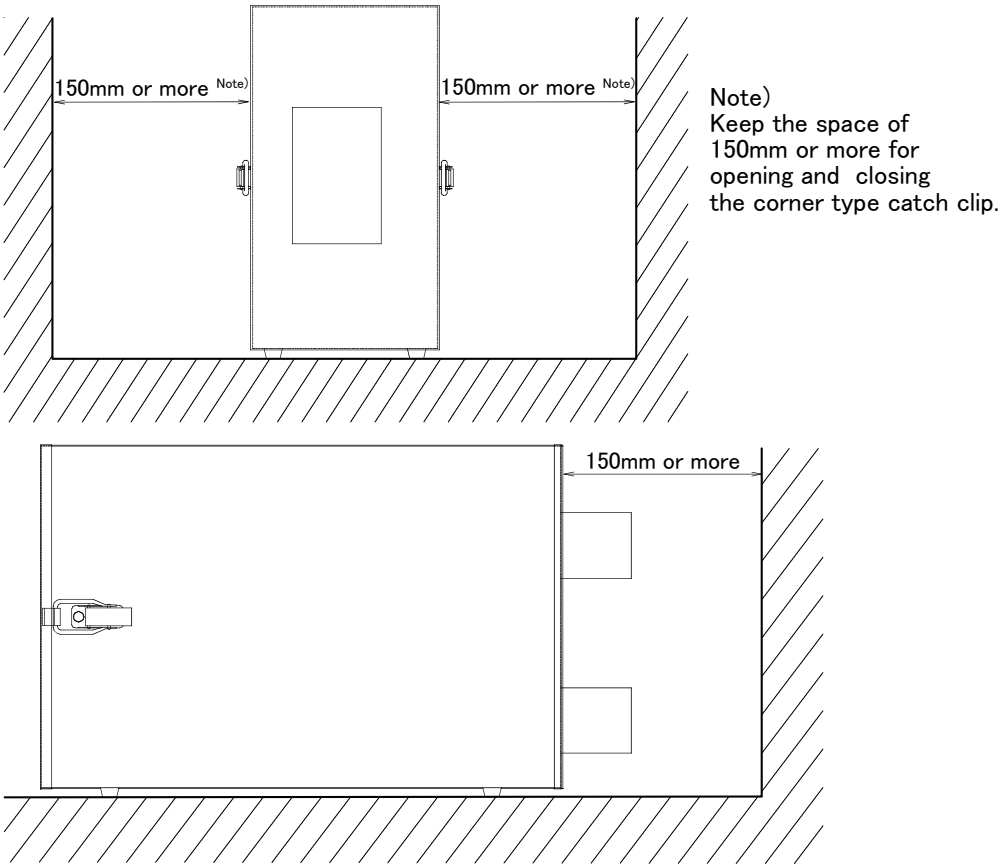


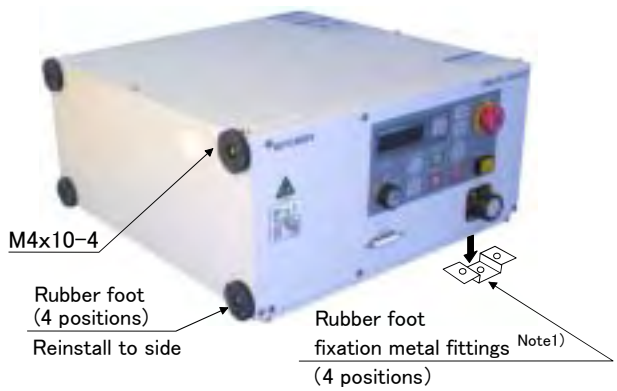
Fig.3-8 : Installation dimensions

⚠CAUTION The fan installed at the back inside of the protection box for heat exchange.
Take care to not obstruct the rotation of air.

⚠CAUTION The protection box must be transported by two workers under the condition that the CR2A-572 controller is installed in the protection box. (Mass: approx. 34kg)
Transporting the protection box in one worker could lead to personal injuries or faults from dropping.

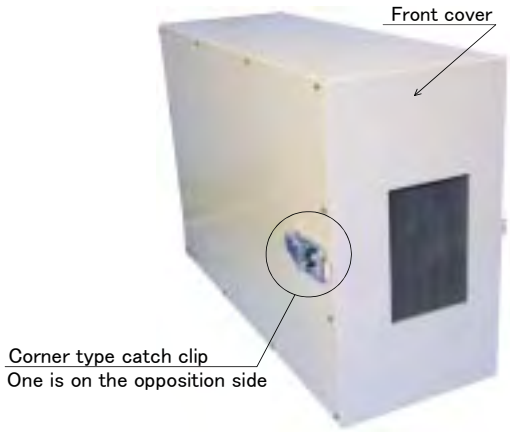
(2) Installation of CR2A-572 controller

The controller fixed lengthwise in the protection box. (The right side of the controller is upside)

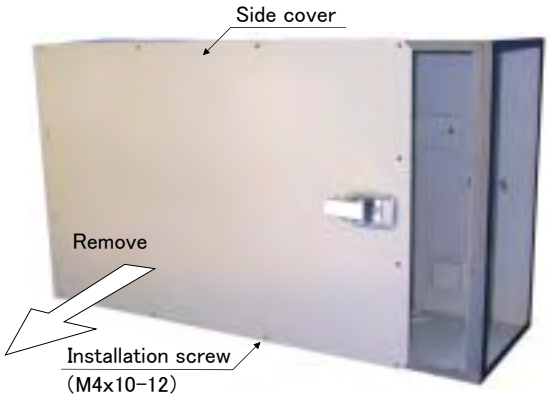


1) Remove the four rubber feet installed at the bottom of the controller, and reinstall them to the side of the controller with the attached four installation screws. Remove the seals sticking in the screw holes of the four corners on the controller. Use two in the removed screws (M5x10-4) when fixing the controller after.

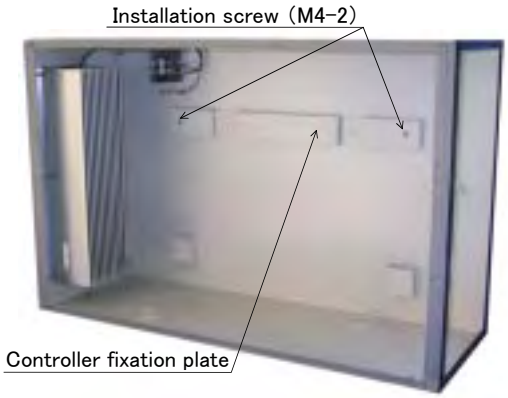
Note1) In the case of RV-4A/5AJ/3AL/4AJL compatible controllers, remove the four rubber feet first, and then remove the four fixation metal fittings (two screws) from the areas where the rubber feet were mounted. (The removed fixation metal fittings are not used during the installation of the protection box, so store them separately.)



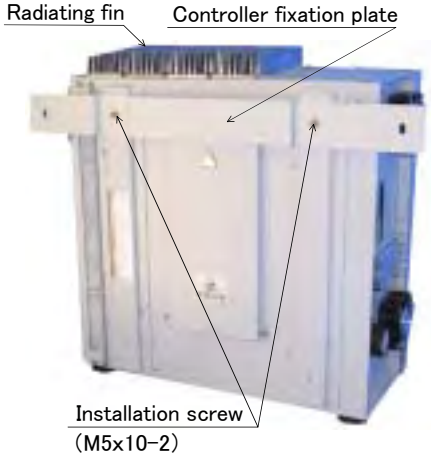
2) Remove the corner type catch clip (two places of the right and left) fixing the front cover of the protection box, and remove the front cover.



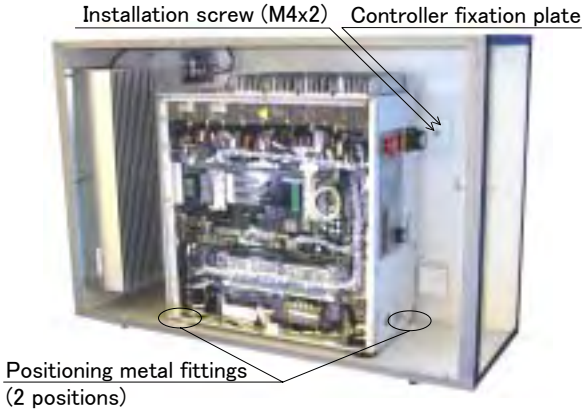
3) Remove the side cover of protection box by removing the twelve installation screws.



4) Remove the controller fixation plate installed in the protection box removing the two installation screws. Use the removed screws when fixing the controller.



5) Place the controller lengthwise, install the controller fixation plate removed with the above "4)" to the bottom of the controller.
Using the two screws that were used to fix the rubber foot, fix the controller fixing plate securely as shown in the figure at left onto the two screw holes (radiating fin side) where the rubber foot were fixed on the bottom surface of the controller.

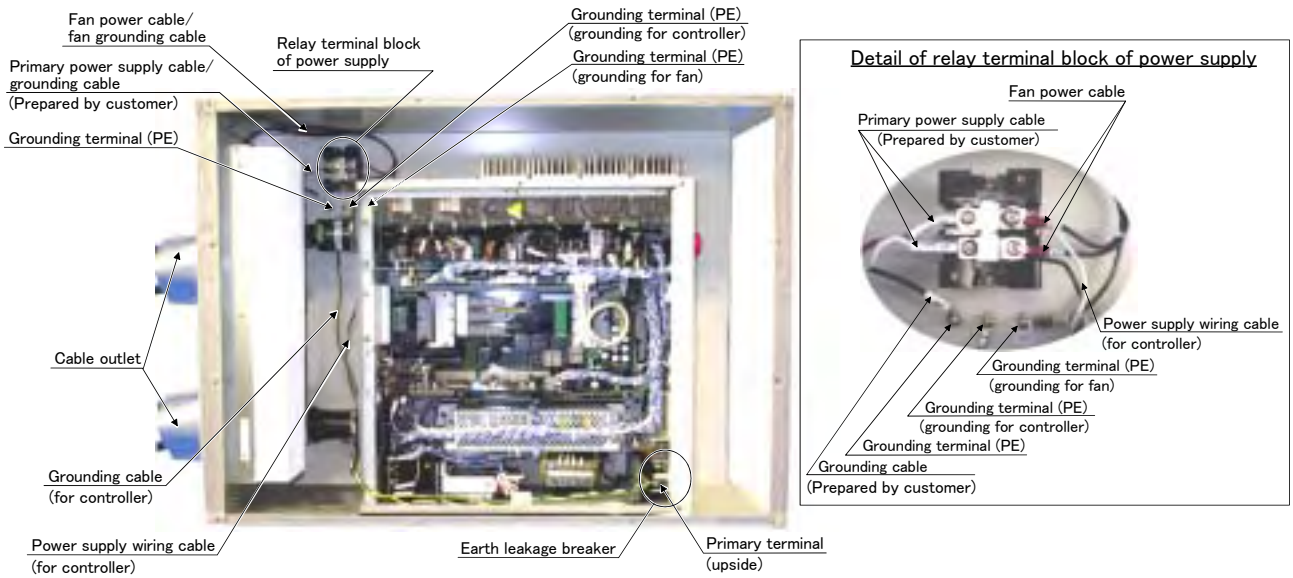


6) Install the controller in protection box
Placing the controller fixation plate at the rear top side, insert the rubber foot of the controller into the positioning metal fittings (2 positions).

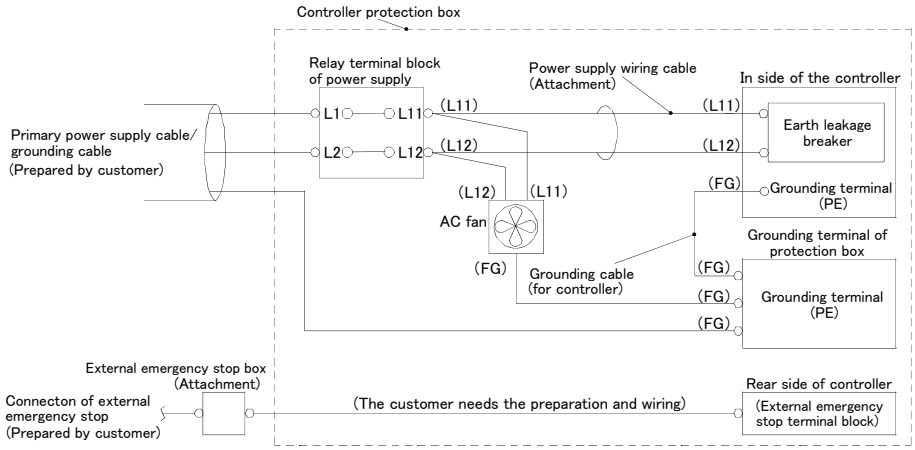
7) Using the originally provided two installation screws, securely fix the controller fixation plate into the screw holes of the protection box.

(3) Connecting the power cable, grounding cable, fan power cable

Fig. 3-9 shows wiring configuration and wiring system diagram of power, grounding, fan power cable.



Appearance diagram



Wiring system diagram

Fig.3-9 : Connecting the power cable, grounding cable

1) Connecting the power cable and grounding cable

Prepare the 2 primary power cables and 1 grounding cable (both AWG#14(2mm2) or more).

At inside of the protection box, use the attached power supply wiring cable for the connection of relay terminal block of power supply and controller, and use the attached grounding cable for the grounding of the controller and the grounding terminal of protection box.

Connect the both power cable and grounding cable referring to Fig. 3-9 and "2.2.4 Connecting the power cable and grounding cable" on page 11.

Connect the grounding cable prepared by customer to grounding terminal (PE), connect the attached grounding cable for controller grounding to another grounding terminal (PE).

Pull out the primary power supply cable and grounding cable from the cable outlet of the protection box, and then fix them with a cable tie together with the machine cable.

[Note] While the primary power supply is being supplied, the fan rotate through of ON/OFF of the controller power supply.

(4) Connection of the external emergency stop

Install the attached external emergency stop box to the place easy to operate for safety surely.
Because the CR2A-572 controller is enclosed in the protection box, the emergency stop switch located on the front side of the controller cannot be operated.

Install the attached external emergency stop box to the place easy to operate.
The outside and installation dimensions of the external emergency stop box are shown in Fig. 3-10 for your reference.
For the cable connection method, refer to "2.2.5 Connecting the external emergency stop" on page 14.
Please prepare a cable clamp that is fit for the external emergency stop box cable.
For details of the external emergency stop box, refer to the Instruction Manual attached to the product.
Also, pull out the external emergency stop cable from the cable outlet of the protection box, and then fix them with a cable tie together with the machine cable.

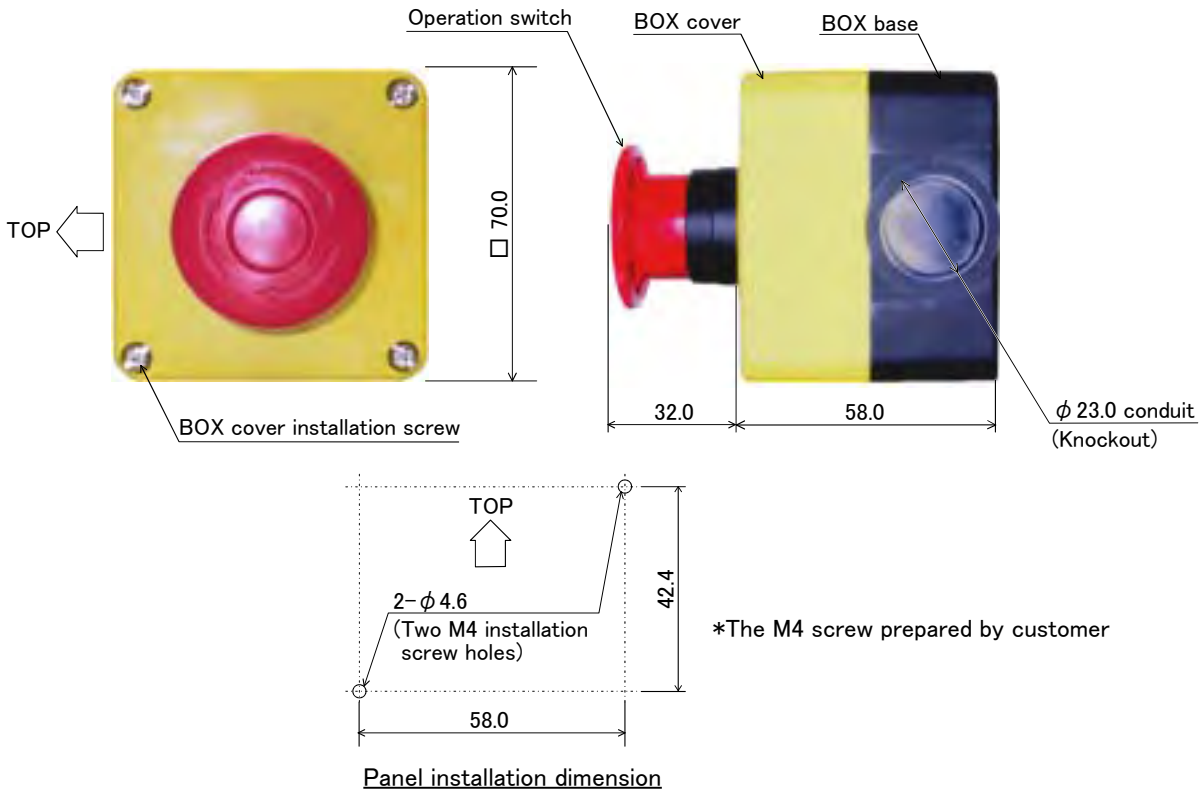


Fig.3-10 : The outside dimensions and installation dimensions of emergency stop box

(5) Connecting to the robot arm
Refer to the separate manual "Robot arm setup and maintenance", and connect the controller and robot arm with machine cables.
Lead the machine cable from the cable outlet on the rear of the protection box.

(6) Block the cable outlet

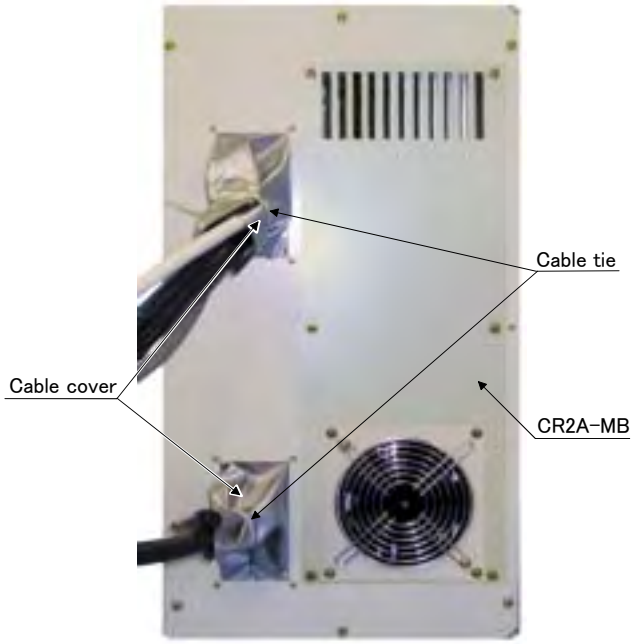


Fig.3-11 : Block the cable outlet

The cable cover is attached to the cable outlet.(two places of top and bottom.)
Fix the cable taken out from cable outlet by using the cable tie from the top of the cable cover, and block the cable outlet so that the oil-mist etc. not come in.

[CAUTION] Make the cable connected with the controller (the external emergency stop cable, the option card connection cable, etc.) have the margin of 300mm to make the drawer of the controller to easy later, and fix the cable. It is not necessary about the machine cable, because it can be connected and disconnected by connector.

(7) Sticking the serial number posting label
Stick the serial number posting label written down in "3.4.2 Confirmation before installation" on page 27 to front panel as shown in Fig. 3-12. And stick the protection seal transparent last.

Fig.3-12 : Sticking the serial number posting label

(8) Installation of side cover and front panel

Remove the sheet on the surface of packing stuck on the side cover contact part at the up side of the protection box. Reinstall the side cover and securely fix with twelve screws. Reinstall the front panel, and close the catch clip (two places of the right and left) for fixing the panel.

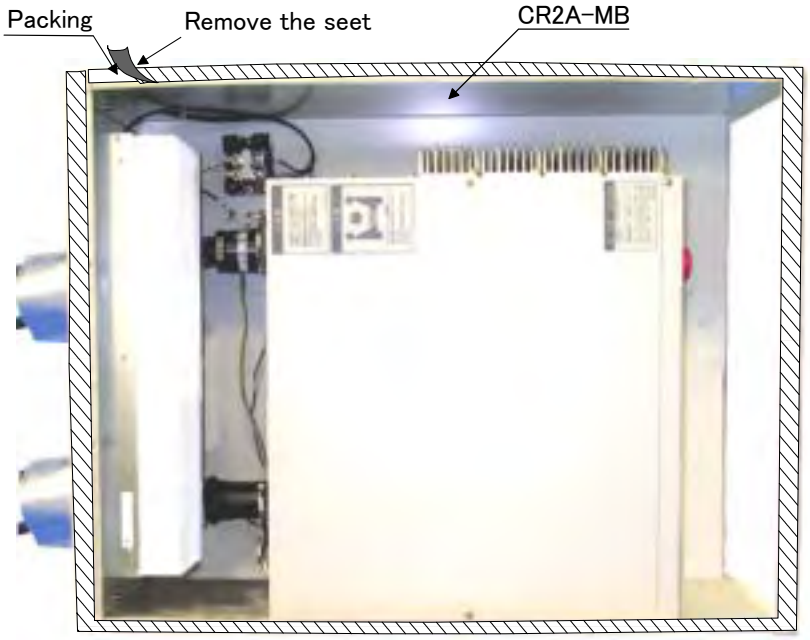


Fig.3-13 : Installation of side cover, front panel

(9) Installing of the protection box

Secure and install the installation dimension shown in "3.4.5 Installation procedures" on page 28.

The installation is only put with the rubber foot facing the bottom, because the protection box is self-contained floor type.

Moreover when fixing the protection box by fixing screw, remove the rubber feet removing the installation screws of rubber feet, and fix the protection box by M4 screw with the screw holes (M4) which the rubber feet were fixed on.

⚠CAUTION The protection box must be transported by two workers under the condition that the CR2A-572 controller is installed in the protection box. (Mass: approx. 34kg)
Transporting the protection box in one worker could lead to personal injuries or faults from dropping.

This completes the installation of the protection box.

3.4.6 Handling the protection box

(1) Operation with removing the panel

The power supply ON/OFF of the controller, the operation of the front panel, the operation under the condition that T/B is connected are carried out under the condition that the front panel of protection box is removed.

4 Basic operations

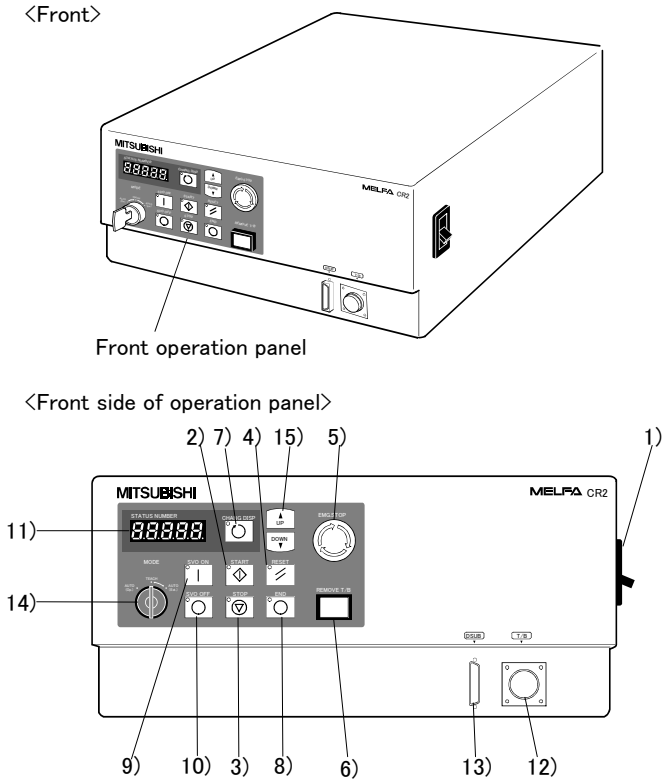
In this chapter, the following items will be explained regarding the basic operations for handling the robot.

Handling the controller	The functions of the various keys on the controller are explained.
Handling the teaching pendant	The methods of installing/removing the T/B, and the functions of the various keys are explained.
Turning the power ON/OFF	The items to confirm before turning on the controller power, and the methods of turning the power ON and OFF are explained.
Operating the robot with jog operation	The methods for manually operating the robot arm using the teaching pendant are explained. This is mainly used for teaching work.
Opening and closing the hand	The methods of opening and closing the hand using the teaching pendant are explained.
Program creation to automatic operation	The procedures of creating the program are explained in order.

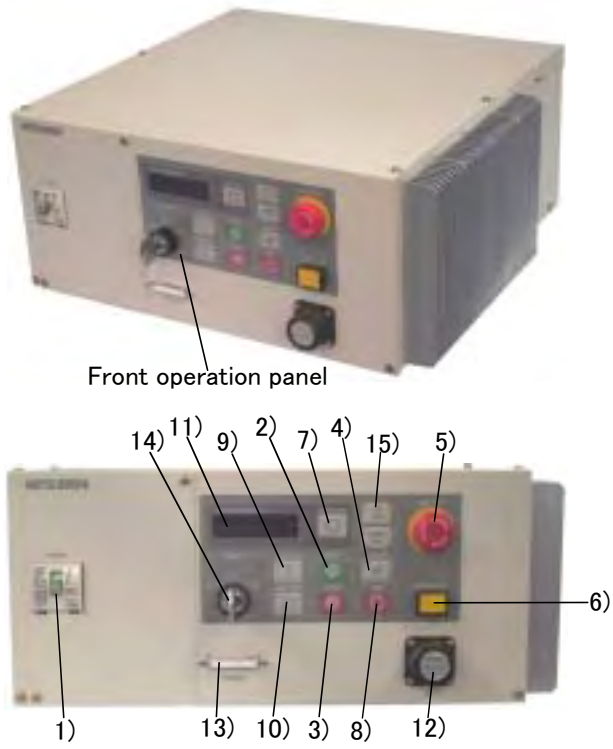
4.1 Handling the controller

4.1.1 Functions of each key

<CR2-532>



<CR2A-572>



<CR2B-574>

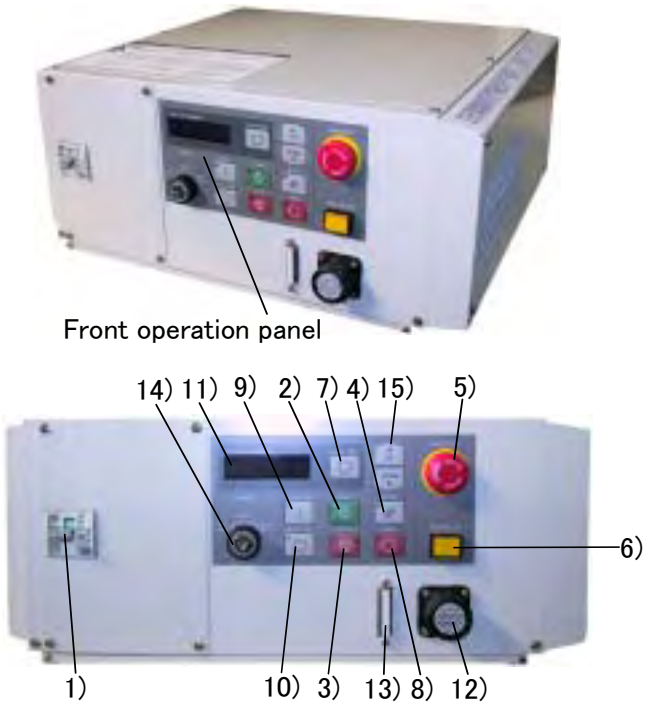


Fig.4-1 : Names of controller parts(CR2-532/CR2A-572/CR2B-574)

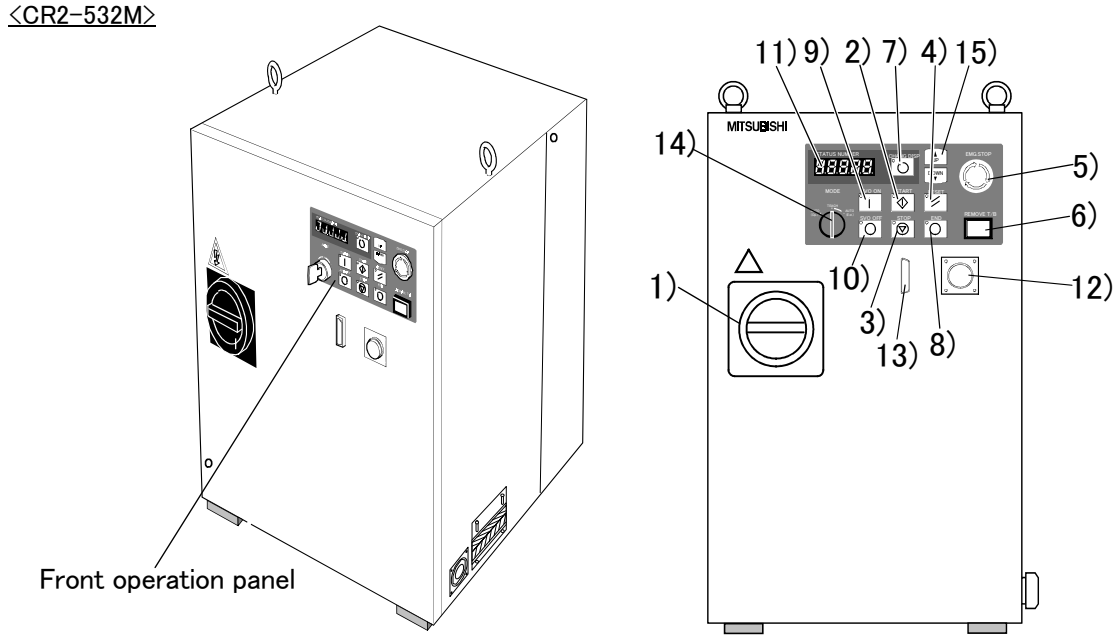


Fig.4-2 : Names of controller parts(CR2-532M)

1) POWER switch ..... This turns the control power ON/OFF. (With earth leakage breaker function)
2) START button ..... This executes the program and operates the robot. The program is run continuously.
3) STOP button ..... This stops the robot immediately. The servo does not turn OFF.
4) RESET button ..... This resets the error. This also resets the program's halted state and resets the program.
5) Emergency stop switch ..... This stops the robot in an emergency state. The servo turns OFF.
6) T/B remove switch ..... This is used to connect/disconnect the T/B without turning OFF the controller's control power.
7) CHNGDISP button ..... This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".
8) END button ..... This stops the program being executed at the last line or END statement.
9) SVO.ON button ..... This turns ON the servo power. (The servo turns ON.)
10) SVO.OFF button ..... This turns OFF the servo power. (The servo turns OFF.)
11) STATUS NUMBER (display panel) ..... The alarm No., program No., override value (%), etc., are displayed.
12) T/B connection connector ..... This is a dedicated connector for connecting the T/B.
13) Personal computer connection connector ..... This is an RS-232C specification connector for connecting the personal computer.
14) MODE changeover switch ..... This changes the robot's operation mode. Note)
    - AUTO (Op.) ..... Only operations from the controller are valid. Operations for which the operation mode must be at the external device or T/B are not possible.
    - TEACH ..... When the T/B is valid, only operations from the T/B are valid. Operations for which the operation mode must be at the external device or controller are not possible.
    - AUTO (Ext.) ..... Only operations from the external device are valid. Operations for which the operation mode must be at the T/B or controller are not possible.
15) UP/DOWN button ..... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.

⚠ CAUTION

Note) The servo will turn OFF when the controller's [MODE] switch is changed. Note that axes not provided with brakes could drop with their own weight. Carry out the following operations to prevent the servo from turning OFF whenthe [MODE] switch is changed.

The servo on status can be maintained by changing the mode with keeping pressing lightly the deadman switch of T/B. The operating method is shown below.

■ When the mode is changed from TEACH to AUTO.

1) While holding down the deadman switch on the T/B, set the [ENABLE/DISABLE] switch to "DISABLE".
2) While holding down the deadman switch on the T/B, set the controller [MODE] switch to "AUTO".
3) Release the T/B deadman switch.

■ When the mode is changed from AUTO to TEACH.

1) While the [ENABLE/DISABLE] switch on the T/B is "DISABLE", hold down the deadman switch.
2) While holding down the deadman switch on the T/B, set the controller [MODE] switch to "TEACH".
3) While holding down the deadman switch on the T/B, set the [ENABLE/DISABLE] switch to "ENABLE", then do the operation of T/B that you wish.

◇◆◇ What are the operation rights? ◇◆◇

Even when multiple devices, such as a T/B and personal computer, are connected to the controller, the operation at one time is limited to one device. This limited device (has the operation rights)

◇◆◇ What operations require the operation rights? ◇◆◇

Operations that start the robot, such as program start and alarm reset, and operations that can cause starting require the operation rights.
Conversely, operation that stop the robot, such as stopping and servo OFF, can be used without the operation rights for safety purposes.
Refer to the separate manual "Explanation of functions and operations" for details on the functions related to operation rights.

4.2 Handling the T/B

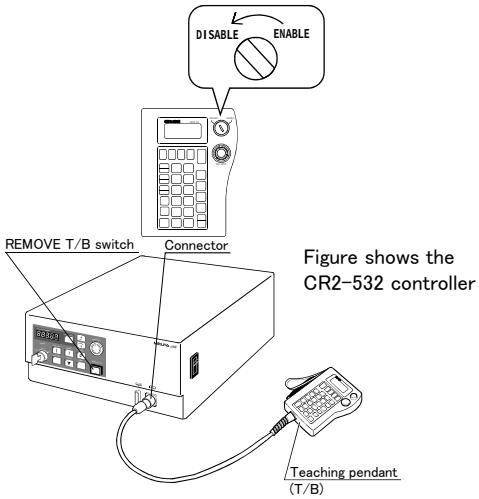
4.2.1 Installing and removing the T/B

By using the "REMOVE T/B" switch, the T/B can be installed and removed while the controller's control power is ON.

(1) Installing with the control power OFF

Refer to the separate manual "From robot arm setup to maintenance" for details on installing the T/B with the power OFF.

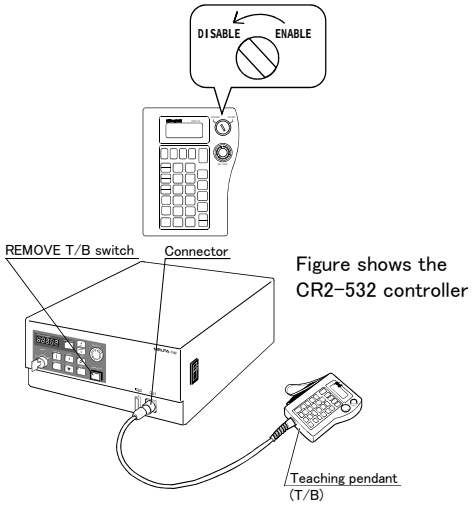
(2) Removing with the control power ON



1) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

2) Press the [REMOVE T/B] switch on the controller. (Indented state) The switch's LED will start flickering.
3) Securely hold the T/B connector, and turn it to the left to remove it.
4) Remove the T/B connector within 5 seconds after the LED starts flickering. The switch's LED will turn OFF when the work is completed.

(3) Installing with the control power ON



1) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

2) Connect the T/B connector. The switch's LED will start flickering.
3) Press the [REMOVE T/B] switch on the side of the controller within 5 seconds after installing the T/B. (Projected state) The switch's LED will light when the work is completed.

⚠ WARNING The T/B emergency stop is invalid while the [REMOVE T/B] switch is pressed (indented state) even after the T/B is connected. This state will cause an emergency stop within 5 seconds, but as the T/B is invalid, starting operations from devices other than the T/B will be valid.

◇◆◇ When an emergency stop state occurs ◇◆◇

If the emergency stop state occurs during the above operations, cancel it with the following procedures.

(1) Press the [REMOVE T/B] switch on the side of the controller, and light the switch's LED. (Projected state)
(2) Set the T/B [ENABLE/DISABLE] switch to "ENABLE".
(3) Press the T/B [ERROR RESET] key.

4.2.2 Functions of each key

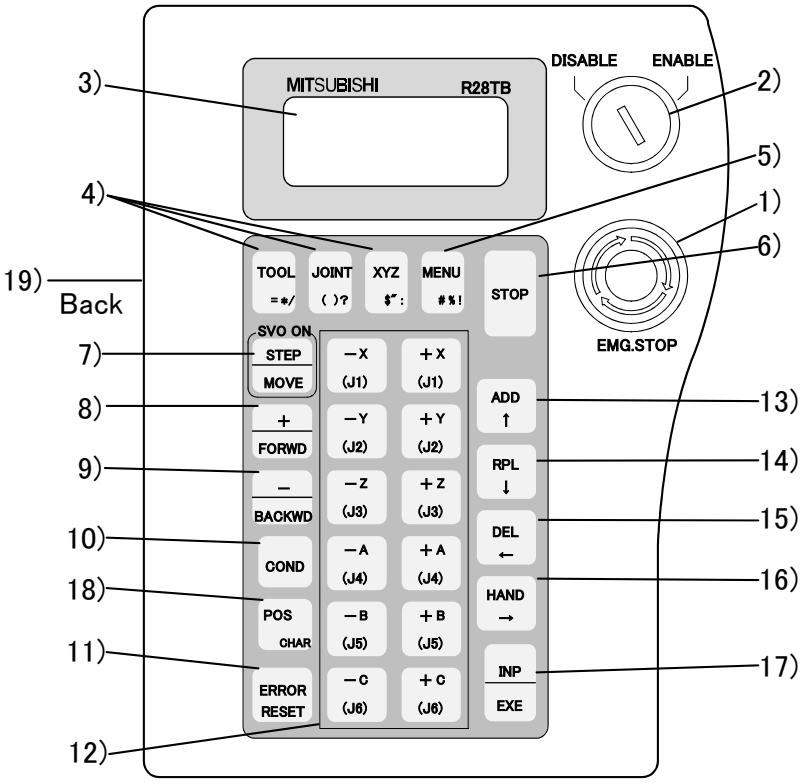


Fig.4-3 : Teaching pendant (Front side of R28TB)

1) [EMG. STOP] switch
This is a push-button switch with lock function for emergency stop. When this switch is pressed, the servo will turn OFF and the robot will stop immediately regardless of the T/B enable/disable state. To cancel this state, turn the switch clockwise.

2) [ENABLE/DISABLE] switch
This changeover switch is used to enable or disable the T/B key operations. To carry out operations using the T/B, always set this switch to "ENABLE" (valid). Operations with the T/B will be enabled, and operations from the controller and external sources will be disabled. The T/B will have the operation rights. To operate with the controller or external source, set this switch to "DISABLE" (invalid).

3) Display LCD
The program contents and robot state are displayed with the T/B key operations.

4) [TOOL] key
This selects the TOOL JOG mode.

4) [JOINT] key
This selects the JOINT JOG mode.

4) [XYZ] key
This selects the XYZ JOG, 3-AXIS XYZ or CYLINDER JOG mode.

5) [MENU] key
This returns the display screen to the "menu screen"

6) [STOP] key
This stops the program and decelerates the robot to a stop. This is the same function as the [STOP] switch on the front of the controller, and can be used even when the T/B [ENABLE/DISABLE] switch is set to DISABLE.

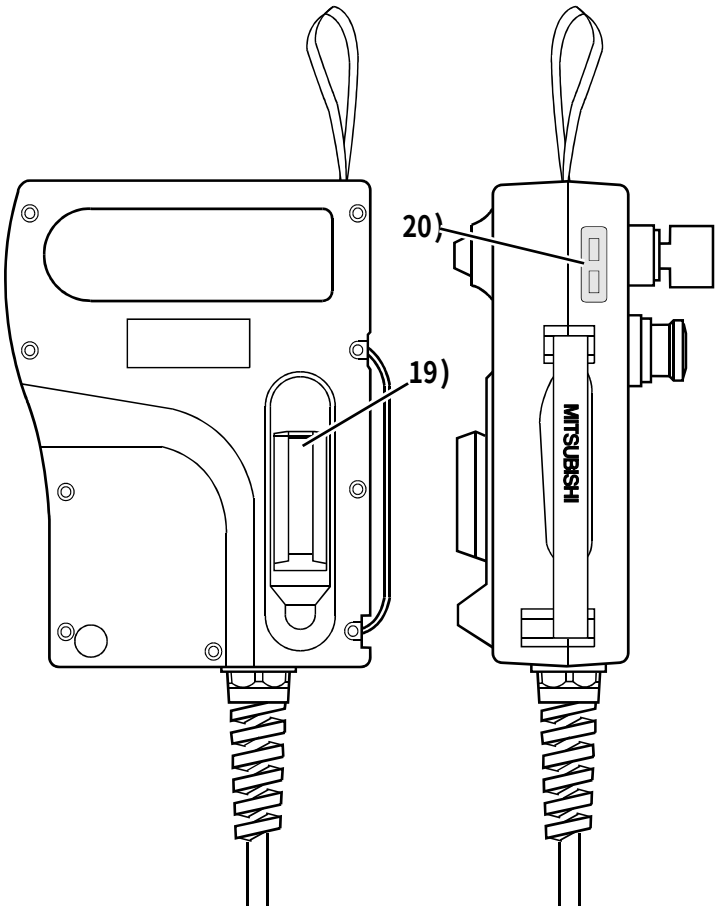
7) [STEP/MOVE] key
Jog operations are possible when this key is pressed simultaneously with the 12) jog operation key. Step jump is carried out when pressed simultaneously with the [INP/EXE] key. This also turns the servo ON.

8) [+/FORWD] key
Step feed is carried out when this key is pressed simultaneously with the [INP/EXE] key. On the edit screen, the next program line is displayed. When pressed simultaneously with the [STEP/MOVE] key, the override will increase.

9) [-/BACKWD] key
On the edit screen, the previous program line is displayed. When pressed simultaneously with the [INP/EXE] key, the axis will return along the robot's operation path. When pressed simultaneously with the [STEP/MOVE] key, the override (speed) will decrease.

10) [COND] key
This is used to edit the program.

11) [ERROR RESET] key
This key resets an error state that has occurred. When pressed simultaneously with the [INP/EXE] key, the program will be reset.



12) [Jog operation] key (12 keys from [−X (J1)] to [+C (J6)]
In this manual, these keys are generically called the "jog operation" keys. When JOINT JOG is selected, each axis will rotate, and when XYZ JOG is selected, the robot will move along each coordinate system. These keys are also used to input numeric values such as when selecting a menu or inputting a step No.

13) [ADD/ ↑] key
This additionally registers the position data. It also moves the cursor upward.

14) [RPL/ ↓] key
It also moves the cursor downward .

15) [DEL/ ←] key
This deletes the position data. It also moves the cursor to the left .

16) [HAND/ →] key
When pressed simultaneously with the [+C (J6)] or [−C (J6)] key, hand 1 will open or close. In the same manner, hand 2 will open/close when pressed simultaneously with the [+B (J5)] or [−B (J5)] key, hand 3 with the [+A (J4)] or [−A (J4)] key, and hand 4 with the [+Z (J3)] or [−Z (J3)] key. This key also moves the cursor to the right .

Fig.4-4 : Teaching pendant (Rear and side of R28TB)

17) [INP/EXE] key
This inputs the program, and carries out step feed/return.

18) [POS CHAR] key This changes between numbers and alphabetic characters when editing the position data, etc.

19) Deadman switch
When the [ENABLE/DISABLE] switch 2) is set to "ENABLE", and this key is released or pressed with force, the servo will turn OFF. Press this switch lightly when carrying out functions with the servo ON, such as jog operations. If emergency stop or servo OFF operation have been applied, and the servo is OFF, the servo will not turn ON even when this switch is pressed. In this case, carry out the servo ON operation again.

20) Contrast setting switch (Top: Dark, bottom: light)
This sets the display LCD brightness.

◇◆◇ Remove the protection seal of the teaching pendant before using ◇◆◇

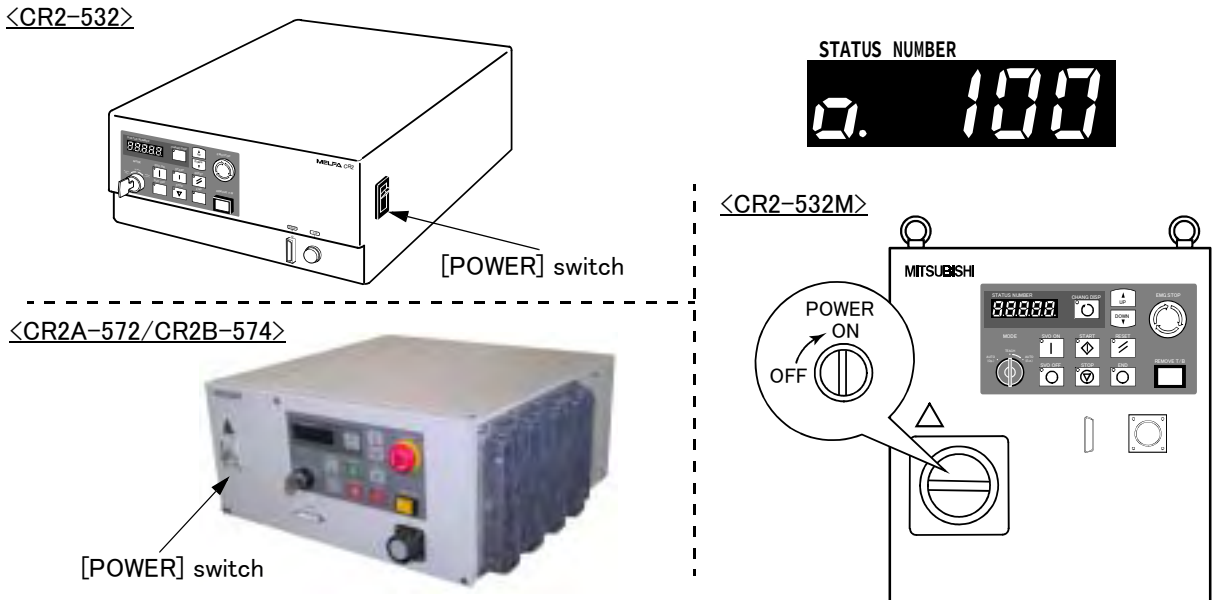
Installed the protection seal on the teaching pendant to prevent the damage of the display LCD and the key seat when shipping. Remove the protection seal when using. The operation of the key and the confirmation of the display is possible without removing the protection seal, however the adhesive may be left on the teaching pendant as the time passes.

4.3 Turning the power ON and OFF

4.3.1 Turning the control power ON

⚠ CAUTION Always confirm the following items before turning the controller power ON.

1) Make sure that there are no operators in the robot operation range.
2) Make sure that the controller and robot arm are securely connected with the machine cable.
3) Make sure that the external emergency stop switch is connected to the controller.
4) Make sure that the controller's power cable and grounding cable are correctly connected.
5) Make sure that the grounding cable is connected to the robot arm.
6) Make sure that there are no obstacles, such as tools, in the robot operation range.

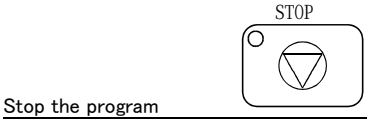


Turn the controller [POWER] switch ON.
" □ . 100" will appear on the STATUS NUMBER display.
This completes the turning ON of the control power.

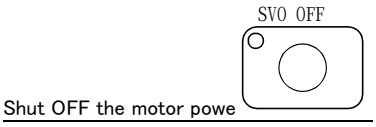
◇◆◇ What is the main power, control power and servo power? ◇◆◇

Main power ------This supplies power to the controller. (Primary power)
Control power --- This supplies power to the control sections (PCB, etc.) in the controller.
Servo power -----This supplies power to the motor that drives the robot.
When energized, this is called servo ON, and when shut off, this is called servo OFF.

4.3.2 Shutting OFF the control power



1) If the robot is operating, press the controller [STOP] switch, and stop the robot.



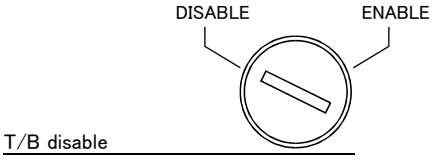
2) After the robot has stopped, press the controller [SVO OFF] switch, and turn the servo OFF.

3) Turn the controller [POWER] switch OFF.

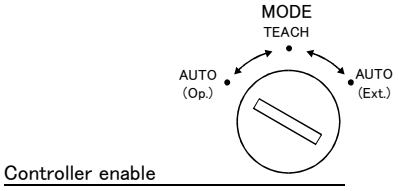
The control power will be shut OFF.

4.4 Turning the servo power ON/OFF

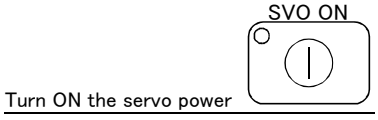
4.4.1 Turning the servo power ON (servo ON)



1) Confirm that the T/B [ENABLE/DISABLE] switch is set to "DISABLE".



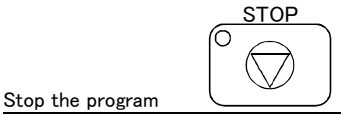
2) Confirm that the [MODE] switch on the front of the controller is set to "TEACH" or "Auto (Op.)".



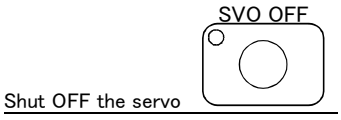
3) Press the [SVO ON] switch on the front of the controller.
The switch's lamp will light indicating that the servo is ON.

⚠ CAUTION Make sure that there are not operators in the robot operation range before turning ON the servo.

4.4.2 Shutting OFF the servo power (servo OFF)



1) If the robot is operating, press the controller [STOP] switch on the front of the controller, and stop the robot.



2) After the robot has stopped, press the controller [SVO OFF] switch on the front of the controller, and turn the servo OFF. The switch's lamp will light indicating that the servo is OFF.

◇◆◇ Operation rights not required ◇◆◇

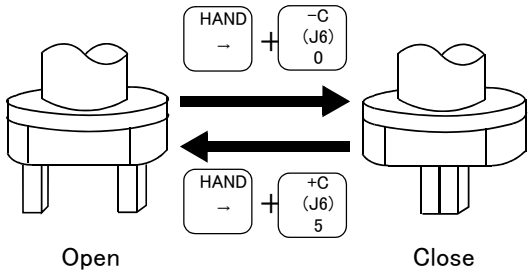
This operation does not require the operation rights, so the servo can be turned OFF at any time by pressing the [SVO OFF] switch.

4.5 Jog operation

Refer to the separate manual "Robot arm setup and maintenance" when carrying out jog operation.
The following jog operation modes are available. Use these according to the purpose.
Table 4-1 : Jog modes

Jog mode	Main application	Explanation
JOINT JOG	・Moves each joint. ・Moves the robot arm largely. ・Changes the robot posture.	Separate manual "Robot arm setup and maintenance"
XYZ JOG	・Accurately sets the teaching position. ・Moves the axis straight along the XYZ coordinate system. ・Moves the axis straight while maintaining the robot posture. ・Changes the posture while maintaining the hand position.	
TOOL JOG	・Accurately sets the teaching position. ・Moves the axis straight along the hand direction. ・Changes the posture while maintaining the hand position. ・Rotates the hand while maintaining the hand position.	
3-AXIS XYZ JOG	・When the axis cannot be moved with XYZ JOG that maintains the posture. ・When the tip is to be moved linearly but the posture is to be changed.	
CYLINDER JOG	・Moves in a cylindrical shape centering on the Z axis while maintaining the posture. ・Moves linearly in a radial shape centering on the Z axis while maintaining the posture.	

4.6 Opening and closing the hand



Hands 1 to 4 can be opened and closed with the T/B.

Opening and closing hand 1
Open: Press [HAND] + [+C (J6)] key
Close: Press [HAND] + [−C (J6)] key
Opening and closing hand 2
Open: Press [HAND] + [+B (J5)] key
Close: Press [HAND] + [−B (J5)] key
Opening and closing hand 3
Open: Press [HAND] + [+A (J4)] key
Close: Press [HAND] + [−A (J4)] key
Opening and closing hand 4
Open: Press [HAND] + [+Z (J3)] key
Close: Press [HAND] + [−Z (J3)] key

4.7 Programming

The procedures from creating the program to automatic operation are explained in order using a simple procedure as an example.

(1) Creation procedures

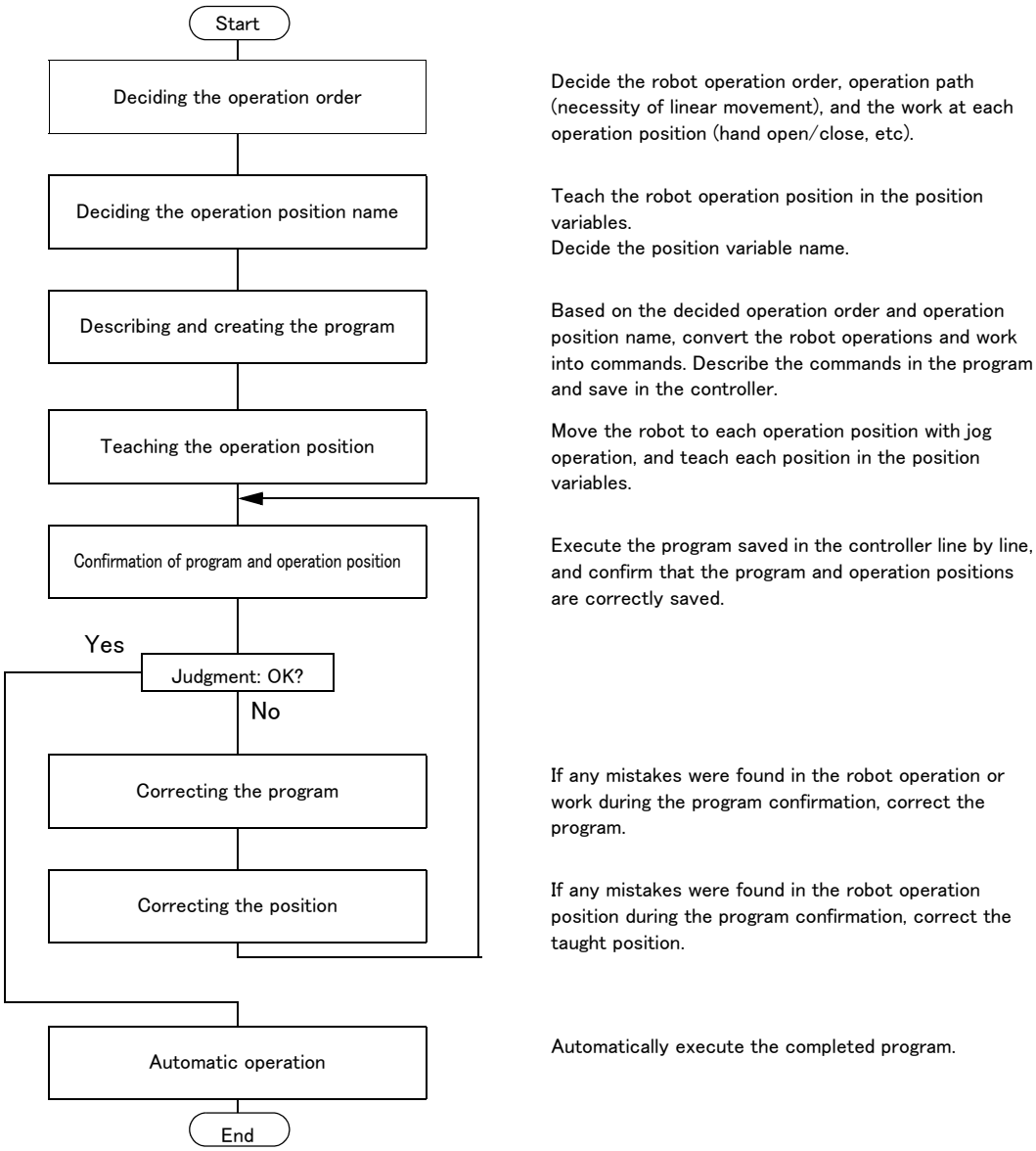


Fig.4-5 : Program creation procedures

(2) Robot work

Assume that the robot is going to carry the workpiece from the left to the right.

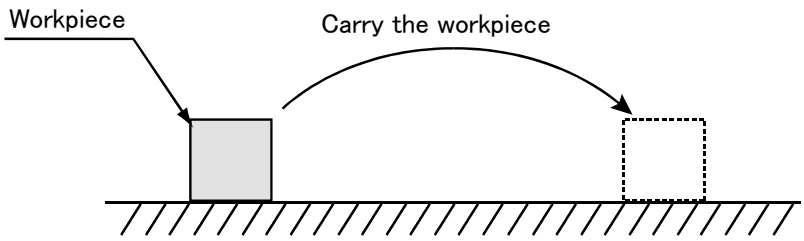
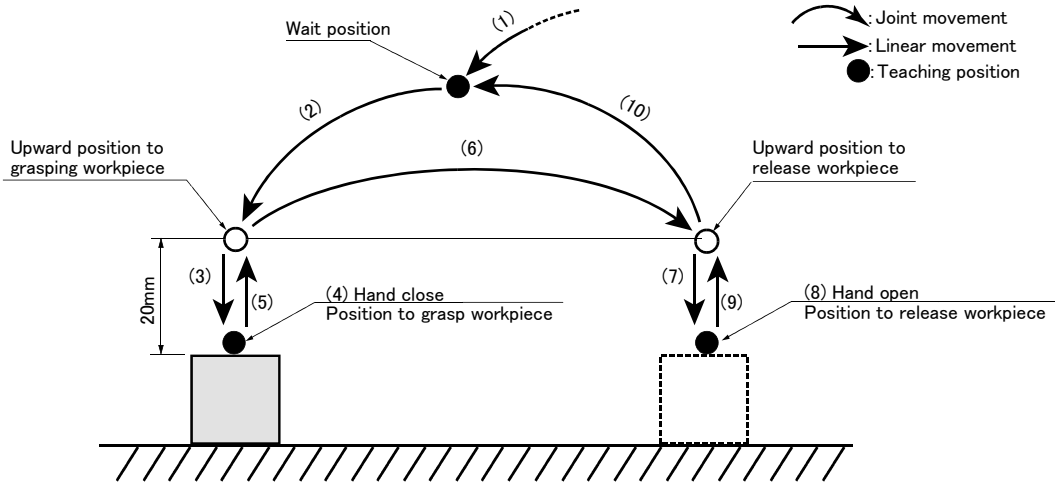


Fig.4-6 : Example of work

4.7.1 Creating the program

(1) Deciding the operation order



Start

(1) Move to wait position (joint movement).
(2) Move to 20mm upward workpiece (joint movement).
(3) Move to position to grasp workpiece (linear movement).
(4) Grasp workpiece (hand close).
(5) Move 20mm upward (linear movement).
(6) Move to 20mm upward position to place workpiece (joint movement).
(7) Move to position to place workpiece (linear movement).
(8) Release workpiece (hand open).
(9) Move 20mm upward (linear movement).
(10) Move to wait position (joint movement).

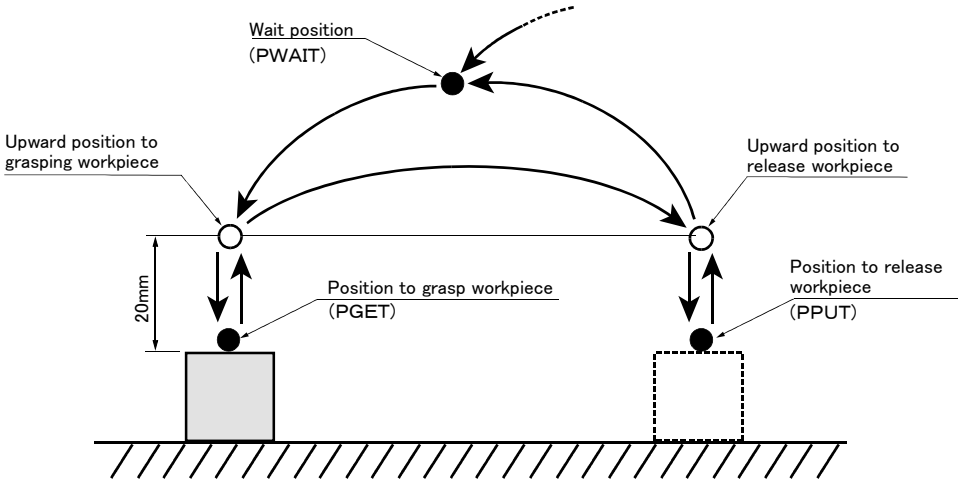
End

Fig.4-7 : Deciding the operation order

◇◆◇ Joint movement and linear movement ◇◆◇

The operation for which the robot movement path is not designated in particular is the "joint movement". The operation for which the movement path is designated as linear is "linear movement".
If the robot could interfere with the peripheral devices, such as the workpiece, when moving to grasp or release the workpiece, designate "linear movement" to prevent any interference.

(2) Deciding the operation position name



Name	Position variable name	Teaching	Remarks
Wait position	PWAIT	Required	
Upward position to grasping workpiece	—	Not required	Designate with commands.
Position to grasp workpiece	PGET	Required	
Upward position to release workpiece	—	Not required	Designate with commands.
Position to release workpiece	PPUT	Required	

Position variable name ···· Designate a random character string starting with "P".
Up to eight characters can be designated.

Fig.4-8 : Deciding the operation position name

◇◆◇ Teaching the operation position ◇◆◇

The operation position does not necessarily need to be taught.
The positions shown with white circles in Fig. 4-8 can be designated with commands as "position 20mm away from target position". Refer to "(3) Describing and creating the program" on page 48.

⚠CAUTION The designation of the direction separated from the target position differs according to the robot type.
The position is along the Z axis of the TOOL coordinate system, and the direction is designated with the + and − signs.
Refer to the section on the TOOL JOG operation in the separate "Instruction Manual/ Robot arm setup and maintenance", and confirm the Z axis direction of the TOOL coordinate system. Then, designate the correct sign (direction) that matches the robot being used.
Designating the reverse direction could lead to interference with the peripheral devices and damage.
Generally (in the default state), the hand retract direction is the "−" sign with the vertical articulate type robot, and the "+" sign is the robot's upward direction with the other robots

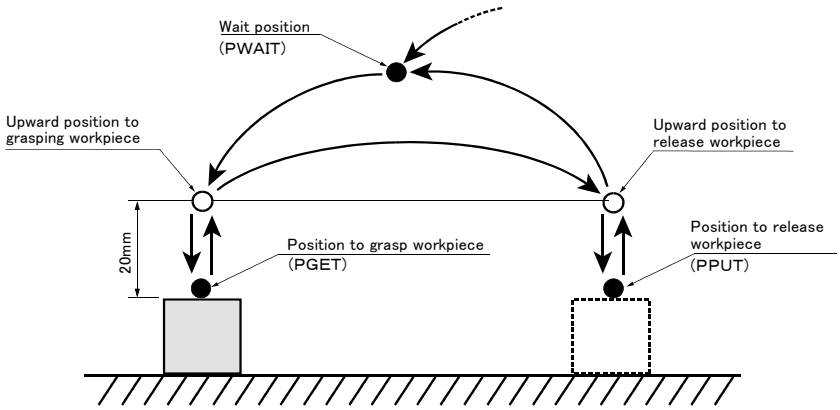
(3) Describing and creating the program

■ Convert the target robot operations and work into commands.
Refer to the separate manual "Instruction Manual: Detailed explanations of functions and operations" for details on the commands.

Table 4-2 : Commands used

Target operation and work	Command	Example of designation	
Joint movement	MOV	Move to position variable PWAIT	MOV PWAIT
		Move to 20mm upward position variable PGET	MOV PGET,+20 Note)
Linear movement	MVS	Move to position variable PGET	MVS PWAIT
		Move to 20mm upward position variable PGET	MVS PGET,+20 Note)
Hand open	HOPEN	Open hand 1	HOPEN 1
Hand close	HCLOSE	Close hand 1	HCLOSE 1
Wait	DLY	Wait 1 second	DLY 1.0
End	END	End the program	END

■ Program the converted commands



Start
(1) Move to wait position (joint movement) .....10 MOV PWAIT
(2) Move to 20mm upward workpiece (joint movement) .....20 MOV PGET,+20 Note)
(3) Move to position to grasp workpiece (linear movement) .....30 MVS PGET
(4) Grasp workpiece (hand close) .....40 HCLOSE 1
.....50 DLY 1.0
(5) Move 20mm upward (linear movement) .....60 MVS PGET,+20 Note)
(6) Move to 20mm upward position to place workpiece (joint movement) .....70 MOV PPUT,+20 Note)
(7) Move to position to place workpiece (linear movement) .....80 MVS PPUT
(8) Release workpiece (hand open) .....90 HOPEN 1
.....100 DLY 1.0
(9) Move 20mm upward (linear movement) .....110 MVS PPUT,+20 Note)
(10) Move to wait position (joint movement) .....120 MOV PWAIT
End .....130 END

Hand ···· Up to four hands can be installed. However, in the above program, the 1st hand connected to hand 1 is the target.

Fig.4-9 : Describing the program

⚠CAUTION Note) Upward movement is designated at a position along the Z axis of the TOOL coordinate system, and the direction is designated with the + and − signs.
Refer to the section on the TOOL JOG operation in the separate "Installation Manual/ Robot arm setup and maintenance", and confirm the Z axis direction of the TOOL coordinate system. Then, designate the correct sign (direction) that matches the robot being used.
Designating the reverse direction could lead to interference with the peripheral devices and damage.
Generally (in the default state), the hand retract direction is the "−" sign with the vertical articulate type robot, and the "+" sign is the robot's upward direction with the other robots.

◇◆◇ Program format ◇◆◇

The program format is configured of the "line No. command parameter affixed to command" as shown in Fig. 4-9.

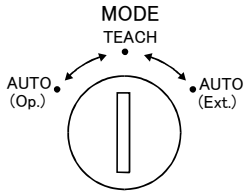
Example) 1 0 M O V P W A I T

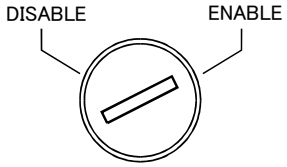
Line No. Command Parameter affixed to command

The program is executed in order from the line No. with the smallest number.

■ Input the described program into the controller.
The T/B is used for this operation.

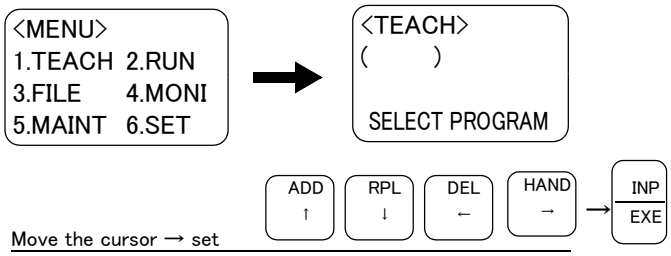
Preparing the T/B



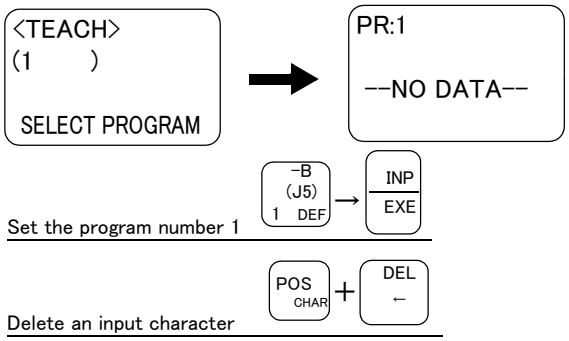


1) Set the controller [MODE] switch to "TEACH".
2) Set the T/B [ENABLE/DISABLE] switch to "ENABLE".

Opening the program editing screen



3) In the <MENU> screen, press the arrow keys (" ↑ ", " ↓ ", " ← ", " → ") and move the cursor to "1. TEACH", and then press the [INP] key. The <TEACH> screen will appear.



4) Press the [1] → [INP] keys.
The program No. 1 editing screen will appear.

◇◆◇ Using the T/B ◇◆◇

Set the controller [MODE] switch to "TEACH" and the T/B [ENABLE/DISABLE] switch to "ENABLE".
Operations from the T/B are not possible unless the controller [MODE] switch is set to "TEACH".

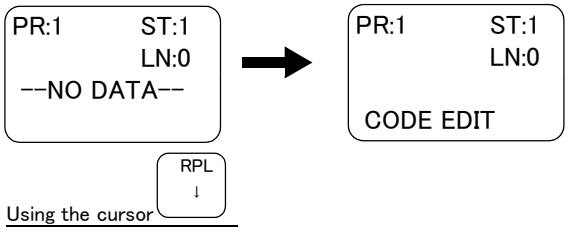
◇◆◇ Inputting numbers and spaces ◇◆◇

To input a number, press the key having a number on the lower left.
To input a space, press the key having "SPACE" on the lower left.

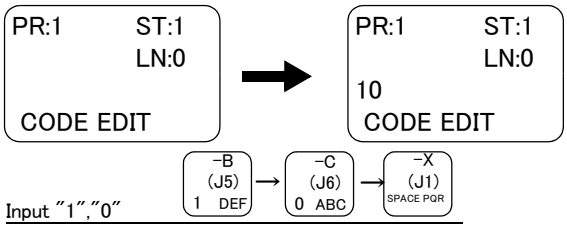
◇◆◇ Correcting incorrect numbers ◇◆◇

Press the [DEL] key while holding down the [CHAR] key to delete the character, and then input it again.
If the cursor is returned by pressing the [←] key, and a character is input, it will be inserted.

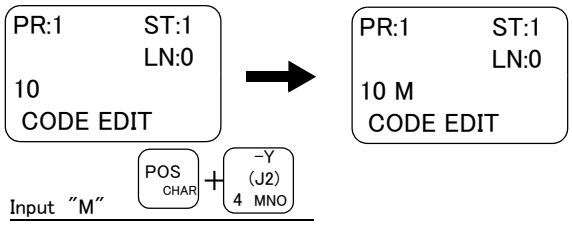
Input the program 10 MOV PWAIT



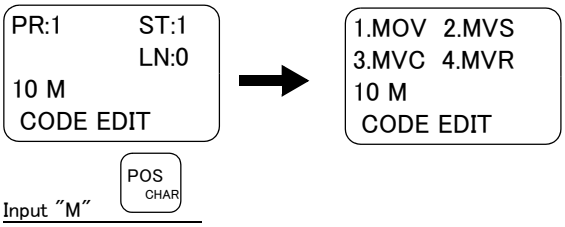
5) Press the [↓] key three times.
The cursor will move to the command editing line.



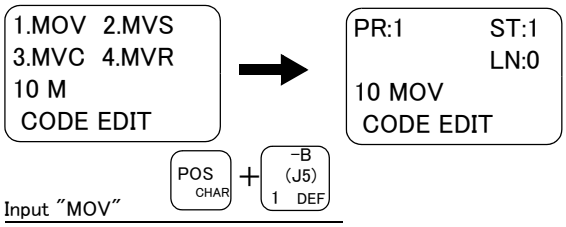
6) Press the [1], [0] and [SPACE] keys.
The line No. "10" will be input.



7) Press the [M] key while holding down the [POS CHAR] key. "M" will appear.



8) Hold down the [CHAR] key. The four commands assigned to "M" will appear.



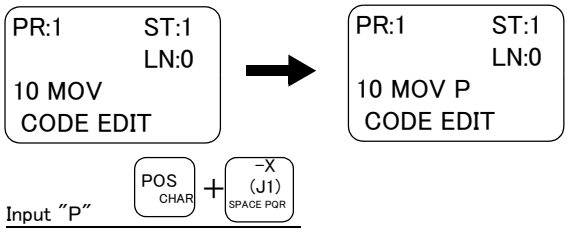
9) Press the [1] key while holding down the [CHAR] key.
The "MOV" command will be input.

◇◆◇ Inputting characters ◇◆◇

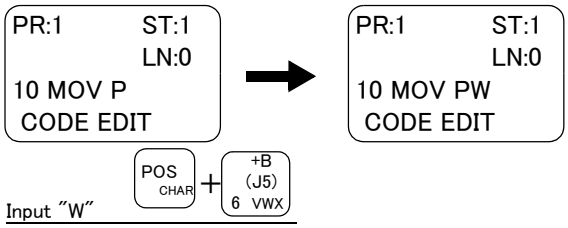
The characters that can be input are indicated, three in a group, on the lower right of each key.
To input a character, hold down the [CHAR] key and press the key having the character to be input. Each time the corresponding character key is pressed while the [CHAR] key is pressed, the three characters will appear alternately.
Release the [CHAR] key when the target character appears, and set the character.

◇◆◇ Inputting commands ◇◆◇

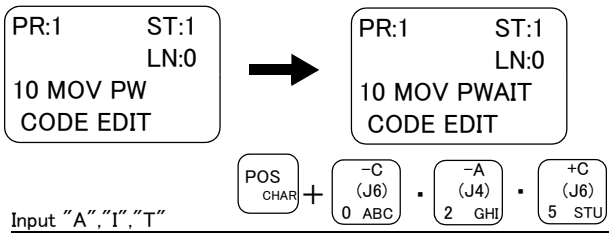
The commands can be input one character at a time (ex., for "M" → "O" → "V" for the MOV command), but if the head character of the command is input, the command can be selected as a number from the list of commands that appears.
After inputting the head character of the command, press the [CHAR] key. The list of commands will appear.
While holding down the [CHAR] key, press the numeral key for the target command No., and select the commanc
If the target command is not found in the list, press the [CHAR] key again to update the list.



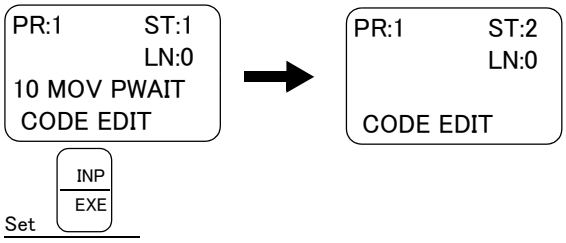
10) Press the [P] key while holding down the [CHAR] key, and then release the [CHAR] key.
"P" will be input.



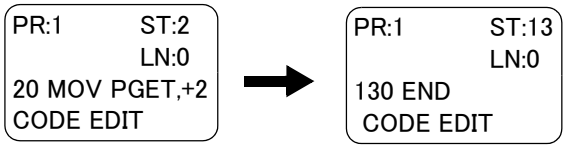
11) Press the [W] key twice while holding down the [CHAR] key, and then release the [CHAR] key.
"W" will be input.



12) Input "A", "I" and "T" in the same manner.



13) Press the [INP] key.
"10 MOV PWAIT" will be set.



14) Input the program from line 20 to line 130 in the same manner.

This completes the inputting of the program.

◇◆◇ Displaying the previous and next command line ◇◆◇

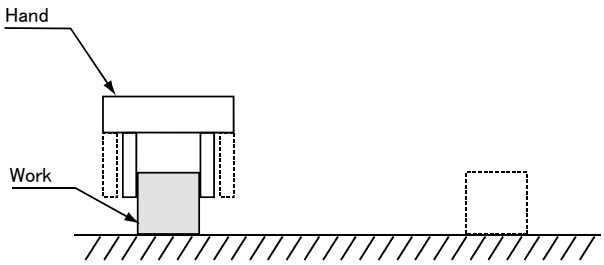
To display the previous line, press the [BACKWD] key, and to display the next line, press the [FORWD] key.

◇◆◇ Displaying a specific line ◇◆◇

Press the [↑] and move the cursor to LN:. Input the No. of the line to be displayed in the parentheses, and then press the [INP] key. The designated line will appear.

■ Teach the robot operation position.

Set the position with jog operation (Teaching PGET)

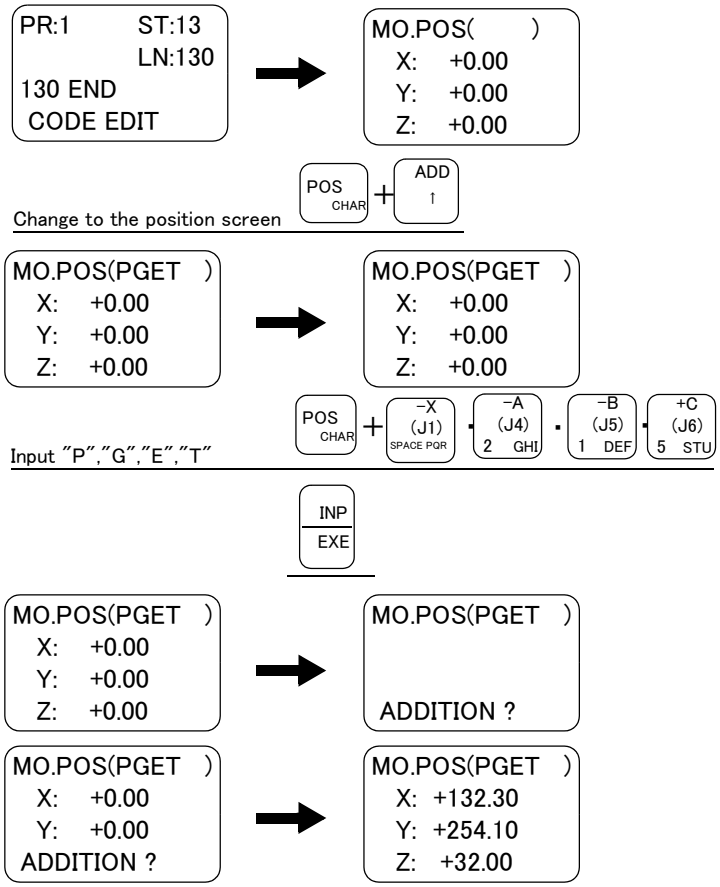


1) Move the robot with jog operation, and set the end of the hand to the position for grasping the workpiece. When the position has been set, open and close the hand to confirm that the workpiece can be grasped. Refer to "4.5 Jog operation" on page 44 for details on the jog operation, and section "4.6 Opening and closing the hand" on page 44 for detains on opening and closing the hand.

◇◆◇ Effective use of jog mode ◇◆◇

When the robot's current position is greatly separate from the target position, move the robot in axis units with the "JOINT JOG mode", to approach the position.
If the target position is nearby, move linearly with the "XYZ JOG mode", and finely adjust the position. The position can be set accurately by delaying the override (operation speed) at this time.

Registering the position (Teaching PGET)



2) On the command editing screen, press the [ADD] key while holding down the [POS] key. The position editing screen will appear.

3) Input "PGET" in the parentheses at MO.POS, and then press the [INP] key. The position variable name PGET will be called, and the currently registered coordinate value will appear.

Refer to " ◇◆◇ Inputting characters ◇◆◇ " on page 50 for details on inputting characters.

4) Press the [ADD] key while holding down the [STEP] key, and release only the [ADD] key. The buzzer will sound a "beep", and a confirmation message will appear.
While holding down the [STEP] key, press the [ADD] key again.
The buzzer will sound a "beep", and the message "ADDING" will appear. Then, the current position will be registered.

◇◆◇ Changing between the command editing screen and position editing screen. ◇◆◇

The commands are edited on the command editing screen, and the positions are edited on the position editing screen.
To change from the command editing screen to the position editing screen, press the [POS] + [ADD] keys.
To change from the position editing screen to the command editing screen, press the [COND] key.

```
MO.POS(PPUT   )
  X:    +0.00
  Y:    +0.00
  Z:    +0.00
```

→

```
MO.POS(PPUT   )
  X:  +132.30
  Y:  +554.10
  Z:   +32.00
```

```
MO.POS(PWAIT )
  X:    +0.00
  Y:    +0.00
  Z:    +0.00
```

→

```
MO.POS(PWAIT )
  X:  +132.30
  Y:  +354.10
  Z:  +132.00
```

5) Teach PPUT (position to place workpiece) and PWAIT (wait position) in the same manner.

This completes teaching of the robot operation positions.

(4) Confirming the program

Using the T/B execute the program line by line (step operation), and confirm the operation.
The following operations are carried out while lightly pressing the deadman switch on the T/B.

```
MO.POS(PWAIT )
  X:  +132.30
  Y:  +354.10
  Z:  +132.00
```

→

```
PR:1          ST:1
              LN:10
10 MOV PWAIT
 CODE EDIT
```

1) Press the [COND] key, and display the command editing screen.

Change to the command screen [COND]

```
PR:1          ST:1
              LN:10
10 MOV PWAIT
 CODE EDIT
```

→

```
PR:1          ST:2
              LN:20
20 MOV PGET
 CODE EDIT
```

2) While holding down the [FORWD] key, hold down the [EXE] key.
The robot will start moving.

When the execution of one line is completed, the robot will stop, and the next line will appear on the screen.
If [EXE] is released during this step, the robot will stop.

Start of step execution [+ FORWD] + [INP EXE]

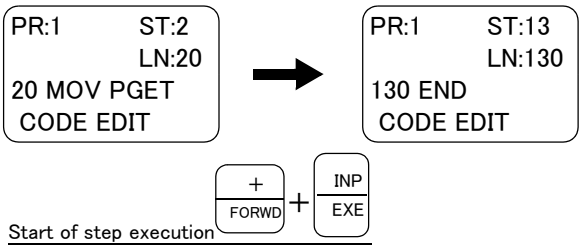
⚠ CAUTION Take special care to the robot movements during operation. If any abnormality occurs, such as interference with the peripheral devices, release the [EXE] key and stop the robot.

◇◆◇ Step operation ◇◆◇

"Step operation" executes the program line by line. The operation speed is slow, and the robot stops after each line, so the program and operation position can be confirmed.
During execution, the lamp on the controller's [START] switch will light.

◇◆◇ Immediately stopping the robot during operation ◇◆◇

- Press the [EMG. STOP] (emergency stop) switch.
  The servo will turn OFF, and the moving robot will immediately stop.
  To resume operation, reset the alarm, turn the servo ON, and start step operation.
- Release or forcibly press the "deadman" switch.
  The servo will turn OFF, and the moving robot will immediately stop.
  To resume operation, lightly press the "deadman" switch, and start step operation.
- Release the [EXE] key.
  The step execution will be stopped. The servo will not turn OFF.
  To resume operation, press the [EXE] key.



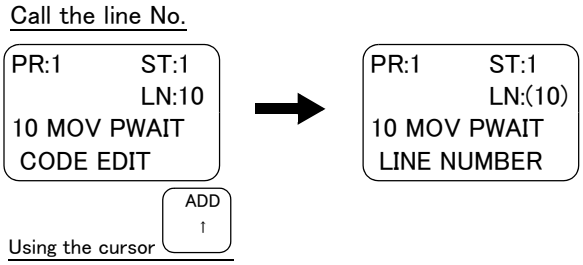
3) Carry out step operation up to the END command at line No. 130, and confirm the operation in the same manner.
If the robot operation or position is incorrect, refer to the following operations and make corrections.

(5) Correcting the program

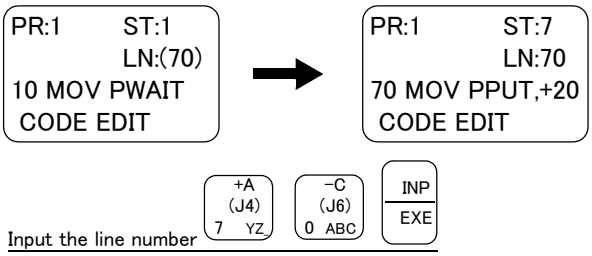
■ Correcting the commands

As an example, the joint movement at line No. 70 will be changed to linear movement.

(Change 70 MOV PPUT, +20 to 70 MVS PPUT, +20) Note)



1) Press the [↑] key to move the cursor to LN: ( ).



2) Press the [7], [0] and [INP] keys. Line No. 70 will appear.

⚠ CAUTION

Note) Upward movement is designated at a position along the Z axis of the TOOL coordinate system, and the direction is designated with the + and − signs.
Refer to the section on the TOOL JOG operation in the separate "Installation Manual/ Robot arm setup and maintenance", and confirm the Z axis direction of the TOOL coordinate system. Then, designate the correct sign (direction) that matches the robot being used.
Designating the reverse direction could lead to interference with the peripheral devices and damage.
Generally (in the default state), the hand retract direction is the "−" sign with the vertical articulate type robot, and the "+" sign is the robot's upward direction with the other robots.

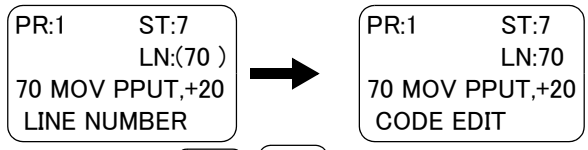
◇◆◇ Cursor movement ◇◆◇

When the cursor is at a command line display, the command can be edited. When at a line No. display (LN:), the line No. is designated.
The cursor is moved with the [↑], [↓], [←] and [→] keys.

◇◆◇ Calling out a line No. ◇◆◇

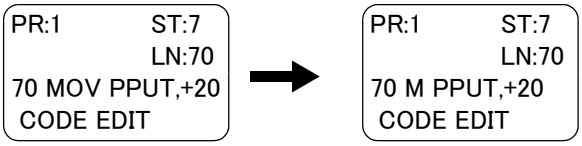
When designating and calling out a line No., move the cursor to the line No. display (LN:), input the line No., and then press the [INP] key.
The displayed line can be scrolled up or down by pressing the [FORWD] or [BACKWD] key.

Change to the command



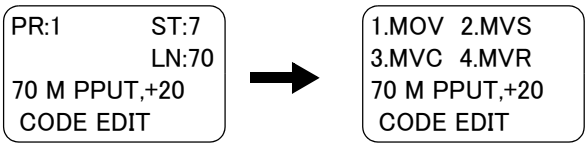
Using the cursor

3) Press the [↓] key and move the cursor to the command line.
Press the [→] key six times, and move the cursor to the right of "V".



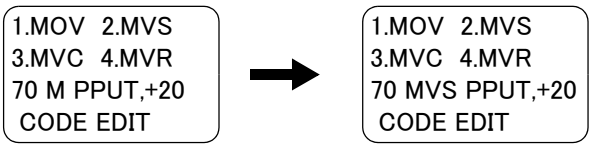
Deleting a character

4) Press the [DEL] key, and delete "OV". "M" will remain displayed.

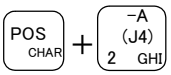


Display the command list

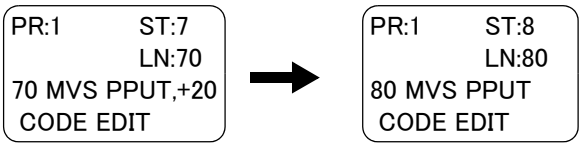
5) Hold down the [CHAR] key.
The four commands assigned to "M" will appear.



Select the "MVS" command



6) Press the [2] key while holding down the [CHAR] key, and select "MVS".



Set line 70

7) Press the [INP] key, and set line No. 70. The next line will appear on the screen.

Line No. 70 has been changed to linear movement with the above operation.

◇◆◇ Correcting a character ◇◆◇

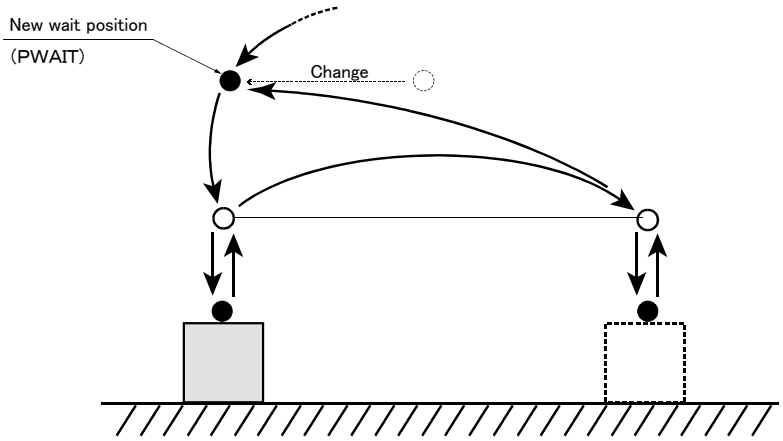
Move the cursor to the right of the incorrect character, and press the [DEL] key to delete in the left direction. Then, input the correct character. The input character will be inserted at the cursor position.
If the cursor is returned by pressing the [←] key, and a character is input, it will be inserted.

◇◆◇ After correcting a program ◇◆◇

After correcting the program, carry out step operation, and confirm that the program has been corrected.

■ Correcting the taught position

As an example, the wait position (PWAIT) will be corrected.



Change the movement position

```
PR:1        ST:8
            LN:(80 )
80 MVS PPUT
 CODE EDIT
```

→

```
MO.POS(       )
  X:    +0.00
  Y:    +0.00
  Z:    +0.00
```

1) On the command editing screen, press the [ADD] key while holding down the [CHAR] key.
The position editing screen will appear.

Change to the position screen

[POS CHAR] + [ADD ↑]

```
MO.POS(PWAIT )
  X:    +0.00
  Y:    +0.00
  Z:    +0.00
```

→

```
MO.POS(PWAIT )
  X:  +132.30
  Y:  +354.10
  Z:  +132.00
```

2) Input "PWAIT" in the parentheses at MO.POS, and then press the [INP] key.
The position variable name PWAIT will be called out, and the currently registered coordinate value will appear.

Input "P","W","A","I","T"

[POS CHAR] + [−X (J1) SPACE PQR] · [+B (J5) 6 VWX] · [−C (J6) 0 ABC] ·

[−A (J4) 2 GHI] · [+C (J6) 5 STU] [INP/EXE]

◇◆◇ Calling out a position variable ◇◆◇

Input the name of the variable to be called out in the parentheses at MO. POS on the position editing screen. Then, press the [INP] key.
The displayed position variable can be scrolled up or down by pressing the [FORWD] or [BACKWD] key.

```
JOINT      LOW
 J1    +34.50
 J2    +20.00
 J3    +80.00
```

3) Move the robot to the new wait position with jog operation.

```
MO.POS(PWAIT )
  X:  +132.30
  Y:  +354.10
  Z:  +132.00
```

→

```
MO.POS(PWAIT )
  X:  +132.30
  Y:  -284.10
  Z:  +132.00
```

Correct the position [STEP/MOVE] + [RPL ↓] · [RPL ↓]

4) Press the [RPL] key while holding down the [STEP] key, and release only the [RPL] key.
The buzzer will sound a "beep", and a confirmation message will appear.
While holding down the [STEP] key, press the [RPL] key again.
The buzzer will sound a "beep", and the message "Replacing" will appear. Then, the current position will be registered.

This completes correction of the wait position.

◇◆◇ After correcting a program ◇◆◇

After correcting the program, carry out step operation, and confirm that the program has been corrected.

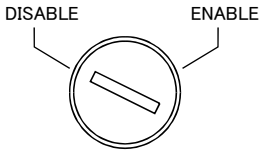
(6) Start automatic operation.

⚠ CAUTION Before starting automatic operation, always confirm the following item. Starting automatic operation without confirming these items could lead to property damage or physical injury.

- Make sure that there are no operators near the robot.
- Make sure that the safety fence is locked, and operators cannot enter unintentionally.
- Make sure that there are no unnecessary items, such as tools, inside the robot operation range.
- Make sure that the workpiece is correctly placed at the designated position.
- Confirm that the program operates correctly with step operation.

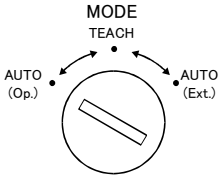
In the following explanation, automatic operation will be carried out with the controller.

Prepare the controller



T/B disable

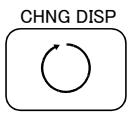
1) Set the T/B [ENABLE/DISABLE] switch to "DISABLE".

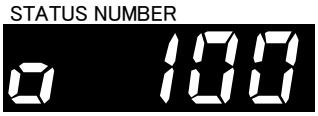


Controller enable

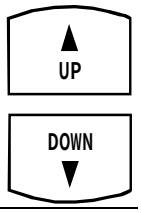
2) Set the controller [MODE] switch to "AUTO (Op.)".

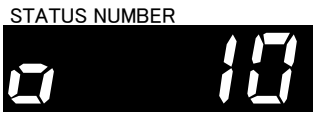
Set the operation speed





Display the override





Set the override

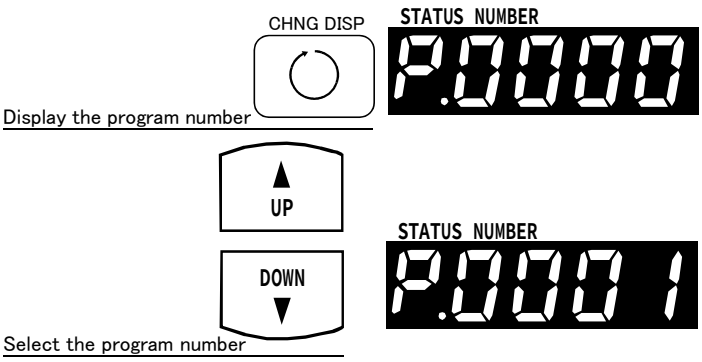
3) Press the controller [CHNG DISP] switch twice, and display the "OVERRIDE" on the STATUS NUMBER display panel. (A "(" will appear at the lower left.)
Press the [DOWN] key several times, and display "10".
The operation speed will be set to 10%.

⚠ CAUTION The servo will turn OFF when the controller's [MODE] switch is changed.
Note that axes not provided with brakes could drop with their own weight.

◇◆◇ Operations to change [MODE] switch without turning servo OFF ◇◆◇

(1) While holding down the deadman switch on the T/B, set the [ENABLE/DISABLE] switch to "DISABLE".
(2) While holding down the deadman switch on the T/B, set the controller [MODE] switch to "AUTO (Op.)".
(3) Release the T/B deadman switch.

Select the program number

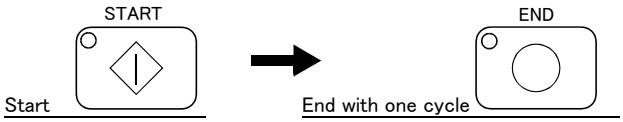


4) Press the [CHNG DISP] switch, and display the "program No." on the STATUS NUMBER display panel. (A "P" will appear at the head.)

Confirm that the program No. targeted for automatic operation is displayed.
With the previous operation, the program was created in program No. 1, so "P. 0001" will appear.

If the correct program No. is not displayed, press the [UP] and [DOWN] keys to display the correct program No.

Start automatic operation



5) After pressing the controller [START] switch, press the [END] switch.
The robot operation will start and will stop after one cycle.

⚠ CAUTION When executing the work example given in "Fig. 4-6Example of work" on page 45, always press the [END] switch and end the program after one cycle. If the [END] switch is not pressed, the hand will interfere with the existing workpiece when it goes to pale the workpiece in the second cycle.

⚠ CAUTION Before starting automatic operation, always confirm that the target program No. is selected.

⚠ CAUTION Take special care to the robot movements during automatic operation. If any abnormality occurs, press the [EMG. STOP] switch and immediately stop the robot.

◇◆◇ Operating from the controller ◇◆◇

Set the T/B [ENABLE/DISABLE] switch to "DISABLE" and the controller [MODE] switch to "AUTO (Op.)".
Operations from the controller are not possible unless the controller [MODE] switch is set to "AUTO (Op.)".

◇◆◇ Operation speed ◇◆◇

The operation speed for automatic operation with the controller can be set.
When the override is displayed on the STATUS NUMBER display panel (with a " □ " displayed on the lower left) the override display will increment or decrement each time the [UP] or [DOWN] key is pressed. The max. speed is 100%.
Initially set a low speed, and gradually increase it.

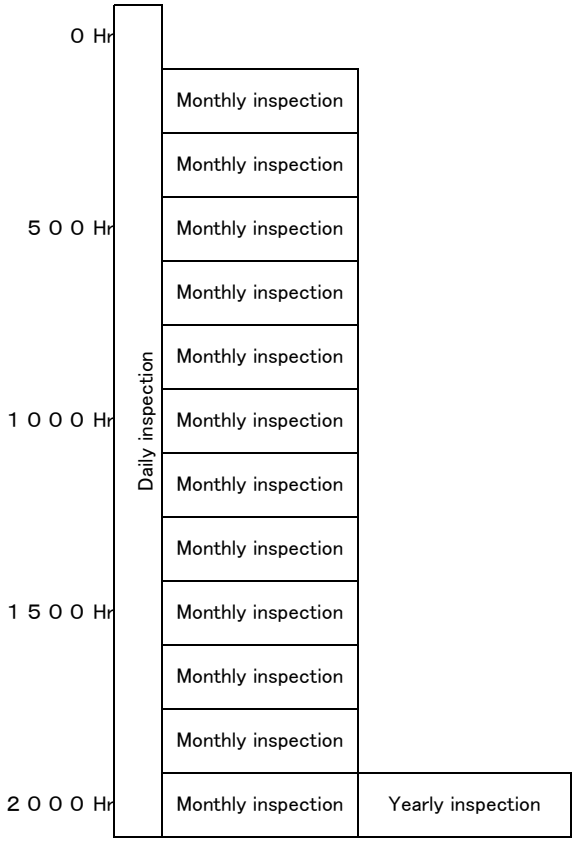
5 Maintenance and Inspection

The maintenance and inspection procedures to be carried out to use the robot for a long time without trouble are described in this chapter. The types and replacement methods of consumable parts are also explained.

5.1 Maintenance and inspection interval

Maintenance and inspection are divided into the inspections carried out daily, and the periodic inspections carry out at set intervals. Always carry these out to prevent unforeseen trouble, to maintain the product for a long time, and to secure safety.

(1) Inspection schedule



Operating time

<Guideline for inspection period>

For one shift

8 Hr/day x 20 days/month x 12 months = approx. 1800 Hr

10 Hr/day x 20 days/month x 12 months = approx. 2400 Hr

For two shifts

15 Hr/day x 20 days/month x 12 months = approx. 3600 Hr

[Caution] According to the schedule on the above, when using the double shift, you should make the inspections at half the regular intervals.

Fig.5-1 : Inspection schedule

5.2 Inspection items

The controller inspection items are shown below.
Refer to section "Maintenance and Inspection" in the separate manual "Robot arm setup and maintenance", and inspect the robot arm at the same time.

5.2.1 Daily inspection items

Carry out daily inspections following the procedures given in Table 5-1.

Table 5-1 : Daily inspection items (details)

Procedure	Inspection items (details)	Remedies
Before turning the power ON (Check the following inspection items before turning the power ON.)		
1	Is the power cable securely connected? (Visual)	Securely connect.
2	Are the machine cables between the robot arm and controller securely connected? (Visual)	Securely connect.
3	Is the controller cover cracked, has any foreign matter adhered, or is there any interference?	Replace with a new part, or take remedial measures.
After turning the power ON (Turn the power ON while monitoring the robot.)		
1	Is there any abnormal movement or noise when the power was turned ON?	Refer to the Troubleshooting section and remedy.
During operation (Try moving with an original program.)		
1	Check that the operation point is not deviated. If deviated, check the following items. 1) Are any of the installation bolts loose? 2) Are the bolts at the hand installation section loose? 3) Is the position of the jigs, other than the robot, deviated? 4) If the positional deviation cannot be eliminated, refer to "Troubleshooting", and remedy.	Refer to the Troubleshooting section and remedy.
2	Is there any abnormal movement or noise? (Visual)	Refer to the Troubleshooting section and remedy.

5.2.2 Periodic inspections

Carry out periodic inspections following the procedures given in Table 5-2.

Table 5-2 : Periodic inspection items (details)

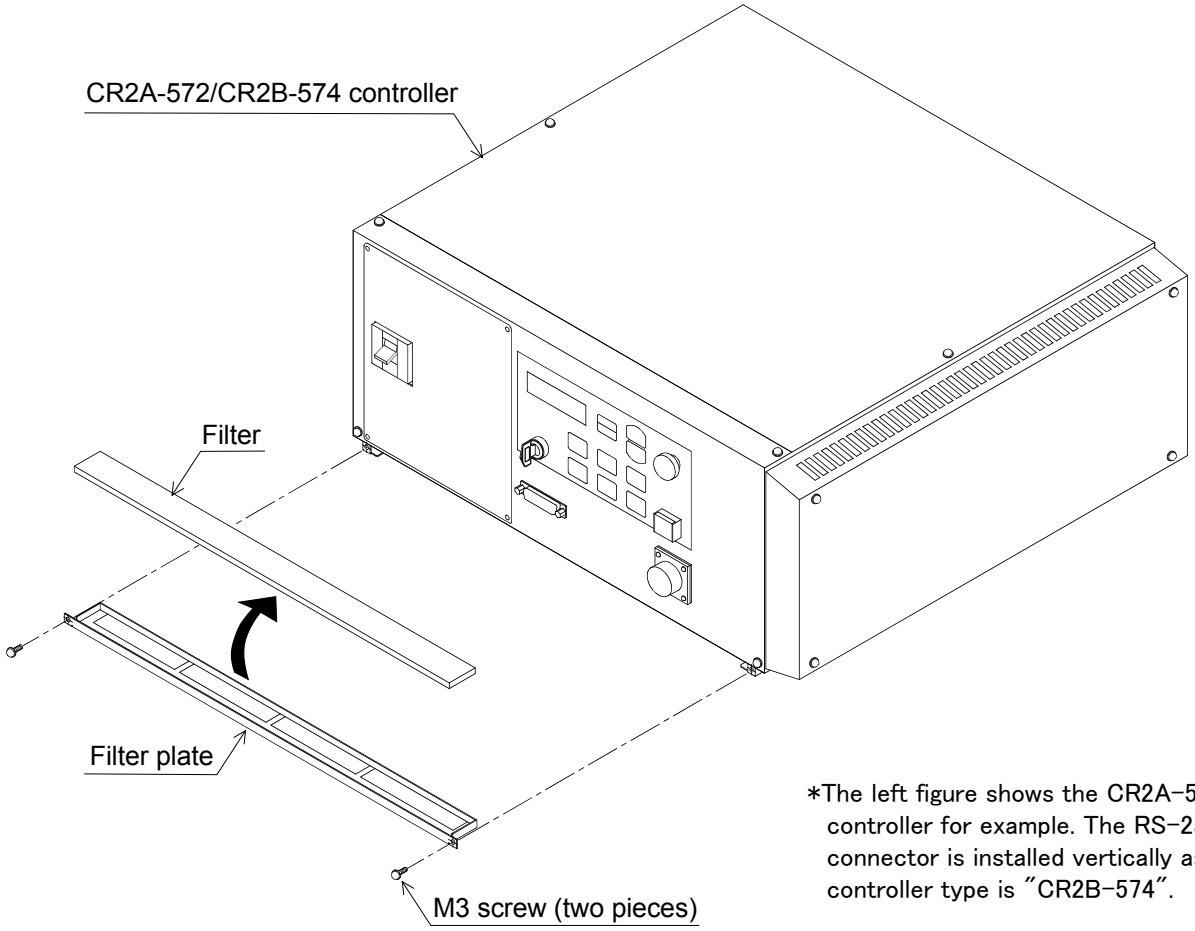
Procedure	Inspection items (details)	Remedies
Monthly inspection items		
1	Are any of the connector fixing screws or terminal block terminal screws loose?	Securely tighten the screws.
2	Is the controller filter (bottom side) dirty? (Visual)	Clean or replace with a new part. Inspect, clean and replace the filter by refer to "5.3.1 Inspecting, cleaning and replacing the filter" on page 62.
6-month inspection items		
1	Is the fan motor of the controller protection box rotating normally? Are the radiating fins and fan free from dust and oil mist, and clean?	Clean the radiating fins by refer to "5.3.3 Cleaning the heat radiating fins of the controller protection box (CR2A-MB)" on page 66.
Yearly inspection items		
1	Replace the backup battery in the controller.	Exchange it referring to "5.3.2 Replacing the battery" on page 63.

5.3 Maintenance and inspection procedures

The procedures for carrying out periodic maintenance and inspection are described below. Thoroughly comprehend the procedures, and follow the instructions. This work can be commissioned to the Mitsubishi Service Dept. for a fee. (Never disassemble, etc., any of the parts not described in this section.)
The maintenance parts required for the maintenance and inspection are shown in section "5.4 Maintenance parts" on page 40. Contact your dealer for these parts when required.

5.3.1 Inspecting, cleaning and replacing the filter

A filter has been installed in the front part of the controller's bottom surface.
The following shows the procedure for inspecting, cleaning and replacing the filter:



*The left figure shows the CR2A-572 controller for example. The RS-232C connector is installed vertically as the controller type is "CR2B-574".

Fig.5-2 : How to remove the filter

1) Remove the filter plate in the bottom of the front side of the controller by unscrewing the M3 screws (2 pcs.).
2) Remove the filter from the filter plate, and then remove dust and particles accumulated on the filter.
   If the filter is heavily soiled, rinse it well with water and similar solution and dry it completely, or replace it with a new one.
3) Attach the cleaned or new filter to the filter plate, and install it to the controller with the M3 screws (2 pcs.).

This completes the inspection, cleaning and replace of the filter for the CR2A-572/CR2B-574 controller.

5.3.2 Replacing the battery

⚠ CAUTION

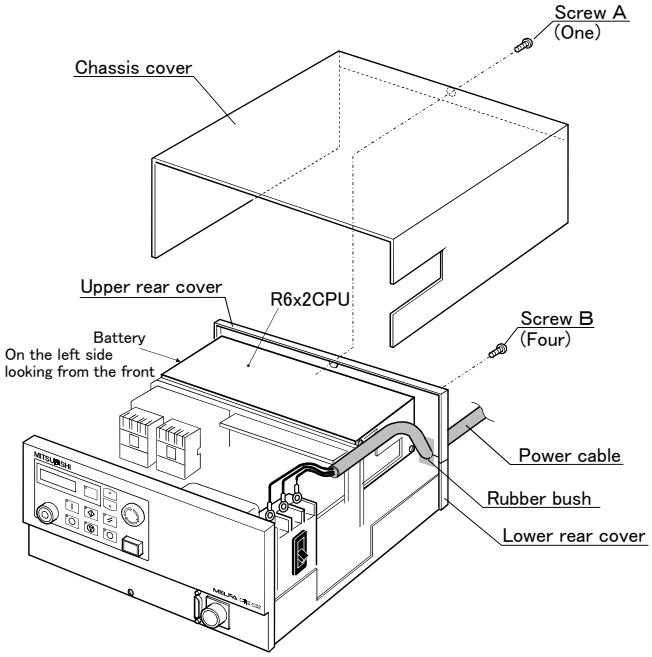
The procedures for replacing the battery are described below.
If the system is used after the battery cumulative time over error (Error No. 7520) occurs, the backup fault alarm will occur. If the backup fault alarm occurs, the contents of the memory cannot be guaranteed, so save important program and position data on a floppy disk using personal computer support software, etc.

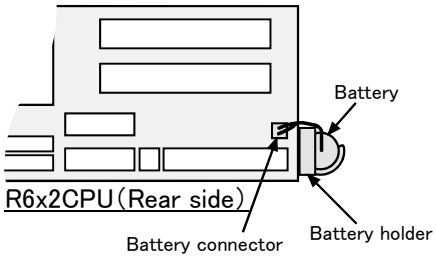
⚠ CAUTION

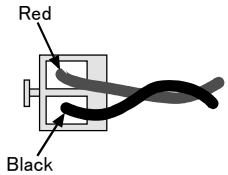
Replace the batteries for the controller and robot arm at the same time. Replace the controller battery within 15 minutes after removing the old battery.

Note that the battery-change method differs, depending on the controller being used. When the CR2-532 controller is used, refer to "(1) For the CR2-532 Controller" on page 63. When the CR2A-572 controller is used, refer to "(2) For the CR2A-572/CR2B-574 Controller" on page 64. When the CR2-532M controller is used, refer to "(3) For the CR2-532M Controller" on page 65.

(1) For the CR2-532 Controller





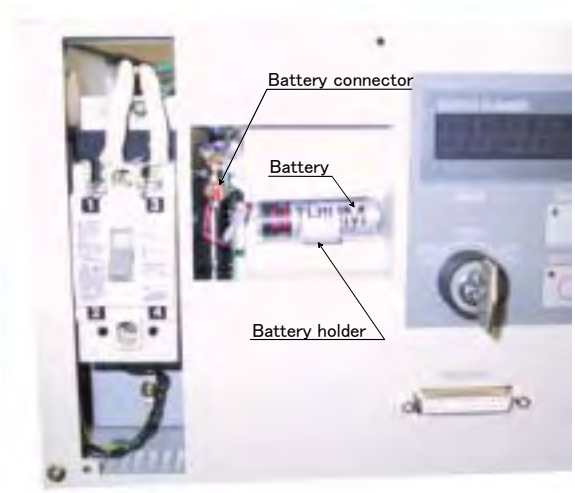


Battery connector direction

1) Turn the controller power ON once. (For approx. one minute.)
2) Wait at least three minutes after turning the power OFF, and then remove the controller Chassis cover.
   To remove the cover, remove the one installation screw A, and slide the cover approx. 100mm toward the back. Then, lift it up.
3) Remove the upper rear cover by removing the four installation screws B on the back.
   The battery is on the left R6x2CPU looking from the front of the controller.
4) Hold and pull out the old battery connector, and remove from the battery holder.
5) Install the new battery into the battery holder. Install so that the lead line come to the front.
6) Connect the new battery cable connector to the connector removed in step "4)". Connect so that the red lead line is at the top.
   Connect the new battery within 15 minutes of removing the old battery.
7) Return the upper rear cover, removed in step "3)"
   Sandwich the power cable and grounding cable with the rubber bushing installed on the lower rear cover and upper rear cover. After installing, securely fix with the four screws.
   Install the chassis cover, removed in step "2)", and fix securely with screws.
8) Initialize the battery consumption time. Always carry out this step after replacing the battery, and initialize the battery usage time.
   Refer to the separate "Instruction Manual/ Detailed Explanation of Functions and Operations" for details on the initialization methods.

This completes the replace the battery of the CR2-532 controller.

(2) For the CR2A-572/CR2B-574 Controller



View from A

1) Turn the controller power ON once. (For approx. one minute.)

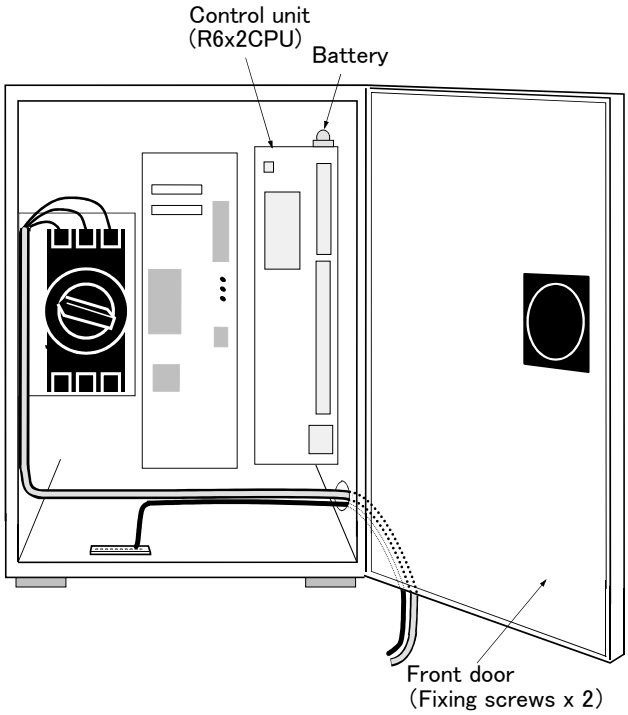
2) Wait at least three minutes after turning OFF the power and primary power supply. Then remove the battery cover of the controller by removing the four installation screws.

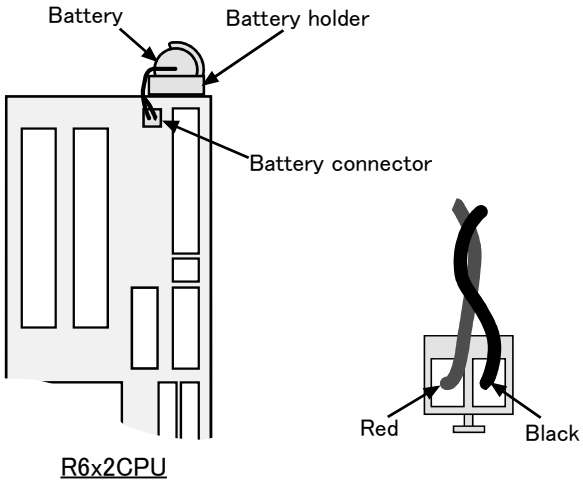
3) Hold and pull out the old battery connector, and remove from the battery holder.
4) Install the new battery into the battery holder. Install it so that the lead wire comes out to the left when viewed from the front.
5) Connect the new battery cable connector to the connector removed in step "3)". Connect so that the red lead line is at the top.
6) Connect the new battery within 15 minutes of removing the old battery.
7) Reinstall the battery cover, which was removed in step "2)" avobe, and fasten the cover securely with the four installation screws.

8) Initialize the battery consumption time. Always carry out this step after replacing the battery, and initialize the battery usage time. Refer to the separate "Instruction Manual/ Detailed Explanation of Functions and Operations" for details on the initialization methods.

This completes the replace the battery of the CR2A-572/CR2B-574 controller.

(3) For the CR2-532M Controller





1) Turn the controller power ON once. (For approx. one minute.)

2) Wait at least three minutes after turning OFF the power and primary power supply, then loosen the fixing screws on the controller front door, and open the front door.
The battery is on the R6x2CPU.

3) Hold and pull out the old battery connector, and remove from the battery holder.

4) Install the new battery into the battery holder. Install so that the lead line come to the front.

5) Connect the new battery cable connector to the connector removed in step "3)". Connect so that the red lead line is at the left.
Connect the new battery within 15 minutes of removing the old battery.

6) Close the controller's front door, and fix with the fixing screws.

7) Initialize the battery consumption time.
Always carry out this step after replacing the battery, and initialize the battery usage time.
Refer to the separate "Instruction Manual/ Detailed Explanation of Functions and Operations" for details on the initialization methods.

This completes the replace the battery of the CR2-532M controller.

5.3.3 Cleaning the heat radiating fins of the controller protection box (CR2A-MB)

The following shows the procedure for cleaning the radiating fins:
Perform this cleaning by referring to Fig. 5-3.

(1) If the fins are soiled with dust and particles, blow them off using an air blower.
1) Remove the power wire of the relay terminal box inside the panel.
2) Remove the rear panel of the controller protection box from the main unit.
3) Remove the heat exchanger from the rear panel.
4) Remove the fan mounting plate from the rear panel, and then remove the fan.
5) Remove the cable(2pair) and grounding wire connected to the fan.
6) Blow off the exterior of the fins with an air blower.

(2) If dirt does not come off, clean the fins according to the following procedure:
1) Pour a neutral detergent over the exterior of the fins to clean.
2) Feed a dry cloth through the fins to remove dirt, and then air-dry them.
3) After the fins are completely dry, install the heat exchanger to the controller protection box in the reverse order of the steps for removing it.

⚠ CAUTION When removing and/or installing the heat exchanger, pay extra attention as such operations may cause injury by sharp corners of metal plates.

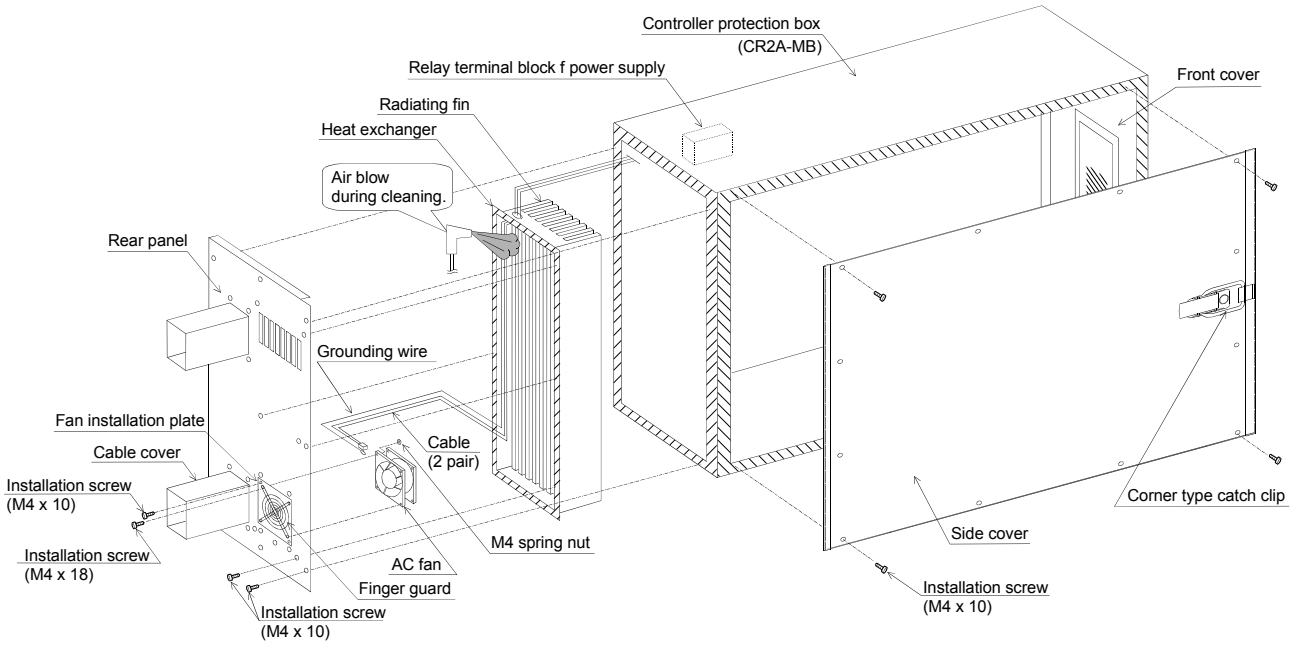


Fig.5-3 : Cleaning the radiating fins (CR2A-MB)

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-3, and spare parts that may be required during repairs are shown in Table 5-4. Purchase these parts from the dealer when required. Some Mitsubishi-designated parts differ from the maker's standard parts. Thus, confirm the part name, robot arm and controller serial No. and purchase the parts from the dealer.

Table 5-3 : Controller consumable part list

No.	Part name	Type	Qty.	Usage section	Maker
1	Lithium battery	ER6 BKO-NC2157H01	1	Control unit	Mitsubishi Electric System & Service;Co.,Ltd.
2	Filter	BKO-FA0688H01	1	Bottom of the controller	

Table 5-4 : Controller spare part list

No.	Part name	Type	Qty.	Usage section	Maker
CR2-532/CR2-532M controller					
1	Fuse	LM16	2	Control unit	Mitsubishi Electric System & Service;Co.,Ltd.
2		LM05	2		
3		LM32	12		
CR2A-572/CR2B-574 controller					
1	Fuse	LM16	1	RZ326A or RZ327 board	Mitsubishi Electric System & Service;Co.,Ltd.
2		LM32	5		
3		HM32	1		
4		LM05	4	RZ804 board	
5		HM32	1		

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