MITSUBISHI

Mitsubishi Industrial Robot

CR1DA/CR2DA/CR3D Controller

INSTRUCTION MANUAL

Controller setup, basic operation, and maintenance

MELFA

BFP−A8660−P

⚠ 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. Moreover, it may interfere with the peripheral device by drop or move by inertia of the arm.

⚠ **CAUTION**   Do not turn off the main power to the robot controller while rewriting the internal information of the robot controller such as the program or parameters. If the main power to the robot controller is turned off while in automatic operation or rewriting the program or parameters, the internal information of the robot controller may be damaged.
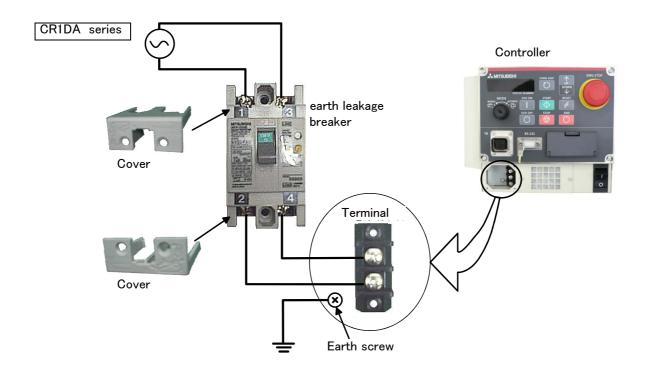
⚠ **CAUTION**   Use the network equipments (personal computer, USB hub, LAN hub, etc) confirmed by manufacturer. The thing unsuitable for the FA environment (related with conformity, temperature or noise) exists in the equipments connected to USB, RS-232 or LAN. When using network equipment, measures against the noise, such as measures against EMI and the addition of the ferrite core, may be necessary. Please fully confirm the operation by customer. Guarantee and maintenance of the equipment on the market (usual office automation equipment) cannot be performed.

C.Notes of the basic component are shown.
　　*SD series: CR1DA-700 series

⚠ **CAUTION**   Please install the earth leakage breaker in the primary side supply power supply of the controller because of leakage protection.

Revision history

Date of print	Specifications No.	Details of revisions
2008-05-09	BFP-A8660	・First print
2008-06-25	BFP-A8660-A	・The electric specification of magnet contactor control (AXMC) was changed ・Change the power cable connection method (CR1D-700).
2008-11-18	BFP-A8660-B	・The Sink/Source setting method of the pneumatic hand interface was added. ・Table 2-1: Standard configuration was changed. 　The filter was added. (All the series controllers) 　The line noise filter and Knob locking device were added. (CR2D and CR3D series controller)
2009-04-24	BFP-A8660-C	・The contact capacity of the emergency stop connector was added. ・The example of wiring of the emergency stop was added. ・The installation method of the interface was corrected. ・The installation method of the memory cassette was corrected. ・The emergency stop release method of T/B was added. ・The enabling switch explanation of T/B was corrected. ・The cursor was added to the serial number input screen. ・It added that the sample program is the example in horizontal multiple-jointed type robot.
2009-06-08	BFP-A8660-D	・Expression was corrected. 　(2.3.4 Connecting the external emergency stop, 3.2 Installing and removing the Option Card, 3.3 Installing the extension memory cassette)
2009-09-11	BFP-A8660-E	・The examples of safety measures (Wiring example 3 〜 5) were corrected.
2009-10-23	BFP-A8660-F	・The EC Declaration of Conformity was changed. (Correspond to the EMC directive; 2006/42/EC)
2009-12-24	BFP-A8660-G	・The ferrite core and the line noise filter quantity were divided by CE / non-CE specification ・The wiring example 3 of safety measures was deleted.(same as wiring example 4)
2010-02-05	BFP-A8660-H	・The explanation of CR1DA-700 series was added.
2010-03-01	BFP-A8660-I	・The "power switch" of CR2 controller was corrected to the "earth leakage breaker". (Error in writing) ・CE specification of the CR1DA controller was added.
2010-07-04	BFP-A8660-J	・The type of controller was changed. (CR1D to CR1DA, CR2D to CR2DA)
2011-01-12	BFP-A8660-K	・The installation position of the SINK/SOURCE setting pin of pneumatic hand interface was changed. (CR2DA controller)
2011-02-02	BFP-A8660-L	・The rear cover of the CR1DA controller was made unnecessary.
2011-05-09	BFP-A8660-M	・Fuse LM10 was added to the attachments of the CR1DA controller.
2011-07-01	BFP-A8660-N	・The note about the connection of the emergency stop was added.
2012-07-03	BFP-A8660-P	・The note about the connection of the emergency stop was added. ・The notes about frequent installation and removal of TB and the dummy connector were added.

■ 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."

Installation of the emergency stop switch

To be able to stop the robot immediately at the time of the abnormalities because of safety, please install the emergency stop switch in the position which is certainly easy to operate it, and connect with the controller. Refer to the Page 15, "2.2.5 Connecting the external emergency stop" for the connection method.
And, the connection method of the door switch or the enabling device is also indicated here. Please use it together with the emergency stop switch.

Synchronous connection of the addition axis servo power supply

It is building the circuit so that the output point of contact (the contactor control output for addition axes: AXMC) installed in the drive unit may be used in use of the addition axis function and the power supply of the servo amplifier for addition axes may be shut down by opening of this output,The servo ON/OFF state of the addition axis can be synchronized with the servo ON/OFF state of the robot arm. With reference to Page 24, "2.2.7 Magnet contactor control connector output (AXMC) for addition axes", I ask you to have synchronous connection made.

Notice
 *ONLY QUALIFIED SERVICE PERSONNEL MAY INSTALL OR SERVICE THE ROBOT SYSTEM.
 *ANY PERSON WHO PROGRAM, TEACHES, OPERATE, MAINTENANCE OR REPAIRS THE ROBOT
  SYSTEM IS TRAINED AND DEMONSTRATES COMPETENCE TO SAFELY PERFORM THE
  ASSIGNED TASK.
 *ENSURE COMPLIANCE WITH ALL LOCAL AND NATIONAL SAFETY AND ELECTRICAL CODES
  FOR THE INSTALLATION AND OPERATION OF THE ROBOT SYSTEM.

Contents

Contents

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 or special 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.
Additional axis function	Explains the specifications, functions and operations of the additional axis control.
Tracking Function Manual	Explains the control function and specifications of conveyor tracking.

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

Terminology	Item/Symbol	Meaning
Item	The "Robot controller" or the "Controller"	Indicates the controller which controls the robot arm. Indicates the box which arranged control parts, such as robot CPU, servo amplifier, and the safety circuit.
Symbol	⚠ 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.
	[JOG]	If a word is enclosed in brackets or a box in the text, this refers to a key on the teaching pendant.
	[RESET] + [EXE] (A)　　　(B)	This indicates to press the (B) key while holding down the (A) key. In this example, the [RESET] key is pressed while holding down the [+EXE] key.
	T/B	This indicates the teaching pendant.
	O/P	This indicates the operating panel on the front of the controller.

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

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

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

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

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

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

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

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

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.

⚠ DANGER   If the automatic operation of the robot is operated by two or more control equipment, design the right management of operation of each equipment of the customer.

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

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

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

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

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

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

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

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

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

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

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

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

⚠ DANGER

When the SSCNETⅢ cable is removed, install the cap in the connector.
If the cap is not installed, there is a possibility of malfunctioning by adhesion of the dust etc.

⚠ DANGER

Don't remove the SSCNETⅢ cable, when the power supply of the robot controller is turned on. Don't face squarely the light emitted from the tip of the SSCNETⅢ connector or the cable. If light strikes the eyes, there is a possibility of feeling the sense of incongruity for the eyes. (The light source of SSCNETⅢ is equivalent to the class 1 specified to JISC6802 and IEC60825-1.)

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
CR1DA-700 controller				
1	Controller	CR1DA-7xx	Each 1 unit	With machine cable
2	Safety Manual	BFP-A8682	1 copy	
3	CD-ROM (Instruction manual)	5S-D***-C**	1 pc.	
4	Dummy connector for T/B		1 pc.	Connect, when not using T/B.
5	Ferrite core [Note1] (CR1DA-700 controller)		3 pc.	Non-CE specification: For wiring of emergency stop , tracking function
6			7 pc.	CE specification: For wiring of emergency stop, tracking function, remote I/O, ethernet, special input/output terminal
7	Fuse (reserves)	LM16	2 pc.	1.6A
8		LM10	1 pc.	For the fuse F3 on TZ801A card.
9	Earth leakage breaker	NV30FAU-2P-10A	1 pc.	The terminal cover, two fixing screw attachment
10	Cable clamp (CR1DA-700 controller)	AL3	1 pc.	For cable shield grounding
11		AL5	1 pc.	
12	Filter		1 pc.	46 x 41 For front filter reserves
13	Line noise filter [Note1]	FR-BSF01	1 pc.	CE specification: For ethernet
14	Guarantee Card		1 copy	
CR2DA-700 controller				
1	Controller	CR2DA-7xx	1 unit	With machine cable
2	Safety Manual	BFP-A8682	1 copy	
3	CD-ROM (Instruction manual)	5S-D***-C**	1 pc.	
4	Dummy connector for T/B		1 pc.	Connect, when not using T/B.
5	Ferrite core [Note1]		5 pc.	Non-CE specification: For wiring of emergency stop, tracking function, remote I/O
			6 pc.	CE specification: For wiring of emergency stop, tracking function, remote I/O, ethernet, special input/output terminal
6	Cable clamp	AL3	1 pc.	For cable shield grounding
7	Fuse (reserves)	LM16	2 pc.	1.6A
		LM32	1 pc.	3.2A
		MF60NRF-1.6A	1 pc.	For the hand 1.6A
8	Union band	T30R	2 pc.	For primary power cable fixing
9	Filter mat		1 pc.	356 x 32 For bottom filter reserves
10	Line noise filter [Note1]	FR-BSF01	1 pc.	CE specification: For ethernet
11	Knob locking device	HL-05FA	1 pc.	For the lock of the power switch
12	Guarantee Card		1 copy	
CR3D-700 controller				
1	Controller	CR3D-7xxM/ CR3D-7xx/	Each 1 unit	With machine cable
2	Safety Manual	BFP-A8682	1 copy	
3	CD-ROM (Instruction manual)	5S-D***-C**	1 pc.	
4	Connector for power supply unit connecting cables and connector pin	2-178128-3 1-175218-5	1 pc 2 pc	For connection with the sequencer power supply unit
5	Dummy connector for T/B		1 pc.	Connect, when not using T/B.

No.	Part name	Type	Qty.	Remarks
6	Ferrite core Note1)		3 pc.	Non-CE specification: For wiring of emergency stop, tracking function
			4 pc.	CE specification: For wiring of emergency stop, tracking function, remote I/O, ethernet, special input/output terminal
7	Fuse (reserves)	LM16	2 pc.	
		LM32	1 pc.	
8	Filter mat		1 pc.	For the protection specification drive unit 337 x 57 For rear filter reserves
9	Line noise filter Note1)	FR-BSF01	1 pc.	CE specification: For ethernet
10	Guarantee Card		1 copy	

Note1) The attachments in which "CE specification" is written to the remarks column are attached to CE specification only.
"Non-CE specification" is attached only to non-CE specification in the same way.

2.2 Installation

2.2.1 Unpacking procedures
The controller is shipped from the factory packaged in cardboard.

2.2.2 Transportation procedures
The following shows how to transport the controller.

(1) CR1DA-700 series

Mass : Approx.10kg
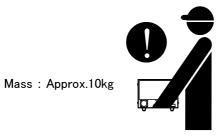
Fig. 2-1 : Transporting the controller (CR1DA-700)

1) Insert, raise and transport the hand in the crevice between the lower of the controller side. Do not hold switch or connector.

(2) CR2DA-700 series
The controller must always be transported by two workers.

Mass : Approx.21kg
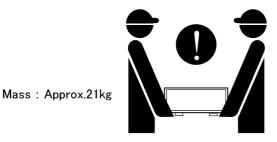
Fig. 2-2 : Transporting the controller （CR2DA-700）

(3) CR3D-700 series

Mass : Approx.60kg

Wire

Eye bolt
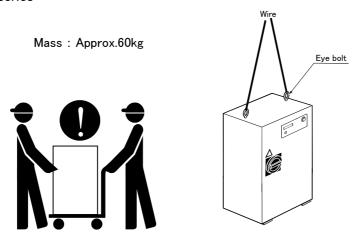
Fig. 2-3 : Transporting the controller (CR3D-700/700M)

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

2.2.3 Installation procedures
The installed size is shown as follows.

（1）CR1DA-700 series

<u>CR1DA-700 series</u>
Standard specification

<u>CR1DA-700 series</u>
CE marking specification
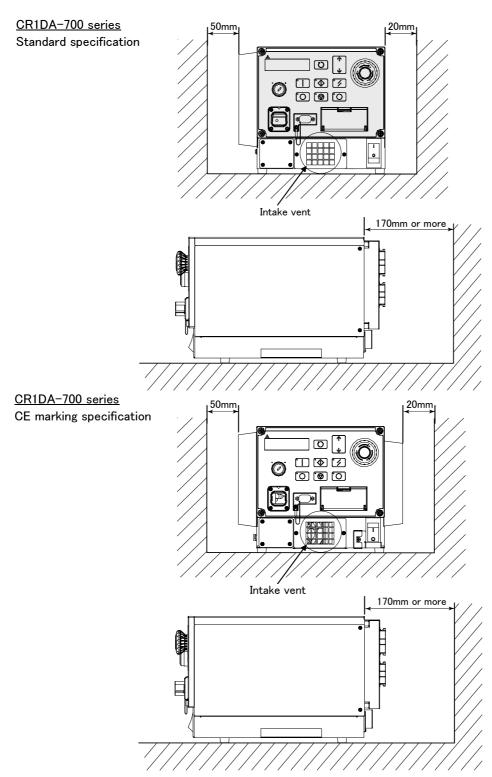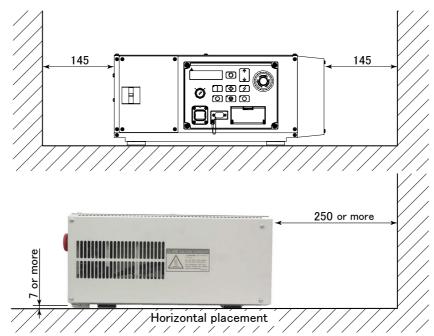
Fig. 2-4 : Installation dimensions (CR1DA-700 series)
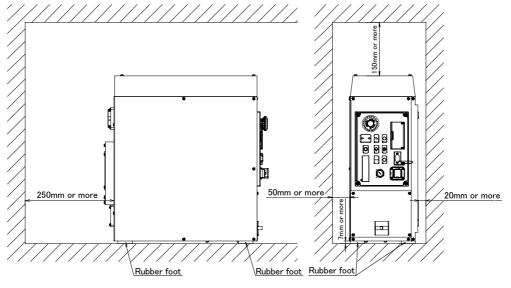
[Caution] A suction port is installed on the bottom of the controller, so do not remove the rubber foot and install the controller flat on a surface.

(2) CR2DA-700 series

Horizontal placement

⚠️**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 smaller than 7mm case, the air intake hole at the bottom of the controller is occupied, and temperature rises in the board, and causes the trouble.

⚠️**CAUTION**   The installation section needs to be fixed so that the controller may not fall. When fixing the controller with the bolt, please use the bolt of the length which does not protrude 5mm or more into the controller case.
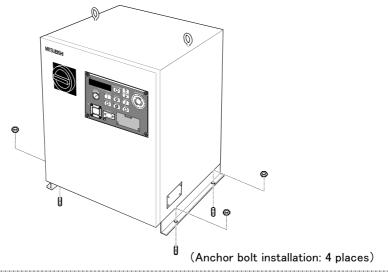
(1) Remove the rubber foot at the bottom of the controller (four places, M5 x 10 screws).
(2) Remove the controller side white round seal (four places).
(3) Use the rubber foot and the 5xM10 screw which were removed by above-mentioned (1), and fix the rubber foot to the screw hole of the seal pasting place of (2).

Fig. 2-5 : Installation dimensions（CR2DA-700）

⚠️**CAUTION**   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.

(3) CR3D-700 series

(Anchor bolt installation: 4 places)

〈CR3D-700M〉

〈CR3D-700〉

(View from upside)

(View from upside)
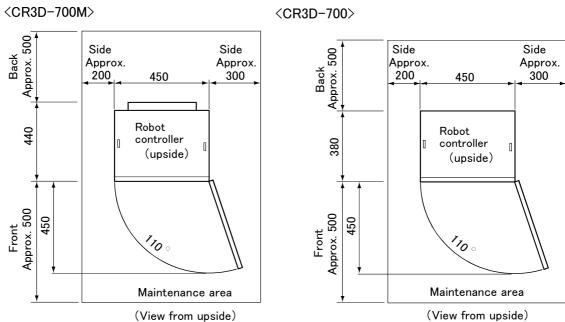
Fig. 2-6 : Installation dimensions (CR3D-700)

1) Install the controller so that it is level.
2) Do not block the ventilation holes on the side and rear surfaces of the controller.
3) When storing the controller in a cabinet,etc., take special care to the heat dissipation and ventilation properties so that the ambient temperature is within the specification values.

2.2.4 Connecting the power cable and grounding cable
The following shows how to connect the power cables and grounding cables.

(1) CR1DA-700 series

⚠ **CAUTION** Provide an earth leakage breaker in the primary power supply circuit of the controller to prevent short circuit. Failure to do so may result in electric shock.
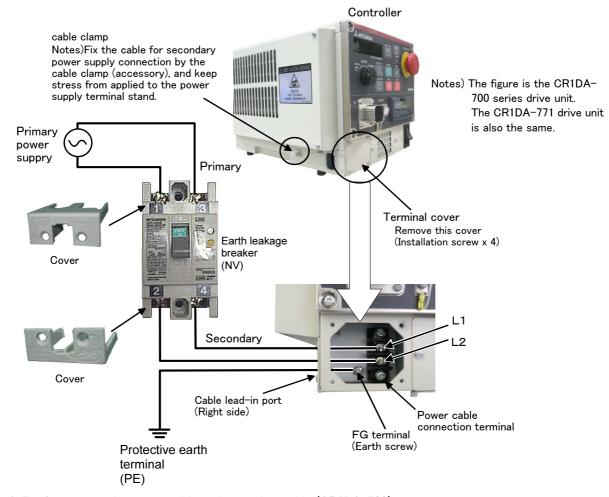
Fig. 2-7 : Connecting the power cable and grounding cable (CR1DA-700)

1) Prepare the power cable and grounding cable (both must be AWG#14 or more thickly).
2) Loosen the four screws fixing the terminal cover, and remove the cover.
3) Confirm that the primary power matches the specifications.
4) Confirm that the primary power is OFF and that the controller power switch is OFF.
5) Connect the secondary power cable to L1,L2 of controller terminal and earth leakage breaker.
6) Connect the grounding cable to the FG terminal.
7) Connect the cable for primary power supplies to the primary side terminal (upper terminal) of the earth leakage breaker.
8) Install the power terminal cover as before.

This completes the connection of the power and grounding cables.

[Note] Please do installation of the earth leakage breaker attached of the customer. The length of the power cable changes according to the distance for the setting position and the controller.

(2) CR2DA-700 series
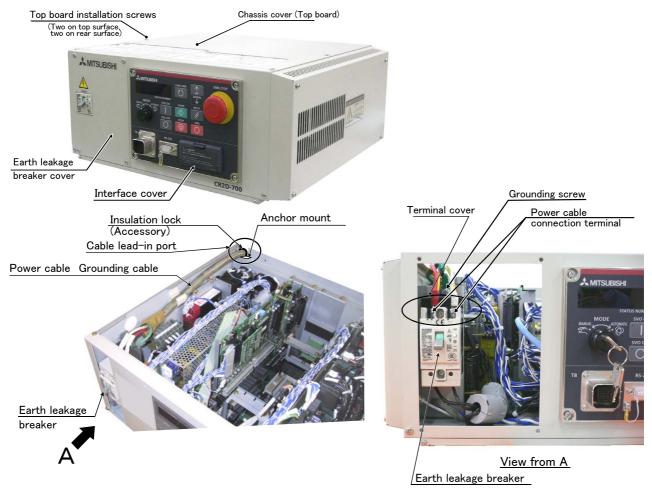
Fig. 2-8 : Connecting the power cable and grounding cable (CR2DA-700)

1) Prepare the power cable and grounding cable (both must be AWG#14 or more thickly).
2) Remove the controller chassis cover (top board) by removing the four installation screws. To remove the chassis cover, slide it to the rear and then lift it. Remove the four fixing screws which are fixing the earth leakage breaker cover, and remove that cover.
3) Confirm that the primary power supply matches the specifications.
4) Confirm that the primary power supply is OFF and that the earth leakage breaker on the controller is OFF.
5) Pull out the terminal cover of the earth leakage breaker.
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 earth leakage breaker terminals (M5 screw).
8) Connect the grounding cable with the screw hole on the controller's chassis, located above the earth leakage breaker (PE marking).
9) Press in the earth leakage breaker terminal cover, until a "click" is heard.
10) Re-install both the controller's chassis and the earth leakage breaker cover back.

This completes the connection of the power and grounding cables of the CR2DA-700 series controller.

(3) CR3D-700 series
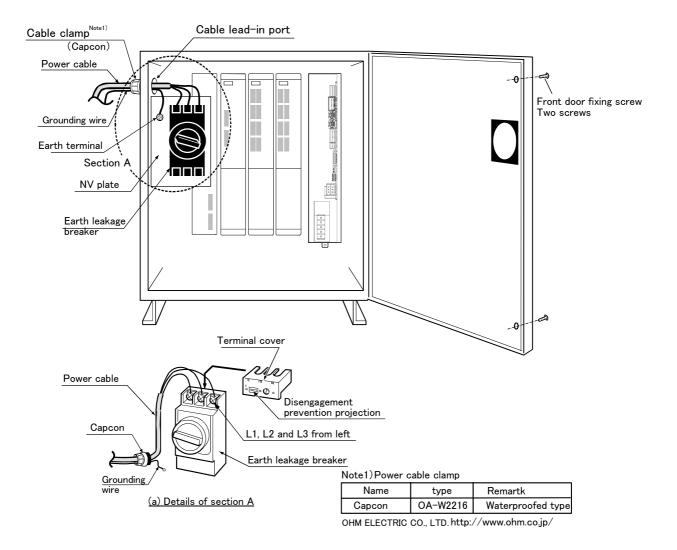
Fig. 2-9 : Connecting the power cable and grounding cable (CR3D-700)

1) Prepare the power cable and grounding cable (both must be AWG#14 or more for 3-phase).
2) Loosen the two screws fixing the controller 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 both the power cable and ground cable from the cable inlet hole located on the side of the controller, and fix them using a power cable clamp (Capcon).
7) Connect the power cable to the earth leakage breaker terminal (M5 screw). (L1, L2 and L3 from left)
8) Connect the grounding cable to the NV plate terminal (M5 screw).
9) Insert the earth leakage breaker terminal cover removed in step (3) until a "click" is heard.
10) Close the controller front door, and fix with the fixing screws.

This completes the connection of the power and grounding cables of the CR3D-700 series controller.

⚠ CAUTION   Uses earth leakage breaker of corresponding to inverter products and working by leak current of the commercial frequency domain (50-60Hz). It will become the cause of malfunction if the thing sensitive to the high frequency ingredient is used.

2.2.5 Connecting the external emergency stop

The following shows how to connect the external emergency stop.

External emergency connection (Refer to Fig. 2-10)

a)CR1DA-700/CR2DA-700 : Rear side connector

b)CR3D-700 : Safety unit
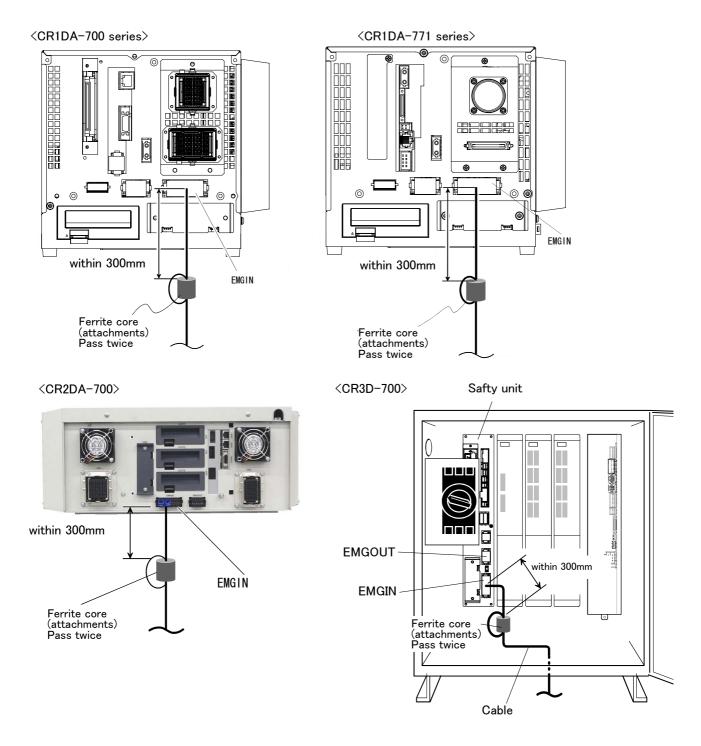
The external emergency stop input and door switch input and enabling device input are opened at shipment as shown in Page 17 "Fig. 2-11External emergency stop connection". Please be sure to prepare the external emergency stop, the door switch, the enabling device, etc. of the customer, and to use the robot in the state where it connected. Below, the procedure of connection is shown.

[Caution] When wiring the emergency stop switch (double emergency line type), wire both contacts to the two terminal blocks on the controller.

1) Prepare the emergency stop switch and door switch and enabling device .

2) Securely connect the external emergency stop's contacts across 3A-4A, 3B-4B, and the door switch's contacts across 8A-9A, 8B-9B, and the enabling device switch's contacts across 10A-11A, 10B-11B, on the terminal block.

[Caution] When wiring the emergency stop switch (double 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.

[Caution] The cable uses the shielded cable and installs the ferrite core. Install the ferrite core in less than 30cm from the contact button.

<CR1DA-700 series>

<CR1DA-771 series>

within 300mm

EMGIN

Ferrite core
(attachments)
Pass twice

within 300mm

EMGIN

Ferrite core
(attachments)
Pass twice

<CR2DA-700>

<CR3D-700>

Safty unit

within 300mm

EMGIN

Ferrite core
(attachments)
Pass twice

EMGOUT

EMGIN

within 300mm

Ferrite core
(attachments)
Pass twice

Cable

Pin allotment of EMGIN and the EMGOUT connector is shown in .

Fig. 2-10 : Emergency stop cable connection

Internal circuit structure
(Controller)

(Customer)   (Customer)

EMGOUT1

⊗	1A
⊗	2A	Robot error output
⊗	3A
⊗	4A	Mode output
⊗	5A	Add. axis contacts
⊗	6A	control output (AXMC1)

OP EMG. stop   TB EMG. stop   +24V

EMGIN1

⊗	1A	Short
⊗	2A	
⊗	3A	External emergency input (prepare by customer)
⊗	4A	
⊗	5A	Short
⊗	6A	
⊗	7A	
⊗	8A	Door switch input (prepare by customer)
⊗	9A	
⊗	10A	Enabling device input (prepare by customer)
⊗	11A	

Relay (RA)   24GND   +24V

EMGOUT2

⊗	1B
⊗	2B	Robot error output
⊗	3B
⊗	4B	Mode output
⊗	5B	Add. axis contacts
⊗	6B	control output (AXMC2)

EMGIN2   +24V

⊗	1B	Short
⊗	2B	
⊗	3B	External emergency input (prepare by customer)
⊗	4B	
⊗	5B	Short
⊗	6B	
⊗	7B	
⊗	8B	Door switch input (prepare by customer)
⊗	9B	
⊗	10B	Enabling device input (prepare by customer)
⊗	11B	

24GND   +24V   24GND

> ⚠ **Warning** Please do not do the withstand voltage examination.
> Moreover, it becomes the cause of failure if it connects incorrectly.

EMGOUT pin arrangement

EMGOUT2   EMGOUT1

6B		6A
5B		5A
4B		4A
3B		3A
2B		2A
1B		1A

Minus driver plug

Electric wire plug AWG#24〜#18(0.2〜0.75mm²)

Type : 1-1871940-6

EMGIN pin arrangement

EMGIN2   EMGIN1

11B		11A
10B		10A
9B		9A
8B		8A
7B		7A
6B		6A
5B		5A
4B		4A
3B		3A
2B		2A
1B		1A

Minus driver plug

Electric wire plug AWG#24〜#18 (0.2〜0.75mm²)

Type : 2-1871940-1

Contact capacity(input/output) : DC24V/10mA to 500mA

7mm

1)Remove the sticker of the connector.
2)Remove the wire skin 7 mm.
3)Push the back spring with the small minus driver etc.
4)Insert the electric wire to the connector.
5)Remove the minus driver, the wire will be locked.
*Recommendation driver size are 1.4mm to 2.4mm.
(The driver plug area of the connector is 2.5mm)

Fig. 2-11 : External emergency stop connection

⚠ CAUTION Please install the emergency stop switch in a accesable location where it is easy to operate.

⚠ CAUTION Be careful not to short circuit with the next terminal while connecting the wires to the EMGIN connector. The use of plated wires is not recommended.
The example of safety measures is shown in the following. Please refer to the figure and build safety measures.

2.2.6 Examples of safety measures

Two emergency-stop input circuits are prepared on the user wiring terminal block of the controller. Create a circuit as shown below for safety measures. In addition, the figure shows the normal state which is not in the emergency stop state.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 23, "(1) External emergency stop connection [supplementary explanation]" and Page 15, "2.2.5 Connecting the external emergency stop".

[Note] · In the emergency-stop related wiring by the customer, if the coil (is not the contact points) of the relay prepared by the customer is connected to the controller, please be sure to implement the measure against the noise by the customer in the coil section. And, please also take the lifetime of noise suppression parts into consideration.

· Electric specification of the emergency-stop-related output terminal: 100mA/24V or less.

<Wiring example 1>: Connect the emergency stop switch to peripheral equipment to the robot controller.
The power supply for emergency stop input uses the power supply in the robot controller.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.

*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments.
*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments.
Notes) If "*2" and "*3" are removed, it will be in the emergency stop state.
*4) The emergency stop button of the robot controller operation panel.
*5) The emergency stop button of T/B connected to the robot controller.
*6) Emergency stop input relay.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 17, "Fig. 2-11 : External emergency stop connection".

Fig.2-12 : Example of safety measures (Wiring example 1)

<Wiring example 2>: Connect the emergency stop switch to peripheral equipment to the robot controller.
The power supply for emergency stop input uses the power supply of peripheral equipment.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state.

*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments. Remove it, and connect the power supply of peripheral equipment. Connect the power supply of peripheral equipment by the polarity shown in the figure.
*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments. Notes) Please use 5A/5B and 6A/6B terminal, connected.
*4) The emergency stop button of the robot controller operation panel.
*5) The emergency stop button of T/B connected to the robot controller.
*6) Emergency stop input relay.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 17, "Fig. 2-11 : External emergency stop connection".

Fig.2-13 : Example of safety measures（Wiring example 2）

<Wiring example 3>: Connect the emergency stop switch, door switch, and enabling device of peripheral equipment to the robot
controller. The power supply for emergency stop input uses the power supply of peripheral equipment.
Monitor the emergency stop state by the peripheral equipment side.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency
stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of robot
controller OFF, peripheral equipment state can be the emergency stop also.

*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments. Remove it, and connect the emergency stop switch and power supply of peripheral equipment. Connect the power supply of peripheral equipment by the polarity shown in the figure.

*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments. Remove it and connect with the power supply ground of peripheral equipment.
*4) Please use a A contact type of the relay with the compulsive guide.*5) The emergency stop button of the robot controller operation panel.
*5) The emergency stop button of the robot controller operation panel.
*6) The emergency stop button of T/B connected to the robot controller.
*7) Emergency stop input relay.
*8) Refer to the separate manual "Standard Specifications Manual" for the enabling device.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the
product. Also refer to Page 17, "Fig. 2-11 : External emergency stop connection".
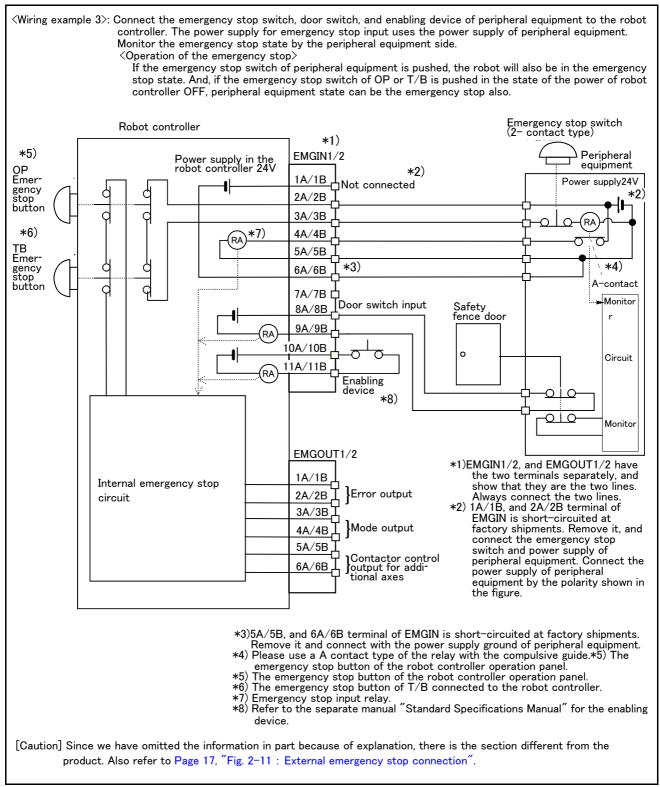
Fig.2-14 : Example of safety measures（Wiring example 3）

<Wiring example 4>: Connect the emergency stop switch of peripheral equipment, and the door switch to two robot controllers, and it interlocks.Connect the enabling device to the robot controller.The power supply for emergency stop input uses the power supply of peripheral equipment. Monitor the emergency stop state by the peripheral equipment side.
<Operation of the emergency stop>
If the emergency stop switch of peripheral equipment is pushed, the robot will also be in the emergency stop state. And, if the emergency stop switch of OP or T/B is pushed in the state of the power of robot controller OFF, peripheral equipment state can be the emergency stop also.

*1)EMGIN1/2, and EMGOUT1/2 have the two terminals separately, and show that they are the two lines. Always connect the two lines.
If necessary to stop two robots simultaneously by one emergency stop switch please use the 4 contact type emergency stop switch.
*2) 1A/1B, and 2A/2B terminal of EMGIN is short-circuited at factory shipments. Remove it, and connect the emergency stop switch and power supply of peripheral equipment. Connect the power supply of peripheral equipment by the polarity shown in the figure.
*3)5A/5B, and 6A/6B terminal of EMGIN is short-circuited at factory shipments.
Remove it and connect with the power supply ground of peripheral equipment.
*4) Please use a A contact type of the relay with the compulsiveguide.
*5) The emergency stop button of the robot controller operation panel.
*6) The emergency stop button of T/B connected to the robot controller.
*7) Emergency stop input relay.
*8) Refer to the separate manual "Standard Specifications Manual"for the enabling device.

[Caution] Since we have omitted the information in part because of explanation, there is the section different from the product. Also refer to Page 17, "Fig. 2-11 : External emergency stop connection".

Fig.2-15 : Example of safety measures（Wiring example 4）

(1) External emergency stop connection [supplementary explanation]
    (1) Use a 2-contact type switch for all switches.
    (2) Install a limit switch on the safety fence's door. With a constantly open contact (a contact), wire to the door switch input terminal so that the switch turns ON (is conducted) when the door is closed, and turns OFF (is opened) when the door is open.
    (3) Use a manual-return type 2b-contact for the emergency stop button.
    (4) Classify the faults into minor faults (faults that are easily restored and that do not have a great effect) and major faults (faults that cause the entire system to stop immediately, and that require care in restoration), and wire accordingly.

[Caution] The emergency stop input (terminal block) on the user wiring in the controller can be used for safety measures as shown in Fig. 2-12 to Fig. 2-15. Note that there are limits to the No. of switch contacts, capacity and cable length, so refer to the following and install.

    ・Switch contact.............................Prepare a 2-contact type. [1]
    ・Switch contact capacity...........Use a contact that operates with a switch contact capacity of approx. 1mA to 100mA/24V. [1]
        If you connect the relay etc., rated current of the coil should use the relay which is 100mA/24V or less. (Refer to Fig. 2-16)
    ・Cable length..................................The length of the wire between the switch and terminal block must be max. 15m or less. Please use the shield line, in case of the cable may receive the noise etc. by other equipment, such as servo amplifier. And, since the ferrite core is attached as noise measures parts, please utilize.
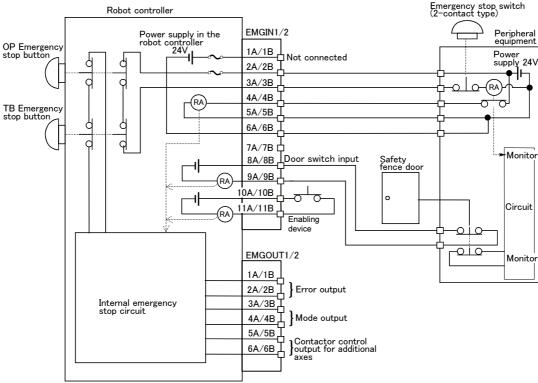
Fig. 2-16 : Limitations when connecting the relay etc.

⚠ **CAUTION** Please be sure to check that each function operates normally for the prevention of malfunction. Surely check that the operation of the emergency stop of the robot controller, the emergency stop of the teaching pendant, the customer's emergency stop, etc are normally.

⚠ **CAUTION** Be sufficiently careful and wiring so that two or more emergency stop switches work independently. Don't function only on AND conditions (Two or more emergency stop switch status are all ON).

⚠ **CAUTION** You should always connect doubly connection of the emergency stop, the door switch, and the enabling switch. (Connect with both of side-A and side-B of the controller rear connector) In connection of only one side, if the relay of customer use should break down, it may not function correctly.

*1) The minimum load electric current of the switch is more than 5mA/24V.

2.2.7 Magnet contactor control connector output (AXMC) for addition axes

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 (AXMC) provided on the rear or inside 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. 2-17 shows an example of its circuit, and show the layout drawings of the outp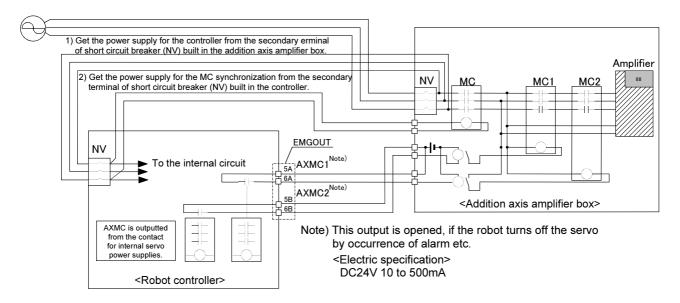ut contact (AXMC1). When you are using an additional axis, please perform appropriate circuit connections by referring to these drawings.

Note1) you use the addition axis function as a user mechanism who became independent of the robot arm, please do not connect this output signal. Servo-on of the user mechanism
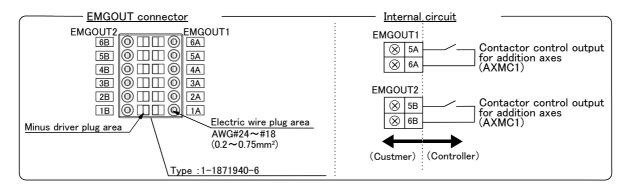
Fig. 2-17 : Example of circuit for addition axes of Magnet contactor control output

2.2.8 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.

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

Refer to Page 38, "4.2.1 Installing and removing the T/B" for installing method of T/B. Refer to the separate "Standard Specifications" or each option's manual for the optional devices other than those described in this manual.

3.1 Iinstalling the pneumatic hand interface
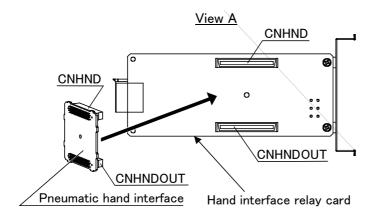
3.1.1 Installing

The following shows the installing procedure of pneumatic hand interface which is installed inside the controller.

⚠ **CAUTION**   Confirm that the supplying power supply to the controller and the power switch of the controller are off before doing this work.

[Note] Confirm that the pneumatic hand interface is installed securely. If not installed certainly, opening and closing of the hand cannot be done.
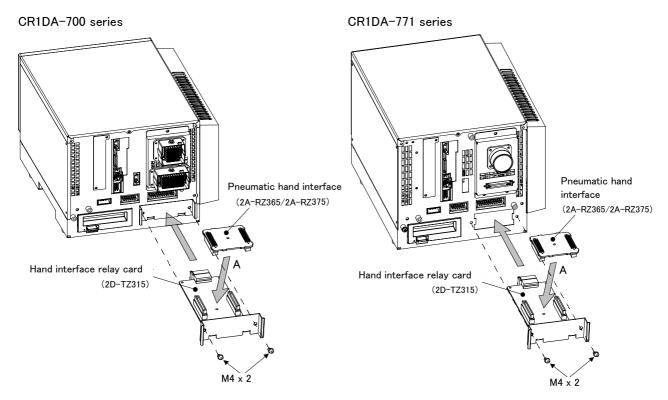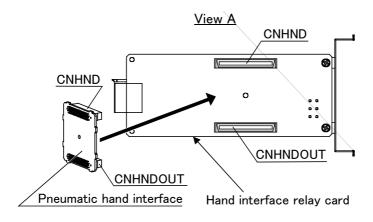
Fig. 3-1 : Installing the pneumatic hand interface (CR1DA-700)
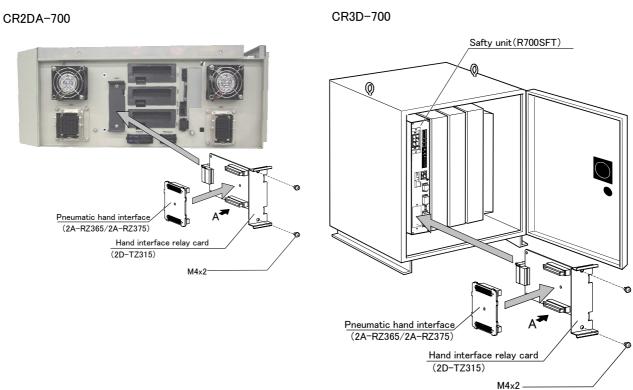
Fig. 3-2 : Installing the pneumatic hand interface (CR2DA-700/CR3D-700)

1) Shut off the power of the supply source.
2) Remove the M4 screw (two places) and pull out the hand interface relay card (2D-TZ315).
3) Install the pneumatic hand interface (2A-RZ365/2A-RZ375) in the hand interface relay card (2D-TZ315).
4) Insert the hand interface relay card (2D-TZ315) to the controller, and fix with M4 screw (two places).

3.1.2 SINK/SOURCE setting

Please switch the SINK/SOURCE setting switch or set pin according to the option specification when you use the option pneumatic interface. The following shows the procedure of setting the SINK/SOURCE switch or set pin

（1）CR1DA-700 series controller

1) Confirm that the primary power is OFF and that the controller power switch is OFF, please remove the controller's cover.
2) Please pick up the switch at the position shown in figure, and switch the SINK/SOURCE setting.
3) Please install the controller's cover as before.

notes)The CR1DA-771 controller is also the same.
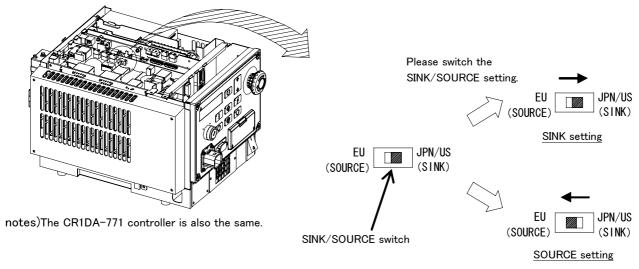
Fig. 3-3 : SINK/SOURCE setting(CR1DA)

（2）CR2DA-700 series controller

1) Confirm that the primary power is OFF and that the controller power switch is OFF, please remove the controller's cover.
2) Please pick up the set pin at the position shown in figure, and switch the SINK/SOURCE setting.
3) Please install the controller's cover as before.
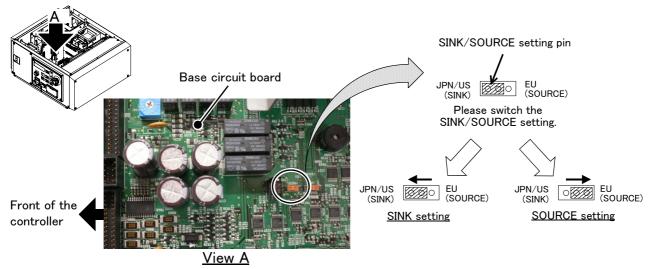
Fig. 3-4 : SINK/SOURCE setting(CR2DA)

(3) CR3D-700 series controller

    1) Confirm that the primary power is OFF and that the controller power switch is OFF, please open the controller's door.

    2) Please pick up the switch at the position shown in figure, and switch the SINK/SOURCE setting.

    3) Please close the controller's door as before.

SINK/SOURCE switch

R700SFT-A UNIT

Please switch the SINK/SOURCE setting.

SINK
SOURCE

SINK
SOURCE
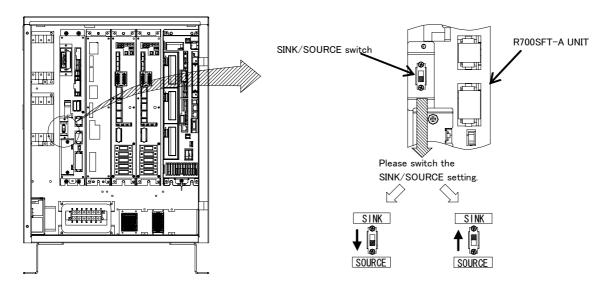
Fig. 3-5 : SINK/SOURCE setting(CR3D)

This completes the installation of the pneumatic hand interface.

3.2 Installing and removing the Option Card

The installation procedure of the interface card .

CR1DA-700 [*1)]

Controller rear

CR2DA-700

*1) The figure is the CR1DA-700 series controller. The CR1DA-771 controller is also the same.

CR3D-700

R700CPU unit

R700CPU unit

Removal method
When removing, push the removal lever in the direction of the arrow, and pull up the interface card.

Fig. 3-6 : Installation of the interface card
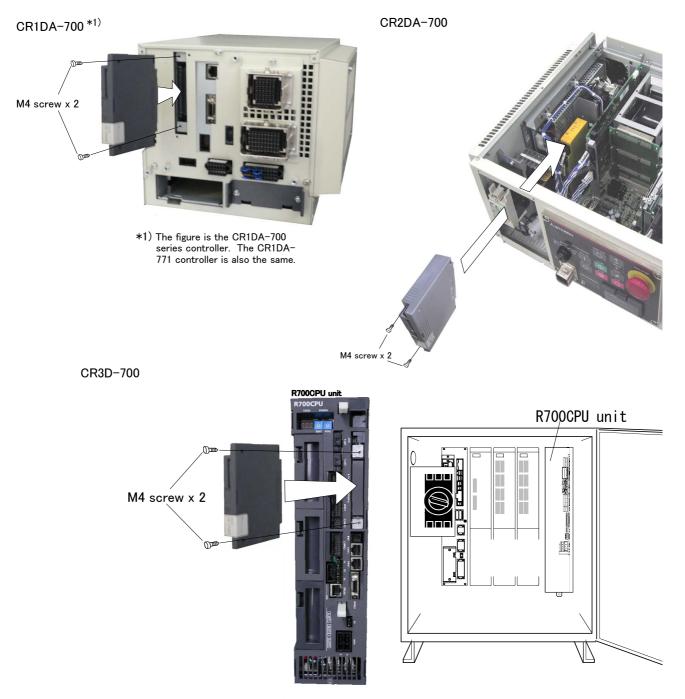
1) Turn off the power.
2) Pick the interface cover removal lever and pull up the interface cover.
3) Insert the interface card in SLOT1, SLOT2, or SLOT3.
   Insert the card as both ends of the card may fit into the guide of slot(SLOT1, SLOT2, or SLOT3 showed in Fig. 3-5).
4) Insert the connection connector securely to the back until the removal lever is locked with the sound.
This completes the installation of the interface card.

3.3 Installing the extension memory cassette

CR1DA-700 *1)

M4 screw x 2

*1) The figure is the CR1DA-700 series controller. The CR1DA-771 controller is also the same.

CR2DA-700

M4 screw x 2

CR3D-700

R700CPU unit

M4 screw x 2

R700CPU unit

The " ▲ " is facing downward.

Fig. 3-7 : Installing the extension memory cassette

1) Completely back up the memory information in the robot controller by using the RT ToolBox 2. (This must be performed as a preventive measure in case the contents of the internal memory are destroyed while inserting a memory cassette.)
2) Turn off the controller power.

⚠ CAUTION   Also turn off the supplying source power switch at the controller.
If that is not right, there is danger of the electric shock.

3) Remove the power switch cover installed in the front of the controller with removing the four fixing screws.(CR2D-700 controller)

4) Remove the rear cover installed in the back side of the controller with removing the three fixing screws.(CR1DA-700 controller)

5) Open the front door of the controller. (CR3D-700 controller)

6) Install the memory cassette to the controller, and fix surely two screws attached.

7) Insert the memory cassette all the way to the back with the "arrow mark"(the surface which inserts screw has the mark) facing downward.
   Note) Please keep in mind that the cassette will change if it fastens too much.

8) Install the removed cover as before.

9) Turn on the controller power.

This completes the installation of the extension memory cassette.

[CAUTION]
The programs that are stored in the control unit will be moved into the extension memory cassette; they will be deleted from the memory in the control unit.
Please be careful not to remove the memory cassette, since if you remove it, there will be no program information residing in the controller (the information is in the memory cassette).
Although the program information (***.mb5) is copied into the memory cassette, the parameter information (***.prm) is still stored in the control unit.

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
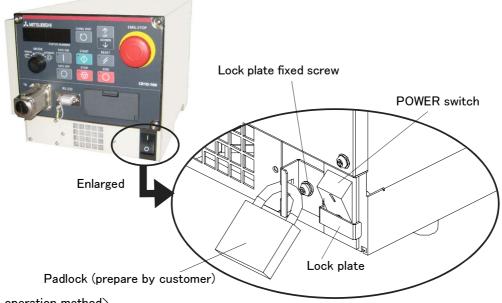
Fig. 4-1 : Operation panel

① START button .... This executes the program and operates the robot. The program is run continuously.

② STOP button .... This stops the robot immediately. The servo does not turn OFF.

③ RESET button .... This resets the error. This also resets the program's halted state and resets the program.

④ Emergency stop switch .... This stops the robot in an emergency state. The servo turns OFF.

⑤ CHNGDISP button .... This changes the details displayed on the display panel in the order of "Override" → "Program No." → "Line No.".

⑥ END button .... This stops the program being executed at the last line or END statement.

⑦ SVO.ON button .... This turns ON the servo power. (The servo turns ON.)

⑧ SVO.OFF button .... This turns OFF the servo power. (The servo turns OFF.)

⑨ STATUS NUMBER
　(display panel) .... The alarm No., program No., override value (%), etc., are displayed.

⑩ MODE key switch .... This changes the robot's operation mode.

　　AUTOMATIC .... operations from the controller or external equipment are valid. Operations for which the operation mode must be at the external device or T/B are not possible. It is necessary to set the parameter for the rights of operation to connection between the operation panel and external equipment. For details, please refer to "INSTRUCTION MANUAL/Detailed explanations of functions and operations" of the separate volume.

　　MANUAL .... 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.

⑪ UP/DOWN button .... This scrolls up or down the details displayed on the "STATUS. NUMBER" display panel.

⑫ T/B connection connector .... This is a dedicated connector for connecting the T/B. When not using T/B, connect the attached dummy connector.

⑬ Interface cover .... USB interface and battery are mounted.

⑭ RS-232 connector .... This is an RS-232C specification connector for connecting the personal computer.

◇◆◇ 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.

(1) Padlock specification(CR1DA-700)

If the robot is not used, the power switch can be locked with the padlock so that power supply ON cannot be done easily. The specification is shown in the following.

<The operation method>

(1) The lock method (power supply OFF)

1) Turn OFF the power switch.

2) Loosen the lock plate fixing screw and make it slide upwards (cover the power switch). Tighten the fixing screw certainly in that position.

3) Install the padlock (customer preparation) to the hole of the lock plate, and lock it.

The lock is completion

(2) The release method (power supply ON)

1) Remove the padlock.

2) Loosen the lock plate fixing screw and make it slide downward (position which does not cover the power switch). Tighten the fixing screw certainly in that position.

The lock device which can be used

Dimension of the padlock

Dimension (mm)		
A	B	C
25	14	4mm or less
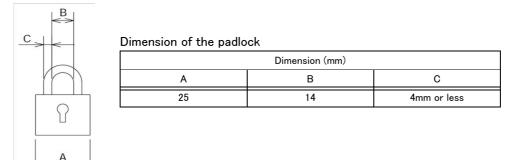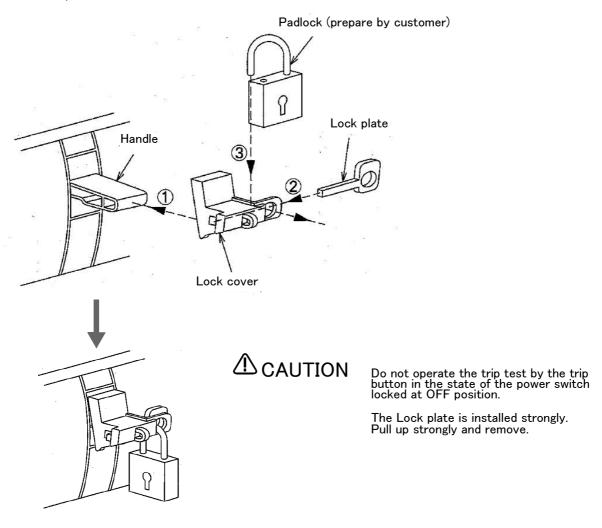
Fig. 4-2 : Operation lock of the power switch(CR1DA-700)

< CR2DA-700 >

Padlock (prepare by customer)

Handle

Lock plate

③

①

②

Lock cover

⚠ CAUTION

Do not operate the trip test by the trip button in the state of the power switch locked at OFF position.

The Lock plate is installed strongly. Pull up strongly and remove.

The lock device which can be used

Dimension of the padlock

Dimension (mm)		
A	B	C
25	14	4mm or less
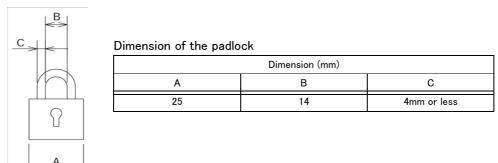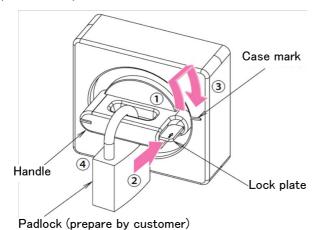
Fig.4-3 : operation lock of the power switch(CR2DA-700)

＜ CR3D-700 ＞

Case mark

③

①

Handle

④

②

Lock plate

Padlock (prepare by customer)

Usage of lock function
① Turn the handle to the reset direction until the mark of the lock plate and the case mark is in match.
② Push in the lock plate.
③ Return the handle to the OFF position, with pushing the lock plate.
④ Lock the handle with the padlock.

The lock device which can be used

B

C

A

Dimension of the padlock

Dimension (mm)		
A	B	C
35(0.11)	19	5
40(0.13)	22 or 23	5.5

The maximum size of "C" which can be installed is 8mm.

Fig.4-4 : Operation lock of the power switch(CR3D-700)

4.2 Handling the T/B

4.2.1 Installing and removing the T/B

Installing and removing the T/B, with turning off the controller power. If T/B is Installed and removed in the state of control source ON, emergency stop alarm will be occurred.

If you use the robot wherein T/B is removed, install the dummy connector of attachment for the product instead of T/B. Take out and insert the dummy connector with the connector itself.
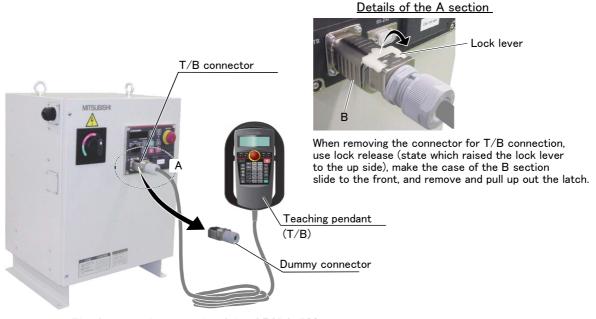
⚠ **CAUTION** Please do not pull the cable of T/B strongly or do not bend it too much.
It becomes the breaking of a wire of the cable and the cause of breakage of the connector. Please installing and removing so that stress does not start the cable with the connector itself. The connector may be felt hard if installation and removal of the teaching pendant or the dummy plug is repeated to the frequent.

(1) Installing the T/B

Explain the installation method of T/B below.
1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Connects T/B connector to the robot controller. Use as the upper surface the lock lever shown in Fig. 4-5, and push in until there is sound.

Details of the A section

Lock lever

When removing the connector for T/B connection, use lock release (state which raised the lock lever to the up side), make the case of the B section slide to the front, and remove and pull up out the latch.

T/B connector

A

B

Teaching pendant (T/B)

Dummy connector

＊ The figure is the example of the CR3D3-700 series.

Fig. 4-5 : Installing and removing the T/B

The installation of T/B is finished.

(2) Removing the T/B

Explain the removing method of T/B below.
1) Check that the POWER (power supply) switch of the robot controller is OFF.
2) Raise up the lock lever in the connector upper part , and pull up the connector.
3) Please install the dummy connector, if you use the robot, without connecting T/B.

The removing of T/B is finished.

4.2.2 Functions of each key
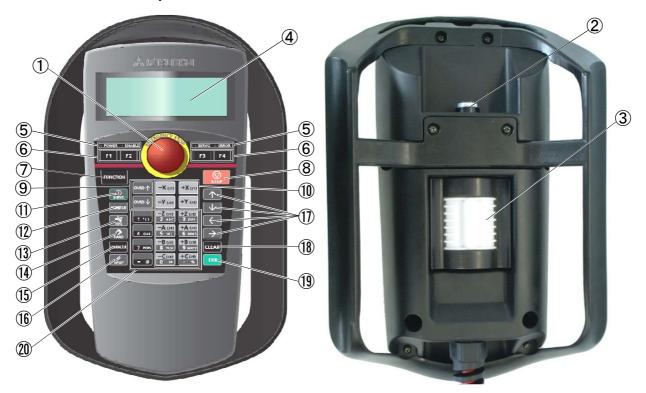
Fig. 4-6 : Teaching pendant (R32TB)

1) : [Emergency stop] switch ....The robot servo turns OFF and the operation stops immediately. The release of the emergency stop turns the switch to the right, or pulls it.
2) : [Enable/Disable] switch ....This switch changes the T/B key operation between enable and disable.
3) : [Enable] switch..................................When the [Enable/Disable] switch is available, the servo will be turned off, if this switch is release or it pushes strongly. And the robot will stop immediately.
4) : LCD display panel ....The robot status and various menus are displayed.
5) : Status display lamp ....Display the state of the robot or T/B.
6) : [F1], [F2], [F3], [F4].......................Execute the function corresponding to each function currently displayed on LCD.
7) : [FUNCTION].....................................Change the function display of LCD.
8) : [STOP] key...This stops the program and decelerates the robot to a stop.
9) : [OVRD ↑][OVRD ↓] key ....Change moving speed. Speed goes up by ［OVRD ↑] key. Speed goes down by ［OVRD ↓] key
10) : JOG operation key........................Move the robot according to jog mode. And, input the numerical value.
11) : [SERVO] key ....Press this key with holding AA key lightly, then servo power will turn on.
12) : [MONITOR] key...............................It becomes monitor mode and display the monitor menu.
13) : [JOG] key ....It becomes jog mode and display the jog operation.
14) : [HAND] key ....It becomes hand mode and display the hand operation.
15) : [CHAR] key ....This changes the edit screen, and changes between numbers and alphabetic characters.
16) : [RESET] key ....This resets the error. The program reset will execute, if this key and the EXE key are pressed.
17) : [↑][↓][←][→] key ....Moves the cursor each direction .
18) : [CLEAR] key.....................................Erase the one character on the cursor position .
19) : [EXE] key ....Input operation is fixed. And, while pressing this key, the robot moves when direct mode.
20) : Number/Character key ....Erase the one character on the cursor position . And, inputs the number or character

◇◆◇ 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
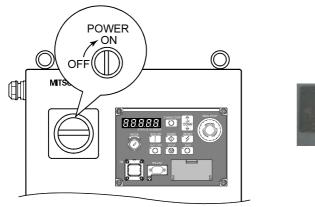
⚠ **CAUTION**   Always confirm the following items before turning the controller power ON.
1) Make sure that there are no operators in the robot operation range.
2) Make sure that the controller and robot arm are securely connected with the machine cable.
3) Make sure that the external emergency stop switch is connected to the controller.
4) Make sure that the controller 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.

〈CR1DA-700〉   〈CR2DA-700〉

[POWER] switch

〈CR3D-700〉

POWER ON
OFF

STATUS NUMBER

Turn the controller [POWER] switch ON.
"o. 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.

◇◆◇ Error: It is if C0150 occurs. ◇◆◇

At the time of the first power supply on, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.

Please input the serial number of the robot arm into Parameter: RBSERIAL. The input method is shown in next page.
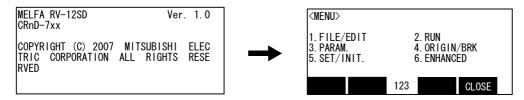
4.3.2 Input the serial number

At the time of the first power supply on, error:C0150 (the serial number of the robot arm has not been set up) occur the robot after purchase.
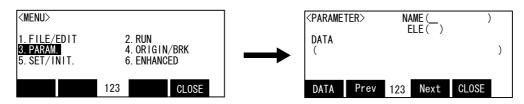
Please input the serial number of the robot arm into Parameter: RBSERIAL.

The serial number is printed to the rating name board on the back of the robot arm.
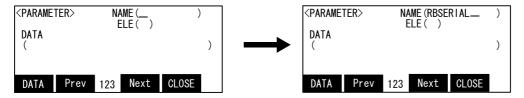
1) Press the [RESET] key of T/B and cancel the error of T/B.
2) Press the [EXE] key of T/B and display the menu panel.

```
MELFA RV-12SD        Ver. 1.0
CRnD-7xx

COPYRIGHT (C) 2007 MITSUBISHI  ELEC
TRIC  CORPORATION  ALL  RIGHTS  RESE
RVED
```
➡
```
<MENU>

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

                  123          CLOSE
```
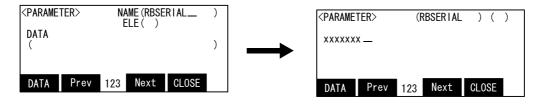
3) Press the [3] key of T/B and display the parameter.

```
<MENU>

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

                  123          CLOSE
```
➡
```
<PARAMETER>        NAME (_      )
                      ELE( )
DATA
(                                )

 DATA   Prev  123  Next   CLOSE
```

4) Input "RBSERIAL" into the name.

```
<PARAMETER>        NAME (_      )
                      ELE( )
DATA
(                            )

 DATA   Prev  123  Next   CLOSE
```
➡
```
<PARAMETER>      NAME (RBSERIAL_   )
                      ELE( )
DATA
(                            )

 DATA   Prev  123  Next   CLOSE
```

5) Press the function key ([F1]) corresponding to the "data", and input the serial number of the robot arm.

```
<PARAMETER>      NAME (RBSERIAL_  )
                     ELE( )
DATA
(                          )

 DATA   Prev  123  Next   CLOSE
```
➡
```
<PARAMETER>       (RBSERIAL  ) ( )

xxxxxxx _



 DATA   Prev  123  Next   CLOSE
```

Press the [EXE] key, and fix the value with sound, and return to the parameter screen.

◇◆◇ The input of the number/character ◇◆◇
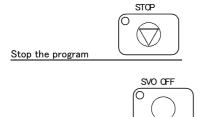
Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change. The current input mode is displayed in the center under the screen, and the display of "123" shows that the number input mode and "ABC" is the character input mode.

For details, please refer to "INSTRUCTION MANUAL/ Detailed explanations of functions and operations" of the separate volume.

6) Press the function key ([F1]) corresponding to the "close", and return to the menu screen.

```
<PARAMETER>      NAME(RBSERIAL    )
                 ELE( )
DATA
(XXXXXXXX ___                    )


 DATA   Prev  123  Next  CLOSE
```

→

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

                 123        CLOSE
```

4.3.3 Shutting OFF the control power

STOP

Stop the program

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

SVO OFF
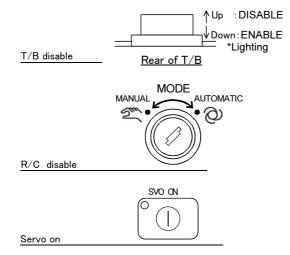
Shut OFF the motor powe

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)

↑Up : DISABLE
↓Down：ENABLE
*Lighting

T/B disable

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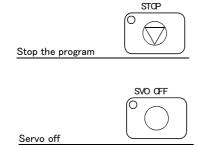
1) Confirm that the T/B [ENABLE] switch is set to "DISABLE".

MODE
MANUAL   AUTOMATIC

R/C disable

2) Confirm that the [MODE] switch on the front of the controller is set to "AUTOMATIC".

SVO ON

Servo on

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)

STOP

Stop the program

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

SVO OFF

Servo off

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
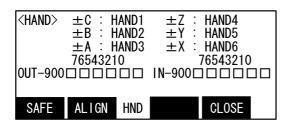
Refer to the separate manual "Robot arm setup and maintenance" when carrying out jog operation.

The following jog operation modes are available. Use these according to the purpose.

Table 4-1 : Jog modes
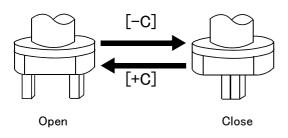
Jog mode	Main application	Explanation
JOINT JOG	・Moves each joint. ・Moves the robot arm largely. ・Changes the robot posture.	Separate manual "Robot arm setup and maintenance"
XYZ JOG	・Accurately sets the teaching position. ・Moves the axis straight along the XYZ coordinate system. ・Moves the axis straight 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 6 can be opened and closed with the T/B.

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

  SAFE   ALIGN  HND            CLOSE
```

Press the [HAND] key, and display the hand screen.

[−C]

[+C]

Open   Close

Opening and closing hand 1
   Open: Press [+C] key
   Close: Press [−C] key
Opening and closing hand 2
   Open: Press [+B] key
   Close: Press [−B] key
Opening and closing hand 3
   Open: Press [+A] key
   Close: Press [−A] key
Opening and closing hand 4
   Open: Press [+Z] key
   Close: Press [−Z] key
Opening and closing hand 5
   Open: Press [+Y] key
   Close: Press [−Y] key
Opening and closing hand 6
   Open: Press [+X] key
   Close: Press [−X] 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

Flowchart	Description
Start	
Deciding the operation order	Decide the robot operation order, operation path (necessity of linear movement), and the work at each operation position (hand open/close, etc).
Deciding the operation position name	Teach the robot operation position in the position variables. Decide the position variable name.
Describing and creating the program	Based on the decided operation order and operation position name, convert the robot operations and work into commands. Describe the commands in the program and save in the controller.
Teaching the operation position	Move the robot to each operation position with jog operation, and teach each position in the position variables.
Confirmation of program and operation position	Execute the program saved in the controller line by line, and confirm that the program and operation positions are correctly saved.
Judgment: OK? — Yes / No	
Correcting the program	If any mistakes were found in the robot operation or work during the program confirmation, correct the program.
Correcting the position	If any mistakes were found in the robot operation position during the program confirmation, correct the taught position.
Automatic operation	Automatically execute the completed program.
End	

Fig.4-7 : Program creation procedures

(2) Robot work

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

Workpiece   Carry the workpiece
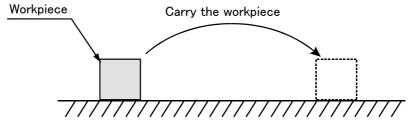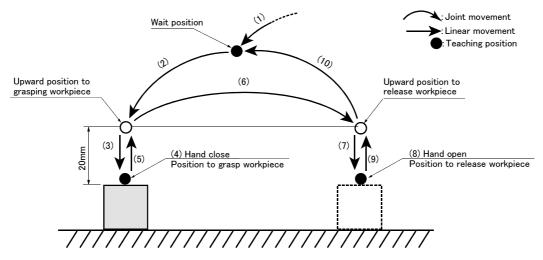
Fig.4-8 : Example of work

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 release workpiece
      (joint movement).
  (7) Move to position to release workpiece (linear movement).
  (8) Release workpiece (hand open).
  (9) Move 20mm upward (linear movement).
  (10) Move to wait position (joint movement).
End
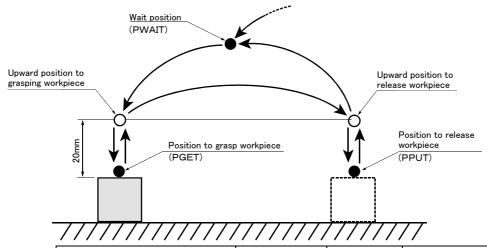
Fig.4-9 : Deciding the operation order

◇◆◇ 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.4-10 : 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. 4-10 can be designated with commands as "position 20mm away from target position". Refer to Page 49, "(3) Describing and creating the program".

⚠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.
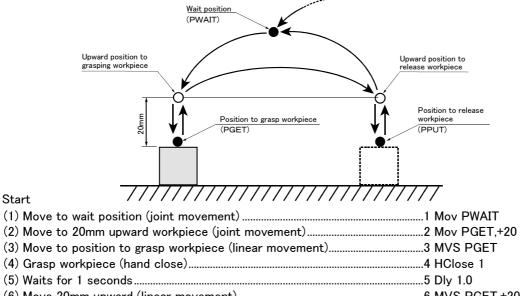
(3) Describing and creating the program

■ 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 PGET
		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) ....1 Mov PWAIT

(2) Move to 20mm upward workpiece (joint movement)...2 Mov PGET,+20   Note)

(3) Move to position to grasp workpiece (linear movement)...............................3 MVS PGET

(4) Grasp workpiece (hand close)..4 HClose 1

(5) Waits for 1 seconds...5 Dly 1.0

(6) Move 20mm upward (linear movement)...6 MVS PGET,+20   Note)

(7) Move to 20mm upward position to release workpiece (joint movement) ...7 Mov PPUT,+20   Note)

(8) Move to position to place workpiece (linear movement)................................8 MVS PPUT

(9) Release workpiece (hand open)..9 HOpen 1

(10) Waits for 1 seconds ....10 Dly 1.0

(11) Move 20mm upward (linear movement)...11 MVS PPUT,+20   Note)

(12) Move to wait position (joint movement)...12 Mov PWAIT

End...13 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. 4-11 : 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. "+20" in the command line is a example in horizontal multiple-jointed type robot.

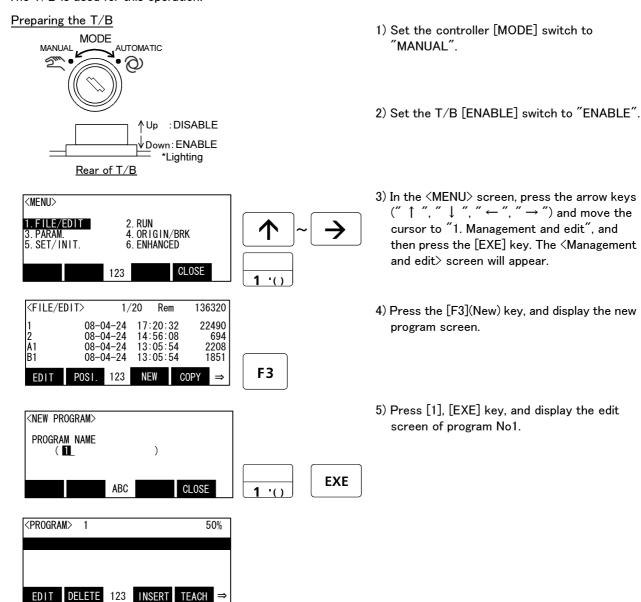◇◆◇ Program format ◇◆◇
   The program format is configured of the "step No. command parameter affixed to command" as shown in Fig. 4-11.
   Example) 1   M o v   P W A I T
         step No. Command Parameter affixed to command
   The program is executed in order from the step No. with the smallest number.

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

Preparing the T/B

MODE
MANUAL   AUTOMATIC

↑ Up   : DISABLE
↓ Down : ENABLE
*Lighting

Rear of T/B

<MENU>

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

123   CLOSE

↑ ~ →

1 '( )

<FILE/EDIT>   1/20   Rem   136320

1	08-04-24	17:20:32	22490
2	08-04-24	14:56:08	694
A1	08-04-24	13:05:54	2208
B1	08-04-24	13:05:54	1851

EDIT POSI. 123 NEW COPY ⇒

F3

<NEW PROGRAM>

PROGRAM NAME
(1   )

ABC   CLOSE

1 '( )   EXE

<PROGRAM> 1   50%

EDIT DELETE 123 INSERT TEACH ⇒

CLEAR

1) Set the controller [MODE] switch to
   "MANUAL".

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

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

4) Press the [F3](New) key, and display the new
   program screen.

5) Press [1], [EXE] key, and display the edit
   screen of program No1.

◇◆◇ Using the T/B ◇◆◇
   Set the controller [MODE] switch to "MANUAL" and the T/B [ENABLE] switch to "ENABLE". Operations from
   the T/B are not possible unless the controller [MODE] switch is set to "MANUAL".
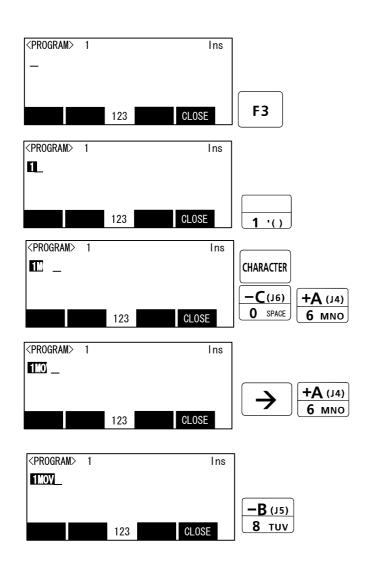
◇◆◇ Inputting numbers ◇◆◇
   Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change.
   The current input mode is displayed in the center under the screen, and the display of "123" shows that the
   number input mode. The number currently written to the lower left of each key in this state can be inputted.

◇◆◇ Correcting incorrect numbers ◇◆◇
   Press the [CLREAR] key to delete the character, and then input it again. And, if the long pushing [CLEAR] key,
   all the data in the parenthesis can be deleted.
   If the cursor is returned by pressing the [←] key, and a character is input, it will be inserted.

```
<PROGRAM>  1                Ins
—


              123        CLOSE
```

F3

6) Press the [F3] key three times.
   The cursor will move to the command editing line.

```
<PROGRAM>  1                Ins
1_


              123        CLOSE
```

1 '( )

7) Confirm that the number input mode and press the [1] key.
   "1" of the step number is inputted.

```
<PROGRAM>  1                Ins
1M _


              123        CLOSE
```

CHARACTER

−C (J6) 0 SPACE   **+A (J4) 6 MNO**

8) Press the [CHARACTER] key, and set to the character input mode, then press [SP], [MNO] key. Display the space and "M."

```
<PROGRAM>  1                Ins
1MO _


              123        CLOSE
```

→   **+A (J4) 6 MNO**

9) Press the [→] key, and the cursor is moved. Then press the [M N O] key 3 times, and input "o".

```
<PROGRAM>  1                Ins
1MOV_


              123        CLOSE
```

−B (J5) 8 TUV

10) Press the [T U V] key 3 times, and input "v".
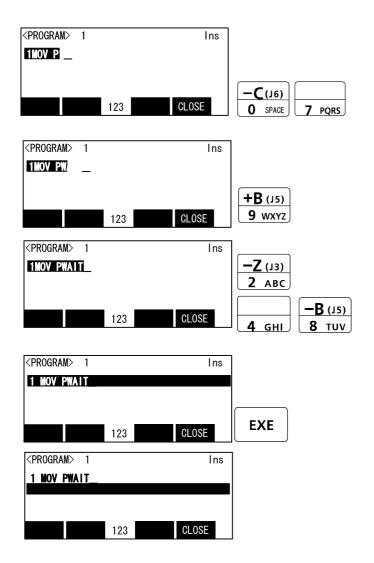
◇◆◇ Inputting characters and space ◇◆◇
Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change. The current input mode is displayed in the center under the screen, and the display of "ABC" shows that the character input mode. The character currently written to the lower right of each key in this state can be inputted. When you continue and input the character in the same key, once press the [→] key and advance the cursor. The space is assigned to the [SP] key.

◇◆◇ The input method of the mark ◇◆◇
It comes out to input the character which is not displayed on the key. The character currently assigned to the key is shown below.
  a) [' ( )] key .... ' → (→) → " → ^ → : → ; → ¥ → ?
  b) [@ =] key .... @ → = → + → − → ＊ → ／ → < → >
  c) [, %] key .... , → % → # → $ → ! → & → ＿ → .

```
<PROGRAM>  1                    Ins
1MOV P _


                  123        CLOSE
```

11) Press the [SP], [PQRS] key, and input the
space and "P".

```
<PROGRAM>  1                    Ins
1MOV PW _


                  123        CLOSE
```
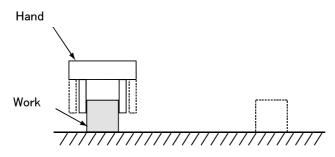
12) Press the [WXYZ] key, and input the space
and "W".

```
<PROGRAM>  1                    Ins
1MOV PWAIT_


                  123        CLOSE
```

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

```
<PROGRAM>  1                    Ins
1 MOV PWAIT


                  123        CLOSE
```

14) Press the [EXE] key.
"1 Mov PWAIT" will be set.

```
<PROGRAM>  1                    Ins
1 MOV PWAIT_


                  123        CLOSE
```

15) Input the program from step 2 to line 13 in
the same manner.

This completes the inputting of the program.

◇◆◇ Displaying the previous and next command step ◇◆◇
Display the four lines on the screen of T/B. For moving the cursor to the front line, the [↑] key is pressed, for
moving the cursor to the next line, press the [↓] key, and select.

◇◆◇ Displaying a specific line ◇◆◇
Press the [FUNCTION] key, and change the function display, and press the [F2] key. The display changes to the
JUNP screen. The specification line can be displayed, if the step number to display in the parenthesis is
inputted and the [EXE] key is pressed.

■ Teach the robot operation position.
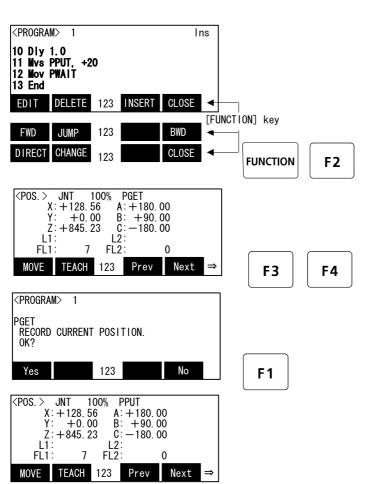 Set the position with jog operation (Teaching PGET)

Hand

Work

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 Page 45, "4.5 Jog operation" for details on the jog operation, and section Page 45, "4.6 Opening and closing the hand" 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.

```
<PROGRAM>  1                    Ins
10 Dly 1.0
11 Mvs PPUT, +20
12 Mov PWAIT
13 End
EDIT  DELETE  123  INSERT  CLOSE
```

[FUNCTION] key

```
FWD   JUMP   123         BWD
DIRECT CHANGE 123        CLOSE
```

FUNCTION   F2

```
<POS.>  JNT  100%  PGET
    X:+128.56   A:+180.00
    Y:  +0.00   B:  +90.00
    Z:+845.23   C:-180.00
    L1:         L2:
    FL1:    7   FL2:       0
MOVE  TEACH  123  Prev  Next  ⇒
```

F3   F4

```
<PROGRAM>  1

PGET
 RECORD CURRENT POSITION.
 OK?

Yes         123        No
```

F1

```
<POS.>  JNT  100%  PPUT
    X:+128.56   A:+180.00
    Y:  +0.00   B:  +90.00
    Z:+845.23   C:-180.00
    L1:         L2:
    FL1:    7   FL2:       0
MOVE  TEACH  123  Prev  Next  ⇒
```

2) In the program edit screen, press the [FUNCTION] key twice and change the function display. [F2](change) Press the key and display the position edit screen.

3) Press the [F3](Next) or the [F4](Prev) key, and display "PGET" on the screen upper right.
The current registration coordinate value of the position variable name PGET is displayed.

4) Press the [F2] (teaching) key.
The teaching confirmation screen is displayed.

5) Press the [F1] (being) key and register the position.

6) Teach PPUT (position to place workpiece) and PWAIT (wait position) in the same manner.
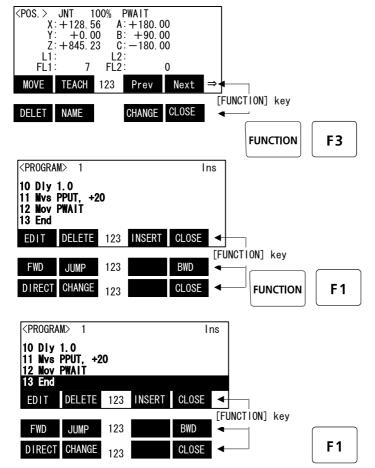
This completes teaching of the robot operation positions.

◇◆◇ 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 [F3] (Cange) keys.
To change from the position editing screen to the command editing screen, press the [F2] (Cange) keys.

(4) Confirming the program

Using the T/B execute the program line by line (step operation), and confirm the operation.

Following operations are operated with lightly pressing the enabling switch on the T/B.

```
<POS.>  JNT   100%  PWAIT
    X:+128.56   A:+180.00
    Y:  +0.00   B: +90.00
    Z:+845.23   C:−180.00
   L1:         L2:
   FL1:     7  FL2:      0
 MOVE  TEACH  123  Prev  Next  ⇒
```
```
 DELET  NAME        CHANGE  CLOSE
```
[FUNCTION] key

FUNCTION   F3

1) Press the [FUNCTION] key and change the function display. Press the [F3](change) and display the command edit screen.

```
<PROGRAM>  1                    Ins
10 Dly 1.0
11 Mvs PPUT, +20
12 Mov PWAIT
13 End
 EDIT  DELETE  123  INSERT  CLOSE
```
[FUNCTION] key
```
 FWD  JUMP  123           BWD
 DIRECT  CHANGE  123      CLOSE
```

FUNCTION   F1

2) Press the [FUNCTION] key and change the function display. Pressing the [F1] (FWD) key is kept, and 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 [F1] (FWD) is released during this step, the robot will stop.

```
<PROGRAM>  1                    Ins
10 Dly 1.0
11 Mvs PPUT, +20
12 Mov PWAIT
13 End
 EDIT  DELETE  123  INSERT  CLOSE
```
[FUNCTION] key
```
 FWD  JUMP  123           BWD
 DIRECT  CHANGE  123      CLOSE
```

F1

3) By the same operation as the above-mentioned, carry out step operation to the END command of the 13 lines, and confirm movement.
If movement of the robot and the position are wrong, correct with reference to the following operations.

⚠ CAUTION Take special care to the robot movements during operation. If any abnormality occurs, such as interference with the peripheral devices, release the [F1] (FWD) i 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 [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 "enable" switch.
  The servo will turn OFF, and the moving robot will immediately stop.
  To resume operation, lightly press the "enable" switch, and start step operation.
・Release the [F1] (FWD)key.
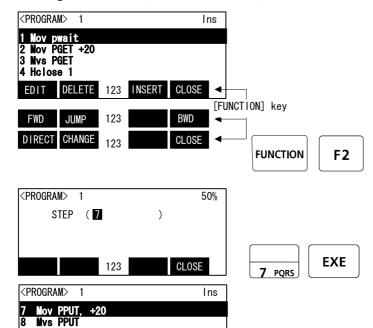 The step execution will be stopped. The servo will not turn OFF.
  To resume operation, press the [F1] (FWD)key.

(5) Correcting the program

■ Correcting the commands

As an example, the joint movement at line No.7 will be changed to linear movement.

(Change 7 Mov PPUT, +20 to 7 Mvs PPUT, +20) [Note)]

```
<PROGRAM>  1                    Ins
1 Mov pwait
2 Mov PGET +20
3 Mvs PGET
4 Hclose 1
EDIT  DELETE  123  INSERT  CLOSE  ◄
```
[FUNCTION] key
```
FWD   JUMP   123         BWD    ◄
DIRECT CHANGE 123        CLOSE  ◄
```

FUNCTION   F2

1) Press the [FUNCTION] key and change the function display. Press the [F2](Jump) key and display the command edit screen.

```
<PROGRAM>  1                    50%
       STEP  ( 7        )


                    123      CLOSE
```

7 PQRS   EXE

2) Press the [7], [EXE] key and display the 7th step.

```
<PROGRAM>  1                    Ins
7  Mov PPUT, +20
8  Mvs PPUT
9  Hopen 1
10 Dly 1.0
EDIT  DELETE  123  INSERT  CLOSE
```

⚠ **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.
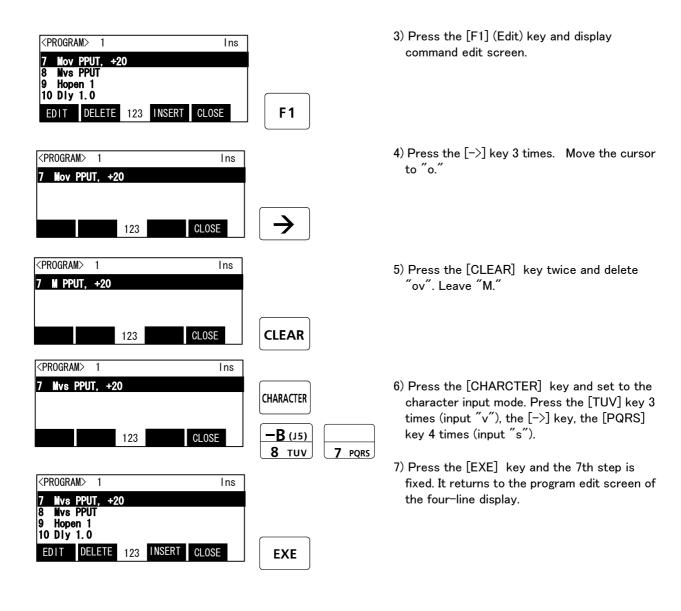Designating the reverse direction could lead to interference with the peripheral devices and damage.
Generally (in the default state), the hand retract direction is the "−" sign with the vertical articulate type robot, and the "+" sign is the robot's upward direction with the other robots.

◇◆◇ Displaying a specific line ◇◆◇
Press the [FUNCTION] key, and change the function display, and press the [F2] key. The display changes to the JUNP screen. The specification line can be displayed, if the step number to display in the parenthesis is inputted and the [EXE] key is pressed.

◇◆◇ Displaying the previous and next command step ◇◆◇
Display the four lines on the screen of T/B. For moving the cursor to the front line, the [↑] key is pressed, for moving the cursor to the next line, press the [↓] key, and select.

```
<PROGRAM>  1                    Ins
7   Mov PPUT,  +20
8   Mvs PPUT
9   Hopen 1
10  Dly 1.0
 EDIT  DELETE  123  INSERT  CLOSE
```

[F1]

3) Press the [F1] (Edit) key and display command edit screen.

```
<PROGRAM>  1                    Ins
7   Mov PPUT,  +20


              123       CLOSE
```

[→]

4) Press the [->] key 3 times.   Move the cursor to "o."

```
<PROGRAM>  1                    Ins
7   M PPUT,  +20


              123       CLOSE
```

[CLEAR]

5) Press the [CLEAR] key twice and delete "ov". Leave "M."

```
<PROGRAM>  1                    Ins
7   Mvs PPUT,  +20


              123       CLOSE
```

[CHARACTER]

[−B (J5) 8 TUV] [7 PQRS]

6) Press the [CHARCTER] key and set to the character input mode. Press the [TUV] key 3 times (input "v"), the [->] key, the [PQRS] key 4 times (input "s").

7) Press the [EXE] key and the 7th step is fixed. It returns to the program edit screen of the four-line display.

```
<PROGRAM>  1                    Ins
7   Mvs PPUT,  +20
8   Mvs PPUT
9   Hopen 1
10  Dly 1.0
 EDIT  DELETE  123  INSERT  CLOSE
```

[EXE]

Step No. 7 has been changed to linear movement with the above operation.

◇◆◇ Correcting incorrect numbers ◇◆◇
Press the [CLREAR] key to delete the character, and then input it again. And, if the long pushing [CLEAR] key, all the data in the parenthesis can be deleted.
If the cursor is returned by pressing the [←] key, and a character is input, it will be inserted.
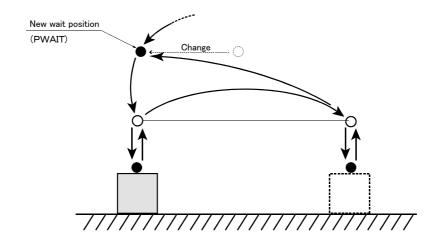
◇◆◇ After correcting a program ◇◆◇
After correcting the program, carry out step operation, and confirm that the program has been corrected.

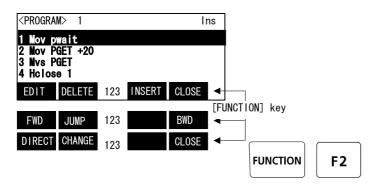◇◆◇ Inputting characters and space ◇◆◇
Each time the [CHARACTER] key is pressed, the number input mode and the character input mode change. The current input mode is displayed in the center under the screen, and the display of "ABC" shows that the character input mode. The character currently written to the lower right of each key in this state can be inputted. When you continue and input the character in the same key, once press the [->] key and advance the cursor. The space is assigned to the [SP] key.
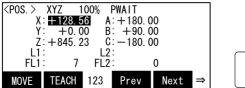
■ Correcting the taught position
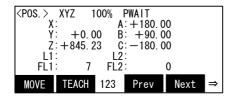   As an example, the wait position (PWAIT) will be corrected.

New wait position
(PWAIT)
Change


```
<PROGRAM>  1                    Ins
1 Mov pwait
2 Mov PGET +20
3 Mvs PGET
4 Hclose 1
 EDIT  DELETE  123  INSERT  CLOSE
```

[FUNCTION] key

```
 FWD   JUMP   123         BWD
 DIRECT CHANGE 123         CLOSE
```

FUNCTION   F2

1) In the program edit screen, press the [FUNCTION] key twice and change the function display. [F2](change) Press the key and display the position edit screen.

```
<POS.>  XYZ   100%  PWAIT
     X:+128.56   A:+180.00
     Y:  +0.00   B:  +90.00
     Z:+845.23   C:-180.00
    L1:         L2:
   FL1:     7  FL2:        0
 MOVE  TEACH  123  Prev  Next ⇒
```

F3   F4

Press the [F3](Next) or the [F4](Prev) key, and display "PWAIT" on the screen upper right.
2) The current registration coordinate value of the position variable name PWAIT is displayed.

```
<POS.>  XYZ   100%  PWAIT
     X:
     Y:  +0.00   B:  +90.00
     Z:+845.23   C:-180.00
    L1:         L2:
   FL1:     7  FL2:        0
 MOVE  TEACH  123  Prev  Next ⇒
```
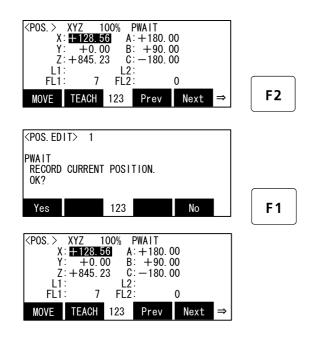
Move the robot to the new standby position by jog operation.

Refer to Page 45, "4.5 Jog operation" for details on the jog operation, and section Page 45, "4.6 Opening and closing the hand" for detains on opening and closing the hand.

◇◆◇ Calling out a position variable ◇◆◇
   The displayed position variable can be scrolled up or down by pressing the [F3] (Next) or [F4] (Prev) key.

```
<POS.>  XYZ    100%   PWAIT
    X: +128.56   A:+180.00
    Y:   +0.00   B:  +90.00
    Z:+845.23   C:−180.00
    L1:         L2:
    FL1:      7  FL2:        0
  MOVE │ TEACH │ 123 │ Prev │ Next │ ⇒
```

F2

3) Press the [F2] (Teaching) key.
4) The teaching confirmation screen is displayed.

```
<POS.EDIT>  1

PWAIT
RECORD CURRENT POSITION.
OK?

  Yes │       │ 123 │       │ No
```

F1

5) Press the [F1] (Yes) key and register the position.

```
<POS.>  XYZ    100%   PWAIT
    X: +128.56   A:+180.00
    Y:   +0.00   B:  +90.00
    Z:+845.23   C:−180.00
    L1:         L2:
    FL1:      7  FL2:        0
  MOVE │ TEACH │ 123 │ Prev │ Next │ ⇒
```

This completes correction of the standby position.

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

(6) Saving the program

If creation of the program or correction finishes, the program will certainly be saved.
If the [F4 (close)] key is pressed in the command edit screen or the position edit screen, the confirmation message "the program was saved" is displayed and the details of edit are saved.

◇◆◇ Attention about the edit save ◇◆◇
Please keep in mind that the details of edit including teaching data will be canceled if the power supply is shut down with the program edit screen.
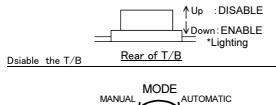
(7) Start automatic operation.

⚠ **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

↑ Up : DISABLE
↓ Down : ENABLE
*Lighting

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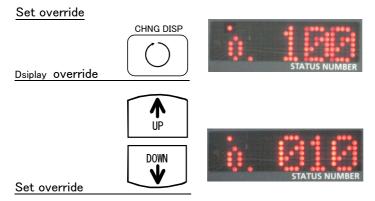
1) Set the T/B [ENABLE] switch to "DISABLE".

MODE
MANUAL   AUTOMATIC

Enable the R/C

2) Set the controller [MODE] switch to "AUTOMATIC".

Set override

CHNG DISP

Dsiplay override

STATUS NUMBER

UP

DOWN

STATUS NUMBER

Set override

3) Press the controller [CHNG DISP] switch twice, and display the "OVERRIDE" on the STATUS NUMBER display panel. (A "o" 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 [MODE] switch is changed.
Note that axes not provided with brakes could drop with their own weight.

Select the program number

CHNG DISP

Display the program number

UP

DOWN

Select the program number

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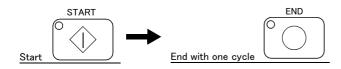(A "P" will appear at the head.)

Confirm that the program number targeted for automatic operation is displayed.

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

Start automatic operation

SVO ON

Servo on

START

Start

END

End with one cycle

5) Push the [SVO ON] switch of the controller, and servo power turn on.

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

⚠ CAUTION   When executing the work example given in Page 46, "Fig.4-8 : Example of work", 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] switch to "DISABLE" and the controller [MODE] switch to "AUTOMATIC". Operations from the controller are not possible unless the controller [MODE] switch is set to "AUTOMATIC".

◇◆◇ 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 "o" 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%.
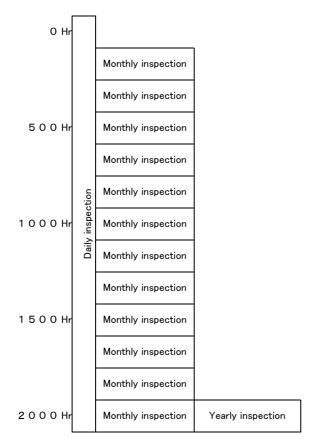Initially set a low speed, and gradually increase it.

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

0 Hr	
	Monthly inspection
	Monthly inspection
5 0 0 Hr	Monthly inspection
	Monthly inspection
	Monthly inspection
1 0 0 0 Hr	Monthly inspection
	Monthly inspection
	Monthly inspection
1 5 0 0 Hr	Monthly inspection
	Monthly inspection
	Monthly inspection
2 0 0 0 Hr	Monthly inspection	Yearly inspection

(Daily inspection column spans the full height. Operating time axis on the left.)

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 dirty? (Visual)	Clean or replace with a new part. Inspect, clean and replace the filter by refer to Page 67, "5.3.2 The check of the filter, cleaning, exchange".
Yearly inspection items		
1	Replace the backup battery in the controller.	Exchange it referring to Page 65, "5.3.1 Replacing the battery".

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 Replacing the battery

The batteries are installed when the robot is shipped from the factory, but as these are consumable parts, they must be replaced periodically by the customer.

The guideline for replacing the battery is one year, but this will differ according to the robot's usage state.

There are the kind of the errors about the battery shown in Table 5-3. If error 7500 occurs, please exchange the batteries of the robot arm and the robot controller simultaneously.

Table 5-3 : The error about the battery

Section	Error number	Description	Disposition
Controller	7520	The exhausting time is over.	Exchange the batteries.
	7510	Voltage is falling.	
	7500	Voltage fell.	Backup data cannot be secured.
Robot arm	7520	The exhausting time is over.	Exchange the batteries.
	133n [Note1]	Voltage is falling.	
	112n	The absolute position data of the encoder disappeared.	Backup data cannot be secured.

Note1) "n" shows the axial number.

⚠ **CAUTION**   If error No. 7500 or 112n occurs, the program data and other data in the controller is lost and it becomes necessary to load the data again.

⚠ **CAUTION**   Replace the batteries for the controller and robot arm at the same time. Replace the controller battery within 3 minutes after removing the old battery.
It is also recommended to save programs and position data on the personal computer side via the RT ToolBox 2 and so forth in advance.
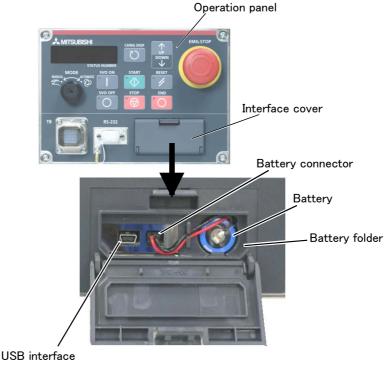
（1）The battery exchange method of the controller

Fig. 5-2：Exchange of the battery

1) Turn the controller power ON once. (For approx. one minute.)
2) Turn OFF the power supply of the controller and open the interface cover of the operation panel. The battery is in the interface cover.
3) Pick and pull up the connector of the old battery and remove from battery holder.
4) Fix the new battery into the battery holder. Install so that the lead may come out to the front.
5) Connect the connector of the new battery cable. Connect so that the red lead may become left-hand side. Complete the work within 3 minutes after removing the old battery.
6) Close the interface cover of the operation panel certainly.
7) Refer to the separate manual "Detailed Explanation of Functions and Operations", and reset the battery cumulative time over alarm.

[Caution]
If the old battery is replaced because it has been used up, it is necessary to set the origin again. Refer to the separate "Robot arm setup, basic operation, and maintenance" and reset the origin.

This completes the replacement of the controller battery.

5.3.2 The check of the filter, cleaning, exchange

The filter is installed in the controller.

The following shows the procedure for inspecting, cleaning and replacing the filter:

（1）CR1DA-700

1) Remove the filter cover in the bottom of the front side of the controller by unscrewing the M3 screws (2 pcs.).

2) Remove the filter from the controller, and then remove dust and particles accumulated on the filter.
   *If the filter is heavily soiled, wash it using neutral a detergent diluted with water, dry it completely, and then mount it to the controller.

3) Attach the cleaned or new filter to the controller, and install the filter cover to controller with the M3 screws (2 pcs.).

Fig. 5-3 : Cleaning, exchanging the filter(CR1DA-700)

This completes the inspection, cleaning and replace of the filter for the controller.

(2) CR2DA-700
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, wash it using neutral a detergent diluted with water, dry it completely, and then mount it to the controller.
3) Attach the cleaned or new filter to the filter plate, and install it to the controller with the M3 screws (2 pcs.).
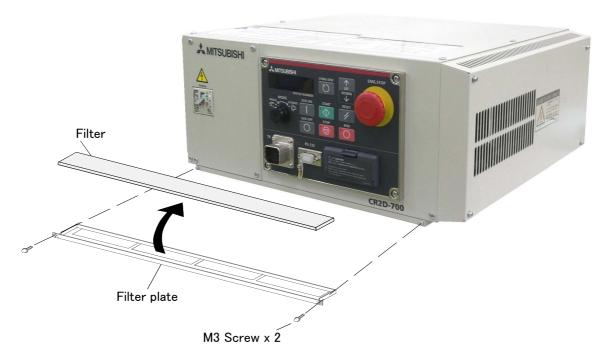

Fig. 5-4 : Cleaning, exchanging the filter(CR2DA-700)

　This completes the inspection, cleaning and replace of the filter for the controller.

(3) CR3D-700
    1) Remove the filter plate in the bottom of the rear cover of the controller by unscrewing the 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, wash it using neutral a detergent diluted with water, dry it completely, and
         then mount it to the controller.
    3) Attach the cleaned or new filter to the filter plate, and install it to the rear cover of controller with the
       screws (2 pcs.).
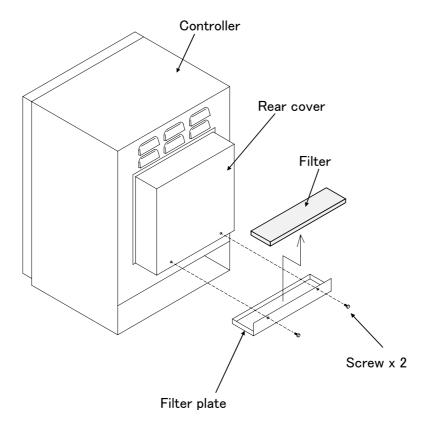

Fig. 5-5 : Cleaning, exchanging the filter(CR3D-700)

    This completes the inspection, cleaning and replace of the filter for the controller.

5.4 Maintenance parts

The consumable parts that must be replaced periodically are shown in Table 5-4, and spare parts that may be required during repairs are shown in Table 5-5. 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 5-4 : Controller consumable part list

No.	Part name	Type Note1)	Qty.	Usage section	Maker
All the controller commonness					
1	Lithium battery	Q6BAT	1	Inside of the interface cover of the operation panel	Mitsubishi Electric System & Service;Co.,Ltd.
CR1DA-700					
1	Filter		1	Front of the controller	Mitsubishi Electric System & Service;Co.,Ltd.
CR2DA-700					
1	Filter		1	Under the front of the controller	Mitsubishi Electric System & Service;Co.,Ltd.
CR3D-700					
1	Fan (40 square)		5	Amplifier unit Converter unit	Mitsubishi Electric System & Service;Co.,Ltd.
2	Filter		1	Rear of the controller	

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

Table 5-5 : Controller spare part list

No.	Part name	Type Note1)	Qty.	Usage section	Maker
CR1DA-700					
1	Fuse	LM16	2		Mitsubishi Electric System & Service;Co.,Ltd.
CR2DA-700					
1	Fuse	LM32	1		Mitsubishi Electric System & Service;Co.,Ltd.
2		LM16	2		
3		MF60NRF-1.6A	1	Inside of the controller Glass tube fuse)	
CR3D-700					
1	Fuse	LM32	4	CPU unit (R700CPU)	Mitsubishi Electric System & Service;Co.,Ltd.
2		LM16	6	Safty unit (R700SFT)	
3		LM32	3	Amplifier unit	

Note1) Confirm the robot arm serial No., and contact the dealer or service branch of Mitsubishi Electric Co., for the type.

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Specifications are subject to change without notice.